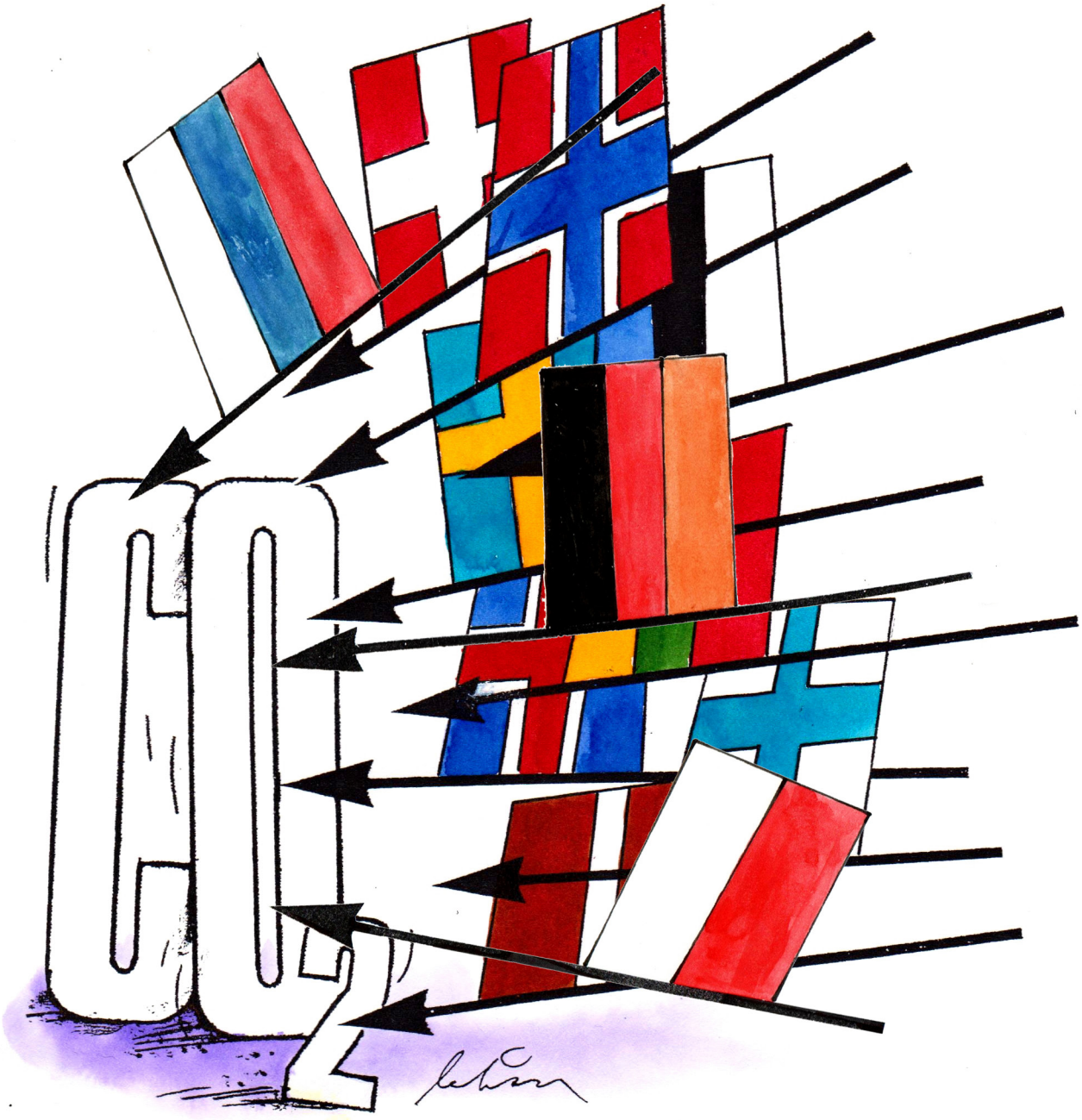
31

The 10 best climate mitigation measures in Northern Europe



Air Pollution & Climate Secretariat

AirClim

AIR POLLUTION AND CLIMATE SERIES 31

The 10 best climate mitigation measures in Northern Europe

By Janis Brizga (Latvia), Nicole Bosquet (Germany), Jan Burck (Germany), Sören Dyck-Madsen (Denmark), Alexander Fedorov (Russia), Arni Finnsson (Iceland), Zbigniev Karaczun (Poland), Alexey Kokorin (Russia), Valdur Lahtvee (Estonia), Fredrik Lundberg (Sweden), Thomas Martinsen (Norway), Gunnar Boye Olesen (Denmark), Meri Pukarinen (Finland), Olga Senova (Russia), Vladimir Tchuprov (Russia) and Linas Vainius (Lithuania).

About the authors: The national reports were compiled by energy and climate policy experts from environmental NGOs in Northern Europe who consulted with other NGO experts in each country.

The synthesis report was written by energy experts Fredrik Lundberg from Sweden and Gunnar Boye Olesen (INFORSE) from Denmark.

The report has been submitted for consideration to the Council of Baltic Sea States, the Barents Council and the Nordic Council.

AirClim would like to sincerely thank Tore Braend and Tore Killingland from the Minor Foundation for Major Challenges in Norway for all support and advice.

Cover illustration: Lars-Erik Håkansson (Lehån).

Graphics and layout: Sven Ängermark/Monoclick

Language consultant: Malcolm Berry, Seven G Translations, UK

ISBN: 978-91-979623-3-9

Published in June 2014 by the Air Pollution & Climate Secretariat (AirClim).

Editor: Reinhold Pape (AirClim).

Address: AirClim, Norra Allégatan 5, 413 01 Göteborg, Sweden.

Phone: +46(0)31 711 45 15

Website: www.airclim.org

The Secretariat is a joint project by Friends of the Earth Sweden, Nature and Youth Sweden, the Swedish Society for Nature Conservation and the World Wide Fund for Nature Sweden.

The report is also available in pdf format at www.airclim.org.

Contents

The 10 best climate mitigation measures in Northern Europe 2

Synthesis 10

The list of ten best measures 12

1. Taxing carbon 12

2. Support for renewable electricity 13

3. Improved efficiency of buildings 14

4. Other efficiency improvements 15

5. District heating efficiency 16

6. Vehicle emission standards 16

7. Other measures to reduce traffic CO_2 16

8. Infrastructure planning 16

9. Waste and recycling 17

10. Land use 17

Other policies 17

Climate law 18

Smart grid strategies 18

Congestion charges 18

Technology procurement 18

Net metering 18

Mandatory use of straw 18

Transport policies 19

Danish Initiatives for Reduction of CO_2 and Energy use or more Renewables: 20

37 Instruments: 20

1. Energy taxation for households 20

2. CO_2 taxation for business – including energy savings agreements 21

3. Fuel Taxes 23

4. Energy distribution companies energy savings obligations 23

5. Building codes 24

Renovation 24

Low energy 2015 25

Low energy 2020 25

6. Cogeneration and district heating 26

7. Implemented taxes and duties relevant to consumption and emissions of HFCs, PFCs, and SF6 27

8. Registration tax for cars 28

9. Annual green ownership tax for cars 29

10. Biofuels and exemption of registration tax for electric and hydrogen cars 30

"Electricity and biomass in the transport sector 31

11. Planning publicly accessible buildings near public transport 31

12.Feed-in tariffs for wind turbines on-shore, near-shore and off-shore 31

Production of Renewable Energy 32

"A green and sustainable energy supply based on renewable energy 33

13. Increasing use of biomass – mandatory use of straw for power production ... 33
"Converting to green heating ... 34
"Large increase in consumption of renewable energy ... 34
"More renewable energy in industry ... 36
14. Establishing conditions for Smart Grid ... 37
"Smart Grids ... 37
15. PV – letting the meter run backwards (netmetering) ... 37
16. Research and development ... 37
"More research, development and demonstration ... 38
17. Energy labelling of buildings ... 39
18. Electricity Savings Trust – Centre for Energy Savings – Danish knowledge centre for energy savings in buildings ... 39
19. Energy labelling of appliances ... 39
20. Heat Pump initiative for replacing old oil burners ... 40
21. Scrapping of oil-fired boilers ... 40
22. Banning of new oil-fired boilers ... 41
"More renewable energy in buildings ... 41
23. Mandatory for public authorities to make energy savings in their own buildings ... 41
24. Green public procurement ... 41
Regions ... 42
Municipalities ... 42
25. Loan possibility for local communities and regions for energy savings ... 43
26. Action Plans for the Aquatic Environment I and II and Action Plan for Sustainable Agriculture ... 43
27. Ban on burning straw in fields ... 44
28. Ammonia action plan and statuary order on manure ... 45
29. Planting of windbreaks ... 46
30. Biogas plants ... 46
"Better framework conditions for biogas expansion ... 47
31. Afforestation on agricultural land and elsewhere ... 47
32. Taking vulnerable agricultural areas out of production ... 47
"Fewer greenhouse gases ... 48
33. Ban on combustible waste in land fills ... 48
34. Waste tax ... 49
35. Package tax ... 50
36. Recycling of waste packaging plastics ... 50
37. Support for gas recovery at landfill sites ... 50
Appendix 1: ... 52
Emissions of CO_2 from energy consumption and overall greenhouse gas emissions ... 52
Danish emissions of Greenhouse gases 2010 ... 52
Historical Emissions of GHG in Denmark ... 52
Carbon dioxide, CO_2 ... 53
Nitrous oxide, N_2O ... 54
Methane (CH4) ... 55
Industrial gases HFCs, PFCs and SF_6 ... 56

Best GHG mitigation measures in Estonia. 58
Current situation with GHG emissions. 58
GHG mitigation measures in Estonia 64
Feed-in tariff 68
Government subsidies for support of renovation of buildings 68
Government subsidies for RES generation capacities 68
Government subsidies for energy efficiency 68
Ecological tax reform 69
Stricter energy efficiency standards of buildings 69
Establishment of regulations for use of sea bottom for construction of offshore installations 69
Preparation of thematic spatial planning for development of wind energy in 4 counties in Western Estonia 69
Investment support to upgrade public transport infrastructure 69
National electromobility programme 69
Ten best mitigation measures in Finnish climate and energy policy 70
Introduction 70
Trends in Finnish emissions 70
Implementation of EU policy forms the basis of national policy 72
Overarching policy framework: climate and energy strategies 72
Measures to meet the renewables target 74
Measure 1: Feed-in tariff for wind power, biogas and wood-based fuels from plants 75
Measure 2: Removing bureaucratic hurdles in wind energy development 76
Measure 3: allowances to households replacing oil and direct electric heating with renewables 77
Energy efficiency measures 78
Measure 4: energy efficiency agreements 78
Measure 5: energy efficiency standards for new buildings 79
Measure 6: energy efficiency measures in old buildings 80
Measure 7: energy savings through Energy Performance Contracting (EPC) 81
Reducing emissions from transport 82
Sub-national measures 82
Measure 9: carbon-neutral municipalities as forerunners 83
Measures in preparation 84
Measure 10: climate law enhancing the effectiveness of policy measures 84
Mitigation measures ranked 86
List of references 86
Appendix 1. NGO experts having ranked the measures 89
Ten best mitigation measures in Germany 90
Introduction 90
Conditions in Germany 90
German Energiewende 91
1. EEG 93
Energy-efficient building package 95
2. EnEV 96
3. EEWärmeG 96

4. MAP ... 97
5. Efficiency in building programme (KfW programme) ... 98
6. BAFA programme (Bundesamt für Wirtschaft und Ausfuhrkontrolle) ... 100
7. Cogeneration Act (KWKG) ... 101
8. Eco-tax ... 102
9. Levy on air traffic ... 103
10. Road tax for trucks ... 104
Conclusion ... 105
Reference List ... 106
The 10 best Mitigation Measures in Iceland ... 110
Special status? ... 110
These 10 key actions are: ... 111
Implementing a trade system with emission allowances (ETS) ... 111
14/CP.7 ... 111
Carbon tax ... 112
Cars in public ownership (state and municipalities) must be fuel-efficient and eco-friendly ... 114
Strengthen the net of pathways for pedestrians, roads for bikers as well as public transport as an alternative for transportation ... 114
Utilizing biofuels for fishing vessels ... 114
Fuel fish meal factories with electricity ... 114
Sequestration - More afforestation and soil conservation ... 115
Wetland reclamation ... 115
Mitigation potential ... 115
10. Provide more support for research and innovation with regard to climate issues. ... 116
Interconnector ... 116
Climate Policy instruments in Latvia ... 118
Introduction ... 118
Climate Change Mitigation Policy ... 119
Emission trading ... 120
European Union Emissions Trading Scheme (EU ETS) ... 120
International Emissions Trading ... 121
EU Structural Funds ... 123
Taxes ... 124
CO_2 tax ... 125
Other taxes ... 125
Policy instruments by sector ... 126
Transport ... 126
Feed-in tariffs ... 126
Industrial processes ... 127
Agriculture ... 127
Forestry ... 127
Waste ... 127
Communication instruments ... 128
Energy efficiency labelling ... 129

Local-level initiatives ... 129
Research & science ... 129
Best GHG mitigation measures in Lithuania ... 130
General situation: ... 130
Enhancement of the use of RES until 2020 ... 131
Modernisation of multi-apartment buildings. Governmental programme ... 131
Modernisation of public buildings ... 132
Promotion of cogeneration ... 132
Increase in energy efficiency ... 132
LNG import terminal in Klaipeda ... 132
Integration into the European Energy Systems ... 133
Government subsidies for energy efficiency, renovation and installation of small RES applications ... 133
Afforestation ... 133
Best practice policies for climate change mitigation, Norway ... 134
Foreword ... 134
Introduction ... 134
Brief history of emissions of greenhouse gases in Norway ... 134
Norwegian policies influencing greenhouse gas emissions ... 137
1.1 Taxation ... 137
Direct regulation ... 138
Research, development and deployment ... 139
Selected best practice measures ... 139
CO_2 tax on emissions from oil and gas production (D) ... 139
Emission quota on N2O emissions from fertilizer production ... 140
All new gas-fired power stations must have carbon capture and storage (M) ... 140
Automobile purchase tax (D) ... 140
Incentive for increased deployment and use of electric vehicles (J) ... 141
Voluntary agreement with the industry (S) ... 141
Outlawing and taxation of biodegradable waste deposited in landfills (M) ... 141
Stricter requirement for insulation of buildings in the Building Code (L) ... 142
Economic support to replace oil-fired boilers for heating (H) ... 143
Government grant for public transport to cities implementing measures to reduce car use (B) ... 143
Industrial energy efficiency network (I) ... 143
Compulsory evaluation of alternatives to new large road projects (B) ... 143
Guide to categorization and criteria ... 144
Instruments For Climate Protection In Poland ... 145
1. Introduction ... 145
2. Climate protection instruments: currently used and designed for future use according to the Draft Sixth Government Report for COP UNFCCC ... 147
2.1 Transport ... 147
2.1.1 Summary – transport ... 152
2.2 The building industry ... 153
2.2.1 Summary– construction ... 154

2.3.1 Summary – agriculture. 157
2.4 Waste 158
Summary – waste 159
2.5 Power industry 160
2.5.1 Summary – power industry 162
3. Conclusion 163
Measures To Reduce Emissions Of Greenhouse Gases In Russia And Priorities Of Russian Ngos 166
Foreword 166
General possibilities for reducing emissions of greenhouse gases in Russia 167
Measures to improve energy efficiency in buildings 168
1. "Small" measures to improve insulation of existing buildings 169
2. The use of modern, energy-efficient lighting systems 169
3. The use of modern household appliances and office equipment 170
4. Installation of heat and hot water meters and regulation in residential buildings 170
6. Improving insulation and upgrading existing non-residential buildings 172
8. Construction of more energy-efficient, new non-residential buildings 173
Measures in the energy sector 173
9. Modernisation of the energy sector, including heating and power lines 173
10. Termination of flaring associated with petroleum gas 174
11. Radical reduction of methane emissions in the gas distribution system 175
Measures in the transport sector 177
13. Improving transport system efficiency 178
14. Use of vehicles with lower CO_2 emissions 179
Measures in the waste sector 179
15. Separate collection of waste and recycling 180
Long-term measures for the future: Forests 181
Long-term measures for the future:
Effective payments for greenhouse gas emissions 182
Introduction of effective charges for emissions of greenhouse gases 182
References 183
Climate Policy Instruments in Sweden 185
Top 10 instruments, ranked 185
1. Energy and carbon dioxide taxes 185
2. Building regulations 187
3. Congestion charges 187
4. Climate investment programmes 188
5. EU ban on incandescent lamps 189
6. Programme for energy efficiency in industry (PFE) 189
7. Railway investments and improved railways 190
8. Electricity certificates 190
9. Technology procurement 191
10. Special initiatives for wind and solar power 192
(Other instruments, not ranked) 193

Emissions trading 193
Environmental Code (environmental quality targets, etc.) 194
Planning and Building Act 194
"Energy check" – energy saving for SMEs 195
Investment support for conversion of heating systems and energy-efficiency measures 195
Building regulations 196
Research and development funding 196
Heat Research 197
Eco-labelling and Green Electricity 198
Green car rebates and other advantages for cars 199
Appendix 201
Criteria for the instruments 201
Guidelines for the national reports: 201
Content of the summary report: The ten best mitigation measures in the Northern Europe 202
Compilation process: 202

Synthesis

Compiled by Fredrik Lundberg (Sweden), Gunnar Boye Olesen (Denmark)

When we asked a number of national environmental NGOs from Denmark, Estonia, Finland, Germany, Iceland, Latvia, Lithuania, Norway, Poland, Russia and Sweden to describe and rank their ten best climate measures, we had thought that those measures would to a large extent be universal.

Instead we have found an overwhelming diversity. This diversity reflects the fact that different people focus on different aspects and time scales. It also seems that hardly any country seems to have noticed what their neighbours are doing.

Everybody invents the wheel.

Climate policymakers should take a look, not only at the ten winners, but also at the full smorgasbord of measures in neighbouring nations. Yes it is heterogeneous and messy, small is mixed with big, long-term is mixed with short-term, proven is mixed with what hopefully might work etc. – but the lasting impression is that there are a lot of things to do. It is a wonderful exposé of options.

We would like to thank all the respondent NGOs for your great work!

The national NGO reports are largely based on the National Communications (NC5) to the Climate Convention, but several other measures are included in some of the reports. The results and expectations of each measure are also seen in a different light in different countries. Even the same measure is judged in a different way in the different national reports.

We hope this synthesis report and the national NGO reports will be used to inspire stronger climate policies.

The heterogeneous reporting reflects the complexity of the task. It is messy, but not all bad.

The good news: much can be done to cut greenhouse emissions, and we know this for sure, because it already has been done, in another country. You do not have to re-invent the wheel.

The bad news: Our politicians do not learn much from each other, or have not so far. Cutting emissions is actually not all that difficult.

Most of us have lower emissions now than in 1990, without trying very hard, and on the whole GDP and living standards have risen in the meantime.

Some of the changes in emissions are caused by structural change, such as de-industrialisation in ex-communist countries in the early 1990s and the more drawn-out development in the so-called "rust belts" of Western Europe; whole industries have gone, due to technological change, or moved, due to globalisation.

But in the sectors with the biggest reductions in emissions, such as the housing sector or electricity production, policies have played a major role.

Politicians want things to be quick, simple, uncontroversial and cheap. But you cannot have it all at the same time.

We can produce carbon-free power from wind and replace coal, as Denmark has shown. We can shut down dirty and obsolete industry, as the Baltic republics had to do, and still survive. We can buy, and produce, much more efficient cars, as Sweden has done. We can build much more efficient build¬ings, as we are all beginning to do, with Germany, Norway and Denmark setting the best examples.

It is happening, but slowly, slowly. Why is it so slow? The reason is that some of the most efficient measures are political dynamite: very high taxes on energy and CO_2 are known to work wonders for emissions, but are not perceived as popular with the electorate.

It also takes very different tax rates to bring about change. It takes a very low CO_2 tax to make industry save energy or switch fuels. It takes a very high CO_2 tax to make people travel more by train and less by car. Many economists who advise governments rely on simplistic models, and give governments useless advice.

Other measures, which are also known to be very effective in the long term, do not achieve much very fast. Stricter building codes and subsidies for renewable energy are examples.

Selecting the very best ten measures all over the region, from about 150 candidates, is not a straightforward exercise. Any one measure can be characterised in several ways, such as by the type of measure (legal, economic), its purpose (fuel shift, energy saving) and its area of application (power, buildings).

The national NGO reports also have different points of departure. Germany and Denmark have had very active energy policies for many years. They have targets, timetables and instruments in place. The administration is good. The politicians know what they want, often in consensus. Other NGOs have a much more uphill task, as the politicians and bureaucracy have not prepared the ground.

Behind the diversity or heterogeneity, however, some kind of unity can be discerned. All agree that energy efficiency, renewable energy and some curbing of road traffic are necessary, and there is a fair consensus about where instruments are most needed, and that a mix of legal, economic and informative instruments is required.

The following "11 best" are for this reason a subjective distillate, though the top 3 measures are high up on most national reports.

What is best cannot be seen in isolation. Every measure can be enhanced by other measures in synergy, or be cancelled out by measures that work in the opposite direction. The context is important, because even very strong incentives may not have much influence if people do not believe that they will be lasting. That is why overall national climate policies with targets and timetables are so important, especially if they have a broad parliamentary majority behind them.

One criterion is replicability. We have ranked a measure higher if the same thing can be done in many other countries. But it is also important to use

what you have. Geothermal power stations are rather unique to Iceland, but can still be of great importance. The effective use of EU Structural Funds in the Baltic republics is not an option for most other countries, but still turned out to be a great improvement there.

The 11 NGO national reports are each different, but each one can also serve as a mirror for policymakers in every other country. It is the differences that show the potential for change.

Denmark increased its solar power production from 104 GWh in 2012 to 518 GWh in 2013, or 92 kWh/capita. This is pale by comparison with Germany's 30 TWh, almost 400 kWh/capita. But it is still an annual increase of 398 per cent, almost all due to one simple measure: net metering. There is a lot of sunshine in Poland and Sweden, and Russia too, but they have almost no solar power.

The opportunities to cut greenhouse gases are huge, and the knowledge about how to do so is right on the doorstep. We know which knobs to turn, it is just a question of using all or most of them, and turning them up higher.

The list of ten best measures

1. Taxing carbon

Denmark, Germany, Estonia, Iceland, Latvia, Norway and Poland and the European Union

CO_2 is by far the most important greenhouse gas and was responsible for 85 per cent of the warming effect in 2002–2012 (WMO 2013). It is also fairly simple to establish its source and quantify it.

Effective carbon taxation means that more carbon-intensive fuels are taxed more. It does not matter if it is called a carbon tax or an energy tax. It has been a cornerstone of Nordic climate and energy policies for 20–25 years and has achieved many millions of tons of CO_2 reductions, especially in oil for heating and coal for district heating.[1] The theory and experience show that economic instruments work. First, we stop subsidising fossil fuels, then tax them, upstream or downstream. The tax revenue can either be used for more useful spending or just to cut taxes. The essential thing is that the price signal is clear. The energy/CO_2 tax works best for electricity and heating, but is problematic for heavy industry because of competition and has alone not been sufficient for decarbonising transport.

Emissions trading, once called the flagship of European Climate Policy, also belongs to this family. Everybody agrees that it is a great idea, but it has not delivered much. The reason for this is the ludicrously low target of 20 per cent emission reductions between 1990 and 2020, which largely has been achieved today, and loopholes in the system with overallocations to some industries and inclusion of questionnable CDM cedits. Much of the target was in fact inherited by the EU after the reunification of Germany and later enlargement of countries that had already cut their emissions in the early 1990s.

1 http://www.eea.europa.eu/media/newsreleases/greenhouse-gas-inventory-report-press-release

The CO_2 price is now way too low to play a role for reduction of fossil fuel use. Perhaps the leaking ship will be repaired someday, but meanwhile national economic instruments are very important.

The reason why many NGOs have not mentioned energy taxation is not because they do not think it efficient, but because they have no experience to report.

2. Support for renewable electricity

Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Russia and Sweden

Feed-in-tariffs are well proven in several countries, but most effective in Denmark and Germany. They brought wind power from nowhere to become the fastest growing low-carbon power source in the world. Then Germany grew solar power from nothing into a multi-gigawatt industry. Germany produced 30 TWh of solar power in 2013, starting from zero in the year 2000, making it the largest producer in the world – no mean feat for a country with Germany's climate. Bio-energy has also grown spectacularly with feed-in tariffs.

This success is now being replicated in much of the world, especially in China and (for solar) in Japan.

Feed-in-tariffs also explain how two countries, first Denmark and then Germany, could turn wind power from a hobby for enthusiasts into a very big industry. By mid-2014 the world has some 350 GW of wind power installed, which if it replaces coal power, cuts CO_2 emissions by some 500 million tons every year.[2]

The tremendous success of the feed-in-tariffs (FIT) has been pioneering for wind and solar. An alternative method for supporting renewables is renewables obligations or green certificates, which oblige consumers or producers to buy a certain percentage of renewable electricity. The difference is that FIT is tailored to give each technology as much support as needed, and then cut the subsidies as it takes off. Renewables obligations focus on benefits of scale and cost-effectiveness, fostering competitiveness between renewable sources and between projects.

This method has also produced remarkable results. Poland and Sweden are now among the world leaders in wind power installations: on the world top 10 list of wind power[3] installations in 2013, Poland and Sweden came in at numbers 9 and 10 respectively.

2 Assuming they are run at average 25 per cent of capacity, and that most of the wind power replaces coal and lignite, and that the coal power plants emit 1000 grams of CO_2/kWh, which is a conservative figure for China and the United States, and for the worst power plants in Germany, Russia, Poland and Estonia. If wind power replaces modern natural gas power, the reduction is much smaller, and if it replaces nuclear, still smaller.

3 http://www.gwec.net/wp-content/uploads/2014/04/8_Top-ten-annual-2013.jpg

3. Improved efficiency of buildings

Denmark, Germany, Estonia, Finland, Norway, Poland, Russia and Sweden

Building codes and other instruments to improve thermal efficiency in buildings are ranked highly in many of the national NGO reports.

The reason is obvious. A rule of thumb says that 40 per cent of energy input goes towards heating and cooling buildings. This is a huge direct source of greenhouse gases if fossil fuels are used for heating. It is a huge indirect source if electricity or district heating is used. Wasteful use of biomass for heating should also be avoided, as this leaves less biomass for vehicle fuel and for replacement of fossil resources.

It is not only of huge importance. It is also a field in which legislative action has huge importance. Energy requirements for new buildings differ by a factor of 1.5–2 between Denmark and Estonia, which do not have very different climates.

The legal requirements for new buildings and renovation of existing buildings differ a lot between nations, for no very good reason. Almost every square metre indoors has to be heated in the winter, and a lot of offices and other commercial buildings have to be cooled in the summer. The need for heating, as well as cooling, can be much reduced by improved building design.

Building codes are strictly aimed at new buildings, but standards can also be enforced or incentivised for existing buildings, for example as a requirement for subsidies or soft loans. Further building codes can be enforced for building renovations.

Denmark is a good example with strict requirements for new buildings, measured in kWh/m^2 per year, and with additional requirements for maximum heat losses through different parts of the building and how much air the building is allowed to leak.

These requirements are probably stricter, both in kWh/m^2 and U-values, than in all the other countries, at least in Sweden, Norway, Finland, according to a Swedish study, and Estonia. But as metrics are not the same, comparability is difficult.

In Denmark there are also requirements for the renovation of buildings.

As energy requirements can differ by a factor 1.5–2, this has a huge impact over a long time.

Much more energy is, however, used by existing buildings. Many of them will probably be there for another 100 years. Codes for new buildings have only an indirect influence on them; people who live or work in old buildings will raise their demands for indoor climate and economy once they have experienced what can actually be done. This also raises the professional standard of the construction industry.

Another way to raise that standard is promotion of low-energy building. Measures of this type in Denmark are known as Low Energy 2015 and Low Energy 2020 (still stricter), named after expected future building codes.

As discussed in the Finland report, energy labelling and certification could possibly create a market for efficiency, but this may not be enough.

Denmark has requirements for building components, such as circulation pumps, boilers and windows after renovation, both for new and renovated building. These requirements will be stricter from 2015.

The Norwegian government has expressed its intention to strengthen the building codes "so as to reach passive house standard within the next decade". If this is enacted with a strict quantitative meaning, it will transform the construction business in Norway and set an example for everybody else, but that has not happened yet.

Other countries will follow the EU directive on energy performance of buildings, and adopt "near zero energy houses" before 2020.

Energy-efficient buildings are prominent on all the lists, sometimes divided by the kind of building (apartment, government, factories, commercial) or with respect to building codes for new buildings or requirements/subsidies for simple or extensive renovation. The technologies for reducing heat losses are essentially the same: better insulation, draught proofing, better windows, recovery of heat from outgoing air, better control systems and more metering. These also apply to cooling, as it is easier to keep a well-insulated building cool when it is hot.

The way to make this happen for new buildings is through building codes. For existing buildings there are many methods: white certificates, subsidies for renovation that include energy efficiency requirements, energy performance contracting and various innovative schemes for government buildings and energy labelling, for example.

4. Other efficiency improvements

European Union (also including EEA countries Norway and Iceland), Russia

Other areas for improving efficiency (aside from electricity, heating and vehicles) include lighting, household appliances and office equipment.

In the EU/EEA countries, that is all except Russia, this is mainly an issue to be tackled at EU level. That is where the battles are fought, often within the Eco-design directive, such as the ban on incandescent bulbs and the very much improved efficiency of refrigerators.

Labelling may seem a weak incentive, but has actually transformed the market for refrigerators, for example, as people seem to prefer to buy an A-labelled fridge to one labelled C.

Some NGOs call for campaigns to raise awareness about energy efficiency.

5. District heating efficiency

Denmark, Estonia, Germany, Lithuania, Poland, Russia

District heat efficiency can be much improved in at least all former communist countries through better insulation and through more cogeneration, where the heat is put to better use as it also generates power. Improvement saves a lot of energy, but the utilities are often unable to finance such measures. Some NGOs have noted support from the EU.

Combined heat and power, from natural gas or biomass, can also play an important part in balancing the variable renewables.

Tri-generation, combined with district cooling, can increase efficiency even more. Both heating and cooling can use surplus hot water from industry.

Also geothermal heat and solar heating can be distributed via district heating networks.

6. Vehicle emission standards

European Union (incl Norway and Iceland), Poland

Vehicle efficiency standards are similarly dependent on EU legislation everywhere except Russia. But as Russia has as many people as the other ten nations put together, it is an important exception.

Just because the standards are decided by the EU, it does not follow that nothing can be done nationally. Measures for electromobility are mentioned in some reports (Norway, Poland, Estonia) as are various incentives and subsidies for biogas, ethanol and wood-to-diesel, and for alternative-fuel vehicles.

7. Other measures to reduce traffic CO_2

Denmark, Germany, Iceland, Norway, Finland, Sweden

Other measures to reduce traffic CO_2 feature in most NGO reports, varying from road tolls, vehicle taxation, CO_2-related sales tax or annual vehicle tax, road tax for trucks, levies on air traffic, support for lightweight rail vehicles, and in some countries support for electric vehicles.

A differentiated registration tax in Norway has increased the demand for new cars with low specific emissions, and reduced the average specific emission figure for CO_2 from 180 g/km in 2006 to 140 g/km in 2010.

Whereas emissions from heating and electricity generation can be controlled by just a few instruments, the markets for cars and their usage needs much more political intervention.

8. Infrastructure planning

Estonia, Finland, Iceland, Poland, Russia, Sweden, and the European Union

Traffic infrastructure and long-term planning may be grouped together. More railways do not constitute a quick and cheap way to cut emissions, but may be necessary for long-term sustainability. New railways take a long time to build, though closing old railways can happen fast. Sustainable urban

planning is a prerequisite for good public transport, good urban life, and for higher levels of district heating and cooling. Another critical aspect for the integration of wind and solar power is more high-voltage transmission lines or cables, within countries or cross-border (Lituania, Iceland). Wind power itself needs a good long term planning organization, especially offshore.

9. Waste and recycling

Denmark Latvia, Poland,Russia

Waste management is of importance for greenhouse gas emissions in many countries. Reduction and sorting of waste at source are well developed in some countries, and contribute to resource efficiency, lower greenhouse gas emissions and reduced environmental impact in several ways. Methods to reduce waste include bans on landfill disposal of some waste categories, such as in Sweden and Denmark. Taxes on waste can work separately or in tandem.

10. Land use

Iceland, Lithuania, Poland, RussiaLand use is not a main theme in this report. NGOs are wary about LULUCF, as it invites cheating with emission statistics for countries that logged heavily in the decades before 1990. It nevertheless features in reports from Iceland (wetland reclamation, afforestation), Denmark (afforestation, though not top 10), Lithuania (afforestation), Poland (good agricultural practice) and above all Russia. Russia has by far the largest forested area in the world. What Russia does with its forests, and how they change with rising temperature and higher CO_2 content in the atmosphere is important for the whole planet, for biodiversity, for air quality and for the climate. At stake in the 2050 perspective, this could represent a sink of 500 million tons CO_2eq net – or a large source of carbon that could be released into the atmosphere. This is however by no means unique to Russia. All our nations are at the same crossroads, especially those that have large forests.

Other policies

The selection of the10 most effective policies leaves out important policies in fields not covered by the selected policies. They can be very important, however. An example of this is R&D, which was prioritised in two countries (9th and 10th priority). While R&D is important for the medium- to long term, it is less important in the short term, where policies that promote investment and other elements of the transition are more important. Another example is consumer information, which is important for the success of many of the policies, but is less effective for large-scale changes as a stand-alone measure.

One of the selection criteria was to select policies that were proven successes and seem to be replicable, while other policies that are only at the planning stage, or are only used with success in one country, were not selected only. They could be future successes, and therefore we think it is important to highlight them, which we do below.

Climate law

Climate laws that make targets and timetables for emission reduction a legal requirement, are planned in several countries in the region (and already in place in Britain) and they were prioritised in two countries. They may be important frameworks for future climate policies in the region.

Smart grid strategies

Smarter energy grids (electricity, heat) are seen as an important part of integration of large-scale renewables. They were prioritised in one country, but are likely to be important in all countries. A strategy for implementing smarter grids with requirements for smarter meters, more online communication of power production data, etc. is important for realising a future smart grid, and thereby facilitating the change to renewable energy.

Congestion charges

Congestion charges were prioritised in Sweden (3rd priority), and are also used with success in Norwegian cities, and in the centre of Riga in Latvia. They are likely to be an important part of a sustainable transport policy, even though they have not spread more widely, mainly because of the strong road lobby against them.

Technology procurement

The coordination of purchases of energy-consuming equipment and renewable energy to increase sales and reduce prices has been carried out in Sweden with considerable success. This has been a national priority and considerable experience exists that other countries can also benefit from. It was prioritised in Sweden (9th priority).

Net metering

Photovoltaics have usually not been given much thought in our region. Germany, parts of which is less sunny than some other countries in the Northern Europe region, has however showed that solar PV panels can produce large amounts of electricity: 30 TWh in 2013. Support schemes have existed in several countries, but produced very modest results. The Danish net metering system brought photovoltaics to more than 100 MW in 2012, far more than all the other countries, except Germany, combined. In 2013 it increased to more than 500 MW. Net metering allows the owner to run the meter backwards when a house with solar PVpanels produces more electricity than needed, and to use this surplus at a later time. The success in Denmark led, however to a change in PV support to a feed-in like system.

Mandatory use of straw

While use of dedicated crops for biofuel often invites controversy, the use of bark, sawdust etc., from wood, biogas from sewage, and agricultural by-products have no such problem. The Danish insistence on using straw has paid off, and now accounts for about 20 PJ/year, mainly for power and heat.

Almost every nation in the world has an energy resource in waste from agriculture, but unlike in Denmark, very little of this resource is mobilized.

Transport policies

A number of transport policies were included with lower ranks in some countries: promotion of railways and other public transport, "green" annual tax on cars, planning for public transport, promotion of electric and hydrogen vehicles including tax exemption, public vehicles' standards. We did not evaluate these policies to be among the 10 most effective, but that does not mean that they are not important. It is rather a result of the fact that sustainable transport policies have not been very successful in the Nordic-Baltic regions that have experienced increasing fossil fuel use in transport until the start of the recent economic crisis. Therefore, in general the energy and climate measures for transport have not been very effective in the region. If implemented more forcefully, they could be more effective, as is the case in some German regions.

DENMARK

Danish Initiatives for Reduction of CO_2 and Energy use or more Renewables:

Compiled by Søren Dyck-Madsen, The Danish Ecological Council

Since 1990, Denmark has had an energy policy that aims to increase the use of renewables and improve energy efficiency to encourage sustainable development. This policy consists of a large number of instruments (measures) that in combination are expected to lead to 100% renewable energy by 2050, with 2020 as an important milestone. This paper describes the most significant instruments

37 Instruments:

1. Energy taxation for households

"Denmark has had taxes on energy for many years. Since the first oil crisis in the early 1970s these taxes have been set with the aim of reducing consumption and promoting the instigation of more energy-saving measures. Lower energy consumption will reduce the emissions of CO_2, methane (CH4), and nitrous oxide (N_2O) associated with combustion of fossil fuels. Energy taxes from 1999 to 2009 are stated in Table 4.4 below. Behind the taxes is also a philosophy of taxing resource use rather than work.

TABLE 4.4 ENERGY TAXES 1999-2009
Source: Ministry of Taxation

		Unit	1999	2000	2001	2002-2004	2005-2007	2008[1]	2009
Coal		*DKK/toe*	1,884	1,968	2,051	2,135	2,173	2,211	2,252
Natural gas		*DKK/toe*	1,536	1,672	2,048	2,111	2,134	2,173	2,211
Natural gas		*DKK/m³*	1.47	1.60	1.96	2.02	2.042	2.079	2.116
Oil products:	Diesel	*DKK/toe*	2,030	2,255	2,255	2,432	2,439	2,439	2,547
	Fuel oil	*DKK/toe*	1,967	2,008	2,060	2,122	2,155	2,194	2,233
Electricity:	For heating	*DKK/kWh*	0.42	0.47	0.486	0.501	0.511	0.52	0.529
	Other	*DKK/kWh*	0.48	0.54	0.551	0.566	0.576	0.587	0.596
Waste:	Heating from waste	*DKK/toe*	209	335	427	540	540	548	561
Other compostable biomass		*DKK/toe*	0	0	0	0	0	0	0

[1] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.

	2011	2012
Electricity tax for heating – more than 4000 kWh per year	0.614 DKK/kWh	0.624DKK/kWh
Other electricity use tax	0.73 DKK/kWh	0.742 DKK/kWh

Most companies can get almost all of the electricity tax refunded – so they practically do not pay electricity tax.

Danish energy taxes are laid down in the four Danish tax acts on mineral oil, gas, coal, and electricity, respectively. In the years 2002-7 the energy taxes were not indexed according to inflation, and therefore their real value was reduced. But from 1 January 2008 the tax rates set in these four tax acts have been subject to a yearly increase of 1.8% over the period 2008-2015. The indexation was estimated to lead to a reduction in emissions of 0.14 million tones of CO_2 in 2008 and 0.98 million tonnes of CO_2 in 2015.

The introduction of CO_2 taxes and the increase in the rates of individual energy taxes since 1990 have had an effect on the consumption of a number of energy products and have therefore reduced the CO_2 emissions associated with consumption of these products.

The Effort Analysis from 1 April 2005 made an estimate of the effects of the measures implemented in the period 1990-2001. The report's calculations show that the total effect of the introduction of CO_2 taxes and raised energy taxes meant a reduction in annual emissions of about 1.5 million tonnes of CO_2 equivalents in 2001.

The socio-economic reduction costs were estimated at DKK 325/tonne. The expected average reduction in emissions for the years 2008-12 is the same as for 2001, namely about 1.5 million tonnes of CO_2 equivalents."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

In March 2012 a broad energy agreement was reached, including new taxes that will be introduced in the coming years.

The agreement stipulates:

- that the increased efforts within energy savings made by energy companies are to be financed via the tariffs on energy distribution,
- that funding for expanding renewable energy that is supplied to the electricity and gas grids is to be financed via PSO (Public Service Obligation) schemes and thus via the energy bill,
- that a space heating tax (called "security of supply tax") is to be introduced to cover government funding for biogas, industrial CHP, state funds for energy savings in privately owned rental properties, renewable energy in businesses, as well as the government's loss of fossil fuel tax revenues due to lower consumption of fossil fuels,
- that a share of the security of supply tax is to be offset against lower energy taxes on electricity and fuel for industry with a view to maintaining Denmark's competitiveness.

Source: "Short summary of the Energy agreement in Denmark from 22.3.2012"

2. CO_2 taxation for business – including energy savings agreements

"The CO_2 tax on energy products was introduced on 1 March 1992. CO_2 tax is placed on different types of energy products relative to their CO_2 emissions, cf. Table 4.10.

TABLE 4.10 CO_2 TAX RATES, 2000-2009, STATED IN DKK PER TONNE OF CO_2
Source: Ministry of Taxation

	2000	2001	2002	2003	2004	2005	2006	2007	2008[1 2]	2009[2]
Basic rate										
Heating in industry	100	100	100	100	100	90	*90*	*90*	*90*	*90*
Light industrial processes										
Basic rate	90	90	90	90	90	90	90	90	90	90
With a voluntary agreement	68	68	68	68	68	68	68	68	68	68
Resulting subsidy	22	22	22	22	22	22	22	22	22	22
Heavy industrial processes										
Basic rate	25	25	25	25	25	25	25	25	25	25
With a voluntary agreement	3	3	3	3	3	3	3	3	3	3
Resulting subsidy	22	22	22	22	22	22	22	22	22	22

[1] As from 1 January 2008 the tax rates are following a yearly regulation of 1,8% in the period 2008-2015.
[2] With the implementation of an amendment of the energy taxes, which is currently pending approval by the European Commission, only subsidies regarding CO_2 tax on electricity to firms with a voluntary agreement will be given.

The voluntary agreement for companies with a heavy industrial process actually was very successful in delivering energy savings at a very cost-effective level.

Table 4.11 shows examples of the different types of CO_2 taxes converted into consumer units.

TABLE 4.11 EXAMPLES OF CO_2 TAXES
Source: Ministry of Taxation

	Unit	15.5.1992-31.12.2004	1.1.2005-31.12.2007	1.1.2008-31.12.2008[1]	1.1.2009-31.12.09
Gas oil and diesel oil	*DKK/litre*	0.27	0.243	0.247	0.252
Fuel oil	*DKK/kg*	0.32	0.288	0.293	0.298
Electricity	*DKK/kWh*	0.10	0.09	0.088	0.089
Lignite	*DKK/tonne*	242	217.8	221.7	225.7
Natural gas and town gas	*DKK/Nm^3*	0.22	0.198	0.202	0.205
Petrol	*DKK/litre*	-	0.22	0.224	0.228

[1] As from 1 January 2008 the tax rates are following a yearly regulation of 1,8% in the period 2008-2015.

In addition to this, there are CO_2 taxes on heating tar, crude oil, coke, crude oil coke, lignite briquettes and lignite, LPG, and other gases. As evident from Table 4.11, the CO_2 taxes were reduced from 1 July 2004. This reduction, however, does not mean a reduction in the tax burden and resulting increased CO_2 emissions.

The tax reductions were part of a reorganization of the energy taxes to make them more transparent, and the energy taxes on the different energy products have been raised correspondingly, so that the overall tax on the individual product is the same. As part of the reorganization of the taxes, from 1 January 2005 a tax was placed on petrol and the energy tax on petrol was reduced correspondingly, so that the total tax burden on petrol remains unchanged. This reorganization was introduced in order to make it possible to exempt biofuels from CO_2 tax. As from 1 January 2008 the CO_2 tax is subject to a yearly increase of 1.8% over the period 2008-2015, like the energy taxes."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

3. Fuel Taxes

"The increased fuel taxes have led to an annual reduction of about 1.2 million tonnes of CO_2 equivalents in 2001 with a socio-economic reduction cost of DKK 775/tonne. The average for 2008-12 is expected to be at the 2001 level."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

4. Energy distribution companies energy savings obligations

"As a part of the 2005 political agreement, grid and distribution companies in the electricity, natural gas, district heating and oil sectors are obligated to realize savings in the final energy consumption of end-users. Furthermore the companies are obligated to provide information to their own customers on energy consumption and provide advice on saving energy. The companies have a high degree of freedom regarding methodology.

These obligations are implemented as a voluntary agreement between the minister for climate and energy and trade associations representing the electricity grid, natural gas, district heating, and oil companies.

In the 2008 political agreement the companies' obligation to deliver energy savings was increased by more than 80% from 2.95 PJ to 5.4 PJ. The elevated obligation of 5.4 PJ will enter into force from 1 January 2010.

Electricity companies have worked with energy savings since the early 1990s. Natural gas and district heating companies' activities have only been formalized in recent years. Today's costs are in principal financed through energy prices."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

In the new Danish Energy Agreement from 22 March 2012, the demand for energy savings from energy distribution companies is increased.

"Energy efficiency improvements are crucial if DK is to increase the share of renewable energy in its total energy consumption. This is good for enterprises and households in today's age of increasing and volatile fossil fuel energy prices. With the agreement's initiatives, in 2020 Denmark will have reduced its final energy consumption (excluding consumption for transport) by almost 7% compared to 2010. (Around half of the reduction comes from final energy savings and half comes from conversion to wind turbines that reduces losses at power plants). The agreement contains the following elements:

- Energy companies must realize specific energy savings exceeding today's requirements, e.g. by consulting energy experts and by offering subsidies to e.g. households and businesses,
- Energy companies must increase efforts by 75% from 2013 to 2014, and by 100% from 2015 to 2020 compared to 2010-12,
- A comprehensive strategy for energy renovation of all Danish buildings will be developed."

Source: The Danish Energy Agreement from 22 March 2012

5. Building codes

The Building Regulations 2010 (BR10) contain rules for the construction of buildings in Denmark, both private and commercial. Regulation is primarily based on functional requirements. BR10 also contains requirements for low-energy buildings class 2015, and in an appendix also for low-energy buildings 2020.

See: http://www.ebst.dk/link/42549/link

Most important requirement concerning energy in BR2010

In the case of dwellings, student accommodation, hotels etc., the total energy demand of the building for heating, ventilation, cooling and domestic hot water per m^2 of heated floor area must not exceed 52.5 kWh/m^2/ year plus 1650 kWh/year divided by the heated floor area counted on the outside of the house (including walls).

For offices, schools, institutions etc., the total energy demand of the building for heating, ventilation, cooling and domestic hot water and lighting per m^2 of heated floor area must not exceed 71.3 kWh/m^2/year plus 1650 kWh/year divided by the heated floor area.

These requirements are supplemented by a number of maximum heat losses through different parts of the building envelope to ensure that no part of the building can be constructed too badly.

Air changes through leakage in the building envelope must not exceed 1.5 l/s/m^2 of the heated floor area when tested at a pressure of 50 Pa.

The surface temperature of window frames in external walls must not be lower than 9.3°C measured with an indoor temperature of 20°C and an outdoor temperature of 0°C.

Renovation

Energy savings must be implemented if the conversion or alterations affect the building envelope. Specific measures only apply to that part of the building envelope which is affected by the alterations.

For renovation the specifications are weaker – and can be avoided if cost-effective-calculations show that the below cited requirement is too costly to implement.

When replacing windows, the net energy loss (heat loss minus useful solar input) through the window in the heating season must not be more than 33 kWh/m^2/year. When replacing roof lights, the net energy loss through the window in the heating season must not be more than 10 Kwh/m^2/year.

When replacing windows after 1 January 2015, the net energy loss in the heating season through the window must not be less than minus 17 kWh/m^2/year. When replacing roof lights after 1 January 2015, the energy loss in the heating season through the roof light must not be more than 0 kWh/m^2/year. When replacing roof lights after 1 January 2015, the U value of the roof lights including frames must not exceed 1.40 W/m^2K.

Low energy 2015

A building may be classified as a class 2015 low energy building when the total energy demand for heating, ventilation, cooling and domestic hot water per m^2 of heated floor area does not exceed 30 kWh/m^2/year plus 1000 kWh/year divided by the heated floor area.

Offices, schools, institutions and other buildings may be classified as class 2015 low-energy buildings when the energy requirement for heating, ventilation, cooling, domestic hot water and lighting per m^2 of heated floor area does not exceed 41 kWh/m^2/year plus 1100 kWh/year divided by the heated floor area.

Buildings covered by the low-energy performance framework must be built such that the design transmission loss does not exceed 4.0 W per m^2 of the building envelope in the case of single-storey buildings, 5.0 W per m^2 for two-storey buildings and 6.0 W for buildings with three storeys or more.

In the case of low-energy buildings, air changes through the building envelope must not exceed 1.0 l/s pr. m^2

For buildings supplied with district heating, an energy factor of 0.8 for district heating applies for verification of compliance with the low-energy performance framework.

The energy loss in the heating season through the windows must not be more than 17 kWh/m^2/year. There must not be energy loss in the heating season through the roof lights (loss below 0 kWh/m^2/year). The U value of the roof lights including frames must not exceed 1.40 W/m^2K.

The provision for surface temperature of window frames in external walls will be re-assessed.

Low energy 2020

Buildings covered by the low-energy performance framework for 2020 buildings must be built such that the design transmission loss does not exceed 3.7 W per m^2 of the building envelope in the case of single-storey buildings, 4.7 W per m^2 for two-storey buildings and 5.7 W for buildings with three storeys or more.

The energy gain in the heating season through the windows must not be less than 0 kWh/m^2/year. The energy gain in the heating season through the roof lights must not be less than 10 kWh/m^2/year (requiring net gain instead of net loss). The U value of the roof lights including frames must not exceed 1.20 W/m^2K.

In the case of low-energy buildings 2020, air changes through the building envelope must not exceed 1.0 l/s pr. m^2

For low-energy buildings 2020 – in the case of dwellings, student accommodation, hotels etc – the window glass area shall be at least 15% of the floor area in rooms that are used for living, and for kitchens.

In case of collective renewables production that is established in connection with new low-energy buildings (2020 standard) and where the building owner economically invests in the construction of the renewables, the size of this

production can be subtracted when calculating the building's total energy demand. The renewables production has to be installed at the building or nearby.

For buildings supplied with district heating, an energy factor of 0.8 for district heating and an energy factor of 1.8 for electricity apply for verification of compliance with the low-energy performance framework.

In offices, schools and institutions it must be ensured that the content of CO_2in the indoor air does not exceed 900 ppm for extended periods of time.

In low-energy buildings 2020, airborne heating must not be the only source for heating the building.

Component requirements for new buildings and for retrofitting old ones

Circulation pumps in heating, hot water, geothermal heating and cooling systems must be A rated or must comply with the corresponding energy requirements. Ventilation installations must incorporate heat recovery with a dry temperature efficiency of no less than 70%. The heat recovery unit can be combined with a heat pump for heat recovery. This must have a minimum COP (coefficient of performance) of 3.6 in heating mode. To be CE labelled, oil-fired boilers must have a fuel use efficiency of no less than 93% at full load and 98% at part load. To be CE labelled, gas-fired boilers must have a fuel use efficiency of no less than 96% at full load and 105% at 30% part load. Oil-fired hot air units for heating buildings must meet the requirements for class A air heating systems.

6. Cogeneration and district heating

"Increased use of CHP and enlarged district heating areas have been the main elements of the Danish strategy to promote RE and the efficient use of energy resources since the end of the 1970s. Effective heat supply planning has ensured the highest share of district heating and CHP in the western hemisphere. This has secured early markets for district heating technologies and a cheap avenue for the use of many renewable energy sources like straw, municipal waste, wood waste and geothermal energy. More than half of Denmark's domestic electricity consumption is co-generated with heat at CHP plants, and the potential for further use of CHP is limited. For this reason, only a smaller increase in CHP production is expected in the future, but the share of CHP in thermal electricity production could increase up to about 90% with more heat storage, more PV and more intelligent energy networks

The surveys "District heating in Denmark 1.0 and 2.0" show that an increase in district heating to include about 10–15% more buildings would be cost effective, but with increasing energy efficiency in houses, the total district heat consumption is not likely to increase

CHP has been promoted partly by the tax system, partly by electricity production grants for small-scale CHP plants and, lastly, by prioritizing electricity from small-scale CHP plants."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

7. Implemented taxes and duties relevant to consumption and emissions of HFCs, PFCs, and SF6

"Since 1 March 2001, imports of the industrial gases HFCs, PFCs, and SF_6 (F-gases) in the industrial/business sector have been subject to taxation. The tax is based on the Danish CO_2 tax correlated with GWP up to a maximum of DKK 400/kg, cf. the examples in Table 4.14.

TABLE 4.14 EXAMPLES OF TAXES ON F-GASES
Source: Ministry of Taxation

Substance	GWP	Tax in DKK per kg
HFC-134a	1300	130
R404a (a combination of 3 HFCs)	3780	378
SF_6	23900	400

Regarding the effect of taxes on the consumption of HFCs, PFCs, and SF_6 on emissions of greenhouse gases, the Effort Analysis has estimated that the tax on the industrial gases HFCs, PFCs, and SF_6, in combination with the effect of regulation adopted and introduced, led to a **reduction** of 49,000 tonnes of CO_2 equivalents in 2001. In 2005, reduction was expected to be somewhere around 150,000 tonnes of CO_2 equivalents, increasing to around 370,000 tonnes in 2010. The socio-economic reduction cost is estimated at about DKK 200/tonne CO_2.

Please note that it has not been possible to calculate the effects and costs of taxes and regulation separately.

The tax reform on 1 March 2009 has raised the tax on consumption of HFCs, PFCs, and SF_6 to bring it in line with the new CO_2 tax rate of DKK 150 per tonne. In addition to this, taxes are imposed on other greenhouse gasses than CO_2 in relation to use of energy. The tax rates on these greenhouse gasses will likewise equate to the new CO_2 tax rate.

TABLE 5.8 EMISSIONS OF INDUSTRIAL GREENHOUSE GASES (HFCS, PFCS AND SF_6), 1990-2007 ARE OBSERVED.
Source: 1990-2007: National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025. NERI Technical report no. 703, 2009.

'000 tonnes of CO_2 equivalents	1995	2000	2007	"2010"	2015	2020	2025
HFCs	218	605	840	786	488	152	152
PFCs	1	18	15	10	7	6	6
SF_6	107	59	30	58	123	59	59
F-gases total	**326**	**682**	**886**	**855**	**619**	**217**	**217**

Taxes corresponding to their GWP have been imposed on each of the greenhouse gases from March 2001 in combination with the Danish CO_2 tax of DKK 0.1 per kg CO_2 as described in section 4.3.3. This means that HFC-134a is subject to a tax of DKK 130/kg, as it has a GWP of 1,300. There is a ceiling of DKK 400/kg, so although SF_6 has a GWP of 23,900, the tax is only DKK 400/kg and not DKK 2,390/kg.

The tax is imposed on import of the substances because none of them are produced in Denmark. The tax is payable whether the substances are imported as pure substances or are part of imported products. If the content in the products is not known, the tax is based on a fixed tariff.

The tax is payable on a wide range of products, including:

- Refrigerating and freezing plants
- Air-conditioning plants
- PUR foam for cooling plants, district heating pipes, insulated gates and doors, panels for refrigeration and freezer rooms, extruded polystyrene for insulation (XPS foam), jointing foam
- Spray canisters
- Insulation gas

The tax is also payable on service on existing and new installations/products.

The projection of the emissions is based on implemented and adopted policies and measures, including a statutory order on phasing out certain industrial gases.

This statutory order will result in a **reduction** in greenhouse gas emissions of, on average, 0.4-0.7 million tonnes of CO_2 equivalents per year in the period 2008-2012. It is covered by a ban on the use of HFC as a coolant in the retail trade and stationary A/C systems from 1 January 2007, except for the refilling of existing systems, and as a foaming agent in PUR foam from 1 January 2006.

With regard to process emissions, unchanged market and production conditions have been assumed consistently.

The only deviations are, that from 2004 production of **nitric acid** ceased in Denmark; that in the period 2002-2007 an increase of 5% in the production of clinker for cement production is assumed; and that emissions of process CO_2 from steel production from 2005 are assumed to be at the 2001 level as from 2010 production will resume after a period of zero production from 2002-2007.

On the basis of the effects described above, for example, it can be assumed that the resumption of **production of nitric** acid in Denmark – using the same technology as prior to the cessation in 2004, which in practice will probably not be the case – will increase annual emissions in 2008-2012 by about 1 million tonnes of CO_2 equivalents. In other contexts it has also been assumed that any relaxation of Danish regulations regarding F gases to align with EU regulation will increase Danish emissions of F gases by 0.4–0.7 million tonnes of CO_2 equivalents per year in 2008-2012."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

8. Registration tax for cars

"The registration tax for passenger cars and vans has since 15 June 2007 been reduced or increased according to the fuel efficiency of the vehicle. Petrol and diesel driven passenger cars and vans receive a tax reduction of DKK 4,000 for each kilometre in excess of 16 kilometres (18 kilometres) the vehicles run per litre of petrol or diesel. Similarly, a tax increase of DKK 1,000 for each

kilometre less than 16 kilometres (18 kilometres) the vehicles run per litre of petrol (diesel) is received.

This is expected to lead to a yearly emission reduction of 0.05 million tonnes of CO_2[4]. This incentive replaces a reduction in the registration tax for highly energy-efficient private cars, which was introduced on 1 January 2000.

In the transport sector a higher annual tax was imposed on LCVs and the registration tax on taxis was reorganized. These changes increased the incentive to buy more energy-efficient vehicles."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

9. Annual green ownership tax for cars

"Since 1 July 1997 the annual tax on motor vehicles has been based partly on energy consumption (the green owner tax) measured in accordance with EU Directive 93/116/EC. Before this date, the taxation was based only on weight. 24 classes of energy consumption have been defined for both petrol-driven and diesel-driven vehicles. Examples of classes from 2009 are shown in Table 4.12.

TABLE 4.12 EXAMPLES FROM THE DANISH STRUCTURE OF TAX INCENTIVES BASED ON ANNUAL TAXES ON MOTOR VEHICLES (2008-09), DKK/YEAR

Source: Ministry of Taxation

Class of motor vehicle		Fuel consumption (km/l)	Annual tax (DKK/year)
Petrol	1	> 20.0	520
	11	10.0 – 10.5	5,500
	24	< 4.5	18,460
Diesel	1	25> 22.5	1,960
	12	10.2 – 11.3	9,620
	24	< 5.1	25,060

From 1 January 2000, three new classes were defined for diesel-driven private cars. The annual tax is given in Table 4.13.

TABLE 4.13 ANNUAL TAX FOR DIESEL-DRIVEN PRIVATE CARS, DKK/YEAR

Source: Ministry of Taxation

DKK/year	2000	2001	2002-2009
> 32.1 km/l	140	200	160
28.1-32.1 km/l	700	780	740
25-28.1 km/l	1,280	1,380	1,320

The reason for the fall from 2002 and onwards is a reduction in the green owner tax as a consequence of rising fuel taxes. With effect from 1 January 2002, there was an increase in the tax on diesel.

Tax differentiation based on air pollution (the Euro norms) has also been introduced – giving reductions on annual taxes for light commercial vehicles (LCVs) fulfilling the EURO3 and EURO4 standards. But as these standards

4 The quotation is correct, but the effect seems very small.

became obligatory, these reductions of annual taxes for light commercial vehicles (LCVs) as an incentive to buy vehicles which fulfilled these standards were no longer relevant. From 1 January 2007, a reduction of DKK 4.000 in the tax base for the registration tax was implemented for diesel-driven personal cars and LCVs fulfilling the standards for emission of particles set out originally in EU Council directive 70/220/EØF, dated 20 March 1970.

In 2001, the introduction of the green owner tax meant an approx. 2% reduction in CO_2 emissions from cars, corresponding to 0.158 million tonnes of CO_2 equivalents. The average for 2008-12 is expected to be around 7% (0.540 million tonnes of CO_2 equivalents)."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

10. Biofuels and exemption of registration tax for electric and hydrogen cars

"In 2008 the government reached an energy agreement with the majority of the parliament for the period 2008 to 2011. For the transport sector, the government's aim is that biofuels should account for a total of 5.75 per cent by 2010. In the energy extrapolation, biofuel is implemented over the period 2008 to 2010 (1.5 per cent in 2008 and 3 per cent in 2009). Only biofuel can be used to meet the goals of the agreement in that biofuel meets the demands formulated by the EU as to the future sustainability criteria.

The CO_2emissions of the transport sector are expected to increase over the period, however not in the period 2009 to 2010, since the energy agreement determines that there should be a blending of 5.75 per cent biofuels in petrol and diesel. The use of biofuels in the transport sector gets full impact on the transport sector's CO_2emissions.

Hydrogen cars are exempted from charges until 2015. The exemption from charges for electric cars was also extended until 2012, but has now been extended further. A test programme for electric cars has been established with an appropriation of DKK 10 million yearly in 2008-09, followed by DKK 5 million yearly in 2010-12.

In January 2009 the government reached a green transport agreement with the majority of the parliament with an overall aim to reduce CO_2 emissions from the transport sector. Green Transport Vision Denmark is a long-term vision aiming at creating a green transport system that rests on a three-legged base of being able to effectively reduce greenhouse gas emissions and at the same time maintain mobility in society.

The focus of Green Transport Vision Denmark is an environment-friendly renewal of car taxes, more and better public transport plus new sustainable technologies.

The long-term effort is a combination of a concrete endeavor to diffuse and mature for market new technologies through a comprehensive trial and a marked strengthening of research into sustainable technologies in the transport sector.

Denmark will become a laboratory, so to speak, for the development of sustainable technologies within the field of transport. With the establishment of the Centre for Green Transport, Denmark is stepping up the development of sustainable technologies. Foreign partners are to think of Denmark as an attractive place to test new technologies. Funds worth DKK 200 million have been allocated for expanding and maturing the market for new technologies, including large-scale trials of electric cars. A number of initiatives to reduce greenhouse gas emissions will be taken as early as 2009 as a means of supporting increased energy effectiveness in the transport sector in the short term."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

It was politically agreed in the broadly politically backed Energy agreement on 22 March 2012 to extend the exemption from charges for electric cars until 2015.

"Electricity and biomass in the transport sector

In the long term, the transport sector will face a radical conversion from fossil fuels to electricity and biofuels. The March 22 agreement contains the following elements:

- preparation of an overall strategy for the promotion of energy-efficient vehicles,
- subsidies of a total of DKK 70 million are to be earmarked for recharging stations for electric cars, infrastructure for hydrogen as well as infrastructure for gas in heavy transport,
- fuels must contain 10% biofuels in 2020." (This is, however, subject to a coming analysis of sustainability of biofuels).

From "Short summary of the Energy agreement in Denmark from 22.3.2012"

11. Planning publicly accessible buildings near public transport

The Danish planning laws require all buildings with some amount of public accessibility to be placed less than one kilometre from a public transport service point. This has a double effect – people without a car can access public services, and people who own a car are incentivized not to use the car for public service.

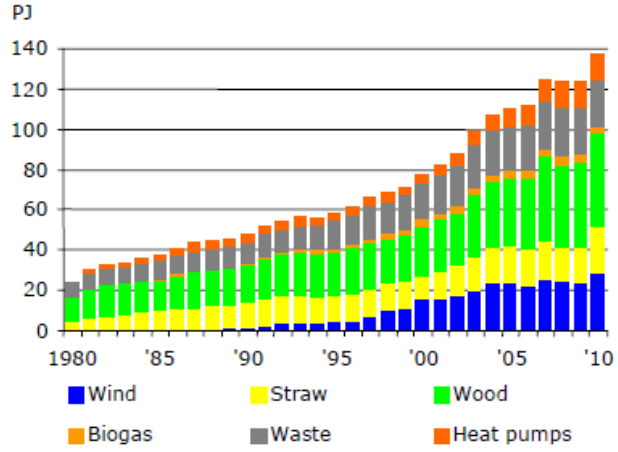
12.Feed-in tariffs for wind turbines on-shore, near-shore and off-shore

Since the amendment of the Electricity Supply Act entered into force on 1 January 2005, most environmentally friendly electricity, i.e. electricity from wind turbines and other renewable energy (RE) plants, decentralized cogeneration of heating and power etc., has been sold on market conditions + a supplement depending on technology. The previous support for environmentally friendly electricity, where consumers had an obligation to take the electricity at a fixed price, was converted to financial support in the form of a price supplement on the market price for electricity.

In order to reduce the environmental impact of electricity production, support is granted in the form of a price supplement for environmentally friendly electricity from wind turbines and many other RE plants (straw, woodchips, hydro power etc.) and decentralized cogeneration of heating and power. Biogas and some small-scale biomass technologies receive a fixed feed-in tariff. Solar PV and some small-scale solutions below 6 kW capacity can be connected with grid-metering (see below). Due to the energy agreement from February 2008 all price supplements were increased as a measure for meeting the RE goals and they are to be adjusted again following the agreement on 22 March 2012. The supplement and feed-in tariff is paid by most electricity consumers via a public service obligation (PSO) on the electricity price. Industries are exempted. The RE legislation is gathered in the Renewable Energy Law

Source: Denmark's Fifth National Communication on Climate Change, December 2009

Production of Renewable Energy



"Renewable energy includes solar energy, wind energy, hydropower, geothermal energy, biomass (including bio-degradable waste), biodiesel, bioethanol, biogas, and heat pumps.

In 2010 production of renewable energy was calculated at 137.0 PJ, which is 11.0% more than the year before. Between 1990 and 2010, renewable energy production increased by 187%.

Wind power production was 28.1 PJ in 2010, which is 16.2% more than in 2009.

Energy production based on biomass was 93.6 PJ in 2010. Of this, straw accounted for 23.6 PJ, wood accounted for 45.8 PJ, renewable waste accounted for 22.4 PJ, and bio oil accounted for 1.9 PJ. Compared with 2009, Energy production bases on biomass increased by 11.1%."

Source: The Danish Energy Agency: Energy Statistics 2010

The supplement for new wind turbines is at the moment 0.25 DKK/kWh for 22,000 full load hours + 0.023 DKK/kWh in balancing costs + 0.004 DKK/kWh to a green fund. After 22,000 full load hours (typically 8-10 years) the production from the wind turbines is supposed to be sold at market price level.

"A green and sustainable energy supply based on renewable energy

The agreement secures substantial expansion of wind power, corresponding to the annual consumption of 1½ million households. Thus in 2020, wind power will account for approximately 50% of our electricity consumption compared to 25% today. The agreement implies:

- that 600 MW of offshore wind turbines will be built at Kriegers Flak and 400 MW of offshore wind turbines will be built at Horns Rev before 2020.
- that a further 500 MW of offshore wind turbines will be installed near the coast before 2020.
- new planning tools will encourage development of onshore wind turbines with a total capacity of 1,800 MW up until 2020. This will mean that electricity production from onshore turbines will increase despite the decommissioning of older turbines.
- that subsidies for wind turbines are reduced by introducing a cap on high electricity prices in order to prevent over-compensation,
- that over a period of four years, a total of DKK 100 million will be committed to funding development and the use of new renewable energy technologies for electricity production (solar, waves, etc.) as well as DKK 25 million for wave power demonstration facilities."

From "Short summary of the Energy agreement in Denmark from 22.3.2012"

13. Increasing use of biomass – mandatory use of straw for power production

"The main tendency during the last 25 years has been that biomass has mostly been used in the form of solid biomass (wood, straw and waste); that biomass is used in larger and larger plants because of the economic advantages of scaling up; and that biomass is increasingly used for cogeneration instead of just heat production. The latter is part of the overall energy policy that has the goal of optimizing energy conversion, which among other things can be done by promoting cogeneration instead of just heat production.
The biomass agreement from 1993 is part of this development. A broad majority in the Danish Parliament is behind the agreement that mandates power plants to use 1.4 million tonnes of straw and wood, adding up to almost 20 PJ per year. The energy agreement from 21 February 2008 would further increase the use of biomass by up to 700,000 tonnes in 2011 – this implies that the renewable energy part of the overall energy use will be increased by 1.2 percentage points."

Source: Web page of The Danish Energy Agency

"Converting to green heating

Heating consumption must also gradually be converted to renewable energy.

The agreement contains the following elements:

- converting from coal to biomass at large-scale power plants will be made more attractive by amending the Heating Supply Act,
- the smaller open-field plants that are struggling in the wake of high heating prices will be allowed to produce cheap heating based on biomass"

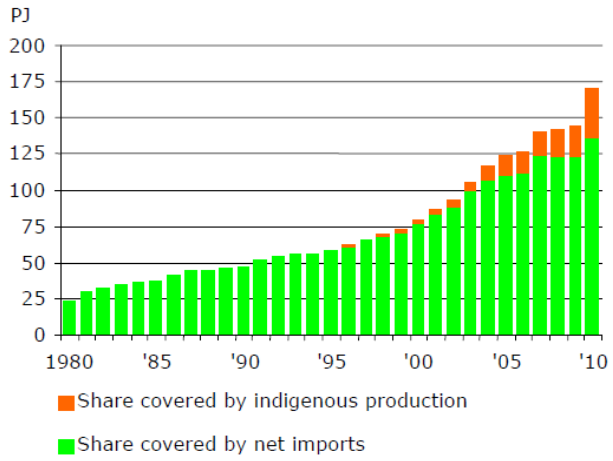
From "Short summary of the Energy agreement in Denmark from 22.3.2012"

"Large increase in consumption of renewable energy

Consumption of renewable energy increased from 145 PJ in 2009 to 170 PJ in 2010, which corresponds to an increase of 17.4%. This development is mainly due to a considerable increase in the use of biomass for electricity and district heating production in 2010.

Calculated according to the EU's method of calculation, the share of renewable energy grew from 20.1% to 22.3% in 2010. Production of electricity from renewables accounted for 33.1% of Danish domestic electricity supply in 2010. Of this figure, wind power accounted for 20.7%."

Consumption of renewable energy



Please note that this graph is incorrectly labelled. The orange is the share covered by net imports, and the green is the share covered by indigenous production.

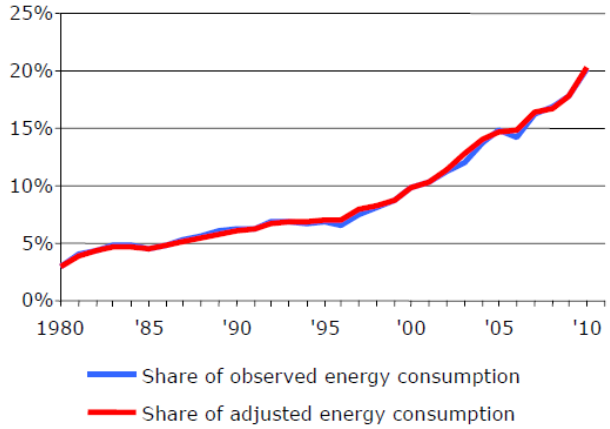
"Production of renewable energy has increased dramatically since 1980. In addition, net imports have increased. In 2010, net imports of renewable energy were 32.9 PJ, as 35.7 PJ (primarily biomass) were imported and 2.8 PJ (biodiesel) were exported.

In 2010 total consumption of renewable energy was 169.9 PJ, as opposed to 144.7 PJ in 2009 and 47.7 PJ in 1990. Final consumption of renewable energy was 17.4% higher in 2010 than the year before.

The increased use of renewable energy makes a significant contribution to reducing Danish CO_2 emissions."

Source: The Danish Energy Agency: Energy Statistics 2010

Renewable energy - share of total energy consumption



"Total consumption of renewable energy in 2010 (production plus net imports) was 169.9 PJ, of which 109.6 PJ was used in the production of electricity and district heating. Renewable waste, wood pellets and wind power were predominant in the production of electricity and district heating, accounting for 28.1 PJ, 21.1 PJ and 18.2 PJ, respectively.

Consumption of wood, straw and biogas accounted for 17.7 PJ, 18.8 PJ and 3.3 PJ, respectively.

A total of 60.3 PJ renewable energy was included in final energy consumption, i.e. for process consumption and consumption for heating in the agriculture and industry sector, in the trade and service sector, as well as for space heating in households. In final energy consumption, biomass, particularly firewood, is most prominent.

Observed energy consumption shows the registered amount of energy consumed in a calendar year. In 2010 renewable energy covered 20.1% of total observed energy consumption, as opposed to 17.9% the year before. In 1990 this figure was 6.3%.

Adjusted gross energy consumption is found by adjusting observed energy consumption for the fuel linked to foreign trade in electricity, and by adjusting for fluctuations in climate with respect to a normal weather year. In 2010 renewable energy's share of adjusted gross energy consumption was 20.2%, as opposed to 17.8% the previous year. In 1990 this figure was 6.1%.

Except for years with large net exports of electricity, the renewable energy share shows an identical trend when calculated according to the following two different methods.

Renewable energy includes solar energy, wind energy, hydropower, geothermal energy, biomass (including bio-degradable waste), biodiesel, bioethanol, biogas, and heat pumps.

In 2010 production of renewable energy was calculated at 137.0 PJ, which is 11.0% more than the year before. Between 1990 and 2010, renewable energy production increased by 187%.

Wind power production was 28.1 PJ in 2010, which is 16.2% more than in 2009.

Production of biomass was 93.6 PJ in 2010. Of this, straw accounted for 23.6 PJ, wood accounted for 45.8 PJ, renewable waste accounted for 22.4 PJ, and bio oil accounted for 1.9 PJ. Compared with 2009, biomass production increased by 11.1%."

Source: The Danish Energy Agency: Energy Statistics 2010

Production and consumption of renewable energy

Direct energy content [TJ]	1980	1990	1995	2000	2005	2008	2009	2010	Change '90-'10
Production of renewable Energy	**24 085**	**47 688**	**58 160**	**77 519**	**110 153**	**123 464**	**123 371**	**137 003**	**187%**
Solar energy	50	100	213	335	419	519	585	653	554%
Wind power	38	2 197	4 238	15 268	23 810	24 940	24 194	28 114	1 180%
Hydro power	123	101	109	109	81	93	68	74	-26,3%
Geothermal energy	-	96	94	116	344	499	483	425	342%
Biomass	23 384	41 980	48 817	55 194	74 978	84 029	84 255	93 618	123%
- Straw	4 840	12 481	13 050	12 220	18 485	15 853	17 354	23 581	88.9%
- Wood chips	-	1 724	2 340	2 744	6 082	8 237	9 798	11 184	549%
- Firewood	7 621	8 757	11 479	12 432	17 667	24 038	23 054	24 580	181%
- Wood pellets	-	1 575	2 099	2 984	3 262	2 410	2 452	2 407	52.8%
- Wood waste	3 710	6 191	5 694	6 895	6 500	7 289	6 879	7 604	22.8%
- Waste, renewable	7 213	10 508	13 904	17 870	22 222	24 408	23 095	22 377	113%
- Bio oil	-	744	251	49	761	1 794	1 622	1 886	153%
Biogas	184	752	1 758	2 912	3 830	3 928	4 171	4 278	469%
Bio diesel	-	-	-	-	2 632	3 713	3 268	2 875	•
Heat pumps	306	2 462	2 931	3 585	4 058	5 743	6 348	6 966	183%
Imports of renewable energy	-	-	**233**	**2 466**	**16 286**	**21 962**	**24 428**	**35 735**	•
Firewood	-	-	-	-	1 963	2 090	2 005	2 137	•
Wood chips	-	-	-	305	1 521	3 530	4 199	4 793	•
Wood pellets	-	-	233	2 161	12 802	16 131	17 984	27 676	•
Bioethanol	-	-	-	-	-	210	204	1 118	•
Bio diesel	-	-	-	-	-	-	35	11	•
Exports of renewable energy	-	-	-	-	**2 632**	**3 661**	**3 122**	**2 846**	•
Bio diesel	-	-	-	-	2 632	3 661	3 122	2 846	•
Consumption of renewable energy	**24 085**	**47 688**	**58 393**	**79 985**	**123 807**	**141 765**	**144 677**	**169 892**	**256%**

Source: The Danish Energy Agency – Energy Statistics 2010

"More renewable energy in industry

Industry must also convert to a greener energy system. Therefore the agreement lays down that:

- a subsidy should be given to help promote investment in energy-efficient use of renewable energy in the production processes of enterprises. In the period 2014 to 2020, the subsidy will be increased to DKK 500 million a year from DKK 250 million in 2013,
- funding of DKK 30 million per year from 2013 to 2020 will be introduced to maintain and promote industrial CHP in industries and greenhouses."

From "Short summary of the Energy agreement in Denmark from 22.3.2012"

14. Establishing conditions for Smart Grid

"Smart Grids

High electricity consumption in combination with wind power requires an intelligent energy system. Therefore the agreement lays down that:

- a comprehensive strategy for establishing smart grids in Denmark is to be drawn up,
- an agreement with grid companies on roll-out of remotely readable hourly electricity meters is to be accomplished."

From "Short summary of the Energy agreement in Denmark from 22.3.2012"

15. PV – letting the meter run backwards (netmetering)

In Denmark the support scheme for Photovoltaic (PV) electricity has been managed by allowing the "meter to run backwards", known as net-metering. In principle this means that you could cover your own electricity use over a year by producing electricity with PV with most of production during the summer. Taxes, VAT, distribution payments etc. are only paid for the net consumption. If production exceeds consumption, a small price is paid for the surplus electricity.

The effect of this kind of support scheme depends heavily on the investment cost for PV, the actual current electricity price and the estimation of future electricity prices that will not be fully paid.

The recent decrease in investment cost and increase in electricity costs for households and public authorities has led to a boom, with investment in PV increasing from an installed capacity in 2007 of only 500 kW to an installed capacity in 2011 of 11 MW, and a prediction for 2012 of 120 MW of installed capacity. The 11 MW of PV produces 0.03% of the total Danish electricity production.

The support scheme works well for consumers with their own meter and own roof partly facing south, such as single-family houses, but it generally leaves out consumers in flats with individual meters and a common roof, as well as houses without roofs with good solar access. Flats etc. could benefit from a revised system, where larger co-owned PV fields could be shared among several consumers

16. Research and development

Research and development activities in the field of energy are not motivated solely by climate issues, but are relevant to climate issues, since they contribute to determining the overall framework for the CO_2intensity of energy production and consumption in the future.

In 2008, the former Energy Research Programme (EFP) run by the Ministry of Climate and Energy was replaced by the Energy Technology Development and Demonstration Programme (EUDP). EUDP focuses on the development and demonstration of new energy technologies. A board, nominated by the Minister, is responsible for the allocation of funds. The Board is served

by a secretariat established in the Danish Energy Agency. The overall objective of EUDP is to support the government's energy policy objective of providing a cost-effective, environmentally friendly and safe energy supply, and to contribute to promoting the competitiveness of Danish enterprises in the field of energy. Its activities focus on new and efficient energy technologies. EUDP was established in 2008. Available funds in 2009 and 2010 were 227 million DKK and 409 million DKK. On average, 35 percent of the activities under the programme are financed by EUDP.

Energy research, development, and demonstration are supported by PSO funds (Public Service Obligation). The transmission system operator Energinet.dk also has a scheme for research and development in environmentally friendly power production technology, in 2009 administering support funds amounting to DKK 130 million.

Under this scheme support is given to activities relating to fuel cells and renewable energy, for instance solar cells, biomass, hydropower and wave energy. Energinet.dk also administers a new programme in 2008-11 with annual funding of DKK 25 million for the deployment of new technologies.

Furthermore, on behalf of the power distribution companies, the Danish power association Dansk Energi administers a scheme of support for research and development in the energy-efficient use of electricity. In 2009, DKK 25 million was available under the scheme, which aims at the development of energy-efficient products and processes in buildings, industry etc.

Activities relating to strategic energy research were increased in 2003. These activities are administered by the Strategic Research Council under the Ministry of Science, Technology and Innovation, and are aimed at strengthening the knowledge base within renewable energy and environment, including support for inter-disciplinary projects that involve technical, environmental, health, social, economic and political aspects. In the

years 2009-10 available funding for the Ministry's energy research efforts is expected to be DKK 170 million and 304 million.

Source: Denmark's Fifth National Communication on Climate Change, December 2009

"More research, development and demonstration

The focus on research and development is continued in the latest energy strategies:

Investments in RD&D are essential if we are to develop and test Danish green solutions and create green jobs in Denmark. Therefore the agreement lays down that:

- efforts to uphold a high level of RD&D in energy technology where there is a commercial and growth potential should be maintained,
- DKK 9.5 million is to be committed to the project of making the Island of Samsø fossil-free."

From "Short summary of the Energy agreement in Denmark from 22.3.2012"

17. Energy labelling of buildings

"Denmark has long experience with energy efficiency and energy savings in buildings. Since 1980 energy consumption for heating has been reduced by 27% per m^2. The goal is to reduce energy consumption in new buildings by 75% by 2020. The benefits of reducing energy consumption are tangible: less fossil fuel is consumed and the environment has improved substantially. Strict and progressively tightened building regulations since 1977 have ensured stable demand for energy-efficient building technologies.

Energy labelling of buildings must be implemented after finishing the construction of a building and on the sale or rental of the building – primarily heating consumption. This applies in principle to all buildings, regardless of size, apart from production facilities, factories etc.

Energy labels and an energy plan must be prepared regularly every five years for all large buildings over 1,500 m^2 (1000 m^2 at July 2009) and for all public buildings over 60 m^2 – primarily heating consumption and air conditioning systems."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

18. Electricity Savings Trust – Centre for Energy Savings – Danish knowledge centre for energy savings in buildings

The Electricity Savings Trust originally set up requirements for energy companies, negotiated and marketed fixed-price agreements, advised customers, and granted subsidies. It prepared market analyses and campaigns focusing on the price and efficiency of energy appliances. It made it simple, safe, and cheap to trade in an energy-appropriate manner. Its activities were financed by a small levy on electricity.

On 1 March 2011 The Electricity Saving Trust was replaced by The Centre for Energy Savings ("Go'Energi"/ "Good Energy"), with the purpose of contributing to the development and implementation of campaigns, market impact activities, etc. covering the use of heating as well as electricity.

Following the Danish Energy Agreement of 22 March 2012 The Centre for Energy Savings will be closed, while some of its activities will be continued by the Danish Energy Agency, and some will be dropped. (See also 19).

19. Energy labelling of appliances

Energy labeling (A-G) of white goods, lighting etc. is compulsory, following EU regulation. There are also voluntary labeling schemes, such as Energy Star, for a number of products, and Energy labelling (A-F) for windows, boilers, and other products. Danish authorities play an active role in securing compliance with the compulsory requirements. The Danish Electricity Saving Trust ran a comprehensive programme in order to promote energy-efficient appliances and products.

The fact that both the Danish Electricity Savings Trust and "Go'Energi" were kept independent from direct political influence by having their own board made it possible for them to focus on their purpose, including taking a front runner concept – promoting the most efficient products and taking up the fight with many producers of legal, but less efficient products.

The Danish Electricity Savings Trust followed by "Go'Energi" developed a "top runner" certificate for different kinds of products in order to include more effects than just energy use and in order to promote the very best products in each class to inform consumers of the best, energy-efficient buy. It also aimed to motivate retailers to actually put the best products on the shelves and run promotion campaigns for the best products using the "Recommended by Go'Energi" certificate – rather than mainstream products or the worst allowed by law. This labeling scheme has gained more and more interest from buyers and can be said to have been one of the major drivers for the demands for A-marked appliances for new buildings and for replacement of appliances.

As a result of the broad political energy agreement reached on 23 February 2012, "Go'Energi" will be shut down, and its task split between the energy distribution companies, which will handle energy savings campaigning and the Danish Energy Agency, which will take over the rest. Whether or not this is an acceptable solution is still to be discussed, since the Danish Energy Agency will not be independent – and thus will have difficulties keeping up the top runner concept.

20. Heat Pump initiative for replacing old oil burners

A pool of 30 million DKK over two years (2010 and 2011) for information campaigns, labelling of efficient pumps, limited subsidy schemes, etc. aimed at heating consumers outside of the areas with collective heat supply.

Source: Denmark's Fifth National Communication on Climate Change, December 2009

21. Scrapping of oil-fired boilers

"Allocation of DKK 400 million to support the substitution of individual oil-based furnaces with modern, low-emission heating solutions, including systems based on renewable energy, such as heat pumps and solar heating. Reduces emissions by 0.05 million tonnes annually on average 2008-2012."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

22. Banning of new oil-fired boilers

"More renewable energy in buildings

The agreement on 22 March 2012 supports the phasing-out of oil-fired boilers in existing buildings by:

- banning installation of oil-fired boilers and natural gas boilers in new buildings from 2013,
- banning installation of new oil-fired boilers in existing buildings in areas where district heating or natural gas is available from 2016,
- committing DKK 42 million in 2012-15 to fund the conversion from oil-fired boilers and natural gas boilers in existing buildings to renewable energy."

From "Short summary of the Energy agreement in Denmark from 22.3.2012"

23. Mandatory for public authorities to make energy savings in their own buildings

A statutory order on energy-efficiency in state institutions (including implementation of profitable energy savings, energy-efficient procurement, and energy-efficient behaviour and operation) made it mandatory for state authorities to make energy savings with a simple payback time of 5 years or less – identified through the energy certificate report for the buildings.

The agreement now also covers buildings owned by the regions, and under a voluntary agreement buildings owned by municipalities are also covered by the mandate.

24. Green public procurement

The action plan for a renewed energy saving efforts from 2005 also contains a number of initiatives with the objective to save energy in the public sector. The main initiatives in this respect are:

Guidelines for procurement in the public sector, e.g. through preparation of environmental guidelines for large buyers in the public sector.

Energy labelling and energy-checking of large properties.

A club for public institutions, introduced by the Electricity Saving Trust. The members of the club undertake only to buy energy-efficient appliances that meet specific requirements given in guidelines for procurement and in a positive list.

Campaigns by the Electricity Saving Trust for energy-efficient lighting, ventilation and office equipment, etc.

Consultancy by supply companies for institutions.

The Ministry of Finance is responsible for the governmental procurement policy. The purpose of the policy is to simplify and streamline governmental procurement. These requirements are explained in the Departmental Circular on Procurement.

The practical implementation of government procurement policy is performed by the State Procurement (Statens Indkøb). State Procurement has been established by the Ministry of Finance and is located at the Danish Agency of Modernisation. State Procurement makes framework agreements that all governmental institutions are obliged to use. Regions and municipalities can choose to use the governmental agreements.

While "Statens Indkøb" makes mandatory agreements for the state, the State and Municipal Procurement ("Statens og Kommunernes Indkøbsservice"/ SKI) makes voluntary agreements for the state and the municipalities. The state can use these for product groups where there are no mandatory agreements.

Regions

The Association of Danish Regions coordinates the procurement strategy for the five regions in Denmark. They coordinate common projects, outsourcing, public-private partnerships and function as secretariat for the network of the regional Procurement Officers. The regions have established a common procurement strategy.

Municipalities

Local Government Denmark (LGDK – the association of municipalities, in Danish KL) coordinates the procurement strategy for the Danish municipalities. A joint procurement strategy has been established for the municipalities. The strategy describes how the municipalities can optimize their procurement power and thereby obtain financial benefits. SKI (see above) does the work on behalf of KL, developing criteria for GPP etc. From January 2011 mandatory agreements for municipal procurement are also developed by SKI. The first to be completed is on copying and printing. It is only mandatory for municipalities that decide to join the system. 70 out of 98 municipalities have now decided to join these agreements.

b) Implementation and development of GPP

The Danish Ministry of the Environment has the overall responsibility for Danish GPP policy. The ministry focuses on the following areas:

- Intensified efforts to promote GPP within the following sectors: transportation, building and food
- Intensified efforts to promote GPP within the municipalities, since 2/3 of the public procurement budget is spent in the municipalities
- Intensified efforts to promote GPP in private companies
- Increase awareness of existing tools and advances in GPP and sustainable procurement

GPP/SRPP is an element of the governmental procurement strategy being implemented by State Procurement and SKI. State Procurement is responsible for the implementation of this strategy within state institutions.

The Danish Energy Agency has the overall responsibly for energy-efficient procurement in governmental institutions. The policy has been implemented in a Departmental Circular on Energy Efficiency. The Energy

Agency has also entered a voluntary agreement with Danish Regions and Local Government Denmark on energy-efficient procurement within the regions and municipalities. Mandatory agreements for municipalities are now also being reached, see above.

In 2008 The Danish Government published an action plan for corporate social responsibility (CSR). According to this action plan CSR should be implemented in all common procurement agreements, as stated in the conventions on which the principles of the UN Global Compact are based. The Danish Government Centre for CSR at the Commerce and Companies Agency has the task of implementing the action plan.

Large businesses (businesses over a certain size) and government-owned companies must report on CSR policies, strategies and actions in their annual business reports. The aim is to inspire businesses to take an active position on social responsibility and communicate this. The statutory requirement is part of the Government's action plan for CSR and is intended to help improve the international competitiveness of Danish trade and industry.

Source: Mainstreaming GPP in the Nordic countries – a scoping study, Nordic Council of Ministers, 2012 – and Rikke Dreyer, SKI, 2 May 2012

25. Loan possibility for local communities and regions for energy savings

Regions and municipalities normally have very strict and government-regulated possibilities for taking loans. But when it comes to energy savings, new loans can be taken without having to consider these restrictions. This has the advantage of providing communities, municipalities and regional authorities with investment capital without the need to cut down on other activities in order to invest in profitable energy savings.

To be able to get those extra loans it is necessary that the energy savings project in question has been recommended in connection with the building energy certificate or a similar energy audit.

26. Action Plans for the Aquatic Environment I and II and Action Plan for Sustainable Agriculture

"These action plans have, in particular, reduced the emissions of nitrous oxide.

There have presumably also been small effects on methane emissions from manure stores, particularly as a consequence of increased use of anaerobic fermentation of manure in biogas plants. The increased use of catch crops, larger areas with organic farming and re-establishment of wetlands must also be expected to lead to increased storage of carbon in the soil."

"Most of the changes in nitrous oxide emissions from agriculture in the period since 1990 can be attributed to these action plans. However, it has been calculated that even without the action plans there would have been a reduction in emissions, although to a much lesser extent. The effect of these action plans on emissions of nitrous oxide has been calculated at about 2.2 million tones of CO_2 equivalents/year19.

There are no estimates of the effect of the Action Plans I and II on the Aquatic Environment and the Action Plan for Sustainable Agriculture on carbon storage in the soil."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

Name of measure or initiative **Agriculture**	***Objective***	***GHG affected***	***Type of instrument***	***Status for implementation***	***Implementing entity/ player***	***CO_2 reduction in 2001*** mill. tonnes CO_2 eq.	***Emissions reduction 2010*** mill. tonnes CO_2 eq.
Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture	Reduction of N run-off from agriculture by 100,000 t N/year	N_2O	Regulation (order), economic, information	Implemented (1987, 1991, 1998)	State and county authorities	1.6	2.2
Action Plan for the Aquatic Environment III	Further reduction of N and P losses from agriculture	N_2O	Regulation (order), economic	Implemented (2004)	State and county authorities		0.2[1]
Ban on burning straw on fields	Less air pollution	N_2O	Regulation (order)	Implemented (1989)	State and county authorities		
Ammonia action plan and the new statutory order on manure	Reduced emissions of ammonia	N_2O	Regulation (order)	Implemented (2001)	State and county authorities		0.03
Planting of windbreaks	Binding of CO_2	CO_2	Economic (subsidies)	Implemented (1960s)	State		0.14
Biogas plant	Reduced CO_2 and methane emissions and better exploitation of manure	CO_2, N_2O and CH_4	Economic (subsidies)	Implemented (1987)	State	0.2	0.036

Source: Denmark's Fifth National Communication on Climate Change, December 2009

27. Ban on burning straw in fields

"The purpose of the ban has been to reduce air pollution from the burning of straw. The ban has resulted in greater recycling of carbon into the soil and increased use of straw as a fuel. Both uses will result in a net reduction in CO_2 emissions. Not burning straw prevents emissions of methane and nitrous oxide associated with burning. On the other hand, there are some emissions of nitrous oxide in connection with the recycling of nitrogen into the soil when the straw is ploughed into the soil.

The measure works by regulating behaviour, and the ban was introduced from 1990. The measure was implemented in the form of a statutory order under the Environmental Protection Act, and compliance is monitored by the local authorities.

The initiative has also caused increased carbon storage in the soil, but this has not been quantified separately so far."

For effect see the table above.

Source: Denmark's Fifth National Communication on Climate Change, December 2009

28. Ammonia action plan and statuary order on manure

"Ammonia emitted from agriculture will stimulate emissions of nitrous oxide when it is deposited in other ecosystems. Reducing ammonia evaporation will therefore also result in a reduction of nitrous oxide emissions. An Ammonia Action Plan which was adopted in 2001 will, together with the Action Plan for the Aquatic Environment I and II, reduce ammonia emissions by 15-20,000 tonnes of nitrogen annually. This means that ammonia evaporation from agriculture should be reduced from 90,000 tonnes of nitrogen in the mid 1990s to approx. 60,000 tonnes of nitrogen in 2004.

The measures covered by the Ammonia Action Plan are:

1. Optimisation of manure handling during housing of cattle, pigs, poultry and fur animals.
2. Rules on covering storage facilities for solid manure and slurry tanks.
3. Ban on surface spreading and reduction of the time from field application of manure to incorporation.
4. Ban on ammonia treatment of straw.

These measures are estimated to lead to a reduction in emissions of nitrous oxide corresponding to 34,000 tonnes of CO_2 equivalents annually by 2010. A shorter period of manure spreading has the greatest effect of 13,000 tonnes of CO_2 equivalents annually.

The main reason for the drop in the emissions of N_2O in the agricultural sector of 31% from 1990 to 2007 is legislation to improve the utilization of nitrogen in manure. The legislation has resulted in less nitrogen excreted per unit of livestock produced and a considerable reduction in the use of mineral fertilizers."

See the table in topic 26.

"Means: Ammonia action plan and the new statutory order on manure

Purpose: Reduced emissions of ammonia – will also lead to reduction of N_2O

Authority: Implemented (2001) State and county[5] authorities

Reduction: 0.03 million tonnes of CO_2"

Source: Denmark's Fifth National Communication on Climate Change, December 2009

According to the EU directive on National Emission Ceilings (NEC directive), Denmark should reduce its total emissions of ammonia to 69,000 tons per year by 2010. The goal was achieved.

Source: https://www.retsinformation.dk/Forms/R0710.aspx?id=12631

5 Denmark had 14 counties. In 2007 they were changed to 5 regions

29. Planting of windbreaks

"The objective of planting windbreaks is to reduce wind erosion and ensure greater biodiversity. Planting of windbreaks is supported under conditions described in the Statutory Order on subsidies for planting windbreaks and biotope-improving measures (Statutory Order no. 1101 of 12/12/2002). Support is granted under the EU Rural Districts Programme. Since the end of the 1960s about 1,000 km of tree-lined windbreaks have been planted with government subsidies. It is also estimated that about 30% more has been planted without subsidies. Estimates indicate that planting of windbreaks leads to CO_2 sequestration in woody biomass of about 130,000 tonnes of CO_2/year."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

30. Biogas plants

Biogas from digestion of manure and organic wastes has a number of advantages when used to substitute fossil energy: reductions in emissions of greenhouse gases, better utilization of manure as fertilizer, recycling and use of organic wastes for energy and fertilizer purposes, including recycling of phosphorous.

In order to ensure renewed growth the politically fixed subsidy on the sales price of electricity production based on biogas was adjusted by the Energy Policy Agreement of 21 February 2008. The agreement resulted in the Law on Promotion of Renewable Energy of 27 December 2008. All new and existing biogas plants have since 2008 received a fixed electricity price of 0.745 DKK per kWh or a fixed-price premium of 0.405 DKK per kWh when biogas is used in heat and power plants. The fixed electricity price and price premium is adjusted by 60% of the increase in the net price index.

As part of the Green Growth plan from 2009 (see above) the government set a goal for utilization of 50% of Danish manure for biogas. Consequently the latest projection from the Danish Energy Agency expects an increase in biogas production from 4 PJ in 2007 to 12 PJ in 2020. This is expected to imply a five- to six-fold increase in the volume of manure digested, meaning that close to 30 percent of all manure will be used for biogas generation before 2020.

The increase is expected to result in annual emissions of methane and nitrous oxide from agriculture being additionally reduced by approx. about 0.2 million tonnes of CO_2 equivalents by 2020. An additional reduction of 0.4 million tonnes of CO_2 in greenhouse gas emissions from the energy sector is expected by 2020 due to reduced CO_2 emissions from substitution of fossil fuels, primarily natural gas, with the increased production of biogas.

Source: Denmark's Fifth National Communication on Climate Change, December 2009

"Better framework conditions for biogas expansion

A more ambitious plan for biogas expansion will be implemented. With a view to putting this expansion on the right track and achieving the necessary progress, the agreement includes the following elements:

- The current funding of biogas for CHP is to be increased,
- Other opportunities for using biogas – in the natural gas grid, in industrial processes or in the transport sector – are to be made financially more attractive by introducing a series of new funding schemes,
- Capital installation subsidies are to be increased from 20% to 30%,
- A task force is to be established. This task force is to support specific projects and make recommendations for additional initiatives, if, in 2012-13, it is assessed that the expansion process is too slow."

As part of the general energy agreement from 22 March 2012 it was also decided to increase the fixed electricity price from biogas plants to DKK 1.15 per kWh. This is expected to secure the implementation of the above-mentioned goal.

Source: Danish Energy agreement of 22.3.2012

31. Afforestation on agricultural land and elsewhere

The Danish Forest and Nature Agency[6] is responsible for policies on afforestation on private agricultural land and on state-owned land. Afforestation on 18,000 hectares of privately owned farmland, corresponding to additional binding of 323,000 tonnes of CO_2, was subsidized in 1990-2007. The state, counties, and municipalities have contributed approx. 7,200 hectares of new forest since 1990.

Source: Denmark's Fifth National Communication on Climate Change, December 2009

32. Taking vulnerable agricultural areas out of production

"The government (Venstre and De Konservative [Venstre, the Danish Liberal Party and The Danish Conservative Party]) and Dansk Folkeparti [The Danish Peoples' Party]) have signed an agreement on Green Growth. The purpose of the agreement is to ensure that a high level of environmental, nature and climate protection goes hand in hand with modern and competitive agriculture and food industries.

To support establishment of a total of 75,000 ha of new nature by 2015, including:

- About 800 ha of new woods close to urban areas.
- About 6,900 ha of new private woods.
- About 13,000 ha of wetlands and river valleys.
- About 4.300 ha of new nature in Natura 2000 sites.
- About 50,000 ha of spray-, fertilizer- and cultivation-free buffer zones.
- Establishment and operation of five national parks with walking trails, cycling and riding trails, bird hides and overnight accommodation"

Source: "Agreement on Green Growth", Danish Parliament, June 16th 2009

6 Today just called the Nature Agency

"Fewer greenhouse gases

- Reduction of the agricultural sector's emissions of greenhouse gases by an anticipated 800,000 tonnes of CO_2 annually as a consequence of the energy, nature and environment initiatives proposed in Green Growth.
- The opportunities for further reduction of emissions from the agricultural sector using a market-based model (quotas/taxes) will be analysed in more detail. This analysis will be integral to a collective, cross-sectional analysis of possible instruments within the European Climate Action and Renewable Energy package for the entire non-quota area. The analysis will be presented in the autumn of 2009.
- The government will present a collective, cost-effective climate strategy for the non-quota area up to 2020 based on this analysis."

Source: "Agreement on Green Growth", Danish Parliament, June 16th 2009

33. Ban on combustible waste in land fills

"The emission of methane from Danish landfills is calculated to have been 71,100 tonnes gross in 1990, increasing to a maximum of 76,500 tonnes in 1996, corresponding to 1.6 million tonnes of CO_2 equivalents. As a consequence of the ban on landfill disposal of waste suitable for combustion, from 1 January 1997, methane emissions from Danish landfill sites will fall in the years ahead. Annual emissions of methane in 2008-2012 are thus, calculated to be 63,000 tonnes, corresponding to approx. 82% of the maximum in 1996.

The total quantity of waste incinerated rose from 2,216,000 tonnes in 1994 to 3,489,000 tonnes in 2006, i.e. an approximately 57% increase. The energy produced from the incineration plants is included as part of the renewable energy production in the Danish energy statistics. The international greenhouse gas inventories include greenhouse gases from incineration of the content of oil-based products, such as plastics in waste.

In accordance with the targets in the Waste Strategies, waste incineration plants are designed so as to optimize energy utilization.

Besides the direct effect of waste management on greenhouse gas emissions, the emissions are also affected indirectly through recycling of paper, cardboard, plastic, metals, etc., which means less energy consumption and thus lower CO_2 emissions during the production of raw materials and new products."

"Means: Obligation to send combustible waste to incineration (in practice a ban on landfilling).

Purpose: Reduce landfilling, energy production, larger recycling, CH4 reduction

Authority: Implemented State and local authorities

Effects: CO_2 reduction in 2001: 0.02 million tonnes of CO_2, CO_2 reduction in 2010: 0.3 million tonnes of CO_2"

Source: Denmark's Fifth National Communication on Climate Change, December 2009

TABLE 4.23 MEASURES WITHIN THE WASTE SECTOR TO REDUCE EMSSIONS OF GREENHOUSE GASES.
Source (on effects): Danish EPA and Denmark's CO_2 emissions - the effort in the period 1990-2001 and the associated costs

Name of measure or initiative **Waste sector**	*Objective*	*GHG affected*	*Type of instrument*	*Status for implementation*	*Implementing entity/player*	*CO_2 reduction in mill. tonnes CO_2* in 2001	in "2010"	in 2020
Obligation to send combustible waste to incineration (in practice a ban on landfilling).	Reduce landfilling, energy production, greater recycling, CH_4 reduction	CH_4	Regulation (admin.)	Implemented	State and local authorities	0.02	0.3	
The waste tax	Greater recycling, least possible landfilling	CH_4	Economic	Implemented	State authorities /waste plants			
Weight-and-volume-based packaging taxes	Waste reduction	CH_4, CO_2	Economic	Implemented	State authorities			
Subsidy programme – Enterprise Scheme (special scheme for businesses)	Reduce environmental impacts from waste	CO_2 and CH_4	Financial	Implemented	State authorities			
Increased recycling of waste plastic packaging	22,5% recycling of waste plastic packaging in 2008 onwards	CO_2	Regulation	Implemented	State and local authorities/ enterprises and the public		0.005	
Implementation of the EU landfill directive	More focus on gas in environmental approvals, less waste to landfills	CH_4	Regulation	Implemented	State and local authorities			
Support for (construction of facilities for) gas recovery at landfill sites	Increase CH_4 recovery at landfills	CH_4	Financial	Discontinued	State authorities	0.2	0,10	
Subsidy programme for cleaner products	Waste reduction, pollutants out of waste	CH_4	Financial	Discontinued	State authorities			
The waste tax on incineration of waste	Greater recycling, least possible landfilling	CH_4	Economic	Discontinued	State authorities /waste plants			
Energy and CO_2 tax on waste incineration	To increase cost-effectiveness of waste incineration and improve the structure of tax on waste incineration	CO_2	Economic	Implemented	State authorities/ waste plants			

Source: Denmark's Fifth National Communication on Climate Change, December 2009

34. Waste tax

The contribution of the waste sector to greenhouse gas emissions consists primarily of methane from the decomposition of organic waste that takes place at landfill sites. Greenhouse gas emissions from wastewater treatment include both methane (81%) and nitrous oxide (19%). Of the total greenhouse gas emissions from the waste sector – 1.4 million tonnes of CO_2 equivalents in 2007, corresponding to 2.1% of total Danish greenhouse gas emissions – the proportion from landfills was 78%, and the proportion from wastewater was 22%.

Please note that all incineration of waste in Denmark is associated with energy utilization, which is why the emission of CO_2 from the incineration of plastic waste is included under the energy sector.

A tax on landfilling and incinerating waste was introduced in 1987. Since 1993 the tax has been differentiated to reflect the prioritization of the different forms of treatment. It thus costs most to deposit waste, less to incinerate it and no tax to recycle it. The waste tax has been increased several times

and it is now DKK 375 per tonne of waste for landfilling and DKK 330 per tonne of waste for incineration. The size of the tax thus provides an incentive to recycle as much of the waste produced as possible and to use non-recyclable, combustible waste as fuel in energy production instead of depositing it at a landfill site.

It is not possible to make a quantitative estimate of the effects of the various measures in the waste sector. The objectives in the national waste plans are related to waste amounts and their treatment. Developments are monitored through the annual waste statistics. However, changes in the treatment of waste cannot immediately be converted into changes in emissions of greenhouse gases.

Source: Denmark's Fifth National Communication on Climate Change, December 2009

The waste strategy expires in 2012. The government has declared that the next will be a resource strategy, with much more emphasis on waste minimization and recycling.

35. Package tax

"Weight-and-volume-based taxes (e.g. on various packaging, carrier bags and PVC film) encourage a reduction in packaging consumption and thus the quantities of waste. The weight-based tax is based on an index that reflects the environmental burden of the materials used."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

36. Recycling of waste packaging plastics

"As a result of the EU Packaging Directive, collection of plastic packaging waste for recycling has been increased to 22.5%, corresponding to an increase in recycling of about 11,000 tonnes of plastic per year from 2008, through an amendment to the Statutory Order on Waste requiring municipalities to improve the opportunities for people and enterprises to separate and deliver plastic packaging waste for recycling."[7]

Source: Denmark's Fifth National Communication on Climate Change, December 2009

37. Support for gas recovery at landfill sites

"According to the Danish Energy Authority's inventory, Biogas, Production, Forecast and Target Figures, Denmark had in total 25 landfill gas plants in the autumn of 2002. These installations produced 10,000 tonnes of methane annually, compared to approx. 1,700 tonnes in 1993. In 2004, methane recovery from landfills amounted to 7,700 tonnes methane. The same study shows that, through optimizing existing plants, a further 1,800 tonnes of methane

7 In spite of this, Danish recycling is on a low level compared with several other Northern European countries.

per year could be recovered over the next five years. Furthermore, the establishment of new gas-collection equipment at five landfills could contribute an additional 1,300 tonnes of methane per year over the next five years.

As a consequence of the new landfill strategy, only a few landfill gas plants are expected to be established in the future. The maximum quantity of methane recovered peaked in 1998 at about 13,200 tonnes. The quantity of methane recovered will continue to fall gradually over many years.

On the basis of the above, net emissions of methane (methane produced minus methane recovered) from Danish landfill sites have been calculated at 63,600 tonnes in 1990, rising to 65,900 tonnes in 1993, and then falling steadily to 51,800 tonnes in 2012. The average annual net methane emissions in 2008-2012 correspond to about 1.1 million tonnes of CO_2 equivalents."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

Appendix 1:

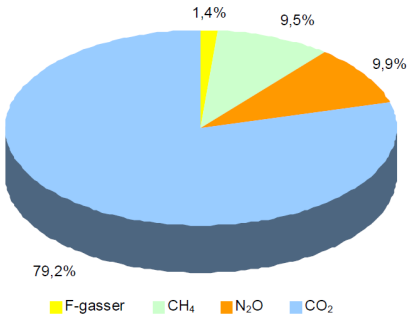
Emissions of CO_2 from energy consumption and overall greenhouse gas emissions

Observed CO_2 emissions from energy consumption rose by 0.8% in 2010. Adjusted for fuel consumption linked to foreign trade in electricity and fluctuations in climate, CO_2 emissions decreased by 4.9%.

Since 1990 Danish-adjusted CO_2 emissions from energy consumption were reduced by 23.2%.

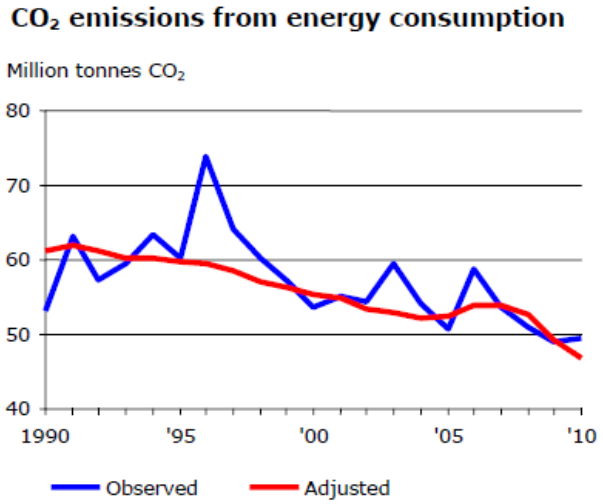
A preliminary statement of Denmark's total observed emissions of greenhouse gases shows an increase of 0.7% from 2009 to 2010. Compared with the base year, observed emissions decreased by 11.4%.

Danish emissions of Greenhouse gases 2010



Source: Danish Energy Statistics 2010 – Danish Energy Agency

Historical Emissions of GHG in Denmark



The figure shows emissions of greenhouse gases, excluding the effects of CO_2 removal in forests and land use.

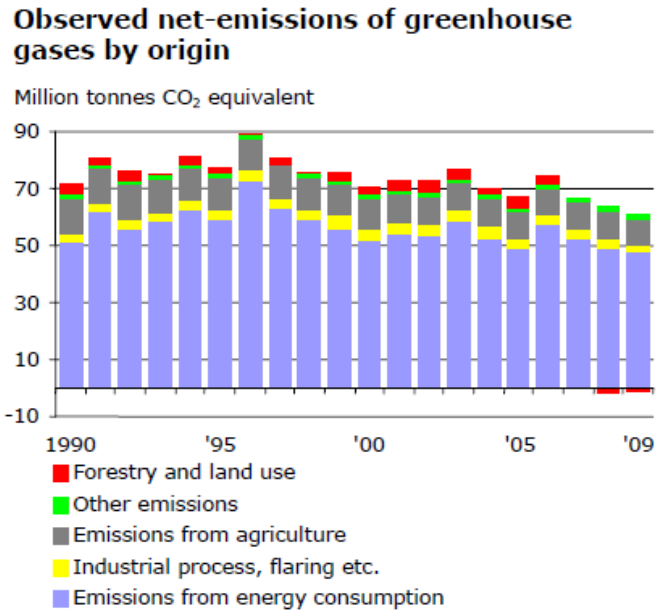
Observed emissions of greenhouse gases were 61.0 million tonnes of CO_2 equivalent in 2009, which is 4.2% less than in 2008. Compared with the base year, observed emissions decreased by 12.0%.

Adjusted for climate fluctuations and fuel consumption linked to foreign trade in electricity, emissions of greenhouse gases were 61.4 million tonnes

of CO_2 equivalents in 2009, which is 6.3% less than in 2008. Compared with the base year, observed emissions decreased by 20.6%.

Source: National Environmental Research Institute www.dmu.dk

Source: Danish Energy Statistics 2010 – Danish Energy Agency



Emissions from energy consumption make the largest contribution to total net emissions of greenhouse gases. Such emissions derive from the energy and transformation sector as well as from final energy consumption. The second-largest contribution derives from agriculture.

In 2009, observed emissions were: Emissions from energy consumption 79.8%, emissions from agriculture 16.0%, industrial processes, flaring etc. 3.7%, forests and land use -1.9%, and other emissions, 2.2%.

Source: National Environmental Research Institute www.dmu.dk

Source: The Danish Energy Agency: Energy Statistics 2010

Carbon dioxide, CO_2

The figure below shows the expected development in CO_2 emissions in Denmark's economic sectors. The biggest source of CO_2 emissions in Denmark is combustion of fossil fuels, including electricity, heat production and transport.

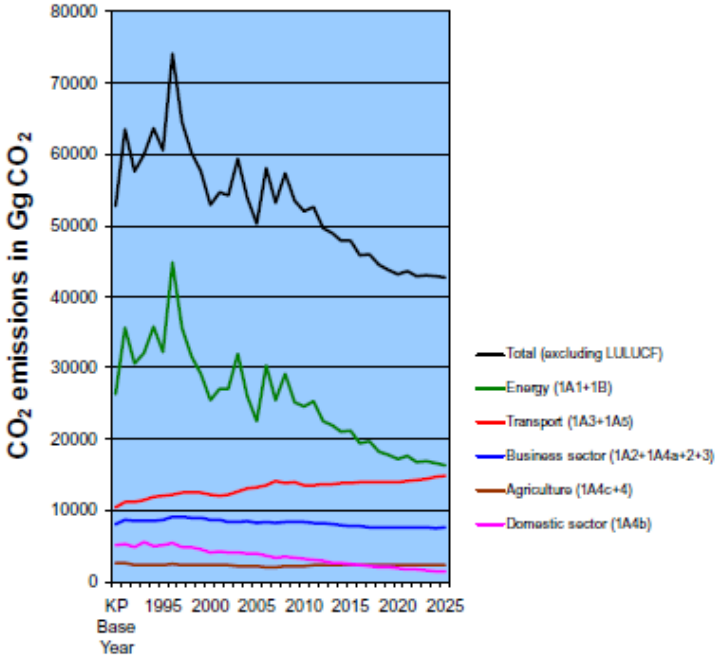
"The transport sector has had the biggest increase in CO_2 emissions since 1990, and the emissions are expected to continue rising for the whole of the projection period. CO_2 emissions from the transport sector were 10,528 Gg of CO_2 in 1990 and had risen to 13,986 Gg of CO_2 in 2007, whereas the projection for 2008-2012 is 13,585 Gg of CO_2 annually. Emissions from energy production, including conversion and distribution, have varied in 1990-2007 due to great variations in exports/imports of energy.

Total CO_2 emissions without land-use change and forestry (LUCF) were

52,793 Gg in 1990 and 53,228 Gg in 2007, while for the period 2008-2012 it has been calculated that the average annual CO_2emissions will be 53,000 Gg CO_2.

Another reason for not including the LULUCF sector in the projections is that only specific parts of the emissions and removals estimated in accordance with the rules under the UNFCCC are to be taken into account under the Kyoto Protocol's Articles 3.3 and 3.4 in the period 2008-2012. And for the period after 2012, the effect of activities in the LULUCF sector on Denmark's efforts to achieve its post-2012 reduction targets will not be known until detailed accounting rules have been decided for the accounting of emissions and removals in the LULUCF sector under an international post-2012 agreement."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

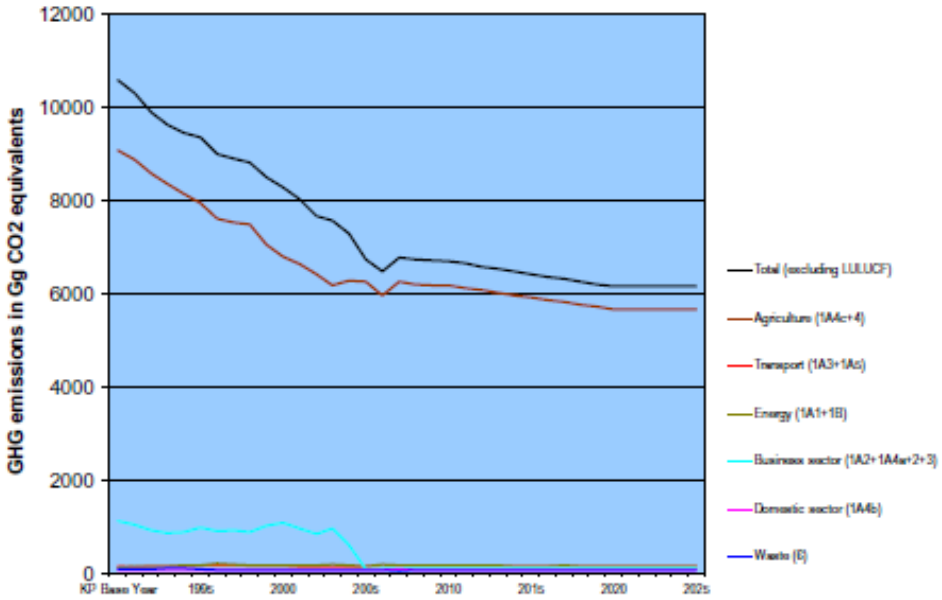


Nitrous oxide, N_2O

"Agriculture is by far the main source of emissions of nitrous oxide because it forms in soil through bacterial conversion of nitrogen in fertilizer and manure. The projections are shown in Figure 5.8. The main reason for the reduction in total nitrous oxide emissions from 10,527 Gg of CO_2 equivalents in 1990 to 6,780 Gg of CO_2 equivalents in 2007 is a combination of the Action Plans for the Aquatic Environment I and II and the Action Plan for Sustainable Agriculture. The projection for 2008-12 is 6,674 Gg of CO_2 equivalents annually. This substantial reduction is not least due to the fact that Denmark ceased to produce nitrous acid in 2004, as shown under the Business sector (industrial processes) in Figure 5.8. Contributions from the transport and energy sectors are expected to increase, whereas contributions from agriculture are expected to be somewhat less than in 2001."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

FIGURE 5.8 PROJECTIONS OF DENMARK'S NITROUS OXIDE EMISSIONS IN 2008-25, EMISSIONS IN 1990-2007 ARE OBSERVED
Source: 1990-2007: The National Inventory Report (NIR), NERI, April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009

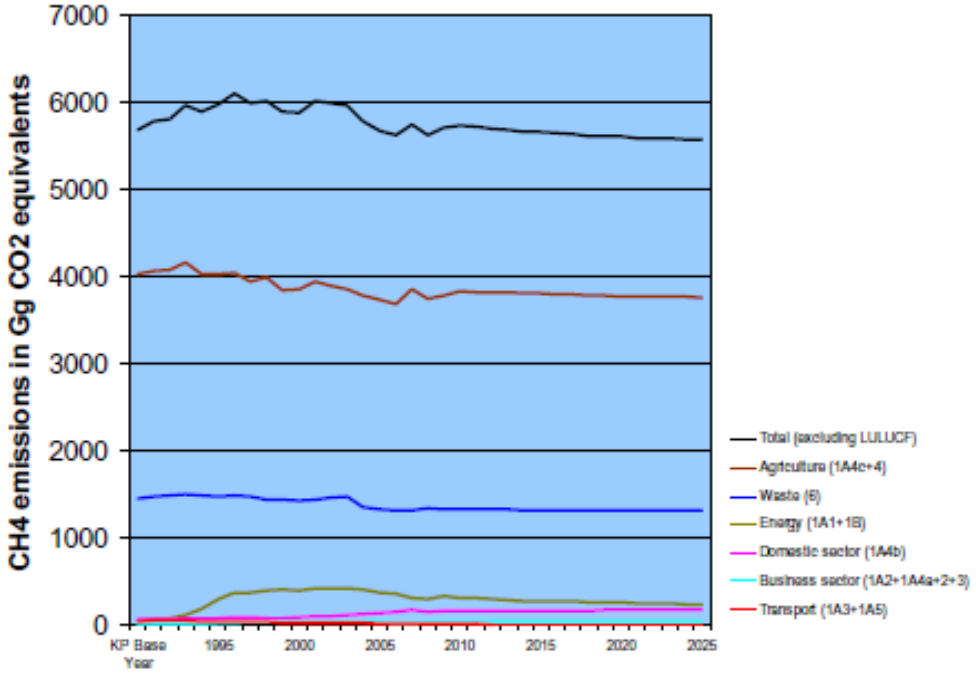


Methane (CH4)

"Most of the methane emissions come from farm animals' digestive systems (enteric fermentation). The projections are shown in Figure 5.7. The very small changes in emissions from agriculture from 1990 to 2012 and the continued reductions in the projection period are primarily due to very little changes in cattle stocks. The second largest source of methane is landfills, from which emissions were also reduced from 1990 to 2007. Methane emissions from the energy sector have, however, increased considerably during the same period, due to an increase in the use of gas-driven motors. This has altogether led to an increase in total methane emissions from 5,695 Gg of CO_2 equivalents in 1990 to 5,748 Gg of CO_2 equivalents in 2007, whereas the projection for 2008-2012 is lower, i.e. 5,702 Gg of CO_2 equivalents annually."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

FIGURE 5.7 PROJECTIONS OF DENMARK'S METHANE EMISSIONS 2008 – 25, EMISSIONS IN 1990-2007 ARE OBSERVED
Source: 1990-2007: The National Inventory Report (NIR), NERI, April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009



Industrial gases HFCs, PFCs and SF_6

"In accordance with the possibilities offered in the Kyoto Protocol, Denmark has chosen 1995 as the base year for emissions of the industrial gases, or F-gases, HFCs, PFCs and SF_6. Total emissions of these gases corresponded to 326 Gg of CO_2 equivalents in 1995 and annual emissions have more than doubled since the year 2000. The rate of increase has decreased since 2003, when emissions corresponded to 746 Gg of CO_2 equivalents. In the projections, total F-gas emissions are expected to peak in 2008 at 895 Gg of CO_2 equivalents.

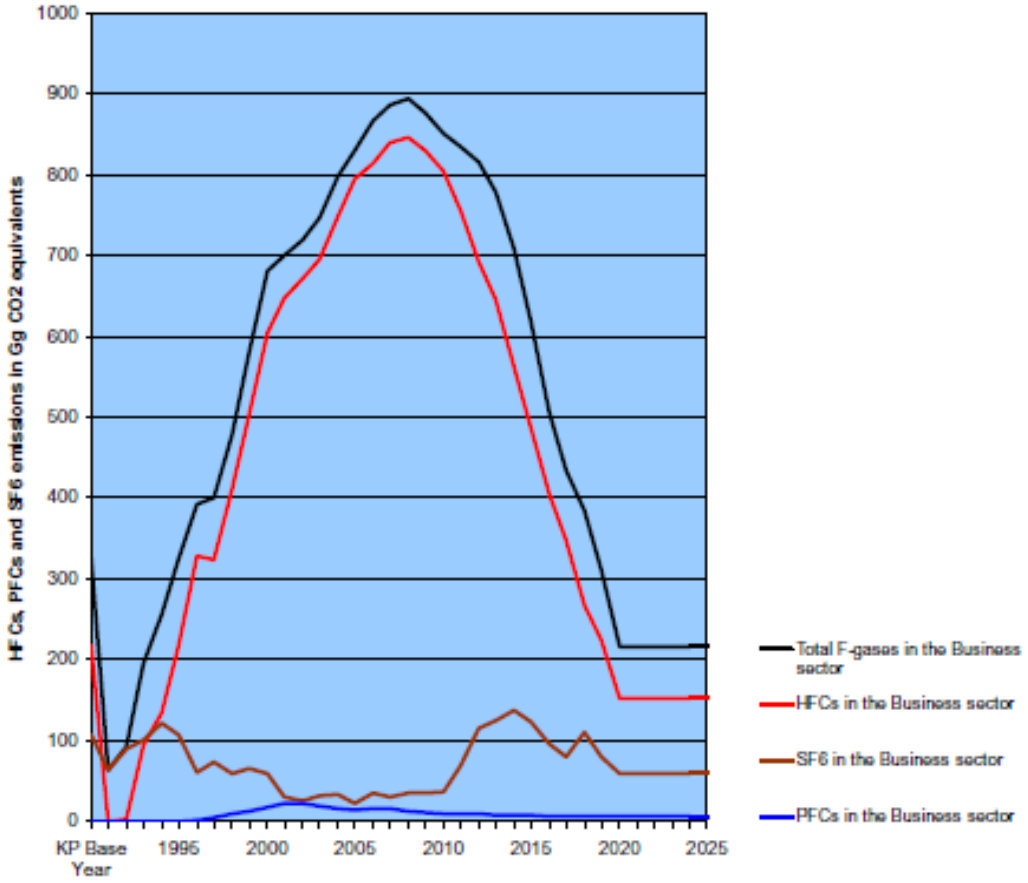
As can be seen from Figure 5.9, the trends for the three individual types of F-gas are very different due to the different uses of these gases. With HFCs being the major contributor, the trend for HFC emissions follows the trend for total F-gas emissions closely.

The slowdown in the rate of increase is primarily due to taxes and regulations introduced concerning the use of new installations/products. For the period 2008-12, total emissions of industrial gases corresponding to 786 Gg of CO_2 equivalents annually are projected, after which a major reduction in emissions of HFCs is expected and will result in a considerable reduction in emissions of industrial gases following the first period of commitment."

Source: Denmark's Fifth National Communication on Climate Change, December 2009

FIGURE 5.9 PROJECTIONS OF DENMARK'S INDUSTRIAL GREENHOUSE GAS EMISSIONS (THE F-GASES) IN 2008-25, EMISSIONS IN 1995-2007 ARE OBSERVED

Source: 1990-2007: The National Inventory Report (NIR), NERI, April 2009
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009



ESTONIA

Best GHG mitigation measures in Estonia.

Compiled by Valdur Lahtvee, Senior Research Fellow, SEI Tallinn Centre.

Measures were discussed and ranked by members of Estonian Council of Environmental NGOs (www.eko.org.ee/) and the Estonian Renewable Energy Association (www.taastuvenergeetika.ee/en/).

Current situation with GHG emissions.

Estonia, officially the Republic of Estonia, is a state in the Baltic region of Northern Europe. It is bordered to the north by the Gulf of Finland, to the west by the Baltic Sea, to the south by Latvia (343 km), and to the east by Lake Peipsi and the Russian Federation (338.6 km). Across the Baltic Sea lies Sweden in the west and Finland in the north. The Estonian territory covers 45,227 square kilometres, and is influenced by a temperate seasonal climate. Estonia is a democratic parliamentary republic and is divided into 15 counties and 246 municipalities. About 69% of the population is urban. The capital and largest city is Tallinn. With a population of 1.34 million, Estonia is one of the least-populous members of the European Union, Eurozone and NATO. Today, Estonia has the highest GDP per person of any country that used to be part of the Soviet Union. GDP, PPP was 27,616,870,958 USD (2010), equivalent to 20,608 USD per capita.

Table 1: GDP development of Estonia

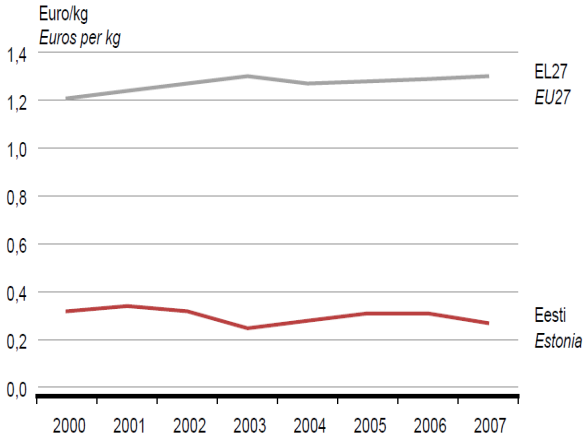
		2006	2007	2008	2009	2010
Gross domestic product (GDP)	billion USD current PPPs	25.7	28.5	29.2	26.6	27.6
GDP per capita	USD current PPPs	19 134	21 262	21 802	19 876	20 608
Gross national income (GNI) per capita	USD current PPPs	18 134	19 795	20 626	19 414	19 682
Household disposable income (deflated)	Annual growth %	10.8	11.8	0.4	-6.7	-2.7

Source: OECD

Estonia is listed as a high-income economy by the World Bank and a high-income OECD member. The United Nations lists Estonia as a developed country with a Human Development Index of "Very High". The country is also ranked highly for press freedom, economic freedom, democracy and political freedom and education.

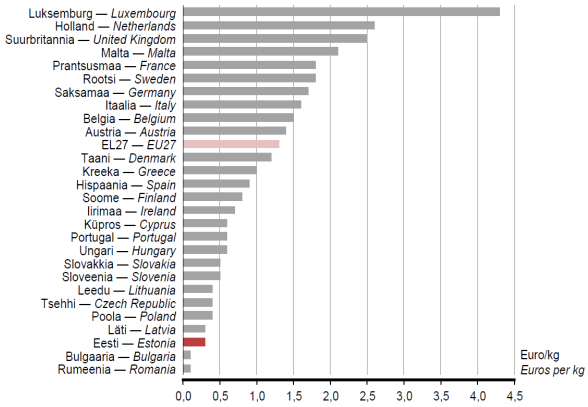
The energy and material content of Estonian GDP are 4-5 times higher than the EU average due to the low efficiency of energy production and dependency of the energy sector on domestic mineral-rich oil shale and the low efficiency of natural resource use.

Table 3: Material productivity of Estonian GDP (EUR/kg)



Source: Eurostat

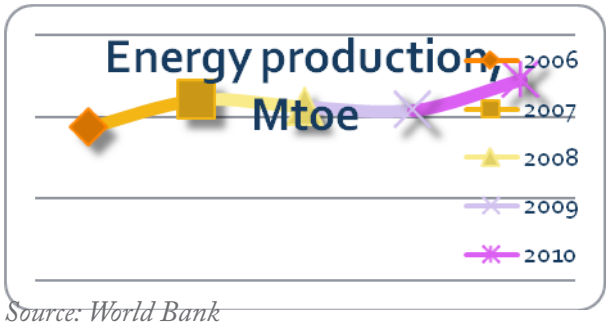
Table 4: Material productivity of EU member states 2007



Source: Eurostat

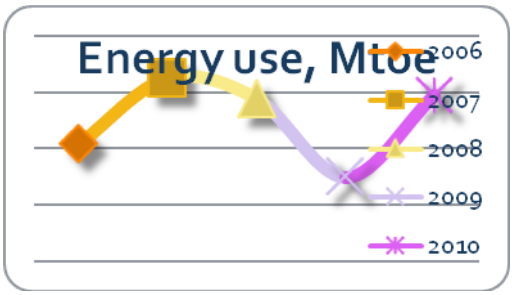
Estonia's energy production is heavily dependent on imported liquid fossil fuels for the transport sector and domestic oil shale for electricity production. The natural gas share of energy production is modest, but all gas is imported from the neighbouring Russian Federation. The share of renewable fuels and sources in primary energy production is relatively high due to the tradition of using biomass (wood) for heat production by households. Recent years are witnessing rapid deployment of wind power and biomass use in electricity production due to purchase obligations and attractive feed-in tariffs designed to support renewable electricity since 2007. Basic energy data from 2006 to 2010 (where available) are presented in the following tables. Availability of domestic renewable energy resources (wind, biomass) in Estonia is several times higher than needed to cover the energy demand of the country.

Table 5: Energy production in Estonia.



Source: World Bank

Table 6: Energy use in Estonia

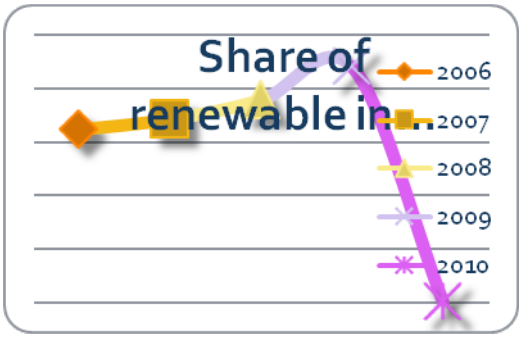


Source: World Bank

Table 7: Final energy consumption

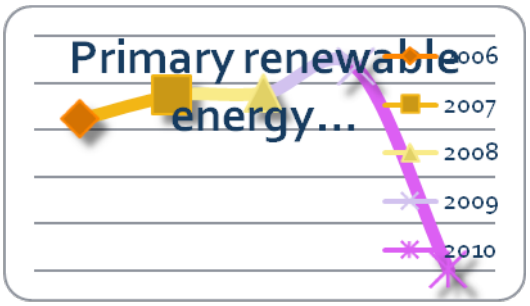
Source: World Bank

Table 8: Share of renewable energy in gross final energy consumption



Source: Eurostat

Table 9: Primary energy production from renewable sources

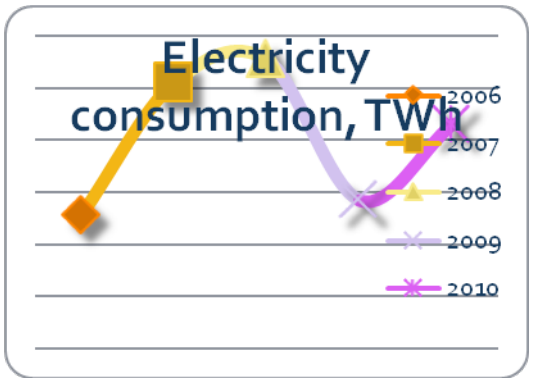


Source: Eurostat

Table 10: Electricity production in Estonia

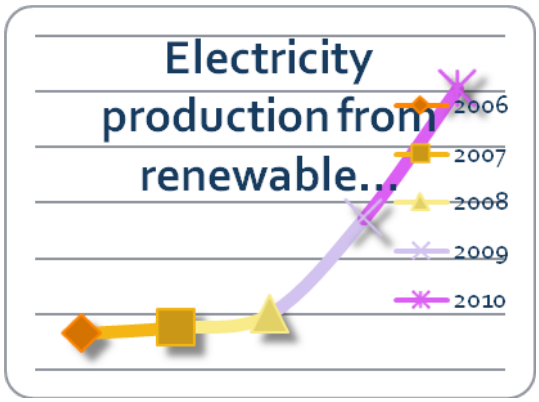
Source: World Bank

Table 11: Electricity consumption in Estonia



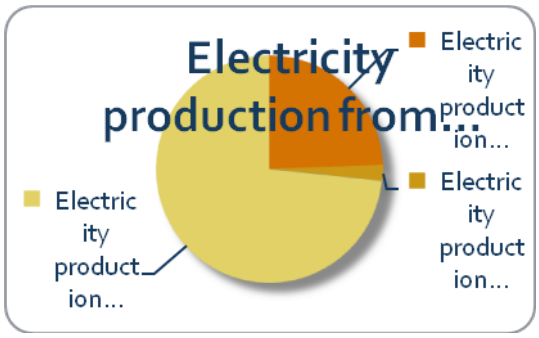
Source: World Bank

Table 12: Electricity production from renewable sources in Estonia



Source: Estonia's national report to EU Commission on RES development, 2011

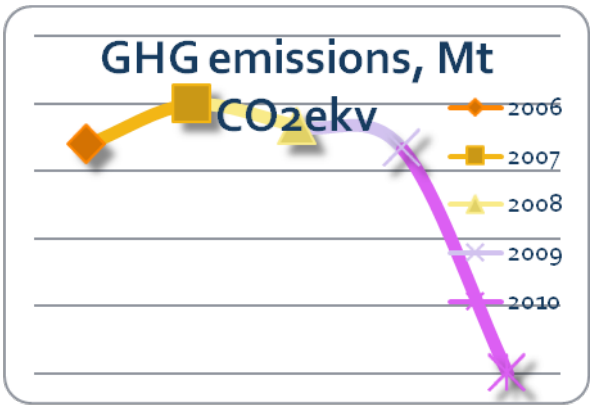
Table 13: Distribution of renewable energy production by source



Source: Estonia's national report to the EU Commission on RES development, 2011

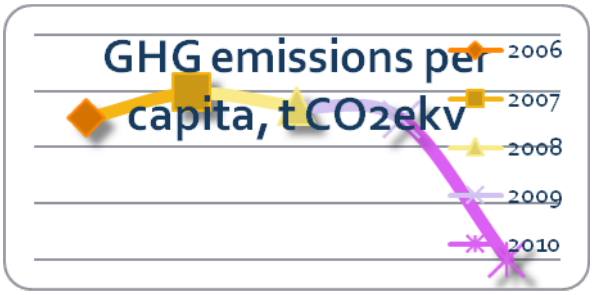
Due to the high concentration of power production, the fact that the majority of the electricity production in condensing oil shale power plants with an efficiency of 32-36%, the high share of fossil fuels in energy production and the relatively high losses during the distribution of electricity and heat and during final use, Estonia's energy sector and economy as a whole are high emitters of greenhouse gases. Per capita GHG emissions were 12.43 tonnes of CO_2 equivalents in 2009.

Table 14: Emission of Greenhouse Gases (GHG) in Estonia



Source: UNFCCC

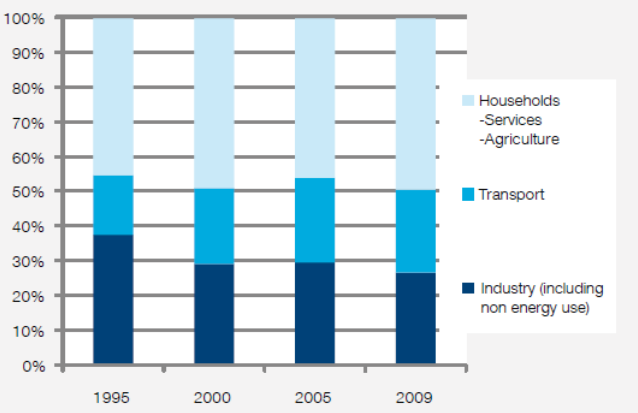
Table 15: GHG emissions per capita in Estonia



Source: UNFCCC

The energy sector has been the biggest emitter of GHG in Estonia, accounting for about 70% of total CO_2 emissions in 2010. When looking for possible mitigation measures one must note that the household share of energy consumption is relatively high and still growing, and exceeded 30% in 2010. Agriculture and services have a relatively small share, accounting together for about 20%, while industry and the transport sector each have a share of around 25%.

Table 16: Energy consumption by sectors in Estonia



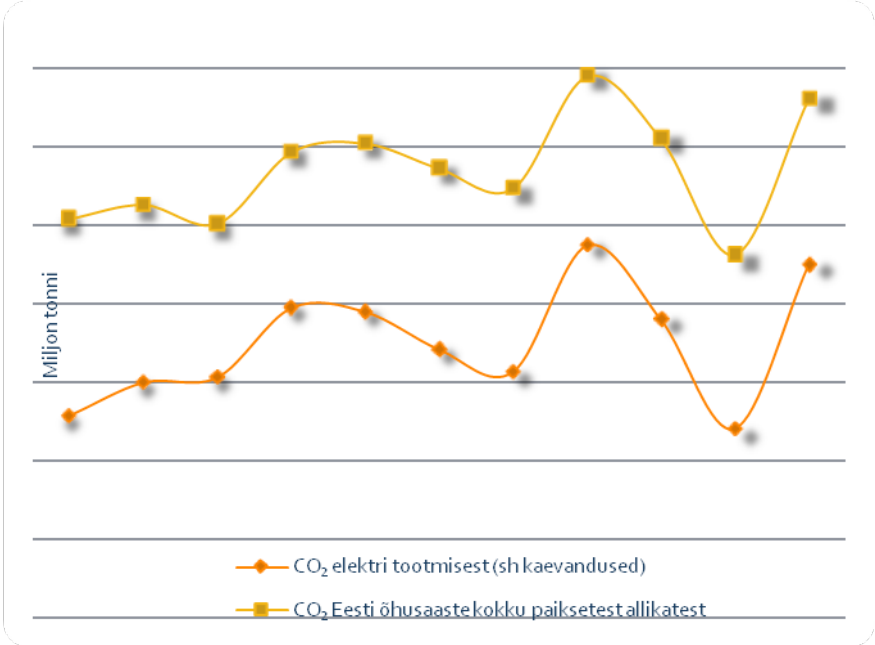
Source: Enerdata

Over the period 1995-2009 primary energy intensity (primary energy consumption per unit of GDP) fell at the rapid pace of 4.4 percent/year, which is more than twice as fast as the EU average. Nevertheless, the country's primary energy intensity, measured at purchasing power parity, remains 82 percent higher than the EU average. Final energy intensity (final energy consumption per unit of GDP) decreased slightly less rapidly (by 3.8 percent/year). Such

improvement in energy efficiency is linked to the sharp decrease in the energy intensity of the industrial sector (-7.4 percent/year between 1995 and 2008); efficiency gains were lower between 2000 and 2008 (-4.1 percent/year), which in part limited the reduction in final energy intensity over that period. The main reasons behind the shift towards higher efficiency are structural changes in production towards less resource- and energy-consuming products and the assembly of pre-produced products, as well as the replacement of old technologies with modern and technology that is more energy efficient.

CO_2 intensity (CO_2 emissions per unit of GDP) fell by 5.2 percent/year between 1995 and 2009; 47 percent of this improvement was achieved through the fall in final energy intensity, 22 percent through efficiency gains in the energy transformation sector and 21 percent through fuel substitutions in favour of low-carbon energies. Despite this rapid improvement, Estonia's CO_2 intensity remains more than twice as high as the EU average, which is mainly due to the importance of oil shale in the country's energy supply.

Table 17: Estonian CO_2 emissions 2000-2010



blue line – CO_2 emissions from electricity production, Mt
red line – Estonia's total CO_2 emissions, Mt

Source: Estonian Environmental Information Centre

Between 1996 and 2009, the ODEX for the household sector as a whole decreased by 27%. Due to poor statistics on energy consumption in households, the efficiency analysis has to be based mainly on case studies and expert estimations. The efficiency improvement (2.4%) is to a great extent a result of the renovation of building envelopes – additional insulation of outer walls and roofs, replacing windows, etc. An important factor has been the introduction of heat metering (incl. hot water meters in apartments) which gives incentive to take efficiency measures. The specific heat consumption in new dwelling houses is lower due to more strict thermal standards in building codes. At the same time, there is an opposite trend – new dwellings are larger and higher living standards need more energy. The latest study on energy consumption in multi-flat dwellings, which were built as standard during the 1970s in the Capital area (Tallinn Technical University, 2010), revealed that the average energy use of households is 238 kWh/m^2 per year, of which space heating accounts for 62%, water heating accounts for 13% and electricity for running household equipment accounts for 25% of total energy use.

GHG mitigation measures in Estonia

In order to mitigate climate change, Estonia is implementing a range of policy measures including setting quantitative goals and targets to reduce greenhouse gas emissions; establishing energy efficiency requirements for buildings and introducing energy efficiency labelling systems for buildings, equipment and vehicles; providing credit, guarantees and support for energy efficiency renovation of buildings for both the private and public sectors; implementing tax reforms which largely focus on increased taxation of fossil

energy products; supporting research and development and raising awareness of energy efficiency, energy saving and climate, as well as promoting the development of renewables through purchase obligations and feed-in tariffs for electricity produced from renewables and from efficient co-generation. At the same time the government has not yet abolished, either direct or indirect subsidies for oil shale energy production, which are several times higher than the support for renewable energy, distort the energy market and do not give fair treatment to all energy producers. Full deregulation of the electricity market opening is expected after 1 January 2013, but at present the market is open for about 30-40% of larger consumers but not for households.

Mandatory targets set by the Directive on the promotion of the use of energy from renewable sources for Estonia are as follows:

25% share of RES on the final consumption of energy in 2020;

at least 10% share of renewable energy in final consumption of energy in transport by 2020.

Indicative Target set by the RES electricity European Directive from 2001 is a 5.1% share of renewable electricity on gross electricity consumption by 2010. Actual share in 2010 was about 9.5%.

Indicative Target set by the European Biofuels Directive from 2003 is for biofuels consumption of 5.75% of petrol and diesel use for transport in 2010. Actual share of biofuels use as motor fuels in Estonia in 2010 was 0.2%.

The "Long-term national development plan for the fuel and energy sector until 2015" adopted through a decision by parliament on 15 December 2004 set following targets:

- a target for biofuels of 2% by 2006 and 5.75% by 2011, calculated on the basis of energy value.
- share of renewable sources 12% of gross national energy consumption by 2010. This target has already been achieved due to a high share of wood and wood waste for heat production
- share of renewable electricity 5.1% of gross national electricity consumption by 2010 and 8% by 2015 .

The strongest incentive for the development of renewable energy production in Estonia has been a purchase obligation and feed-in tariffs for electricity produced from renewable sources and from efficient co-generation, which were introduced in 2001. In May 2007 a scheme for subsidizing renewable sources and cogeneration was changed and tariffs were increased significantly. According to the scheme producers had two options: either to sell electricity at a fixed purchase obligation price or receive a subsidy and sell electricity at a market price. According to the system established in 2007 the subsidies for production from renewable sources were paid only in cases where the production equipment capacity was below 100 MW. In July 2009 the amendments to the electricity Market Act removed the capacity limitation. As a result of this, Narva Power Plants also received the subsidy, when they used wood chips in addition to oil shale fuel in electricity production. The amendment had a substantial effect on the subsidy payments, raising the total subsidy amount in 2009 to €25.9 million. €4.7 million of this, or 18%, was paid to

Narva Power Plants. In 2010 the respective figures were €45 million, or 26%.

Subsidy-related issues were further amended in February 2010. The most significant change in the system of subsidies payable to producers was the abandoning of the purchase obligation. At the same time the circle of undertakings eligible for subsidies was enlarged. With effect from 27 February 2010 producers have the right to receive subsidies in the following cases and amounts:

beginning from 1 July 2010 for electricity produced from renewable sources, excluding biomass, 5.37 €cent/kWh;

beginning from 1 July 2010 for the electricity, if it is produced from biomass in a cogeneration process, 5.4 €cent/kWh. If the electricity is produced from biomass in a condensing process then it is not subject to the subsidy. In this case it is a new stipulation that is intended for the limitation of inefficient use of renewable resources;

for electricity produced in an efficient cogeneration process from waste as defined in the Waste Act, from peat or from the pyrolysis gas of oil shale processing 3.2 €cent/kWh;

for electricity produced in an efficient cogeneration process using production equipment with a capacity not exceeding 10 MW, 3.2 €cent/kWh;

for the utilization of installed net capacity of production equipment using oil shale, if the production equipment started operation within the period 1 January 2013 to 1 January 2016, depending on the CO_2 quota price, 1.4-1.6 €cent/kWh.

Furthermore, the quantity of electricity produced from wind energy in Estonia and eligible for subsidy was increased from the earlier 400 GWh to the limit quantity of 600 MWh in a calendar year.

Increased tariffs have led to rapid growth in the installation of new RES capacity and the use of wood for co-generation in oil-shale power plants. The 2010 national target for the RES share of final electricity consumption, 5.1%, has been achieved and exceeded – the RES electricity share was 9.7%[8] in 2010. In 2011, renewable electricity made up 13% of total domestic consumption of electricity. Of the total contribution of RES electricity, 32% was produced from wind, 2% from hydro and 66% from biomass. In first half of 2012, RES electricity made up 20.4% of domestic electricity consumption.

Since 2010, the government has tripled support to housing cooperatives both by increasing credit guarantees and contributing direct investment grants for the renovation of houses for energy efficiency gains as well as allocating a big portion of revenues from sales of the CO_2 quotas (AAUs) via the Kyoto Emission Trade and national Green Investment Scheme for renovation of public sector buildings. Estonia has been successful in selling a surplus of Assigned Amount Units (AAUs) for saved CO_2 emissions to Japan, Liechtenstein, Spain and Austria, and revenues from sales have been used for investment support to private and public buildings, improvement and expan-

8 Elering AS varustuskindluse aruanne 2011 - http://elering.ee/public/Infokeskus/Aruanded/Elering_Varustuskindluse_aruanne_2011.pdf

sion of public transport and for the establishment of national infrastructure supporting electro-mobility. If support schemes remain as high in coming years, one may expect a relatively high rise in energy efficiency figures in the housing sector.

The use of fiscal instruments to increase resource and energy use efficiency in Estonia has been steadily strengthened in Estonia since June 2005, when the government adopted a National Strategy for Ecological Tax Reform. Since then, fees for environmental use (emission fees, fees for water use and water effluents, waste generation and landfill fees and natural resources extraction fees) were doubled and increased annually by an average of 20%. A tax on electricity produced from fossil fuels was also introduced in 2006. In the second phase of the Ecological Tax Reform, in 2010, further increases were introduced by doubling tariffs for major environmental emissions and resources, with annual tariffs rising at a fixed rate of 20% until 2015. Part of the second phase of ETR also consisted of rises in fuel and electricity taxes (to fill in revenue shortfalls after the 2009 economic crisis) and the elimination of excise tax reductions for use of fossil fuels for non-road vehicles and machinery in forestry, construction and mining sectors. Such exemptions still exist for agriculture and fisheries, but are planned to be removed in the near future and replaced with direct subsidies to the mentioned sectors. ETR was weakened by a decision in 2006 to exempt electricity producers from paying CO_2 emission fees as electricity excise was established.

Implementation of the EU Emissions Trade Directive covers CO_2 emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Altogether, 45 major installations were included in the scheme in 2005-2007 with total emissions of 56,859,003 tons of CO_2 equivalents and 47 installations with total emissions of 13,301,720tons of CO_2 equivalents were allocated to the installations for the period 2008-2012. The Estonian National allocation plan was approved by the EU Commission as a compromise between Estonia's initial proposal and the Commission's proposed caps after rejection of national proposals by the Commission and European Court decision in favour of Estonia. During the period 2005-2008 the national allocation to the ETS installations amounted on average to 76.5% of national total annual CO_2 emissions. Despite the fact that implementation of the ETS Directive and cap-and-trade system encouraged investments into energy and fuel efficiency in many industrial installations as well as fuel switches and increased use of renewable fuels for heat and electricity production, the expected sharp reduction in GHG emissions did not occur, since the first trading period allocation was too generous to the installations and the sale of excess allowances yielded extraordinary revenues for enterprises. In addition, the free allocation of allowances in both trading periods in Estonia did not generate significant reductions in GHG emissions at national level, because the reduction in power production capacities in the closed Baltic Energy market (the closure of Ignalina NPP second reactor in 2009) increased demand and doubled exports of Estonian oil shale electricity, and consequently increased CO_2 emissions from oil shale power plants.

From the National report to the EU Commission (2011), there can be highlighted other policy measures implemented in Estonia for the support of wider use of renewable energy as follows:

- investment support for wider use of sources of renewable energy in energy generation;
- investment support for bioenergy generation;
- investment support for adding value to forestry products;
- investment support for electricity producers who use wind as a source of energy;
- training sessions on regional energy planning to improve the administrative capacity of municipalities and their agencies with respect to coordination of energy efficiency activities;
- a thematic spatial planning for 4 counties related to wind energy development;
- devising legal bases for developing off-shore wind farms;
- electrical mobility programme in Estonia: Introduction of electric cars and their charging infrastructure as well as the introduction of electricity from renewable sources in the transport sector.

Comparing used mitigation measures by their scope and impact, major environmental NGOs and RES producers have prioritised the selected ten best mitigation measures according to their impact as follows:

No.	Name of the measure	Type	Achieved or expected result	Time and trends of application
1	Feed-in tariff and purchase obligation for electricity from renewable sources and fuels	Fiscal	RES share in domestic electricity consumption has increased 10 times - from 0.1% (2006) to 13% (2011), in real production from 128 GWh to 1181 GWh.	Started in 2001, sharp increase in tariffs from 2007, tariffs planned to be reduced from 01.01.2013 for new power producers, but increase expected to be continued +30% capacities increase per annum, as many wind projects underway.
2	Government subsidies for support of renovation of buildings in public sector and housing cooperatives aiming to increase energy efficiency	Fiscal	Average dwelling's heat energy consumption of buildings has fallen by 2% per year, slowing overall increase of energy end use (electricity consumption is expected to grow 2.4% per year). Overall existing renovations currently cover only 1.9% of building stock, whereas renovation rates need to be over 2 percent per annumto achieve retrofits by 2050.	Started in 1998, subsidy volumes declined in mid-2000s and sharply increased in 2010 due to the allocation of revenues from AAU sales.
3	Government subsidies through the Environmental Investment Centre for support of investments for the reconstruction of boiler houses, district heating networks and the construction of RES (wind, biomass, biogas) generation capacities.	Fiscal	Installed RES capacities increased 60-fold, from 2.4 MW (2003) to 132 MW (2010) incl. 5.1 MW biogas CHP, 7 MW biomass CHP and 25 MW wind generators installed by 2012 using EIC subsidies. Expected annual production 80 GWh.	2007-2013 (EU Structural Funds allocation). Support level continues until 2013, further support volume unknown.
4	Government subsidies for energy efficiency renovation and installation of small RES applications (heat pumps, wind, solar heat and PV) for single-family houses.	Fiscal	Installation of range of applications initiates wider acceptance of small RES use by households. Expected savings of 0.5% from total final energy consumption	Started 2012, further application depends on revenues from AAU sales.

5	Ecological tax reform.	Fiscal	Electricity excise and continuous emission fees increase lead to decrease in energy and resource intensity of GDP by 0.5 % per annum.	Started in 2006 by doubling emission and resource use fees and introducing electricity excise duty; II phase of ETR with doubling tariffs and reducing exemptions from fuel excise from 2010.
6	Adoption of stricter energy efficiency standards for design of buildings, U-values since 30.08.2012 in small private houses 160 kWh/(m^2); multi-storey dwellings 150 kWh/(m^2); offices160 kWh/(m^2); industrial buildings 210 kWh/(m^2); public buildings 200 kWh/(m^2); schools 160 kWh/(m^2); nurseries 190 kWh/(m^2); hospitals 380 kWh/(m^2).	Regulative	New buildings are 70% more energy efficient than average. Annual energy savings about 2% of total heat energy.	2007, transposition and implementation of reformulated EPBD directive expected to generate further savings from 2013.
7	Establishment of regulations for use of sea bottom for construction of offshore installations.	Regulative	Creation of opportunity for seeking permits /consents for erection of offshore wind farms. 3 wind farm projects under preparation with expected installed capacity of 1490 MW.	2009, offshore wind farm installation expected to take place in 2013-2020.
8	Preparation of thematic spatial planning for development of wind energy in 4 counties in Western Estonia[1].	Spatial Planning	Creating opportunity for speeding up permitting of construction of wind capacities in 4 counties, area covered by planning may allow up to 1300 MW of wind capacity. Increased acceptance of wind energy installation.	2012-2013 thematic plans adopted by County Governors. Other counties may follow approach from 2013 onwards.
9	Investment support to upgrade public transport infrastructure: purchase new efficient buses (120 for rural lines) and renting to operators, purchase of new diesel trains (10) and of new trams (16).	Technical, Fiscal	Reduction of total fossil vehicle fuel use by 0.5%, shift from private car use to use of public transport. Stop annual decline of 2% in public transport share of transported passengers.	Started in 2011-2012 (project finalised 2013). Continuation of measure unknown, depends on AAU transfer over 2012 and sales success.
10	National electromobility programme: construction of national network of charging stations, purchase of 500 electric vehicles (mostly used by municipal social workers) and subsidy for purchase of (500 x €18000) electric and plug-in hybrid vehicles for private use.	Technical, Fiscal	Reduction of fossil motor fuel use by 3000 t per year. Creation of increased fuel savings in the future by increased no. of electric vehicles.	05.2011 - 2012

It must be noted that quantitative and qualitative assessment of achieved or expected GHG reduction for individual policy measures is highly uncertain as no comprehensive evaluation has been conducted in Estonia for specific measures, and because most measures have been implemented simultaneously, so the exact impact of individual measures compared to other policy measures or other driving forces, such as changes in demand, impact of global financial and economic crisis etc., could not been eliminated while assessing the causes of trends in GHG emissions.

Tallinn, August 2012.

FINLAND

Ten best mitigation measures in Finnish climate and energy policy

Compiled by Meri Pukarinen (Finland)

Introduction

This paper identifies the ten most effective mitigation measures in Finnish climate and energy policy as part of a project to compile the best mitigation measures in the Baltic-Nordic region. This sub-project was undertaken by Meri Pukarinen, with Reinhold Pape at AirClim being the project manager. Three Finnish NGO experts ranked the mitigation measures.

This paper first introduces the general policy landscape and emission trends in Finland. Policy measures are then looked at from the following points of view: measures to meet the renewables target set by the EU, measures to meet the energy efficiency target set by the EU, measures to meet the emission reduction target imposed by the EU on the transport sector, and measures at the sub-national level to cut greenhouse gas emissions. A policy measure on the pre-implementation stage is discussed as its expected impact on GHG emissions is large. Finally, the measures are ranked. The appendix lists the NGO experts who ranked the measures.

Trends in Finnish emissions

Finnish emissions vary significantly year-on-year, depending on the availability of hydropower in the Nordic countries as well as the severity of the winter and subsequent use of energy for heating. The overall trend is that of growing emissions throughout the 1990s and the 2000s, before the economic downturn of the recent years bent emissions downwards. The downward trend in emissions during the recession is, however, not likely to be sustained when the economy starts growing again unless new climate policy measures are introduced. The split in Finnish emissions between sectors and trends in emissions are as follows[9]:

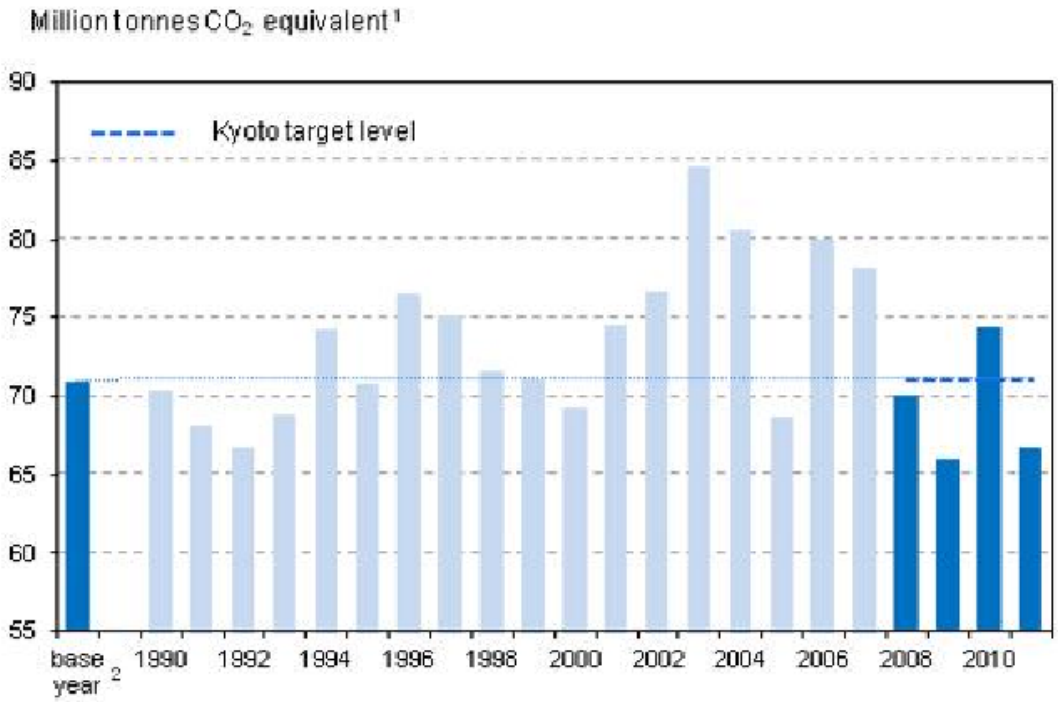
9 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 12. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

Table 1.1
Greenhouse gas emissions (+) and removals (–) by sector, 1990, 1995 and 1997–2007 (million tonnes CO_2 eq.)

Sector	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Energy	54.6	56.3	60.3	57.2	56.6	54.6	59.9	62.5	70.0	65.9	54.3	65.6	63.6
Industrial processes[1]	4.9	4.5	5.0	4.9	4.9	4.9	4.9	4.9	5.2	5.4	5.3	5.3	5.7
F-gases[2]	0.1	0.1	0.2	0.3	0.4	0.6	0.7	0.5	0.7	0.7	0.9	0.8	0.9
Use of solvents and other products	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Agriculture	7.1	6.3	6.2	6.1	5.9	6.0	5.9	5.8	5.7	5.6	5.6	5.6	5.5
Waste	4.0	3.9	3.8	3.6	3.5	3.3	3.2	3.0	2.8	2.7	2.5	2.5	2.4
Total	**70.9**	**71.2**	**75.7**	**72.1**	**71.5**	**69.5**	**74.7**	**76.8**	**84.5**	**80.5**	**68.7**	**79.9**	**78.3**
Land use, land-use change and forestry[3]	–17.8	–16.6	–19.7	–16.6	–18.5	–18.4	–21.5	–22.5	–22.5	–23.3	–28.3	–32.2	–25.3

1 Excluding F-gases
2 F-gases refer to fluorinated greenhouse gases (HFC compounds, PFC compounds and SF_6)
3 A negative figure denotes a net sink, which means that in this sector more greenhouse gases are absorbed from the atmosphere than are released into it.

Greenhouse gas emissions in Finland in have developed in the following way in relation to the Kyoto target level for 2008-2012[10]:



1 CO_2 equivalent describes the warming effect of various gases in relation to CO_2, e.g. 1 t of N_2O is equivalent to 310 t of CO_2
2 Finland's base year under the Kyoto Protocol is 1990, expect for the so-called F-gases (HFC, PFC and SF_6) 1995. Finland's Kyoto target for 2008 - 2012 is estimated and fixed based on the reviewed base year inventory in the initial inventory submission under the Protocol

Implementation of EU policy forms the basis of national policy

The requirements set by the EU guide Finnish climate and energy policy. Finland's emission reduction obligation under the Climate and Energy Package for sectors not covered by the EU ETS is 16 per cent by 2020, compared to 2005 levels. The package also requires Finland to increase its energy efficiency, as well as the share of biofuels in gasoline and diesel to 10 per cent by 2020. The use of renewable energy sources is to grow to 38 per cent of final energy consumption by 2020.[11]

In the traded sector, Finland argues it avoids double regulation and thereby relies on the EU-ETS to cut emissions union-wide, wherever it is most cost-efficient. As the EU-ETS currently suffers from historically low permit prices, which do not encourage investments in low-carbon technologies, this position is quite contestable. However, the Renewables Directive as well as the Energy Efficiency Directive affect the traded sector, and Finland has executed and planned measures to meet the targets set in the directives. By and large, however, Finnish decision-makers tend to focus on the emissions in the non-traded sector as they lie within the national jurisdiction.

Overarching policy framework: climate and energy strategies

Finnish climate and energy policy is planned through so-called Climate and Energy Strategies[12]. These strategies have been prepared once in every government's term of office since 2001. In 2008, the Government approved the new Long-term Climate and Energy Strategy, with detailed proposals for climate and energy policy measures up to 2020, and suggestions up to 2050. The 'with measures' (WM) scenario in the most recent strategy, approved by the parliament, includes the implemented and adopted policies and measures with which the emission limitation target under the Kyoto Protocol will be achieved. The 'with additional measures' (WAM) scenario aims at meeting the objectives of the EU Climate and Energy Package. As a result of the domestic targets and measures, Finland's greenhouse gas emissions are forecast to decline by an estimated 23 per cent by 2020 compared to a situation without the new measures.[13] The VTT Technical Research Centre of Finland has, however, estimated that with the current policies and measures Finland will not reach the emission reduction target of 16% in the non-traded sectors by 2020, set by the EU. Emission reductions enabled by the current policies and measures will amount to a mere 7% emission reduction by 2020[14].

When estimating the mitigation potential of different measures in the government's scenarios, a challenge arises: the emission reduction effect has not always been stated. This is explained to be due to there not being a "without

11 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 14. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

12 National Climate and Energy Strategy. See http://www.tem.fi/index.phtml?l=en&s=2542

13 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 15. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

14 Arvio ei-päästökauppasektorin päästövähennyskeinoista ja kustannuksista Suomessa. See http://www.vtt.fi/news/2012/20120111paastovahennystavoitteet.jsp (in Finnish)

measures" scenario. The point of view chosen as regards impact assessment is described as follows:

"The WM [with measures] scenario does not state how probable or acceptable the final result will be. Neither does it assess the probability of the basic variables, such as economic growth or the trend in fuel prices on the world market. The scenario describes one vision that is internally consistent and is based on calculations with pre-defined starting points. From a greenhouse gas emissions point of view, the scenario represents a development path that shows the magnitude of new appropriate additional measures needed to reach the emissions targets"[15].

Table 4.5
Major policies and measures affecting greenhouse gas emissions in the energy sector in the 'with measures' (WM) scenario, 2007–2020

Policy	Objective	Type of instrument	Status	Estimated mitigation impact		
				2010	2015	2020
EU ETS	To reduce emissions, renewables	Economic	Implemented	na	na	na
Nuclear power	Supply of electricity	Regulatory, economic	Under construction, in use in 2013	0	About 8 Tg	About 8 Tg
Energy taxation	Energy saving, renewables	Fiscal	Implemented	na	na	na
Voluntary agreement scheme	Energy saving	Agreements	Implemented	4 Tg	na	na
Subsidies	Renewables, energy saving, R&D	Fiscal	Implemented	na	na	na
Regulatory measures	Energy efficiency, buildings	Regulatory	Implemented	na	na	na

na = Not available

Source of the table: Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 109. Please note the Olkiluoto 3 nuclear power plant, assumed to feed electricity to the grid in 2013 in the table above, is currently estimated to be in operation in 2016 – seven years behind schedule [16].

Where impact assessments are provided, estimated reductions in emissions are not specified per policy measure but shown in aggregate for different sectors[17]. This prevents us from actually estimating the impact of a specific policy measure.

15 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Changep. 138. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

16 Finland's Olkiluoto 3 reactor seen delayed to 2016. See http://www.reuters.com/article/2013/02/11/teollisuudenvoima-olkiluoto-idUSL5N0BBEZ520130211

17 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 149. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

Table 1.5
Effect of policies and measures on longer term trends: The estimated emissions in the WM and WAM scenarios in 2020 (million tonnes CO_2 eq.)

Sectors	2005	2006	2007	2020	
				WM	WAM
Transport	13.4	13.6	14.0	14.2	11.4
Space heating	3.1	3.0	3.1	2.6	1.2
Agriculture	5.6	5.6	5.5	5.7	5.1
F-gases	0.9	0.8	0.9	0.6	0.3
Waste management	2.4	2.5	2.4	1.8	1.7
Machinery	2.6	2.6	2.6	2.7	2.5
Other sources, of which:	7.7	7.2	7.5	8.4	7.5
• Non-ETS industry CO_2	1.6	1.6	1.6	1.5	1.1
• Combustion, N_2O	0.9	1.0	1.0	1.1	1.0
• Hydrogen production, CO_2	0.07	0.07	0.07	0.8	0.8
Non-ETS total	**35.7**	**35.3**	**36.0**	**36.0**	**29.7**
Emissions in the ETS sector	**33.1**	**44.6**	**42.5**	**52.6**	**38.8**
Total emissions	**68.8**	**79.9**	**78.5**	**88.6**	**68.5**

Source of the table: Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 18[18]

The vague impact analysis of policies to cut greenhouse gas emissions has been criticized by the National Audit Office of Finland.[19] This has, however, neither resulted in an enhanced impact assessment analysis of the measures in the 2008 Climate and Energy Strategy nor guided the updating of the strategy which is currently in process. This represents a particular challenge to effective climate policy.

Measures to meet the renewables target

The proportion of renewable energy in final consumption was 28.5 per cent in 2005[20]. In 2010, the proportion had risen to 33.1 per cent[21]. One of the NGO experts having ranked these measures highlights that this rise is, however, due to the good availability of hydropower on the Nordic market rather than active policy to increase the share of renewables in the energy mix. The relatively high share of renewables is due to the forest industry using their own process residues for energy. Finland aims to increase the proportion of renewable energy in final energy consumption to 38 per cent by 2020. This target is to be achieved by reducing energy consumption and increasing the use of renewables. Wood-based fuels, wind power and heat pumps will contribute most to the target.

18 "Machinery" refers to machines equipped with an internal combustion engine and used in, for example, agriculture or construction. Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 121

19 Valtiontalouden tarkastusvirasto. See http://www.e-julkaisu.fi/vtv/ilmastonmuutoksen_hillinta/pdf/ilmastonmuutoksen_hillinta_208.pdf (in Finnish)

20 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 113. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

21 European Commission. See http://ec.europa.eu/energy/renewables/reports/2011_en.htm

Measure 1: Feed-in tariff for wind power, biogas and wood-based fuels from plants

In September 2009 the working group set up by the Ministry of Employment and the Economy to consider the structure and size of renewable energy feed-in tariffs submitted its final report for a feed-in tariff for wind power and electricity generated from biogas. The working group suggested that a market-based guaranteed price be introduced for wind power in Finland. The guaranteed price for wind power would be introduced in early 2010 for a period of 12 years. At the initial stage, the guaranteed price for wind power determined by the authorities would be EUR 83.5/MWh. The difference between the market price of electricity and the guaranteed price would be paid to wind power producers as a feed-in tariff. For example, at a EUR 50/MWh market price, the premium guaranteed by the feed-in tariff would be EUR 33.5/MWh. The tariff levels are set to be somewhat higher in the initial stage of the scheme in order to facilitate the rapid launch of investments.[22] For a maximum period of three years, until the end of 2015, the guaranteed price is EUR 105.3/MWh.[23]

The feed-in tariff is expected to further the construction of wind power in line with the Long-term Climate and Energy Strategy, the objective of which is to increase the production of wind power to 6 TWh by the year 2020 [24]. The current production level is approximately 0.5 TWh[25]: meeting the 6 TWh goal would mean 12 times more electricity from wind than today. In comparison to e.g. Denmark or Sweden, this goal is still modest. In terms of capacity, meeting the 6 TWh goal means about a 2500 MW capacity and 800 wind turbines. Upping wind energy production in alignment with this goal would mean investments adding up to EUR 4 billion, which in 2020 would mean employment for 25 000 people in Finland. In addition, EUR 300 million would be saved in avoided costs of imported fuel [26].

In addition to the feed-in tariff, a heating premium can be paid to plants using biogas and wood-based fuels if the heat they produce is also fed into the grid. The premium for biogas plants is EUR 50/MWh and EUR 20/MWh for plants using wood-based fuels [27].

The experts having ranked the mitigation measures in this paper noted that the benefits of the feed-in tariff include the "anti lock-in" effect in fossil fuels, positive impact on the market balance of different energy options by altering the economic playing field and the direct emission reduction impact. The cons of the measure include a serious disjoint with the emissions trading

22 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 114. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

23 Energiamarkkinavirasto. See http://www.emvi.fi/files/Sy%C3%B6tt%C3%B6tariffin%20m%C3%A4%C3%A4r%C3%A4ytyminen%202013-01-16%20FI.pdf (in Finnish)

24 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 114. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

25 Finnish Energy Industries. http://energia.fi/en/statistics-and-publications

26 Tuulivoimaa edistämään. See http://www.tem.fi/files/32699/Tuulivoimaa_edistamaan_A4_lop.pdf (in Finnish)

27 Syöttötariffin määräytyminen. See http://www.emvi.fi/files/Sy%C3%B6tt%C3%B6tariffin%20m%C3%A4%C3%A4r%C3%A4ytyminen%202013-01-16%20FI.pdf (in Finnish)

scheme: emission reductions enabled by renewables should be counted out of the permits allocation on the traded sector. In the current situation incoherent regulation results in the problem of "hot air" with too many permits on the market, lowering the permit price and disincentivising investments in low-carbon technologies. Another disjoint prevails in policy planning: policy-makers are incapable of analysing the whole chain of steps energy producers have to go through – and the many obstacles along the chain – before they can actually feed energy into the grid. This results in a jigsaw of suboptimal policies or only a part of the necessary policy measures being utilised. In addition to this, the capacity limit set for biogas plants enjoying the feed-in tariff should be lower in order for the scheme to actually encourage the utilisation of biogas. In spite of the critique, the overall ranking of this measure is high, as the feed-in tariff is one of the few serious national attempts to further the development of renewables.

Measure 2: Removing bureaucratic hurdles in wind energy development

In spite of the feed-in tariff, wind energy development has not taken off as hoped and planned. This is due to a host of issues, ranging from local acceptability to flight security, impacts on radar used by the military to noise, impacts on birds to the applicable distance of the turbines from roads, and most of all bureaucratic hurdles. The permission processes are lengthy and tiresome. The government has now addressed these issues through a special report[28], published in early 2012, also making suggestions to overcome them. The suggested improvements to remove the barriers identified have been taken forward and wind energy development can be expected to finally take off.

This underlines the importance of coherent policy planning: feed-in tariffs alone will not suffice unless the whole policy environment is favourable.

The experts noted that the benefit of removing bureaucratic obstacles in wind energy development lies in enabling the feed-in tariff to be effective. On the flip side, lightening regulation as regards the complaint procedure in wind energy development may be problematic from the point of view of natural values. This is a common point of view in NGOs focusing on traditional nature conservation, which another expert found contestable. It can be argued that streamlining permit procedures does not automatically mean overlooking natural values, and it would in effect enhance citizen participation in planning processes. Current processes are unclear and difficult to follow, and they encourage opposition more than genuine participation. However, it remains to be seen whether all the obstacles to wind energy development will be removed in an optimal manner or whether perverse incentives still prevail. One of the experts stated that those barriers that are rather mechanical in nature are easy to remove but the politically touchier obstacles, namely the wind turbines' impacts on radar used by the military, are unlikely to be deconstructed. Due to these concerns, the measure was ranked in the middle.

28 Tuulivoimaa edistämään. See http://www.tem.fi/files/32699/Tuulivoimaa_edistamaan_A4_lop.pdf (in Finnish)

Measure 3: allowances to households replacing oil and direct electric heating with renewables

In 2012, the state reserved EUR 10 million to support households replacing heating systems based on oil or direct electric heating with renewables [29]. These allowances are applicable for all kinds of households as long as the buildings in question are used throughout the year. The allowances encourage investing in borehole heat pump systems, air-to-water heat pump systems, systems using pellets or other wood-based energy sources, building storage facilities for systems using pellets or other wood-based energy sources and building a combined heating system, using either heat pumps or wood-based energy sources and some other form of extra heating or a combination of heat pumps and wood-based energy sources.

Municipalities are responsible for the allocation of the allowances. Residents must apply for the allowance and, once their application has been approved, the Housing Finance and Development Centre of Finland (ARA)[30] provides the municipalities with the funds. 25% of the overall costs can be reimbursed. The aim is to influence the behaviour of building users, owners and individual consumers by making investment in renewables more attractive.

The experts were sceptical regarding the effectiveness of these allowances. The scepticism arises from the fact that, from a cost-effectiveness point of view, it would make sense to reduce GHG emissions relating to energy in the traded sector, as the marginal cost is many times higher in the non-traded sector[31]. The energy sector is, however, almost untouchable in Finland due to its traditional political significance. This results in the allowances being a patchy initiative, not looking at the big emission sources in the energy sector. Rather than supporting the shift away from oil on a small scale, one should look at the value chain of oil as a whole and identify the biggest emission sources. In addition to these political economy obstacles, the reimbursement for investments in houses utilising direct electricity is too low at 25%. Furthermore, these allowances should not be paid one-off but be continuous in the state budget. As allowances are allocated to certain years and demand fluctuates, the supply side suffers: installers are very busy towards the end of the budget year, but wait for orders for the rest of time. According to one of the experts, the message from the industry is quite clear: allowances should either be continuous or not exist at all. Due to the direct emission reduction impact being small, cost-efficiency being low and the impact on the economic playing field and business opportunities remaining limited, this measure was ranked low.

29 Kuntien myöntämät korjaus- ja energia-avustukset. See http://www.ara.fi/download.asp?contentid=25336&lan=fi (in Finnish)

30 Kuntien myöntämät korjaus- ja energia-avustukset. See http://www.ara.fi/fi-FI/Rahoitus/Avustukset/Kuntien_myontamat_korjaus_ja_energiaavustukset (in Finnish)

31 Ilmastopaneeli. See http://www.ilmastopaneeli.fi/uploads/selvitykset_lausunnot/Yhteenvetoraportti-Energiaj%C3%A4rjestelm%C3%A4%20ja%20p%C3%A4%C3%A4st%C3%B6v%C3%A4hennystoimet%2029-1-2013.pdf p.11 (in Finnish)

Energy efficiency measures

As part of the EU, Finland has to participate in meeting the indicative target of 20% improvements in energy efficiency by 2020. The main measures to this end consist of energy efficiency agreements and improving energy efficiency in buildings. Energy savings through Energy Performance Contracting (EPC) also contribute.

Measure 4: energy efficiency agreements

Finland has favoured voluntary agreements with the industry as regards furthering energy efficiency. Since the 1990s, Finland has employed a voluntary energy efficiency agreement scheme for companies and municipalities. Voluntary measures include energy conservation agreements, energy audits and sector or measure-specific programmes. The scheme covers around 85 per cent of all industrial energy use and over 50 per cent of the building stock of the service sector. New energy efficiency agreements for industries, municipalities and the oil sector are mainly the responsibility of the Ministry of Employment and the Economy and have been signed for the period 2008–2016. They follow the energy conservation agreements that were in force in 1997–2007. Additional energy efficiency agreements are currently in force for goods transport, logistics and public transport. These agreements fall under the responsibility of the Ministry of Transport and Communications. The housing sector has an energy conservation agreement scheme, which is overseen by the Ministry of the Environment [32].

Total savings from measures under energy efficiency agreements within the industry, energy, municipal, property and building sectors at the end of 2010 are estimated to be about 9 TWh per year. The cumulative CO_2 reductions under the energy efficiency agreements are estimated to be about 3.4 million tonnes of CO_2 per year by the end of 2007, based on a marginal emissions rate of 700 kg CO_2/MWh. By the end of 2010 the emissions reduction will exceed 4 million CO_2 tonnes per year[33]. On the other hand, tax refunds for energy-intensive industries can be argued to disincentivise improvements in energy efficiency. These refunds amount to around EUR 9 million annually[34].

The experts were sceptical towards voluntary agreements. Low additionality was the main concern: in a regulated environment, what is the added value of voluntary agreements, and what exactly is the reference scenario against which impacts can be estimated? If energy efficiency improvements make economic sense, they will happen anyway and voluntary agreements bring little added value. In addition to this, the validation of the effectiveness of such schemes differs between countries, which makes comparison difficult. On the positive side, voluntary agreements can be a good complimentary measure if an otherwise comprehensive energy efficiency policy package exists, and

32 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 112. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

33 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 112-113. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

34 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 129. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

if the details of such agreement schemes are well tailored. However, a major concern with voluntary measures, visible in environmental policy more generally, is the dynamic of industries actually dodging regulation through voluntary agreements. In the Finnish context, the concern is valid as industries oppose legally binding energy efficiency improvements by default. Low additionality and a very limited direct emission reduction impact cause these agreements to rank lowest.

Measure 5: energy efficiency standards for new buildings

In 2010, the government tightened the energy efficiency standards for new buildings by 30% compared to the previous level. Standards were amended again in 2011 when an upper limit for the energy use of buildings was set. This limit takes into account the type of the building as well as the source of the energy used in the building [35]. The tightened standards regulate the upper limits for the energy used in the buildings in the following manner (a non-exhaustive set of examples)[36]:

Building type	kWh/m2 per year
Detached houses less than 120 m2 in size	204
Townhouses	150
Apartment houses	130
Office buildings	170
Hotels etc.	240

When counting the "e figure", stating the overall energy consumption of the building, different fuels used for the heating of the building are allocated different factors by which the actual energy consumption must be multiplied. For direct electricity heating, the factor is 1.7; for district heating 0.7; for district cooling 0.4; for renewable fuels 0.5; and for fossil fuels 1[37].

The tightened standards have not sunk in without opposition as the building industry opposes ambitious energy efficiency standards. This is due to quality concerns as the know-how does not follow the speedy tightening of regulation[38].

The experts estimated these standards to make good sense – it would be irrational not to tighten the standards and lock-in high energy consumption for decades. Furthermore, the Finnish building stock is young compared to many European countries, which makes tightening the standards for new buildings a meaningful measure: the potential in existing buildings is not quite as large as elsewhere in Europe. One of the experts said it is very embarrassing for

35 Rakennuksen energia- ja ekotehokkuus. See http://www.ymparisto.fi/default.asp?node=20644&lan=fi (in Finnish)

36 Asetus rakennusten energiatehokkuudesta. See http://www.finlex.fi/data/normit/37188-D3-2012_Suomi.pdf (in Finnish)

37 Ibid.

38 Energiatehokkuus suututtaa rakentajia. See http://yle.fi/uutiset/energiatehokkuus_suututtaa_rakentajia_-_maailmanparannus_mennyt_terveyden_edelle/6501528 (in Finnish)

the building industry not to keep up with tightening standards: perhaps the state could support the sector with funds for further education if need be. The "anti lock-in" effect, potential to create low-carbon business opportunities and large direct emission reduction impact especially over time resulted in a high ranking for the tightened standards.

Measure 6: energy efficiency measures in old buildings

CO_2 emissions from the use of energy in buildings are mainly covered by the emissions trading sector. District heating is the source for about half of the space heating in Finland. The majority of district heating production – as with electricity produced in CHP plants – falls within the sphere of the emissions trading sector. Much of the rest of Finland's electricity production is also covered by the emission trading sector. Therefore, the category of direct CO_2 emissions from energy use in buildings in Finland only comprises emissions from domestic heating using light fuel oil and to a very small extent natural gas, which is typical of much of the country's detached housing stock. These CO_2 emissions amount to about 3 million tonnes annually. The non-CO_2 emissions from energy use in buildings are much smaller, approximately 0.2 million tonnes CO_2 equivalent annually. Most of these emissions are CH4 emissions from wood combustion. The Directive on the energy performance of buildings aims at reducing CO_2 emissions by improving the energy efficiency of buildings. The directive was implemented in Finland by a new regulation which came into force at the beginning of 2008. New Finnish legislation on the energy efficiency of buildings includes [39]:

• Act on energy certification of buildings and Ministry of the Environment Decree on Energy Certification of Buildings. The energy certification enables comparison and bettering of the energy efficiency of buildings through the provision of energy use information when selling or renting them. The certificate includes information not only on the current energy efficiency of the building but also recommendations to enhance it. The certification is undertaken by professionals. The certification system aims to raise awareness of the energy use of residential buildings as they are responsible for 27% of the energy use of all buildings. All in all, buildings use up to 40% of all energy used in Finland [40].

• Act on energy efficiency inspections of cooling equipment used in air conditioning systems in buildings. This act requires that the energy efficiency of cooling equipment used in air conditioning systems in buildings is inspected once every ten years. This does not apply to district cooling systems. The inspection must examine the overall condition of the cooling equipment along with its efficiency, and a certificate must be given to the owner of the building. This certificate ought to include recommendations to improve the energy efficiency of the equipment[41].

39 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 115. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

40 Laki rakennuksen energiatodistuksesta 22.1.2013: Usein kysyttyjä kysymyksiä & vastauksia. See http://www.ymparisto.fi/download.asp?contentid=141230&lan=fi (in Finnish)

41 Laki rakennuksen ilmastointijärjestelmän kylmälaitteiden energiatehokkuuden tarkastamisesta. See http://www.ymparisto.fi/download.asp?contentid=66032 (in Finnish)

From a regulatory point of view, one of the experts stated that it makes sense to regulate when people make some of their biggest decision – like buying a house or a car. At these moments, a window opens up for people to think about their behaviour and consumption in the long term. This is why the idea of the energy certificate deserves credit, but, on the other hand, regulation should have a clear effect on the price of the house, depending on energy consumption over time. The provision of information is seldom enough to steer decision making. Another expert echoed this view, stating that a better understanding of the steering of behaviour is needed. Setting the building tax in alignment with the energy consumption of the building would actually create an economic incentive to improve energy efficiency. What matters for people buying a house is its location especially in terms of services and price: raising awareness does not thus create much of an incentive. However, due to the potential "anti lock-in" effect in big consumption rates of often fossil energy over time, as well as the direct emission reduction impact, these measures avoid scoring at the very bottom.

Measure 7: energy savings through Energy Performance Contracting (EPC)

ESCO services – better known as Energy Performance Contracting (EPC) outside of Finland – mean investments to save energy in client companies, enabled by an external energy expert (Energy Service Company). These companies commit to ensuring energy efficiency goals in the client company are met. The costs, including the initial energy efficiency investment, are paid back by the client company's reduced fuel costs over time. ESCO services are used in industry, the public sector and the private service sector, and specific projects include e.g. heat recovery systems, renewal of lighting, optimising pump systems in industry and heat recovery from flue gas [42].

Energy Performance Contracting was started in the 1980s in the US, Canada and France, and it has spread around the world during the past decade [43].

The emission reduction potential of ESCO projects in Finland was estimated in a Climtech project report. The report found the emission reduction potential in industry to be 0.3–0.4 Mt CO_2 [44].

Although the idea of the ESCO concept is good, the actual impact in reducing emissions is not applauded. Additionality and validation remain concerns, similar to the case with voluntary energy efficiency agreements. Furthermore, one of the experts stated that ESCO suffers from either its being marginal or creating risks for the core processes of industries. The biggest energy savings do lie within the core processes, where quality concerns and worries of production stoppages create barriers to enhancing energy efficiency. A risk insurance of some sort would therefore be needed in order for energy efficiency improvements to take off. These notions explain why this measure scores a low ranking.

42 ESCO-palvelu. See http://www.motiva.fi/toimialueet/energiakatselmustoiminta/esco-palvelu (in Finnish)

43 ESCO maailmalla. See http://www.motiva.fi/toimialueet/energiakatselmustoiminta/esco-palvelu/esco-palvelu_kaytannossa/esco_maailmalla (in Finnish)

44 Climtech-ohjelma. Loppuraportti. See http://www.motiva.fi/files/825/CO2esco.pdf (in Finnish)

Reducing emissions from transport

The single most important measure having reduced emissions from transport is the differentiation of taxation according to vehicle-specific emissions.

Measure 8: differentiation of car and vehicle taxation according to vehicle-specific emissions

The aim is that by 2020 specific emissions of new cars sold in Finland would be close to the EU objective (95 g/km; the current level is at around 163.5 g/km) and the rate of vehicle fleet renewal would be around 7 per cent a year. The goal with regard to the entire vehicle fleet is that by 2020 the average carbon dioxide emissions would be 137.9 g/km at most (currently around 180.1g/km). This means that the specific emissions of the Finnish vehicle fleet would be reduced by a third[45]. The emission reduction potential is estimated to be 2.1–2.3 million tons per year and with a cost of about 0.5 M€ per year[46]. As regards the costs of reducing emissions from cars, more efficient cars arguably save money in both production and use.

According to data from the year 2012, the target seems to be met with regard to new cars. The average CO_2 emissions of new cars have dropped by 24% between 2007 and 2012. However, as regards the entire vehicle fleet, the target seems not to be met as the renewal rate is worse than expected: the aim was to sell 150 000 new cars per year but in 2011 only some 130 000 were sold [47].

According to expert estimations, the emission reduction impact from new cars was 68 000 tons of CO_2 in 2011[48].

Altering behaviour through economic incentives was seen as an effective measure by the experts. Pros of the measure include additionality to EU regulation, setting a good example that is replicable in many other countries, good overall design of the measure and the impact on the market balance of different mobility options. An expert noted that similar measures should be used in e.g. enhancing energy efficiency in buildings. One benefit of taxes, all in all, is their psychological effect: the tax need not be large but it being a tax already steers behaviour at least in the Finnish context. Unfortunately, however, the emission reduction impact on the entire fleet is limited although emissions have dropped as regards new cars. In addition to this, other policy measures should support the positive impacts created by taxation. Due to the positive impacts, the measure ranks in the top three.

Sub-national measures

Although the state has moved rather slowly in climate policy, a group of municipalities have initiated ambitious emission reduction schemes in an internationally unique project.

45 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 118. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

46 Liikenne- ja viestintäministeriön hallinnonalan ilmastopoliittinen ohjelma 2009–2020. Seuranta 2012. See http://www.lvm.fi/c/document_library/get_file?folderId=1986562&name=DLFE-18457.pdf&title=Julkaisuja%2023-2012 p. 8 (in Finnish)

47 Ibid. p. 10

48 Ibid. p. 11

Measure 9: carbon-neutral municipalities as forerunners

In 2008, five Finnish municipalities launched a climate project, carbon-neutral municipalities, that is unique not only in Finland but internationally too. Their objective is to reduce greenhouse gas emissions by more than required by the EU targets and more quickly than has been agreed: these municipalities have committed to an 80 per cent emission reduction by 2030 from the level of 2007[49].

The project aimed to create tools and procedures to enable Finnish municipalities to mitigate climate change and promote the adoption of climate-friendly technologies. Suitable solutions were sought through close cooperation between researchers, the public sector and businesses. The aim was that successful tools and practices could also be applied elsewhere in Finland and abroad. The municipalities were to define short-term goals and plan required measures together with experts. Consequently, achieving concrete results within just a few years was envisaged. The project aims at greenhouse gas emission reductions both in the near future (2–5 years) and in the longer term (6–20 years). The ultimate goal is a carbon-neutral municipality.[50]

Since the beginning of the project, the number of municipalities involved has grown to 10[51]. The municipality most praised is Uusikaupunki, aiming for a 30 per cent reduction compared to the 2007 emissions level by 2012[52]. One of the project's most significant private sector measures comes in the shape of the Yara fertiliser plant's investment in catalyst technology. This will cut the factory's greenhouse gas emissions by approximately 90 per cent. Another remarkable initiative is the closed circulation energy solution devised by Sybimar Oy. This facilitates the utilisation of nutrients, water and carbon dioxide in energy and food production[53].

The activities undertaken in carbon-neutral municipalities vary from enhancing energy efficiency to installing renewable power capacity. The newest examples range from switching from oil to borehole heating in 18 households in the Mynämäki municipality, having reduced emissions by 28 000 kg CO_2e/a[54]; a beneficial "green loan" enabled by a local bank for households switching from oil heating to renewables in the Padasjoki municipality[55]; testing a new technology in biogas production, multiplying the energy

49 HINKU-municipalities. See http://www.ymparisto.fi/default.asp?contentid=392091&lan=en&clan=en

50 Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change p. 100. See http://unfccc.int/resource/docs/natc/fin_nc5.pdf

51 HINKU-kunnat. See http://www.ymparisto.fi/default.asp?node=26610&lan=FI (in Finnish)

52 Proven by experience in five municipalities: carbon-neutral municipality not a utopian idea. See http://www.ymparisto.fi/default.asp?contentid=367135&lan=en&clan=en

53 Ibid.

54 Lämpökeskus öljylämmityksestä maalämpöön. See https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=206 (in Finnish)

55 "Viherlaina". See https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=205 (in Finnish)

output manyfold compared to conventional technologies in the Salo municipality[56]; to creating energy efficiency standards for public procurement in the Parikkala municipality, setting minimum criteria for energy efficiency for e.g. IT and other office equipment, logistics, building projects and heat and electricity procurement.[57]

According to the project manager, Mr. Jyri Seppälä at the Finnish Environment Institute, the main drivers for success are rather simple. The single most important reason for the initiative taking off is the commitment from the highest possible level – mayors. Without their enthusiasm, results would not be as encouraging as they now are. New ways of cooperation within and between municipalities are another driver for success: the sectoral approach in policy implementation often leads to suboptimal and uncoordinated action, and breaking such a way of working has opened up new possibilities in reducing emissions and creating positive impacts for the local economies. The role of the media in showcasing success stories has also been an important factor[58].

For a comprehensive list of activities in carbon-neutral municipalities (in Finnish), see https://wwwp5.ymparisto.fi/hinku/Aloitus.aspx.

Expert evaluations differed regarding the carbon-neutral municipalities initiative. On the one hand, the success stories were seen as important and the initiative as such was praised. In many municipalities replicable examples matter, as the time and resources available for analysing possibilities to reduce emissions are very limited. The initiative shows drastic emission reductions are possible and that businesses benefit from reducing emissions. On the other hand, the initiative does not cover a single major city. In addition, the link from local to national level is missing: how could the lessons learnt in municipalities inform national policy-making? Although the pros range from setting a good example to the initiative being replicable and having produced useful and open data, the low coverage and disjoint to wider policy learning lowers the ranking.

Measures in preparation

The lack of systematic impact assessment of Finnish climate policies is a central concern in terms of the effectiveness of policies and measures (see section 'Overarching policy framework: climate and energy strategies'). A remedy to this is currently under preparation.

Measure 10: climate law enhancing the effectiveness of policy measures

The government has agreed to prepare a climate law which implements the long-term emission reduction target of at least 80% less emissions in 2050

56 Biokaasun tuotanto uudella tekniikalla. See https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=203 (in Finnish)

57 Kunnan hankintaohjeistuksen päivitys energiatehokkuuden osalta. See https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=189 (in Finnish)

58 Pers. comm.

than in 1990 [59]. The law is currently under preparation in the Ministry of Environment[60]. The law would make sure emission reductions happen on an annual basis, and the process for planning, implementing and following up on the effectiveness of the policy measures chosen would be legally binding. So-called carbon budgets would include the maximum amount of GHG emissions different sectors may emit within the tentative four-year carbon budget period, and the path towards the 2050 emission reduction target would be split into such carbon budgets. This would improve the predictability and coherence of climate and energy policy[61]. This measure is inspired by the Climate Act passed in 2008 in the UK[62].

As the impact assessments of policies so far have been vague and, as a result, emissions have not started to decline, the overarching climate law can significantly improve the effectiveness of climate policy measures, implementing the targets set in the carbon budgets. In short, the climate law would make sure the emission reduction targets agreed on are met through the most effective policy measures and the policy landscape is coherent.

The experts applauded the Climate Law establishing an overarching scheme to plan, implement and monitor emission reductions. This was seen as the basis of effectiveness. However, due to political horse trading, the law as currently planned would not up the level of ambition for GHG cuts, and the traded sector is outside the law's coverage. Moreover, as the emission reduction targets are not raised by the law, the impact could either be zero on paper or massive in practice, depending on whether we assume that emission reduction targets already agreed on could be met with other measures. So far this has clearly not been the case. As regards the level of emission cuts within the climate law, the devil lies in the detail. Depending on the final architecture and wording of the law, the law could include a mechanism to evaluate the adequacy of current emission reduction targets. This would create a framework in which upping the emission reduction targets could be discussed – for now, such a framework does not exist on the political fora.

Although some problematic limitations do exist, the law scores points due to its overarching nature in preventing carbon lock-in, direct emission reduction impact, setting a good example, being replicable and additional, and bringing with it good data availability and monitoring as regards the development of emissions.

59 Ilmastolaki valmistellaan vielä tämän hallituskauden aikana. See http://www.ymparisto.fi/default.asp?contentid=428736&lan=FI (in Finnish)

60 Ibid.

61 Ilmastopaneeli. http://www.ilmastopaneeli.fi/uploads/selvitykset_lausunnot/Abstact_Assesment%20of%20the%20Need%20and%20Opinions%20for%20Climate%20Act.pdf

62 Climate Change Act 2008. See http://www.legislation.gov.uk/ukpga/2008/27/contents; for early lessons learnt see The UK Climate Change Act 2008 – Lessons for national climate laws. http://www.clientearth.org/reports/climate-and-energy-lessons-from-the-climate-change-act.pdf

Mitigation measures ranked

Measure	Type	Direct impact	Criteria	Ranking
Feed-in tariff for wind, biogas and wood-based fuels in plants	Subsidy	Wind capacity to increase to 6 TWh by the year 2020	Direct emission reduction impact; altering the economic playing field; anti-lock-in effect in fossils; steering behaviour	1
Tightening of energy efficiency standards for new buildings	Regulatory	30% less energy use in new buildings since 2010	Direct emission reduction impact; anti-lock-in effect in fossils, creating business opportunities for clean tech	2
Differentiation of car and vehicle taxation according to vehicle-specific emissions	Taxation	Average CO_2 emissions of new cars have dropped by 24% between 2007 and 2012; emission reduction impact from new cars was 68 000 tons of CO_2 in 2011	Direct emission reduction impact; good example; replicable; additional, steering behaviour	3
Climate Law	Regulatory	Creating a coherent emission reduction path and ensuring emission reduction targets are met	Overarching nature; direct emission reduction impact; good example; replicable; additional; good data availability and monitoring	4
Removing bureaucratic hurdles in wind energy development	Regulatory	Enable feed-in tariff to kick in	Steering behaviour; direct emission reduction impact; creating business opportunities for clean tech	5
Carbon-neutral municipalities	Voluntary cooperation	Ten municipalities have committed to an 80 per cent emission reduction by 2030 from the level of 2007	Direct emission reduction impact; good example; replicable; additional; good data availability and monitoring; anti-lock-in effect; creating business opportunities for clean tech	6
Energy efficiency measures in old buildings	Regulatory	n.a.	Anti-lock-in effect in fossils; direct emission reduction impact; steering behaviour	7
Allowances to households replacing oil and direct electric heating with renewables	Allowance	Renewable heating sources become more cost-competitive	Altering the economic playing field; direct emission reduction impact; impact to the market balance of different energy options; steering behaviour	8
Energy savings through Energy Performance Contracting (EPC)	Voluntary business model	Emission reduction potential in industry 0.3-0.4 Mt CO_2	Direct emission reduction impact; additionality, direct emission reduction impact, creating business opportunities	9
Voluntary energy efficiency agreements with industry and municipalities	Voluntary agreement	Total savings at the end of 2010 are estimated to be about 9 TWh per year. The cumulative CO_2 reductions are estimated to exceed 4 million CO_2 tonnes per year by 2010	Additionality; direct emission reduction impact; steering behaviour, creating business opportunities for clean tech	10

List of references

Finland's Fifth National Communication under the United Nations Framework Convention on Climate Change. 2009. Ministry of the Environment and Statistics Finland, Helsinki. 280 p. http://unfccc.int/resource/docs/natc/fin_nc5.pdf

Greenhouse gas inventory. Statistics Finland. http://www.stat.fi/tup/khkinv/index_en.html
Cited on March 9 2013.

National Climate and Energy Strategy. Ministry for Employment and the Economy. http://www.tem.fi/index.phtml?l=en&s=2542
Cited on March 9 2013.

Lindroos, Hast, Ekholm ja Savolainen. 2012. Arvio ei-päästökauppasektorin päästövähennyskeinoista ja kustannuksista Suomessa. VTT tiedotteita 2605. http://www.vtt.fi/news/2012/20120111paastovahennystavoitteet.jsp

Reuters. 2013. UPDATE 3-Finland's Olkiluoto 3 reactor seen delayed to 2016. http://www.reuters.com/article/2013/02/11/teollisuudenvoima-olkiluoto-idUSL5N0BBEZ520130211
Cited on March 13 2013.

Valtiontalouden tarkastusvirasto. 2011. Tuloksellisuustarkastuskertomus 235/2011. Ilmastonmuutoksen hillintä. Ilmasto- ja energiastrategian valmistelu ja toimeenpano. http://www.e-julkaisu.fi/vtv/ilmastonmuutoksen_hillinta/pdf/ilmastonmuutoksen_hillinta_208.pdf

European Commission. 2011. Renewable energy. Progress reports. http://ec.europa.eu/energy/renewables/reports/2011_en.htm
Cited on March 9 2013.

Energiamarkkinavirasto. 2013. Syöttötariffin määräytyminen. Tuuli-, biokaasu- ja puupolttoainevoimalat. http://www.emvi.fi/files/Sy%C3%B6tt%C3%B6tariffin%20m%C3%A4%C3%A4r%C3%A4ytyminen%202013-01-16%20FI.pdf

Finnish Energy Industries. Statistics and publications. http://energia.fi/en/statistics-and-publications
Cited on March 9 2013.

Tarasti. 2013. Tuulivoimaa edistämään. http://www.tem.fi/files/32699/Tuulivoimaa_edistamaan_A4_lop.pdf

Syöttötariffin määräytyminen. 2013. http://www.emvi.fi/files/Sy%C3%B6tt%C3%B6tariffin%20m%C3%A4%C3%A4r%C3%A4ytyminen%202013-01-16%20FI.pdf

Asumisen rahoitus- ja kehittämiskeskus. 2013. Kuntien myöntämät energia-avustukset. http://www.ara.fi/download.asp?contentid=25336&lan=fi
Cited on March 9 2013.

Asumisen rahoitus- ja kehittämiskeskus. 2013. Kuntien myöntämät energia-avustukset. http://www.ara.fi/fi-FI/Rahoitus/Avustukset/Kuntien_myontamat_korjaus_ja_energiaavustukset
Cited on March 13 2013.

Ilmastopaneeli. 2013. Energiajärjestelmä ja päästövähennystoimet. Yhteenvetoraportti. http://www.ilmastopaneeli.fi/uploads/selvitykset_lausunnot/Yhteenvetoraportti-Energiaj%C3%A4rjestelm%C3%A4%20ja%20p%C3%A4%C3%A4st%C3%B6v%C3%A4hennystoimet%2029-1-2013.pdf

Ympäristöministeriö. Rakennuksen energia- ja ekotehokkuus. http://www.ymparisto.fi/default.asp?node=20644&lan=fi
Cited on March 9 2013.

Ympäristöministeriö. Asetus rakennusten energiatehokkuudesta 2/11. http://www.finlex.fi/data/normit/37188-D3-2012_Suomi.pdf

Yle Uutiset. Energiatehokkuus suututtaa rakentajia - “maailmanparannus mennyt terveyden edelle”. http://yle.fi/uutiset/energiatehokkuus_suututtaa_rakentajia_-_maailmanparannus_mennyt_terveyden_edelle/6501528
Cited on March 9 2013.

Ympäristöministeriö. 2013. Laki rakennuksen energiatodistuksesta 22.1.2013: Usein kysyttyjä kysymyksiä & vastauksia. http://www.ymparisto.fi/download.asp?contentid=141230&lan=fi
Cited on March 9 2013.

Ympäristöministeriö. 2007. Laki rakennuksen ilmastointijärjestelmän kylmälaitteiden energiatehokkuuden tarkastamisesta. http://www.ymparisto.fi/download.asp?contentid=66032
Cited on March 9 2013.

Motiva. ESCO-palvelu. http://www.motiva.fi/toimialueet/energiakatselmustoiminta/esco-palvelu
Cited on March 9 2013.

Motiva. ESCO maailmalla. http://www.motiva.fi/toimialueet/energiakatselmustoiminta/esco-palvelu/esco-palvelu_kaytannossa/esco_maailmalla
Cited on March 9 2013.

Motiva. 2002. Climtech-ohjelma. Loppuraportti. CO_2ESCO - Energiapalveluyritysten (ESCO) toiminta ilmastonmuutoksen rajoittamisen näkökulmasta. http://www.motiva.fi/files/825/CO_2esco.pdf

Liikenne- ja viestintäministeriö. 2012. Liikenne- ja viestintäministeriön hallinnonalan ilmastopoliittinen ohjelma 2009–2020. Seuranta 2012. http://www.lvm.fi/c/document_library/get_file?folderId=1986562&name=DLFE-18457.pdf&title=Julkaisuja%2023-2012

Ministry of Environment. HINKU municipalities. http://www.ymparisto.fi/default.asp?contentid=392091&lan=en&clan=en
Cited on March 9 2013.

Ympäristöministeriö. HINKU-kunnat. http://www.ymparisto.fi/default.asp?node=26610&lan=FI
Cited on March 9 2013.

Finnish Environment Institute. Proven by experience in five municipalities: carbon-neutral municipality not a utopian idea. http://www.ymparisto.fi/default.asp?contentid=367135&lan=en&clan=en
Cited on March 9 2013.

Suomen ympäristökeskus. 2011. Hinkumappi. Lämpökeskus öljylämmityksestä maalämpöön. https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=206
Cited on March 13 2013.

Suomen ympäristökeskus. 2011. Hinkumappi. "Viherlaina". https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=205
Cited on March 13 2013.

Suomen ympäristökeskus. 2011. Hinkumappi. Biokaasun tuotanto uudella tekniikalla. https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=203
Cited on March 13 2013.

Suomen ympäristökeskus. 2011. Hinkumappi. Kunnan hankintaohjeistuksen päivitys energiatehokkuuden osalta. https://wwwp5.ymparisto.fi/hinku/Kohteet/Tiedot.aspx?Id=189
Cited on March 13 2013.

Personal communication with Mr. Jyri Seppälä. March 12 2013.

Ympäristöministeriö. Ilmastolaki valmistellaan vielä tämän hallituskauden aikana. http://www.ymparisto.fi/default.asp?contentid=428736&lan=FI
Cited on March 9 2013.

Ilmastopaneeli. 2012. Abstract: Assessment of the need and options for a climate act. http://www.ilmastopaneeli.fi/uploads/selvitykset_lausunnot/Abstact_Assesment%20of%20the%20Need%20and%20Opinions%20for%20Climate%20Act.pdf

The National Archives. Climate Change Act 2008. http://www.legislation.gov.uk/ukpga/2008/27/contents
Cited on March 9 2013.

ClientEarth. 2009. The UK Climate Change Act 2008 – Lessons for national climate laws. http://www.clientearth.org/reports/climate-and-energy-lessons-from-the-climate-change-act.pdf

Appendix 1. NGO experts having ranked the measures

Ms. Karoliina Auvinen, Senior Lead, Ecoefficiency , SITRA (The Finnish Innovation Fund) http://www.sitra.fi/en

Ms. Hanna Hakko, Environmental Policy Officer, Finnish Association for Nature Conservation http://www.sll.fi/site-actions/english

Ms. Kaisa-Reeta Koskinen, Energy Campaigner, Greenpeace Nordic http://www.greenpeace.org/finland/en/

GERMANY

Ten best mitigation measures in Germany

Compiled by Nicole Bosquet and Jan Burck from German Watch

Introduction

In this study the ten best mitigation actions for the reduction of greenhouse gas (GHG) emissions in Germany are compiled as part of a study of the ten best mitigation measures in the whole Baltic region. The criteria for the selection of policies as one of the ten best mitigation measures in Germany and the Baltic region as a whole are that they create the largest GHG cuts, save the most energy, have positive social or economic side effects and can be readily replicated in other countries.

Conditions in Germany

The mitigation aspects are dependent on the following key indicators:

Germany[63] has a GDP of US$33,421.36 per capita, with a population of 81.76 million people. Energy-related emissions in Germany are 9.32 t CO_2 per capita. In comparison to other countries from the Baltic region, energy-related CO_2 emissions per capita in Germany are rather high. In Sweden for example, CO_2 emissions per capita are 5.07 t, in Poland 7.99 t and in Denmark 8.48 t per capita. However, in Finland, CO_2 emissions per capita are much higher, at 11.73 t per capita.

Concerning the energy intensity of the example countries, the total primary energy supply (TPES) per GDP in Germany is 5.02 MJ/US$. Compared with the other countries from the Baltic region this figure is rather low, as only Denmark has a lower TPES per GDP of 4.51 MJ/US$. The highest figure is achieved by Finland, with 9.02 MJ/US$.

Regarding the CO_2 intensity of the example countries, the CO_2 per TPES for energy-related emissions in Germany is 55.56 t/TJ, which is again only average compared with other Baltic countries. The lowest CO_2 per TPES for energy-related emissions is again in Sweden, with 22.16 t/TJ and the highest TPES for energy-related emissions is achieved by Poland, with 71.83 t/TJ.

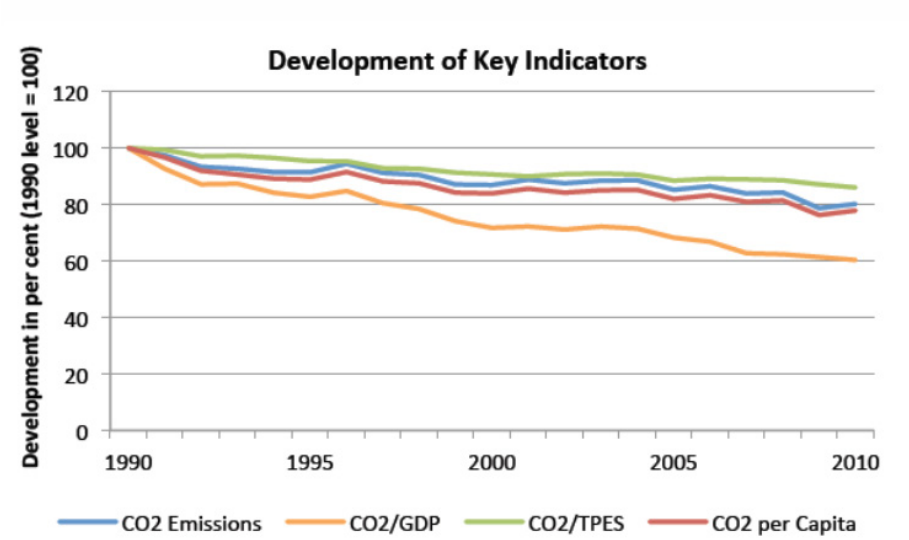
The CO_2 energy-related emissions per GDP in Germany are 0.28 t/1000US$, which is average compared with the Baltic countries. Again Sweden has lower CO_2 energy-related emissions per GDP, with 0.15 t/1000US$. Denmark also has slightly lower CO_2 energy-related emissions per GDP, with 0.26 t/1000US$. However, Finland with 0.37 t/1000US$ and Poland with 0.46 t/1000US$ have higher CO_2 energy-related emissions per GDP than Germany.

The overall contribution of renewable energy to TPES in Germany is 9.94%, which is again quite low compared to the renewable energy share of Sweden, Finland and Denmark. The contribution of renewable energy to TPES in Sweden is 33.94%, in Finland 25.34%, and in Denmark 20.30%. Only Poland has a lower renewable energy share than Germany, with 7.17% (IEA 2012).

63 All data are from 2010

When comparing the key figures of the different Nordic Baltic countries, which are based on data from 2010, Germany's figures are behind the figures of Sweden and Denmark. However, Germany gets a better score than Finland and Poland regarding its emissions.

The graph below describes the development of the key indicators from the years 1990 to 2010. Looking at the CO_2 emissions, it can be seen that there has been an overall reduction of about 20% from 1990 to 2010. The CO_2/GDP ratio has fallen by a full 40%. The CO_2/TPES, in comparison has declined by approximately 17%. And finally the CO_2 per capita level has decreased by 21%.



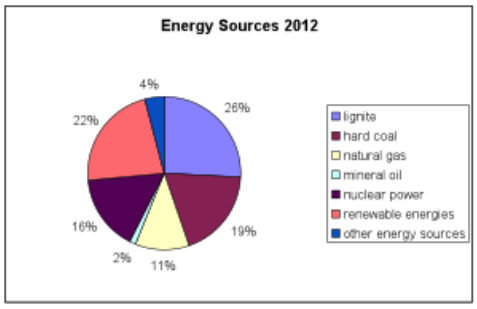
German Energiewende

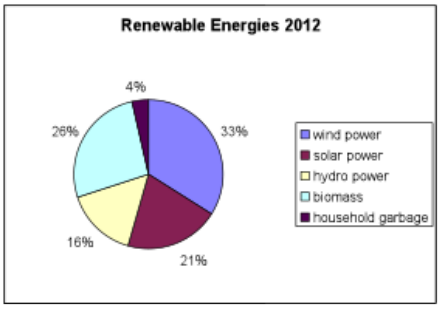
Germany currently faces a political trend towards the transformation of its energy system, which is called the "Energiewende". The term "Energiewende" has a long history in Germany. The starting point for the German "Energiewende" is rooted in the increasing environmental awareness and the anti-nuclear movement of the 1970s. Back then, the term "Energiewende" was coined and used by nuclear opponents, who were searching for alternative forms of energy supply. The nuclear power plant accident in Chernobyl in 1986 as well as the oil crises in 1973 and 1979 enforced the search for alternative energy sources and were the starting point for feed-in tariffs. In the late 1980s, the first prototypes for feed-in tariffs were introduced for photovoltaic power in several towns in Germany. In these first prototypes, the compensation for the generated power was able to cover the expenses of the investments made. This approach was later referred to as the Aachener Model. These first attempts led to the first German national feed-in tariff in 1991, called the "Stromeinspeisegesetz". Another important step towards the energy transition was the carbon reduction programme established by the KfW development bank in 1996, with the focus on improving the energy efficiency of buildings (Heinrich Böll Stiftung, 2013a).

Two years later the first steps were taken towards liberalising the German power market by changing the law on the energy industry. This turned the complete monopoly of the energy market into a more open market, making the grid accessible for renewable energy sources (Lenk et al., 2000).

Another important step towards the Energiewende was the introduction of the renewable energy law, known as EEG, in the year 2000. In this year the first phase-out of nuclear power plants and the introduction of the renewable energy law was agreed by the coalition between the Social Democrats and the Green Party under Chancellor Schröder (Heinrich Böll Stiftung, 2013a). The introduction of the EEG was an important step towards the inclusion of renewable energies in the German electrical power supply mix and raised the percentage of renewable energies in German electricity consumption from just 3.2% in the year 1991 to 22.9% by the year 2012 (AGEB, 2013).

The figures below show which energy sources the electrical supply was made up of in 2012. In 2012 the greatest percentage of the energy supply in Germany was supplied by lignite with a share of 25.7%. Other energy sources in the German energy mix are hard coal, at 19.1% and nuclear power, at 16.1%. Natural gas contributes 11.3% and mineral oil 1.5% to the electricity supply mix. Renewables make up 22.9% of the total energy supply and comprise 7.4% wind power, 5.8% biomass, 4.5% photovoltaic power, 3.4% hydropower and 0.8% household waste (AGEB, 2013).





Another crucial step towards the Energiewende was the so-called Meseberg decisions on climate and energy measures in 2007. A comprehensive legislative package was decided in order to meet the CO_2 reduction target of -40% by the year 2020. Important laws included the amendment of the cogeneration act (KWKG) and the amendment of the energy saving ordinance (EnEV). Moreover, cleaner power plants and the amendment of the renewable energy source act (EEG) are part of the Meseberg decisions. Funding for biofuels and traffic measures was also approved in order to reduce GHG emissions (BMU, 2007a).

Then, in 2010 the "Energy concept" was adopted with the goal of covering Germany's energy demand mainly through renewable energies by 2050 and to reduce CO_2 emissions by 80–95%. The main focus is placed on renewable energies as well as on energy efficiency (BMU, 2011a). Another goal is to reduce GHG emissions by 40% by 2020 compared to the base year 1990. GHG emissions are supposed to be reduced by 80–95% by the year 2050. Furthermore, primary energy consumption needs to be cut by 20% by the year 2020 and by 50% by the year 2050. In addition, energy productivity

is supposed to rise by 2.1% each year based on final energy consumption. Electricity consumption should be cut by 10% by 2020 and by 25% by 2050 compared to consumption in 2008. Regarding the heating requirements for buildings, demand will be lowered by 20% by 2020 and by a total of 80% by 2050 compared to the heating demand of buildings in 2008. Moreover, renewable energies should make up 18% of the total gross final energy consumption by 2020 and 30% by 2030 and finally reach 60% by the year 2050. Concerning gross power consumption, renewables should make up 35% by the year 2020 and 80% by the year 2050 (BMU, 2011a).

As mentioned before, the coalition between the Social Democratic Party (SPD) and the Green Party (Die Grünen) decided in 2000 in their nuclear consensus to phase out nuclear power within approximately the next 20 years. However, the decision was revised in the energy concept of 2010 under the coalition of the Christian Democratic Union (CDU) and the Free Democratic Party (FDP). In their nuclear amendment in 2010 they decided to extend the lifespan of the nuclear reactors by an average of 12 years and thereby postponed the nuclear phase-out. However, after the nuclear accident in Fukushima in March 2011 the eight oldest nuclear power plants were shut down. Furthermore, the lifetime extensions for the nuclear power plants were revised and the nuclear phase-out was brought forward again to 2022. The aim is to use renewables to close the resulting power supply gap.

Described below are the ten best mitigation measures in Germany, which should help to achieve the goals connected with the Energiewende.

1. EEG

The renewable energy sources act, known as EEG (Energie-Einspeise-Gesetz) was introduced in 2000 in order to promote renewable energy supply in Germany (BWE, 2013). Every two years, reports are published by the Federal Ministry of Economics and Technology (BMWi), the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), which describe the experiences and results of the EEG up to that point and further describe potential improvements and adjustments. The EEG is continuously improved and adapted to allow for newly occurring problems and changes (Burck et. al., 2009).

The EEG ensures that operators of renewable energies receive a certain compensation per kWh (kilowatt-hour) for a total of 20 years. The amount of the compensation for the electricity that is fed into the grid is dependent on the type, the location as well as the size of the power generation site. The supplier receives more money per kWh from the grid provider than the end-user pays per kWh (Burck et. al., 2009). The end consumer has to pay the price deviation to the grid operator. The cost allocation for the EEG is calculated on the basis of the predicted revenues and predicted expenses for the following year, as well as the current revenues and expenses at the point of time of the calculation (ÜNB, 2013) This had the effect that the end-users paid an average of 5.27 cents/kWh i.e. €15.5 more per month for an average household that consumes 3500 kWh per month (conventional and renewable energy) in

2013 (BDEW, 2013). In the following graph, the price development of the EEG surcharge from the past ten years is presented.

Year	EEG surcharge (cents/kWh)
2002	0.35
2003	0.42
2004	0.51
2005	0.69
2006	0.88
2007	1.02
2008	1.16
2009	1.31
2010	2.05
2011	3.53
2012	3.59
2013	5.27

Source: Bundesverband der Energie und Wasserwirtschaft (BDEW), 2013

However, the annual compensation is subject to degression in order to foster cost reduction and innovation. Another important aspect of the EEG is the precedence of the feed-in of renewable energies into the grid (BWE, 2013). Furthermore, companies operating in energy-intensive industry receive special treatment and have to pay a lower share contribution for the EEG. These so-called privileged corporations can apply at the Federal Office of Economics and Export Control (BAFA) for a reduction in the EEG cost allocation of between 1 and 10%, when they have an electricity consumption of over one GWh per year. A reduction to 0.05 cents/kWh is possible when the business has an energy consumption of over 100 GWh per year (Bundesnetzagentur, 2013).

The EEG has led to a significant rise in renewable energies in the German electrical power supply. In the year 1991 only 3.2% of the German electricity consumption was covered by renewable energy sources. In the same year the first feed-in law (Stromeinspeisungsgesetz) was introduced and by 2000, 6.6% of the total electricity consumption was covered by renewables. After the introduction of the EEG in the year 2000 the percentage of renewables increased significantly. By the year 2012 a full 22.9% of the total German electrical power supply was supplied by renewable energy sources (AGEB, 2013). The goal is to cover 35% of the German electrical power supply with renewables by 2020 and 80% by 2050 (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2012a). In the year 2010, renewable energies promoted through the EEG were able to cut 74 million tons of GHG (BWE, 2013). The success of the EEG is based on the active investment of the middle class, house owners and farmers as well as from cooperatives and municipal energy suppliers (Alt, 2013). Approximately 300

million euro have been invested by German citizens in 150 to 200 participation models since the beginning of the Energiewende (dpa, 2013).

The EEG has made considerable progress towards incorporating renewable energies into the power supply, but in order to make further progress towards the German Energiewende a reform of the current EEG is required (BMU, 2013c). The EEG was criticised for being expensive for end consumers as well as for small businesses, as the compensation costs are carried by consumers, and many energy-intensive industries were excluded from the EEG surcharge (Heinrich Böll Stiftung, 2013c). In addition, there must be a form of incentive for flexible biomass power plants to shut down production when the weather conditions are ideal for sufficient power supply through wind and solar power. It is also crucial to coordinate energy production by wind and solar power stations, when expensive coal and gas plants are also delivering energy. Another aspect for the improvement of the reform of the EEG is to pass on more of the costs of the energy transition to large energy users. Solar and wind energy providers must also be willing to take higher risks and should not receive full compensation in case of overloading of the grid (Matthes, 2013). However, the reformation of the EEG is dependent on the German elections in September 2013, as the decision was postponed by the current minister of environment Peter Altmaier (Weber, 2013).

Criteria	Points
Green effects	**43 of 50**
The largest GHG cuts in tons or as a percentage	25 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	15 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	3 of 10
Social/Economic effects	**20 of 30**
Compatibility with other environmental targets and social welfare	5 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	8 of 10
Cost-effectiveness	7 of 10
Outreach	20
The measure that is most replicable in other countries, within or outside the region	20 of 20
Total for the EEG	**83 of 100**

Energy-efficient building package

Under the following section you can find the measures taken under the German building regulation (EnEV), the renewable energy heat law (EEWärmeG) and the market stimulation programme MAP, which make up mitigation measures two to four. These measures all contribute to making buildings more energy efficient (Burck et. al., 2009).

2. EnEV

The German building regulation prescribes energy performance in terms of maximum primary energy consumption, depending on type and shape of both new and existing buildings (Burck et. al., 2009). The German energy-saving ordinance, known as EnEV (Energieeinsparverordnung), sets a standard for the annual primary energy consumption based on a reference building, which cannot be exceeded (Tuschinski, 2013a). Standards are set for example for air exchange, leak tightness as well as for heating systems and insulation (Tuschinski, 2013b). One major aspect of EnEV is the introduction of the so-called energy pass (BMU, 2013e). The energy pass states the energy value for a building and permits comparison of the energy consumption of buildings. The energy pass further includes information on the energy demand and energy consumption (BMVBS, 2013a). In the year 2009, the EnEV reduced 183 thousand tons of CO_2 emissions (Böhmer et al., 2011).

Criteria	Points
Green effects	**15 of 50**
The largest GHG cuts in tons or as a percentage	5 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	5 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	5of 10
Social/Economic effects	**30 of 30**
Compatibility with other environmental targets and social welfare	10 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	10 of 10
Cost-effectiveness	10 of 10
Outreach	**10 of 20**
The measure that is most replicable in other countries, within or outside the region	10 of 20
Total	**55 of 100**

3. EEWärmeG

EEWärmeG regulates the use of renewable energy for a certain amount of heat used in newly constructed buildings. To encourage widespread adoption of the standards, there are support programmes through low-interest loans and investment subsidies (Burck et. al., 2009). This measure is a crucial element in the reduction of GHG, as 90% of the energy consumption of private households in Germany is used for heating and warm water supply (BMU, 2013d). The EEWärmeG was introduced in 2009 and the owner of a building can decide which renewable energy he wants to use to heat or cool his building. The percentage of renewable energy used for heating is dependent on the type of renewable energy. There is also the possibility to apply compensating measures instead of using renewable energies for the building. The EEWärmeG was amended in 2011 and is now also applicable to already existing public buildings (BMU, 2013b). The compulsory application

of the EEWärmeG for newly constructed buildings will lead to an increase in renewable energy in the heating market by approximately 2.8 – 4.7%. The overall goal is to reach 14% of renewable energies in the heating market by 2020 through the introduction of EEWärmeG. By the year 2020 the EE-WärmeG is supposed to cut 14 million tons of CO_2 (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, n.d.).

Criteria	Points
Green effects	**25 of 50**
The largest GHG cuts in tons or as a percentage	15 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	10 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	0 of 10
Social/Economic effects	**20 of 30**
Compatibility with other environmental targets and social welfare	10 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	5 of 10
Cost-effectiveness	5 of 10
Outreach	**15 of 20**
The measure that is most replicable in other countries, within or outside the region	15 of 20
Total	**70 of 100**

4. MAP

The market incentive programme (MAP) is an instrument of the German government to ensure that 14% of renewable energies are used for the heating of buildings until 2020. Renewable energy technology is funded by this programme and the funds are calculated annually according to the development of technology and the current market. Private persons, business or municipalities as well as public institutions can receive funds according to the MAP guidelines, when they decide to invest in renewable energies. Large-scale enterprises underlie different regulations. The MAP provides two means of funding. The first is the KfW programme, and second is BAFA funding, which will be described in detail below (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2013b).

Criteria	Points
Green effects	**15 of 50**
The largest GHG cuts in tons or as a percentage	10 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	5 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	0 of 10
Social/Economic effects	**18 of 30**
Compatibility with other environmental targets and social welfare	5 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	5 of 10
Cost-effectiveness	8 of 10
Outreach	**10 of 20**
The measure that is most replicable in other countries, within or outside the region	10 of 20
Total	**43 of 100**

5. Efficiency in building programme (KfW programme)

KfW – German Bank of Reconstruction
The KfW bank (bank for the reconstruction) was founded in 1948 and has always worked towards the economic development of Germany with a close link to forward-thinking ideas (KfW, 2013c). The KfW bank provides funds for private house owners as well as for businesses and municipalities and helps house owners to finance and renovate their houses in an energy-efficient way (KfW, 2013c).

The energy efficiency building programme is a programme initiated by the KfW development bank in a joint venture with the German government. The programme supports house owners and constructors that want to modernise the insulation of buildings in order to cut CO_2 emissions and save energy. Under the programme, house owners receive loans at low interest rates or subsidies for the energy-efficient modernisation of buildings. The overall effect of the KfW programme is that the more energy that is saved through modernisation, the more benefits/funds the house owner will receive. 1.5 bn euro are provided annually for the modernisation of buildings by the energy and climate funds between 2012 and 2014 (BMVBS, 2013c). KfW has several support programmes for the construction of new buildings as well as for the modernisation of buildings by private owners, organisations and public institutions (KfW, 2013d).

The KfW programme offers different forms of financial support. First, the KfW bank offers credits to house owners. One example is credit no. 151 for energy-efficient renovation, which has an annual percentage rate of only 1.00%. The credit covers up to 75,000 euro for every accommodation unit or 50,000 euro for single energy-efficiency measures. The credit can also be combined with other subsidies (KfW, 2013b).

In addition, KfW also offers subsidies for house owners living in one or two family houses, who want to renovate their houses in a more energy-efficient way. The amount of the subsidy is dependent on the resulting energy savings, which is calculated on the basis of the annual primary energy consumption (KfW, 2013a).

For example the "KfW Energy Efficiency House 55" only requires 55% of the annual primary energy consumption of the EnEV requirements. The "Energy Efficiency House 55" receives a maximum of 25% subsidy from KfW and a maximum of 18,750 euro per accommodation unit (BMVBS, 2013c). In order to meet the standard of the KfW "Energy Efficiency House 55" the house has to have an overall energy package that includes measures such as a heating pump, a solar collector for the heating of drinking water or the insulation of the exterior wall.

Moreover, KfW also offers energy consulting and construction supervision. The energy consultation is provided by a qualified consultant. For a so-called on-the-post consultation, funds can be received through the Federal Office of Economics and Export Control (BAFA). To ensure the high quality of construction supervision, KfW offers a subsidy of 50% of the cost up to a maximum of 4000 euro (BMVBS, 2013c).

However, KfW also offers credits to businesses, such as the "renewable energy credit premium". This credit includes a 1.46% annual percentage rate for investments in renewable energies used in the heating market as well as repayment bonuses. This credit is specially designed for municipalities and businesses. Small business enterprises receive an interest advantage (KfW, 2013a).

The KFW programme of the is a crucial mitigation measure as buildings are responsible for around 40% of the consumption of end-use energy. This is because 75% of residential buildings were constructed prior to the heat insulation ordinance in 1979 (BMU, 2013f).

In the year 2008 the CO_2 building renovation programme and the KfW modernisation programmes led to a reduction of 546,000 tons of CO_2e. Approximately 62,000 tons of the total reductions per year are based on the subsidies provided and the other 484,000 tons are reduced through loans provided by KfW (Clausnitzer et al., 2008).

Criteria	Points
Green effects	**42 of 50**
The largest GHG cuts in tons or as a percentage	20 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	12 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	10 of 10
Social/Economic effects	**30 of 30**
Compatibility with other environmental targets and social welfare	10 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	10 of 10
Cost-effectiveness	10 of 10
Outreach	**20**
The measure that is most replicable in other countries, within or outside the region	20 of 20
Total	**92 of 100**

6. BAFA programme (Bundesamt für Wirtschaft und Ausfuhrkontrolle)

The Federal Office of Economics and Export Control (BAFA) also provides financial support for several forms of heating with renewable energies, as part of the MAP. The BAFA programme predominantly supports private investments for one or two family houses. The funds are tailored for already existing buildings and new builds can only receive funds for installations for process heat and innovation enhancement (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2012b).

Grants can be obtained, for example, for solar heating installations that are used for space heating or hot water generation. The grants for solar heating installations are calculated per square metre and depend on the size of solar heating installations. Additional bonuses are paid for particularly innovative and efficient solar heating installations (BAFA, 2013b).

BAFA also funds biomass installations such as boilers that burn wood pellets. The grants are linked to a fixed amount per generated kilowatt of nominal heat output. Again additional bonuses are provided for biomass installations that are especially efficient or innovative (BAFA, 2013a).

Criteria	Points
Green effects	**13 of 50**
The largest GHG cuts in tons or as a percentage	8 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	5 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	0 of 10
Social/Economic effects	**18 of 30**
Compatibility with other environmental targets and social welfare	5 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	5 of 10
Cost-effectiveness	8 of 10
Outreach	**10 of 20**
The measure that is most replicable in other countries, within or outside the region	10 of 20
Total	**41 of 100**

7. Cogeneration Act (KWKG)

Combined heat and power (CHP) plants produce electricity as well as useful heat (Nutzwärme) simultaneously. These plants use fuel much more efficiently and therefore also produce less CO_2 (BAFA, 2013c). The cogeneration act is a law that is intended to help save energy by increasing the production of electricity through CHPs by up to 20% by the year 2020. This should be achieved through the modernisation and new construction of CHPs (Juris, n.d.c). The cogeneration act further regulates the purchase and payment of CHP-generated electricity (Juris, n.d.b). Grid operators are obliged to prioritise power plants with CHP. They can either sell the electricity or use it to cover their own electricity demand (Juris, n.d.a).

BAFA also funds CHPs and has two forms of funding them. For CHPs with an output of up to 20 kW, BAFA pays a fixed amount as an investment grant. According to the cogeneration act (KWKG) the grid operator pays, based on approval by BAFA, an extra amount over a fixed time period. For small CHPs, however, with an output of 2 kW, the CHP operator can also choose to receive the KWK funds at once (BAFA, 2013c).

Criteria	Points
Green effects	**25 of 50**
The largest GHG cuts in tons or as a percentage	12 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	8 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	5 of 10
Social/Economic effects	**15 of 30**
Compatibility with other environmental targets and social welfare	5 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	5 of 10
Cost-effectiveness	5 of 10
Outreach	**10 of 20**
The measure that is most replicable in other countries, within or outside the region	15 of 20
Total	**50 of 100**

8. Eco-tax

The eco-tax is a consumption tax based on the assessment of certain products and is meant to reduce energy consumption by increasing the costs for polluting behaviour. The eco-tax was introduced in Germany in 1999 as part of the introduction of the ecological tax reform. The eco-tax is composed of a tax on power and on mineral oil. Another part of the eco-tax is the reduction of pension contributions. The increased costs of energy through the eco-tax are intended to motivate businesses to invest in innovative technology and to reduce energy consumption. The revenue made through the eco-tax is then used to reduce pension contributions (BMU, 2007b). The eco-tax is levied on petrol, diesel oil, light fuel oil, natural gas and electricity. Special regulations apply to energy-intensive industries, CHPs, private power-generating systems as well as gas and steam turbines. These energy consumers are partially exempted from the eco-tax (Grawe, 2001). Based on a study by the Rosa Luxemburg Stiftung, 10 million tons of CO_2 are cut per year by the eco-tax (Schachtschneider, 2013).

Criteria	Points
Green effects	**34 of 50**
The largest GHG cuts in tons or as a percentage	20 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	8 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	6 of 10
Social/Economic effects	**26 of 30**
Compatibility with other environmental targets and social welfare	10 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	8 of 10
Cost-effectiveness	8 of 10
Outreach	**20 of 20**
The measure that is most replicable in other countries, within or outside the region	20 of 20
Total	**80 of 100**

9. Levy on air traffic

The levy on air traffic was introduced at the beginning of 2011 at all German airports in order to foster more ecological behaviour. The tax is levied on every ticket and is dependent on the distance of the flight. The distance is calculated from Frankfurt/Main in Germany to the largest commercial airport at the destination. For short flights up to 2,500 km there is a tax of 8 euro on each passenger ticket. In addition, for flights between 2,500 and 6000 km every passenger has to pay 25 euro. Finally, flights with a distance of over 6,000 km have to pay 45 euro per ticket. The tax is also imposed on the return tickets. However, this tax levy is not imposed on the air cargo industry. Flights for medical reasons, sightseeing flights and flights to domestic islands are also excluded from the tax. Through the air traffic levy, approximately one million euro are collected annually (Bundesregierung, 2010b). Due to the levy on air traffic approximately two million fewer passengers travelled by plane, which led to a reduction of about 0.38 million tons of CO_2 in German airspace in the year 2011. This accounts for 1.2% of the total German air traffic emissions in 2011 (Bundesregierung, 2012a).

Criteria	Points
Green effects	**10 of 50**
The largest GHG cuts in tons or as a percentage	5 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	5 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	0 of 10
Social/Economic effects	**20 of 30**
Compatibility with other environmental targets and social welfare	10 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	5 of 10
Cost-effectiveness	5 of 10
Outreach	**20 of 20**
The measure that is most replicable in other countries, within or outside the region	10 of 20
Total	**50 of 100**

10. Road tax for trucks

A road tax for trucks has been levied since 2005 on trucks using German highways and is dependent on the kilometres driven. The toll only applies to trucks that have a gross vehicle weight of at least 12 tons and are used for road haulage. The company that administers the road tax is called Toll Collect, and it collects the toll via a device in the vehicle, over the nternet or at a toll terminal. The amount of the tax depends on the number of axles the vehicle has. In addition, there are also four different toll categories based on the emission class of the vehicle, in order to motivate vehicle owners to invest in systems that reduce particle emissions. The overall range of the toll lies between 0.141 and 0.288 euro per kilometre (BMVBS, 2013b). Positive effects of the road tax for trucks according to the BMVBS and Toll Collect are that vehicle owners invest in better particle filters and the reduction of unloaded journeys. Since 2011 the road tax has been invested in highways, after deducting the costs for control and administration. Prior to 2011 the tax was also invested in railways, waterways and roads (BMVBS, 2013d). According to calculations by the Frauenhofer Institut the introduction of the road tax for trucks cut emissions by 2.4 million tons of CO_2e in the year 2010 (Markewitz, 2008).

Criteria	Points
Green effects	**27 of 50**
The largest GHG cuts in tons or as a percentage	12 of 25
The greatest future potential to produce the largest GHG cuts in tons or as a percentage	10 of 15
Saves most energy (even if the immediate effect is not very large in terms of reducing GHGs)	5 of 10
Social/Economic effects	**27 of 30**
Compatibility with other environmental targets and social welfare	10 of 10
Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets	7 of 10
Cost-effectiveness	10 of 10
Outreach	**20 of 20**
The measure that is most replicable in other countries, within or outside the region	20 of 20
Total	**74 of 100**

Conclusion

In conclusion it can be said, that based on the criteria for the best mitigation policies and the data included in this research, the EEG and the KfW programme can be seen as the two best mitigation policies in Germany. They both have the greatest potential for cutting GHG emissions and are also applicable in other countries. However, as comparable data and figures are not equally available for all policies it is difficult to compare all policies and rank them accordingly. It is therefore suggested that the policies are ranked by experts with the help of questionnaires.

Provisional ranking

1.	Efficiency in building programme (KfW programme)	92 of 100 Points
2.	EEG (Feed-in tariffs)	83 of 100 Points
3.	Eco-tax	80 of 100 Points
4.	Road tax for trucks	74 of 100 Points
5.	EEWärmeG	70 of 100 Points
6.	EnEV	55 of 100 Points
7.	Levy on air traffic	50 of 100 Points
8.	Cogeneration Act (KWKG)	50 of 100 Points
9.	MAP	43 of 100 Points
10.	BAFA programme	41 of 100 Points

Reference List

AGEB (2013). Bruttostromerzeugung in Deutschland von 1990 bis 2012 nach Energieträgern. Retrieved from http://ag-energiebilanzen.de/viewpage.php?idpage=1

Alt, F. (2013). Gegner des EEG sind Gegner der Energiewende. Retrieved from http://www.klimaretter.info/standpunkte/13785-gegner-des-eeg-sind-gegner-der-energiewende

BAFA (2013a). Förderung von Biomasseanlagen. Retrieved from http://www.bafa.de/bafa/de/energie/erneuerbare_energien/biomasse/index.html

BAFA (2013b). Förderung von Solarthermieanlagen. Retrieved from http://www.bafa.de/bafa/de/energie/erneuerbare_energien/solarthermie/index.html

BAFA (2013c). Kraft-Wärme-Kopplung. Retrieved from http://www.bafa.de/bafa/de/energie/kraft_waerme_kopplung/index.html

BMU (2011a). Das Energiekonzept und seine beschleunigte Umsetzung. Retrieved from http://www.bmu.de/themen/klima-energie/energiewende/beschluesse-und-massnahmen/

BMU (2013b). Das Erneuerbare-Energien-Wärmegesetz. Retrieved from http://www.bmu.de/service/publikationen/downloads/details/artikel/das-erneuerbare-energien-waermegesetz/

BMU (2007a). Das Integrierte Energie- und Klimaprogramm der Bundesregierung. Retrieved from http://www.bmu.de/uebrige-seiten/hintergrund-das-integrierte-energie-und-klimaprogramm-der-bundesregierung-html/

BMU (2007b). EU genehmigt Ökosteuerabsenkung für Industrie. Retrieved from http://www.bmu.de/bmu/presse-reden/pressemitteilungen/pm/artikel/eu-genehmigt-oekosteuerabsenkung-fuer-industrie/?tx_ttnews[backPid]=1892&cHash=239918b926e848b3b92e74e441202be2

BMU (2013c). EEG-Dialog, Gesprächsreihe zur EEG-Reform. Retrieved from http://www.bmu.de/themen/klima-energie/energiewende/eeg-reform/

BMU (2013d). Gebäude. Retrieved from http://www.bmu.de/themen/klima-energie/energieeffizienz/gebaeude/

BMU (2013e). Gebäude/Rechtsvorschriften. Retrieved from http://www.bmu.de/themen/klima-energie/energieeffizienz/gebaeude/rechtsvorschriften/

BMU (2013f). Kurzinfo Energieeffizienz. Retrieved from http://www.bmu.de/themen/klima-energie/energieeffizienz/kurzinfo/

BMU (2012g). Mit neuer Energie. Retrieved from http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/10_punkte_programm_bf.pdf

BMVBS (2013a). Fragen und Antworten zum Energieausweis. Retrieved

from http://www.bmvbs.de/SharedDocs/DE/FAQs/Energieausweis/energieausweis-faq.html

BMVBS (2013b). Fragen und Antworten zur LKW-Maut. Retrieved from http://www.bmvbs.de/SharedDocs/DE/FAQs/Lkw-Maut/lkw-maut-faq.html

BMVBS (2013c). KfW-Programm "Energieeffizient Sanieren" im Rahmen des CO_2-Gebäudesanierungsprogramms des Bundes. Retrieved from http://www.bmvbs.de/SharedDocs/DE/Artikel/SW/kfw-programm-energieeffizient-sanieren-im-rahmen-des-co2-gebaeudesanierungsprogramm-des-bundes.html

BMVBS (2013d). Weitere Informationen zur Maut. Retrieved from http://www.bmvbs.de/SharedDocs/DE/Artikel/UI/lkw-maut-weitere-informationen.html?nn=35926#doc24830bodyText3

Böhmer, M. et.al. (2011). Volkswirtschaftliche Bewertung der EnEV 2009. Retrieved from http://www.prognos.com/fileadmin/pdf/aktuelles/11_08_30_Volkswirtschaftliche_Bewertung_der_EnEV_2009.pdf

Bundesnetzagentur (2013). Erneuerbare Energien Gesetz. Retrieved from http://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Verbraucher/Energielexikon/energielexikon-node.html

Bundesregierung (2012a). Bericht an den Deutschen Bundestag über die Auswirkungen der Einführung des Luftverkehrsteuergesetzes auf den Luftverkehrssektor und die Entwicklung der Steuereinnahmen aus der Luftverkehrsteuer. Retrieved from http://dipbt.bundestag.de/dip21/btd/17/102/1710225.pdf

Bundesregierung (2010b). Luftverkehrssteuer. http://www.bundesregierung.de/Content/DE/Artikel/2010/09/2010-09-01-luftverkehrssteuer.html

Bundesverband der Energie und Wasserwirtschaft (BDEW) (2013). Retrieved from https://www.bdew.de/internet.nsf/id/17DF3FA36BF264EBC1257B0A003EE8B8/$file/Foliensatz_Energie-Info-EE-und-das-EEG2013_31.01.2013.pdf

Burck et al. (2009). Scorecards on best and worst policies for a green new deal.

BWE (2013). Das erneuerbare Energien-Gesetz. Retrieved from http://www.eeg-aktuell.de/das-eeg/

Clausnitzer, K.-D. et al.(2008). Effekte des CO_2-Gebäudesanierungsprogramms 2008. Retrieved from https://www.kfw.de/Download-Center/Konzernthemen/Research/PDF-Dokumente-alle-Evaluationen/Effekte-CO_2-Geb%C3%A4udesanierung-2008.pdf

Dpa (2013). Bürger investieren in die Energiewende. Hannoversche Allgemeine Zeitung. Retrieved from http://www.haz.de/Nachrichten/Wirtschaft/Deutschland-Welt/Buerger-investieren-in-die-Energiewende

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2012a). Renewable Energy Sources Act (EEG). Retrieved from www.erneuerbare-energien.de/en/topics/acts-and-ordinances/renewable-energy-sources-act/eeg-2012/

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (n.d). Informationen zum erneuerbaren Energien Wärmegesetz (EEWärmeG). Retrieved from http://www.erneuerbare-energien.de/fileadmin/ee-import/files/pdfs/allgemein/application/pdf/daten_fakten_eewaermeg_2008.pdf

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2012b). Marktanreizprogramm für erneuerbare Energien im Wärmemarkt. Retrieved from http://www.erneuerbare-energien.de/die-themen/foerderung/marktanreizprogramm/marktanreizprogramm-fuer-erneuerbare-energien-im-waermemarkt/

Germanwatch (2013). Climate Change Performance Index. Retrieved from www.germanwatch.org/en/ccpi

Grawe, J. (2001). Was ist und was bringt die Ökosteuer? Retrieved from http://www.energie-fakten.de/pdf/allgemein_oekosteuer.pdf

Heinrich Böll Stiftung (2013a). History of the Energiewende. Retrieved from http://energytransition.de/

Heinrich Böll Stiftung (2013b). Policies for clean energies. Retrieved from http://energytransition.de/

Heinrich Böll Stiftung (2013c). Renewable energy act with feed-in tariffs. Retrieved from http://energytransition.de/

Juris, (n.d.a). Anschluss-, Abnahme- und Vergütungspflicht. Retrieved from http://www.gesetze-im-internet.de/kwkg_2002/__4.html

Juris, (n.d.b). Anwendungsbereich. Retrieved from http://www.gesetze-im-internet.de/kwkg_2002/__2.html

Juris, (n.d.c). Zweck des Gesetzes. Retrieved from http://www.gesetze-im-internet.de/kwkg_2002/__1.html

KfW, (2013a). Erneuerbare Energien-Premium. Retrieved from https://www.kfw.de/inlandsfoerderung/Unternehmen/Energie-Umwelt/Finanzierungsangebote/Erneuerbare-Energien-Premium-%28271-281%29/

KfW, (2013b). Energieeffizient Sanieren - Kredit. Retrieved from https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilien/Finanzierungsangebote/Energieeffizient-Sanieren-Kredit-%28151-152%29/index.html

KfW, (2013c). Geschichte der KfW. Retrieved from www.kfw.de/KfW-Konzern/%C3%9Cber-die-KfW/Identit%C3%A4t/Geschichte-der-KfW/

KfW, (2013d). Inländische Förderung. Retrieved from https://www.kfw.de/KfW-Konzern/%C3%9Cber-die-KfW/Auftrag/Inl%C3%A4ndische-F%C3%B6rderung/

Lenk, T. et al. (2000). Die ostdeutsche Elektrizitätswirtschaft zwischen Volkseigentum und Wettbewerb. Retrieved from http://www.uni-leipzig.de/fiwi/Forschung/arbeitspapiere/22%20Strommarkt.pdf

Markewitz, P. (2008). Politikszenarien für den Umweltschutz IV - Szenarien bis 2030. Jülich: Forschungszentrum Jülich

Matthes, F. (2013). Energiewende: So könnte eine gute EEG-Reform aussehen. Wirtschaftswoche Green. Retrieved from http://green.wiwo.de/energiewende-so-konnte-eine-erfolgreiche-eeg-reform-aussehen/

ÜNB (2013). EEG - Umlage 2013. Retrieved from http://www.eeg-kwk.net/de/EEG-Umlage.htm

Schlegelmilch, K. (2012). Energie verteuern, aber richtig. Die Zeit. Retrieved from http://www.zeit.de/wirtschaft/2012-08/oekosteuer

Schachtschneider,U. (2013). Wer gewinnt und wer verliert...bei Verteilungswirkungen ökonomischer Instrumente zur Steuerung der Energiewende. Retrieved from http://rosalux.de/fileadmin/rls_uploads/pdfs/Studien/Studien_Verteilungswirkungen.pdf

Tuschinski (2013a). Anforderungen an Wohngebäude. Retrieved from http://www.enev-online.org/enev_2009_volltext/enev_2009_03_anforderungen_an_wohngebaeude.htm

Tuschinski (2013b). EnEV 2009 - Energiesparverordnung für Gebäude. Retrieved from http://www.enev-online.org/enev_2009_volltext/index.htm

Weber, T. (2013). Altmaier: “Grundlegende EEG-Reform”. Retrieved from http://www.erneuerbareenergien.de/altmaier-grundlegende-eeg-reform/150/438/61827/

ISLAND

The 10 best Mitigation Measures in Iceland

Compiled by Arni Finnsson

Iceland Nature Conservation Associaiton (INCA)

In an Action Plan presented by the Minister for the Environment in November 2010, Iceland lists 10 key actions in order to reduce net emissions of greenhouse gases in Iceland. The Action Plan is only available in Icelandic.[64] The Action Plan, however, is based on Iceland's 5th National Communication from early 2010[65], published in late 2011.

Iceland's climate ambition can be read in a submission sent to the UNFCCC Secretariat, dated 8 February 2010, which says

> … the Icelandic government adopted in 2009 the goal of reducing net greenhouse gas emissions by 15% in 2020, compared to 1990, with the understanding that the rules governing the Kyoto Protocol would continue to apply after 2012. In Copenhagen Iceland announced that it was ready, in a joint effort with the European Union, to cut emissions up to 30% by from 1990 levels in 2020, as part of a global ambitious agreement. The 30% reduction target would be achieved jointly by Iceland and the Member States of the European Union, with Iceland adhering fully to the Energy and Climate Package. …"[66]

For 2020 this meant a 30% reduction in a joint effort with the European Union. Even though the European ambition level would remain at 20%, Iceland would only have to reduce its emissions by 15% net, that is including sequestration.

Special status?

Iceland being a small economy – tiny really – has made for some difficulties or challenges, which may be radically different from other Annex I countries. Iceland has presented this as blessing in the sense that almost all stationary energy is produced by renewable energy, although Icelandic NGOs would argue that large hydro and geothermal energy may not be so renewable.[67]

Between 1990 and 2008 greenhouse gas emissions increased by 43% in Iceland, from 3443 tonnes to 4881 tons. This includes energy-intensive industries like aluminium smelters and ferrosilicon plants.[68] If sequestration due to afforestation and revegetation is accounted for, the 2008 figure would be 4510, an increase of 32%.

In 2008 emissions per capita were 15.6 tonnes as compared to 13.4 tonnes in 1990.

64 http://www.umhverfisraduneyti.is/frettir/nr/1711

65 http://unfccc.int/resource/docs/natc/isl_nc5_resubmit.pdf

66 http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/icelandcphaccord_app1.pdf

67 Eventually reservoirs will be filled with glacier mud and some geologists argue that geothermal power plants will only last for decades.

68 http://www.umhverfisraduneyti.is/frettir/nr/1711

In 2008, the Icelandic government still expected a significant increase in emissions from energy intensive industries, from about 1800 Gg of CO_2 equivalents to 2900 equivalents, an increase by 62%. Whereas the increase in emissions during the first commitment period would be covered by Decision 14/CP.7 (see below), an increase by 46% compared to 1990 (8000 Gg during the first commitment period).

Total greenhouse gas emissions in Iceland increased by 32% in the period 1990 to 2007. Emissions per capita increased by 6% in the same period, but emissions per GDP (1990–2006) decreased by 23%.[69]

Iceland has been reluctant to provide more recent figures on emissions per capita.

These 10 key actions are:

1. Implementing a trade system with emission allowances.
2. Carbon tax
3. Changes in tax system and levies on cars and fuel
4. Cars in public ownership (state and municipalities) shall be fuel efficient and eco friendly
5. Strengthen public transportation and increase the number of trails for bikers and pedestrians to provide more options for sustainable transportation
6. Utilizing biofuels for fishing vessels
7. Fuel fish meal factories with electricity
8. Increase in afforestation and revegetation projects
9. Wetland reclamation
10. Provide more support for research and innovation with regard to climate issues.

Implementing a trade system with emission allowances (ETS)

Under the European Economic Area Agreement (EEA) Iceland is part of the ETS system and this looks like one of the most promising mitigation actions. Domestic flight is already a part of the ETS and so will the aluminium and ferrosilicon industry from 1 January 2013.

14/CP.7

During the first period under the Kyoto Protocol, Iceland has enjoyed an exemption for its aluminium industry, in accordance with decision 14/CP.7

> Under decision 14/CP.7 Iceland can exclude emissions from large projects. In 2003, this accounted for 0.45 Mt of CO_2 equivalents, coming exclusively from industrial process emissions. The emissions qualify for exclusion under 14/CP.7 when "the proportional impact of single projects are over 5% of total carbon dioxide emissions of a country in 1990". Projects exceeding this threshold shall be reported separately and carbon dioxide emissions from them not included in national totals to the extent that they would cause the party to exceed its assigned amount.[70]

69 http://unfccc.int/resource/docs/natc/isl_nc5_resubmit.pdf

70 Greenhouse gas emission trends and projections in Europe 2007 – Country profile

The projects presently covered by Decision 14/CP.7 – aluminium plants and one ferrosilicon plant – will be part of the EU-ETS in 2013.

In an answer to the EU Commission, during a screening process for the negotiations on Iceland's accession to the EU:

> 98. Is Iceland planning on continuing with decision 14/CP.7 (single project exemption)?
>
> Iceland's answer is:
> The present government would prefer to discontinue Decision 14/CP.7 on the effect of single projects in small economies, as it creates a dual system of accounting for emissions and is complex in its implementation.

In order to avoid this risk, Iceland asked to join the EU Climate Policy, which was granted in December 2009. Hence, Iceland will take on the same obligations as the EU under any new treaty agreed by the Kyoto Protocol and the UNFCCC.

However, Iceland continues:

> It must be considered, however, that a simple discontinuation of the Decision in 2012 would leave those projects presently covered under its provisions without adequate backing with regard to their emissions – both in relation to the UNFCCC and domestic law – if no account is taken to those emissions in other aspects of a post-2012 climate regime. Iceland is therefore keeping open the possibility of extending Decision 14/CP.7 and its provisions for the next commitment period, and has submitted a proposal in that regard in the climate negotiations. That proposal will be withdrawn if other solutions are found with regard to the emissions presently covered under Dec. 14/CP.7.

What this will mean, it is difficult to say, but Iceland Nature Conservation Association strongly criticized the government for pursuing a special status for Iceland, granting the aluminium industry the status of a free ride, which compared to 1990 amounted to a 46% increase in emissions. However, we have welcomed Iceland's accession to the EU Climate Policy, which on its own, could be considered as a climate action by Iceland, providing the government with both a more rigorous and more systematic approach. Approximately 40% of Iceland's emissions will be included in the EU ETS system.

Carbon tax

Last year, 2012, as a part of government policy to improve state finances, which have been poor since the economic collapse in October 2008, the government set a carbon tax on motor vehicles. It is too early to say how this will affect emissions, but the economic collapse of 2008, causing a depreciation of the Icelandic krona, made gas and oil a lot more expensive and to the degree the market for new cars has recovered since than, there is a clear trend towards buying smaller and a more fuel-efficient cars.

Although carbon tax may be seen as a budgetary measure, the government points out that the tax charged is additional to those levies already put on diesel and gas (petrol). The tax is based on the amount of carbon per litre of fuel. Hence the levy is higher on diesel than gas.

> … the carbon tax covers liquid fossil fuels for vehicles and ships. The tax is based on the carbon content of the fuel. The taxation of the fuel carbon corresponds to half the price for CO_2 allowances in the EU emission trading system. The non-ferrous metal industry will fall under the EU emission trading system from 2013. Benchmarking, gradual lowering of the cap and trading of allowances under the EU-ETS are designed to encourage a shift toward cleaner technologies and lower emissions of greenhouse gases.[71]

Therefore the carbon tax is an environmental tax. The value of the tax was initially 50% of the price of CO_2 allowances, but on 1 January 2011 it was raised to 75%. As of 1 January the taxation for all types of fuels except gasoline has been 100% of the EU price for CO_2 allowances. Due to enormous price increases the government has decided to keep the tax for gasoline at 75% of the EU price for emission allowances.[72]

The price of fuel is however cheaper in Iceland than most other Nordic Countries[73] and given the long distances in rural areas plus the urban sprawl in the capital area, the government has chosen a very lenient approach on carbon tax.

The Action Plan admits that Icelanders own the largest car fleet per capita and four-wheel drive vehicles are often one of two cars per household.

The old system favoured gas guzzlers. In fact, in 2000 the government reduced taxes on cars with engines with a bigger displacement than 2 litres. The new system taxes cars in accordance with emissions in grams of CO_2/km. This hashelped to increase sales of smaller cars, while bigger cars like Mercedes and Volvo are now sold with more fuel-efficient engines.

Part of the Action Plan to reduce emissions from private cars is education. However, no major education campaigns have been launched by the government or local authorities. The opposition depicts these measures as new taxes, putting greater burdens on the taxpayer and, in a sense, the climate threat is not seen as great enough to enable the government to call on the public to drive less and turn to more fuel-efficient cars.

It will take time for the public to change values. Whatever people may feel, snow in Reykjavik will not hamper traffic more than a few days a year. Even less so as the climate gets warmer. The best educator, perhaps, is to raise taxes and levies on carbon, but even that will take time as it will take some 10 years to renew the car fleet.

The new system promises a fleet of smaller cars in 10 years, but by comparison, diesel and gas cost more in Denmark, Norway and Sweden, measured in ISK. However, the purchasing power may be greater in these countries than it is in Iceland.

Mostly thanks to the 50% devaluation of the krona in October 2008, with subsequent price hikes for gasoline and diesel, fuel consumption dropped significantly due to less driving, from 3.048 billion km in 2008 to 2.097.5 billion km in 2012.[74]

71 http://unfccc.int/resource/docs/natc/isl_nc5_resubmit.pdf

72 http://www.umhverfisraduneyti.is/media/PDF_skrar/Adgerdir-i-loftslagsmalum-skyrsla.pdf

73 See http://www.fuel-prices-europe.info/, dated 3 April 2013.

74 See http://www.fuel-prices-europe.info/, dated 3 April 2013.

Cars in public ownership (state and municipalities) must be fuel-efficient and eco-friendly

This is probably not having much effect, as yet, because neither the government nor the municipalities have been able to renew their car fleet. However, this is a good signal to the public, if implemented properly. However, there are no specific targets except that 'eco-friendly' cars would emit less than 120g CO_2 per km. In case of four-wheel drive vehicles, those would be diesel rather than gasoline.

Strengthen the net of pathways for pedestrians, roads for bikers as well as public transport as an alternative for transportation

This mostly applies to the Reykjavik area and it certainly is a tall order. Reykjavik and neighbouring communities were planned and built as American cities, allowing for urban sprawl. Although the City Council and other authorities are now calling for more density, this will take decades. Therefore, public transportation is less developed than in most European cities.

In recent years, both the government and the Reykjavik City Council have promoted biking as a means of transportation, and the infrastructure for bikers has been improved. But it is still nowhere near the standard of the Danish or Swedish system, where there are specific traffic lights for bikers. Biking, also, is a long-distance effort for those who live in the suburbs.

Utilizing biofuels for fishing vessels

This alternative, which was listed in the action plan in 2010, is no longer as promising as it was described by those who promoted it. It has turned out to be much more expensive than anticipated. Other measures intended to increase the fuel efficiency of fishing vessels include designing lighter fishing gear such as bottom trawls. Due to the cost of running factory trawlers, the industry has the alternative of landing the fish for freezing on land where clean energy can be used.

Fuel fish meal factories with electricity

This measure has been in the works for more than a decade. The delay can probably be explained by Iceland wanting to time such measures when they count, i.e. during the first commitment period of the KP.

The problem is that fish meal factories only need energy for a limited time each year, energy which cannot be provided by hydropower or geothermal power stations as they need continuous demand for their production.

By 1 January 2013, the fish meal factories will become part of the ETS system. Hence this approach is no longer relevant for mitigating efforts by the Icelandic government.

Sequestration - More afforestation and soil conservation

Iceland has long promoted afforestation and land reclamation as a key part of its climate policy. Hence, Iceland talks of net emissions. That is, emissions – minus sequestration through land reclamation and afforestation.

Wetland reclamation

In Iceland's Fifth National Communication on Climate Change it says:

> Related to agriculture is the issue of emissions from drained wetlands. Research indicates that drained wetlands are a significant source of CO_2 emissions. These emissions can be attributed largely to human influence, from the draining of wetlands undertaken almost entirely before 1990. Some of the land is currently used for crop cultivation or animal grazing, but the rest is of marginal use. The discovery of this apparently significant emission source indicates that the reclamation of wetlands can help stop the emission of CO_2, and even in some cases sequester carbon in vegetation and soil. Increased reclamation of wetlands is listed as a priority measure for the mitigation of climate change in the 2007 climate change strategy, regardless of whether it can result in credits in the Kyoto Protocol GHG accounting or not.[75]

In a "Background paper produced by Iceland for AWG-KP 6, part I meeting in Accra, August 2008" it says:

Mitigation potential

The technical mitigation potential for drained and damaged wetlands, including peatlands, would appear to be sizable on a global scale, perhaps equivalent of up to 10% of global emissions, counting emissions from wooded peatlands. Feasible mitigation by wetland restoration would be smaller, taking into account that much of degraded wetlands are used for food production, habitation and other use, that would render it difficult to restore them. Most countries would have a much lower mitigation potential than Iceland, which has a relatively large surface area compared to its population.

Iceland's proposal on reclamation of wetlands was adopted at COP7 in Durban,[76]as a method of mitigation rather than sequestration, and this could be a gold mine for Iceland. Back in the 50s, 60s, 70s, 80s and well into the 1990s, the Icelandic government subsidized farmers to dry their lands by digging thousands of kilometres of ditches, , in order to provide more land for hayfields or grazing. Yet, these grazing areas or hayfields serve little purpose today as farms have been abandoned en masse.

Filling the ditches again will be even cheaper than digging them, it will provide jobs and it will account for a good share of Iceland's mitigation efforts. It will probably start during the 2nd Kyoto Protocol commitment period. How much carbon can be mitigated by reclaiming wetlands seems unclear, but Icelandic scientists at the Agricultural University of Iceland, which have conducted research on this, believe there is a great potential.

75 http://unfccc.int/resource/docs/natc/isl_nc5_resubmit.pdf See page 54.

76 Decision 2/CMP.7 Land use, land-use change and forestry, http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf

10. Provide more support for research and innovation with regard to climate issues.

In Iceland, research on wetland reclamation and sequestration by soil conservation, revegetation and afforestation receive by far the most attention. Whereas wetland reclamation is a relatively new phenomenon, soil conservation, revegetation and afforestation have enjoyed government support for the last century. Iceland's Fifth National Communication on Climate Change states:

In Iceland the human impact on ecosystems is strong. The entire island was estimated to be about 65% covered with vegetation at the time of settlement in the year 874. Today, Iceland is only about 25% vegetated. This reduction in vegetative cover is the result of a combination of harsh climate and intensive land and resource utilization by a farming and agrarian society over 11 centuries. Estimates vary as to the percentage of the island originally covered with forest and woodlands at settlement, but a range of 25 to 30% is plausible.

This is true, but farmers are still allowed to put their livestock to pasture on poorly vegetated areas. The purpose of soil conservation and revegetation is blurred by different agenda set by scientists, official farmers' interests.

As for mitigation of CO_2 emissions, research is much more limited and does not enjoy a century-old tradition. The fishing industry has made some attempts to investigate biofuels, but apparently without research. The most promising research regards technology to optimize vessel fuel consumption. In 2008, an Icelandic company, Marorka[77] was awarded the Nordic Council Nature and Environment Prize for having developed IT tools which can significantly reduce energy consumption and emissions in shipping.

Interconnector

During the last two years, Landsvirkjun, the National Power Company, has brought up plans for an interconnector to Scotland in cooperation with the British National Grid. That is, Landsvirkjun would sell energy to Scotland via an interconnector which would be laid and funded by another company. The cable would be able to carry some 1000 MW, but as well as export, Iceland could import energy, if need be.

Apparently this is a project in which the British authorities have a great interest in order to be able to meet their 2020 target. The energy would be provided by hydropower plants, geothermal power plants and wind energy, which is a novelty in Iceland.

Wind energy in Iceland looks very promising in the sense that wind turbines on land would produce as much energy as offshore wind turbines in the North Sea. Recently, the Icelandic Met Office published a feasibility study on harnessing wind energy in Iceland and it looks promising. Landsvirkjun has installed two wind turbines from Germany for testing.

77 See: http://www.marorka.com/about-us/

Currently, an exploratory committee, involving the industry, MPs and NGOs (Arni Finnsson), consumer organizations, etc. is studying the feasibility of exporting energy via an interconnector. A report is due in May and will likely recommend further studies. Landsvirkjun, however, has asked for a grace period until 2014, claiming that decisions are not due until then, at the earliest.

Given the interest from the British, who would like to complement offshore wind energy off Scotland with energy from Iceland, this project must have some economic merits. How much carbon it will save, though, is unclear. The number one criterion is whether it will pay off.

LATVIA

Climate Policy instruments in Latvia

Compiled by Janis Brizga, Green Liberty, Latvia

NGOs that participated in the assessment: Green Liberty, Physical Energy Institute, Environmental Protection Club, Latvian Green Movement, Baltic Environmental Forum, Homo Ecos, Latvia's Environmental Management Association.

Introduction

Latvia signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratified it in 1995. Latvia also signed the Kyoto Protocol in 1998 and ratified it in 2002, but nationally climate change is not one of the top political priorities. Like the rest of the former Soviet bloc countries, Latvia over the last 20 years has significantly reduced its CO_2 emissions – almost by 60%. This reduction in GHG emissions has been possible because of the decreasing population – a drop of 16.03% in population between 1990-2010, a drop in economic output, changes in economic structure and rising prices of energy.

The highest CO_2 emissions in Latvia are in the energy, transport, agriculture and waste sectors. However CO_2 absorption is ensured by the forestry sector. Over the last 20 years the energy sector in Latvia has undergone significant change. In 1990 it accounted for 19.3, but in 2007 only 8.8 million tons of CO_2. However its share of GHG emissions in Latvia has not changed much and is still around 75%. Fuel composition dramatically changed as well. Comprising 27.7% of energy sources in 1990, heavy oil, shale oil, and coal usage dropped to a mere 3.1% in 2007. Instead, natural gas became the primary source for heating, power plants, and industrial enterprises. Another rising alternative source of energy is fuel wood, climbing from 8.6% in 1990 to 25.2% in 2007.

Nevertheless, there are still many areas for improvement. This is particularly true of the transportation sector, where emissions rose from 3 million tons in 1990 to close to 3.9 million tons in 2007 due to an increase in road transport, explained mostly by the growing number of vehicles and increasing mileage due to economic growth in the country.[78]

According to the Kyoto Protocol, Latvia, like other countries, has an obligation to reduce CO_2 emissions by 8% by 2012 compared to its 1990 level (25.894 million tons of CO_2 equivalent). So to fulfill the Kyoto obligations in the time period between 2008 and 2012 Latvia's annual CO_2 emissions should not exceed 23.823 million tons. This is an easy target as in 2000 emissions dropped to only 37% of the 1990 level, and have stayed at the 40% level since then, in part thanks to the economic recession in 2008.

78 Latvian Ministry of Environment (2009) "Latvia's national inventory report Submitted under United Nations Convention on Climate Change, Common Reporting Formats (CRF) 1990 – 2007"

However, according to the business as usual scenario, with the existing measures Latvia's GHG emissions by 2020 will increase by 19.6%[79]. The fastest growth in CO_2 emissions is foreseen for the manufacturing, energy and agricultural sectors.

A number of abatement opportunities exist that have the potential to deliver emissions reductions in Latvia, and contribute to its climate targets. The level of abatement potential will vary by sector, as will the cost of the measures. Reductions in GHG emissions could be delivered by providing economic incentives, technological improvements, behavioural measures and structural changes. At the same time the possible rebound effects of these measures should be taken into account when designing policy interventions. The following paper gives a brief overview of the climate policy interventions used in Latvia.

Climate Change Mitigation Policy

The key framework in Latvia through which the requirements of the UNFCCC, Kyoto Protocol and European Union (EU) climate change legislation are delivered is the Climate Change Mitigation Strategy for 2005–2010. Policy goals at both the national level (e.g. environmental policy guidelines for 2009–2015) and the EU level (e.g. the climate and energy package) go beyond 2010, but it is unclear whether the 2005–2010 programme will continue or be replaced by a similar strategy, Green Growth strategy or other type of policy.

Latvia has taken clear targets for GHG emission limitation and renewable energy deployment from the 2008 EU climate and energy package. As an EU member state, Latvia is bound by EU legislation and has set out some key goals that must be achieved by 2020 within the framework of the 2008 EU climate and energy package, namely that:

- 40% of energy (on a consumption basis) by 2020 should come from renewable resources (in 2009 this figure was 34.3%, in 2010 – 32.5% but in 2011 – 33.1%);
- in 2020 GHG emissions should be reduced by 20-35% of the 1990 level;
- Latvia's national target under the Effort Sharing Decision (ESD) is equivalent to a 17% increase in the greenhouse gas emissions from ESD sectors[80] in 2005, by 2020;
- emissions covered by ETS by 2020 should be 21% below the 2005 level.

Other targets and milestones are mentioned for the energy sector (both for renewable energy production and energy efficiency improvements) and for the transport sector (renewable energy sources should account for 10% of total energy consumption in the transport sector by 2020 – in 2009 the

79 Physical Energy Institute, Study „Latvijas Siltumnīcefekta gāzu emisiju un piesaistes prognožu līdz 2020.gadam sagatavošana saskaņā ar Eiropas Parlamenta un Padomes Lēmumu Nr. 280/2400/EK".

80 Emissions from most sectors not included in the EU Emissions Trading System (EU ETS), such as transport (except aviation), buildings, agriculture and waste.

share was 1.1%, in 2010 – 3.3% but in 2011 – 4.8%)[81]. However longer-term targets are not reported, which makes it difficult to assess whether the actions are modifying longer-term trends in anthropogenic GHG emissions and removals consistent with the objective of the UNFCCC.

A longer-term vision for energy policy developments has been established by the government through the Guidelines for Energy Policy Developments in 2007-2016, that include a firm commitment to promote energy efficiency[82]. For the time being the draft Latvia Energy Strategy 2030 and new Latvia National Development Plan 2014-2020 are under development. Both of them continue the measures relevant for climate policy. At the same time the Renewable Energy Act is being developed, which aims at 40% renewable energy resources in the total energy balance. This has been under discussion for almost two years, in an effort to achieve consensus among all involved stakeholders. Nevertheless, taking into account the latest calculations about the cost of green energy, the Ministry of Economy has postponed adoption of the Act.

Currently, the share of renewable energy is about 33.1% of the total energy balance, while in the electricity sector, green energy currently accounts for 41%, with the target for 2020 being 49.3%.

Significant challenges in implementing the overall climate policy in Latvia are linked to the difficulties in monitoring, evaluating and, where necessary, taking corrective measures to ensure that targets are met; difficulties in ensuring that sustainable feedstocks are available to meet the demands of bioenergy policy; and the difficulty in increasing the share of RES in total final energy consumption at a time when a 55% increase in electricity consumption is forecast.[83]

Emission trading

European Union Emissions Trading Scheme (EU ETS)

Latvia has participated in the EU ETS since 2005. For sectors included in the European Trading Scheme (ETS), there is an EU-wide target of 21% reduction in emissions relative to 2005 levels.

During Phase I (2005–2007) ETS in Latvia covered 99 installations emitting approximately 40 per cent of Latvian CO_2 emissions. Installations involved in the first EU ETS period emitted 2.854 million tons of CO_2 in 2005(energy supply installations: 1.922 million tons of CO_2; other combustion installations: 0.179 million tons of CO_2; industrial installations – 0.753 million tons of CO_2) which together make up 26% of the total amount of the country's GHG emissions. However Phase I was more like a learning

81 Republic of Latvia Ministry of Economy 16.10.2012 http://www.em.gov.lv/em/2nd/?cat=30170

82 Klavs, G., Kudrenickis, I. (2012) Energy Efficiency Policies and Measures in Latvia, Institute of Physical Energetics, available at http://www.odyssee-indicators.org/publications/PDF/latvia_nr.pdf

83 http://unfccc.int/resource/docs/2011/idr/lva05.pdf

stage with over-allocation of quotas and easy profits for some of the companies involved (e.g. in 2006 Latvenergo earned €12.9 million from selling its unused quotas[84]). It also did not ensure significant GHG emission reduction as emissions from installations in 2006 totalled 2,941 million tons of CO_2, – compared to 2,849 million tons in 2007 .

In Phase II (2008-2012) the scheme was extended and from 2012 international aviation was included in the EU ETS as well. In this period the government prioritized emission allocation to industry, reducing the amount of quotas in the energy sector by 20%. A total of 3.428 million quotas were allocated to Latvia by the EU.[85] The biggest share (1.596 million quotas) went to the energy sector, which is 20% less than in the previous period. On the other hand, the amount of emission allowances that has been granted to the industry sector has increased by 6% above the base year level, reaching 1.046 million quotas. In total, there are 90 installations in Latvia that are participating in Phase II of the EU ETS. Two-thirds of these installations are boiler plants. There are also seven cogeneration installations and four thermal centrals. Most of the installations generate thermal energy. The reserve for new plants was 785.8 thousand quotas – the same amount as in the previous period.

Up until 2012, emission allowances are allocated to installations free of charge, which gave little incentive to businesses to decrease their GHG emissions. However, from 2013 until 2020 allowances will have to be purchased at auction. Nevertheless ETS sectors in Latvia cover only one quarter of national GHG emissions. Therefore measures also should be taken in non-ETS sectors, where the business as usual scenario shows that emissions could exceed the 17% increase threshold reached in the EU effort-sharing decision.

International Emissions Trading

Latvia began its participation in the International Emissions Trading regime on 12 April 2006 when it designated 40 million assigned amount units (AAU)(out of the 119,182,230 units initially allocated to Latvia) to be earmarked for potential sale during Kyoto's first commitment period. Latvia and Hungary were the first two East European Countries that established frameworks for "green" AAU trading, meaning that AAU revenues would be used to finance environmental programmes to increase energy efficiency and contribute to GHG mitigation. The selection process of greening projects is usually stipulated in the AAU purchase contract. Latvia has decided to carry out selection with the help of tendering processes.

For the time period from 2008 to 2012 it is estimated that 40 million emission allowances will be traded(including those already sold), which would give revenues of €200 million euro or approximately LVL 141 million.

Since 2008, Latvia has signed several AAU purchase (sale) agreements

84 Latvenergo (2006) ANNUAL REPORT 2006, available at http://www.latvenergo.lv/portal/page/portal/english/annual_reports/pdf/LVN_EN_final_sm.pdf

85 National Emissions Allowance Allocation Plan 2008–2012, http://www3.meteo.lv/upload_file/SEG_REGISTRS/NAP2_Latvia_EN.pdf

(AAUPAs) with countries including the Netherlands, Austria, Spain, Japan, and Portugal. These sales have generated over €200 million. The contracts with the Netherlands and Austria were closed in March 2009 (5 million AAUs), the contract with Spain in September 2009 (5 million AAUs), in October 2009 Latvia signed the contracts with Japan and Portugal (total 5.5 million AAUs), a private investor (1.5 million AAUs) and then the second contract with Austria (1.5 million AAUs). The actual AAU price in 2008 and 2009 was two times higher than projected and Latvia was able to sell 50% more AAUs than planned which resulted in €155 million in earnings. The first two trading years proved to be more profitable than expected and Latvia earned €105 million more than initially planned.

Latvia's state budget revenues in 2009 amounted to €5.7 billion (LVL 4 billion). The income from the emission allowance surplus was 2.3% of these revenues (LVL 91.4 million). Although all the collected money goes into the national budget, it does not increase the income directly. The law states that countries must prove that the revenues from emission allowance trading are invested in green technologies. These restrictions are adopted in order to ensure that money is really used for the intended purpose – to mitigate emissions. Latvian AAUs are backed by Green Investment scheme (GIS) projects, thereby guaranteeing that revenues are spent on energy efficiency, green technologies and renewable energy projects.

A Climate Change Financial Instrument (CCFI) was established to manage the funds earned through international emissions trading. This is a government budget programme aiming to "implement activities to improve the energy performance of buildings in both public and private sectors, the development and implementation of technologies that use renewable energy resources, as well as the implementation of integrated solutions to reduce greenhouse gas emissions"[86]. CCFI funds a broad array of greening projects, including, but not limited to, an increase in the energy efficiency of municipal buildings, use of renewable energy sources in the household sector, complex solutions for GHG emission reduction in state and municipal vocational education establishment buildings, technology conversion from fossil to renewable energy sources, complex solutions for GHG emission reduction in municipal buildings and production buildings, public campaigns to raise awareness about the importance of reducing GHG emissions and other projects aimed at GHG emission reduction[87]. Total funds spent in 2011 amounted to LVL 111.7 million:

Increasing energy efficiency in municipal buildings – 25.16 million;

Development of technologies reducing greenhouse gas emissions– 1.74 million;

- Increasing energy performancein higher education establishment buildings – 7.03 million;
- Technology conversionfrom fossil to renewable energy sources – 7.51 million;

86 http://www.varam.gov.lv/lat/darbibas_veidi/KPFI/merki/ (official website of The Ministry of Environmental Protection and Regional Development of the Republic of Latvia)

87 http://www.lvif.gov.lv/?object_id=299

- Complex solutions for greenhouse gas emission reduction in state and municipal vocationaleducation establishmentbuildings – 11.56 million;
- Complex solutions for greenhouse gas emission reduction in municipal buildings – 16.11 million;
- Complex solutions for greenhouse gas emission reduction in production-buildings – 8.5 million;
- Public awareness with regard to the role and opportunities for greenhouse gas emissions reduction – 0.60 million;
- Renewable energy use in transport sector – 1.81 million;
- Low-energy building – 7.26 million;
- Renewable energy use in the household sector – 11.4 million;
- Use of renewable energy to reduce greenhouse gas emissions– 27.72 million.

Demand for this financing is evidently very high and in most tenders the number of applications by far exceeded the available financing.

EU Structural Funds

Latvia's National Reform Programme for implementation of "EU 2020" strategy and the National Development Plan for 2007-2013 acknowledge that the development of low-carbon production and services are key to ensuring Latvia's international competitiveness in the long term. In the EU funds programming period 2007-2013, a number of measures have either directly or indirectly supported GHG emission reductions, e.g. over €340 million has been allocated to fund clean energy and efficiency measures.

The operational programme "Infrastructure and Services", with financial support from the Cohesion Fund, promoted the use of renewable resources in the development of cogeneration power plant. The public service providers received 50% funding to build new renewable energy co-generation power plant or for rebuilding an existing boiler plant using renewable energy resources, CHP. Programme financing - EUR 97.817 million (LVL 68.746 million) from the Cohesion Fund - 50%, from private funding - 50%.

Another Investment programme under the same "Infrastructure and Services" operational programme is "Measures for district heating system efficiency". The aim of this programme is to increase efficiency in heating energy generation, which includes reduction of heating lost in transmission and distribution systems as well as to promote the replacement of fossil fuels in energy generation plants with renewable resources. A total of 58 projects have been approved in the first three rounds of allocation, amounting to almost LVL 33 million.

One more investment line under the "Infrastructure and Services" operational programme provides support for "Heat-efficiency improvements in apartment buildings". This is funded through the EU Regional Development Fund (RDF) with total available funding of EUR 43,704 million. Thermal energy savings funded by this fund should be no less than 20% of the normalized total heat consumption, but it is accepted that the heat consumption of the project is 100 kWh per m^2 (for 1-2 storey multi-apartment buildings)

and 120 kWh per m^2 (for 3 storey and higher multi-apartment buildings). Apartment owners can recover 50%-60% of the total eligible costs.

The second EU RDF activity for energy efficiency in buildings is "Heat efficiency improvements in social housing" – EUR 13,233 million. Both activities should ensure 20% energy efficiency improvement.

Financial support for the production of energy from biogas is provided through Rural Development Programme 2007-2013 measure 312(311) "Support for creation and development of micro-enterprises (including diversification into non-agricultural activities)" sub-measure "Production of energy from biomass which is of an agricultural or forestry origin". Its aim is to support holdings which establish production of energy from biomass of agricultural or forestry origin and which provide the produced energy for use predominantly outside the holding. In assessing the effectiveness of the program it has been recognized that it does not fulfill its initial expectations. The aim of the state programme "Biofuel Production and Use in Latvia (2003-2010)" was to ensure that in 2010 biofuels amount to 5.75% of the total fuel market in Latvia, but the actual share of biofuels was only 2.96%, and the majority of biofuels produced in Latvia were exported.

The EU maintains that investment in energy efficiency is important for reducing GHG emissions and other environmental impacts as well as contributing to economic growth and competitiveness – especially in the new EU member states, which are expected to claim the greater part of the support.

Funding is also available for the period 2009-2014 via the "National climate policy" programme through the **European Economic Area Financial Mechanism and Norway Financial Mechanism.** Total allocation according to the Memorandum of Understanding is €10,365 million. The programme aims to support elaboration of national climate policy, data collection for inventories, capacity building, pilot projects and studies.

The Financial Instrument for Environment (**LIFE+**) was created to support activities which "have European added value, have a leverage or multiplier effect and demonstrative or catalytic character". The Commission proposes to allocate €3.2 billion to the LIFE+ programme (0.8bn on climate and 2.4bn for environment) for 2014-2020. Latvia funded several projects through this programme.

Taxes

Latvia has nearly always been an opponent of energy taxation, which is why the best opportunities for introducing them – when energy prices were low and the economy was growing at a fast pace – have been missed[88]. The current taxation system supports big energy producers, but there are several examples of fiscal incentives.

88 Spruds, A. (ed.) (2010) Latvian energy policy: towards a sustainable and transparent energy sector, Sorosa fonds – Latvija.

CO_2 tax

The Carbon Dioxide Tax (part of the Natural Resource Tax) was introduced in 2006 and it has been gradually increased from LVL 0.10 (EUR 0.14) in 2006 until it will reach LVL 2.0 per ton (EUR 2.82) in 2013. Installations participating in the EU ETS as well as installations which use renewable resources and peat for energy production are exempt from this tax. There are also other exceptions – heat and power production from coal, wood and lignite (brown coal) are also exempt from tax.

The natural resource tax also has to be paid for other types of pollution (PM10, CO, ammonia (NH3), hydrogen sulfide (H2S) and other inorganic compounds, SO_2, NOx, volatile organic compounds and other hydrocarbons (CnHm), heavy metals and vanadium pentoxide emissions) which works in synergy with the climate policy.

Other taxes

Excise tax is levied on oil-based products (including natural gas), however, unlike in many other EU member states, it is not levied on fossil fuel used in heating or electricity production. The tax rate varies from LVL 90 per 1000 kg of petroleum gases and other gaseous hydrocarbons to LVL 320 for leaded petrol.

In December, 2008 the parliament (Saeima) abolished the lowered tax rate on locally produced biomass whilst upholding the lowered rate (10%) for natural gas imported from Russia. This measure unquestionably hinders the competitiveness of local renewables and strengthens the position of Russian gas. Only a year later, in December 2009, the amendments to the Excise Duty law were passed. According to the new law, natural gas used as fuel will have an excise duty of LVL 15.6 per 1000 m3 and natural gas used for heating will have an excise duty of LVL 70 for 1000 m3. The new excise duty, in effect, increases the competiveness of local renewables. However, the process of adopting this legislation was, once again, non-transparent and unpredictable. It left the impression that the reasoning behind the decision was the need to reduce the budget deficit and not the need to act in accordance with the priorities of the energy sector or the need to promote sustainable development of the country's economy.

Latvia aims to increase the proportion of biofuel in transport fuels to 10% by 2020, with a particular focus on vehicles used in agriculture. Latvia provides financial support for biofuel production and promotes the use of biofuel and other renewable fuels in transport by providing reduced rates of excise tax for biofuels used in the transport sector:

- 70 - 85% ethanol fuel produced from agricultural raw materials;
- diesel fuel with at least 30% by volume of biodiesel;
- pure biodiesel is subject to 0% rate;
- petroleum products, which are used as fuel and have at least 5% rapeseed oil or biodiesel admixture.

According to the Cabinet of Ministers Regulation No. 648 from 1 October 2009, petrol and diesel used in transportation should have a mandatory biofuel admixture of 5% (not applicable to diesel fuel for use during the winter season).

Electricity tax was introduced in 2006. However there are several tax exemptions for:

- electricity derived from (i) renewable energy sources, (ii) hydro, and (iii) in cogeneration units if they meet certain performance criteria
- electricity that is used for (i) the production of electricity, (ii) the production of heat and electricity cogeneration, and (iii) goods and passenger traffic in road and rail transport, (iv) the household.

Policy instruments by sector

Transport

Apart from excise tax there are also other instruments used in Latvia to stimulate GHG emission reductions in transport sectors mostly by promoting use of environmentally friendly vehicles and limiting CO_2emissions through renewal of the car fleet and increasing the share of environmentally friendly vehicles in the total car fleet.

Transport emissions account for 30% of total GHG emissions and around 25% of energy consumed in Latvia. The main economic instruments are the vehicle registration fee and annual tax, which is differentiated depending on the vehicle's gross weight, engine capacity and maximum engine power.

The annual road tax is comparable to an energy tax, providing it promotes energy efficiency and environment protection goals. However, the reasoning behind the road tax increase, which was recently introduced as part of a state budget consolidation, is old-fashioned and lacking in motivating incentives. The dependency of the tax on the weight of the car is incorrectly explained and does not help to promote reduced fuel consumption. The tax, once again, mainly harms large families and the owners of gas-guzzlers. The best and most fair method would be to link the tax to CO_2emissions and engine size. This way, the tax would serve three purposes: environment protection, social justice and fiscal benefits.

The vehicle first registration tax is differentiated according to vehicle age and engine capacity. As of 1 January 2009, the tax depends on the vehicle CO_2 emissions per kilometre. The tax rate varies from 0.3 to 5 Ls per gram of carbon dioxide emissions.

Feed-in tariffs

Latvia provides support for energy generation from renewable sources through feed-in tariffs for small hydropower plants, wind electricity generation and for cogeneration plants using renewable fuels. However there has been a lot of discussion concerning these tariffs.

Regulation No. 198 of the Cabinet of Ministers (Regulation on Electric Power Production and Pricing Using Renewable Energy Sources), passed on 14 March 2009, gave grounds for political conflict and suspicion that the criteria were deliberately designed to suit certain lobby groups. A couple of months later, amendments to the regulation were passed and the ambiguities were eliminated.

Nevertheless the quota system used in the feed-in tariff scheme does not assist in increasing the share of renewable energy production as considerable numbers of businesses that have been granted the feed-in tariff rights are receiving funds for existing power stations whilst eligible new businesses have no quotas.

Because of the economic recession and budgetary problems the support for the RES is currently frozen for an uncertain period of time.

Industrial processes

In the industry sector, a permitting process under the provisions of the "Law on Pollution" enhances environmental efficiency in production processes, taking into account GHG emission among others. This encourages implementation of the best available techniques, environmentally friendly technologies and cleaner production, including control of fluorinated gases in the manufacturing industry (including steel and mineral production).

Agriculture

In the agriculture sector, the government has not taken any direct actions toward emission reduction, but other policies might indirectly positively affect it, e.g. development of environmentally friendly agriculture, promotion of good agricultural practice and measures to improve manure storage and use agricultural resources more sustainably, through payments to farmers who comply with good agricultural practice and by providing information and guidance on practices that reduce emissions.

Forestry

In the forestry sector, investments are being made to increase forest stand productivity and afforestation, and measures are also in place to increase the productivity of forests, through forest management techniques, and to convert unmanaged agricultural land into forest. As a result of the change in land use structure, in 2007, LULUCF removed 50% more than it did in 1990.

Waste

The National Waste Management Plan 2003–2012 aims to prevent waste production, reduce the amount and risk of waste, support recycling through energy recovery, safe and environmentally friendly storage, and the establishment of new municipal landfill sites.

The government has been promoting recyclables collection facilities, the installation of sorting, processing and disposal equipment in municipal landfills, and collection of biogas emitted from them. It has also created a voluntary program for packaging waste management, which constitutes 20%-30% of municipal waste.

Policies are in place to ensure collection of biogas from household waste landfills and processing of biologically degradable waste as well as to promote recycling, utilize methane collected at landfill sites, utilize biologically degradable waste for composting, restore landfill sites that do not meet current environmental requirements and reduce waste production through best practices.

The government is also promoting RES while at the same time reducing greenhouse gas emissions by applying a suitable waste management process, and providing support for energy production in biogas plants from agricultural waste and for energy production in biogas plants from waste landfills.

Communication instruments

Communication, education and information instruments can promote the development of environmental awareness in society and contribute to climate change mitigation. In Latvia there are several NGOs which carry out various activities to raise public awareness of climate change issues as well as different policy instruments designed for communication.

The Environmental Protection Law (2006) sets out the environmental science, environmental education and sustainable education procedures. As a consequence of the financial crisis, priority is given to implementing environmental issues concerning mainly the air, water, soil, nature and climate.

One of the NGO activities was a climate change and energy campaign, aimed at eco-schools and other primary education institutions. Under this project, teachers as well as students were trained in climate change issues. NGOs provided educational materials and produced a CO_2 calculator for teaching and calculating how consumption is related to CO_2 creation and climate change promotion.

Non-governmental organizations are involved in the development of polices relating to the use of new technologies. For example, the World Wildlife Fund (Latvia Division) is helping members of the public understand their contribution to emissions from transport and household energy. The World Wildlife Fund also promoted the Earth Hour action across the cities and towns of Latvia. Green Liberty helps to communicate to the public how their lifestyles affect climate change and works within the Baltic region to improve cooperation between neighbouring countries. The Baltic Environmental Forum worked on the BaltClim project to support national adaptation strategies to climate change in the Baltic States. There have also been a number of other NGO initiatives on climate issues.

Energy efficiency labelling

Latvia has adopted EU regulations on energy efficiency labelling for energy-using products as well as energy efficiency labelling for homes, which came into force in June 2010. Energy certificates are awarded to existing buildings, as well as new projects.

Local-level initiatives

Some of the local municipalities have developed their own climate initiatives, e.g. ten municipalities in Latvia have adopted the Covenant of Mayors, which aims to improve energy efficiency and the use of renewable energy sources in their regions. Through their commitment, the covenant signatories aim to meet and exceed the European Union's 20% CO_2 reduction objective by 2020. However, only four municipalities in Latvia (Riga, Jelgava, Tukums and Jekabpils) have adopted sustainable energy action plans. In addition, Salacgriva municipality has developed "Climate change adaptation strategies for Salacgriva municipality", while Riga city has developed a flood risk management plan.

Research & science

As part of a national research programme entitled "Climate Change Impact on the Waters of Latvia" – KALME (Climate, Adaptation, Equilibrium, Variability, Ecosystem) more than 90 Latvian scientists studied the effects of climate change on Latvia's lakes, rivers and the Baltic Sea and its coast during 2006–2009. The programme resulted in science-based recommendations for adaptation and climate change mitigation. The KALME framework provides information on erosion of the sea coast, which includes the endangered coastal strip. There are also a number of other research projects on climate, e.g., BaltCICA – Climate Change: Impacts, Costs and Adaptation in the Baltic Sea Region; BalticClimate – Baltic Challenges and Changes for local and regional development generated by Climate Change; and BaltClim - Supporting strategies on climate change adaptation in the Baltic States.

Prioritization of the measures by Latvia's NGOs (one being the best):

Measure	Score
EU Structural Funds	1
Local-level initiatives	2
Excise tax	3
Energy efficiency labeling	4
Climate Change Mitigation Policy	5
CO_2 tax	6
Feed-in tariffs	7
European Union Emissions Trading Scheme (EU ETS)	8
Research & Science	9
Electricity tax	10
International Emissions Trading	11

LITHUANIA

Best GHG mitigation measures in Lithuania

Compiled by Linas Vainius, Atgaja (Lithuania).

General situation:

In 2010, the main greenhouse gas (GHG) in Lithuania was carbon dioxide (CO_2), accounting for 64.3 per cent of total GHG emissions expressed in carbon dioxide equivalent (CO_2 eq), followed by nitrous oxide (N_2O) (19.9 per cent) and methane (CH4) (14.9 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 0.9 per cent of the overall GHG emissions in the country. The energy sector accounted for 59.7 per cent of total GHG emissions, followed by the agriculture sector (24.0 per cent), the industrial processes sector (10.5 per cent), the waste sector (5.4 per cent) and the solvent and other product use sector (0.4 per cent). Total GHG emissions amounted to 21,521.49 Gg CO_2 eq and decreased by 56.9 per cent between the base year and 2010. The main decreases occurred in the early 1990s following the restoration of independence and the transition from a planned economy to a market economy.

The following are the main GHG mitigation measures foreseen by Lithuania and reviewed by Atgaja with comments from NGOs and some experts, plus an additional review of reports and the current status of implementation.

These GHG mitigation measures were taken and evaluated under review of Lithuania's Fifth National Communication under the United Nations Framework Convention on Climate Change (2010) and current approved national energy and transport strategies, other policy documents and recent changes in their implementation.

The heating sector presents the best opportunities for large cuts in greenhouse gases, with added other economic and social benefits, among the reviewed climate mitigation measures and tools.

A rough estimation of current energy demand in Lithuania (per year) is as follows:

~20 TWh for heating, both central heating which is dominant in all Lithuanian cities and individual houses in the countryside and suburbs. ~20% of total heating was produced from biomass, using natural gas imported from Russia and to lesser extent imported oil products.

~10 TWh for electricity (of which ~6 TWh imported mostly from Russia and the rest produced mostly

from natural gas (again imported from Russia) and ~12% from renewable energy sources.

~10 TWh for transport.

Development of renewable energy sources, increasing energy efficiency and reduction of GHG are mainly driven by European Union policies and requirements in Lithuania. EU targets for the member states are transferred into national legislation and programmes. But Lithuania is facing specific challenge for the diversification of energy production, decreasing energy

import, increasing security of supply and cutting dependence from Russia as a dominant supplier both of natural gas and electricity. Solution of these challenges can bring both social and economic benefits together with reduction of GHG emissions.

No.	Description of measure	Type	Achieved or expected result	Time and trends of application
1.	Enhancement of the use of RES until 2020	Legislation	Targets for renewable energy development are set in the Lithuanian law on Energy from Renewable Sources approved in 2011: - wind energy power plant capacity (currently 205 MW of installed capacity, expected 500MW); - biomass CHP plants (currently 80 MW of installed capacity, expected at least 355 MW); - Hydro (currently 128 MW of installed capacity, expected 141 MW); - solar PVC (currently 1 MW of installed capacity, expected 10 MW).	However, renewable energy associations and experts estimate higher technical and economic potential for renewable energy development with biomass and wind energy as being the main renewable sources in Lithuania. The Lithuanian Renewable Energy Confederation made recent calculations for the potential of renewables in the Lithuanian energy sector, which goes beyond the officially approved targets for the period 2012-2020. Relevant funding from EU structural funds together with rational feed-in tariffs could enforce implementation of such ambitious growth of renewables in Lithuanian energy mix: - new biomass boilers and cogeneration plants with installed capacity of 630 MWe of total annual electricity production 2.6 TWh, heat production 5.1 TWh; total annual demand of biomass fuel 0.63 million Toe. - Wind turbines with installed capacity of 800 MWe, total electricity production 1.7 TWh; - New biogas power plants 85 MWe with electricity production of 0.6 TWh; - more hydropower plants 14 MWe/0.05 TWh; - solar PVC panels 10 MWe/0.009 TWh.
2.	Modernisation of multi-apartment buildings. Governmental programme	National programme	There have been plans to cut energy wastage and some GHG emissions through the modernization and renovation of at least 70% of all multi-apartment buildings (24 000 units) in Lithuania. Savings targets for 2010 are 150 GWh, and for 2016: 1 700 GWh. The programme started in 2005 and its completion date is 2020. A new funding mechanism was established with allocations from EU structural funds and an EIB loan since 2008. There were average savings of 61 kWh/1 m^2 per year with the first projects already implemented. With regard to the useful heated area of all renovated multi-apartment buildings, the calculated energy savings total 60 GWh (as of 2010) from renovated houses. According to the forecasts on multi-apartment building renovation, the projection for 2016 amounts to 250 GWh of estimated energy saving.	Despite high ambitions and high expectations, backed up by available financing, still very little progress since 2008. Only 416 multi-apartment buildings' houses renovated since 2008 due to the unattractive financial support scheme. Government approved review of the financial mechanism and expected new kick-start of the programme since 2013. There is huge potential for large energy savings and reduction of CO_2 emissions from the heating of multi-apartment buildings. E.g. current heat consumption of some of the least efficient multi-apartment houses in Vilnius account for 220-290 kWh/m^2/per year (average 160–180 kWh/m^2/per year). Or otherwise average ~25 kWh/m^2 energy consumption for heating (~55.7% of buildings per country) and ~35 kWh/m^2 energy consumption for heating (~22.4% of buildings per country). Such buildings are on the priority lists of municipalities for renovation. Experts highlight that modernization of multi-apartment buildings should be followed by modernization of central heating systems in order to adjust decreased demand for heat.

No.	Description of measure	Type	Achieved or expected result	Time and trends of application
3.	Modernisation of public buildings	Programme	Modernization of public buildings is implemented via different programmes using EU Structural Funds during 2007-13 financial perspective: renovation of administrative buildings, university student halls, general education schools, libraries. Priority is given to buildings constructed before 1992. The conditions of the buildings varied and they had to pass an energy audit followed by the technical reconstruction project prior to the project approval. Savings targets for 2010 year are 30 GWh, and for 2016 – 100 GWh. The programme started in 2007 and its completion year is 2015.	Ongoing implementation with support of EU funds. There are 293 approved projects with implementation deadline of 2015. Planned energy saving of 80 GWh are expected to increase. All renovated buildings must comply with technical norm of D-class for the projects with renovation permissions and/or construction works started before 2014 and C-class with renovation permission and/or construction works started after 2014. Each project is required to achieve at least 30% of energy saving compared to the previous energy consumption.
4.	Promotion of cogeneration	National energy strategy	- Cogeneration will make up to 20% of the total energy generation balance in 2010; - The share of CHP plants in the total electricity generation balance should reach 35% by 2025; - At least 75% of district heat shall be generated using CHP by 2020; There were more than 360 units of biomass boilers with total installed capacity of ~ 710 MW operating in Lithuanian heating networks in 2011. 395 MW of this capacity supplied central heating systems in 2011. The total energy produced and supplied to the central heating systems consisted of 9267.3 thousand MWh in 2009. It reached 9803.5 thousand MWh in 2010. The share of biomass in the fuel make-up was 19.3% in 2009-2010. Still good potential to grow according to the targets in the energy strategy and existing potential capacity.	Little progress achieved up till now. There was small growth in biomass use to 20% (+ 0.7%) in 2011. The government set up a working group to revise implementation of the national energy strategy. New plans are being discussed for promotion of biomass in district heating until 2020: - CHP using biomass currently 80 MW of installed capacity, planned 600 MW; - heating boilers currently 310 MW, planned 525 MW; Expected increase in renewable energy for district heating no less than 60% from current 20%, mainly from wood-based biomass.
5.	Increase in energy efficiency	National programme	Many ambitious targets for the increase of energy efficiency in various sectors during 2006-2012. Modernization of multi-apartment and public buildings was the most ambitious measure in the programme.	According to some experts the programme itself had high expectations and potential for GHG reduction and many social and economic benefits, but failed to be implemented sufficiently. This programme is legally outdated and needs to be reviewed, new targets set.
6.	LNG import terminal in Klaipeda	Project	Planned in Klaipėda sea port. Aim: to increase security of supply and to decrease dependency on Gasprom, the single Russian supplier of natural gas both for electricity production and central heating. This project is specific to the Lithuanian and regional situation as an interim solution to the transition of the energy sector from fossil fuel to a high share of renewables by 2050. Natural gas is needed to run existing thermal power plants for electricity and central heating systems in major cities, including newly built modern thermal power plant in Elektrenai.	Under implementation, should start operation in 2015. Project could have regional impact on securing supply of LNG in the region and limiting conversion to other fossil fuels (coal, heavy oil fuel, peat, shale oil, etc.). Project can be seen as controversial for GHG reduction, because it competes with possible conversion of Lithuanian central heating sector and partly electricity production to biomass.

No.	Description of measure	Type	Achieved or expected result	Time and trends of application
7.	Integration into the European Energy Systems		Completion of the Lithuanian–Swedish power link*NordBalt* in 2015. Increased opportunities for offshore wind energy projects in the Baltic Sea. Access to the Kruonis HSPP for balancing of the RES in the grid. There are plans for 400-800 MW of offshore wind energy near the Lithuanian coast. Lithuanian renewable energy experts value Kruonis HPSP for its potential to balance wind energy capacities. Likewise for Visaginas NPP if it is built. Originally Kruonis was built to balance Elektrenai thermal power plant and Ignalina NPP and energy fluctuations in north-west energy grid of former USSR. After 1990 its capacity reduced from the planned 1600 MW to 900 MW (4x225 MW).	Project under implementation.
7.1.	Integration into the European Energy Systems		Start-up of the Lithuanian-Polish power link LitPol Link 1 in 2015 and extension of the link in 2020; also the completion of the extra Lithuania-Poland cross-border power connection (LitPol Link 2) which is required for the future synchronous interconnection with the European Continental Network of the European Network of Transmission System Operators for Electricity (henceforth – ENTSO-E).	Project under implementation. Poland could become a net importer of electricity (after 2015), also of renewable electricity from Baltic States and [nuclear and gas-fired electicity] from Russia (re-exported via Lithuania). If Poland implements its nuclear programme the country might be a net exporter of nuclear electricity. For Lithuania and the Baltic States this is an issue of the general security of supply and integration into European grid.
7.2.	Integration into the European Energy Systems		Synchronous interconnection of the Lithuanian, Latvian and Estonianelectricity transmission systemswith the European Continental Network of ENTSO-E.	
8.	Government subsidies for energy efficiency, renovation and installation of small RES applications (heat-pumps, wind, solar heating and PV) for individual private houses.		There are two separate measures for modernisation (renovation) of small private houses and use of RES applications in such houses. Both are applied to individual private houses built according to the norms approved before 1993. Investments are managed by the Lithuanian Environmental Investment Fund.	Under implementation according to the list of approved projects. Projects in a range of 1000-3000 euro. Certificate confirming reduction of energy consumption by 20% and achievement of C-class energy efficiency are required before final payment for the renovated houses. Combines GHG reduction, environmental and social benefits.
9.	Afforestation of low -ertility soils	Programme	Affects mainly CO_2 reduction. One goal is to increase the forest area by 3% by the year 2020. Artificial afforestation should take place over an area of approximately 100-120 thousand ha, or 6-7 thousand ha per year on average. Forests should contain 45% of deciduous and 55% of coniferous trees. In addition self-growing forest expected on 70-90 thousand ha of agricultural land by 2021.	Positive environmental, economic and social effects. Important measure for rural development. EU funds used. Estimate of mitigation impact, by gas in CO_2 eq. Gg -840.

NORWAY

Best practice policies for climate change mitigation, Norway

Compiled by Thomas Martinsen (Norway)

Foreword

Over the last 30 years, governments have introduced some policies to decrease emissions, to promote energy efficiency and savings and to develop renewable sources of energy. Environmental NGOs from our region need to come together again and discuss a new, more radical strategy for emission reductions. AirClim believes we need to exchange ideas and experiences on working strategies, scenarios and policies to expand our future efforts.

Introduction

Norway enacted its initial national climate policy through a government white paperfollowing the Brundtland report "Our common future" in 1987. The basis for policy development has been a combination of bottom-up analysis of measures including an evaluation of cost efficiency and implementation efficiency and top-down macroeconomic studies. Those studies estimate a greenhouse gas (GHG) reduction relative to a projected baseline of future emissions. *The time series of emissions of GHG may thus not reveal the whole story with respect to the influence of policies and measures. If an activity is increasing the baseline emissions will also increase. A measure may thus reduce the specific emissions while the total emissions still increase, e.g., increased oil production offshore. On the other hand, the reduced emission may merely be the result of reduced activity, e.g., closing of an industrial plant* for reasons unrelated to energy or environmental policy. Moreover, the emission reductions are most often not the result of only one policy or measure but rather a combination of measures. This includes research grants to develop technical solutions and non-environmental taxes. Estimating the GHG reduction of a single policy is thus at best uncertain. Moreover, the emission reduction obtained by a measure may vary between years. The emission reduction, when described may be annual or accumulated and is merely intended as an indication. Based on a total evaluation, including GHG emissions development and knowledge of the different policies and potential for replication in the other countries, some measures are selected and described.

Brief history of emissions of greenhouse gases in Norway

The 2011 national inventory report to the UNFCCC describes Norway's historic emissions since 1990 as follows:

The most important sector in Norway with regard to the emissions of greenhouse gases (GHG) is the energy sector, accounting for almost 76 per cent of the total Norwegian emissions. The energy sector includes the energy industries (including oil and gas extraction), the transport sector, energy use in manufacturing and constructing, fugitive emissions from fuels and energy combustion in other sectors. Road traffic and offshore gas turbines (electricity generation and pumping of natural gas) are the largest single contributors, while coastal navigation and energy

commodities used for the production of raw materials are other major sources.

From 1990 to 2009 the increase in the emissions from the energy sector was almost 32 per cent, or more than 9 million tons, mainly due to higher activity in the offshore and transport sectors. Between 1990 and 2009 there have been temporary emission reductions in e.g. 1991 and 2005 and again in 2008 and 2009, when the energy sector emissions decreased by less than 1 per cent from 2008 to 2009.

Industrial processes contributed to 13 per cent of the total national emissions of greenhouse gases. Production of metals and chemicals is the main source of process-related industrial emissions of both CO_2 and other greenhouse gases such as N_2O (fertilizer production) and PFCs (aluminium production). Between 1990 and 2009 emissions from industrial processes experienced an overall decrease by over 50 per cent. This is mainly due to reduced PFC emissions from the production of aluminium and SF_6 from the production of magnesium.

Solvent and other product use accounted for only 0.3 per cent of the total emissions of greenhouse gases in Norway. This contribution has been stable since 1990.

The agricultural sector contributed in 2009 to about 8 per cent to the total emissions of greenhouse gases. This corresponds to 4.2 million tons of CO_2 equivalents, which is 1.4 per cent lower than in 2008. This sector has experienced an emission reduction of about 7 per cent over the period 1990–2009. The dominant sources of GHGs are enteric fermentation (CH4) from domestic animals and agricultural soils (N_2O). These sources contributed to about 45 and 44 per cent respectively of the sector's emissions.

The waste sector contributed 2 per cent of total Norwegian greenhouse gas emissions in 2009. The emissions of greenhouse gases from the waste sector were relatively stable during the 1990s. From 1998 the emissions declined, and in 2009 they were about 32 per cent lower than in 1990. Waste volumes have increased significantly over the period, but this has been offset by increased recycling and incineration of waste as well as increased burning of methane from landfills.

Emissions from transport showed an overall increase of about 29 per cent from 1990 to 2009, while the emissions decreased by more than 2 per cent from 2008 to 2009. The share of transport in the total GHG emissions has increased from 22 per cent in 1990 to almost 28 per cent in 2009. Road transportation accounts for more than 68 per cent of the total mobile emissions, while emissions from navigation and civil aviation account for 15 and 8 per cent respectively. Due to the fact that most railways are electrified in Norway, emissions of GHG from this source are insignificant. Other transportation (off-road vehicles and other machinery and other non-specified) accounts for a bit less than 10 per cent of the emissions from the source transport.

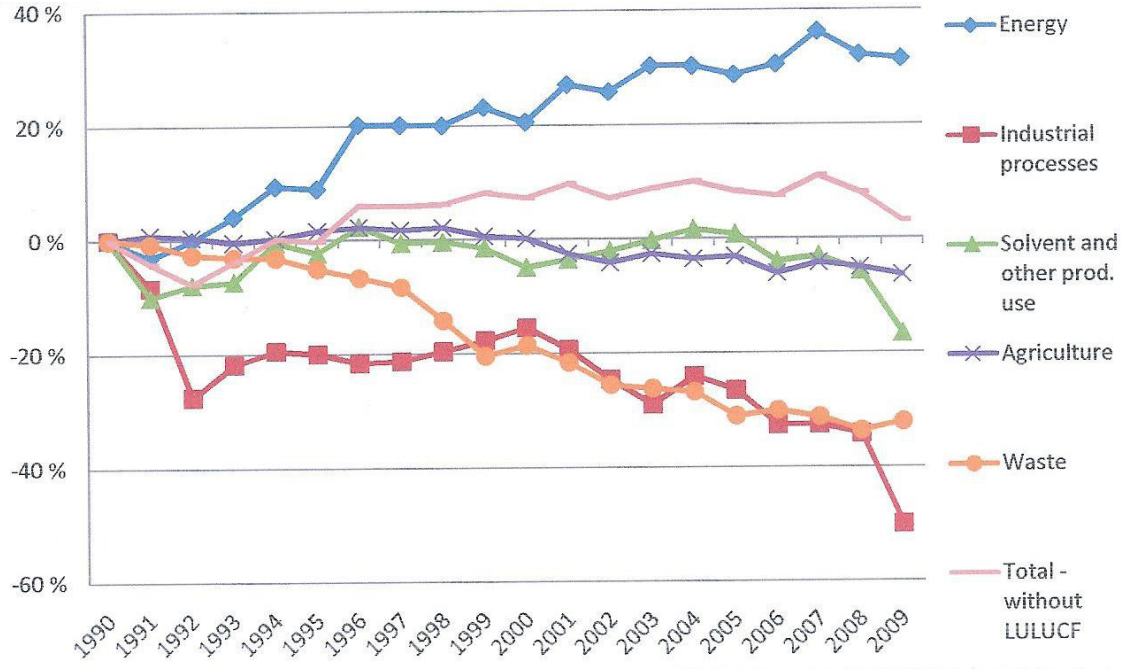


Figure 2 Relative changes in emission of greenhouse gases compared to 1990 aggregated to the IPCC reporting categories. Source: Statistic Norway/Klif in National Inventory Report 2011

The relative share of CO_2 equivalent emissions in 2010 are shown in Figure 2.

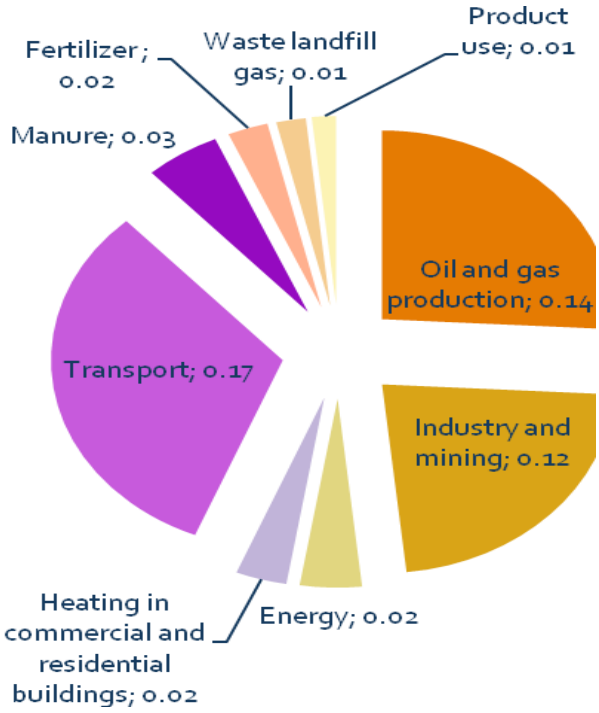


Figure 3 Emissions of CO_2 equivalents (million ton) in 2010 by source. Source: Statistic Norway/Klif

Norwegian policies influencing greenhouse gas emissions

The principle of cost effectiveness has a particularly strong hold in Norway and application of this on an international basis has been advocated. A national CO_2 tax and support for the flexible mechanisms under the UN FCCC have thus been a basis for climate policy. Many emitters have, however, had exemption from the CO_2 tax and other measures including voluntary agreements, inclusion in the emission trading system, support for research and development are implemented to correct this. This overview is not intended to be comprehensive and cover all possible direct and indirect measures influencing GHG emissions but rather to give a background for the selected measures described in the next chapter.

A number of policies may influence the emissions of GHG. Some policies are focused on local or regional problems or improving energy efficiency, but the implementation also reduces the emissions of GHG. Examples of such policies are parking restrictions and road use taxes. On the other hand, there are also policies targeted at improving local or regional air quality, which increase emissions of GHG. Use of catalytic cleaning of exhaust gas on gasoline cars increases N_2O and while diesel cars generally have lower specific CO_2 emissions, particle emissions are higher than for gasoline cars. Technological development is causing both specific CO_2 emissions and particle emissions from gasoline and diesel cars to merge. This is also an example of how technological development may change the order of best practice measures in the future compared to history.

1.1 Taxation

Taxation of emissions of pollutants is one of the backbones of Norwegian environmental policy. Norway introduced a CO_2 tax in 1991 and has changed both the level and the basis for the tax several times since then. Introduction of the emission trading regime has partly replaced the CO_2 tax. Today about 50% of national GHG emissions are subject to a CO_2 tax and the share is expected go down following an expansion of the emission trading regime. While industries included in the emission trading regime get the CO_2 tax refunded when buying feedstock from industries not included that have been charged with a CO_2 tax, offshore petroleum production is subject to both a CO_2 tax and an emission allocation in the emission trading scheme. Taxation is also levied on purchases of new cars, the amount of waste deposited, non-recyclable bottles with content for human consumption, emissions of HFK and PFK and electricity supplied to consumers. The level of the CO_2 tax in 2011 is listed in table 1.

Level of CO_2 tax in 2011	
Petroleum production NOK/litre or Sm^3	0.48
Mineral oil, NOK/litre	0.59
Mineral oil used in national air transportation, NOK/litre	0.69
Mineral oil used inwood processing- and fish flour industry, NOK/litre	0.31
Gasoline, NOK/litre	0.88
Natural gas, NOK/Sm3	0.44
LPG, NOK/kg	0.66

It is, however, the total level of taxation that determines the strength of the incentive. The road usage taxes for gasoline and diesel in 2012 were 4.54 NOK/l and 3.56 NOK/l respectively. For heating oil a basic tax at 0.999 NOK/l plus tax on sulphur emissions and NOx emissions will determine the total incentive. While the sums of these taxes are larger than the CO_2 tax the difference is less than for automobile fuel.

The threat of direct regulation or taxation is sometimes as effective as the tax itself. This is an important element when negotiating voluntary agreements on GHG emission reduction with the industry.

Direct regulation

Several laws may influence GHG emissions. The pollution prevention law in Norway is designed so that the emitter of a pollutant above a specified limit must apply for an emission permit. The permit is based on an individual evaluation. CO_2 is, after some debate defined as a pollutant. This was important in order to apply the pollution prevention law to demand the installation of carbon capture and storage at gas power plants.

All new buildings and renovation projects requiring a building permit must meet the standards of the current building code. The building code gives energy efficiency requirements for the building. The requirements have been stiffened and the calculation method has moved from only specific insulation requirements to also include performance standards from 2007. It is planned to further strengthen the requirements to achieve passive house standard within the next decade. The building code also includes environmental requirements where the particle emission requirement for wood burning stoves also increases the energy efficiency of the stove. All commercial buildings and housing that is sold must have an energy label. The energy labelling scheme focuses on the amount of delivered energy rather than the standard of the building itself.

The road traffic law regulates emissions from cars. Emission standards for NOx are included here.

The national planning law may be applied to reduce the overall need for transport as well facilitating the market for public transport.

Research, development and deployment

Research, development and deployment support includes several research programmes and the new certificate market for electricity production in Sweden and Norway. The government agency Enova also administers a fund providing investment support for new technologies and energy efficiency measures. While research and development increases the pool of opportunity, deployment is necessary to obtain cost reductions through technology learning and emission reductions.

Selected best practice measures

A summary of the policies are given in Table 1.

Table 1 List of policies together with classification and criteria. The type of instrument is indicated by a capital letter and the criteria by a roman letter corresponding to the list at the end of the document.

Title of policy	Type	Criteria
CO_2 tax on emissions from oil and gas production	D	I
All new gas-fired power stations must have carbon capture and storage	M	II
Emission quota on N2O emissions from fertilizer production	E	I
Automobile purchase tax	D	II
Incentive for increased deployment and use of electric vehicles	J	II
Voluntary agreement with the industry	S	I
Outlawing and taxation of biodegradable waste deposited in landfills	M	I
Stricter requirement for insulation of buildings in the Building Code	L	III
Economic support to replace oil-fired boilers for heating	H	V, VIII
Government grant for public transport to cities implementing measures to reduce automobile use	B	II
Industrial energy efficiency network	I	III, VII
Compulsory evaluation of alternatives to new large road projects	B	II, V, VIII

CO_2 tax on emissions from oil and gas production (D)

The CO_2 tax when introduced in 1991 had a significant influence on emissions from oil and gas production. A number of measures with a net cost up to the level of the tax were implemented. The emission reductions from elimination of a continuous safety flare and underground deposition of CO_2 extracted from the gas produced at Sleipner are large. The stored CO_2 at Sleipner varies around 800 ktons per year. The elimination of the safety flare is possible because of the development of an ignition device sufficiently fast to assure that any outburst of gas does not pose danger of explosion. Both measures applied new and advanced technology, were important in terms of the image of the industry and offered the potential to export the technology and thus to generate of new business. However, the process of separating the CO_2 from the natural gas at Sleipner is not directly comparable with separation from flue gas because of its high CO_2 content and high pressure.

Emission quota on N2O emissions from fertilizer production

Emissions of nitric acid used in the manufacture of fertilizer were subject in the 1990s to an emission permit for N_2O emissions. As the emission trading scheme was developed and discussed it was clear to the industry that N_2O, which is a powerful greenhouse gas, was to be included. The expectation and later allocation of emission quotas initiated development of cleaning technology. The emission quota is the main policy causing the observed reduction in annual N_2O emissions of about 4.7 ktons from the year 2000 until today. Given a global warming potential of 310 this equals about 1.5 million tons of CO_2 equivalent.

All new gas-fired power stations must have carbon capture and storage (M)

The history of introducing gas power plants into the Norwegian energy system has mostly been a struggle of symbols, though important. The government policy requiring carbon capture and storage (CCS) to be fitted from day one of operation has had a preventive effect. This is true despite the fact that exemption from the requirement has been granted to other large facilities using gas for energy generation. The test centre for CCS has not provided results in the time expected and the gas power plant is on standby rather than production because electricity prices are currently too low.

Automobile purchase tax (D)

Norway has always had a substantial car purchase tax. The tax base was initially related to the cost and size of the car. In the last decade there has been a shift towards using specific CO_2 emissions as a parameter. Several revisions have increased the relative weight of the CO_2 emissions. This has led to changes in the retail prices of cars in the order of 10 000 – 30 000 NOK. Electric cars have been exempt from the purchase tax altogether. The new plug-in hybrid cars led to considerable discussion over the level of purchase tax. For cars with emissions lower than 50 g/km an additional tax rebate has been introduced to make sure these cars will not experience a price increase.

This has increased the demand for new cars with low specific emissions and reduced the average specific emission of CO_2 from cars in Norway from about 180 g/km in 2006 to 140 g/km in 2010. The specific emissions of CO_2 exhibit a reduction of 22%. Because new cars are generally used more, the total CO_2 emission reduction in 2010 compared to 2006 caused by the policy may be up to 25% or 1.4 million tons. The observed reduction in the emission inventory will be less because, for instance, the number of vehicle kilometres has increased. The policy will influence emissions for more than a decade into the future.

A prerequisite for this policy is some sort of purchase tax. Moreover, the reduction would most likely not have taken place without the pressure for technological development from the EU to reduce specific emissions of GHG from cars. This is thus an example of concerted action where demands on the industry are pushing technological development and measures to increase demand in the market are working together.

Incentive for increased deployment and use of electric vehicles (J)

Fully electric cars have been granted the right to drive in the separate bus lane for public transport and thus avoid getting stuck in traffic jams. They are also exempt from purchase tax and highway road toll, have free parking with charging possibilities. These benefits have been highly valued between Oslo and the western suburbs with a large population with two cars per household and a daily traffic jam as well a bus lane in between them. The latter is probably the most important reason for the high per capita share of electric cars in Norway. As of the end of March 2012 there are 6242 electric vehicles in Norway. The average CO_2 emissions for the national car fleet are about 140 g/km and if we assume 10 000 km/year, the reduction in emissions is 9 ktons/year. The number of electric cars in Norway is growing and in September 2012, 5.2% of all cars sold in Norway were electric. It has recently been decided that these benefits will be retained through the next government period (2013 – 2017) unless the number of electric cars increases above 50 000.

While the annual GHG reduction is limited up to now, the niche market created by the policy has been important for development of the technology and thus increasing the future potential emission reduction. It is also an example of how concerted action by various actors, e.g., the ministry of finance, ministry of transportation and local authorities works together to increase the influence of the policy.

Voluntary agreement with the industry (S)

Several agreements were negotiated with different industries. One example with good results is described here. The substantial reductions in emissions of SF_6 in the industry are mostly a result of a voluntary agreement. Its application to electrical equipment has exhibited particularly good results. The SF_6 gas is captured from the electrical equipment when serviced or at the end of its lifetime and recycled. The measure has initiated increased awareness, better registration and control routines. RENAS is a firm chosen by many companies to handle their commitment to recycle the gas. The emission reduction obtained by the measure may be illustrated by the rapid drop from 13 tons in 2005 to a stable level of around 3 tons from 2007 onwards. A reduction of 10 tons of SF_6 is equivalent to about 228 ktons of CO_2 equivalents. Some of the reduction may be reduced consumption because of the cost to cover collection and recycling or destruction. The accumulated collected amount is 21 tons for the period 2002–2010. Negotiating this type of policy is probably most successful when there is a threat of applying other measures, e.g., direct regulation.

Outlawing and taxation of biodegradable waste deposited in landfills (M)

The deposition of easily degradable organic waste including wastewater has been forbidden since the early 1990s. A deposition fee was also introduced. Deposition of organic biodegradable waste in landfills has been forbidden since 2009. It is, however, a possibility to apply for an exemption and if granted a charge is levied at 447 NOK/ton of waste deposited. The amount of biodegradable waste deposited in landfills is significantly reduced. More-

over, the policy also includes a requirement to extract and burn the methane. Lately many communities have households sort the waste in order to separate the wet organic waste to optimize the methane generation and use it, e.g., for transport. The reduced emission of methane by the policies is not estimated. Annual emissions of CO_2 equivalents was reduced from 1.8 million tons in 1990 to 1.2 million tons in 2010. A further indication may be obtained from the amount of reduced emission of methane from old landfills.

Methane from abandoned landfills is extracted and burned. The methane may also be used for energy purposes where it may replace fossil fuels and reduce the emissions further. Methane emissions collected in 2010 totalled 19415 tons, equivalent to 408 tons of CO_2. The accumulated reduction in emissions since extraction of methane from landfills started in 1988 is 72.5 million tons of CO_2 equivalents.

Stricter requirement for insulation of buildings in the Building Code (L)

Energy-related standards in the building code were first introduced in code of 1949. Requirements for insulation of new buildings and refurbishment where a building permit is required have gradually been tightened. These apply to insulation thickness in all parts of the building shell as well as windows. In 2007 the approach to energy performance of the building increased, more components were subjected energy requirements and the energy performance of the building as a whole with respect to energy demand was included. Moreover, the need for cooling must also be taken into account. With the 2010 revision of the building code one may either apply computer modelling of the energy balance for the building or meet a specific energy requirement or standard for the components, e.g., insulation thickness and specific heat loss values for windows. The specific energy consumption in new individual residential houses has been reduced from more than 400 kWh/m^2 to the new standard (Tek 10) specifying a calculated average of about 100 kWh/m^2 today.

The new building code also prohibits the installation of oil-fired boilers in new buildings and requires part of the demand for heating to be met by other renewable energy forms than electricity.

Electricity is the dominant energy form for heating and nearly all electricity is produced by hydroelectric power. Under the IPCC GHG reporting guidelines there are no emissions. However, a large portion (currently about 60%) of the electricity generated in Norway by hydropower is committed to customers outside Norway through green energy certificates. If an average of the energy mix sold at the Nordic power exchange and certificates of origin is used the emission factor will be above zero. A value of 0.25 kg CO_2/kWh is suggested for measuring the energy performance of housing. While increased energy efficiency is valuable, the reduction in emissions of CO_2 under Norwegian policy is difficult to estimate and the answer will to a large extent depend on the method chosen.

Economic support to replace oil-fired boilers for heating (H)

The city of Oslo has since 2008 provided direct economic support to residents willing to replace oil-fired boilers for heating with alternatives using bio-energy, heat pumps, solar thermal energy or connection to the district heating network. The level of support depends on the choice of technology as well as the size of the building in question. The oil storage tank, pumps and other equipment must be removed. This is to make sure it impossible to convert back to fossil fuel at a later stage. The estimated emission reduction was 9.5 ktons of CO_2 in 2010.

Government grant for public transport to cities implementing measures to reduce car use (B)

The transfer of travel from cars to public transportation and meeting the projected increase in transport needs by public transportation reduces a number of environmental problems. This includes reduced emissions of GHG. Increased service by public transportation facilitates this. It is, however, acknowledged that measures to constrain car use are required. A government grant providing funds for public transport is therefore awarded to those cities implementing measures to constrain private car use over and above the average. Upon receiving the grant a quantified commitment to reduce car traffic and estimates of CO_2 reduction is agreed. Car traffic is monitored by counting the annual number of cars passing the local road toll stations. In the city of Trondheim, where it has been most successful, a 10% reduction in car traffic has been observed. While the target was a 20% reduction in CO_2 emissions, the results have not been quantified because of uncertainty in the estimates.

Industrial energy efficiency network (I)

A network for industrial energy efficiency was established in Norway in the 1980s. Participating companies receive economic support for selected energy efficiency measures. In return they are committed to report their specific energy consumption to a secretariat that provides feedback on their performance relative to other companies within the same type of industry. Later interactive Internet portals were established where a company may enter its data and get immediate feedback on its performance compared to a benchmark. Moreover, companies that have implemented a system for energy management according to ISO 50001 had about 5% lower specific energy use. The network is operated today by a consulting company under contract with the government agency Enova. The reduced energy consumption may influence several energy forms including fossil fuel. Estimating the reduced emissions of GHG is thus not possible.

Compulsory evaluation of alternatives to new large road projects (B)

A number of policies have been implemented to reduce environmental pollution from transportation. These include urban planning, road taxation, reduced parking availability in cities and improved public transport. The aim of the policies may vary and reducing emissions of GHG is most often only

one positive effect. Recently a new law has been implemented in Norway demanding a separate evaluation of alternative ways to meet a need for transportation underlying the proposal for new large road projects. While the immediate effect may be small it has a long-term potential to shift the mindset of planners. As in energy systems analysis, where demand for energy service is the objective rather than the need for energy carriers, analysis of the transportation sector is forced to focus on the need for transport services. Removing the need for transport through better urban planning may be the preferred solution.

Guide to categorization and criteria

A. Overall climate and energy policy
B. General planning, including urban planning. (e.g. city planning to optimize for public transport and heating with district heating)
C. Energy planning
D. Energy and CO_2 taxes
E. Emissions trading
F. Operational (running) support for renewable energy: feed-in tariffs, certificates etc. support for biogas used in gas grids, etc.
G. Investment support for renewable energy
H. Investment support for fuel shift in buildings
I. Investment support for energy efficiency
J. Support for clean/electric transport
K. Support for R&D and demonstration projects for renewable energy, energy efficiency, energy system integration etc.
L. Building codes/building regulation
M. Requirements, such as mandatory energy efficiency labelling of houses
N. Energy efficiency requirements for energy suppliers (used in Denmark. "White certificates" is one form, used for example in the UK and Italy.)
O. Promotion of smart grid technology which enables more use of renewables.
P. Consumer information activities on energy efficiency and renewable energy
Q. Technology procurement for energy efficiency and renewable energy
R. Specific support for development and implementation of GHG mitigation in (high-emission) industrial processes
S. Voluntary agreement with industry for emission targets

I. Large GHG cuts
II. Future potential for GHG reduction
III. Saves significant energy
IV. Replicable
V. Compatibility with other environmental targets
VI. Social welfare
VII. Cost-effective
VIII. Positive side-effects

POLAND

Instruments For Climate Protection In Poland

Zbigniew M. Karaczun
Department of Environment Protection SGGW[89]
Polish Ecological Club – Mazovian Branch member of Polish Climate Coalition

1. Introduction.

The official position of the Polish government regarding climate protection is shaped mainly by Poland's dependence on hydrocarbon fuels, primarily coal. Although it has declined in importance in the last twenty years (Fig. 1) Poland still depends on coal, which remains the key energy source. The balance of fuels presented in the figure below does not fully reveal this dependence – in reality about 90% of electric power is generated from coal, and as for heating, coal's share in its generation is only slightly smaller amounting to 76% in the year 2010![90]

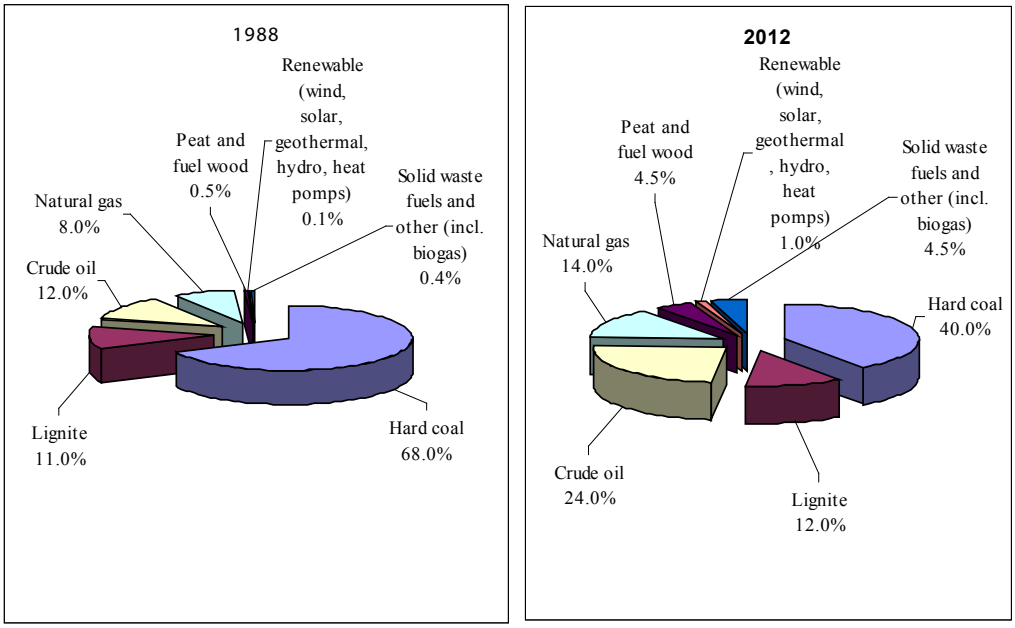


Fig. 1 Share of primary energy commodities in Poland 1988–2011 (source: own calculation based on statistical data[91]*)*

Despite the fact that in the last 25 years Poland has made great progress in environmental protection, activities related to climate protection have never been given priority. The significant reduction in greenhouse gas emissions was rather a by-product of actions undertaken for other purposes. On the threshold of the 1990s the priority was on modernising heavy industry and developing the free market, and later on reducing air pollution.

89 zbigniew_karaczun@sggw.pl

90 Urząd Regulacji Energetyki, 2011: Energetyka cieplna w liczbach 2010. URE. Warszawa

91 GUS, 2013: Ochrona środowiska. Statistical Yearbook. GUS. Warszawa

The attempt to develop a more active climate protection policy at the beginning of the 21st century was successful to some extent only. The government approved a document entitled "*Poland's Climate Policy. The Strategy of Greenhouse Gases Emission Reduction by Year 2020*"[92] with the goal of a 40% reduction in emissions by 2020 compared to emissions in the base year (1988). But in practice the document was stillborn, with no effort made to meet the objectives adopted therein. Since then the Polish government has consistently evaded proposing any ambitious goals related to greenhouse gas emissions.

An example of such an attitude was the Fifth Government Report for COP UNFCCC[93] published in 2010. Its opening statement was as follows: "... *Economical and political changes that have been taking place since 1990 resulted in the emission of GHG that is far below the level adopted by Poland in the Kyoto Protocol. Between 1988 and 2007 emissions of greenhouse gases decreased by 29.3% (...).* ***As a country that has been modernising its economy, Poland forecasts an increase in emissions of greenhouse gases.*** *The reason for that being the kind of available key fuels (hard coal and lignite), which impedes further emission reduction by switching to natural gas or not existing in Poland nuclear power...*". In the Fifth Government Report Poland limited itself to "...*joining the effort of the international community aimed at protecting global climate...*". This goal is identical with the one adopted in 1991 in the First Ecological Policy of Poland[94]!

In the draft of the latest Draft Sixth Report of the Government of Poland for COP UNFCCC[95] the government demonstrates a rather sceptical view on the possibility of emission reduction: "... *in 2011 national emissions of greenhouse gases (excluding the sector of land use change and forestry) were lower by 29.6% comparing to the base year 1988. This was a result of a whole range of actions aimed mainly at improving the efficiency of energy use and changing the structure of fuel and energy carriers use. In the reporting period (2008–2011) emissions of greenhouse carriers, expressed in carbon dioxide equivalents, started to grow by 1.9% after a period of decrease. This is caused by economic growth and the structure of fuels used (hard coal and lignite), which impedes further emission reduction* ...". At the same time however, the report presents in a more detailed way instruments of climate policy. The aim of this paper is to analyse them and to choose the ones that can be described as the most effective and efficient.

92 *Polityka klimatyczna Polski. Strategie redukcji emisji gazów cieplarnianych w Polsce do 2020 roku.* Ministerstwo Środowiska, Warszawa, Październik 2003 r. Document adopted by the Council of Ministers on October 4th, 2003. http://manhaz.cyf.gov.pl/manhaz/links/Poland_climate_change/polityka_klimatyczna.pdf

93 Rzeczpospolita Polska, 2010: Piąty raport rządowy dla konferencji stron Ramowej Konwencji Narodów Zjednoczonych w sprawie zmian klimatu. MŚ. Warszawa

94 Ministerstwo Ochrony Środowiska, Zasobów Naturalnych i Leśnictwa, 1991: Polityka ekologiczna Polski. MOSZNiL. Warszawa

95 Ministerstwo Środowiska, 2013: Projekt szóstego raportu rządowego dla konferencji stron Ramowej Konwencji Narodów Zjednoczonych w sprawie zmian klimatu. MŚ. Warszawa [Draft Sixth Government Report for COP UNFCCC (further in the footnotes referred to as "VI Raport Polski...." ["Draft Sixth Government Report ..."]). At present the draft is available only in Polish

The evaluation is based on the opinions of representatives of Polish ecological organisations that are active in climate protection or in selected areas of environment protection. Due to the rather detailed scope of the evaluation particular respondents did not express their points of view on all instruments, but only on those they were familiar with and could assess the effectiveness of. After initial evaluation and selection of the most effective tools, the results were reached in consultation with representatives of NGOs. The final results of the selection are presented in the summary.

It should be born in mind, however, that the selected instruments cannot be deemed unequivocally as the most effective or efficient in greenhouse gas emission reduction in Poland. Rather than that they are instruments that currently have the biggest potential to be implemented and offer solutions to selected problems of environment protection (and as a result help to reduce GHG emissions). Hence their description contains information on conditions that have to be fulfilled for them to be effective in climate protection.

2. Climate protection instruments: currently used and designed for future use according to the Draft Sixth Government Report for COP UNFCCC

The text below discusses tools and instruments described in the "*Draft Sixth Government Report ...*" in reference to the key sectors of the economy.

2.1 Transport.

GHG emissions produced by transport have been growing at an almost steady pace since 1988 (Fig. 2) and in the year 2011 amounted to 47,987 Gg $CO_{2\,eq}$, i.e. 12% of the total GHG emissions in Poland in 2011[96]. Such a huge impact can be ascribed mainly to an explosive growth in the number of vehicles. Emissions produced by road transport constituted 98% of all transport emissions in 2011[97].

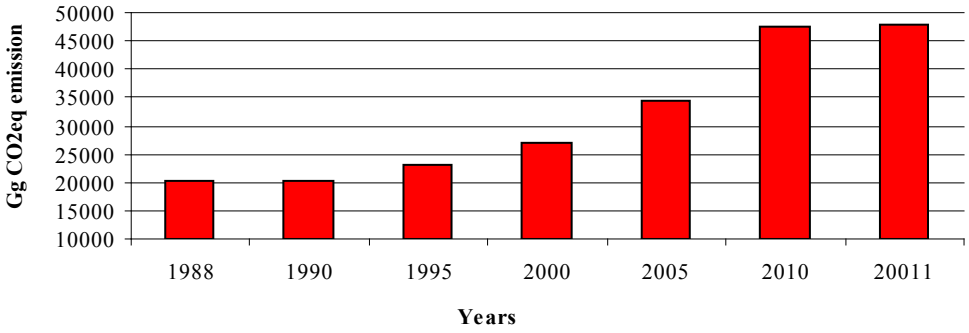


Fig. 2 CO_2 emissions by transport (1988–2011) (source "Draft Sixth Government Report ...")

96 In 2012, GHG emissions from transport increased by 1.4% to 48,572 Gg $CO_{2\,eq}$ (data according to: GUS, 2013: Ochrona środowiska. Statistical Yearbook. GUS. Warszawa)

97 Ministerstwo Środowiska, 2013: VI Raport Polski ... Ibidem

For a long time reducing pollution generated by transport has not been a priority. Transport development concentrated mainly on expanding the existing road network. The authors of the *"Draft Sixth Government Report..."* state[98] that between 2007 and 2013 one of the key priorities was *"... linking key economic centres in Poland by a network of motorways and express ways and modern railroads..."*. As for the road network development, the plans are being implemented, but the railroads lag behind. Hence it can be expected that as a consequence of such policy there will be a further decrease in passenger and cargo transport by rail, and consequently, significant growth in emissions generated from road transport (Fig. 3)

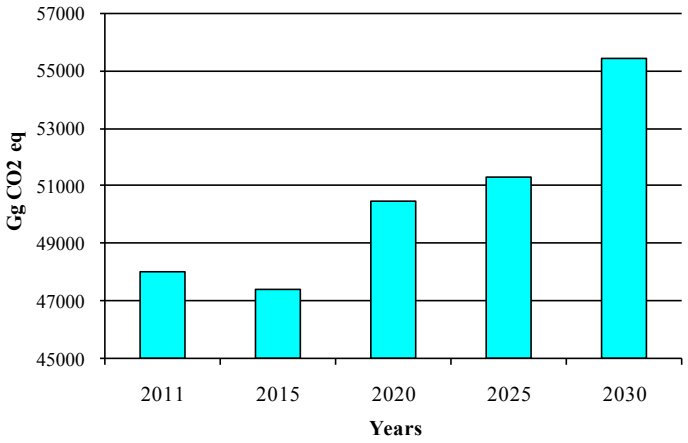


Fig 3. Forecast of CO_2 eq emissions generated by transport 2011–2030 (source "Draft Sixth Government Report ...")

The growing number of vehicles became the principal source of emissions of nitrogen oxides, which in urban areas are to be blamed for the bad quality of air and pollution that exceeds acceptable norms (mainly NO_x and ground-level ozone).

Among the areas of actions that were undertaken and that are proposed to reduce the burden transport puts on environment, the authors of the *"Draft Sixth Government Report..."*[99] indicate first of all the following: stricter norms on emissions for internal combustion engines related to the implementation of the Regulations (EC) No 443/2009 and (EC) No 510/2011; the introduction of different fees for circulation on national roads; the launch of a system informing consumers about CO_2 emission level and fuel use; and social campaigns aimed at boosting social acceptance for not exceeding speed limits[100] and ensuring the good technical condition of vehicles. Detailed information on the instruments presented in the *"Draft Sixth Government Report..."* and evaluations of their efficacy by NGO experts are presented in the table below.

98 Ibidem, p. 64

99 Ibidem

100 Unfortunatelly the camapign has reached only limited results. However, the Polish police undertook various activities to ensure compliance with speed limits on the roads.

Table 1. Evaluation of instruments for the reduction of GHG emission from transport proposed in the "Draft Sixth Government Report ..."

Description of emission reduction instrument	Average score of experts' evaluation[1]	
	Level of implementation	Efficacy of emission reduction
Different fees for circulation on national roads depending on the level of exhaust emissions of a given vehicle	4	3
Instrument implemented only for heavy good vehicles under Viatoll system. It covers only about 1% of public roads. There are even some toll motorways that are not within the Viatoll system, and don't apply different fees. The instrument should encourage purchasers of new lorries and trucks make their choice based on efficiency and profitability. So far this has been done on such a small scale that it does not result in any significant emission reduction.		
Fees for using combustion engine fuels from non-renewable sources.	3	1
The instrument has not had much impact due to lack of publicity. The environmental impact of the fee (similar to excise tax) is further diminished by the fact that income obtained from its collection is used to build new roads with more traffic on them. This is essentially why the instrument will not reduce emissions.		
System to inform consumers about fuel use and CO_2 emissions in new passenger vehicles.	3	2
Instrument implemented in theory. In practice it is used in the wrong way by car dealers (the information is either not shown or not visible enough) and therefore does not influence the choice made by consumers. The use of this instrument is not practically monitored (many ads do not contain the required information at all).		
Obligatory monitoring of exhaust emissions during vehicle technical inspection.	3	3
The efficacy would be high if such inspection were done in a scrupulous way. In passenger vehicles it is hardly ever conducted (the problem is inadequate compliance with existing standards).		
Financial support for purchasing ecological vehicles under regional operational programmes and the Green Investment Scheme.	3	2
In practice applied only in the case of public transport in cities. National Fund for Environment Protection and Water Management launched GAZELA scheme that allows for financing such purchases.		
Stricter emission standards for internal combustion engines.	2	2
Vast majority of vehicles in Poland are old. Emission standards are introduced only to adjust to EU requirements. Poland is not in favour of stricter emission standards for new vehicles.		
Tax relief on LPG and biocomponents for internal combustion engines (dehydrated alcohol, ethers and esters).	2	2
Recently the incentives to use LPG and biocomponents have been significantly reduced. Due to the low cost of LPG it is widely used, mainly in passenger vehicles including taxis.		
Promotional prices of gas fuel, mechanisms supporting the construction of equipment for biocomponents and biofuels production, or their advertising (biofuel production for own use, excise tax).	5	0

1 Score 1 – 2: instrument has either not been implemented, or it's not effective in emission reduction; score 3 – 4: instrument not sufficiently implemented and moderately effective in emission reduction; score 5: well implemented instrument with high efficacy in GHG emission reduction. For better legibility of the table blue colour marks instruments of moderate implementation and efficacy, and green – fully implemented and very effective instruments. White colour is for instrument of low efficacy or not implemented.

Description of emission reduction instrument	Average score of experts' evaluation[1]	
	Level of implementation	Efficacy of emission reduction
Poland has not introduced any criteria for sustainable production of biofuels in spite of EU requirements to do so (the deadline was December 2010), but it maintains a high level of obligatory share of biofuels in fuel mix. Its aim however is to support national producers of biofuels, and not mitigate GHG emission. Emission calculations are not conducted, and Poland objects to the introduction of such an obligation at EU level.		
Enhancing the efficiency of fuel use in new cars, heavy goods vehicles and buses (development of electric plug-in motors and hybrid engines in buses).	3	3
Support is given almost exclusively to hybrid buses. Electric vehicles, if they are purchased at all, are generally used in pilot schemes. The purchase of vehicles can be financed under the GAZELA scheme (which, however, is not technologically neutral, and as a result does not assure the greatest reduction possible). It should be kept in mind though, that Poland is an important manufacturer of hybrid buses (Solaris).		
Social campaigns on the environmental impact of transport.	3	2
Communication activities are neither planned nor run as part of a consistent strategy. Campaigns are few, usually local, with little media coverage. Their efficacy is not monitored. There are subsidies ascribed to such informational activities, but the criteria for granting them are not too clear.		
Reducing speed limit for internal combustion engine vehicles in urban areas.	3	2
Theoretically there is a speed limit in urban areas of up to 50 km/h (at night 60 km/h), in practice, however, there are many streets with speed limits of 70–80 km/h, and exceeding the speed limit by up to 10 km/h is a tolerated practice. There is no effective monitoring of vehicles' speed or infrastructure to impose safe speeds, which does not encourage observance of the speed regulations.		
Modernisation of railroad infrastructure (including railway stations), retrofitting the existing rolling stock and purchasing new stock (almost 90% of trains use electricity).	4	3
Railway stations and rolling stock have been the first to be modernised. Upgrading of railways has been far too slow. As a result the share of railways in transport, especially goods transport, has been continuously decreasing.		
The introduction of light railway vehicles, e.g. railbuses for local passenger traffic.	3	3
Activities in this area flourished after Polish accession to the EU and financing obtained from EU funds. Nevertheless the popularity of this means of transport remains too low.		
Adjusting the number of railway cars or trucks to match actual needs and replacing traditional passenger trains with light railway vehicles on branches with less traffic.	3	3
The introduction of light vehicles reduces fuel consumption, and as a result brings down emissions. However, this is done only in those places where local authorities support such actions. Railway companies are more willing to suspend a given connection than work towards its optimisation.		
Modernisation of railway infrastructure to increase the speed and the frequency of transport.	3	2
The last two years were the first within nearly two decades when the introduction of new train timetables saw more sections of the tracks with improved speed parameters than those that actually got worse. But it should also be kept in mind that in December 2013 yet another group of railway branches was withdrawn from service. As a result the network density deteriorated, connections with neighbouring countries became sparser, and thousands of tonnes of freight had to be transported by road.		
Developing and adopting international rules on Energy Efficiency Design Index (EEDI) for newly built ships.	2	1
Activities aimed at designing Single European Sky (SES), Airport Carbon Accreditation (ACI).	2	2

Description of emission reduction instrument	Average score of experts' evaluation[1]	
	Level of implementation	Efficacy of emission reduction
Stricter emission standards regarding aircraft, economical use of aviation fuel.	1	1
Reorganising the system of airways.[2]	-1	-1
Many local authorities boast the ambition to build their own airports (with EU funding). As a result even in those locations that are absurd from an economic point of view, such ideas have been implemented. In consequence there may be an increased pressure on multiplying airplane connections.		
Introducing a system of incentives for people to use public transport.	3	3
Public transport in cities, on principle, has always been subsidised. But its quality varies depending on location: it is very high in richer cities (e.g. Gdynia, Cracow, Warsaw) and very low in poorer locations (Łódź, a part of the Upper Silesian Industrial Region (GOP)). Mobility management is implemented to a very limited extent. A lack of integration of fees and timetables reduces effectiveness. The overall share of public transport in total transport has been decreasing and the Strategy of Transport Development forecasts further drops. However, recently more and more towns and cities have realised that the quality of public transport is a major factor that has an impact on life quality. Hence attempts at its enhancement and optimisation as well as lowering costs by proposing one ticket for different means of transport, diversifying ticket types and prices, and even introducing free tickets for city inhabitants.		
Building bypasses (around cities and inside them) and improving road surfaces, as well as changes in traffic arrangement.	5	1
Many investments induce new traffic, and intelligent transport systems frequently favour private vehicles, which results in lower speeds for public transport or even discrimination against it. In addition they very often impair pedestrian traffic (e.g. introduce the need to press a button and wait a long time). Calculations of the carbon footprint for Poddębice and Starogard Gdański[3] reveal that such trends are present in small towns too, i.e. the traffic on the road that was supposed to get fewer vehicles stays at the same level, while the traffic on the newly constructed bypass is grows rapidly, following the principles of the Lewis-Mogridge Position.		
The growth of intermodal transport as an alternative to the dominance of road transport, thanks to the construction and modernisation of terminals, purchase of rolling stock, lower fees for access to railway infrastructure.	2	3
Preferential tariffs for intermodal transport were withdrawn a few years ago. The recommendation of the Office of Rail Transportation in February 2013 referring to the preferential prices proposed for this model of transport fell on deaf ears. As a result, intermodal transport is seldom used. Recently the spending on intermodal infrastructure has grown but it is not equally spread (hard to encourage transport from the East); the system is mainly westbound (to Germany).		
Law amendments, construction of cycle lanes, introduction of public bicycles for rent schemes, and promotion of the bicycle as a means of transport.	4	3
Recently bicycles have been gaining popularity; a breakthrough in this respect was the introduction of an urban bicycle scheme in Warsaw. Bicycle lanes and the network of paths have been growing rapidly. At the same time, however, the relevant secondary legislation is already two years late. In addition, the only permanent body for the central administration of bicycle traffic, the Team for Cycle Paths (Lanes) in the General Directorate of National Roads and Motorways, was disbanded in 2012. There is no monitoring of cycle traffic at the national level. The estimates made for the development of the Strategy for Transport Development reveal that in spite of visible growth in cycle traffic in big cities, the total number of cycle kilometres per year has been decreasing[4], due to the fact that cycle traffic outside big cities ebbs as a result of growing vehicle traffic intensity (local roads without cycle lanes become more and more dangerous). As a result of lack of quality standards at national level, newly built infrastructure impairs circulation conditions and is in fact discriminating against cyclists (e.g. cycle path surfaces are made of stone, so riding on this requires greater effort than riding on an asphalt surface and in addition it is not healthy due to vibrations; cycle paths are also disrupted at crossroads). As a result the significance of the support given to bicycles is low with regard to climate protection.		

2 Cells marked in red colour – this is the only instrument assessed as having a negative impact on GHG emission reduction.

3 This piece of information comes from the EU co-financed project "Klimat dla powiatów" under LIFE + and has been facilitated by the Institute for Sustainable Development.

4 Oral information obtained from one of the experts not verified by other sources.

Yet another instrument mentioned by experts and not described in the *"Draft Sixth Government Report..."* is paid parking in cities – practically self-financing and with big potential to reduce traffic. However, according to NGO experts its efficacy is curbed by the law on public roads, which stipulates the maximum parking fees[101]. Another tool that is not forbidden by the Polish law and could be very effective in reducing road traffic is levying tolls on vehicles that use bridges and tunnels.

2.1.1 Summary – transport.

In the light of the independent evaluation of experts from non-governmental organisations[102], bringing down emissions from transport requires an active public policy in the following three areas:

1. Improving fuel efficiency of vehicles (change construction elements, reduce vehicle weight, introduce new propulsion methods including electric drive);
2. Diversifying fuel mix (introduce second-generation biofuels, and widespread use of electric transport);
3. Promoting sustainable forms of transport (public transport, intermodal, cycle).

Spatial policy will also need changing to include preferential treatment for those solutions that reduce transport needs (e.g. avoid locating big shopping centres in city outskirts; prevent the sprawl of the urban areas). Hence the key instrument that can reduce the need for transport and is actually not mentioned at all in *"Draft Sixth Government Report..."* is spatial planning.

Unfortunately the measures proposed by the government hardly meet those needs. In the experts' view none of the currently used instruments described in *"Draft Sixth Government Report..."* aimed at reducing transport emissions is fully effective. The reason is either their insufficient implementation, or lack of consistency in their application and use. This situation raises concern, especially since, according to forecasts, unless effective actions are undertaken, GHG emissions in this sector will continue to grow rapidly.

The "Draft Sixth Government Report..." identifies the expected level of emission reduction for some instruments only (Table 2). For the overwhelming majority of the measures such forecasts have not been prepared at all.

Table 2. The forecast emission reduction level resulting from the use of selected climate policy instruments in transport (source: "Draft Sixth Government Report...".)[103]

Name of mitigation action	GHGs affected	Type of instrument	Estimate of mitigation effect CO_{2eq}/year (in Gg)		
			2015	2020	2025
Reduction in environmental nuisance of road freight.	CO_2, N_2O	Legal, financial, technical and educational.	2,241	3,247	4,983
Increase in the use of alternative fuels in transport.	CO_2	Financial.	Share of biofuels 7.10%	Share of biofuels 10%	nd

101 Currently, the parking fee for the first hour of parking can not be higher than 3 zł (approx. 0.7 euro). The fee for the following hours may not exceed 20 percent of the initial rate.

102 2050.pl. Podróż do niskoemisyjnej Polski. Pod red. M. Bukowskiego. Instytut Badań Strukturalnych i Instytut na Rzecz Ekorozwoju. Warszawa 2013.

103 VI Raport Polski… Ibidem p. 222 - 223

2.2 The building industry

In Poland, households are important consumers of energy. They use approx. 20% of final energy. About 76% of this energy is used to heat homes, 15% to heat water, and 9% to provide light, make meals and use household equipment and appliances[104]. It should be expected that energy consumption, and especially the consumption of electric energy will be growing because the housing rate per 1000 people in Poland in 2011 was 351, which places Poland as the last in the EU ranking of housing availability. The energy consumption *per capita* in Poland is also lower than the average in other EU countries.

The problem in this sector is low energy efficiency. In spite of introducing new heating efficiency standards, no major progress has been made in this respect. Poland is also late at transposing the relevant European Union regulations into the Polish legal framework. The "*Draft Sixth Government Report...*" presents a range of measures to be applied in Poland to mitigate emissions from this sector i.e.: enforcing requirements concerning energy efficiency standards in construction, obligatory evaluation of the energy performance of buildings, thermo-modernisation, and boosting the awareness of the owners and users of flats and buildings regarding energy efficiency. Detailed information on the measures proposed in the "*Draft Sixth Government Report...*", and evaluations of their efficacy according to experts from NGOs are presented in the table below.

Table 3. Evaluation of instruments for the reduction of GHG emission from construction proposed in the "Draft Sixth Government Report...".

Description of emission reduction instrument	Experts' evaluation	
	Level of implementation	Efficacy in emission reduction
Modification and extension of construction regulations related to thermal protection of buildings[1].	2	3
The instrument has a very high potential for bringing down emissions and yet it is not fully used due to its low level of implementation therefore its efficiency in emission reduction is currently weak. For example, despite knowing that the current system for evaluating the energy efficiency of buildings is inadequate, the Ministry of Economy has not changed the defective regulations. Harmonisation of Polish law with EU legislation is also delayed.		
Financial support for thermo-modernisation projects in existing buildings (Thermo-modernisation Fund).	3	4
The Thermo-modernisation Fund was one of the key measures for facilitating the reduction of energy demand in existing buildings. It was set up in the mid-1990s and enabled several thousand modernisation undertakings. Unfortunately, for the last few years there have not been enough financial resources to support such activities. There is a programme introduced by the National Fund for Environmental Protection and Water Management but it is very restrictive and demanding.		
Knowledge dissemination regarding activities leading to energy saving.	3	3
The Ministry of Environment has run a few information campaigns, but they were not very legible and they did not promote comprehensive solutions. Lack of analysis of the efficacy of the information campaigns.		

1 The new standards entered into force in January 2014.

104 VI Raport Polski... Ibidem

2.2.1 Summary– construction.

Energy demand in residential construction and municipal housing construction (approx. 320–340 TWh) exceeds transport demand (approx. 200 TWh), industry demand (160 TWh) and farming (approx. 60 TWh)[105]. As a result there is a great scope to reduce GHG emissions thanks to rational and more efficient energy use in this sector.

In the opinion of independent non-governmental organisations' studies[106], bringing down emissions from the construction sector requires active public policy in the following three areas:

1. Public support (direct subsidies, preferential loans, the potential for ESCO activities) for an extensive public programme of energy-efficiency building (about 75% of buildings in Poland need thermo-modernisation), with special focus on more detailed energy efficiency improvements to existing buildings, not just enhancing their thermal insulation;
2. Improvement of energy efficiency standards for newly constructed buildings;
3. Regulatory incentives encouraging the reduction of energy consumption of household electronic equipment, white goods, and lighting – both to support energy efficiency solutions and boost their demand;
4. Promotional and educational campaigns regarding energy efficiency.

According to the experts' evaluation, the applied and proposed climate policy instruments fulfil the above-mentioned criteria to a small extent only. In spite of verbal declarations about the need and possibilities for improving energy efficiency, there is lack of political will to support more impactful activities in this area. Harmonisation of Polish law with EU legislation has been delayed, and regulations are implemented in such a way as to limit the amounts of money spent from the state budget on efficiency-enhancing measures (e.g. new standards of heat demand in nearly zero-energy buildings in Poland are set at 70 kWh/m^2!).

The *"Draft Sixth Government Report..."* presents the forecast effects of emission reductions, but only those that are related to the thermo-modernisation of buildings. The implemented measures in this area are to mitigate CO_2 emissions by 15,673 Gg per year, and in the years 2020 and 2025 by 16,000 Gg CO_2 per year[107].

105 NP2050. Podróż do niskoemisyjnej Polski..... Ibidem p. 54

106 NP2050. Podróż do niskoemisyjnej Polski.....Ibidem

107 VI Raport Polski....Ibidem. p. 225

2.3 Agriculture.

In the year 2010, farms in Poland covered an area of approx. 18 million hectares, which constitutes approx. 58% of the country. Polish agriculture is marked by a relatively low intensity of farming. Most farms are small and produce mainly for their own needs. As a result the emissions from this sector are rather low. But in spite of this, agriculture has an approx. 9% share of total emissions, mainly N_2O emissions from land cultivation and CH_4 from animal breeding. Between 1988 and 2011, emissions from this sector decreased by approx. 31%[108] (Fig. 5). However, it is of great concern that the trend reversed upon Poland's accession to the EU and emissions started to grow, which can be explained by the increased intensification of farming and breeding activities resulting from gaining access to the single European market.

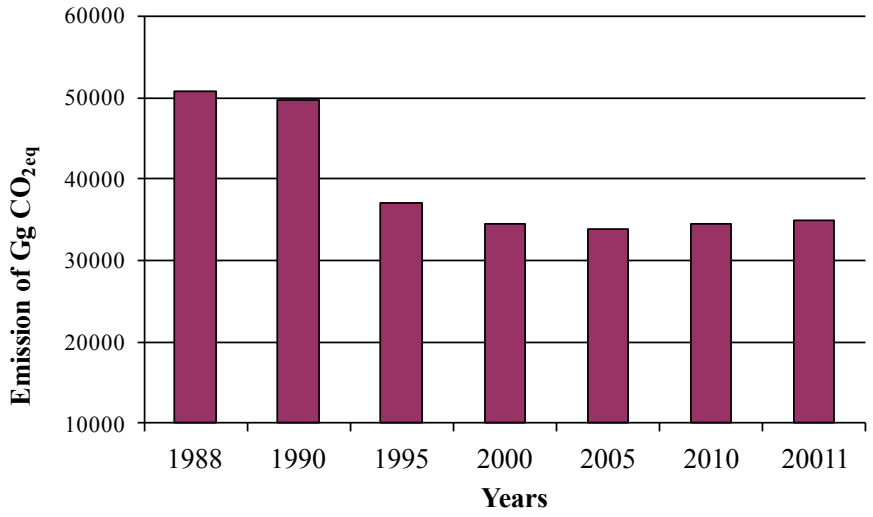


Fig. 5 Changes in emission from agricultural activity between 1988 and 2011 (source: "Draft Sixth Government Report... .")

As for the measures stipulated in the *"Draft Sixth Government Report..."* relating to this sector, the following directions have been indicated: more rational use of fertilisers, support for energy generated from biomass (waste, manure and slurry), the improvement of animal feeding and breeding techniques, reforestation of farming land and other types of land, preference for crops that have high carbon dioxide absorption, more rational management of arable land, elimination of emissions from farm buildings. Detailed information on the measures proposed in the "*Draft Sixth Government Report...*", and evaluations of their efficacy according to experts from NGOs are presented in the table below.

108 VI Raport Polski....Ibidem. 2. 220

Table 4. Evaluation of instruments for the reduction of GHG emission from agriculture proposed in the "Draft Sixth Government Report...".

Description of emission reduction instrument	Experts' evaluation	
	Level of implementation	Efficacy in emission reduction
More rational fertilising, reducing the N fertiliser dose to 170 kg/ha; advisory services related to fertiliser usage.	2	3
The 170 kg N/ha norm is applied only in the areas at risk of nitrates from agricultural sources. Most farms do not take any advice on fertilisers and have no fertilising schemes.		
Popularisation of agricultural biomass as energy source.	2	2
In the case of small installations the potential of this instrument is not used due to unstable legislation and lack of support for building a national market. As a result new investments are hardly implemented at all. Large amounts of waste biomass (approx. 2 million tonnes/year) are brought to Poland for co-firing in big coal facilities (including imported hardwood and waste biomass). Co-firing reduces the efficiency of energy production and reduces the scope for the development of renewable energy sources (70% of the public subsidies for renewables go to large coal companies which use co-firing).		
Construction of agricultural biogas plants.	2	4
There is a big potential in the announced implementation of the national programme for biogas plant development[1] (especially for small installations). However, in practice, the implementation is not there and lack of financial support limits the number of new installations.		
Support for building manure and slurry containers.	2	3
Activities were implemented upon Poland's accession to EU. Currently there is a lack of such support. However, there are legal provisions that require farmers to store manure and slurry in sealed containers throughout the period when their agricultural use is forbidden.		
The implementation of breeding schemes and precise feeding norms combined with increased efficiency, which allows reducing of the number of bred animals.	3	2
A measure aimed at lowering breeding cost. In practice this does not mitigate emission. The changes in the number of bred animals stem from market trends, and not the need to reduce GHG emissions.		
Reforestation of arable land and other types of land under the Rural Development Programme (PROW).	3	3
The reforestation scheme is no longer as dynamic as it was a few years ago. Nevertheless forest management is becoming more and more sustainable.		
Support for energy crops. Enhancing cultivation and harvesting technology and developing new technologies and new varieties of energy crops.	2	3
Due to lack of systemic support for renewable energy sources a strong stimulus for the development of energy crops is lacking.		
Obligation to follow good agricultural practices such as minimum soil cover, crop rotation within Common Agricultural Policy.	3	3
The obligation was introduced when adjusting Polish law to EU requirements. Agricultural services monitor if the law is being observed.		
Research on slowing down the process of the mineralisation of organic soil used as pastures and meadows through their hydration and reduction of groundwater outflow.	4	3
Poland has good research capacities related to effective soil protection and management.		
Popularisation of no-tillage cultivation methods to bring down gas emissions from the mineralisation of organic matter.	2	4
Due to the widespread cultivation of cereals the method has a big emission reduction potential. But it is implemented mainly on big farms, and since the prevailing majority of farms are small, the no-tillage method is applied to a limited extent.		
Research into methods of plant production and animal production that can reduce GHG emissions.	3	3
There is growing interest in such activity although the existing research potential is not fully used. Another issue is the risk that the new methods will not be implemented in agricultural practice.		

1 In January 2014 yellow certificates that support energy generated from gas (including biogas) were restored, which may provide a stimulus for biogas plants growth in Poland.

2.3.1 Summary – agriculture.

As previously mentioned, Polish agriculture is less intense than in other, more developed, EU countries. It is also less energy-consuming. But access to the European market and growing competition impose changes that will result in higher emission levels from this sector. Hence it is essential to support the activities that can stop the process. In the view of independent non-governmental studies[109] this will be possible thanks to the following measures:

1. Support for the right soil management (from the point of view of climate protection): intercropping, using crop residues as fertiliser ("green manure"), effective crop rotation with legumes as one of the crop types;
2. The use of crop residues to produce biogas and wider use of local energy sources (including solar energy and wind energy) to support agricultural production.

The potential of agriculture for emission reduction was noted in the *"Draft Sixth Government Report..."*. There are relatively many instruments to be applied in this sector. One of the reasons is the ecologisation of this sector conducted at EU level. A great number of instruments are introduced as a consequence of changes within the Common Agricultural Policy. However, the efficacy of the planned activities will depend mainly on the absence of strong pressure on increasing the competitiveness of agricultural production even at the expense of quality delivered to consumers.

The *"Draft Sixth Government Report..."* defines the expected level of emission reduction for selected instruments (Table 5).

Table 5. Forecast emission reduction stemming from the application of selected measures of climate policy in agriculture (source: "Draft Sixth Government Report...").[110]

Name of mitigation action	GHGs affected	Type of instrument	Estimate of mitigation effect CO_2eq/year (in Gg)		
			2015	2020	2025
Energy production from biomass and manure.	CO_2 CH_4	Legal, educational and research, organisational.	nd	nd	3.5 (CO_2) 0.01 (CH_4)
Improvements in feeding.	CO_2 CH_4	Legal, organisational.	nd	nd	0.8 (CO_2) 0.1 (CH_4)
Preference for crops with high uptake of CO_2.	CO_2	Legal, financial, educational and research.	ndn	nd	16.6 CO_2
New breeding methods.	CH_4, N_2O, NH_3	Research.	nd	nd	7.8 (CH_4) 0.3 (NH_3) 0.1 (N_2O)

109 NP2050. Podróż do niskoemisyjnej Polski.....

110 VI Raport Polski .... Ibidem p. 226 – 227. Reduction potential presented in the table is taken from "*Draft Sixth Government Report...*" and seems to be lower than actual.

2.4 Waste

Waste management remains an area where little progress regarding environment protection has been made. Although quite effective instruments for reducing the amount of industrial waste were introduced and businesses were effectively stimulated to recycle and re-use, there is still no efficient system for the management of municipal waste. The new regulations regarding this aspect were developed late – in 2010. They entered into force in 2013, and because of this it is too early to assess their effectiveness.

Greenhouse gas emissions from this sector continued to grow until the end of the 20th century and then dropped. Currently they are approx. 6.5% lower than in the base year for Poland (Fig. 6).

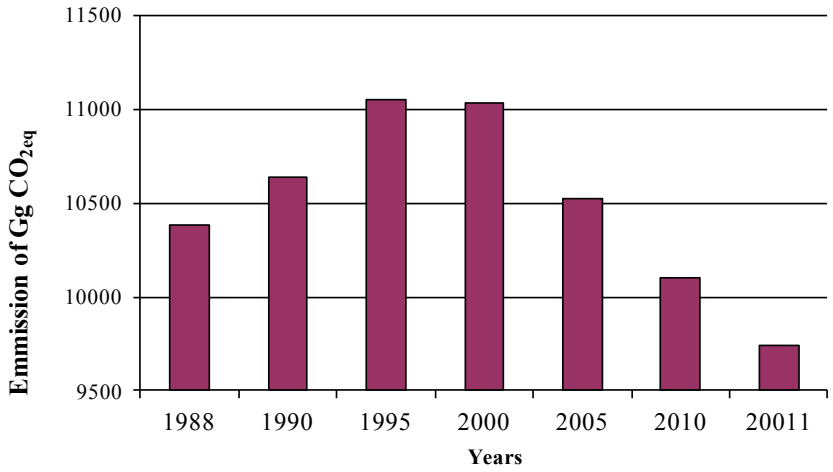


Figure. 6 Changes in emissions from waste management sector between the years 1988–2011 (source: "Draft Sixth Government Report...").

The basic activities aimed at bringing down GHG emissions from the waste management sector focus on decreasing the amount of waste produced and achieving the planned recycling rates for secondary raw materials set out in EU law. Detailed information on the measures proposed in the "*Draft Sixth Government Report...*", and evaluations of their efficacy according to experts from NGOs are presented in the table below.

Table 6. Evaluation of instruments for the reduction of GHG emission from waste management proposed in the "Draft Sixth Government Report ...".

Description of emission reduction instrument	Experts' evaluation	
	Level of implementation	Efficacy in emission reduction
Increased recycling of selected fractions of municipal waste. By the end of 2020 the level of recycling of paper, metal, plastics and glass and their preparation for re-use should be at least 50% of their weight (at present it is about 10%).	3	3
Before the year 2013 the level of recycling and recovery of raw materials was inadequate. The changed legal regulations lay good foundations for success in achieving the goals.		
Energy generation from thermal (waste combustion) treatment of waste and use of landfill gas.	2	2
The measure is not implemented to a sufficient extent. Most landfills are not equipped with installations for capturing landfill gas. Some landfills that do have such installations do not use landfill gas for energy production but just flare it. Currently there is just one incineration plant for municipal waste, although a number of cities plan to build more.		
Reduction of waste amount (biodegradable waste included) transported to and stored at municipal waste landfills.	3	3
Building municipal waste composting plants (for decomposition of organic substances by microorganisms under aerobic conditions) has been started, but it is not effective enough. Thanks to the new law it is expected that more efficient management of biodegradable waste will be possible.		

Summary – waste

As a result of lack of consistency in public policy, waste utilisation in Poland differed fundamentally from the EU average. Nearly all municipal waste was stored on landfills. As a result the emission level from this sector in Poland is three times higher than in Germany[111]. Poland is starting a journey whose aim is to reduce emissions from waste management. A new law enforced as of the beginning of 2013 raises hopes of achieving the planned level of waste recovery and recycling, which will bring down emissions from this sector. This is important, because according to studies[112] by independent, non-governmental organisations, the key directions of activities in the sector should be: reduction of waste production, recovery and recycling.

The *"Draft Sixth Government Report..."* defines the expected level of emission reduction for selected instruments (Table 7).

111 NP2050. Podróż do niskoemisyjnej Polski..... Ibidem p. 100.

112 NP2050. Podróż do niskoemisyjnej Polski..... Ibidem

Table 7. Forecast[113] emission reduction stemming from the application of selected measures of climate policy in waste management (source: "Draft Sixth Government Report...)[114]

Name of mitigation action	GHGs affected	Type of instrument	Estimate of mitigation effect "avoided" emissions
Increased waste recycling.	CO_2 CH4 N2O	Legal, organisational.	2015: 3,000–3,500 Gg CO_2eq 2020: 4,000–4,500 Gg CO_2eq
Waste as energy source.	CO_2 CH4	Legal, organisational.	374 Gg CO_2eq (in 2011)
Reduction of waste amount.	CO_2 CH4	Legal, organisational.	Emission reduction: 2015: 383–766 Gg CO_2eq 2020: 345–728 Gg CO_2eq

2.5 Power industry

Power generation is the main source of greenhouse gases emissions in Poland. It is also responsible for major air and water pollution as well as soil pollution. The reason behind that is the fact that energy is produced mainly from coal firing. The Polish power industry is faced with a major problem of replacement of the old production installations and of modernisation of the transmission infrastructure. The power industry uses 30% of the energy it produces for its own needs and to cover the losses in transmission and distribution[115]! As a result of many years of neglect, the majority of installations are of very low efficiency: average power plant efficiency is 36.5% (EU average is 46.5%). The transmission networks are in a very bad shape: their inadequate topology causes frequent power cuts. The average duration of blackouts in Poland is approximately 500 minutes[116] (!). Only 20% of heating networks are equipped with effective thermal insulation. Renewable energy sources are used to a very small extent, and there is lack of political will to support this form of power generation.

Among the key directions of activities in this sector leading to GHG emission reduction, the authors of the "*Draft Sixth Government Report...*" list the following: energy efficiency improvement, increased safety of fuel and energy supply, diversification of power generation sources (which is understood in the "*Draft Sixth Government Report...*" as building nuclear power plant), use of renewable energy sources (RES) and reduction of the environmental impact of power generation. Detailed information on the measures proposed in the "*Draft Sixth Government Report...*", and evaluations of their efficacy according to experts from NGOs are presented in the table below.

113 See note 29

114 VI Raport Polski .... Ibidem p. 225 - 227

115 VI Raport Polski .... Ibidem

116 http://www.renewablesinternational.net/overview-of-grid-reliability-in-eu/150/537/75716/ Access: February 3rd, 2014

Table 8. Evaluation of instruments for reduction of GHG emissions from power industry proposed in the "Draft Sixth Government Report ... ."[117]

Description of emission reduction instrument	Experts' evaluation	
	Level of implementation	Efficacy in emission reduction
Support schemes for generation of combined power and heat.	2	3
The support scheme (yellow, red, and purple certificates) introduced in 2006 to boost co-generation was nearly non-existent in 2013 because the Polish government did not notify EC about it in time. As a result some power facilities are withdrawing from it (e.g. EC Lublin Wrotków). The scheme was restored in January 2014 but it is too early to say if it is effective or not.		
A system of support mechanisms enhancing energy efficiency – modernisation of heating networks.	3	4
Due to lack of sufficient funds, modernisation is done to a small extent – far too small in relation to needs. Between 2007 and 2014 a significant number of power network upgrades were conducted, although not enough to meet demand.		
A system of support mechanisms enhancing energy efficiency – modernisation of heat generation sources (which produce heat for the district heating systems or for public buildings such as offices, schools and hospitals).	2	3
In the past few years many modernisation works were conducted, especially to smaller, local generation sources. Unfortunately, the change usually means replacing old coal facilities with new coal facilities. As a result the opportunity to develop renewable energy sources is missed.		
A system of support mechanisms enhancing energy efficiency – modernisation of industry installations.	2	3
A system of mechanisms supporting the enhancement of energy efficiency in industry is based on the so-called white certificate. Until now its efficacy has been low. So far only one tender has been conducted. The projects selected in the tender accounted for 4% of the available funds only. A call for the second tender has just been launched.		
A system of support mechanisms enhancing energy efficiency – modernisation of lighting.	2	3
Lack of systemic support for this measure. It is implemented by commune [the basic administrative unit in Poland] authorities that are interested in co-financing and reducing the cost of energy. In Poland following EU recommendations it is forbidden to market conventional bulbs.		
Industrial use of methane from demethanisation of coal mines.	2	3
According to data from the State Mining Authority, approximately 30% of methane released during coal mining is captured by demethanisation systems, but only half of the gas is used for energy production. For many years both Polish coal mines and authorities have not been interested in turning the captured methane into energy.		
Support for energy obtained from renewable sources: exemption from excise tax from the sale of electricity produced from RES. Obligation imposed on power producing facilities selling energy to final users to obtain a given number of the certificates for energy generated from renewable energy sources.	4	3
This instrument has very big potential but is not used at all. As a result of the adopted definition of RES, which includes co-firing and big hydropower facilities, nearly 90% of the support goes to big power generating corporations, and the instrument has not encouraged investments in RES other than co-firing and big hydropower facilities. The problems with grid access have not been solved. According to a report by the President of the Energy Regulatory Office, between 2011 and 2012 power distribution companies refused access to the grid to new RES with a total capacity of 5.6 GW.		

117 VI Raport Polski .... Ibidem p. 227

2.5.1 Summary – power industry

Activities undertaken in the power industry will be of key importance for the reduction of emissions produced in Poland. Hence the climate protection measures designed for this sector must be very effective. According to studies conducted under the "Low Emission Poland" project, the power generation industry can develop following different scenarios[118]: it is possible to maintain its coal dependence or to base power generation on an extensive use of renewable energy sources. In each scenario there is a lot of room to significantly mitigate greenhouse gas emissions (in the case of GHG by as much as 90% by 2050). Each scenario will require different measures: sticking to coal and other non-renewable energy sources as key energy carriers will force the construction of costly and risky CCS installations; basing the power industry on RES will require a more active state policy and development of effective and efficient instruments supporting new investments. However, irrespective of the chosen direction, the modernisation of energy production should be based on boosting the efficiency of its generation, transmission and use.

The problems that the power industry is faced with now can be seen as an opportunity for conducting changes that will enable its safe growth, and lower its environmental impact. Modernisation conducted with a view to achieving a low level of emissions is going to be only slightly more expensive than sticking to hydrocarbon sources and will help to reduce other costs such as external costs, which in Poland are the highest of all EU countries[119]. It seems, however, that this may be difficult due to a lack of political will to support the development of low-emission solutions. For example, a law on support for renewable energy sources has been in the pipeline for nearly four years now and there are still a number of problems related to it.

Hence it is no surprise that none of the instruments presented in the *"Draft Sixth Government Report ..."* and aimed at the reduction of GHG emissions from the power industry was evaluated by NGO experts as sufficiently effective. Some of them can become efficient tools for climate protection, but in order to do that they must be far more effectively implemented. The *"Draft Sixth Government Report ..."* defines an expected level of emission reduction for the following selected instruments that are to be used in the power industry (Table 9).

118 NP2050. Podróż do niskoemisyjnej Polski..... Ibidem

119 NP2050. Podróż do niskoemisyjnej Polski..... Ibidem

Table 9. The forecast emission reduction level resulting from the use of selected climate policy instruments in the power industry (source: "Draft Sixth Government Report ...").[120]

Name of mitigation action	GHGs affected	Type of instrument	Estimate of mitigation effect* CO_2eq/year (in Gg)		
			2015	2020	2025
Development of cogeneration.	CO_2	Legal, financial, organisational.	199,890*	30,005	30,005
Modernisation of local heating networks.	CO_2	Legal, financial.	143,063*	127,140*	171,565*
Modernisation of heating sources.	CO_2	Legal, financial.	287,556*	96 60*1	119,971*
Modernisation of industrial installations.	CO_2	Legal, financial.	5719	nd	nd
Modernisation of lighting.	CO_2	Legal, financial.	0,6	nd	nd
Development of RES.	CO_2 CH4	Legal, financial, organisational.	187,048*	163,846*	169,853*

* **- all data about on reduction potential as presented in *"Draft Sixth Government Report ..."*. However there are mistakes in these data because the total reduction potential in 2030 is bigger current total emissions in Poland !!! (remark ZK)**

3. Conclusion

It is not easy to choose the most effective climate protection instruments mentioned in the *Draft Sixth Government Report for COP UNFCCC*. Poland does not have an active climate policy and as a result the instruments that are intended to bring down greenhouse gas emissions have in fact been introduced for other reasons. Hence none of them is fully effective or efficient in the opinion of NGO experts.

The instruments that are presented in the table below have therefore been selected as the ones with the biggest potential for climate protection.

120 VI Raport Polski .... Ibidem p.228 - 229

Table 10. The most effective climate protection instruments in Poland according to the evaluation of NGO experts.[121]

	Name of mitigation action	Type of instrument	Comments
1	Support for thermo-modernisation of existing buildings.	Legal, financial, organisational.	Enormous, available potential. Its use depends on the provision of sufficient funds. It should be underlined that it goes far beyond simple thermo-insulation of buildings, and includes the full range of advanced energy efficiency-boosting solutions.
2	Mechanism of support for the modernisation of heat sources and heating networks including the connection of new users.	Legal, financial, organisational.	Sizeable potential. Its use depends on the provision of sufficient funds to carry out the required activities.
3	Support for development of RES.	Legal, financial.	The use of the existing potential depends on the way in which support for RES is introduced under the new law. Currently according to the NGOs and expert opinion there is no political will to support RES development.
4	Support for light rail vehicles for local traffic.	Financial, organisational.	Purchase of rail buses can save rail links, which will prevent further growth of car use.
5	Support for waste recovery systems, achieving effective levels of recycling.	Educational, legal, organisational.	Legal regulations regarding waste recycling must be strictly observed. It is also necessary to educate the public on the need to recycle.
6	Modernisation of railway infrastructure.	Financial, organisational.	It is essential to shorten the time of travel on main train routes and improve network density.
7	The introduction of new efficiency standards for new buildings.	Legal.	The efficiency of the instrument will depend on the actual standards that will be adopted.
8	More efficient fuel use, new drive systems.	Legal, financial, educational, Organisational.	It will not be possible to introduce electric vehicles until the proper infrastructure for charging batteries in cities is provided. Regulations supporting the purchase of fuel-efficient vehicles for public transport are essential.
9	Observation of good practices in soil cultivation.	Legal, educational	There is a big potential for increased binding of carbon in farming soil. Its use will depend on the implementation of current legal provisions regarding good farming practices and on an agricultural advisory system that can support farmers in this regard.
10	Educational activities regarding energy efficiency.	Educational	There is little awareness of effective energy use. This is why intense educational activities in this area are necessary.

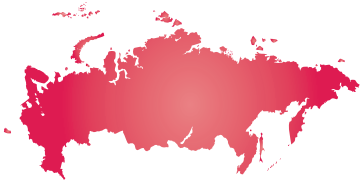
Poland has great potential to reduce greenhouse gas emissions due to the high share of coal in its energy mix, sizeable renewable energy sources, and high energy intensity. In theory the country already has a number of instruments and measures that can be used to support climate protection efforts. Unfortunately, they are not sufficiently implemented or applied. If the approach towards climate policy does not change, the level of GHG emissions from Poland may soon start to grow rapidly.

121 According to one NGO expert, one of key instruments for reducing transport needs, i.e. spatial planning, is missing from the table.

Acknowledgements

Preparing this paper would not have been possible if it hadn't been for the support of experts from non-governmental organisations. The author would like to express his gratitude to the following people in particular:

1. Tobiasz Adamczewski from WWF Poland
2. Radosław Gawlik from EKO – UNIA
3. Ilona Jędrasik from the Polish Ecological Club and Secretariat of the Climate Coalition
4. Andrzej Kassenberg from the Institute for Sustainable Development
5. Iwo Łoś from Greenpeace Poland
6. Wojciech Makowski from The Civil Affairs Institute (INSPRO)
7. Mirosław Sobolewski from the Polish Ecological Club
8. Marcin Stoczkiewicz from Client Earth
9. Wojciech Szmalski from the Institute for Sustainable Development and Green Mazovia
10. (Footnotes)



RUSSIA

Measures To Reduce Emissions Of Greenhouse Gases In Russia And Priorities Of Russian Ngos

Compiled by: Alexey Kokorin, Alexander Fedorov, Olga Senova and Vladimir Tchuprov

Measures to reduce emissions of greenhouse gases in Russia and priorities of Russian NGOs. 2012, Moscow, WWF Russia.

This paper was prepared as part of a joint project by environmental NGOs in Northern Europe, whose goal was to determine national priorities for reducing greenhouse gas emissions and to assist them in co-ordinated public activities. In this work, the partner of WWF Russia was the Air Pollution & Climate Secretariat, Gothenburg, Sweden. The paper is a supplement to the public report "Climate Change and Possibilities of Low-carbon Russia" (Russian Social Ecological Union, 2012), which describes in detail the measures taken to reduce emissions in different sectors and the role of the public in supporting their implementation. The material is addressed to NGOs that work on climate change and sustainable energy, as well as to a broad range of other organisations and individuals who are interested in energy-efficient modernisation of the Russian economy and in slowing global climate change.

Project leader: A. O. Kokorin, WWF Russia, Moscow.

This paper was prepared by A.O. Kokorin (WWF Russia, Moscow), A. V. Fedorov, O. N. Senova (Russian Social Ecological Union) and V. A. Chuprov (Greenpeace Russia).

Foreword

In spring 2012, the Russian Social Ecological Union prepared a report entitled "Climate Change and Possibilities of Low-carbon Russia" [1]. This report provides a general overview of the Russian prospects in the sphere of energy and climate, and summarises the most promising measures to reduce greenhouse gas emissions. Simultaneously, environmental NGOs of ten countries in Northern Europe, including Russia, decided to set up a joint project to determine national priorities for reducing emissions and unite them in co-ordinated public activities. This publication is the contribution of Russian environmental NGOs to the project, and a supplement to the above-mentioned public report, with more details on the measures that we would like to pay the most attention.

This article focuses on NGOs in Russia and other countries, whose members are usually not professionals in the reduction of greenhouse gas (GHG) emissions. Therefore, it is more practical for them to get a concise and rather popular presentation of each of the measures without technical details, but with an indication of the resulting reductions in GHG emissions. In addi-

tion, this target audience is naturally most interested in measures that enable active participation, and where the role of NGOs and the public is important. Priority is therefore given to the residential sector and transport, as well as to issues of public concern, in particular, waste, renewable energy, forests, as well as the outrageous situation of associated gas flaring and enormous gas leaks from Gazprom facilities.

Measures in industry, where the role of NGOs is relatively small, are essentially merged into a single measure of introducing effective charges for GHG emissions. These charges must accelerate transition to new technologies in all sectors of production. There are only first indications of movement in this direction in Russia, as described below. In fact, this is the activity for the future, and NGOs plan to encourage its development.

The second and equally important long-term measure is sustainable and efficient management of forests. Without a radical change in management practices, including changes in the approach to managing and protecting forests, in a few decades our forests will become a source of CO_2 instead of being sinks (please see below consideration of the forestry measures).

When we consider measures to reduce GHG emissions, it is of course necessary to understand which emissions are important and what are the sources of anthropogenic greenhouse gases in the world and in Russia. This is not a simple question. In addition, it is not always correctly covered by the media and the Internet. Therefore, the authors of this publication decided to supplement it with a special Annex (not translated into English) that explains in detail all these questions.

The Annex also provides a brief analysis of the ways to reduce emissions, with appropriate references to the predictive calculations and the main sources of information: the state programme of the Russian Federation "Energy saving and increasing energy efficiency for the period to 2020" [2], the detailed analytical study "Energy Efficiency in Russia: Untapped Reserves" [3], and the review of individual measures in the report "Energy efficient Russia. Ways to reduce energy intensity and greenhouse gas emissions" [4]. It should be noted that these sources cannot be considered as environmentally friendly studies of long-term dynamics for Russian GHG emissions, because they do not bring emissions down to the levels required to solve the problem of human influence on the climate system [5].

General possibilities for reducing emissions of greenhouse gases in Russia

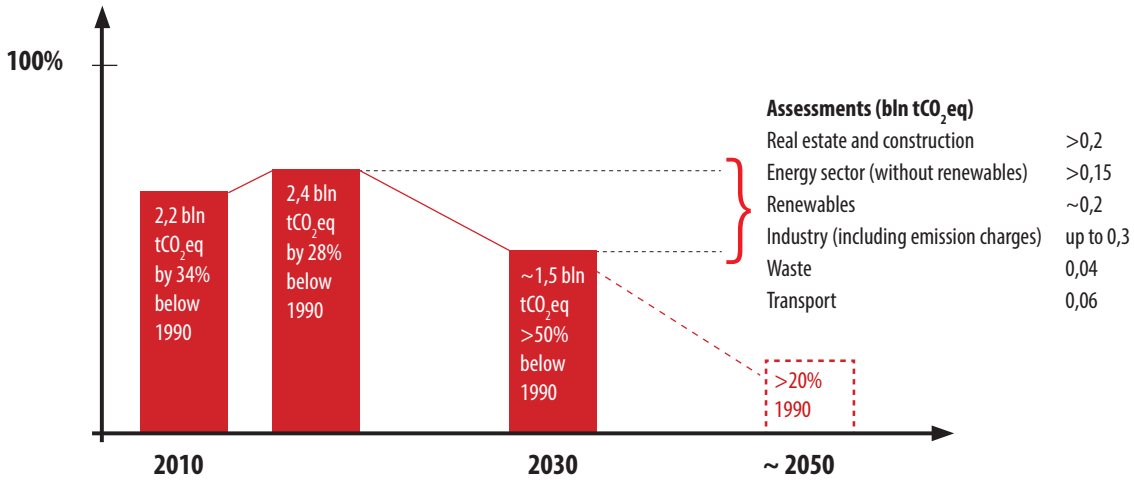
Based on the above-indicated sources of information, one can make a rough assessment of the possibilities to reduce greenhouse gas emissions over the next 20 years (please see the chart below). We believe that Russia can stop the growth of the emissions, and then start to decrease them [5], though official sources have different views, predicting growth of GHG emissions in most scenarios [6].

Greenhouse gases differ in the "power" of their greenhouse effect, as well as the duration of their presence in the atmosphere. In order to compare the

greenhouse effects of various greenhouse gases, their effects are converted into the effect of the most common greenhouse gas – carbon dioxide, CO_2. Numerical assessments for emissions of all greenhouse gases are given in tons of CO_2 equivalent resulting from such conversion. The symbol for this measurement unit is tCO_2eq (tons of CO_2 equivalent).

These assessments do not include carbon sequestration by forests, which should be treated separately, and where the challenge for the next 20 years should be the prevention of strong reduction in absorption (for details please see below the consideration of the forestry measures).

It is understood that total emissions will grow from the current level (2010) of 2.2 billion tCO_2eq (34% lower than in 1990) to 2.4 billion tCO_2eq (28% lower than in 1990) in the next few years, and then will fall to around 1.5 billion tCO_2eq in 2030, which is less than half the level in 1990. This emission dynamic is needed to achieve the 2050 emission levels that allow a solution to the problem of anthropogenic climate change. For developed countries, this implies a reduction of no less than 80% from the 1990 level [7]. The Group of Eight (G8) recommended a 50% reduction in global emissions. Russia can certainly follow this indicator. In addition, the Group of Eight recommended that leading industrialised countries should reduce emissions by 80%.



Approximate assessments for dynamics of GHG emission in Russia (not including CO_2 absorption by forests) and for effectiveness of potential mitigation measures in certain sectors

Measures to improve energy efficiency in buildings

According to the International Energy Agency [8], buildings account for approximately 40% of energy use in most countries. In Russia, the task of improving energy efficiency in residential, public and industrial buildings is particularly important in connection with the harsh climate, and because of extremely low energy efficiency, as compared to buildings in developed countries with similar climate.

Here we present the steps ranked according to the extent to which the

public can support and encourage their implementation. Large measures, in particular, major repairs, modernisation of buildings and installation of heat meters, are given separately for residential and non-residential buildings, as they require different actions by the public and the population. On the other hand, actions such as simple insulation and modern lighting and appliances, are similar to actions by specific individuals and are considered together for all types of premises. Public participation can be most effective in the implementation of such measures. In total, the measures discussed below can provide emission reductions of more than 200 million tCO_2eq per year within 20 years.

1. "Small" measures to improve insulation of existing buildings

A number of low-cost, small-scale solutions can reduce heat losses in buildings. These include draughtproofing windows and doors, plinths and other locations of heat leaks; insulation of attics, floors of ground storeys, and wall cavities. If these measures are extended to 90% of existing residential buildings within 20 years, the reduction in emissions can be estimated as approximately 35 million tCO_2eq. Investments in elimination of heat leaks, insulation of doors and windows and additional insulation of attics give at least double the profit.

Installation of mechanical ventilation systems to improve indoor air quality can give additional improvement (otherwise tenants open windows for ventilation).

The state programme for energy efficiency provides comprehensive energy-saving major repairs in apartment buildings by 2020 with a total area of 340 million square metres (10% of the total housing stock in Russia).

The role of NGOs – informing the public about available methods for insulation of premises – is the most effective for measures to insulate apartments. These measures are simple; they have the direct effect of increasing the thermal comfort of flats, as well as enabling cost savings by eliminating the need to use additional heaters. The public may also influence decision-making on measures to improve the thermal insulation of houses, showing the promising benefits of such measures and the efficiency of investments.

2. The use of modern, energy-efficient lighting systems

Looking ahead over the next 20 years, priority can be given to the widespread use of LED light sources. Complete replacement of incandescent bulbs with newer ones includes the transition to compact fluorescent lamps and LED lamps.

The state programme on energy efficiency provides for replacement of incandescent bulbs by compact fluorescent lamps, with an increase by 2021 in the proportion of compact fluorescent lamps to 83%, and full withdrawal of incandescent light bulbs from use.

Assuming that the cost of LED lamps will be reduced, as is happening to the cost of solar power, the transition to LEDs will become widespread by 2030, especially in the 2020s. In residential houses this gives about 6 million

tCO_2eq (replacement of incandescent bulbs by LEDs – 5, replacement of fluorescent tubes by LEDs – 1), and in commercial buildings – about 3 million tCO_2eq (replacement of incandescent bulbs by LEDs – 1.3, replacement of fluorescent tubes by LEDs – about 1, replacement of outdated T12 bulbs by T8/5 – 0.7). In total, the effect can be estimated as about 10 million tCO_2eq.

Note added by Alexey Kokorin, spring 2014: The average CO_2 emission level for Russian electricity is about 400 grams/kWh, due to a high proportion of hydro and nuclear.

It is expedient to build on NGO activities to raise awareness about the benefits of energy savings by replacing lighting, based on objective calculations of the payback from new bulbs. This will allow each family to calculate the necessary investments and benefits of switching to efficient lighting. The "Step by Step" system is good for efficient lighting solutions for houses on the whole. Investing in the replacement of several bulbs, for example, on the stairs, enables the residential community to put the money saved into the next step – purchasing other devices, allowing even greater power savings. Savings from the first two steps are cumulative and allow the programme to continue.

3. The use of modern household appliances and office equipment

Replacing existing electronic devices (computers, TV sets, VCRs, DVD players, chargers) by energy-efficient ones can give an effect estimated at 4 million tCO_2eq. Replacement of existing household appliances (refrigerators, washing machines, dishwashers, etc.) by more energy-efficient models is estimated at 5 million tCO_2eq. In commercial and other non-residential buildings, replacement of existing equipment (such as refrigerators and freezers) and office electronics with high-efficiency models is estimated at 6 million tCO_2eq. Thus, the total effect by 2030 could be about 15 million tCO_2eq.

Note added by Alexey Kokorin, spring 2014: Even without any policy some of these appliances and office equipment will be replaced, but not so much outside Moscow.

Here, the role of NGOs is important in informing all groups of the population about the significance of energy efficiency labelling, about the possibility of choosing a device that consumes less energy. It is important to show potential buyers that by buying somewhat more expensive, but more energy-efficient appliances, the owner can recoup the difference in price in a few months, and from then on will only benefit from energy savings.

4. Installation of heat and hot water meters and regulation in residential buildings

The vast proportion of houses in Russia has no metering or regulation of heating and hot water. In urban areas in recent years the installation of thermal units in apartment buildings has begun, but equipment for regulating and conserving water flow throughout the house is available in a very small number of houses. A major barrier is the fact that many houses use a direct flow dependent heating system that does not allow heating to be adjusted.

Reconstruction of the heating system in these houses is necessary to install proper metering and regulation facilities.

The state programme for energy efficiency provides installation by 2021 of 2434 thousand collective heat meters.

Most Russian families have no individual heat meters or controllers to adjust the use of heat. Moreover, the vertical heating system most often found in Russian houses does not allow for installation of meters and controllers in separate apartments. A common way of controlling the temperature is opening windows. We open a window when it is too warm, or turn on electric heaters when it is too cold. Estimates show that every thousand roubles invested in the domestic heat regulation system brings savings of about three thousand.

Note added by Alexey Kokorin, spring 2014: The average CO_2 emission level for Russian electricity is about 400 grams/kWh, due to a high proportion of hydro and nuclear.

In general, installation of heat meters and thermostats will allow emissions to be cut by about 35 million tCO_2eq by 2030. It is assumed that heat savings will be at least 20%. To do this, 90% of radiators must be equipped with thermostats, and 90% of houses must have heat meters installed.

NGO support for simple measures such as installation of hot water meters in apartments stimulates the monitoring of hot water consumption – and shifts behaviour towards economical water use. The public can also influence decisions to install meters and regulation of heat in houses, upgrading heating systems, which will then permit per-apartment heating regulation. It is important to inform all residents not only of the short-term costs, but also the long-term advantages of such a solution, both in terms of energy savings, and of the quality (and cost) of their homes.

Major repairs to existing buildings to reduce energy consumption to the level of regulatory requirements for new construction include the installation of windows and doors, insulation of facades, roofs and basement floors, and installation of mechanical ventilation systems with a heat recovery function. These improvements should bring the power consumption to the standards adopted for new construction (105 kWh per sq. m., or 0.09 Gcal per sq. m., representing reduction of the average power consumption by 50–60%).

The corresponding measures are provided under the state programme for energy efficiency [2]. As expected, their implementation in the housing stock would yield annual primary energy savings of 17.04 million tCO_2eq and total primary energy savings of 97.83 million tCO_2eq over the ten years of the programme (2011–2020 years). In CO_2 equivalent, implementation of activities in the residential building sector will reduce greenhouse gas emissions by 56.69 million tons by 2015 and by 33.04 million tons by 2021.

If 70% of residential buildings undergo major repairs by 2030, the reduction in emissions will be 60–65 million tCO_2eq. Improved maintenance of buildings and their heating systems (timely repair of heating and ventilation systems, insulation of pipes) brings the total reduction in emissions up to about 70 million tCO_2eq. We can also add modernisation of water heating

systems in existing buildings (and in some cases, partial replacement of district heating), including, where cost-effective, use of solar water heaters and heat pumps. Even with limited application this measure can provide emission reductions of about 5.7 million tCO_2eq. Thus, we can assume the total effect of major repairs in residential buildings as 75 million tCO_2eq.

Costs of capital repairs to residential buildings are very high. If these costs entirely lay on the shoulders of tenants/owners, they could not be fully paid back through the increased energy efficiency of the building. It is important to help housing communities to learn more about state programmes that offer state aid for these repairs. Some experience has been acquired in Apatity town, where limited funds for capital repairs were distributed to houses where there were plans to make repairs to improve energy efficiency – through the insulation of roofs, facades, etc. NGOs can spread such experiences.

Through their information activities, NGOs may help to shape educated consumer demand for real estate with high energy efficiency performance. Such demand will support those companies that build more energy-efficient (i.e. more comfortable and more economical) buildings.

6. Improving insulation and upgrading existing non-residential buildings

The range of modernisation measures includes sealing of air leaks and draughtproofing of windows and doors, which can yield energy savings of 50%. As a result, it can lead to a reduction of about 50 million tCO_2eq. Greater potential for savings in non-residential buildings is due to the fact that many of them, such as warehouses, have very high ceilings, large door openings, etc. For non-residential buildings, an investment of one thousand roubles in energy efficiency will save 10.5 thousand roubles. Adding improved building maintenance (timely repair of heating, ventilation and air conditioning, insulation of pipes) and improved governance (modern management), can increase the total reduction in emissions to about 65 million tCO_2eq.

The role of NGOs in informing the public about the benefits of energy efficiency in non-residential buildings is also in demand. It is important to show that an energy-efficient office is an economical office. Energy savings in production premises make a significant contribution to the reduction of energy consumption, and hence production cost. For most Russian businessmen this is not clear yet. The NGO mission is to show the best practices and examples of cost-effective solutions.

According to Article 11 of Law 261-FZ, buildings and structures, except for some otherwise specified, must meet energy efficiency requirements. These requirements for the energy performance of buildings must be revised at least every five years. If we assume the reduction of heat consumption from 0.09 Gcal per square metre (105 kWh per sq. m. under the existing norms) to 0.04 Gcal per square metre (42 kWh per sq. m.), the reduction in emissions can be estimated as more than 50 million tCO_2eq. This measure involves the use of energy-efficient materials and technologies to reduce the energy

consumption of buildings. Reducing energy consumption is achieved by improving the design and location of buildings, improving the insulation of buildings and reducing air leaks, the use of modern materials and construction methods for walls, roofs, floors and windows, the use of highly efficient heating, ventilation, air conditioning and water heating systems.

NGOs can encourage public support for legislation and higher standards of energy efficiency, organise dialogue between residents and authorities when decisions are implemented.

8. Construction of more energy-efficient, new non-residential buildings

In the next 20 years, it is expected that 15–20 million m^2 of industrial buildings and 50–60 million m^2 of commercial and other non-residential property will be constructed each year, including social, educational and cultural buildings. Improving the design and location of buildings, their insulation and draughtproofing, the use of modern materials and construction of walls, roofs, floors and windows, the use of highly efficient heating, ventilation, air conditioning and water heating systems can provide up to 50% energy savings. As a result, the effect in terms of reduced greenhouse gas emissions can be estimated for the year 2030 as 30 million tCO_2eq.

Measures in the energy sector

In many countries, these measures are mainly aimed at the development of various renewable energy sources. These actions are very important for Russia. But, in any case, other "holes" must be closed in the next 10–20 years in our country. This refers to the situation of wasteful energy management (heating, electricity, the efficiency of power plants and the like), and such specific problems for Russia as the flagrant flaring of associated gas and massive "scheduled" loss of methane during maintenance and repair works.

By 2030, the overall effect of "plugging holes" can be estimated at approximately 150 million tCO_2eq per year. In addition, by 2030 the active development of renewable energy could give 200 million tCO_2eq per year.

9. Modernisation of the energy sector, including heating and power lines

The terrible state of heating systems is well known. Better insulation of old heating systems with modern technologies (polyurethane insulation) should reduce heat losses by a factor of 2–3 at least. In terms of greenhouse gas emissions, the effect can be estimated at more than 40 million tCO_2eq per year. Transmission losses for electricity are lower, but they can and should be reduced by a factor of at least 1.5 (from the current 12% down to 10% in 2020 and 8% in 2030). Savings can be achieved both through technical innovation and by increasing the density of networks through construction of additional lines, which also increases the reliability of electricity supply. The possible effect is estimated at 20 million tCO_2eq per year.

The greatest effect in generation of electricity and heat directly can be achieved by building combined cycle power plants (CCPP) with cogenera-

tion mode (co-generation of electricity and heat, the fuel efficiency of such plants during the annual cycle is 10% higher), instead of power plants working in condensing mode.

The state programme for energy efficiency provides for appropriate measures at gas stations, including decommissioning old gas power stations, building stations that use gas turbines and combined cycle technologies. This should lead to a reduction in greenhouse gas emissions for the period 2011–2020 by 244.56 million tCO_2eq. In addition, the introduction of cogeneration boilers will further reduce emissions by 32.87 million tCO_2eq.

Another promising area is to increase the share of cogeneration through the construction of mini-CHP boilers in small and medium-sized towns. This effect, combined with increasing the efficiency of the plants by reducing energy consumption for their own needs, is estimated by 2030 at 20 million tCO_2eq per year. Thus, the total effect of measures in the energy sector is very high – up to 80 million tCO_2eq per year.

10. Termination of flaring associated with petroleum gas

Gas flaring has long been a literally visible example of the situation in Russia, when it is easier to take the "cream" and to burn the side stream of revenues. Despite the very large volumes that are flared, emissions of greenhouse gases are not very large. Flaring produces CO_2, while the main components of the associated gas – propane and butane – do not contribute to the greenhouse effect. According to Russia's national inventory of greenhouse gases, CO_2 emissions associated with the production of oil and gas, where flaring occupied first place, were only 26 million tCO_2eq per year in 2009. According to data from the Federal State Statistics Service (Rosstat), extraction, i.e. utilisation of associated gas, amounted to 56 billion m3 (flaring is not included in production), with utilisation of about 80%, and burning about 15 billion m3. According to a number of foreign sources, the volume of gas flaring is much larger – several times more than the data in the Russian inventory.

The Russian government has already taken decisions on mandatory utilisation of at least 95% of the associated gas, but the time limits for implementation have been changed several times. According to official data, about 80% of associated gas is utilised now (note that in 2010 the percentage of utilisation decreased from 81 to 77%), that is, even according to the lowest official assessments, it is necessary to reduce flaring by a factor of 4 (from 20% to 5%).

The state programme on energy efficiency includes plans to reduce associated gas flaring, which should lead to a reduction of CO_2 emissions by 11.4 million tCO_2eq during 2011–2020.

However, from the public point of view, accurate knowledge about the amounts of gas being flared is probably not so important; it is important to achieve its complete termination (utilisation of 95–98%). Then we can talk about reducing annual greenhouse gas emissions by about 20–40 million tCO_2eq per year.

11. Radical reduction of methane emissions in the gas distribution system

In contrast to the visible and well-known flaring of gas in Russia, there is another, "quiet and inconspicuous" source – the main "greenhouse problem" of our oil and gas sector. This source is an order of magnitude greater. It is the officially sanctioned emission of methane gas during maintenance and repair works. This has a huge effect, estimated according to official figures for 2009 at 340 million tCO_2eq per year (equivalent to a loss of 20 billion m3 of methane). This Russian official information is based on Gazprom data and on simplified assessments with the use of approximate coefficients (multiplication of pumped or used gas by certain standard values).

Leakages of natural gas have four components. More than 35% are losses by Gazprom during gas transportation and storage, 20% are losses during extraction and primary processing, 20% are losses by gas distribution companies in low-pressure networks, and 25% are losses by consumers.

A Gazprom pilot study by one of its divisions, the Gazprom mining company Yamburg, in 2010–2011, has shown that 99.85% of methane emissions are related to organised emission sources. It is possible that leakages from fugitive sources are higher than shown in the official statistics.

The state programme on energy efficiency envisages the reduction of methane emissions in the gas production sector in 2011–2020 to 192.95 million tCO_2eq. At present, measures for the transportation of gas are the most clear and elaborated. The project "Increasing energy efficiency in gas pipeline transportation" aims to reduce greenhouse gas emissions from gas transportation to 59.55 million tCO_2eq in 2011–2020.

These measures are presented in detail in the report [4]. New programmes for inspection and repair of the distribution network will allow for an 80% reduction in the gap between current practice and best international experience. It will prevent the release of 42 million tCO_2eq per year (or loss 2.5 billion m3 of methane). The use of mobile compressors for scheduled maintenance of pipelines, which prevents gas releases into the atmosphere, will give more than 7 million tCO_2eq per year, the new programme for inspection and repair of compressors – 5 million tCO_2eq per year, and replacement of seals with modern versions (80–85% of compressors) – almost 9 million tCO_2eq per year. The total effect of measures associated with compressors is above 20 million tCO_2eq per year. Measures to improve logistics of gas flow and to minimise equipment operation in inefficient modes give approximately 10 million tCO_2eq per year more. In particular, better planning reduces the number of unnecessary compressions/decompressions. Thus, all these measures will reduce emissions by 80 million tCO_2eq per year and save about 5 billion m3 of gas.

This is only a quarter of the total losses, which must be addressed in the very first place. Later, of course, it will be necessary to implement measures in natural gas extraction, in low-pressure networks, and at end users, which will reduce emissions even more, to a few percent of the current level. Right now it is important to achieve emission reductions from Gazprom of at least 80 million tCO_2eq, which is already fully calculated technologically.

The decision to increase the share of environmentally sound renewable energy sources, excluding large hydropower, in electricity generation to 4.5% by 2020 was taken over three years ago. Its implementation is very difficult. The share of these renewables in Russia is still about 1%. The Government still thinks that renewables have low prospects in Russia. On the other hand, there is a lot of information about the construction and launching of small- and medium-scale renewable energy facilities, about economic viability of renewable energy in remote areas, their profitability in production of heat or gas for own consumption, and so on and so forth. RusHydro actively lobbies for the introduction of compensatory payments for small hydropower plants and talks about plans for their mass construction (alas, wind and solar power are excluded from these payments). Possibilities for accelerated development of renewable energy sources in Russia are broad, but it is very difficult to count on their development in the next 10–20 years.

The report [4] described the issues of energy efficiency in great detail, but discusses renewable energy sources on the basis of very conservative views. Therefore, the estimates given in the report can only be used as a lower assessment for possible accelerated development of renewables. According to the report, by 2030, the effect of development of renewable energy sources (excluding large hydro) will be approximately 50 million tCO_2eq per year. A number of sources is recognised as promising for rapid growth: biomass (mostly wood) – more than 15 million tCO_2eq per year; wind – up to 15 million tCO_2eq per year; geothermal and tidal energy up to 10 and up to 7 million tCO_2eq per year, respectively. On the other hand, small hydro is assessed as 1.5 million tCO_2eq per year, and solar energy as 0.5 million tCO_2eq per year.

Regarding the upper bound for development of renewable energy, we must emphasise that the world at large has all the technical possibilities to fully switch to renewable energy sources by 2050. A number of NGO reports speak about the possibility and the need to shift to 60, 80 or even 95% renewables in Russia by 2050. This is the only way to solve the climate problem. Of course, much of the development of renewable energy is expected after 2030. One can assume that by 2030, energy efficiency measures will stabilise energy consumption at a level slightly higher than the present one (emissions from burning fossil fuels and methane emissions are now about 1.8 billion tCO_2eq per year). If renewable energy (excluding large hydro) accounted for at least 15% of total primary energy consumption, it would be equivalent to 300 million tCO_2eq per year. As an approximate estimation, one can assume 10% of primary energy consumption. The effect of the accelerated development of renewable energy would then be equal to 200 million tCO_2eq per year. This equates to about 15% of electricity generation from renewable energy sources, excluding large hydropower plants, in 2030. This goal does not appear easy to meet, but is achievable (as a proportion of primary energy consumption, electricity represents 40%, heat – 25%, fuel combustion in industry and transport sector – about 20 and 15%, respectively).

Public support for renewables is very important today – from the dissemination of best practices at the local level to support for and promotion of state programmes on renewable energy and related legislation.

Note added by Alexey Kokhorin, spring 2014: Electricity in Russia is very cheap, about 3 eurocents on the wholesale market and about 7eurocents for consumers and business.

Measures in the transport sector

Transport is one of the major consumers of energy and one of the main sources of greenhouse gas emissions. The reason for this is the combustion of massive amounts of fossil fuels (mainly oil products such as gasoline, kerosene and diesel) in internal combustion engines for transport by land, air and water. According to the International Energy Agency [8], about 60% of oil in the world is consumed in the transport sector. Transport accounts for over 17% of final energy consumption in Russia, and this share is growing. Road transport alone accounts for more than 10% of total energy consumption in Russia (see e.g. [4]).

Progress in the energy efficiency of the transport sector is the weakest. There is no system for collecting data on total energy consumption and energy efficiency; energy efficiency indicators are not entered on the basis of an assessment of progress in transport and traffic management in urban areas; there are no fuel efficiency standards for cars; there is no system to encourage small-car buyers, and no system of training for economical eco-driving. And this is despite the fact that transport accounts for the largest part of the growth in energy consumption in Russia (54% during 2000–2010). Unless there is concerted action to reduce GHG emissions from transport, the annual increase in the number of cars by 3.5% alone will more than double by 2030 the fuel consumption and emissions of greenhouse gases and pollutants.

Often, only technical measures, such as improving the energy efficiency of cars, switching to alternative fuels and eco-driving training, are considered as methods for reducing (or rather, slowing the growth) of fuel consumption and emissions. However, such measures will only slightly slow down the growth of energy consumption by road transport and greenhouse gas emissions (by 14% and 24%, respectively, compared with the scenario of non-use of such measures [4]). Thus, even with these measures, the energy consumption by automobiles in Russia could grow by more than 70% by 2030.

Improving the efficiency of transport systems is a promising way to reduce energy consumption and greenhouse gas emissions in the transport sector. The International Energy Agency in its updated version "25 Energy Efficiency Policy Recommendations" in 2011 [9] supplemented the recommendations relating to transport with a recommendation to improve transport system efficiency.

The state programme on energy efficiency provides for voluntary and mandatory energy audits of transport organisations, that is, of public transport. Private vehicles are not covered by any state programme; evaluation of possible reductions in greenhouse gas emissions from automobile transport is not covered by the state program, except for the fuel economy of tractors in the agricultural sector.

13. Improving transport system efficiency

The most effective measure for improving transport efficiency and reducing greenhouse gas emissions (and, in addition, emissions of pollutants) in the transport sector is the so-called "modal shift". In relation to urban transport, this means the priority development of public transport and the transfer of passengers from private to public transport. Indeed, the energy consumption per passenger when travelling by bus/trolley bus is about 5 times less than when travelling by car (even if the car has four passengers). A tram or a subway train consumes 10 times less than a car per passenger. If a car has a single occupant rather than four (as usually happens), it consumes 20 times more fuel and emits 20 times more greenhouse gases than a bus/trolleybus, and 40 times more than a tram or metro train.

The modal shift also means giving people more opportunities to travel by bike and on foot. Development of public transport, cycling and pedestrian infrastructure simultaneously solves two other problems – air pollution and congestion. Indeed, emissions of pollutants per passenger in public transport are 5–10 times less than for car passengers. Additionally, one passenger in public transport requires 10–20 times less road area. The passenger capacity of a street with a tram line is, on average, six times higher than the same street without a tram line. The modal shift additionally creates positive social changes: it creates healthier urban environments and increases mobility opportunities for the elderly, children and the poor.

It is important to note that improvement of transport system efficiency does not mean construction of new roads and expansion of existing roads in cities. Moreover, it is almost impossible and practically useless. For example, in cities such as Moscow and St. Petersburg, the total carriageway area of avenues, streets, squares and lanes is five times less than is required for the movement of all the cars already present in these cities.

As for commuter and intercity transport, the modal shift means providing passengers with opportunities for the convenient use of (in priority order): railways, buses and water transport, road transport and air transport. Consumption of fuel per passenger per kilometre grows namely in this order for these transport modes.

In terms of energy efficiency rail freight and water transport leave automobile transport far behind. Therefore, the modal shift to railways and shipping is also very important.

Estimates show that an increase in passenger public transport by just 10% of the existing value will ensure reduction of greenhouse gas emissions by 20 million tCO_2eq per year.

NGOs can play an important role in this process, by promoting the development and improvement of public transport, promoting other ways to improve mobility without increasing energy consumption (e.g., bicycle) and explaining the need for the transport modal shift, especially in cities.

14. Use of vehicles with lower CO_2 emissions

The transition to more efficient models of cars is encouraged by fuel prices. In addition, prices force more economical use of personal transport. If appropriate tax and regulatory measures were adopted, in 20 years more than half of passenger cars with combustion engines will meet a certain level of technical improvements. However, the projected drastic increase in the number of cars will nevertheless lead to a significant increase in greenhouse gas emissions. We can only compare the two options, two scenarios – not taking any action, or taking action – and talk about slowing down the growth of GHG emissions. According to the report [4], the effect of slowing down the growth in greenhouse gas emissions by switching to more efficient cars could be more than 40 million tCO_2eq per year. The effect of slowing down the growth of emissions due to the use of hybrid and electric vehicles can be estimated as 10 million tCO_2eq per year.

The overall effect of measures to promote the use of more fuel-efficient cars of all types can be estimated as more than 50 million tCO_2eq per year. It is important to note that here we are not talking about reducing the current level, but only about slowing the growth in emissions; their reduction compared with what level they would be at without these measures.

There are many measures both for passenger and freight vehicles that can accelerate the "natural" process of transition to more efficient models, driven by fuel prices. In addition, prices and requirements to reduce air pollution force more advanced logistics, greater use of electric and gas-driven vehicles in cities, etc.

According to the report [4], the effect of slowing the growth of greenhouse gas emissions by accelerated introduction of technical improvements to vehicles with internal combustion engines will be about 5 million tCO_2eq per year. Such a small amount is due to the fact that most of the improvements will come through no additional measures, simply due to higher fuel prices. An assessment of the effects of slowing the growth in greenhouse gas emissions by accelerated transition to hybrid models and electric transport is missing from the report. It should be noted that the main effect of such a transition is the reduction of air pollution in big cities.

Slowing down the growth in GHG emissions resulting from the transition of 15% of all vehicles (trucks, cars, buses) to biofuels from Russian raw materials (to bio-ethanol and diesel biofuels) is estimated at approximately 25 million tCO_2eq per year.

Measures in the waste sector

It is well known that the problem of waste in our country is very serious. The issue is not only to clear waste from our forests, rivers and parks. The main task is to organize effective waste disposal, and to take measures to limit the accelerating growth in waste. Primarily, it is about municipal solid waste (construction and other industrial waste is somewhat less of a problem.) Separate waste collection and, most importantly, its recycling are needed. It is unacceptable when separately collected waste is not processed and is disposed

of as landfill. It is important to note that the use of recycled materials makes a big contribution to energy saving and reducing GHG emissions. Note that waste incineration plants and their operation in our country raise many questions and concerns, so the construction of such plants should in no way be regarded as a measure to reduce emissions in Russia. Replacement of primary raw materials and recyclable materials to achieve this goal is the correct path of action in this country.

Production plays an important role in waste management. Legislative restrictions on production of materials and products that cannot be recycled, reducing the amount of unnecessary packaging, and the basic transition from disposable products to durable goods will also make direct contributions to reducing waste, energy consumption, and emissions.

NGOs can contribute by building a culture of consumption in which individuals can support those products that create the minimum amount of waste, and waste that is suitable for reuse or recycling, through their consumer choices.

15. Separate collection of waste and recycling

The report [4] contains very detailed estimates for reducing GHG emissions in Russia using various recycled materials. The reduction in emissions per ton of recycled waste is 4.8 tCO_2e for paper; 5.6 t CO_2e for paperboard; 1.8 tCO_2e for plastics; 0.4 tCO_2e for glass; 1.8 tCO_2e for steel; and 13.6 tCO_2e for aluminium. In comparison with the current situation, almost complete utilisation of these types of waste (in the volumes likely to be produced in the next 10–20 years) will give emission reductions of 30–35 million tCO_2eq per year.

Unfortunately, the state programme for energy efficiency does not provide any measures for the use of waste for energy purposes. However, this is a very significant additional energy resource.

Production of compost from organic waste is an additional measure. The use of 1 ton of organic waste results in reduced emissions of 1 tCO_2eq. The total effect that can be obtained in the next 20 years is assessed as more than 5 million tCO_2eq per year. In addition, there is a possibility of utilising landfill gas (methane), since its collection is not too complex. Of course, it is much better to use the gas as a fuel, but even its simple burning already leads to a considerable effect, because the CO_2 produced during combustion gives a greenhouse effect that is 20–25 times lower than methane. The potential of landfill gas is estimated at more than 3 million tCO_2eq per year. Thus, the effect of all waste disposal operations could be about 40 million tCO_2eq per year, in which separate waste collection and recycling play the major role.

To introduce separate waste collection and recycling in this country, legislative regulation is necessary, which would consider waste as a resource. Draft law FZ No. 584399-5 "Treatment of industrial and domestic waste and secondary resources", which has passed the first reading in the State Duma, does not fully solve the problem.

Long-term measures for the future: Forests

The well-known phrase "Forests are the lungs of the planet", as well as the belief that our forests are environmental guardians that preserve the Earth's climate are, alas, incorrect. The entire planet lives on oxygen that has accumulated over millions of years, and neither the oceans nor the forests are serious sources of oxygen on the global scale. Its content in the atmosphere is reduced quite insignificantly and is not in the slightest danger [10]. On the other hand, this does not rule out the fact that forests effectively clean the air of dust and pollutants and should certainly be considered as the "lungs" of a district or a city, affecting their microclimate. Of course, forests absorb CO_2 during photosynthesis, but they also release it during respiration and decomposition of organic matter. A young, fast-growing forest is a net absorber, and an old one is a net source of CO_2.

Russia has a long history of extensive logging from the 1960s to the 1980s, which resulted in a strong shift of forest age distribution towards young forests. In those years, logging totalled approximately 350 million m3, and since 2000 has totalled 150–200 million m3. Today, despite a lot of logging and forest fires, our forests are a powerful net sink for CO_2 from the atmosphere, equal to about 600 million tCO_2eq per year. The detailed dynamics of these processes (absorption due to age distribution, human activities, logging, fires, destruction of forests by pests, etc.) are recorded in the National Inventory Report of sources and sinks issues each year by Roshydromet in collaboration with the Forestry Department and the relevant scientific and research institutions [11]. The reason is, of course, human activities, although there is no merit for Russia here; it is simply that high emissions 30–50 years ago have resulted in the present absorption level. Note that in 1990, our forests had close to zero net absorption or emissions for the same reason. The phrase "with account for absorption by forests, Russia now emits 55% less greenhouse gases than in 1990" is, in fact, a distortion of information, though formally it is true. Emissions from the Russian economy in 2010 were about one third less than in 1990, and the above situation with forests added another 20% of "reduction". For this reason, it is more correct to consider emissions in the economy and absorption by forests separately, because they have different reasons and we have different opportunities to influence them.

Forests will inevitably grow old, and calculations show that by the 2040s the net absorption may become zero. It is impossible to influence this process, but one can influence two other factors: fires and logging. The first obvious measure is to fight forest fires. The second, less visible but a very important factor is the volume of felling, and how it is carried out. With a constant volume of logging, our forests will remain a net sink of approximately 300 million tCO_2eq per year in the 2040s, and if logging is increased by 5% per year (planned in a number of government documents) our forests will become a net emitter of 100-200 million tCO_2eq per year. However, in the long run it is not the volume of logging, but forest management that is important. If logging is conducted in the same way as it is now, even the absence of any increase will only postpone the moment when our forests will cease to be a net sink for CO_2 [12].

A different approach is required – long-term sustainable forest management, in general, similar to that in Scandinavian. Now, when forest is felled in new areas, a lot of relatively low-value wood remains in the logging area (burned or rotted), and loggers do not care what happens to this forest plot in 10, 20 or 50 years.

Sustainable forest management means that part of the country's forests is managed as a "garden." It means that the management knows what will be grown in each forest area as the forest recovers from logging, forest roads are laid for long-term use, all parts of the felled trees are used, etc. This naturally costs much more than just logging, even where logging is certified according to the FSC, which regulates felling, but does not regulate all operations in the forest for decades.

We have experience of "gardening" or so-called intensive forestry in Russia, for example, in the Pskov region. There, one hectare of forest gives several times more profits than usual. But, of course, initial investments in the forest infrastructure are needed, together with long-term agreements with customers for different types of wood products, from furniture to wood fuel pellets.

The transition to environmentally sustainable forest management is a complex and long-term task, which by 2050 will have a huge "climate issue price" of about 500 million tCO_2eq per year. For 2030, the potential is, of course, smaller, but still very high – about 200 million tCO_2eq per year.

The problem can be solved only in stages, starting with the regions where forest users are already thinking about intensive forest management, for example, in the Arkhangelsk region. Without the voice of the public, it is hardly possible to expect a quick solution to the issue of assistance (benefits) for sustainable forest management at the regional and federal levels.

Long-term measures for the future: Effective payments for greenhouse gas emissions

In the measures described above, the omission of industry is not accidental. First, the business world quickly selects new technologies itself, if they have appropriate tax or other fiscal conditions. Second, the role of NGOs and the public in the selection of new technologies is minimal, unless, of course, this is to stop the use of extremely harmful technologies, construction of chemical plants, large hydro, nuclear power plants, etc. Therefore, in this publication we have incorporated all the industrial measures (in fact, and in the economy as a whole) in a single measure – introduction of effective charges for emissions of greenhouse gases.

Introduction of effective charges for emissions of greenhouse gases

Payments for emissions of greenhouse gases already exist in many countries. Experience shows that it is an effective means of introducing new technologies with low emissions. In many cases, CO_2 is only a "common metric" or a convenient and easily verifiable way of measuring the degree of implementation of new technologies that unite different companies and even different industries in a single system of action. So far, the climatic effect of the introduction of fees is secondary, and the modernisation of the economy is prima-

ry. This has its advantages; the argument of technological development can act as the "hook" that will attract the government. At present we can only see the first very cautious steps, the Ministry of Economic Development, together with "Business Russia", has created a working group to study the feasibility of such payments. Obviously, in the Russian context there should not be a single emission tax for all. Payments must promote new technologies using funds collected from the companies that continue to use old technologies. It is hardly possible to talk about payments by the population; in practice, it is likely to result in a tariff increase.

It is difficult to talk about the effect of the introduction of charges for emissions of greenhouse gases. Calculations carried out at the Gaidar Institute for Economic Policy show that the introduction of payments (in particular, 50–80 dollars per tCO_2eq from 2020 to 2050) reduces the country's emissions by 10–20% from 1990 levels. In terms of GHG emissions, this means 300–600 million tCO_2eq per year in 2050. For 2030, the effect is estimated at 100–300 million tCO_2eq per year and is heavily dependent on the year the charges are introduced – the sooner, the greater is the effect. Therefore, the question of rapid development and deployment of an effective system for payments should now be in the public eye.

References

1. "Climate Change and Possibilities of Low-carbon Russia." Report by the Russian Social Ecological Union, 2012, http://rusecounion.ru/doc_rseu_20912

2. The State Programme of the Russian Federation "Energy saving and increasing energy efficiency for the period to 2020". Order of the Government of the Russian Federation of 27 December, 2010 No. 2446-p., http://www.rg.ru/2011/01/25/energosberejenie-site-dok.html

3. "Energy Efficiency in Russia: Untapped Reserves". CENEF, World Bank, IFC, Moscow, 2008, 164 p., http://www.ifc.org/ifcext/rsefp.nsf/AttachmentsByTitle/FINAL_EE_report_rus.pdf/$FILE/FINAL_EE_report_rus.pdf, see also Bashmakov I.A. Low Carbon Russia: 2050. CENEF, 2009.

4. "Energy efficient Russia. Ways to reduce energy intensity and greenhouse gas emissions". McKinsey & Company, 2009, http://energosber.info/upload/pdf/CO_2_Russia_RUS_final.pdf

5. "Energy revolution. Perspectives for establishment of a system of energy security of Russia". "Russia energy [r]evolution". Greenpeace International, EREC. 2009, 44 pp. http://www.energyblueprint.info/822.0.html

6. Outlook for Energy Development in the World and in Russia up to 2035. INEI, REA, Moscow, 2012, 196 p. http://www.eriras.ru/data/94/rus; Outlook for Russian Energy, IEA WEO11 Part B, http://www.worldenergyoutlook.org; World Energy – 2050 (White Book) / Ed. Bushuev V.V. (PG PWI), Kalamanov V.A. (MCEDC) – Moscow: " Energy", 2011. 360 p. http://www.energystrategy.ru/editions/white_book2.htm

7. “Responsible leadership for a sustainable future”. G8 Declaration, Italy, 2009, para 65. http://www.g8italia2009.it/static/G8_Allegato/G8_Declaration_08_07_09_final %2c0.pdf.

8. IEA, Energy Efficiency Policy Recommendations, 2009, http://energosber.info/upload/EE_recommendations_russian.pdf

9. “25 Energy Efficiency Policy Recommendations”, IEA, 2011, http://www.iea.org/publications/freepublications/publication/25recom_2011.pdf

10. Zamolodchikov D.G., Oxygen as the basis of life. Bulletin of the Russian Academy of Sciences, Environmental issues, 2006, Volume 76, No. 3, pp. 209–218.

11. National Report on Inventory of Sources and Sinks, http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/6598.php

12. Stocks and flows: carbon inventory and mitigation potential of the Russian forest and land base. World Resource Institute Report, 2005;

Zamolodchikov D.G., Korovin G.N., Utkin A.I., Chestnykh O.V., Songen B. Carbon in forests and agricultural areas of Russia. Moscow: KMK, 2005. 200 pp.;

Zamolodchikov D.G., V.I. Grabowski and G.N. Kraev. Dynamics carbon budget of Russian forests in the last two decades. Forestry, 2011, No. 6, pp. 16–28;

Zamolodchikov D.G. Forests and Climate – Yesterday, Today and Tomorrow. Living Forest, 3, 2011, No. 3, pp. 16–22 http://givoyles.ru/.

SWEDEN

Climate Policy Instruments in Sweden

Compiled by Fredrik Lundberg (Sweden)

Most of the instruments are taken from Sweden's Fifth National Communication on Climate Change[122]. (Entries on Green Consumerism, R&D on heating (Värmeforsk), railway investments, congestion charges, "energy vouchers", and the lightbulb ban have been added.)

Top 10 instruments, ranked

The following all gave valuable input to the list of instruments, as well as their pros and cons: Stefan Henningsson for WWF Sweden, Martina Krüger for Greenpeace Nordic, Svante Axelsson for the Swedish Society for Nature Conservation and Tomas Kåberger, Professor of Industrial Energy Policy at Chalmers Institute of Technology.

Their lines of argument are considerably more complex than what follows from the text below, for which Fredrik Lundberg bears the sole responsibility.

Three things should be noted:

1. The ranking is not a straightforward matter. Obviously some of the instruments have received a high rank because they are evidence-based, others because of their evident potential. The reader is encouraged to see each instrument in its best light!
2. Most reviewers (rankers) pointed out that strong synergies exist between instruments. The (modest) Swedish success story of fairly good economic growth and falling CO_2 emissions is the result of both sticks (such as CO_2 tax) and carrots (such as the climate investment programmes).
3. The "flagship"[123] of EU climate policy is given short shrift. No reviewer ranked it anywhere near the top.

1. Energy and carbon dioxide taxes

CO_2 tax introduced 1 Jan 1991.

Initial level: SEK 250/ton, or SEK 334 in 2010 money or €35 (2010). First substantial CO_2 tax in the world.

Initial and extant exemptions. Exemption for electricity production. Exemption for most heavy industry (steel, paper, oil refineries, cement, lime, aluminium). Exemption for peat.

Light industry, including large engineering companies such as Volvo and ABB, was initially levied full tax. In 1993 the "general tax" was increased to SEK 320/ton, though tax for (light) industry was cut 75%.

The industry tax was re-increased to 50 per cent of the "general tax" in 1997.

The "general tax" level was again increased in several stages to its present level of SEK 1100/ton (2012), while the tax for light industry has varied and is now at SEK 330/ton. Heavy industry does not pay energy tax.

122 http://www.regeringen.se/sb/d/108/a/139745

123 See for example Commissioner Dimas at www.eu-un.europa.eu/articles/en/article_5436_en.htm

Present exemption. Exemption for all industry in the European Emission Trading System, with exception for district heating.

Effects mainly on **heating** of houses, flats, offices and commercial buildings directly and through district heating. Oil and coal have been replaced by biomass in the growing district heating network. In other heating, oil has been replaced by (electric) heat pumps, district heating and wood pellets.

This trend goes back to even before 1991, since it has been Swedish policy since 1974 to reduce oil dependence through a number of taxes and subsidies. This has been reinforced by increasing oil prices over the last 10 years and to some extent by VAT.

For **light industry** it is likely that the same thing has happened to a lesser degree, but statistics are not very good.

Heavy industry (process industry) and **electric power production** has not paid the tax.

The transport sector has not been very much influenced by the tax since the energy tax was lowered almost as much as the CO_2 tax was increased.

Combined heat and power was initially taxable for the heat but not the power component, which led to some creative accounting. Heat delivered to industries was taxed at the lower rate. Now (2012) the heat component pays 7 per cent or SEK 7.7/ton or less than one extra euro on top of the ETS cost.

It is questionable if this tax can be retained after implementation of proposed amendments of the Energy Tax Directive and Emission Trading Directive.

In theory the tax has also been applied to **vehicle fuels**, but essentially this has been a change not in the tax itself, but in its name, from energy tax till CO_2 tax. For obvious reasons this has not changed behaviour, such as fewer kilometres or smaller cars. But it has had some effect in that it favours ethanol, RME and biogas, though other factors have been of consequence, and more so.

Quantitative effects are hard to discern, since the CO_2 tax works together with an energy tax, which also had the aim and effect of oil phase-out, as well as other instruments such as subsidies for house-owners to change from oil-fired heating to anything else, by VAT on fuels, and by coincidence, i.e. the oil price hike after the year 2000.

Nevertheless the effects were very strong.

Oil for heating in houses, apartments, offices, and shops decreased[124] from 41 TWh in 1990 (before the CO_2 tax) to some 13 TWh by 2011. Despite a considerable growth in living area and office area the total energy use decreased. Biomass increased from 11 to 19 TWh. District heating increased from 31 to 53. Electricity did not change much[125]. This resulted in an emissions decrease from 10.3 to 3.3 Mtons of CO_2 over the period.

124 http://www.energimyndigheten.se/en/Facts-and-figures1/Publications/ Energy in Sweden Excel table 8

125 www.energimyndigheten.se/Global/Statistik/Energilaget/Kopia%20av%20Energilaget%20i%20siffror%202011.xlsx table 12

Emissions did not shift elsewhere. The growing district heating uses much more biomass, and much less fossil fuel[126] now than it did in 1990, and much less electricity with roughly the same CO_2 emissions.

Much of the Swedish GHG cut was achieved in the heating sector, where the CO_2 tax was the most important instrument.

To sum it up, the CO_2 tax has been very powerful, where fully applied, less so where partially or inconsistently applied and not at all where not applied.

2. Building regulations

Sweden is far north and has cold winters. This has necessitated a higher average thermal standard than in continental Europe, but better insulation has also led to very high indoor temperatures for at least the last 50 years. Double glazing has been standard for much longer, and triple glazing became very common from the 1970s onwards. Even better windows with infrared reflective coating are now more or less standard.

Much of the heating is electric, but much of the direct resistive electric heating has been replaced by heat pumps, and to lesser extent by district heating.

Building regulation is a potentially very important instrument. In practice, however, Swedish regulation is very weak. Boverket, the Swedish National Board of Housing, Building and Planning issues the energy requirements for new buildings. The same requirements are, in principle, also applied to renovated buildings.

The new requirements for new buildings from 2010 are about twice the passive house standard, though there is no good economic argument against applying full passive house requirements in Sweden.

3. Congestion charges

Congestion charges were introduced on trial in central Stockholm in 2006, and permanently from 2007. The charge or tax is levied per car passage in or out of the town centre from 6.29 in the morning to 18.29 in the evening. The charge is SEK 10-20 (€1.15-2.3), the latter for rush-hour traffic.

The aim of the charge is to use the road infrastructure in a more efficient manner with revenues used to finance more infrastructure, especially public transport. It was not intended to cut CO_2 emissions, but rather to level out traffic peaks, so as to avoid the choice between gridlock or extremely expensive new roads in the growing Greater Stockholm area.

It produced a 15-18 per cent reduction in traffic peaks. The effect was immediate, and lasting[127].

The congestion charge in Stockholm was initially quite controversial, but is now generally accepted. From 2013 Gothenburg also has a congestion charge.

Though, as noted, the congestion charge is not intended to be a climate poli-

126 ibid table 29

127 www.transportstyrelsen.se/Vag/Trangselskatt/Fragor--svar/Fragor--svar-for-Goteborg/Fragor-svar-om-trangselskatt-i-goteborg1111/Paverkar-trangselskatt-verkligen-trangseln-Hur-ar-det-till-exempel-i-Stockholm/

cy instrument, it could well be used as a general method to reduce traffic (not just time-shift it), and to promote/demote various kinds of vehicles. Stockholm exempted "environmental cars" from the charge up to July 2012. The definition of "environmental car" is a tricky issue, but it was not a problem for the system to implement.[128]

The instrument is not limited to big towns, or towns at all. It can be used to reduce traffic and differentiate vehicles on all roads. If the main object is to reduce other pollutants (especially particles) and to reduce costs for infrastructure, CO_2 emissions can also be cut at a little or negative cost.

Though later than the London congestion charge, the Stockholm zone covers a larger area, in relative and absolute terms. The London zone covers 22 square kilometres of central London, or 1.4% of the Greater London area[129], whereas the Stockholm zone covers some 34 square kilometres out of the much smaller greater Stockholm area.

An innovation compared to the London experience is that the tax is more differentiated.

4. Climate investment programmes

The Local Investment Programmes (LIP) 1998-2002 were intended to both reduce unemployment and to improve the environment, with climate mitigation as only one parameter. About half of the projects and project money were dedicated to greenhouse mitigation. The LIPs were funded by the national government after local government applications usually co-financed by local government or private industry.

The LIPs were important in at least two respects.

They did not state preference for any specific technology or method, but left that to the local governments (which are fairly strong and independent in relation to the national government). This innovative "let a hundred flowers bloom" approach actually did produce a broad spectrum of results.
The programme was, for Sweden, well funded. LIP and its follower KLIMP (climate investment program 2003-2012) spent about €500 million with added funding from other sources.

Much of the LIP money went into a fuel shift from fossil fuels to biomass. This is hard to evaluate for the same reasons that CDM projects are hard to evaluate: it is impossible to know if what happened would have happened anyway.

Some projects were however clearly additive. One example is the biogas factory that uses slaughter residue, in Linköping 200 km south of Stockholm. Buses, taxis and many cars in Linköping were converted to biogas. Swedish Biogas[130], the operator of the biogas plants, owned by the local government, became a leading developer of biogas projects in Sweden, and to some extent

128 www.energimyndigheten.se/Global/F%c3%b6retag/Energikartl%c3%a4ggningscheckar/Goda%20exempel/Aroma.pdf

129 www.erg.kcl.ac.uk/Monitoring.aspx?DeptID=Monitoring&CaseStudyID=MonitoringCCS

130 http://www.swedishbiogas.com/

also in other countries. This development work started before LIP, but was reinforced by LIP projects, for example the construction of a public filling station for biogas, conversion of some refuse collection vehicles from diesel to biogas and collection of refuse from school kitchens etc. The positive results from those biogas projects, as well as very positive results from life cycle analyses compared to other fuels, led to an emphasis on biogas in the following KLIMP projects.

Though evaluation is difficult, and may underestimate the long-term effect, the official account[131] says that LIP achieved a GHG reduction of close to one million tons, and KLIMP 0.9 Mton. For KLIMP, the cost per ton of CO_2 equivalent was estimated at SEK 100/ton (roughly €10/ton). The electricity consumption reduction, 874 GWh/year was not credited. If the electricity is assumed to be marginal coal or lignite power in surrounding countries, this would add an extra million tons per year. If it is assumed to be natural gas power (or a mix to that effect), it is still worth some 350 000 tons.

KLIMP came to end end in 2012, but was overlapped by its successor Hållbara Städer (sustainable cities and towns), which began in 2009, and shares some of its features.

5. EU ban on incandescent lamps

The EU-wide ban on incandescent lamps was not Swedish in any sense, but is clearly of importance itself, as an example of the EcoDesign directive and as a general example of what can actually be done. It is added here so it will not be forgotten in the final list of instruments. The ban will cut EU emissions by about 15 Mtons[132], while also saving money for consumers, as fluorescent bulbs or LEDs reduce electricity costs and last much longer.

6. Programme for energy efficiency in industry (PFE)

The European Union legislated on a minimum tax on electricity with effect from 2005. The Swedish energy-intensive industry had never had to pay such a tax, and was offered a conditional exemption.

The condition was participation in a programme for energy efficiency.(PFE)

Though the tax was very low, about €0.5/MWh, it was very visible, and almost all eligible companies joined the program, with absolutely astonishing results.

During the first five years, the companies had undertaken more than a thousand measures to save electricity. The predicted saving was 0.6 TWh/year.

The actual saving was 1.45 TWh/year for an investment of 708 MSEK – about €5/year per MWh. This means an average payback of 1-2 years.

With a very small carrot in sight, the companies mobilized resources to act in their own interest.

Despite the huge success, PFE will be discontinued in 2014, as it is deemed incompatible with present or future EU legislation.

131 http://www.naturvardsverket.se/Documents/publikationer/978-91-620-6357-3.pdf (in Swedish)

132 http://ec.europa.eu/energy/lumen/faq/index_en.htm

7. Railway investments and improved railways

One way to cut emissions is to shift transport of both goods and people from road and air to rail.

The parliamentary Climate Committee of 2008 concluded that investment in a 50 per cent increase of railway goods capacity would cut CO_2 emissions by 1 million tonnes[133].

This line of argument raises a number of questions, such as

1. Is that so – are we moving in that direction?
2. Is more rail freight really cutting emissions if road transport is also increasing?
3. Can past increases in transport be extrapolated into the future indefinitely?
4. If future road transport is fuelled by non-fossil electricity and biomass, does rail transport decrease CO2 emissions at all?
5. If a large sum of money is available for various purposes such as regional development and emission reductions, is railway investment the most efficient and quickest way to achieve it?
6. Are investments in new infrastructure usually preferable to better maintenance, better trains etc?

The short answer to all these questions is "no, probably not" to all of them. On the other hand, as long as we don't know for sure that road traffic will be de-fossilized for several decades, the government's spending allocation between rail and roads is important.

The Social Democratic government 1998-2006 (which was dependent on the Green and Left parties and cooperated with them on budget and other issues) had the ambition to invest twice as much in rail as in road infrastructure. Whether this actually would have happened is hard to tell, given the long time from intention to realization, but the right-centre government made a policy shift to 50/50. In the budget for 2012 there was some increased budget for rail (more maintenance and more new investment), but no way near the 50 per cent increase mentioned above, nor a decisive shift from road to rail.

The conclusion is that railway investment in Sweden is not a climate instrument, though it possibly might have been.

8. Electricity certificates

As an alternative to feed-in tariffs for renewable energy, Sweden introduced electricity certificates in 2003. Norway joined the system in 2012. This specifies a quota of new renewable electricity sold to (most) customers. It mandates 25 TWh of new renewable energy by 2020 from year 2002.

Wind power, wave power, biomass and peat CHP, solar power, geothermal power and (some) hydropower all qualify for the quotas.

The principles of the system can be weighed against feed-in tariffs: it can produce large amounts of renewable energy at a low cost. The downside is that it does not promote innovation. And whereas it ensures a long-term subsidy for the 15 first years of operation, through to 2035, with little politi-

133 http://www.regeringen.se/content/1/c6/09/96/94/8393cd02.pdf p399

cal interference, the value of that subsidy is not known in advance; it is left to the market.

This, however, also means that if prices drop very much, it gives an indication to the government that the ambition could be raised.

In the first few years almost all new production was from biomass combined heat and power, a technology that was already in widespread use and with little need for innovation. Compared to the feed-in tariff, for example in Germany, it has indeed been cheaper but also produced less innovation. Sweden was several years behind Denmark, Spain, and Germany, and photovoltaics are still insignificant.

However over the last few years, more and more new power is wind power. In 2011 wind power contributed more than 6 TWh or 4 per cent, and it is still growing very fast.

One characteristic of the certificate system is that the prices are up to the market. The prices have fallen from about SEK 350 in 2008 to about 150 per MWh in mid-2012, but, as stated, this has not stopped a high level of investment in wind power. The explanation is probably that wind power development has gathered momentum and that costs are falling, so it is profitable even with a lower subsidy. (After the integration of Norway into the system, and for other reasons, the price has increased again to above SEK 200 in early 2013.)

The practical design of the system has some ugly aspects.

- Peat, which is considered equivalent to fossil fuels by the IPCC, the EU, the IEA etc. is subsidized along with bona fide biomass.
- Heavy industry is exempt from the obligation to buy certificates for their electricity. This is in line with a longstanding Swedish practice of supplying cheap and dirty electricity to the dirtiest industries. As for the paper and pulp industry, they can produce "green" electricity, while using very ungreen electricity for their own consumption.
- Hydropower is very heavily exploited in Sweden; any further exploitation comes at a high cost for nature, according to the NGOs, and should therefore be discouraged and, at least, not be subsidized. This aspect may be even more important in Norway, which joined the system in January 2012.

9. Technology procurement

Technology procurement is a method to create a market for energy efficient technology, either to introduce a new technology or to create more markets for an existing technology.

The government (its energy agency) coordinates a group of purchasers and specifies the criteria for a product, both in terms of energy use and whatever criteria the market – as represented by the group of purchasers – prefers: price, warranty, aesthetics, etc.

In an open competition, the best bidder is elected by the group of purchasers, and is awarded an order for a certain quantity of the product.

This approach was first used in 1990 for refrigerators. The requirement was

a 50% cut in energy demand, which was met by three competitors[134]. The winner was Electrolux, which had up to that date not offered the market any of its more efficient models. Partly as a result of this procurement exercise, Electrolux (a global appliances company based in Sweden) started to make energy efficiency a selling point, not just for fridges and not just in Sweden, but for all its products and most brands, all over the world. Many of their competitors have followed suit.

Would this have happened anyway? Probably yes, but later, and quite possibly somewhere else. Sweden had at the time a large overcapacity of electricity production, low electricity prices and low awareness of energy efficiency. But it did happen in Sweden first, well before the EU energy labelling of fridges and may well have influenced the label classes (A to G, with A+, A++ and A+++ added later.)

The Energy Agency has initiated many procurement projects. Not all of them have been successes. It is sometimes not so easy to make purchasers as a group take collective responsibility to actually purchase the promised number of products, and to make the winning manufacturer live up to all specifications. A too legalistic approach would scare off many purchasers and many manufacturers, so it has to be based more on a "gentlemen's agreement", which sometimes, but not always, is good enough.

Some unsuccessful projects have been too ambitious, too far from the market to really influence it. An electric car procurement initiative in the 1990s, unsurprisingly, did not transform the automobile market.

When technology procurement works, i.e. with the right specification at the right time, it can be very impressive. Two examples:

Heat pumps were introduced in Sweden in the 1970s, but fell into disrepute, because of some substandard manufacturers and many substandard installers. The procurement initiative in 1995 resulted in 30 per cent cheaper and 30 per cent more efficient heat pumps. This kick-started a revival on a very big scale. More than 100 000 heat pumps per year are sold in Sweden alone, and the 1995 winner IVT (a Bosch brand) exports more than 50 per cent. Most down-hole heat pumps have or are replacing oil heating.

A procurement initiative for energy-efficient windows took place in 1990-95, with the target of 45 per cent less heat transmittance than the then average on the market, with stringent requirements for aesthetic aspects such as colour rendition. The specification allowed for a triple-glazed window, as a quadruple-glazed window would be too heavy and expensive.

The winning windows were not an immediate sales success, but the big manufacturers moved much closer to that standard.[135]

10. Special initiatives for wind and solar power

Support for solar heating and for solar photovoltaics has been patchy and often changed. The contribution of both sources is insignificant.

134 http://energimyndigheten.se/PageFiles/18077/Uppf%C3%B6ljning%20Kylfrys.pdf

135 Some of the info here comes from the Energy Agency, www.energimyndigheten.se report Energimyndighetens teknikupphandlingar ET 2006:08

The support, other than R&D and the Elcertifikat, has been significant for offshore wind, which up until 2009 received extra support of SEK 0.12/kWh (about €12/MWh)[136].

Sweden was a very important pioneer for offshore wind, and this previous support was instrumental for some projects. Planning work continues, but actual investment decisions more or less ceased after 2009. The wind power industry is so busy onshore that this has mainly gone unnoticed. Some offshore projects have actually proceeded with nothing more than the Elcertifikat subsidy, but it seems the circumstances were unusual.

There are some very big projects on hold, so some renewed extra support might have very big effects. One single project aims to generate 7 TWh of electricity per year, equal to the production of a 1000 MWe nuclear reactor.

(Other instruments, not ranked)

Emissions trading

Sweden is different from most other EU countries in that most electricity production does not emit fossil CO_2 at source. By Phase I 2005-07, about 50 per cent was hydro, 45 per cent nuclear, and a growing share of the remainder was biomass CHP. So by phase I, only a third of Sweden's GHG emissions were covered by the ETS.

Sweden has of course the same prices for ETS as the rest of Europe. But for the two first phases, the National Allocation Plans were of considerable importance.

In the first NAP for 2005-2007 Sweden gave no allocation for new power plants. As few people predicted the actual price development – i.e. a price collapse in 2007 – this probably killed some projects, notably a Vattenfall oil power plant upgraded from reserve to base load. In the 2008-12 NAP, this policy was reversed, so the existing power plants got very few permits, whereas two new fossil gas-fired combined heat and power plants got 100 per cent free allocations.

In combination with the patchy remaining CO_2 tax, the fear of high CO_2 prices stopped all new fossil power and heat projects, but changed very little else.

The overall allocation was very high in both instances, and was substantially cut by the European Commission for Phase II.

For Phase III, Sweden has applied for a large increase in free allocations. A large part goes to heat plants, even those that use biomass. This is, compared to the present situation, a clear disincentive to energy saving. With the low expected CO_2 price there is much less of incentive to move from coal to gas to biomass than with the previous price.

The notion that overlaps or "double instruments" should be avoided[137] is very problematic in the Swedish context (or indeed in any context). The Swedish

136 http://www.rgp.se/Fakta/Svensk_Vindenergi_Lathund.pdf (in Swedish)

137 http://ec.europa.eu/taxation_customs/resources/documents/taxation/com_2011_169_en.pdf

Energy Administration interprets proposed EU legislation as a prohibition to apply CO_2 tax to district heat plants in the ETS. If this is correct, the ETS rolls back much of what Sweden has achieved over 20 years.

If this happens, the ETS, whatever its merits outside Sweden, has been an instrument for destroying Swedish climate policy, without putting anything positive in its place.

One smaller item on the credit side of the ETS is however that it treats peat as the carbon intensive fuel it is.

Environmental Code (environmental quality targets, etc.)

The 16 environmental targets, of which climate is one, used to be a fairly powerful bureaucratic machine for production of quantitative targets and annual follow up. Though none of the targets were legally binding (other than through EU legislation or other international agreements), this system gave a clear signal when targets were not being met.

The monitoring, and recommended action, was performed by a council of the directors general of the relevant agencies (for the environment, for traffic, for forests etc.) In the Swedish system, the agencies are independent and cannot be ordered around by individual ministers. The ministries are small in staff, with most staff working for the agencies.

The targets were also broken down at regional and municipal level, where indications that things were not moving in the supposed direction sometimes also triggered remedial action.

The system has essentially been dismantled since a right-centre coalition won the election in 2006, and again in 2010. It now produces little more than calls for further investigation

The legal requirements of most importance over the last few years are those resulting from EU legislation on air quality.

This does not directly deal with greenhouse gas emissions, but as it targets NOx and particles, it demands action on traffic emissions, which also reduces CO_2 and black carbon, and indirectly also N_2O.

To improve the air quality of Stockholm, which has had a congestion charge since 2006, it has been suggested by civil servants that the congestion charge should be increased and extended to cover more roads.

Greenhouse gas emissions form part of the permit appraisal procedure. With effect from 2005 it is, however, no longer permitted to issue emission limit values for carbon dioxide

or to limit the use of fossil fuels for installations covered by the EU Emissions Trading Scheme[138].

Planning and Building Act

This could be an instrument to counter road projects and airstrips that will increase CO_2 emissions and prioritize rail and harbour projects so as to offer

138 NC5 p 42

lower carbon alternatives.

In practice, this does not happen too often.

It is however an instrument for adaptation to climate change

The Planning and Building Act was amended in 2008 so that buildings are only allowed to be erected at suitable locations, and account has to be taken of the risk of accidents, flooding and erosion in municipal comprehensive plans and detailed development plans[139].

"Energy check" – energy saving for SMEs

This provides support for energy mapping of small and medium-sized enterprises (mainly light industry), farms and some apartment buildings, and was introduced in 2010. The government (the Energy Agency) pays 50 per cent of the energy analysis cost for hiring an external consultant.

This very modest incentive can produce remarkable results. Aroma, a sweet factory in Stockholm, which produces jelly rats, received SEK 30 000, invested SEK 200 000 and expects to save SEK 500 000/year from a saving of 500 000 kWh.

At Tooltec, an engineering company in Trollhättan, the consultant identified savings (mainly electricity for compressed air and lighting) of 574 000 kWh for an investment cost of SEK 200 000, i.e. a payback time of 3 months.

In several other examples large energy savings were identified with a payback period of around 2 years, still very profitable.

The 'energy check' instrument has not yet been evaluated.

Investment support for conversion of heating systems and energy-efficiency measures

This was a programme that ran in 2005-2010 for converting homes from direct electric heating and oil-fired heating. This spent a large amount of money on what probably would largely have happened anyway, as oil and electricity prices skyrocketed.

An evaluation[140] of the oil conversion component summed it up pretty well in its title "Less oil, better environment, but at what price?" 36 000 houses were converted to heat pumps, biomass or district heating for a subsidy of about €40 million.

Houses, apartments and commercial premises that were converted from direct electric heating, switched mainly to district heating[141].

What is instructive about this kind of instrument is that subsidies have a very strong impact on the exact timing of investments. When it is known that a subsidy will take effect next year, the market will be very quiet until then. When the deadline of the phase-out is known, the market goes into frenzy and then nearly drops dead.

139 NC5 p 13

140 http://www.boverket.se/Global/Webbokhandel/Dokument/2008/Mindre_olja_%20battre_miljo.pdf

141 http://www.boverket.se/Global/Webbokhandel/Dokument/2011/Utv%C3%A4rdering%20av%20st%C3%B6det%20f%C3%B6r%20konvertering%20fr%C3%A5n%20direktverkande%20elv%C3%A4rme.pdf

What also should be considered is that investment support (of any kind) is much cheaper as part of a Keynesian stimulus during a recession, rather than during a boom. The conversion support failed in that respect, too.

Within this package there was also support for energy-efficient windows, which according to one evaluation[142] was also of little effect at a high cost. This may however have missed the market transformation aspect.

Building regulations

Sweden is in the far north and has cold winters. This has necessitated a higher average thermal standard than in continental Europe, but better insulation has also led to very high indoor temperatures for at least the last 50 years. Double glazing has been standard for much longer, and triple glazing became very common from the 1970s. Even better windows with infrared reflective coatings are now more or less standard.

Much of the heating is electric, but much of the direct resistive electric heating has been replaced by heat pumps, and to lesser extent by district heating.

Building regulation is a potentially very important instrument. In practice, however, Swedish regulation is very weak. Boverket, the Swedish National Board of Housing, Building and Planning, issues the energy requirements for new buildings. This is, in principle, also applied to renovated buildings.

The new requirements for new buildings from 2010 are about twice those of the passive house standard, though there is no good economic argument against applying full passive house requirements in Sweden.

Research and development funding

R&D is obviously a very important instrument for cutting GHG emissions, but the early or fundamental research is not relevant for this project.

What is relevant is the pre-commercial development phase for some technologies.

Solar cells are now within reach of grid parity, but needed, and still need, large, diversified and sustained R&D and very large production subsidies to get there – though the potential was understood pretty early.

Swedish R&D in CIGS thin-film cells was one of the factors that led this technology to become the fourth largest photovoltaic production technology after crystalline silicon, amorphous silicon and CdTe. Though the R&D still goes on in Uppsala and is producing record-breaking new cells, the Swedish government missed the opportunity for commercializing CIGS in Sweden. It was commercialized, but Solibro, the second biggest CIGS producer in the world in 2011, has its factory in Germany.

The sad thing is not that the Swedish taxpayer got the costs while Germany got the benefits. (Germany has other, huge, costs for PV, and well deserves some benefits.) The sad thing is that time was lost in the gap between R&D and large-scale production, maybe a couple of years, which is a very long time in a business with a long-term annual growth of 40 per cent.

142 http://www.boverket.se/Global/Webbokhandel/Dokument/2010/Utv%C3%A4rdering%20av%20f%C3%B6nsterbio.pdf

Wave power may become the next big thing in renewables, and possibly the Swedish government will be more proactive this time. At least the promising SeaBased technology will be tested on an intermediate scale, 420 converters and an annual 25 GWh. The Energy Agency pays 40 per cent of the investment cost of MSEK 420 (about €45 million). Energy company Fortum is a big partner. It will start operation 2012-2014. It is a big bet, but it is conceivable that wave power will produce significant amounts of energy by 2020.

Other relevant support from the Energy Agency[143] goes to:

- Vehicle biofuel from paper pulp (Kraft) black liquor
- Lignin (solid biomass with high heat value, can replace coal or oil) from black liquor.
- Methane (for vehicle fuel) from woody biomass

Of those, the black liquor projects have been discussed for more than 15 years, though this was initially aimed more at power production than vehicle fuels. It stands a chance of commercialization before 2020 in an industry of great importance, particularly for Sweden, Finland and Norway. Investment cycles in the pulp industry are long, though. Even when it is profitable to use the black liquor for fuel production, rather than just burning it to meet the pulp plant's own needs, it will take decades before most pulp plants will do so.

Heat Research

Sweden is in the far north, so heating is an important part of the energy supply. Though Sweden has cold winters, or because of it, indoor temperatures are high everywhere even in mid-winter, and the heating share of TPES is not higher than in much warmer countries in Europe.

Sweden has a huge district heating system, largely based on biofuels, especially wood and waste. About 50 TWh of heat[144] is delivered annually to apartments, offices and industry and also to single-family houses. This has almost eliminated smoke from chimneys, and oil-fired boilers, in the inner cities of Sweden.

While the technology to get heat from wood is 500 000 years old, it is rather demanding to do it in a reliable, clean, efficient and inexpensive way. The fuel is relatively cheap, but capital costs are high so equipment must be ensured a long and uneventful life.

Some R&D is futuristic and visionary, but some is there to solve very practical boiler problems of soot, corrosion, sintering, mixing, low NOX emissions etc. These problems have to a certain extent been solved at Värmeforsk[145] ('Heat Research'). This entity is funded by the Swedish Energy Agency (less than 50 per cent) together with the district heat producers, the pulp industry and other sectors of industry.

While district heating is best suited to inner cities or big buildings, it is not

143 http://www.energimyndigheten.se/sv/Press/Nyheter/Stod-till-fullskalig-vagkraftsanlaggning-beviljat-av-EU/

144 See www.svenskfjarrvarme.se and www.euroheat.org

145 http://www.varmeforsk.se/eng-start (english)

practical further away. Small-scale wood heating is, or has at least been, an environmental problem. Many home-owners use heat pumps, which (if too many do so) may not be optimal due to power capacity peaks. Increased use of wood pellets or other refined biomass could play a part in the puzzle. The use of pellets increased from about 500 to 2000 ktons[146] from 1997 to 2011. Of that increase, single-family houses increased even more. There is much untapped potential for other kinds of biofuels such as reed canary grass, other types of biofuels such as briquettes, and other demands on fuel and ash handling.

Such issues have been successfully attacked by the Swedish Energy Agency's "Small-Scale Heating Programme" 2008-11, with implications also for small-scale CHP, and with a view for use in tropical countries.

/To be amended/

Eco-labelling and Green Electricity

Only the EU energy labelling scheme is described in the National Communication, though there was a national energy label for some products before the EU. This was organized by Nutek, a predecessor of the Energy Agency, with some innovative elements. Shops in the trial town of Östersund were invited to compete for the largest share of sales of fridges with the lowest energy consumption. There was also a small prize for the shop that had the best display of efficient fridges. The market penetration for efficient fridges went from zero to fairly high, but as the national label was superseded by the EU label, probably also due to bureaucratic infighting, the effort was not replicated on a national scale.

Sweden has, like other countries, a label for agricultural products, though the Swedish KRAV scheme was earlier and better known than in many other countries, and probably had a relatively high market share. KRAV products have a smaller climate footprint, for example in that it does not allow the use of nitrogen fertilizer, which contributes to N_2O emissions[147]. Also, perhaps more importantly, it established the principle of labelling: if a restaurant wants environmental credibility, it will serve KRAV-labelled food.

The "Good Environmental Choice" ecolabel[148] was also initiated in the late 1980s by the SNF (Swedish Society for Nature Conservation), occasionally reinforced by boycotts against eco-hostile products. Some early successes in this exercise of "Consumer Power" against products, such as chlorine-bleached coffee filters and some detergents, were never quite repeated. The indirect effects may still be considerable, but are very hard to measure: we do not know what would have happened without them.

"Good Environmental Choice" initially competed with the official Nordic label, Svanen[149] (the Swan), but they ended up collaborating and do not

146 http://pelletsforbundet.se/web/Leveransstatistik.aspx

147 http://www.krav.se/Documents/Engelska%20sidor/Information_from%20KRAV_focus_Climate.pdf

148 http://www.naturskyddsforeningen.se/in-english/Ecolabelling/

149 http://www.svanen.se/en/Buy-Svanenmarkt/What-is-Svanen/

label the same goods and services, and do not compete with the EU label. Svanen is a label for a wide range of products from tyres to houses and office equipment, as well as services such as car washes and hotels, and 400 grocery stores. Good Environmental Choice also ecolabels insurance services and district heating, for example.

Following electricity deregulation in 1996, customers were able to choose any supplier and any specified product. One such product, launched by the SNF, is Good Environmental Choice Electricity, or Green Electricity, which excludes nuclear, fossil and new hydro. It has not been a great success on the consumer market, but companies such as SJ (State Railways), which runs much of the trains in Sweden, purchases only Green Electricity, as do other corporations and agencies. Almost all suppliers offer this product, but they also offer confusingly similar products. The Elcertifikat has also been unhelpful for the market.

To end on a more positive note, there is the unlikely success story of the TCO label[150]. TCO is a white-collar trade union. In the 1990s a lot of office workers complained about computer screens, which then used cathode ray tubes. The TCO formulated criteria for the radiation from the screens, which soon became a world standard! The TCO then formulated not only working environment but also sustainability criteria for various IT products, including energy use. Most major manufacturers (LG, Lenovo, Samsung etc.) apply for the TCO certificate. Again we do not know how the energy consumption and carbon footprint of products would have developed otherwise, but it is encouraging to see that a very small number of individuals that came up with the TCO label can make a difference. The slogan for the TCO label is cocky but has some substance: "Good for you. Good for the Planet."

Green car rebates and other advantages for cars

A rebate for "green cars" was in effect in 2007-2009. The rebate was SEK 10 000, not a lot compared to the price of a new car, which is 10-50 times as much. This was replaced by an exemption from car tax for the first five years for green cars.

There were also other advantages: free parking in some towns, no congestion charge in Stockholm, and 5 years free of car tax.

Later a super-green car rebate for electric cars was introduced, resulting in very few cars actually sold.

Initially most of the green cars were ethanol cars, with little incentives for fuel saving. Ethanol was pushed by other means, such as a requirement (decided in 2002) for gas stations to supply an alternative fuel, which usually meant ethanol.

The reason for giving priority to green fuel rather than fuel efficiency is of course that Sweden is the homeland of Volvo and the now defunct Saab cars, both very thirsty cars a few years ago. As in other countries, the green fuel policy went down well with the agricultural lobby, as well as with the Green Party (which formed part of the parliamentary majority for the government 1998-2006).

150 http://www.tcodevelopment.com/

In spite of changing policies, inconsistencies and various definitions of green cars in different parts of Sweden, the combined effect of policies of which green car promotion was a part, was a marked improvement.

In 2008 and for many previous years, Sweden had the least energy-efficient new cars of all EU countries at 180 grams of CO_2/km. In 2011 Sweden was in the mid-range at 138 grams[151].

Some of the improved efficiency comes from an increased share of diesel cars, which is of contentious value. The real improvement in climate terms is however still greater, as the relatively large use of renewable fuels in Sweden is not accounted for in the EU statistics. Swedish renewable fuels include diesel from the forest industry relatively benign ethanol and extremely climate-efficient biogas. Sweden was very close to meeting the 2020 requirement for 10 per cent renewable transport fuels[152] as early as 2011. Consumption of diesel and petrol fuels has fallen, in absolute numbers, since about 2007.

Attribution of such complex changes to one single instrument is hardly possible.

One possible conclusion is that the large number of instruments for green cars has had a strong combined effect: the multitude of incentives sends a strong message. Conversely, the public discussion and awareness of car emission performance has been much enhanced.

151 http://www.transportenvironment.org/sites/te/files/publications/2012_12_TE_cars_CO2_report_web_final.pdf p27 and http://www.trafikverket.se/PageFiles/25435/pm_vagtrafikens_utslapp_20130306.pdf

152 Transportsektorns eneergianvändning 2011 Energimyndigheten 2012 p13.

Appendix

Criteria for the instruments

The objective of the national reports is stated below. Some of the requirements were difficult to fulfil in some countries, and impossible in others. There was not only the recurring problem of attribution of an instrument with an emission cut; most of the instruments in most of the countries have not been strictly evaluated at all by the governments, so there were little data to pick up for the NGOs. Quantitative results was not there, so it had to be qualitative.

Also, some countries have not had much climate policy at all, so the NGOs picked policies they judged will or would be useful, rather than actual experience.

Mistakes are inevitable in a process like this, but if re-iterated (in the same countries or others), it could be much improved.

Guidelines for the national reports:

(Letter sent to the NGOs)

The objective is to produce a summary regional report that lists and ranks the ten best mitigation measures in the region, picked from the country reports for each of the following nations: Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, Sweden, Germany, Russia and Poland

The country reports should follow the same structure, though the number of mitigation measures need not be exactly ten. (A measure that is ranked 11 or 12 in a country report may be ranked higher when considering the whole region. The number of entries may also be fewer than 10, if some measures do not apply in a particular country.)

The criteria for what is "best" are complex, and include:

- The measure that has produced the largest GHG cuts in tons or as a percentage.
- The measure that has the greatest future potential to produce the largest GHG cuts in tons or as a percentage.
- The measure that saves most energy, even if the immediate effect is not very large in terms of reducing GHGs. (Example: electricity savings in Sweden do not now save much CO_2, as most of the electricity is produced by hydro and nuclear. In a longer timescale and in a larger geographical context, however, electricity savings in Sweden are good for the climate.)
- The measure that is most replicable in other countries, within or outside the region.
- Compatibility with other environmental targets and social welfare.
- Cost-effectiveness, though clearly less important than effect, should be considered. Technology that is now far from cost-effective but which is proven technically and shows promise to achieve reasonable economic performance may be considered. (An example may be advanced offshore wind power.)
- Positive side effects for the economy, employment, environment, public health or other generally agreed societal targets.

The focus should be on measures that have been used long enough to produce data on emission cuts. Unproven future technology should not considered.

However, measures that have already been decided but not yet been implemented can be included in the list. (Example: Norwegian building code, the effects of which are probably well assessed in advance by the government or its agencies.) Even measures which have not yet been decided but which will have effects that are large and easy to assess may be included as "extras". (Example: ending tax exemptions for peat in Sweden would immediately end peat use for energy, eliminating corresponding emissions).

Content of the summary report: The ten best mitigation measures in the Northern Europe

(the report should follow the same structure as each of the country reports, although they do not need to include 10 measures each):

For each of the ten, ranked, mitigation measures, the following aspects should be described:

1. The measure, its type (e.g. technical, regulatory etc), the body responsible for introducing it, and a plausible account and documentation of the effects of the measure.
2. The factors that most likely contributed to its success in the given country/ countries.
3. The historical development of the mitigation measure experiences that may illuminate the importance of the political, economic or other factors influencing the outcome. What were the driving forces and barriers to its implementation?
4. Potential for adaptation of the mitigation measure to other countries in the region: What are the requirements for successful implementation? What factors may enhance and what may reduce the efficiency and/or the overall success of a particular mitigation measure?
5. Conclusion: The Nordic-Baltic ranked list of successful mitigation measures. Why have some measures worked well in certain countries and what potential exists for intra-country learning?

Annexes: country reports and national lists including the list of each expert involved.

The summary report described above will be based on the information that is compiled for each country.

Compilation process:

The countries where data should be collected if possible are the following:

Norway, Sweden, Denmark, Finland, Iceland, Estonia, Latvia, Lithuania. Poland, Russia and Germany.

The method for selecting the most successful mitigation efforts should refer to measures that have had an actual, significant effect (independent of costs). Otherwise, the selection of criteria for and evaluation of 'best practice' is left to selected experts who will be asked to rank, explain and document what the most successful mitigation measures have been in their country. Experts may be NGO representatives, researchers or other informed individuals in this field.

Each expert's ranking list (and preferably also their responses to points 1 4 abbove) should be kept as attachments to the country report so that the published country list can be compared with the opinions of the individual experts, should the need arise.

The final summary report, including the ranked list of the best mitigation measures in the Nordic-Baltic region, should be relatively simple and not contain too many details. More detailed results should be described and explained in the country studies, which will be attached to the main report.

The people entrusted with the data collection and who contact the individual experts ought be open-minded, and should not have strong prejudices about particular types of mitigation measures to the exclusion of others.

Further research about the top ten mitigation measures:

- After a list of the top ten mitigation measures has been compiled using the method described above, these measures should then be studied and analyzed in more depth. The analyses and description should focus on the factors described under the content of the report.

Air Pollution & Climate Secretariat

AirClim