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Phasing out fossil gas in Europe

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Phasing out fossil gas in Europe

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Introduction

Fossil natural gas contributes 20 per cent of global CO_2 emissions[1]. Gas use will increase, according to most forecasters: by 30 per cent between 2013 and 2030 if you believe the IEA.

By 2012, the United States experienced a boom in gas from fracking of shale. This was hailed as a game-changer and the IEA heralded a golden age for gas, both in the sense that the US would be able to export large quantities of gas, and that the technology would be replicated in Europe.

This shale gas revolution soon ground to a halt. In 2015 only three nations in the world produced gas from shale: the US, Canada and China. The political resistance was too strong and there was not enough money to be made, at least not in Europe, and especially not after the price drop for coal, other raw materials and electricity, and finally oil in 2011–2015. Natural gas prices in Europe dropped by almost half from their level in 2012–2013 to December 2015.

Cheaper gas, as of late 2015, is good for the power industry and other consumers, but bad news for producers.

Volatility (rapidly changing prices) is bad for both producers and consumers of gas. If you build a power station assuming price X for gas, and price Y for electricity, and three years later find that the gas price is twice what you expected and the power price is half what you expected, you are in deep trouble. If you invest in gas exploration or gas production, and suddenly find that the gas price is half what was expected, you are in much the same situation. Investor confidence will not return soon. The production of gas from a shale well declines fast, typically by 70 per cent in the first year. So new wells have to be drilled in rapid succession just to keep pace. In the US, total shale gas production began dropping[2] in 2015.

This does not mean that we are back to square one. Something has changed.

The gas industry worked very hard to promote natural gas as the much cleaner fossil fuel, but this claim was torn apart by dirty fracking, and by the growing credibility of cleaner alternatives, such as wind, solar and efficiency improvements.

Gas power emits less CO_2 than coal or lignite power, but still too much. Any serious climate mitigation policy must mean less gas, not more gas, at least in the rich countries.

It may be argued that increased use of fossil gas in China can be one of several ways to cut catastrophic coal use, and that this may also be the case in some other developing nations.

1 www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2014.pdf figure 6. Data for 2012.

2 http://www.eia.gov/todayinenergy/detail.cfm?id=18171

But Europe can and must cut all fossil fuel use – coal, oil, gas, shale and peat – if it is to persuade developing countries to peak their CO_2 emissions earlier.

A good reason to believe that gas consumption can be cut in Europe is that this has already happened.

This decrease has already started in Europe, though not because of climate policy. Gas has other drawbacks, such as very fluctuating prices and security-of-supply issues. Wind power, solar, biomass and improved energy efficiency are superior on all scores: climate, price stability and security.

Gas is not needed in any absolute sense, which can be seen in Sweden; most of the country does not have access to natural gas.

European NGOs have somewhat different views on the role of natural gas for balancing intermittent renewables. Some see this as a necessity for the next few decades. Others point out several other ways to balance wind and solar.

Natural gas use will not disappear very soon, as it takes time to change from gas heating to other heating systems, such as electric heat pumps.

A last line of defence for gas is that the gas grid can be used as infrastructure for biogas and hydrogen. Biogas, however, does not need large pipes, and the hydrogen option in a distant future is not a good excuse for fossil gas use now and indefinitely.

Climate change is an arena where the European and North American environmental NGOs have been increasingly in tune, and also made quite a difference. The main battle has been against coal and oil, but now that King Coal is on the retreat, the fight against fracking and other unconventional fossil fuels is moving towards centre stage.

The big problem with natural gas is CO_2, but it is not the only problem. Shale gas uses a lot of water, and water is a limited resource on much of the planet. It can also contaminate ground water. Emissions of methane, a strong greenhouse gas, can be significant. Wind, photovoltaics, solar heating and more efficient use of energy have none of these problems.

Gas industry at crossroads: stay or go?

The natural gas industry faces strategic choices. If it projects itself as a transitory fuel on the road to 100 per cent renewables it will have to answer a lot of questions from investors and others. If the transition is to take place soon, why invest at all?

If it intends to stay for a long time, it will have to fight against all scientists and most world leaders on climate change.

On 1 June 2015, six gas company executives wrote a letter to the Financial Times about the role of gas in relation to COP21 in Paris. They represented Statoil, Total, BG, Shell, ENI and BP. Their message is that renewables will grow fast, and that their companies are investing a lot in this area. But they also state that the "need to cut emissions is so essential that we have to pursue all options to lower carbon" and gas power emits half the carbon of coal power.

This obviously pits gas against coal, not a popular message everywhere. Less obviously, they state that gas will just have a transitory and limited role.

This message is problematic for employees and for investors. Who wants to invest their time and money in business for a dying swan?

Two companies that did not sign the letter, and actually opposed it, were the US giants Exxon Mobil and Chevron. Exxon's official line[3] is that the movement to stop investment in fossil fuels is "out of step with reality", and that in fact the share of renewables in the world energy mix will hardly even grow through 2040, and that fossil growth is the only way to beat world poverty!

Exxon does not come out against coal. This is unsurprising as the company has some coal assets. It has invested in coal-to-liquid, a particularly dirty way to produce petroleum products. They are also into coalbed methane, which often means that first you take out the gas, then you mine the coal. It expects gas to grow fastest of all fuels[4] at 65 per cent from 2010 to 2040, while coal also grows. That leaves only three ways to handle climate change: deny it, ignore it or CCS. Exxon has financed climate deniers, but the present line is to just ignore it, while CCS is getting nowhere. They still give a lot of money to obstructionist politicians in the US.

Exxon leaders must have as a working assumption that they can defeat any effort to limit fossil use or hold back growth of natural gas.

Grant King, CEO of Origin Energy in Australia, was more explicit than the letter to the FT. He said[5] that "the Greenies" loved gas ten years ago, but that that changed with fracking: "there is a lot of gas out there… it's not a transitional fuel and people will be switching to gas for hundreds of years."

3 http://www.exxonmobilperspectives.com/2014/10/10/some-thoughts-on-divestment/

4 http://corporate.exxonmobil.com/en/company/news-and-updates/speeches/natural-gas-and-the-policies-of-the-future

5 http://www.afr.com/business/energy/gas/energy-giants-turn-on-coal-before-paris-climate-conference-20150604-ghgjtk

The European gas industry does not deny or ignore. They say what is politically correct, which is that they will survive even under a strong climate policy regime, at the expense of coal, and that this will be achieved through "widespread carbon pricing in all countries".

All countries, *high* carbon prices? Not likely anytime soon. So if it is a bluff it will not be called.

They also tend to rely on CCS. The UK Task force on shale gas stated in September 2015 that:

"... if a shale gas industry begins to develop at scale, CCS will become essential, and a CCS industry should be developed and grown concurrently."[6]

The difference between the ignorers and deniers of climate change is not so big. They are all playing for time, aiming for more gas and ensuing greenhouse gas emissions for the foreseeable future – while saying one thing or the other.

Even if Exxon is less anti-coal, they all use the same selling point: that fossil fuels are absolutely required, and that gas is much better than coal.

This is not necessarily true, but the gas lobby is very strong and has strong political links. This follows from the structure of the business.

Gas is mainly fed through pipelines. The transport and distribution grids are monopolies, either owned by governments or private monopolies supervised by governments. Once gas users are hooked up to an access point they will then have little choice, whether they are domestic users or a big power station. They can't change fuel and they can't change access point. They can change supplier, unless they have signed a long-term contract. But the pipe stays where it is, the sources stay where they are, and the suppliers are few and large. The ultimate supplier, even if the gas is resold under different brands, is usually Gazprom or any of the six companies that signed the letter to FT.

Some gas, a small share, is imported by LNG tankers. This introduces some supply competition, but LNG terminals and ships are few and expensive. The LNG share of gas imports to the EU is very small.

LNG gas from the US was supposed to be introduced to Europe, but the previous high hopes (or fears) of large amounts of very cheap US fracking gas have vanished. At least little US gas will arrive in Europe anytime soon. The amounts will not be big enough to change the game. And however much LNG gas is fed into the European system, it will still pass through the same grid.

In order to make investments, the gas companies want long-term contracts (captive customers), political backing and political stability. So would any business, but the gas industry has more muscle, so it can get what it wants.

6 https://darkroom.taskforceonshalegas.uk/original/8879c0b838c6e09864638cbd-6902b190:7f5b9e74c66410cff3253321938981d6/right-report.pdf

The gas companies are often also oil companies, and in the power business. Some of them are among the biggest companies in Europe and the world. In Europe, the gas industry is represented by two large organisations: Eurogas and GasNaturally.

The career of Gerhard Schröder is illustrative. As Chancellor of Germany he was a strong advocate for the NordStream pipeline from Russia to Germany though the Baltic Sea. His government granted a one billion euro credit guarantee for a share of the project. Soon thereafter, Schröder stepped down and took up a position as chairman of NordStream AG shareholders' committee. The majority owner of NordStream AG, which first built and now operates the pipeline, is Gazprom. Other shareholders are E.ON, Wintershall (BASF), GDF Suez and NV Nederlandse Gasunie.

The Schröder story invites questions, but it is not certain that Gazprom bought him. It is bad enough that such a thing could even be alleged. A more generous interpretation is that Schröder's energy and climate policy required more natural gas for the phase-out of nuclear power and further CO_2 cuts, or so he believed. And that he saw nothing wrong with continuing to work to that end after he quit politics.

He is not alone.

Former UK Prime Minister Tony Blair and German ex-foreign minister Hans-Dietrich Genscher are advisers to the consortium behind the Trans-Adriatic Pipeline from Azerbajan to Italy[7]. The consortium is owned by the authoritarian Azeri regime, BP and others.

The gas industry in Sweden managed to recruit another top politician, the previous Minister of Finance, Pär Nuder, as advisor for the venture capital group ECT while ECT acquired grid company Swedgas (and used Guernsey as a tax haven).

The gas industry even bought one of the most respected NGOs in the world, the US Sierra Club, as noted below. Their anti-coal campaign was secretly but massively funded by gas company Chesapeake. That stopped in 2010. The campaign goes on, but is now directed against coal, gas and nuclear.

Some NGOs still think it makes sense to see increased gas use as a way to phase out coal and nuclear. B.U.N.D Friends of the Earth and Greenpeace Germany[8] in Germany are examples.

All serious NGOs aim for 100 per cent renewable energy by mid-century globally, and earlier in rich countries. The case for a *long* transition seems to have weakened over the past few years, as renewables, storage, and efficiency are advancing rapidly. Smart grid technology and other demand-side measures can push the limit for the renewable share of electricity even in a country such as Germany that has little hydro and modest wind and solar potential.

7 http://www.theguardian.com/politics/2014/aug/02/tony-blair-gas-pipeline-italy

8 https://www.greenpeace-energy.de/engagement/unsere-gasqualitaet/erdgas-als-bruecke.html

Such technology is in high demand in other countries for other reasons, such as an aging or inadequate power infrastructure.

If Germany can cut coal, gas, and nuclear at the same time, most other countries can do so more easily. And Germany is doing it right now. Between 2010 and 2014 fossil power decreased from 361 to 330 TWh, nuclear from 141 to 97 TWh and net exports went up from 18 to 36 TWh. The trend has continued throughout the first 11 months of 2015.

Biggest oil and gas companies in the world

Six of the seven largest companies in the world are in the oil and gas business. The one exception in the top is #1 retailer Walmart.

The list is taken from Wikipedia's world list of all companies[9], rated by revenue according to the last reported financial year, usually ending on 31 Dec 2014. Several of those not included here have some stake in natural gas, for example conglomerates Berkshire Hathaway (Warren Buffett, #16), Koch Industries (Koch Brothers, #49), E.ON (#21) and BASF (#60), but only those described by Wikipedia as under the heading of gas are listed below. No distinction is made between gas and oil, because most companies are into both.

Other lists of biggest companies in the world, such as Forbes or Fortune, are based on other metrics, e.g. market value, and produce different results, but oil and gas features high on any list. They have a lot of money, which either stems from or results in political power.

9 https://en.wikipedia.org/wiki/List_of_largest_companies_by_revenue downloaded 15-08-26

Rank	Company name	Business	Revenue (billions)	Country
2	Sinopec	Oil and gas	$461	China
3	China National Petroleum Corporation	Oil and gas	$432	China
4	Royal Dutch Shell	Oil and gas	$421	UK, NL
5	ExxonMobil	Oil and gas	$394	US
6	Saudi Aramco	Oil and gas	$378	Saudi
7	BP	Oil and gas	$359	UK, NL
14	Total	Oil and gas	$212	France, Netherlands
15	Chevron	Oil and gas	$192	US
19	Phillips 66	Oil and gas	$161	US
20	Gazprom	Oil and gas	$160	Russia
29	Eni	Oil and gas	$144	Italy
30	Rosneft	Oil and gas	$143	Russia
31	Petrobras	Oil and gas	$141	Brazil
32	Lukoil	Oil and gas	$141	Russia
33	Kuwait Petroleum Corporation	Oil and gas	$140	Kuwait
34	Valero Energy	Oil and gas	$138	US
37	PDVSA	Oil and gas	$134	Venezuela
42	Pemex	Oil and gas	$123	Mexico
45	JX Holdings	Oil and gas	$120	Japan
48	GDF Suez	Electricity and gas utility	$119	France
58	National Iranian Oil Company	Oil and gas	$110	Iran
59	Statoil	Oil and gas	$104	Norway

No room for gas

Gas is better than coal, but not good enough. Much of it has to be left in the ground, so its use has to be cut fast. This is actually happening in Europe. Gas use dropped by 23 per cent between 2010 and 2014.

Natural gas is an important source of energy in Europe. Twenty-three per cent of primary energy supply[10] came from gas in 2012. It is important in many other countries as well.

Of the (very roughly) 5,000 TWh of gas used in the EU, about 40 per cent is used for heating, 25–30 per cent for power, and most of the remainder in industry.

A few years ago many believed gas resources would soon be depleted, but this is not the case.

Proven reserves are estimated[11] at 187.1 trillion cubic metres. New reserves are added each year. The proven reserves have doubled since 1987, despite burning some three trillion cubic metres every year. Even if not another gram is found, the present reserves, if combusted, would emit some 380 billion tons of CO_2 directly[12].

Much of the gas must be left in the ground.

This follows from the IPCC's carbon budgets[13]. The remaining CO_2 budget[14], if we accept a 66 per cent probability of staying within two degrees of global warming from 2015 onwards, is 900 Gtons of CO_2.

Two degrees is not safe, and 66 per cent is not sure. But even within such a generous budget there is no way that we can shoehorn in some 400 Gtons of CO_2, an extra third, from gas reserves.

The remaining budget in say 10 years will be much diminished. Even if the world stops building coal power plants right now, and many old coal power plants are retired, most newer fossil power plants will be around for several years. So will many of the petroleum-burning cars, lorries, ships and aeroplanes.

The rug is being pulled from under our feet, so some gas infrastructure will have to be retired or downgraded well before it has reached the end of its technical or economic life.

If a "natural gas budget" could be defined, Europe could hardly claim priority for a large share of it over China, for example. China is being suffocated by

10 http://www.eurogas.org/uploads/media/Eurogas_Statistical_Report_2013.pdf

11 BP Statistical Review 2015

12 Emission factor 2.03 kg CO_2 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf

13 http://www.climatechange2013.org/images/uploads/7_knutti13sed2_v1.pdf

14 http://www.globalcarbonproject.org/carbonbudget/15/files/GCP_budget_2015_v1.pdf

coal combustion and has to act on every front at once to improve both its air and its economy: cleaner coal, more renewables, more nuclear, more gas, and more efficiency. China doubled its gas consumption during the same period, but it is still only at half the level of the EU – for a much larger population. China will probably double its gas power[15] from 2013 to 2020, while continuing development of renewables at break-neck speed.

Europe has much more of a choice than China. The EU uses about 15 per cent of world gas. This can change. It is changing. It actually reduced its gas consumption by 23 per cent between 2010 and 2014. Most or all of this drop took place in the power sector. In 2012 alone, gas for power dropped 17 per cent[16].

Some of that gas was temporarily replaced by cheaper coal. EU coal use increased between 2010 and 2012, but then reversed, so the 2014 level was below that of 2010. So over the whole period, no gas was substituted for coal.

EU renewable electricity also increased 222 TWh between 2010 and 2014. Electricity production dropped by 205 TWh, which means consumption also dropped, implying that electricity was used more efficiently.[17]

Almost 13 per cent of the EU electricity supply has become either renewable or obsolete, in just four years.

This unforeseen development hurt gas power first, and (for other reasons) nuclear. It hurts coal power as well.

There is now also political momentum to cut gas consumption in the EU for reasons of security of supply.

Carbon budget logic says that Europe will soon have to cut its use of all fossil fuels sharply, including natural gas.

This is not universally recognised, however, even within the NGO community. The Greenpeace 2012 Energy (R)Evolution scenario[18] for OECD Europe, roughly equivalent to the European Union, prescribes an 11 per cent increase in natural gas from 2009 to 2020.

BUND, a leading German NGO, also foresees[19] a substantial use of natural gas in Germany through 2040, but not 2050.

The German Solar Energy Support Club has more recently expressed the view[20] that gas power is an acceptable transitory solution.

15 http://asian-power.com/power-utility/news/heres-why-chinas-gas-power-generation-could-exceed-85-gigawatts-2020

16 Eurogas op. cit.

17 Data from BP op.cit. Coal and its ups and downs are measured in tons and cannot be directly compared with electricity in TWh from renewables (still BP) and gas (Eurogas). But if coal consumption dropped, electricity from coal has also dropped

18 P 307 table 12.58

19 http://www.bund.net/fileadmin/bundnet/publikationen/energie/20110922_energie_position.pdf

20 http://www.sfv.de/artikel/gaskraftwerke_als_uebergangstechnik.htm

The reasons for such views are not hard to see.

With coal, lignite and nuclear phased out fast (in Germany), gas seemed much less harmful and also a good way of balancing the increasing share of renewables.

It is indeed much less harmful. A natural gas power plant does not emit particles or SO_2 and emits much less NOx than a coal power plant. The CO_2 emissions are also much lower. A coal power plant emits about 1,000 grams of CO_2 per kWh. The worst lignite power plants in Germany, for example Vattenfall's Jänschwalde, emit more than 1,200 grams. A new gas power plant emits less than 340 grams, a bit more over the full life cycle.

Even 340 grams is much more than emissions from wind, solar, biomass and, above all, efficiency improvements.

Much gas is used for heating, where it has no climate advantages. The alternative to gas for heating is nowadays seldom coal or oil. It is heat pumps, district heating, and electric heating. The electricity can be, and often is, renewable. Energy for district heating can also be supplied from renewables or waste heat. Another alternative is improved efficiency, such as better windows. It takes time to change heating systems, but efficiency measures may cut gas use in the meantime.

Gas for power is easier. Renewables and efficiency improvements can reduce the need for fossil and nuclear power very fast. They do, in fact.

Gas has some role to play in balancing the increasing wind and solar power, but it should not be overrated.

Balance can be provided by several other means, such as hydro, bio power, import/export, geothermal power, concentrated solar power with heat storage, compressed air, flywheels and batteries. Hydro is now used for balancing in Sweden, for example, but nowhere near its limits. Swedish and Norwegian hydro is used to balance Danish wind power, and to some extent German and Polish wind power. With new power cables to Lithuania in 2016 and to the UK in 2020, followed by more cable capacity to Germany, Scandinavia will provide scope for more renewables in those nations too.

In shorter timescales (seconds) wind power and photovoltaic technologies can provide some grid support. The electronics between wind turbines and the grid can supply "synthetic inertia", so as to maintain voltage and frequency for several seconds and also give a very rapid response to grid disturbances.

The best and cheapest balance comes from demand-side management. This has not been widely explored so far, because it has not been needed. But it has huge potential, as many users, big and small, can shift their use of heating, cooling, pressure and some motive power for minutes or hours without detriment, if the incentive is there and if the technology is simple and automatic. This is also known as "smart grid" technology, and has several other advantages, such as more optimised use of existing grids and improved quality of power supply.

EU Commissioner Maroš Šefčovič has said[21] that "smart grids could become 'Europe's shale gas'", our way to improve energy security and keep prices low.

If, or rather as, some fossil power plants are shut down, the drive for demand-side management will be correspondingly stronger.

It would be nicer if we had a high steady emission price for CO_2, so coal would have to go first and gas after, but things do not happen in an orderly manner. There is no reason to panic over the demise of a few gas power plants along with many coal and nuclear power plants.

Case Study 1: Fracking: more and dirtier gas

In 2012, fracking, exploitation of gas from shale, was seen as game-changer. Fracking meant more, and dirtier, gas. This put an end to a truce between NGOs and the gas industry in the US and in Europe. But the shale gas revolution has so far ground to a halt.

Fracking, short for "hydraulic fracturing", is a way to get at deep natural gas pockets in shales. You drill a couple of kilometre-deep holes, force down a mixture of water, sand and chemicals under high pressure. The pressurised water opens up cracks.

The chemicals are there to make the water more slippery so it can force itself through small cracks. The sand keeps the cracks open. Horizontal drilling is used to increase the surface attacked.

The problem, compared to conventional natural gas drilling, is that more of the gas leaks out. This includes its main constituent methane, a powerful greenhouse gas, and other volatile hydrocarbons. The chemicals and hydrocarbons cannot be collected entirely, so they may end up in the groundwater and drinking water.

Fracking is not really new technology, but it became profitable in the US with the rising oil prices: from $25/barrel in 2002 to around $100 for most of the period 2008–2014, and expanded very fast.

In 2013, a third of US natural gas production came from fracking, and the Energy Information Administration (EIA) expects this share to increase to more than half by 2040 within the context of increasing gas use[22].

The EIA estimates the shale gas reserve in the US and another 32 countries (say half the world)[23] at roughly the same 6,000 trillion cubic feet as the proven reserves of conventional natural gas.

If this is true, shale gas has doubled the gas reserve, adding more than 10 per cent to the carbon content of the total fossil reserves.

21 http://europa.eu/rapid/press-release_SPEECH-15-5948_en.htm

22 http://www.eia.gov/beta/aeo/#/?id=14-AEO2015

23 http://www.eia.gov/analysis/studies/worldshalegas/

Until recently some NGOs in both the US and Europe tended to accept or even embrace natural gas as the lesser evil compared to coal (and an ally against the coal industry), as well as being the simplest and cheapest way to balance intermittent renewables such as wind power and photovoltaic solar power.

Notably, the Sierra Club in the US accepted large donations ($26 million) from Chesapeake Energy, a big natural gas producer[24]. Much of the money went to fund the very successful campaign against coal. When Carl Pope was succeeded as chief executive in 2010 by Michael Brune, the Sierra Club stopped this funding, and actually declined an offer of an additional $30 million, because fracking has changed what natural gas is.

Much damage was done, not least because the management of the Sierra Club did not tell its members where it had got its money. But Carl Pope was not alone:
"National groups such as the Sierra Club, the Environmental Defence Fund and the Natural Resources Defence Council have backed natural gas as a so-called bridge fuel that can help the country move away from coal and oil without waiting for renewable sources of energy, such as wind and solar power, to catch up," wrote The Wall Street Journal in late 2009.

Their case was conditional on four assumptions:

1. Gas replaces coal for electricity (not renewables or efficiency improvements).
2. Greenhouse gas emissions from natural gas power are half those of coal power, or less.
3. Other environmental consequences aside from carbon dioxide emissions are not as bad as coal.
4. The reserves of natural gas are much lower than for coal, so if we use most of the gas but leave most of the coal in the ground we have a chance to save the world.

The first point has always been contested; for example why should it be supposed that 2050 is a better time than now to build wind power, and that the present rate of wind power installation is as high as it can get. Also most gas (in the US) is used for heat, not power.

Points 2 and 3 used to be true. The carbon emissions from a new gas power station are about 340 gram/kWh. Emissions from coal and lignite power are around 700–1,200 grams/kWh, or even more. From a life cycle perspective, the difference is even more marked, because coal mining generally emits more methane than conventional natural gas production. Gas emits no particles, no sulphur and much less NOx than coal.
Fracking may have changed all that.

According to the US EPA, conventional natural gas emits 0.38 grams of methane per MJ whereas shale gas emits 0.6 gram/MJ.

24 Time magazine Feb 2012

A pioneering study by Howarth et al in 2011, later reviewed[25], claimed that over a 20-year period shale gas is far worse than coal, and over a 100-year period about as bad as coal. The difference is explained by the fact that methane, leaking from the shale, is a much stronger greenhouse gas than carbon dioxide, but it does not stay so long in the atmosphere.

By convention, the warming potentials of greenhouse gases are indexed against carbon dioxide in a 100-year perspective. The IPCC has compiled the accepted values for 100 years, as well as for 20 years, and for 500 years. Also, recent research[26] has shown that methane is an even more powerful greenhouse gas than thought. The 100-year value, which was estimated at 21 times the effect of CO_2 when the Kyoto protocol was written in 1997 and which was increased to 25 by the IPCC, is now about 33, due to interactions with the stratosphere and aerosols.

So the methane causes more global warming than was supposed. There is more natural gas than we thought, and it emits more methane.

But it is not written in the stars that we will use more gas just because it is there. It is also possible to cut specific methane emissions from shale, and stricter environmental legislation[27] is now underway in the US.

But Peak Oil? Security of Supply?

This is the point the Obama administration has often made. Fracking in the US makes the US less dependent on fuel imports.

But wait a minute. The really difficult part of energy dependence is the supply of gasoline, diesel and jet fuel. They are made from petroleum, not from natural gas. Fracking solves the wrong problem. Oil dependence cannot be helped by more natural gas.

That is, unless it is used for gas-to-liquid (GTL) methods of producing gasoline etc.

If so, it is at a still higher price for the climate. Even with conventional GTL diesel, there is no greenhouse gas reduction compared to diesel from oil[28]. Shale diesel or gasoline are worse.

The consequence of shale gas and other unconventional fossil fuels such as Canadian tar sand is that the connection between Peak Oil and the climate is now broken.

Peak Oil can be averted in two ways: with more fossil fuels or with less fossil fuels.

25 http://www.eeb.cornell.edu/howarth/publications/Howarth_2014_ESE_methane_emissions.pdf

26 http://www.giss.nasa.gov/research/news/20091029/

27 EPA natgas methane and VOC og_fs_081815

28 http://www.netl.doe.gov/energy-analyses/temp/FY14_AnalysisofNaturalGas-to-LiquidTransportationFuelsviaFischer-Tropsch_090113.pdf

It can be averted either through fuel efficiency, electric cars, biogas and other biofuels, less transport and modal shifts from road to rail. Or by using shale gas, tar sand, and coal as feedstock for liquids.

GTL did look very promising for investors, according to the Financial Times[29]. Gas was cheaper than for many years, thanks to fracking, but oil was still expensive. Shell invested $19bn into the Pearl GTL in Qatar.

The oil price drop in 2014/2015 changed the equation. GTL makes no sense financially[30].

The frackers moved fast during the boom years, but so did resistance.

France has had a moratorium on fracking since 2011. Bulgaria banned it in 2012. So did the state of Vermont in the US, Quebec in Canada and at least parts of Switzerland. Romania and the Czech Republic are preparing similar moves. In Sweden, exploration has stopped. The UK government was enthusiastic for fracking, and still is.

The NGOs, at least in Europe, are hostile to fracking, and have mustered an increasingly efficient opposition.

In 2012 a large number of European NGOs, including FOE, Greenpeace, and EEB lobbied the European Parliament calling for a ban on fracking. This was motivated by an EP report by Polish MEP Boguslaw Sonik for the environment committee. The report made no mention of "climate", "warming" or even "methane".

The International Energy Agency threw its weight behind shale gas with a report entitled "Golden Rules for a Golden Age of Gas", issued in late May 2012.

This is how the IEA sets the scene in its summary: "Natural gas is poised to enter a golden age, but will do so only if a significant proportion of the world's vast resources of unconventional gas ... can be developed profitably".

The Golden Age means a more secure supply of energy for (rich) importer countries, greater energy diversity, and lower energy prices generally. This Golden Age is built on fracking.
There is however one big "but":

"The outlook for unconventional gas production around the world depends critically on how the environmental issues ... are addressed."

In other words: if we can't defeat the environmental NGOs and persuade the politicians and the environmental agencies to allow fracking, the Golden Age will not come.

29 http://www.ft.com/intl/cms/s/0/6a365a54-71c5-11e1-8497-00144feab49a.html#axzz1vWpAQMNz

30 www.ibtimes.com/oil-price-decline-hurting-sasol-shell-efforts-turn-natural-gas-liquid-diesel-1801068

The report admits that we don't know the extent of the greenhouse gas emissions that will result from fracking. It just provides a diagram on methane emissions with an unsourced "typical value" highlighted. And: "If current emissions are poorly known and the numbers above mere estimates, projecting future methane emissions is fraught with even more uncertainties."

It is also mentioned that the Europeans have a precautionary principle in their legislation.

But instead of guessing what emissions will be or waiting for better data, the IEA recommends seven Golden Rules. It should be noted that the original Golden Rule, in the New Testament, states that "So whatever you wish that others would do to you, do also to them".

The Golden Rules are:

- Measure, disclose and engage.
- Watch where you drill ("minimise impacts on the local community, heritage, existing land use, individual livelihoods and ecology").
- Isolate wells and prevent leaks.
- Be ready to think big (many small holes can make a big leak, unless coordinated).
- Treat water responsibly.
- Eliminate venting, minimise flaring and other emissions.
- Ensure a consistently high level of environmental performance.

If implementation of these safeguards is seen as a sure thing, there is one other issue, the IEA admits. Fracking gas will not only replace coal, it will also mean less renewables. Wind and solar will lose 5 per cent globally and 10 per cent in the US up to 2035, compared to the baseline. The cheaper gas can also "postpone the moment at which renewable sources of energy become competitive without subsidies and, all else being equal, therefore make renewables more costly in terms of the required levels of support".

On the other hand, says the IEA, gas can balance wind and solar.

The golden age will come at the expense of efficiency, according to IEA models.

The United States and Canada are the pioneers of fracking, and have a big stake in its future. The IEA also sees a big future for fracking in China and India, otherwise projected as big importers, and Australia. They are less sanguine about Europe.

This could be construed as an effort at a strategic alliance, aimed at reduced Middle East dominance, but with collateral damage for renewables and efficiency.

Box: IEA, the International Energy Agency

IEA, the International Energy Agency, is the energy arm of the rich countries OECD, and was formed in 1974 in response to the first oil crisis. Its message has always been: less oil, more gas, more coal, more nuclear and to some extent also renewables and efficiency.

The IEA is best known for its annual World Energy Outlooks, in which it tries to look some 20 years ahead. The IEA has made a series of inaccurate forecasts in areas such as oil prices (far too low), nuclear capacity (far too high) and renewables (too low). Not only have they been proved wrong in the long run; they have often been wrong by large factors for just a few years ahead.

Nevertheless, the reports of the agency are treated with reverence by the media and politicians.

The usefulness of the IEA can be questioned, but they do produce a lot of data, and source this well (though the sources are not always peer-reviewed articles). Also, their reports usually give a good picture of how "conventional wisdom" looks at a certain time.

Box: Unconventional gas and oil

Shale gas, and sometimes associated oil, is trapped in dense rock, which has to be fractured by water (with additives) under high pressure. Horizontal drilling is also needed to crack up the rock from many points.

Tight oil is essentially the same thing as shale gas, but oil is the main object. Of great importance in the US.

Coalbed methane also often needs fracturing to be released.

Underground coal gasification means partial combustion of coal seams that are not economic to mine.

Oil sand (tar sand) oil is released with steam. This is done on a large scale in West Canada. The planned Keystone XL pipeline, if permitted and built will transport this oil across the US to refineries in Texas.

Oil shale can produce oil when heated, or be combusted as it is to produce power. It is a large resource, but for economic and environmental reasons not widely used except in Estonia.

The unconventionals have one thing in common: they add to the resource base, and, all other things being equal, add to CO_2 emissions.

Fracking revolution grinds to a halt

The "Golden Age" of shale gas, heralded by the International Energy Agency (IEA) a year ago, may not arrive after all, at least not in Europe. The promises of plenty, soon and cheap are not materialising.

When Acid News wrote about shale gas (AN 2/2012), there was a certain triumphalism among frackers, and their standard-bearer, the IEA. The message was that the success of unconventional gas in the United States could and should be replicated in much of the rest of the world, especially Europe.

This is not so sure. The war has just begun and both sides have scored some battle victories.

The frackers, i.e. the exploiters of and proponents for unconventional gas (see Box) have won some.

The EU Parliament voted down a moratorium on fracking in 2012 with a very large majority.

The UK government lifted its moratorium on fracking in 2012, and then moved to a strong pro-shale position. In July it outlined tax breaks for fracking. The plans would make the UK the "most generous" regime for shale gas in the world, according to the government[31].

"Fracking has become a national debate in Britain – and it's one that I'm determined to win", wrote Prime Minister David Cameron in the Telegraph in September 2013. The then energy and climate secretary Ed Davey (Liberal Democrat) claimed that fracking will not add to climate change. This was simultaneously more or less contradicted by a report from his own chief scientist David Mackay[32].

The Conservatives won the 2015 elections, and ejected their Liberal Democrat partners from the government and from the Department of Energy and Climate Change. The new Minister of State for Energy, Andrea Leadsom, blogged that shale gas is needed "if we are to continue to combat climate change and grow the economy"[33], though she has admitted that she was not convinced[34] about the science of climate change until she took up the job in 2015.

The national debate has centred on exploration projects in Sussex, in the south of England. Roadblocks and other civil disobedience action, followed by police arrests, were very successful in getting attention. The explorer, Cuadrilla Resources, backed down there, but several other projects are progressing.

31 http://www.bbc.co.uk/news/business-23368505

32 www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf

33 https://decc.blog.gov.uk/2015/09/23/shale-gas-an-inconvenient-truth-for-the-anti-fracking-lobby/

34 http://www.independent.co.uk/news/uk/politics/energy-minister-andrea-leadsom-asked-whether-climate-change-was-real-when-she-started-the-job-a6710971.html

Public opinion is deeply divided. Many believe fracking to be important for energy security and for lower energy prices, but the trend [35] is that support for fracking is waning and opposition against it waxing. It is also a gender issue: according to research at University of Nottingham, some 58 per cent of men believe shale gas extraction should be allowed, while just 31 per cent of women agreed[36].

Professor Averil Macdonald, chairman of the fracking industry group, then claimed women were opposed to it because they did not understand it.

The main opposition party in England and Wales, the Labour Party, wants more safeguards for fracking. Both the new leader Jeremy Corbyn and many constituent parties are against. In Scotland, ruled by the Scottish Nationalist Party, the government has imposed a moratorium, and many within the party want an outright ban.

The political dynamics are unpredictable, but stakes are high. The British Geological Survey estimated in 2013 there may be 1,300 trillion cubic feet of shale gas present in the north of England – double the previous estimates.

From the EU there are mixed signals. The EU commissioners say different things.

The then EU Energy Commissioner, Günther Oettinger, told Germany in April 2013 that it would be unwise to say no to shale.

One month later the EU Environment Commissioner, Janez Potočnik, expressed caution at a meeting in Poland. His reservation was not only on environmental grounds, but also related to energy strategy:

"Even in the most optimistic case, European shale gas development can only compensate for the decline in conventional gas production," he said. "This would basically help maintaining the current level of EU import dependency to 60%."[37]

The new Commission from November 2014 is in favour of unconventional gas.

That is a far cry from the high hopes of yesteryear, that shale gas would rid Europe of dependence on Russia and OPEC.

The pro-shale forces won a victory when EU requirements for environmental impact assessment[38] were watered down in a directive in 2014.

The Polish shale energy resource has been downgraded by a factor of 10, notes Antoine Simon, campaigner for Friends of the Earth Europe (FoEE).

35 Nottingham University http://www.scribd.com/doc/131787519/public-perceptions-of-shale-gas-in-the-UK-September-2015-pdf

36 http://www.telegraph.co.uk/news/earth/environment/climatechange/11957478/Is-climate-change-real-asks-energy-minister-Andrea-Leadsom.html

37 Shale gas is no bonanza for EU, warns Potočnik ENDS Europe, 14 May 2013

38 http://www.wwf.gr/crisis-watch/crisis-watch/energy-climate/10-energy-climate/new-eu-directive-allows-for-eia-free-fracking

The early estimates said the gas would supply Poland with energy for 300 years.

Now it is more like 30–35 years and that is "resources", he says to Acid News.

The "reserves", the technically and economically recoverable shale, are much less.

Exxon Mobile, Talisman Energy and Marathon Oil have all left Poland. One test well in northern Poland extracts some 5,000 cubic metres of gas per day, which made former Foreign Minister Sikorski exclaim that "Polish shale gas is already out". This is not really the case; it means less than 4 megawatts of gas.

The UK is the only other EU nation where fracking actually goes on, but with growing resistance from grassroots and a clear lack of enthusiasm from some large corporations.

Shell has declared that it has no plans to go into shale in the UK. BP's chief economist, Christof Rühl, foresees "extremely limited growth" for it before 2030[39].

Similar disenchantment is voiced by the big consultancies. "Poland is not Texas", said an IHS consultant to the New York Times.

One of the reasons why fracking will be more difficult here in Europe is the political risk. Only a few European nations have bans or moratoria, such as France, Bulgaria and the Netherlands. But there might be more, and also at the sub-national level, as has already happened in Hessen and North Rhine-Westphalia in Germany and Cantabria in Spain.

The infrastructure and workforce that is already in place in the US will take a long time to develop here.

Antoine Simon doubts that shale gas is cheap, and points to a German study that claims natural gas prices have to go up, not down to make shale gas economic.

The most important goal for Simon and FoEE is an inclusion of all fracking activities in the Environmental Impact Assessment Directive. It should supply baseline data, so a causal link can be established for pollution.

This is in fact not evident at all. Even the famous tap water on fire[40] in a fracked area in the US movie Gasland has been contested on the ground that such things have happened before fracking!

A mandatory impact assessment also gives NGOs a right to participation.

In Poland, which according to Simon, "wants fracking at any cost", requirements for EIA are minimal.

39 www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/9806638/Shale-gas-is-not-a-game-changer-for-the-UK-says-BP.html

40 http://www.youtube.com/watch?v=dZe1AeH0Qz8

While the wider public was either sympathetic or apathetic to fracking a couple of years ago, the issue now has a high profile in the US as well, and resistance is growing. New York governor Andrew Cuomo found one excuse after another not to make a decision about fracking in the state. Opinion polls showed that more New Yorkers are against than for it. A large number of municipalities decided on bans or moratoriums. (The gas industry contested their right to decide, but it was sustained in court.) And then finally in June 2015, the official ban was announced. New York State sits on top of the Marcellus shale field, the most productive field in the US, in neighbouring Pennsylvania.

Efforts from the gas industry to portray their opponents as NIMBYists (Not In My Back Yard) seem to have backfired. It is true that much of the anti-fracking grassroots campaign is locally based, but wider issues are certainly addressed by the NGOs. The strong commitment of a large showing of artists and celebrities has helped.

Even if some of the rhymes are open to criticism, Sean Lennon's song "Don't frack my mother" (with Yoko Ono joining in "Don't frack me") makes a pretty clear statement in that respect:

We can't afford for this world to get hotter
We can't afford polynuclear aromatic hydrocarbons in our water.

The song and video are on YouTube.

The campaigners, for example http://nyagainstfracking.org/, focus both on local pollution and on wider issues, such as renewable energy and conservation against fossil energy and global warming.

This is an important point. It cannot be denied that less coal and more natural gas are a factor behind lower energy prices, decreasing foreign dependence and tumbling CO_2 emissions in the US. But it is just part of the story. Other factors are that Americans buy much more efficient cars, use electricity much more efficiently and that wind power supplied 140 TWh of electricity in 2012 (and 182 TWh in 2014). President Obama noted all these factors in his state-of-the-union speech in February 2013:

"We have doubled the distance our cars will go on a gallon of gas … Last year, wind energy added nearly half of all new power capacity in America. So let's generate even more. Solar energy gets cheaper by the year – let's drive down costs even further."

Some of the factors that are driving down CO_2 emissions in the US are at work in Europe too. Electricity consumption is falling not only because of the slump, but also because of increased efficiency. The Eco-design directive is producing tangible results: practically any new TV, fridge, lamp, razor, computer, etc., will use less electricity than the one it replaces, and you can notice that it, or the charger, does not get as warm. And while Europe used

more coal and less gas in 2012 than in 2011, this does not amount to a trend, as can be seen in the table below. In fact, all consumption of fossil fuels decreased between 2011 and 2014, and coal continued its long-term downward trend.

EU Consumption of fossil fuels 2011–2014

	2011	2012	2013	2014	Chg 2011-2014
Coal Mtoe	288.9	297.4	288.6	269.8	-6.6%
Oil Mton	642.6	617.4	601.8	592.5	-7.8%
Gas Mton	406.6	400.4	394.1	348.2	-14.6%

BP Statistical Review of World Energy 2015

More wind, more solar and better efficiency are part of a trend, all over the world. As it costs next to nothing to use wind and solar once they are there, they are gradually ousting gas, coal and nuclear power.

This does not mean that fracking is not a threat to the climate. It clearly is. The IEA says the Golden Age case puts CO_2 emissions "on a trajectory consistent with a probable temperature rise of more than 3.5 degrees Celsius (°C) in the long term, well above the widely accepted 2°C target"[41].

The rapid fall in oil prices from mid 2014 made fracking less profitable in the US, but it has mainly survived throughout 2015. This is to some degree due to technological progress, but also to a time lag. Some loss-making wells would make even more losses if shut down, others managed to sell their output at a hedged price, still others held out hoping for a reversal of oil and gas prices. That has not happened. LNG prices have dropped even faster than oil[42]. By late 2015, production began to fall[43].

In the UK, fracking is getting ever more explicit support from the government, all-Conservative since May 2015. Just before Christmas, 159 fracking exploration permits were handed out, and fracking was approved under National Parks (but not from them). The government also cut subsidies to renewables. The (fracking) issue remains extremely divisive, however. The new Opposition leader, Jeremy Corbyn, is against it. Governments in Scotland, Wales, and Northern Ireland have all said that they will oppose fracking. It remains to be seen whether political will in Westminster is enough to achieve actual fracking and not just exploration drills. It then has to pass a number of political and legal hurdles, during a period of very low energy prices.

41 P 91 in IEA: Golden Rules for a Golden Age of Gas, can be downloaded for free from http://www.worldenergyoutlook.org/goldenrules/

42 http://www.bloomberg.com/news/articles/2015-12-02/lng-falls-faster-than-oil-as-u-s-fracking-spurs-growing-glut

43 Financial Times November 1, Harsh realities finally push US champions of shale oil into retreat

Case study 2: Sweden without gas

Natural gas is not a necessary part of the fuel mix. Most of Sweden, including Stockholm, has no natural gas. The combined pressure of environmental NGOs and farmers stopped gas and led to the development of biomass instead.

In most of Europe, fossil natural gas is considered a necessity. Not so in Sweden. Only a small part of the country, essentially the coastal region from Malmö in the south to Gothenburg in the southwest, is connected to the European gas grid, from Denmark.

Environmental NGOs have opposed extensions of the grid since 1990. They have seen it as an obstacle to the development of renewable energy, especially bioenergy. And they won that battle, together with the agricultural lobby LRF.

For about 50 years there have been plans to build a natural gas grid covering much of Sweden, taking gas from Russia or Norway. Various consortia ran big lobbying campaigns several times, but little came of it.

In 2014, Sweden used some 10 TWh of natural gas, less than two per cent of primary energy.

Gas is hardly used for heating homes. Swedes use district heating, or heat pumps, or electric heating, or wood or oil to heat their homes. The district heating is provided mainly by burning wood and waste.

Some industries use gas, but most of heavy industry (steel, metals, paper and pulp, cement, lime, iron ore pellets) is far away from the gas grid. They use LPG, LNG (transported by rail) oil, biomass or coal (in ore-based steel) for their processes. If they can they use electricity instead of fuels, because electricity has historically been inexpensive in Sweden, and still is.

Gas for power generation is not widely used and not needed at all. Sweden gets most of its electricity from hydro, nuclear, wind and biomass CHP, and has a huge surplus for export. In 2013 and 2014, natural gas supplied less than one per cent of electricity in Sweden, compared to seven per cent from rapidly growing wind power.

The 1 TWh of gas power can also be compared with net electricity exports of 10 TWh, and with the target of three TWh alone for E.ON's new, highly controversial Öresundsverket power plant in Malmö

This plant was mostly idle in 2013 and even more so in 2014. So was the other big gas power plant in Gothenburg. If E.ON and Gothenburg Energy had listened to the NGOs they would have saved a large amount of money.

The NGO victory over natural gas did not come immediately. E.ON tried to extend the gas grid towards Stockholm for several years, but finally had to give up in 2011. A pipeline has to pay its way every 50 kilometres or so by recruiting customers nearby. E.ON wanted to build a pipeline up north

to Jönköping at the southern tip of Lake Vättern, 300 kilometres south of Stockholm. When the local utility company, Jönköping Energi, decided to fuel its next CHP plants with wood chips and other biofuels, the potential demand for gas in the area became too small.

The road to Stockholm was closed in a most undramatic way. But it reflects a deep change in the energy system.

Biomass is nothing new. More than half of Sweden is covered by forest, so the timber, pulp and paper produced by the wood industry have always been important for the Swedish economy. Just think IKEA!

But the real expansion in biomass started around 1980, in the aftermath of the oil crises. At that time Sweden got 48 TWh of its primary energy from biomass. By 2013 this had increased to 129 TWh[44], which is much more than nuclear (64 TWh) and more than 10 times the amount from natural gas (11 TWh). This development was policy-driven. Sweden was very oil-dependent in the 1970s, and there was a broad political consensus on the need to reduce this dependence. The measures taken included: high taxes on oil, stricter environmental requirements for oil-fired plants, and direct subsidies for biofuel plant investments and R&D. In 1991 a heavy CO_2 tax was added, soon followed by a conversion subsidy for homeowners switching from oil to anything else.

Most of the biomass resource comes from wood by-products, and is used to generate electricity and heat – mainly district heating, or process heat for the paper and pulp industry.

Sweden has a lot of district heating, much more in absolute numbers than the UK and not so far behind Germany, Italy and Poland. The new Stockholm bio-CHP plant, to be commissioned in 2016, is the largest such plant in Europe, according to Fortum.

Besides the bulk use of many forms of biomass for heat and power, Sweden has also pioneered biogas and biodiesel. Biogas development was pioneered by the city of Linköping, which has a population of 150,000 and is situated south of Stockholm. A large plant that used slaughter waste as a substrate was in operation from 1997, with part-financing from the government. Linköping's buses, most of the buses in the surrounding province, other heavy vehicles, taxis and thousands of cars run on biogas. There are 12 public filling stations. Biogas is also produced in nearby Norrköping as a by-product of ethanol production, from food waste and manure in several towns, and from sewage treatment. It is all produced by anaerobic digestion. The gas is refined to the same grade as natural gas.

This shows that qualitatively you can have gas without fossil fuel.

44 http://epi6.energimyndigheten.se/Statistik/Energibalans/Energibalans/

But is it big enough to matter, to cut transport emissions? Until very recently, the answer would have been "not really". Swedish transport GHG emissions did drop some 13 per cent from their peak in 2007 to 2013, some of which can be attributed to biogas but more to improved efficiency and ethanol.

But in 2014, GoBiGas in Gothenburg went into operation and will produce 150 GWh gas/year from thermal gasification of cellulose. This is the second generation of biofuels. It uses as feedstock the branches and tops of trees, parts that cannot be used for timber or paper. This offers huge potential. Later on it may also use other cellulosic waste from agriculture.

A new and much bigger plant with an output of 1,000 GWh gas/year is planned, and was awarded 58.8 million euro from the NER300 EU program, although investment is pending results from the first plant.

In October 2015 the first plant is operating at capacity, with few technical problems. But it cannot make sense economically with present incentives.

The timing is otherwise fairly good. Wood residues for heating do not have a very promising future, as buildings get more efficient and winters get warmer. Demand for paper is dropping. So is demand for electricity, and the room for biomass CHP is shrinking even faster, due to rapid wind power growth in Sweden and surrounding countries. So the forestry industry needs new markets, and biofuel may develop into a great market.

There are other options. Evolution diesel oil, which is made from tall oil, a by-product of the chemical pulp process, is blended with fossil diesel. This is equivalent to taking 276,000 cars off the road, according to oil refinery company Preem. New products, such as resins for paints and glues, are being developed as by-products of the by-product.

There is a real conflict between gas and biomass, just as the NGOs claimed 25 years ago.

The development of wood-based energy and products would largely have been stifled by an abundance of natural gas.

There are more than 2,000 buses and several other vehicle types that run on gas, and though some of it is fossil, most is biogas.

Bridge to nowhere

Is natural gas a "bridge" to a sustainable energy system? That is what the gas industry has been saying for decades. But the bridge is not needed. Sustainable technology is here now.

From 1980 to 2010, natural gas use almost doubled in Europe. European coalmines were uneconomic, and were closed down one after the other.

The fuel shift was also, to some extent, policy-driven. Gas was seen as cleaner than coal, especially for power. Indeed it is.

The supply of gas from the North Sea was shrinking, but gas from Russia and Norway made up for that loss. More imports from other countries that have LNG were another option.

Gas was certainly nowhere near as divisive as nuclear power, so the road from coal to gas was taken for granted. Most European leaders thought renewables a very nice idea, and supported them with generous feed-in tariffs or by other means. Everybody also had a kind word for efficiency measures. But few thought that they or renewables would have any real significance in the foreseeable future.

Gas is the bridge. That was what most politicians thought, and that was what the power companies thought. Other bridges to the future were carbon capture and storage, and for some leaders also nuclear power, either conventional or more "advanced" concepts such as thorium reactors, fast breeder reactors, and fusion.

This time perspective – of CCS now, together with more nuclear and more gas, and followed by sustainability sometime in the future – has turned out to be 180 degrees wrong.

- The nuclear renaissance did not come. Nuclear production in the EU peaked in 2004, and has dropped 13 per cent since then. More reactors will be retired over the next few years. Only four reactors are under construction in the EU, two of them Soviet-era projects in Slovakia. "Advanced nuclear" is moving further and further into the future.
- CCS has failed. Both the EU and member states have offered very large sums of money, but there are no takers. There is no coal power CCS anywhere in the world now or in the near future.
- The few CCS projects that are running or likely to be underway in the near term[45] are of two kinds.
- Two projects in the world, both in Norway, separate CO_2 from natural gas, which is beside the point, as it is only a small niche among fossil fuels.
- The other kind uses CO_2 for "enhanced oil recovery": the CO_2 is injected into old oil wells so as to force up more oil from them. This means more CO_2, not less! No big CCS projects are in the EU, anyway.

45 Database at www.globalccsinstitute.com/projects/large-scale-ccs-projects as of 2015-10-15

- Gas sales have dropped since 2010, and especially for power. Industrial use and domestic use for heating do not change so fast, but power plants can be switched on and off at very short notice. If the gas price is high and the power price is low, they will run much fewer hours per year. Gas prices have dropped, but not enough to stop the decline.
- The relative cleanliness of gas also raised more question marks after the US boom in fracking. European fracking efforts have damaged the image of gas, but have produced no actual gas. And the security of supply issue resurfaced with the Ukraine crisis, if not before. The bridges have crumbled, but the distant shore has moved within wading distance.
- Efficiency improvements have cut electricity use by some five per cent between 2010 and 2014, i.e. not because of the 2008 recession, but after it. There may be a thousand reasons, from LEDs to better fridges, fans and pumps, much as a result of EU and US policy.
- Wind power became mainstream. In the year 2000, Europe got 21 TWh from wind, worth two or three standard nuclear reactors. This is negligible. But in 2014, wind power produced almost 250 TWh[46], equivalent to 45 reactors[47]. That is not negligible, and it is only the beginning. Denmark got 39 per cent of its electricity from the wind in 2014, Portugal 24 per cent. In France, Germany and Spain, wind produced more energy than gas during 2014.
- Wind power is now competitive with any other new power technology in many countries, including the United States[48], Germany and the UK[49] and even threatens existing coal, nuclear and gas power by driving wholesale electricity prices down.
- This is also happening for solar. In 2014, Germany got 33 TWh from solar. This is enough to push peak power prices down in the daytime, which is when the big power stations used to earn most money. Solar is coming fast. The EU produced just 0.1 TWh in the year 2000, but 98 TWh in 2014. Italy got 23 TWh from solar in 2014. According to Deutsche Bank[50], 80 per cent of the world will have "grid parity" before 2017, meaning that homeowners will save money by putting solar panels on their roofs, irrespective of politics.
- Just a few years ago photovoltaic development was an almost exclusive European thing, very dependent on policy in Germany, Spain and Italy. Now the skyrocketing production is heading to China, Japan, India, the US and South America, and the cost keeps falling. No policy decision can stop this development, though active policy can accelerate it, and is likely to do so.

46 BP Statistical Review of World Energy June 2015

47 The world's 439 reactors produced 2410 TWh in 2014, or 5.5 TWh per reactor.

48 http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf

49 http://about.bnef.com/press-releases/wind-solar-boost-cost-competitiveness-versus-fossil-fuels/

50 http://www.energypost.eu/deutsche-bank-solar-grid-parity-world-2017/

From the investor perspective, solar and wind are attractive for several reasons. Solar is predictable. Most projects are built on time and on budget, and the panels then deliver the energy that was calculated. There is no technology risk and no fuel cost risk.

Wind power is almost as safe.

Coal and nuclear power projects, on the other hand, have often disappointed investors. The few nuclear reactor projects in the EU are all far behind schedule and 2–3 times over budget. Coal power projects are much the same. Vattenfall's giant Hamburg-Moorburg plant was commissioned in 2015, but cost underestimates and power price overestimates have already forced a write-down of one billion euro. Vattenfall also lost 5–6 billion euro on Dutch Nuon, with coal and gas assets.

E.ON did bet high on gas, and lost. Its Irsching 4 and 5 power stations are among the most modern and efficient in the world, but are still not making any money. Power prices are too low, and natural gas is too expensive to compete with anything, for most of the year.

E.ON actually threatened suicide, i.e. closing down the Irsching plants. They then received some money from the grid authority to keep them for strategic reserve power.

In the rear-guard fight for big power, this suicide strategy became institutionalised. It is called "capacity market" and means that the government pays for fossil and nuclear power capacity whether it is used or not. In the UK, the compensation (for delivery in winter 2018) is £19.4/kW according to an auction in December 2014. Most of the money goes to existing gas power and some to coal, so many NGOs see it as a fossil subsidy. Some also goes to nuclear, but very little for demand reduction.

In Germany, the government has had second thoughts and Sigmar Gabriel, Minister for Economic Affairs, told the press that he sees no rationale for a capacity market. Prices will fluctuate more, but those swings will spark new investments, he said.

He did not elaborate, but those investments are likely to be: electric storage, more power lines, bio power and demand-side management. Not fossil gas power.

Germany is a densely populated country with modest renewable resources. Hydropower dams act as a battery, but Germany does not have many of them. Most countries have a better match between solar supply and demand. So if Germany can keep adding renewables, phase out nuclear and fossil fuels, including natural gas, and still keep the grid stable, then the whole world can do so.

http://www.sandbag.org.uk/blog/2015/jan/14/eu-power-emissions-fell-more-8-2014/

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