Economic Instruments in Swedish Climate Policy – a success story

In 1991 Sweden introduced a substantial CO_2 tax. Though it had many exemptions and was subject to many changes over the years, it did cut emissions. During that time, Sweden also phased out two nuclear reactors.

Global warming entered the international political agenda with the Brundtland Report in August 1987. This was when it all started. Its importance was reinforced by the US Congress hearings in early 1988.

In June 1988 the Swedish parliament reached a decision which took everybody by surprise, including its originators. A motion from the opposition Conservative Party called for a cap on CO_2 emissions, so that they should not increase over the "present level".

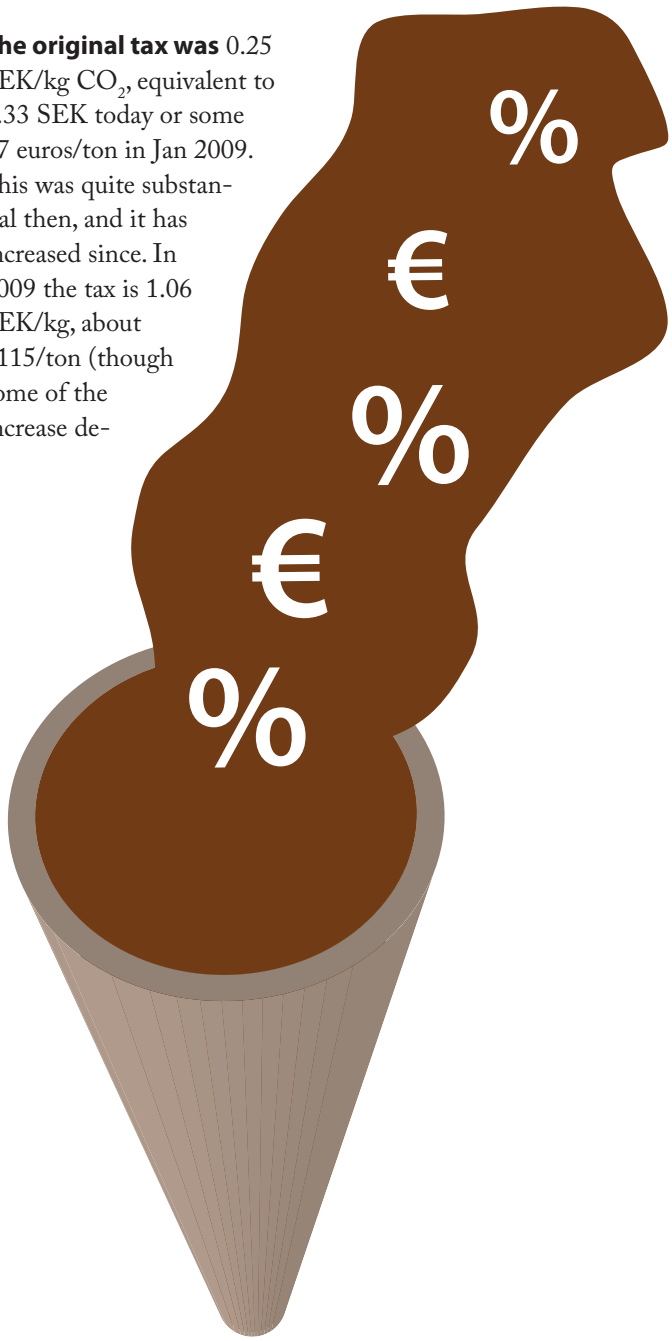
One motive behind the motion was to make a green case for nuclear power, which the social democrat government had promised to phase out. But both the anti-nuclear parties, the Center party (which despite its name is usually on the right side in politics) and the Left/Communist party also voted for the motion. It was most unusual for the Left/Communist party to side with the Conservatives against the Social Democrat Government.

The unusual alliance won the vote, but the social democrats won the election three months later. A committee on environmental taxes saw the CO_2 decision as obligatory; the resolution was now generally interpreted as a cap for CO_2 at 1988 level. The committee called for a CO_2 tax, probably influenced by the Swedish Society for Nature Conservation. The government's bill set out similar proposals. The tax was introduced on 1 January 1991.

As legislative processes go, this was fast. Two and a half years after the parliament first recognized the existence of a problem, an international one at that, it had a far-reaching solution in place.

The timing was of the essence. The sequence of events could not have taken place a year earlier, when few MPs had even heard of global warming. It would hardly have happened much later, as Sweden fell into a deep recession during 1991.

The original tax was 0.25 SEK/kg CO_2, equivalent to 0.33 SEK today or some 37 euros/ton in Jan 2009. This was quite substantial then, and it has increased since. In 2009 the tax is 1.06 SEK/kg, about €115/ton (though some of the increase de-



pends on a factual 10–15 per cent devaluation of the SEK against the euro after the financial crisis in September 2008.) It is expected[1] to be 1.05 SEK in 2010. The small apparent drop is actually a small increase in real terms when deflation is accounted for. Most of the increases took place around the year 2000.Since then it has been fairly stable, and its future remains stable under all outcomes of the 2010 election.

At face value, it is a very high tax. But on closer scrutiny, it was not quite as revolutionary, as the effects were watered down by a large number of loopholes.

In broad terms, nevertheless, the tax has been a success. Sweden has cut its CO_2 emissions - by about 9 per cent from 1990 through 2007. And though it is hard to know what would have happened without the tax, it is reasonable to assume that emissions would have increased – as they have in most other nations, such as the neighboring Finland and Norway. According to the Ministry of Environment[2], CO_2 emissions were 15 per cent lower in 1995 than if "1990 instruments" had still been in place, and it was then also estimated that the divergence was increasing, so that by the year 2000 emissions would be 20–25 percent less than without the 1991 tax (and some other changes of minor importance with regard to CO_2).

The tax worked to the extent it was applied, partially where it was partially applied and not at all where it was not applied. This may sound rather obvious, but these basic facts have often been overlooked in the Swedish debate about costs and cost-effectiveness.

The tax had its strongest effects in the heating sector. In Sweden, district heating is very common in urban districts. The energy output from district heating is 54 TWh, which is roughly equivalent to the electricity output of 7–8 standard nuclear (1000 MWe) reactors. From 1990 to 2007, district heating expanded some 20 per cent, while fossil fuel usage declined sharply.

District Heating, TWh	1990	1990
Oil	3.6	2
Natural gas	2.5	2.3
Coal and coke oven gas	8.2	2.9
Bio. waste and peat	10.4	37.2
Electric boilers	6.3	0.3
Heat pumps	7.1	5.6
Waste heat	3	3.9
Total supply	44.8	54.3

1 Swedish government: Effektivare skatter på klimat- och energiområdet, DS 2009:24

2 National Report to the Climate Convention 1997, here after an OECD paper Economic Instruments in Practice 1: Carbon Tax in Sweden, by Bengt Johansson, Swedish Environmental Protection Agency http://www.oecd.org/dataoecd/25/0/2108273.pdf

In the residential and service sectors, the change was even more dramatic. Oil use had fallen by half from 1980 to 1990, but now it crashed. Coal use was very much reduced; of the remaining 2.9 TWh about a third was residual gas from steel mills. The reason why coal is used at

Residential and service	1990	2007
Oil	41.1	13
Electricity	65	72.3
District heating	30.7	41.8
Biofuels	11.2	13.8
Other	1.8	2.2
Total supply	149.8	143.1

The oil reduction was achieved through

- Improved efficiency: though the heated area grew, energy consumption fell.
- More district heating instead of oil and electric heating.
- Strong growth of home heat pumps.

More biofuels. In 1990, wood heating was mainly a rural practice, and declining. In 1990, wood pellets were not commercially available. From about year 2000, pellets became a normal "one phone call" commodity for house owners; this market expanded[3] from 39,000 tons in 1997 to 635,000 tons in 2007, or some 3 TWh.

Until the year 2000, electricity was very inexpensive in Sweden. One expected consequence of higher fossil fuel prices would have been increased use of electric heating. This did not happen, because taxes on electricity consumption (except for industry) were increased at more or less the same time. In addition, the production tax on nuclear electricity was increased several times from the mid-1990s.

One reason for the huge decline in oil use in the heating sector is a consistent policy by all governments to phase out oil since the mid-1970s. The rationale has always been a combination of environmental concerns and security of supply.

The CO_2 tax was, however, not fully effective even within the heating sector.

Peat is not subject to the tax, nor to energy tax due to the oil-reduction policy of the 1980s and competent lobbying. Peat is equated with fossil fuels by the EU and is reported as such to the Climate Convention. CO_2 emissions from peat, mainly for district heating, are about 1.5

3 Statistics from pellet producers' organisation http://www.pelletsindustrin.org/?p=2510

Mtons per year. This could easily be replaced by wood fuel.

The energy tax diluted the effects of the CO_2 tax, as coal had less energy tax than oil.

More importantly, the CO_2 tax was not applied to electricity production. Sweden produces some 95 per cent of its electricity from hydro and nuclear, and some of the remainder from biomass, so why was the exemption there?

The line of reasoning was that Swedish fossil power from combined heat and power (CHP) should not have a competitive disadvantage to Danish and Finnish coal power. Some of the CHP was fossil-fired and the district heat companies (which at that time were almost always owned by the towns) were politically very strong. Another factor was a push for natural gas. Sweden only had, and still only has, a gas supply in the southwest, from Malmö to Gothenburg. There has been a persistent lobby for a pipeline to Stockholm and further north since the 1960s, though the constituents of the lobby have changed, as well as the strategy and proposed source of the gas. By 1990 natural gas was perceived as an alternative to nuclear power, though the NGOs were against both. As things developed, this potentially fatal flaw in the CO_2 tax was not quantitatively very important. Two nuclear power reactors (Barsebäck) were phased out, and were not replaced by fossil power. The pipeline got nowhere. Fossil fuel use for CHP was largely squeezed out all the same, though probably much slower and less completely than if the tax had been applied to electricity.

The exemption for electricity also had cross-border implications. Finland introduced a CO_2 tax on power production in the mid-1990s and tried to protect its own power industry against unfair Swedish competition by also taxing imported electricity. When both countries joined the EU in 1995, Finland could not keep the tax on imported power, and then abandoned all CO_2 tax on power[4]. Sweden's attitude was also unsupportive towards Danish efforts to cut CO_2 emissions from its coal power some years later. When new power cables were built to Germany (1994) and Poland (2000), CO_2 never became an issue. The tax examption on CO_2 from electricity generation thus helped to conserve fossil power in other countries, too.

The heavy CO_2 tax on heat and zero tax on electricity meant that a CHP company that had both fossil and biomass fuels could attribute the fossil share as being used "for power", i.e. tax-free, and the biomass share as being used "for heat", i.e. tax-free again. This, and other loopholes, made the CO_2 tax much less effective than it should have been.

In practice, it meant that it took much longer time for it to work. While some CHP companies were playing for time, they also lobbied hard for further erosion of the tax, and probably talked themselves into false hopes. One noted example is Västerås Energi which had a coal-fired CHP plant and kept burning coal for base-load until the year 2000. It was by far the biggest emitter of CO_2 outside manufacturing industry. Stockholm's district heat is still partly supplied from coal, though there is a CO_2 tax of about €100/ton on top of the ETS cost. There is a biomass plant under consideration.

Another set of exemptions was made for heavy industry. Oil refineries and ore-based steel production were totally exempt. As for paper & pulp, cement and mining industries, etc., the rules were complicated and changed several times. Suffice it to say that they have not paid a lot of CO_2 tax.

There was a strong case for exemption for parts of heavy industry. A full CO_2 tax for the ore-based steel industry, for example, would have killed that industry immediately. The exemption for paper & pulp was much less needed. Paper is made from wood, not from oil; the residual products (bark, black liquor etc) can supply all the energy this industry needs and much more. But oil was cheap in the 1990s, and the paper & pulp industry is politically very strong.

In retrospect it is doubtful if the all the heavy industries really profited from such lenient taxation. It might have helped if there had been some conditions for the exemptions. The ore-based steel industry emits 6 Mtons of CO_2 per year, or 10 per cent of the Swedish total. The steel industry is now doing some R&D on flue gas recirculation, which may cut its coal use and emissions by some 25 per cent[5].

As for non-heavy industry, such as the Saab and Volvo plants, it originally had to pay the full tax. After only two years, however, the new, centre-right, government drastically lowered the CO_2 tax for industry from 0.25 to 0.08 SEK/kg. In 1997 it was increased again to 0.17 by the Social Democrats, i.e. half the level of the "general" CO_2 tax. As the "general" CO_2 tax increased year by year from 1999 on, the industry tax was kept constant. This meant that heating a house or an apartment building with oil was becoming prohibitively expensive, but to heat a factory – often leaking heat in every direction – with oil was not a problem.

The CO_2 tax was theoretically applied on transport fuels, but in reality it substituted for an existing energy tax of the same level, bar some minor and late adjustment.

4 Finnish Parliament (in Swedish) www.parliament.fi/triphome/bin/akxhref2.sh?%7BKEY%7D=StaUB+44/1996&%7BKIELI%7D=ru

5 (In Swedish) www.nyteknik.se/nyheter/energi_miljo/energi/article438956.ece

As might have been expected, this change of names did not influence the market. Transport emissions (excluding international bunkers) increased from18 to 21 Mtons from 1990 to 2007. The increase was due to heavy traffic, but the high level was due to the fact that Sweden had the thirstiest cars in Europe in 1990 and still had the thirstiest cars in 2007. Saab Automobile and Volvo Cars were badly hit by the oil price hike and the 2008 recession.

It is however interesting to note that whereas in 2000 and 2005 there was a popular outcry against even the smallest increases in car fuel taxes in the name of climate policy, no political party now promises cheaper gas.

The fuel shift from coal and oil to biomass was the big impact of the CO_2 tax. But there were other effects as well. The tax, together with other policy instruments as well as oil price increases, gave a strong boost to small-scale heat pumps and wood pellet heating. It probably also speeded up commercialization of some large-scale biomass combustion technologies. One such technology is heat recovery from flue gas condensation, which increases efficiency by 10–25 per cent, an important improvement.

Other renewable technologies could have benefited from the CO_2 tax, but examples are hard to come by. It may have benefited large-scale solar heating, in which Sweden was a world leader in the 1980s and 1990s, but economic support was too little and changed too often, and disappeared completely by year 2000.

The CO_2 tax was introduced together with a sulphur tax and a NOx "feebate", i.e. a fee for above-average emitters of NOx that was paid back to the below-average emitters.

The sulphur tax was primarily meant to decrease acidification, but in practice and principle it contributed to climate policy as well. The high-sulphur fuels are coal, heavy fuel oil, and peat, whereas renewables and efficiency are low or zero emitters.

The NOx feebate did not help renewables or efficiency, as it only gave incentives for cuts in NOx from combustion plants. Solar heating plants and wind power were outside the system and could take no credit from their zero emissions. Sometimes it has produced rewards for fossil plants with low NOx emissions, such as the Västerås coal CHP plant mentioned above. The feebate gave very strong incentives to cut NO and N_2O emissions, but omitted nitrogen emissions in other forms such as N_2O (which was supposedly expensive to measure) and ammonia, and sometimes gave perverse incentives for increases in acidifying, eutrophication and greenhouse gas emissions.

The CO_2 tax obviously did not benefit renewable electricity.

Wind power came late in Sweden and then it was mainly due to a renewable certificate trade scheme from 2003, which also boosted biomass CHP.

Energy efficiency (except heat pumps) did not profit from the CO_2 tax, and maybe should not have been expected to under any circumstance. Energy efficiency depends on a large number of factors other than price, from building codes to cultural attitudes.

The advances made in energy efficiency since 1991 are generally not linked to any environmental taxes. Sweden has pioneered extremely efficient windows, but that was due to technology procurement, information dissemination and direct subsidies.

To sum it up: the Swedish CO_2 tax was far from efficient in the economic sense of the word. Some of its flaws were unnecessary, whereas others were hard to avoid in the real world, where politicians are sometimes more impressed by strong vested interests than by logical arguments. Anyhow, a small nation, dependent on exports, cannot set all the rules.

Nevertheless, the tax did a good job. Meanwhile, Sweden has had better economic growth than other rich nations. There is no evidence that Sweden lost any growth or jobs or industrial strength because of it.It is also interesting to note that there is now political consensus behind the CO_2 tax. In the 2009 Climate proposition, the government writes that the level of the CO_2 tax shall, together with other economic instruments, in the future be adapted so as to produce a reduction in GHG emissions outside the ETS of 2 million tons by 2020[6].

6 En sammanhållen klimat- och energipolitik www.slv.se/upload/dokument/miljo/klimatproposition_2008.pdf p63

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