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Climate Change and Energy Strategies / Plans / Policies: Sweden heating policies

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Policy Description

The Swedish heating system primarily relies on district heating networks supplied by small scale power plants. The main policy drivers for the decarbonisation of heating are fossil fuel and CO_2 taxation combined with tax reduction and subsidies for preferred technologies. Since the 1970s Sweden has achieved impressive CO_2 intensity reductions and increased energy efficiency with continued support for research, development and deployment of new low carbon technologies, most notably combined heat and power (CHP) plants and biomass fuels.

The heating of space and hot water in buildings is dominated by largely biomass-fired district heating schemes for multi-dwelling residential houses and non-residential premises, while detached houses are most commonly heated by heat pumps and electric heaters. CHP plants in district heating systems are supported by various subsidy programmes and tax reduction schemes, both of which heavily favour biomass and municipal waste fuels. A ban on landfilling burnable and organic waste incentivised waste-to-energy plants (SEPA 2005). A wide range of research and development programmes, favourable loans for household-level investment and information campaigns have helped to establish heat pumps in the single-dwelling market (Kiss et al. 2012). Finally, efficient use of energy is ensured by Energy Performance Certificates and Building Regulations, which require strict energy efficiency standards and limit energy use in new buildings to 90 kWh/m^2. Grants, subsidies and tax reductions are available to progressively upgrade old buildings to this standard. Information campaigns on energy efficiency in the residential sector were designed to inform the public about new regulations and demonstrate technological solutions.

Targets

In February 2017 Sweden committed to completely phasing out all greenhouse gas emissions by 2045. Sweden is set to publish the full legislative proposal in the coming months which will come into action in 2018. Government will establish a climate action plan every four years which will be overseen by an independent advisory body. The idea was initially proposed by the socialist and green parties and backed by a coalition of seven out of eight parties across the political spectrum. The leader of the working group on potential climate law cited the UK's Climate Change Act as one of the major influences for the Swedish cross-party agreement. The UK Climate Act, which was passed unanimously in 2008, encouraged the Swedish conservative parties to lend their support to the new legislation. Despite the political differences, members of the current coalition were willing to compromise and reach a united target for this highly publicly-supported issue.

Heating policy in Sweden sits under the overarching cross-sectoral EU Energy Efficiency Directive (2012/27/EU) with a broad goal of reducing energy intensity by 20% by 2020. In addition, Sweden aims to completely phase out fossil fuels in heating by 2020. The key domestic objectives that have shaped Sweden's heating policy landscape can be summarised as:

- Reduce the dependence on oil
- Reduce CO2 emissions

- Utilise waste heat from electricity generation and industrial processes
- Increase energy efficiency in buildings.

The incentives for renewable energy use are supported by taxing CO_2 and fossil fuels as opposed to using different feed-in tariffs or mandates. Fossil fuel and CO_2 taxation was introduced in 1991 and periodically increased to a current level of £107 (1200 SEK) per tonne of CO_2 being the highest in the world. The tax structure comprises an energy tax, a CO_2 tax and a sulphur tax. CO_2 tax is based on the carbon contents of all fuels with exceptions of biomass and peat. The maximum level of tax is applied to individual consumers, while the industry and service sectors receive varying tax exemptions. This means that energy-intensive industries are encouraged to implement technological change, while less intensive industries are not unfairly burdened and remain competitive internationally. Currently this tax only applies to industries which do not participate in the EU Emissions Trading System (EU ETS).

In line with this, Sweden does not have targets for specific heating sources/fuels or technologies, but rather provides a package of support for district heating, by-product heat utilisation schemes and heat pump use, along with investments in technology development. The major expansion of CHP plants was supported by two stages of subsidy programmes, the second of which directed 50% of funds to biomass-fired plants. Following the landfill bans of burnable waste, a waste-to-energy tax was introduced to the already established waste incineration industry to favour CHPs over heat-only plants. Tax reductions based on whether incineration facilities produce electricity encouraged further expansion of waste-to-heat CHP plants (Jacobsson 2008). District heating is a natural monopoly where individual power plants cannot effectively compete across the network due the localised nature of the technology, therefore policy instruments like subsidies or selective taxation are effective in promoting the preferred type of generation.

Timescales

Since the 1970s Sweden has increased its district heating capacity by 77% (14.6 TWh to 62.6 TWh), while the associated CO_2 emissions remained stable (fig. 1). This has been achieved by diversifying fuel types and phasing out fossil fuels, which currently account for 14% of the supply and are on track to be completely phased out by 2020. The district heating market is mature and not expected to grow considerably because of increasing building efficiency standards and low new housing construction rates. Biomass and waste-heat market shares will continue growing until 2030 (IEA 2013), although growth potential for waste-to-heat is limited given that Sweden is already importing waste for incineration. Investment support schemes for solar heating were introduced in 2011, but the programme was discontinued after solar heating proved to mainly outcompete already low-carbon district heating and heat pumps (SMEE 2014). Further emission reductions will be achieved through replacing old power plants with more efficient CHPs and decreasing energy demand (Ericsson & Werner 2016).

CO_2 emissions in commercial and residential individual heating sector have dropped from 9 TWh to 2 TWh since 1990 (fig. 1). Electric heaters and natural gas boilers are still in the market, so further heat pump deployment is expected to decrease the emissions (Kiss et al. 2012).

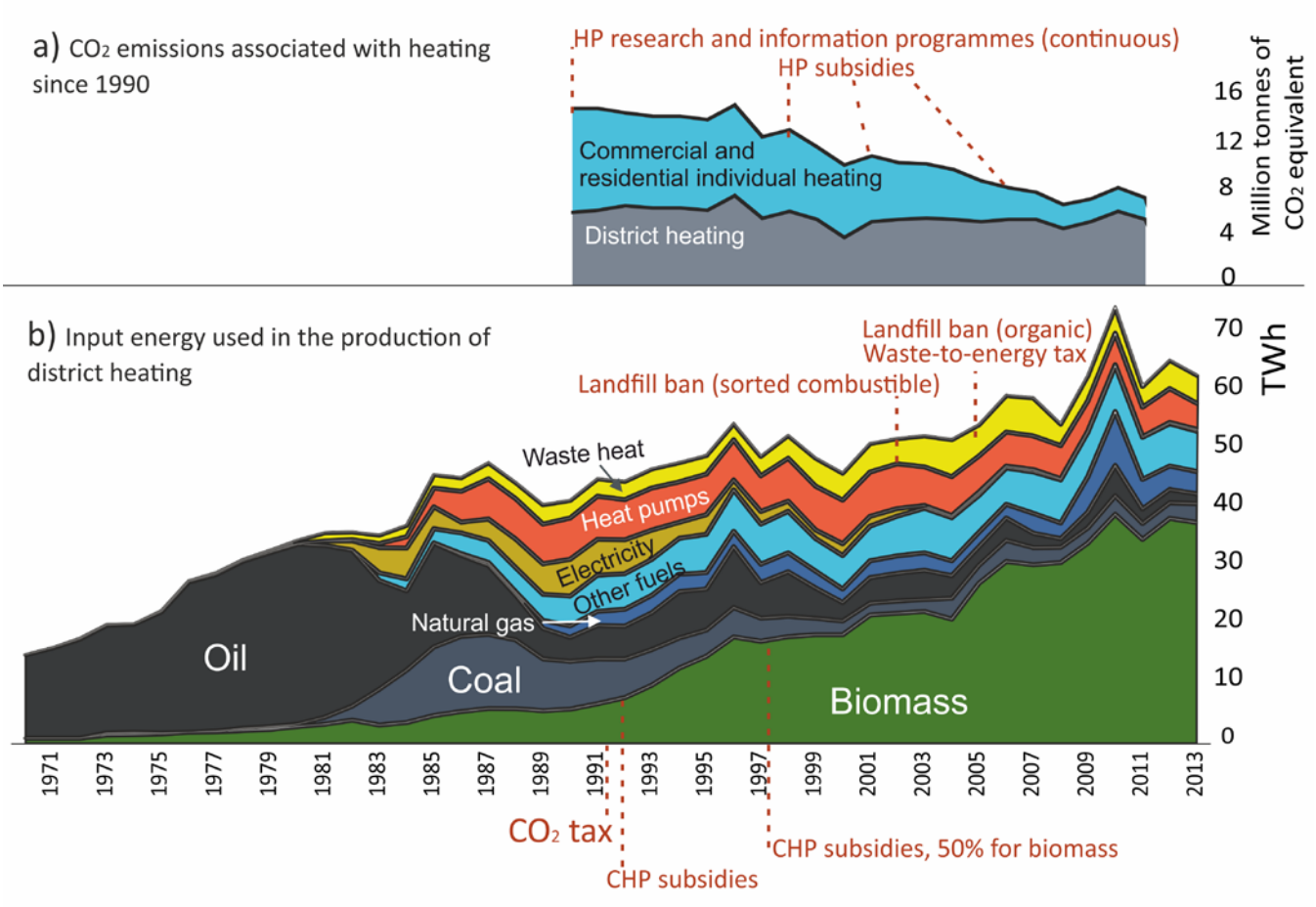

Figure 1. a) CO2 emissions from district heating have remained stable from 1990 to 2011. Heat pump deployment supported by government policy programmes (marked red) lead to a significant emissions decrease in individually heated premises. b) District heating capacity increased from 14.6 TWh in 1970 to 62.6 TWh in 2013. Biomass became the dominant fuel along with the expansion of waste heat and heat pumps, while fossils fuels are being phased out. Data from (SMEE 2014; SEA 2015)

Communication

Sweden actively advocates for more ambitious CO_2 emission reductions targets and higher EU ETS trading price in the EU to match its own progressive domestic policies (Williams 2015). Positioning itself as a global leader in sustainable growth, Sweden runs highly publicised information campaigns about its domestic policies which often go viral. A notable example is the recent photograph of the Deputy Prime Minister Isabella Lövin signing one of the world's most ambitious climate laws surrounded by all-female cabinet members. Lövin used the publicity to encourage European countries to take leading roles in climate action and remind China and India of their Paris commitments. Another example is the waste-to-heat information campaign, which went viral announcing Sweden only landfilled 1% of its domestic waste.

The Swedish public has been supportive of environmental policies, largely due to the Swedish government efforts to increase the amount of accessible information and common political-cultural understandings of the Swedish welfare state and equality. Swedish municipalities have local energy advisers who provide information about building standards and low carbon technologies and practical information on house improvement. Educational campaigns combined with home improvement subsidies were instrumental in preparation for the 1991 CO_2 tax to avoid public push-back and an unfair tax burden for low-income households (Sprei & Holmberg 2006). 'Become Energy-Smart' campaign ran in 2006 – 2009 and included an exhibition of 'The Energy-Smart House' which visisted several cities in Sweden. The campaign provided information on energy saving at home. Among other materials, the campaign distribued energy calculators designed to estimate investments needed to reduce energy requirements in single-family dwellings (SMEE 2014).

In an attempt to improve the public trust in heat pump technology, the government increased investment in research and development and certification programmes. Sweden hosted the International Energy Agency's Heat Pump Centre and other international knowledge exchange initiatives. Investment in research combined with public information campaigns strengthened the market and consumers' trust (Kiss et al., 2012). Currently Sweden is Europe's leading heat pump manufacturer and supplier and has a much higher domestic heat pump take up rate than its neighbours such as Finland. Bayer et al. (2012) suggests that heat pumps are favoured by the public because the extensive research and manufacturing have taken place in Sweden. This example indicates that individual consumers may favour and support locally developed technologies over competing imported alternatives.

Context-specific factors

Sweden's district heating and heat pump development has been influenced by contextual factors such as availability of biomass, lack of fossil fuel reserves and a strong tradition of municipal ownership. Other key factors like policy stability, strategic use of taxation and subsidies, investment in research and development programmes and information campaigns are relevant in other contexts, such as Scotland.

Local resources

Sweden has no natural oil and gas resources and very limited connectivity to a natural gas grid but has widespread and highly productive forests. The availability of cheap biomass fuel and the lack of national fossil fuel reserves were the key factors favouring the expansion of biomass-fired district heating schemes. Clearly, here the Scottish context is different, with an extensive gas network and relatively cheap gas prices.
In 1970s Sweden's district heating system was fully reliant on imported oil. Oil price volatility had a direct impact to consumers and business during market fluctuations associated with the 1970s oil crisis. Numerous government policies to introduce biomass in district heating systems were welcomed favourably by the public (Nykvist & Dzebo 2014). The Swedish pulp and paper industry generates large quantities of by-products which were previously unused. The introduction of biomass to district heating created a new market for forestry waste and offered an opportunity for economic growth. However, the competition for forestry resources is projected to grow in the future from new applications for biomass in the production of transport fuels, chemicals and plastics. Market researchers expect district heating systems to adapt and utilise the waste heat generated by these processes as opposed to directly use biomass as fuel (Ericsson & Werner 2016).

Sweden has historically enjoyed low electricity prices generated in hydro and nuclear power plants. Electric heating has been the most popular option in detached houses since the 1950s and is currently being replaced by a growing heat pump market (Nykvist & Dzebo 2014). Limited household access to a natural gas grid makes heat pumps preferable to gas boilers and less efficient electric heaters.

Policy stability

CO_2 and fossil fuel taxation was introduced in 1991 and has been a stable policy instrument since. No specific emissions targets for heat were set, rather allowing households and businesses to respond to the price signal by implementing their choice of technologies and strategies. The key strength of the policy has been its stability despite changing governments and efforts made to announce any regulatory changes well in advance allowing businesses to adapt accordingly. Business and other stakeholders are involved in decision making via consultations on government proposals before these are presented to parliament (Hammer and Åkerfeld, 2013).

The blanket ban on landfilling burnable and organic waste implemented in 2002 and 2005 provided a strong incentive for business to find innovative and cost effective technologies for waste incineration. Currently Sweden recycles or incinerates 99% of its own waste and imports more from neighbouring countries, which constitutes 7% of total fuels used in district heating (SEA 2015).
In contrast, several authors indicate that fragmented subsidy programmes for heat pump deployment in the early 1980s and 2000s undermined the market stability achieved by carbon tax and discouraged long-term investment. The overall programme achieved success, but economies of scale in production, borehole drilling and technology improvement were arguably more important factors than the subsidies (Kiss et al. 2012; Nykvist & Dzebo 2014).

Community ownership of property and infrastructure

One of the main reasons for district heating expansion was the large affordable housing construction programme known as the Million Homes Programme carried out from 1965 to 1974. This resulted in many new multi-dwelling houses suitable for centralised heating system. Owners of multi-dwelling properties have a share in the whole building rather than ownership of individual flats, which favours centralised heating schemes to individual boilers (Nykvist & Dzebo 2014). The Million Homes Programme is a case study of the relative ease with which district heating can be introduced in newly-built housing developments.

Municipally owned energy companies have traditionally been the main actors in district heating. These public companies own generation plant and the pipeline infrastructure and are responsible for heating distribution. Public companies can be expected to adapt and react to new government policies quicker than private enterprises, which is an important factor in the early stages of district heat system decarbonisation (Johansson 2000). Following heating market deregulation in 1996 companies were allowed to act competitively and regulate their own prices. This resulted in energy price rises in densely populated areas which in turn opened up opportunities for competing heat pump technologies (Magnusson & Palm 2011). Although market deregulation has been controversial, the Swedish government succeeded in creating and supporting a market for district heating technology during its development and subsequently decreased state regulation once the technology reached maturity.

Conclusions

- Sweden has a target to phase out fossil fuels in heating by 2020.
- Sweden has no natural fossil fuel resources and limited connectivity to a natural gas grid, which has favoured biomass as the key fuel for district heating.
- Taxes on CO_2 and fossil fuels, combined with long term policy stability were the critical factors in enabling low carbon technology uptake and ensuring business stakeholders' trust.
- The CO_2 tax was combined with tax relief in different sectors, redistributing the taxation but not increasing the total amount.
- Biomass and waste-fired CHPs are supported with tax exemptions and subsidies.
- New district heating markets were established with sustained government support. When the market reached maturity, further technology development was encouraged through private sector competition underpinned by targeted tax and subsidy regimes.
- Further CO_2 emissions reductions in district heating are expected from increase in waste heat utilisation from industrial and chemical processes and energy demand decrease.
- In addition to relative cost, investment in domestic research & development was a key factor for high heat pump uptake.
- High building efficiency standards ensure low-income households are not penalised by fuel taxation.

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