

Final Report

Analysis of Sweden's success in achieving its national indicative targets for renewable electricity

Pursuant to Article 3.3 of Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market

Analysis No 2

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Summary

Article 3.3 of *Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market* requires the Member States to publish, not later than 27 October 2005, a second report which includes an analysis of success in meeting the national indicative targets.

Sweden set itself the target of increasing renewable electricity by 10 TWh between 2002 and 2010 which, when the target was set, was equivalent to 51% of gross national electricity consumption. The reason that Sweden has not complied with the 60% target set in Directive 2001/77/EC was given in the first report in 2003.

The analysis shows that the *demand* for renewable electricity legally required under the electricity certification scheme will be 11.4 TWh in 2010. This, together with existing renewable electricity production, will bring Sweden's total renewable electricity production to 81.7 TWh in 2010. This is equivalent to 51.5% of gross national electricity consumption.

Demand may be satisfactory, but it is uncertain whether it can be met by sufficient *supply*. It is unclear whether producers will invest enough in new power sources to meet demand. Current plans, which are likely to be carried out, are insufficient to meet the target. The shortfall is 2.5 TWh below the amount needed to meet demand of 11.4 TWh, and 1.1 TWh below that required to meet the 10 TWh target. However, there are further plans for new production plants, and the Swedish Energy Agency notes that the Government has initiated several investigations with the aim of making the main instrument, the electricity certification scheme, so well developed that the market makes the necessary investments. In July 2005 the Ministry of Sustainable Development issued a report for consideration and a Bill on the matter is expected in late 2005/early 2006.

The targets set are in line with Sweden's climate change commitments. The adoption of these measures by the Swedish Parliament will create requirements for renewable

electricity, meaning that the market share which, for commercial reasons, would probably have been filled with natural gas-based production or electricity imports, will be significantly reduced. In this way these measures will prevent any future major increases in carbon dioxide emissions.

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1 Introduction

Under Article 3.3 of *Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market* the Member States must:

“...publish, for the first time not later than 27 October 2003 and thereafter every two years, a report which includes an analysis of success in meeting the national indicative targets taking account, in particular, of climatic factors likely to affect the achievement of those targets and which indicates to what extent the measures taken are consistent with the national climate change commitment.”

Sweden published its first report in accordance with this requirement.

This report is the second report issued pursuant to Article 3.3 and will therefore be published not later than 27 October 2005.

2 Important conclusions from the previous report

Sweden's first report from 2003 arrived at the following conclusions, which are crucial in analysing Sweden's success in meeting its national indicative targets:

The Swedish Parliament has decided on a target of increasing renewable electricity by 10 TWh between 2002 and 2010. The Government considered that the target is well-balanced with regard to the various interests and the introduction and lead time needed for investments in power plants. When this target was set the Government considered that such an increase would mean the share of electricity produced from renewable energy sources would be around 51% in 2010. This was estimated on the basis of the electricity consumption forecasts available at the time and on the inflow at hydropower plants corresponding to that of a normal year. The target adopted by the Swedish Parliament is not consistent with the reference value of 60% set for Sweden in the Annex to Directive 2001/77/EC. The previous report stated the reasons why Sweden has not complied with the reference value. The main reason was quite simply that it was estimated that the supply of renewable electricity would need to increase by 26 TWh for Sweden to reach 60%. The Government considered that this was not reasonable in the short period of time remaining until 2010.

It was also noted that the Commission set a target expressed as a percentage which is based on trends in electricity consumption. However, Sweden has set an absolute target, expressed in TWh because an absolute target is easier to communicate, measure and evaluate. The Government of Sweden is also working to stimulate more efficient electricity consumption, which will also affect the percentage-based target.

The principle means of meeting the target is the introduction of the electricity certification scheme. Sweden's electricity production from renewable sources was divided into two groups in the analysis (section 3 of the previous report): 1: large-scale hydropower production, 2: electricity covered by the electricity certification scheme.

The analysis gives the production from large-scale hydropower production (this term is used in Sweden for plants exceeding 1.5 MW) in a normal year as a *constant* figure of 63.4 TWh net. If the capacity of large-scale hydropower production increases it will become certifiable under the electricity certification scheme and therefore be included in the second group. (*Large-scale hydropower production for a normal year was adjusted to 63.8 TWh gross in this report*).

Electricity covered by the electricity certification scheme is generated mainly from biofuels, small-scale hydropower production (less than 1.5 MW) and windpower. This also includes increases in the capacity of large-scale hydropower production and new hydropower stations exceeding 1.5 MW.

- The volume of production in the electricity certification scheme was estimated at 6.1 TWh when the scheme started in 2003. This statistic was wrong. (*In this report renewable production which existed when the electricity certification scheme started has been revised to 6.5 TWh in accordance with the estimate made in Bill 2002/03:40*).

The electricity certification scheme will cause the volume of renewable electricity to increase by 10 TWh compared to the 6.1 TWh production level when the scheme was launched in 2002. In this way the total volume of electricity in the electricity certification scheme will be 16.1 TWh in 2010. (*Revised to 16.5 TWh in accordance with the above*).

- The analysis carried out in the previous report demonstrated that 50.5% of Sweden's electricity will be generated from renewable sources in 2010.

The analysis showed that the 10 TWh increase in renewable energy will probably significantly reduce the chances of new natural gas-based electricity production taking market shares and thereby help prevent the increase in carbon dioxide emissions generated by electricity production.

3 Analysis

The electricity certificate scheme is the single most important instrument for meeting the target.

It was launched on 1 May 2003 and the aim is that the scheme will generate 10 TWh of renewable electricity in Sweden. The scheme is producing good statistics which can be analysed far more easily than in the previous report.

Since the previous report Sweden has also drawn up a new long-term forecast for energy consumption in 2010 which greatly facilitates the analysis.

Information on the other measures used to meet the target can be found in the first report from 2003 and in section 3.4.

3.1 Normal-year correction of hydropower

Hydropower production in Sweden varies greatly depending on rainfall. The lowest production level to date was 52 TWh in 1996, and the highest was 79 TWh gross in 2001.

Because hydropower production varies so greatly it is necessary to define a *normal-year production level*. Otherwise the evaluation of Sweden's national target will depend entirely on the rainfall in 2010.

In Sweden the normal-year production level is calculated as a statistical average over a long time period, from 1950 onwards. Ascertaining this mean value is, however, complicated by the recent increase in hydropower production. Older statistics must therefore be corrected to reflect the lower level of development at the time. Older statistics are also not as reliable as today's or cannot be directly compared. In addition, the Swedish Energy Agency does not have access to all the data, but rather the calculations are done by the Swedish electricity producers cooperative body, Swedish Energy (*Svensk Energi*). There are alternative calculations for defining normal-year production, but the results are the same.

The Swedish Energy Agency has, in tandem with Swedish Energy, fixed the normal-year production for Swedish hydropower at 65 TWh net, or 65.65 TWh gross.

Hydropower production is in turn divided into *large-scale production* (over 1.5 MW) and *small-scale production* (up to and including 1.5 MW). Existing small-scale hydropower plants (in operation when the scheme started in April 2003) are certifiable in the electricity certification scheme. All new hydropower (built after the end of 2002) is also certifiable, irrespective of the aggregate. No statistics have been produced to date on what proportion of hydropower production is generated by small-scale plants. However, this statistic is now available through the electricity certification scheme. The gross level of small-scale production was 1960 GWh in 2004. Production was high that year because of above-average rainfall. A normal gross level of production for small-scale hydropower is fixed at 1850 GWh.

This means that large-scale production is **63.8 TWh gross** in a normal year. This figure will remain *constant* in Sweden's analysis of its success in meeting its targets. The same procedure was used in the report Sweden submitted in 2003. The constant figure has, however, been adjusted from 63.4 TWh to 63.8 TWh gross. If large-scale hydropower production is developed it will be certifiable and therefore be included in the statement for the quantity of certified electricity.

If the capacity of large-scale hydropower production were to increase due to improved efficiency in existing or new plants, this electricity would be certifiable and therefore be included in the statistics for the electricity certification scheme. For this reason the figure of 63.8 TWh can be constant throughout this analysis.

3.2 Demand for renewable electricity

The demand for renewable electricity¹ (in addition to large-scale hydropower production) is controlled by quotas in the electricity certification scheme. The quota fixes the proportion of certified electricity which electricity consumers bound by these quotas must buy of their total electricity consumption. The quotas increase every year and are currently fixed for every year until 2010. The current quotas are:

Table 1: Final quota requirement pursuant to the Electricity Certificates Act

2003	2004	2005	2006	2007	2008	2009	2010
0.074	0.081	0.104	0.126	0.141	0.153	0.160	0.169

In 2004, therefore, 8.1% of the electricity consumption subject to the quota requirement had to be certified. In 2004 the electricity consumption subject to the quota requirement was 96.9 TWh. The demand for renewable electricity was therefore $96.9 * 0.081 = 7.85$ TWh. The net total electricity consumption that year was 146.3 TWh.

With the help of long-term forecasts it is possible to calculate how the demand for renewable electricity will grow as a result of the electricity certification scheme. The Swedish Energy Agency made a new long-term forecast in 2004. They predicted that electricity consumption in 2010 would be 154.2 TWh net, of which 106 would be subject to the quota requirement, and therefore calculated the demand for renewable energy in 2010 at $106 * 0.169 = 17.9$ TWh.

Since there was 6.5 TWh of production from renewable sources when the electricity certification scheme started, demand is therefore equivalent to an increase of 11.4 TWh according to this analysis. The target was an increase of 10 TWh, but because the quotas are fixed and electricity consumption and the electricity certification scheme have developed, the analysis therefore shows that demand is higher than planned.

Table 2: Demand for renewable electricity until 2010 and the proportion of renewable electricity based on this demand.

	Electricity produced from renewable energy sources	Electricity produced from renewable energy sources	Gross national consumption
Year	TWh	%	
1997	72.03	49.1	146.66
2002	70.30	46.2	152.05
2003	70.95	47.9	147.98
2004	71.14	47.2	150.74

¹ Electricity produced from peat is also certifiable under the electricity certification scheme. However, peat is not a renewable energy source under Directive 2001/77/EC and therefore the quantities of peat in the electricity certification scheme have been deducted from the figures given in this analysis.

2005	73.57	48.5	151.72
2006	75.95	49.6	153.08
2007	78.14	50.6	154.46
2008	79.64	51.1	155.85
2009	80.53	51.2	157.25
2010	81.69	51.5	158.65

3.3 Supply of renewable electricity

The supply of renewable electricity is determined both by whether the market is able to meet the demand for further renewable electricity production created by the electricity certification scheme, and the inflow to large-scale hydropower plants, which is a constant figure of 63.8 TWh in this report.

In 2004 the production of renewable electricity within the electricity certification scheme was 10.5 TWh. 6.5 TWh of this already existed when the scheme started in 2002.² This means there was a 4 TWh increase between 2002 and 2004. This has been overwhelmingly due to the increased use of existing biofuelled plants.

Demand in 2004 was 7.85 TWh according to section 3.2. There was therefore a surplus of renewable production in the scheme for 2004. However, this surplus becomes a deficit when the quotas increase in the scheme. New plants are being built or are planned across the country in order to meet the growing demand. According to the known plans, the Swedish Energy Agency estimates that around 4.9 TWh of new production will be built between 2005 and 2010. In 2010 production will therefore be 15.4 TWh. According to section 3.2 demand will stand at 17.9 TWh in 2010. If current plans remain the same, the annual shortfall within the electricity certification scheme will therefore be 2.5 TWh in 2010. However, the scheme creates a demand for 11.4 TWh instead of the original 10 TWh target. The shortfall compared with Sweden's target of increasing production by 10 TWh is therefore $16.5 - 15.4 = 1.1$ TWh.

The Swedish Energy Agency's estimate that production will be boosted by 4.9 TWh by 2010 is based on information compiled in conjunction with the Agency's review of the electricity certification scheme at the end of 2004. The information was gathered by calling the companies whose plan had been notified to the Agency. It is not claimed that calling companies is comprehensive, and such plans change constantly. This exercise has been supplemented by additional information on a large plant in Stockholm supplied to the Swedish Energy Agency in 2005. The breakdown of the new power sources is summarised in Table 3, together with the overall breakdown of different types of power in the certification scheme.

² The previous report gave production as 6.1 TWh in 2002. This figure was revised to 6.5 TWh in Bill 2002/03:40 *An electricity certificate to promote renewable energy sources (Elcertifikat för att främja förnybara energikällor)*.

Table 3: Supply of renewable electricity in Sweden

	2002	2004	<i>Planned increase</i>	2010 Forecast
Supply:				
Biofuels	4.3	7.7	3.3	11.0
Windpower	0.5	0.85	1.15	2.0
Hydropower	1.7	1.97	0.45	2.4
Total supply	6.5	10.52	4.9	15.4
Demand (electricity certificate)		7.85		17.9
Surplus 11.4 TWh				-2.5
Surplus 10 TWh				-1.1
<i>Constant* hydropower</i>	<i>63.8</i>	<i>63.8</i>	<i>0</i>	<i>63.8</i>

NB. The total does not correspond to Table 2 because Table 2 describes demand and Table 3 supply.

* Large-scale hydropower production is a constant figure of 63.8 TWh throughout this analysis.

The existing known plans are therefore insufficient to meet the demand in the electricity certification scheme or to meet Sweden's target. This is a strong signal to producers that there is more room for expansion. There are also major projects which are in the advanced planning stages and which, if carried out, will meet the demand for renewable electricity. These include a wind park project planned on the Kriegers Flak area of the southern Baltic Sea. The wind park can generate around 2 TWh, and according to the current plans will be expanded in stages during 2010.

The most important requirement for reaching the planned level of production is that investors see the electricity certification scheme as credible and stable. For this reason the Swedish Energy Agency has, at the Government's request, carried out a comprehensive review of the system, resulting in three reports. These reports in turn formed the basis for a report by the Ministry of Sustainable Development issued in July 2005 (Ds 2005:29 Bill on broadening the electricity certification scheme). In this report the Ministry proposes the necessary improvements to the electricity certification scheme. The most important is that the scheme is extended with quotas until 2030 and that the objectives increase from a 10 TWh increase between 2002 and 2010 to a 15 TWh increase between 2002 and 2016.

The report is currently under consideration and will probably result in the introduction of a Bill at the end of 2005 or the start of 2006.

3.4 Result – meeting the target

If the long-term electricity consumption forecast for 2010 is combined with the statutory quotas in the electricity certification scheme, it is calculated that the *demand* for renewable electricity in Sweden will increase by 11.4 TWh between 2002 and 2010, which means the proportion of renewable energy sources will be **51.5%**. This must be compared with the 10 TWh target which was equivalent to 51% when it was set.³ According to the current analysis (with today's electricity consumption forecasts) 10 TWh is equivalent to 50.6%.

The reason that supply will be 11.4 TWh instead of the 10 TWh target is that the quotas are fixed, whereas the system and electricity consumption have developed differently to when the quotas were decided.

The result of the previous analysis in 2003 showed demand was 50.5%.

Although demand is satisfactory, it is uncertain whether it can be met by sufficient supply. Will the market really be able to build the new production plants required by the electricity certification scheme? Too few investment decisions have currently been taken for this to happen. There is estimated to be 2.5 TWh less than is required to meet the demand in the electricity certification scheme (11.4 TWh) and 1.1 TWh less than is needed to meet the target that has been set of increasing renewable production by 10 TWh.

However, there are well advanced plans for new production plants which will meet demand if adopted. At the Government's request the Swedish Energy Agency and the Ministry for Sustainable Development have evaluated the electricity certification scheme. The aim of this was to make the system as credible and stable as possible so that investors will have the courage to take the necessary decisions. This work has been carried out through the review assigned to the Swedish Energy Agency, the report compiled by the Ministry of Sustainable Development and the Bill announced by the Government for late 2005/early 2006.

The Swedish Energy Agency also notes that the Government has initiated several measures, in parallel to the electricity certification scheme, in order to meet the national target:

Windpower is being supported by facilitating establishment. This is done through a national planning target which aims to promote interest in windpower in land-use planning and when examining permit applications, as well as pointing out areas of national interest for windpower and introducing these into legislation. 49 areas were proposed in 2004 as being of national interest for windpower. Windpower is also supported by a subsidy for technical development and marketing. To this end a SEK 318 million subsidy was granted in 2005 to projects such as two large offshore wind parks. The production from these wind parks is included in the electricity certification scheme and the above calculations. Wind power will also receive de-escalating operating aid until the end of 2009. The aid for windpower per county was SEK 0.12/kWh in 2004, becoming SEK 0/kWh in 2009. Aid to offshore plants was SEK 0.17 in 2004, becoming SEK 0.12 in 2009.

Sweden also has a long tradition of long-term research in the energy sector.

³ See previous report from 2003.

For more information on these measures please see the first report from 2003.

4 National climate change commitments

In their analyses, Member States are also required to indicate the extent to which the measures they have taken are consistent with their national climate change commitments.

Electricity production accounts for a relatively small proportion of Sweden's CO₂ emissions. In 2004 emissions from electricity production stood at 2.9 million tonnes, corresponding to 5.6% of total CO₂ emissions in the energy sector.

However, the current electricity production mix could change, and electricity consumption is predicted to rise. The prevailing view is that natural gas-based electricity production is commercially the most attractive alternative for the market as far as investing in new production capacity. According to the long-term forecasts, emissions from electricity production will increase the most, mainly between 2010 and 2020.

The electricity certification scheme will force a large quantity of electricity onto the market which is not generated from fossil fuels and which would probably not have been developed without the aid system. This renewable electricity heavily reduces the market share which, for commercial reasons, would probably have been filled with natural gas or imports. In this way the measures will prevent the expected increase in greenhouse gas emissions.

Sweden also participates in the EU system for trading greenhouse gases. Electricity production is part of the trading sector.