EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

Director-General

TEMPLATE

CONCERNING THE REPORT IN ACCORDANCE WITH ARTICLES 6(3) AND 10(2) OF DIRECTIVE 2004/8/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL ON THE PROMOTION OF COGENERATION BASED ON A USEFUL HEAT DEMAND IN THE INTERNAL ENERGY MARKET AND AMENDING DIRECTIVE 92/42/EEC

1. Transposition/implementation of the legal text of Directive 2004/8/EC

1. What is the level of transposition of the Directive in your country? What is the timeline for the remaining parts of the transposition of the Directive, if any?

The purpose of increasing energy efficiency stated in Article 1 of the Cogeneration Directive) has been achieved in the form of an increased share of heat and electricity produced by cogeneration. In terms of efficiency alone, all cogeneration in Sweden is high efficiency (SOU 2005:33). Therefore there has been no scope for increasing the high efficiency proportion of our total cogeneration. The objective of improving security of supply has been achieved by expanding cogeneration, thereby enabling more efficient use of primary energy for the production of electricity and heat.

Guarantees of origin of electricity, including electricity from high-efficiency cogeneration (Article 5) were introduced in 2006[1] and were replaced in 2010[2] by a new, improved Act on guarantees of origin of electricity.

We consider transposition of the legal text of the Directive to be complete and it has been documented in previous reports. A report on the national potentials for highly-efficient cogeneration (Article 6) was produced in 2005[3] as an additional task for the District Heating Enquiry (Fjärrvärmeutredningen)[4]. The analysis focused particularly on the

[1] Act (2006:329) on guarantees of origin of electricity from high efficiency cogeneration and renewable electricity; Ordinance (2006:331) on guarantees of origin of electricity from high efficiency cogeneration and renewable electricity.

[2] Act (2010:601) on guarantees of origin of electricity; Ordinance (2010:853) on guarantees of origin of electricity.

[3] 'Evaluation of potential for high efficiency cogeneration in Sweden' [*Bedömning av potential för högeffektiv kraftvärme i Sverige*], PriceWaterhouseCoopers, February 2005.

[4] 'District heating and cogeneration in the future' [*Fjärrvärme och kraftvärme i framtiden*] (SOU 2005:33).

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impact that changes to energy taxation made on cogeneration (1 January 2004), the emission allowance trading system (1 January 2005) and the economic potential for the expansion of the district heating networks. A report to establish the potential for cogeneration up to 2020 under Article 6 was produced on behalf of the Swedish Energy Agency in 2009[5]. Additional information and reporting on compliance with Articles 5(3), 6(3), 9(1) and 9(2) were submitted in 2010[6].

2. What is the timeline for implementing measures based on the Commission Decision of 19 November 2008 establishing detailed guidelines? Please indicate how this has taken place (revision of a general energy law, a specific law, decree, regulation,…).

New provisions containing implementing measures for the guidelines include the new Act (2010:601) on guarantees of origin of electricity and the Ordinance (2010:853) on guarantees of origin of electricity.

3. To what extent do you consider your country to have already significantly implemented the Directive?

With regard to changes in the share of high efficiency cogeneration, this share has remained constant, since all cogeneration in Sweden is already high efficiency. Implementation of the Directive has thus not affected this development. However, if we look at the increasing share occupied by cogeneration of the total production of electricity and district heat in Sweden, then Sweden has made progress. Sweden has seen a steady increase in electricity produced by cogeneration over the years, with a particularly large upswing in the last two years (see Table 1). The use of cogeneration in Sweden remains relatively low compared with, say, Finland. One reason for this is that Sweden has invested in nuclear power as a complement to hydropower, and thus not had the same need to produce electricity from cogeneration. Very little fuel-based electricity condensate is produced in Sweden, whereas production is high in heat generation plants, with most of it based on biomass. Meanwhile, the long-term production trend for both electricity and heat in cogeneration installations as shares of the total production of electricity and district heat is rising. Historically low electricity prices previously made it unprofitable to invest in cogeneration. However, various instruments to stimulate increased cogeneration production, such as lower carbon dioxide taxation, combined with increasing electricity prices, have had a major impact on developments. The electricity certificate scheme in particular has had a clear effect on the development of cogeneration (Table 2). The production of condensation power remains at low levels. It is used when electricity is needed during extra demanding periods (Table 3).

Table 1. Electricity produced by cogeneration, TWh.

2002

2003

[5] Presented by the consultancy Profu, reported in Excel with a report explaining the task.

[6] Concerning Reasoned Opinion 2008/2351 on reporting under the CHP Directive.

2004

2005

2006

2007

2008

2009

2010

Industrial back pressure

4.6

4.7

4.6

4.6

5.5

6.1

6.2

5.9

6.4

Cogeneration

6.3

7.9

8.3

7.3

6.9

7.1

7.2

9.3

12.5

Total

10.8

12.6

12.9

11.9

12.4

13.2

13.4

15.2

18.9

Source: The Electricity Year 2010

Table 2 Production of renewable electricity (including peat) eligible for an electricity certificate from high efficiency cogeneration, TWh.

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Industrial back pressure	2.8	4.7	4.7	5.0	5.6	5.9	5.9	6.2
Cogeneration	1.4	3.5	3.8	4.1	4.0	4.5	4.7	5.7
Total	**4.2**	**8.2**	**8.5**	**9.1**	**9.6**	**10.4**	**10.6**	**11.9**

Source : Swedish Energy Agency

NB. 2003 figures refer to the period May - December.

Table 3. Condensation power, TWh

	2006	**2007**	**2008**	**2009**	**2010**
Condensation power	0.9	0.5	0.7	0.7	0.8
Gas turbines, diesel etc.	0.001	0.03	0.02	0.02	0.03

Source: The Electricity Year 2010

4. Is your country using the alternative calculation method according to Article 12(2)?

The Swedish Energy Agency and Statistics Sweden produce figures on fuel allocation according to both the energy and the alternative methods[7]. Official reports use the energy method.

5. Is there any need for your country to review in accordance with Article 13 the threshold values used for calculation of electricity from cogeneration and/or the threshold values used for calculation of efficiency of cogeneration production and primary energy savings?

[7] Latest reported values are in 'Supply of Electricity, Gas and District Heating 2009' [*El-, gas-, och fjärrvärmeförsörjningen 2009*] (EN 11 SM 1101), corrected on 25 March 2011.

There is no need to review the threshold values. Swedish cogeneration is high efficiency and would have no difficulty in meeting higher threshold values. The reference values are well suited to the technology currently used for the separate production of electricity and heat.

2. National potential to increase the share of high-efficiency cogeneration

6. Can your country already show progress in high-efficiency cogeneration since the last report on national potential which can be ascribed to either EU or national legislation and support schemes?

See Tables 1 and 2 for the development of (high efficiency) cogeneration since the previous report. This success is primarily due to *national support measures* in the form of the electricity certification scheme[8], which has encouraged a switch to biofuel-based (electricity) production in cogeneration installations. The expansion of cogeneration has been significantly affected by the electricity certificate scheme and since the electricity certificate scheme was introduced in 2003, no power stations have been built exclusively for generating condensation power. Government Proposal 2010/11:155 proposes a new Electricity Certificates Act which preserves the objectives and working methods of the current electricity certificate system unchanged, but has simpler rules and has been extended to also cover other countries. It is anticipated that the new Act will apply on 1 January 2012 and Norway is also expected to participate in the electricity certificate market[9]. *National legislation* in the form of more advantageous tax rates for cogeneration have also had a clear effect. Carbon dioxide taxation on cogenerated heat is currently seven per cent of the basic amount[10], compared to 94 per cent for plants exclusively producing heat[11]. The effect becomes clear when looking at the increasing share of cogenerated heat in relation to total production of district heating (Figure 4). Exogenous factors, such as rising electricity prices, are another important reason for the expansion of cogeneration. By itself, the CHP Directive has not had any major effect on the development of new cogeneration. Neither has the Directive led to an increase in the share of high efficiency cogeneration, because all cogeneration was already high efficiency when the Directive was introduced.

Potential and forecasts

Surveys of the Swedish district heating member companies shows that many companies are planning to develop new cogeneration installations. It is estimated that around 35 new installations will begin operating between 2009-2015, mainly fuelled using wood fuel and waste[12].

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[8] Electricity Certificates Act (2003:113); Electricity Certificates Ordinance (2003:120); STEMFS (2009:3) [The Swedish Energy Agency's rules and general guidelines on electricity certificates].

[9] The Electricity Certificate System 2011 (ET 2011:32).

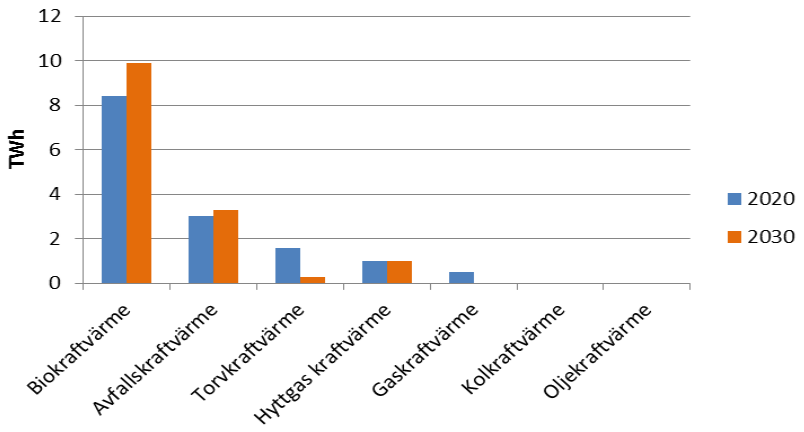
[10] SEK 1.05/kg CO2. In 2011 the cogeneration tax was lowered from 15% to 7%.

[11] Proposal 2009/10:41.

[12] http://www.svenskfjarrvarme.se/Global/Rapporter_och_Dokument/Statistik/Fjarrvarmen_fortsatter_vaxa.prognosrapport_2015.pdf.

According to the Swedish Energy Agency's long-term forecast (ER 2011:03), net production of electricity in Sweden will increase from 145 TWh in 2007 to 177 TWh in 2020 and 2030. Biofuel cogeneration will increase until 2020 and level off after that, as a consequence of the electricity certificate scheme. It should be noted that the electricity certificate scheme has updated the quota levels to a higher share of electricity certificates per electricity volume supplied[13] as a result of the Renewables Directive (Directive 2009/28/EC) which has led to a greater share of biomass in cogeneration production and had a positive impact on the development of cogeneration. Model calculations according to the long-term forecast (ER 2011:03) show that biofuel cogeneration and waste cogeneration are expected to increase between 2020-2030, while peat cogeneration is expected to decrease and gas cogeneration reach zero in 2030 (Figure 1). According to the long-term forecast, biofuel cogeneration in district heating networks will produce 8.4 TWh in 2020 and this will have increased to 9.9 TWh in 2030. In industry, biofuel-based electricity production will increase to just 7 TWh by 2020 and just over 7 TWh by 2030, while waste cogeneration is expected to produce around 3 TWh of electricity in 2020 and 2030. According to the forecast, the composition of input fuel for cogeneration production will change. The predominant type of energy is biofuel, and expansion will be considerable until 2020, after which it will level off. All scenarios indicate that waste fuel[14] will increase significantly during this period. The share of biofuel cogeneration has increased partly at the expense of super heated water boilers using biofuel.

Figure 1. Distributed gross electricity production in district heating networks, broken down by type of cogeneration, forecast according to *Main Scenario,* TWh.



Biokraftvärme = biofuel cogeneration

Avfallskraftvärme = waste cogeneration

Torvkraftvärme = peat cogeneration

[13] Government Proposal 2009/10:133.

[14] For more information on waste potential, see the report 'Access to and demand for treatment capacity for incinerable waste and other organic waste – Documentation for Sweden's national waste plan 2011' [Tillgång och efterfrågan på behandlingskapacitet för brännbart avfall och övrigt organiskt avfall – Underlag till Sveriges nationella avfallsplan 2011] 2011. The evaluation of potential on which the forecast is based was made by Profu for the Swedish Environmental Protection Agency.

Hyttgas kraftvärme = smelter gas cogeneration

Gaskraftvärme = gas cogeneration

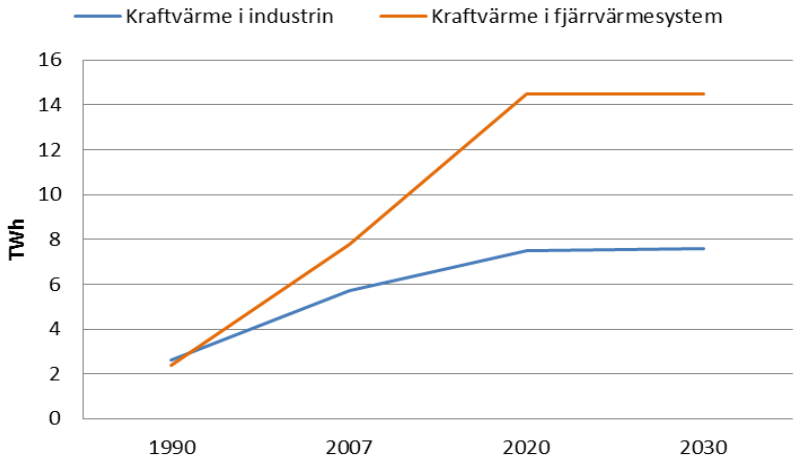
Kolkraftvärme = coal cogeneration

Oljekraftvärme = oil cogeneration

Source : Long-Term Forecast 2010

Cogenerated electricity in industry is forecast to increase from 5.7 TWh in 2007 to 7.6 TWh in 2030 and electricity production in cogeneration installations linked to district heating networks to increase from 7.8 TW to 14.5 TWh in the same period (Figure 2).

Figure 2. Cogenerated electricity in industry and district heating systems according to the forecast for the *Main Scenario*, TWh



Blue line = cogeneration in industry Orange line = cogeneration in district heating systems

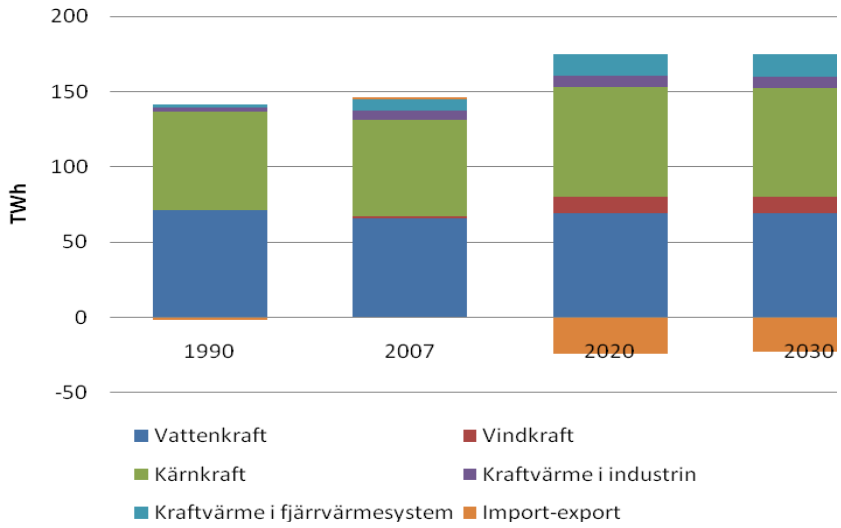
Source : Long-Term Forecast 2010 (ER 2011:03).

The target of the electricity certificate scheme that 25 TW of new electricity from renewable energy sources, calculated from 2002 when 6.5 TWh was renewable, is expected to be achieved. Since the scheme was introduced, electricity production, primarily that produced by bio-based cogeneration installations and wind power, has increased under it[15].

Figure 3 shows clearly that in the future a relatively large part of electricity production is forecast to come from (high efficiency) cogeneration and wind power.

Figure 3. Electricity production in 1990 and 2007, and in the forecast years 2020 and 2030.

[15] Long-Term Forecast 2010 (ER 2011:03).



Vattenkraft = hydropower

Kärnkraft = nuclear power

Kraftvärme i fjärrvärmesystem = cogeneration in district heating systems

Vindkraft = wind power

Kraftvärme i industrin = cogeneration in industry

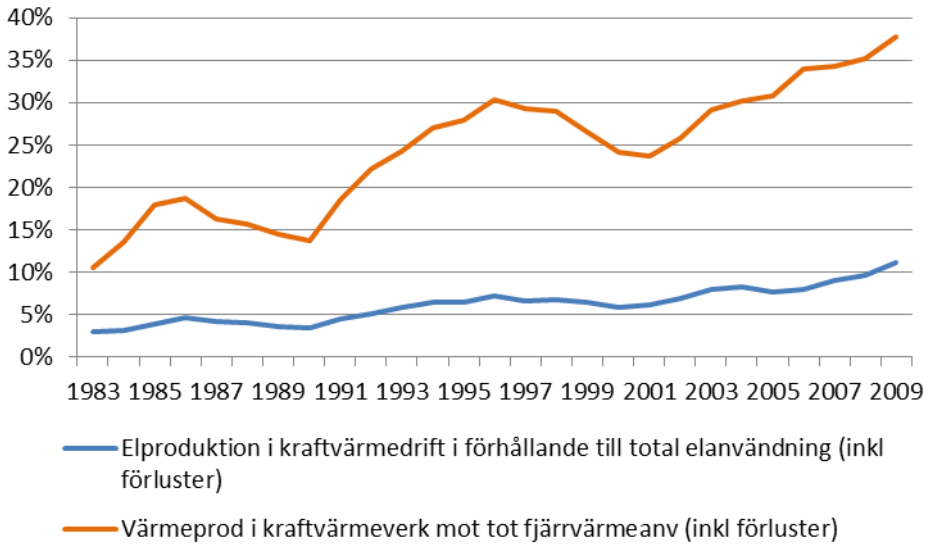
Import-export = import-export

Source : Long-Term Forecast 2010 (ER 2011:03).

7. What is your evaluation of the progress towards increasing the share of high-efficiency cogeneration in your country? Your assessment should be based on the specific figures to be included in the attached spreadsheet (Excel file) designed to facilitate the submission of your data.

All cogeneration production in Sweden is high efficiency and this cogeneration has steadily increased as a share of total electricity production and total district heat production. In 2009, cogeneration met almost 38 per cent of the heat requirement in the district heating system, which is almost a threefold increase compared with 1990. Looking at the share of cogeneration of electricity consumption in 2009, cogeneration produced 11 per cent of the electricity used, including network losses, compared with just 3.4 per cent in 1990 (Figure 4).

Figure 4. Share of electricity and heat production in cogeneration mode in relation to total use



Blue line = electricity production used in cogeneration in relation to total electricity use (including losses)

Orange line = heat production in cogeneration installations compared with total use of district heating (including losses)

NB. This does not include the heat produced in industry.

Source : Energy Indicators 2011 (ER 2011:12)

3. Barriers to high-efficiency cogeneration

8. Please give your views on the current barriers to high-efficiency cogeneration in your country:

- barriers in relation to administrative procedures (authorisation, coordination among competent authorities, streamlined simplified procedures, etc);

- barriers in relation to electricity grid system and tariff issues (including specific measures for small scale and micro cogeneration units);

- other barriers (internalisation of external costs, energy prices, financial & technical barriers, etc) in accordance with Articles 6 and 9 of the CHP Directive 2004/8/EC.

Indicate the measures to overcome them.

There are no barriers in Sweden to high efficiency cogeneration production in terms of administrative procedures or other barriers. The electricity market has been deregulated and made competitive with electricity offered (mainly) on Nordpool. There are no large vertically-integrated operators that 'squeeze out' cogenerated electricity by selling to their own companies in instalments.

With regard to small-scale cogeneration installations, the main barrier is high investment costs, particularly for incinerating solid fuels. The market for district heat is another

decisive factor. Small-scale cogeneration installations also have fairly low electric efficiency and alpha values, which poses challenges for the development of the technology[16].

Potential barriers to the expansion of (high efficiency) cogeneration in Sweden are mainly exogenous by nature and it is not possible to influence them directly. Examples of potential barriers to the expansion of cogeneration include rising steel and biofuel prices. The price of electricity is particularly significant with regard to continued development. A decreasing demand for heat as the result of energy efficiency improving measures for energy consumption can have a negative impact on the development of cogeneration[17]. A barrier of this kind must be overcome by the district heating companies themselves with the development of technology and compensation in the form of a widened customer base.

4. Guarantees of origin and support schemes

9. Article 5 of the Directive requires Member States to ensure that accurate and reliable guarantees of origin are issued according to objective, transparent and non-discriminatory criteria. Please indicate what is the situation concerning the implementation of this measure in your country (information on primary energy savings, type of registration system)?

On 1 December 2010, a new Act (2010:601) on guarantees of origin of electricity entered into force, replacing the Act (2006:329) on guarantees of origin of high efficiency cogenerated heat and renewable electricity. The new Act also means increased safety and reliability, since under it guarantees of origin must be issued, transferred and annulled electronically. The main significance of the new system of electronic registration and annulment is that the possibility of double counting has now been eliminated. Nor is it any longer possible to receive one guarantee of origin for renewable cogeneration and another one for high efficiency cogeneration for the same MWh of electricity. Under the new Act, only one guarantee of origin may be issued for 1 MWh of renewable high efficiency cogeneration.

Guarantees of origin of electricity can be issued for all types of electricity produced. Section 4 and Section 5 of the Ordinance (2010:853) on guarantees of origin of electricity describe the provisions applying to high efficiency cogeneration and provide that this is in line with the CHP Directive (2004/8/EC):

Section 4 A guarantee of origin shall specify:
1. the energy source from which the energy was produced, and the start and end dates of production;
2. the identity, location, type and capacity of the installation where the energy was produced;
3. whether, when and to what extent the installation or energy unit has received support through a national support mechanism, and the type of support mechanism;
4. the date on which the installation became operational; and

[16] 'Small-scale cogeneration based on district heating' [Småskalig fjärrvärmebaserad kraftvärme} Report 2009:2.

[17] 'Incentives for increased cogeneration production' [*Incitament för ökad kraftvärmeproduktion*] Report 2009:9.

5. the date and country of issue.

Section 5. If the guarantee of origin refers to electricity from high efficiency cogeneration, the guarantee of origin shall contain the following information in addition to that set out in Section 4:

1. the lower calorific value of the energy source (the net calorific value);
2. how the heat produced through the cogeneration process was used; and
3. the primary energy saving calculated in accordance with established efficiency reference values and in accordance with Annex III to Directive 2004/8/EC of the European Parliament and of the Council.

The registration system is structured as follows:

The Swedish Energy Agency shall:

- examine applications for allocation allowances for guarantees of origin
- monitor under the Act on guarantees of origin
- provide regular information on guarantees of origin

The Swedish National Grid (Svenska kraftnät) shall:

- issue guarantees of origin
- allocate a guarantee of origin account in CESAR to operators who do not have one
- regularly publish information on the number of guarantees of origin issued, transferred and annulled, and the average price of guarantees of origin

The Energy Markets Inspectorate may:

- issue rules on the origin labelling of electricity

10. Does your country have support schemes for cogeneration/CHP based on Directive 2004/8/EC (operational and/or investment aid)? What kind of support is provided (feed-in tariffs, certificates and quotas, priority access to the grid,…)? Are they designed to provide stable long-term investment conditions? Which sectors will be targeted (agricultural and/or industrial and/or heating cogeneration)?

Sweden does not have any 'direct' investment aid specifically for cogeneration. On the other hand, the electricity certificate scheme particularly encourages cogeneration. Other support schemes have also had a certain impact on the development of cogeneration, albeit only indirectly.

The electricity certificate scheme was introduced in Sweden on 1 May 2003. It is a market-based support scheme in which trading takes place between the producers of renewable electricity and those subject to the quota requirement. The aim of the scheme is to increase the production of renewable electricity in a cost-effective way. This is done by creating competition between renewable sources of energy. The revenue gained by electricity producers when they sell electricity certificates replaces the investment aid and operational aid granted previously. The electricity certificate scheme makes the renewable sources of energy better able to compete with non-renewable sources of energy. Under the scheme, electricity production increased to 18 TWh during 2010. That is an increase of 11.5 TWh in comparison with 2002.

Electricity suppliers are obliged to have electricity certificates corresponding to a certain share of the electricity they sell, i.e. the quota requirement. To meet the quota requirement, the electricity suppliers declare annually to the Swedish Energy Agency how much electricity they invoiced their customers for during the previous year and submit electricity certificates corresponding to a specific share (quota) of electricity sales. The declaration must be submitted by 1 March each year. Electricity-intensive industry and electricity users who have used electricity they have produced themselves, imported or

bought on the Nordic power exchange are subject to quotas. Quotas have been set until 2035[18]. Government proposal 2010/11:155 proposes a new Electricity Certificates Act which preserves the objectives and working methods of the current electricity certificate system unchanged but has simpler rules and has been extended to also cover other countries.

Another aid with an indirect effect on cogeneration is conversion aid from oil boilers and direct effect electricity for small buildings, multi-occupancy dwellings and premises. The aid was granted for conversions to district heating, as well as to biofuel boilers and hot water boilers and it operated during the period 2006-2010. Payments used for conversions from direct-effect electricity amounted to SEK 455 million, of which the majority was paid for district heating conversions[19].

The Local Investment Programme (Lokala investeringsprogram, LIP) was another aid form that had a positive impact on the development of district heat between 1998-2002 when it existed, as does its successor, the Climate Investment Programme (Klimatinvesteringsprogrammet, KLIMP). These have enabled municipalities and other operators to apply for aid to take measures increasing ecological sustainability (LIP) and reduce greenhouse gas emissions (KLIMP). Against this background, the expansion of district heating was considered a good option, and this has promoted district heating. During the years in which LIP and KLIMP funding was paid out, approximately 260 district heating projects were granted funds[20].

11. How much money on a yearly basis has been provided in this way in the past years to the promotion of high-efficiency cogeneration in particular? And how much money is expected to be made available on a yearly basis to the promotion of high-efficiency cogeneration in the coming years?

In total, over 72 million *electricity certificates* from cogeneration production were sold in the period 2003-2010, including industrial back pressure. The value of the aid, which is market-based aid, not State aid[21], amounted to more than SEK 17 billion for the whole period (Table 4). No forecasts have been made concerning future aid, but if the price of electricity certificates remains at the same level as in 2009 and 2010 and the number of cogeneration installations increases (which it is forecast to do), it is reasonable to assume that annual aid to the cogeneration sector will be between 3-4 billion during the next few years. The exact figure will depend on the number of new investments, and the quota levels vary from year to year. At the end of the electricity certificate period, which lasts until 2035, the levels drop significantly, however.

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[18] http://www.energimyndigheten.se/sv/Foretag/Elcertifikat/Om-elcertifikatsystemet

[19] 'Heating in Sweden 2011' [*Uppvärmning i Sverige 2011*] R2011:06.

[20] 'Incentives for increased cogenerated production' [*Incitament för ökad kraftvärmeproduktion*] Report 2009:9.

[21] See explanation provided under Question 10.

Table 4. Number of electricity certificates and SEK for cogeneration

Year	Price of electricity cer SEK	No of electricity certs.	Total
2003	200	4 218 000	843 600 000
2004	231	8 191 000	1 892 121 000
2005	216	8 528 000	1 842 048 000
2006	191	9 124 000	1 742 684 000
2007	195	9 606 000	1 873 170 000
2008	247	10 409 000	2 571 023 000
2009	293	10 610 000	3 108 730 000
2010	294	11 931 000	3 507 714 000
Total		**72 617 000**	**17 381 090 000**

Source : https://elcertifikat.svk.se/cmcall.asp; The Electricity Certificate Scheme 2011, ET 2011:32

With regard to *conversion aid* from direct effect oil and electricity, it is difficult to estimate the contributory effect in SEK, because aid has not been paid specifically for cogeneration production, but has instead been given to customers who have converted to district heating. SEK 450 million was paid for conversions from oil burners and approximately 20 per cent was paid for district heating. SEK 455 million was paid for conversions from direct effect electricity, of which 75 per cent was used for district heating[22]. In total, aid for district heating amounts to SEK 94.5 million + SEK 341 million = SEK 435 million. Assuming that cogeneration represents a share proportional to the share of cogeneration of district heating in total (with regard to heat production), the indirect aid given to cogeneration amounts to approximately 38 per cent of SEK 435 million = SEK 165 million.

The Swedish Parliament set aside SEK 6.2 billion for 1998-2002 in aid for environmental improvements in municipalities under the LIP. Approximately SEK 4.3 billion of the LIP aid granted was used. In 2002, LIP was replaced by aid for climate investments, KLIMP. A total of SEK 1.8 billion was granted in KLIMP aid between 2003 and 2008, when the last grants were made[23]. It is difficult to estimate exactly how much of this has encouraged cogeneration by district heating projects.

[22] 'Heating in Sweden 2011' R2011:06.

[23] www.naturvardsverket.se/Documents/publikationer/978-91-620-5991-0.pdf.