2012

# PUBLIC FUNDING FOR GREEN ENERGY IN A CONTEXT OF CRISIS

## Country report (Sweden)

**Hans Orru**
**Umea University**

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# 1. Introduction

Historically, Sweden has been very dependent on the import and use of fossil fuels. But the development of nuclear power and hydro power, starting in the 1970s, together with earlier development of large scale hydro power, and later on bioenergy, has moved Sweden towards being a low carbon economy nowadays.

Sweden has a long history of environmental and energy policies; indeed, in 1991, Sweden was the first country to introduce an explicit tax on $CO_2$ and as such can be seen as a pioneer in this area. During the period from 1991 to 2012 Swedish greenhouse gas emissions have fallen more than 15% and Sweden's emissions per capita are also amongst the lowest in the OECD countries. This good national record can be ascribed to the use of hydropower, nuclear power and a significant amount of biofuel to produce electricity, as well as to Sweden's active climate and energy policy, in particular the gradual increase in carbon tax. At the same time, Swedish GDP has grown by an average of 3% a year. Sweden constitutes therefore a good illustration of the possibility to combine economic growth and, at the same time, improve the environment. Since 2003, the number of green companies has also increased by 10% and the number of people employed in the environmental sectors has increased by 20% (Anxo, 2009). Moreover, many people might think that the use of nuclear power is unsustainable and non ecological at all.

Currently Sweden has a high share of renewable energy in the energy mix compared to many other countries. Over 47 % of all energy that is used in Sweden comes from renewable energy sources. This is by far the largest in comparison with other countries in the EU. Hydro power and bio energy are the two main reasons. Today, the heating sector in Sweden - to a large extent district heating - is practically fossil fuel free as a result of the increased use of biomass and heat pumps. The same is true for the electricity sector, where hydro power and nuclear stands for the bulk of the production and wind power is increasing rapidly. The growth in renewable energy and decline in the use of fossil fuels has happened at the same time as the positive development of the Swedish economy. Since 1990, the emissions of greenhouse gases decreased by 15 % while GDP increased by 51 %.

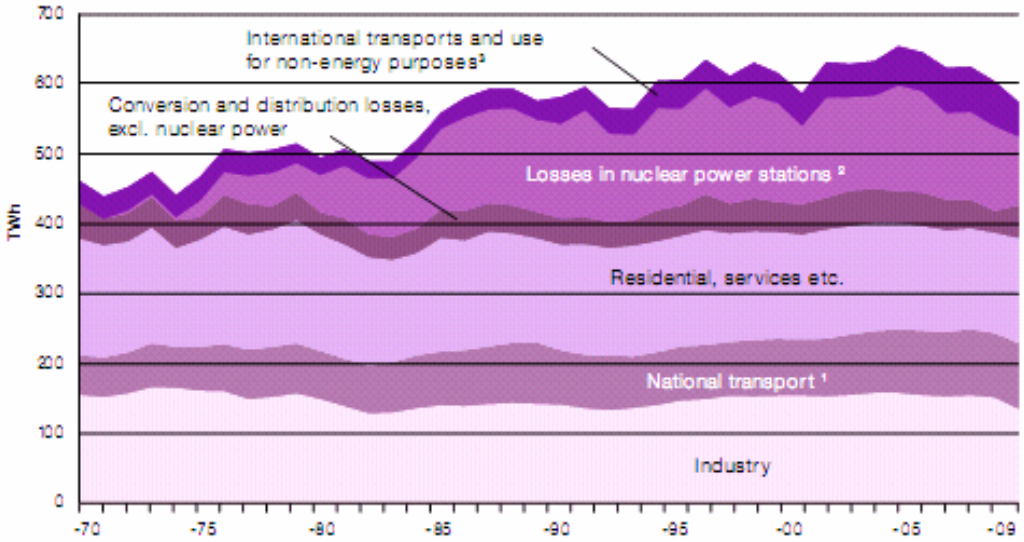
Sweden's target for the share of renewable energy in the year 2020 is 49 % according to EU's Directive on the promotion of the use of energy from renewable sources 2009/28/EC. Furthermore, Sweden has a national target for the share of renewable energy in the year 2020 of 50 %. Sweden also has, as all other EU member states, a target for renewable energy in transport by 2020 at least 10 %.

However, Sweden is highly dependent on events in the world as it is a small and open economy with extensive foreign trade and a financial market that is well integrated with the international markets. This means that a global financial crisis combined with a severe international economic downturn could have had a substantial impact on the Swedish economy as well as renewable energy sector. Nevertheless, it has been currently seen that Sweden has become one of few pockets of resistance, where the impact of the recession has been felt less than elsewhere, having learnt vital lessons from its own recent past. Thus the effect on renewable energy sector might have been lesser than elsewhere. The current analysis will dig into these questions in more detail.

# 2. Renewable energy deployment

In recent years there has been an overall decline in energy use; however, trends differ between sectors. Industry uses about the same amount of energy today as it did in 1970, despite the fact that industrial production is considerably higher today. The residential and services sector has reduced its use of energy since 1970, but this is due to several structural changes. The change from oil to electricity, for example, has meant that some of the losses have been transferred to the supply side of the energy system. Energy use in the transport sector has increased by almost 70 % since 1970. Figure 1 shows Sweden's total energy use from 1970 until 2009.

**Figure 1. Sweden's total energy use, 1970-2009**




*Source: Energy in Sweden, 2010*

In 2009, Sweden's energy supply amounted to 568 TWh. A total fuel input of 149 TWh in nuclear power plants was used, producing somewhat over 50 TWh of electricity. Hydro power production depends on the amount of precipitation during the year. In 2009, it produced 66 TWh of electricity, or somewhat less than the statistically average annual production of 67.5 TWh. Fuel-based thermal power production produced 15.5 TWh of electricity, while wind power supplied 2.5 TWh. Almost 60 TWh of fuels were used for district heating production.

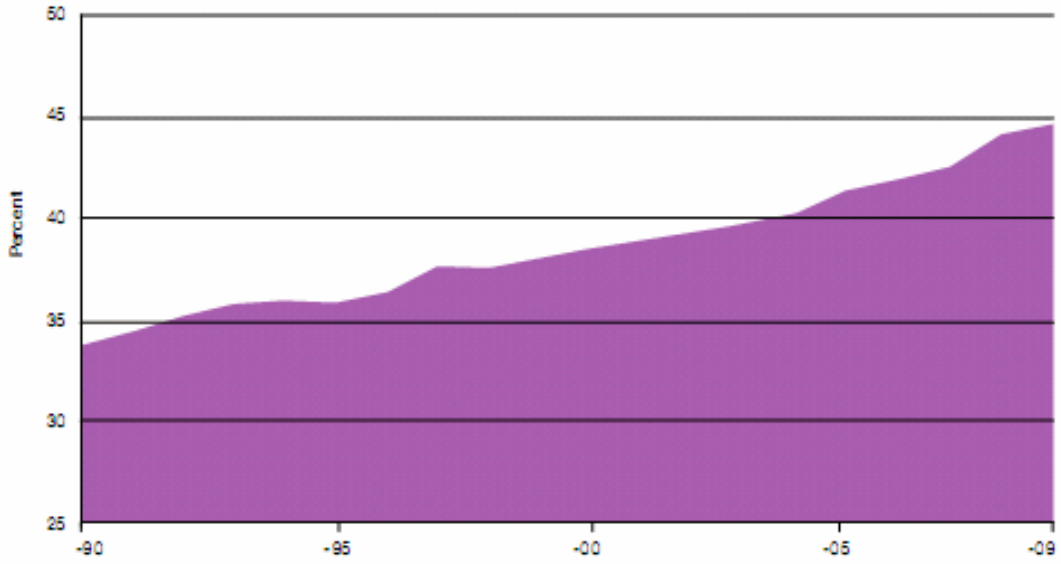
From 1970 until 2009, the energy supply mix has changed substantially, so that the use of crude oil and oil products has declined by over 47 %. Expansion of nuclear power and hydro power production has increased the net production of electricity by 126 % since 1970. The supply of biofuels has increased by over 195 % since 1970.

In 1990, Sweden's proportion of final energy use provided from renewable sources amounted to 33.3 %. By 2011, this had increased to 47 %. The greatest contribution made by renewable energy sources is that to electricity production, of which a major proportion is supplied by hydro power. The next largest user of renewable energy is the industrial sector, followed by district heating production and the residential sector. Only a very small proportion of renewable energy is used by the transport sector. In total, it is wood fuels and black liquors that are the renewable energy sources that are used most in Sweden, followed by hydro power, heat absorbed by heat pumps, organic waste, biobased motor fuels and wind power.

Sweden uses the highest proportion of renewable energy in relation to final energy use of any country in the entire EU. That Sweden's proportion of renewable energy is

considerably higher than the proportions in other countries is due not only to the fact that the country has major renewable energy resources, but also to the fact that it has pursued an active energy policy. This is shown clearly by developments from 2000 to 2005, where Sweden is one of the four countries that have most increased their proportion of renewable energy (Figure 2).

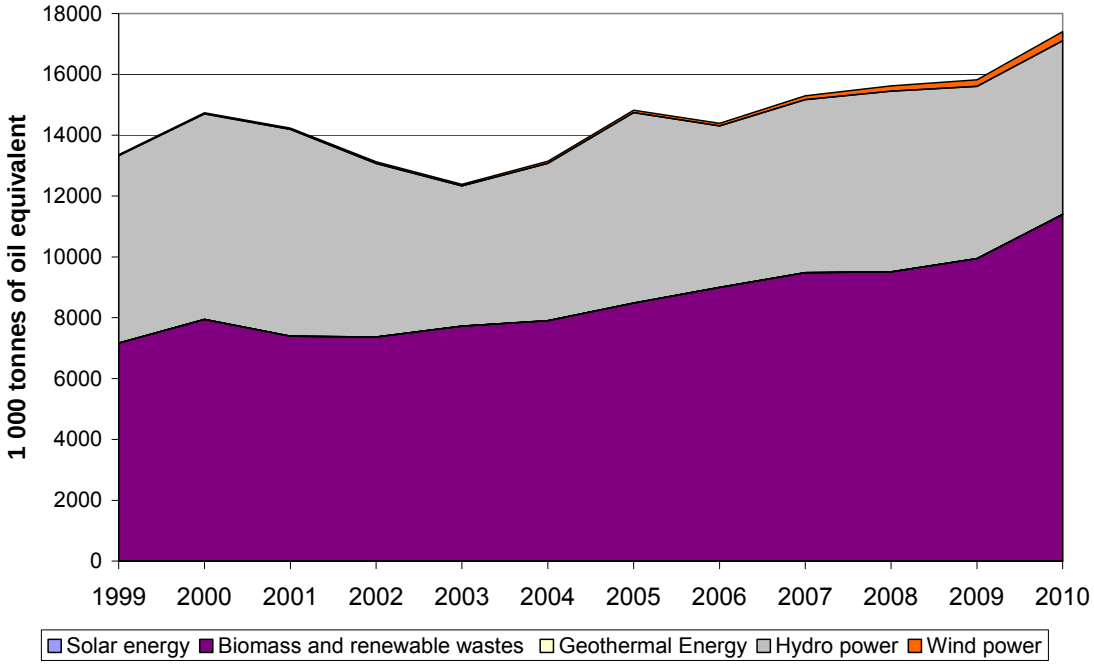
**Figure 2. Sweden's total proportion of renewable energy use, 1990–2009**




*Source: Energy in Sweden, 2010*

In energy mix the increase has been mainly due to increase of biomass use (figure 3).

**Figure 3. Sweden's renewable energy mix, 1999–2010**

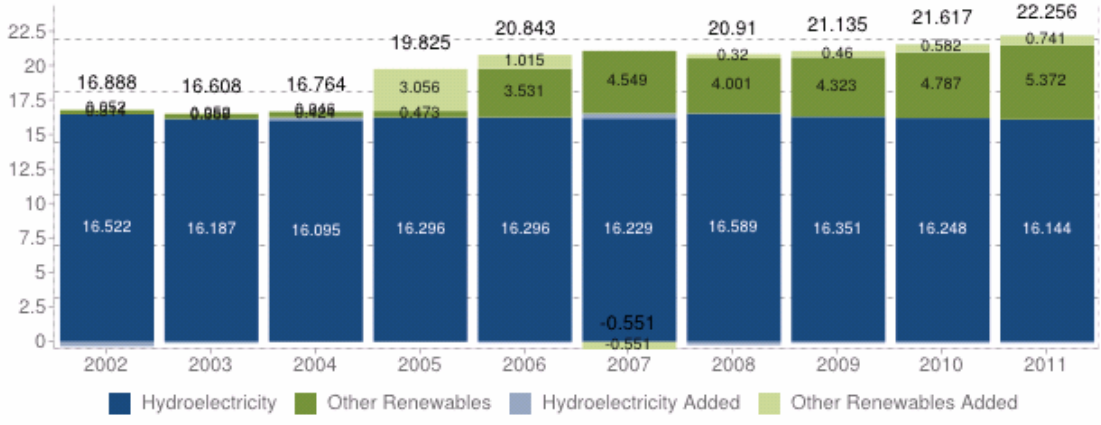



*Source: Eurostat, 2012*

Currently in 2011, Sweden had a total installed renewable capacity (biomass + geothermal + hydroelectricity + solar + wind) of 22,182 megawatts, an increase of 658 megawatts (or 3.06%) on the previous year (Figure 4). Over the previous 5 years, the

total installed renewable energy capacity has increased by 1,588 megawatts or 1.5% on a 5 year compound growth basis.

**Figure 4. Cumulative Renewable Capacity (GW)**

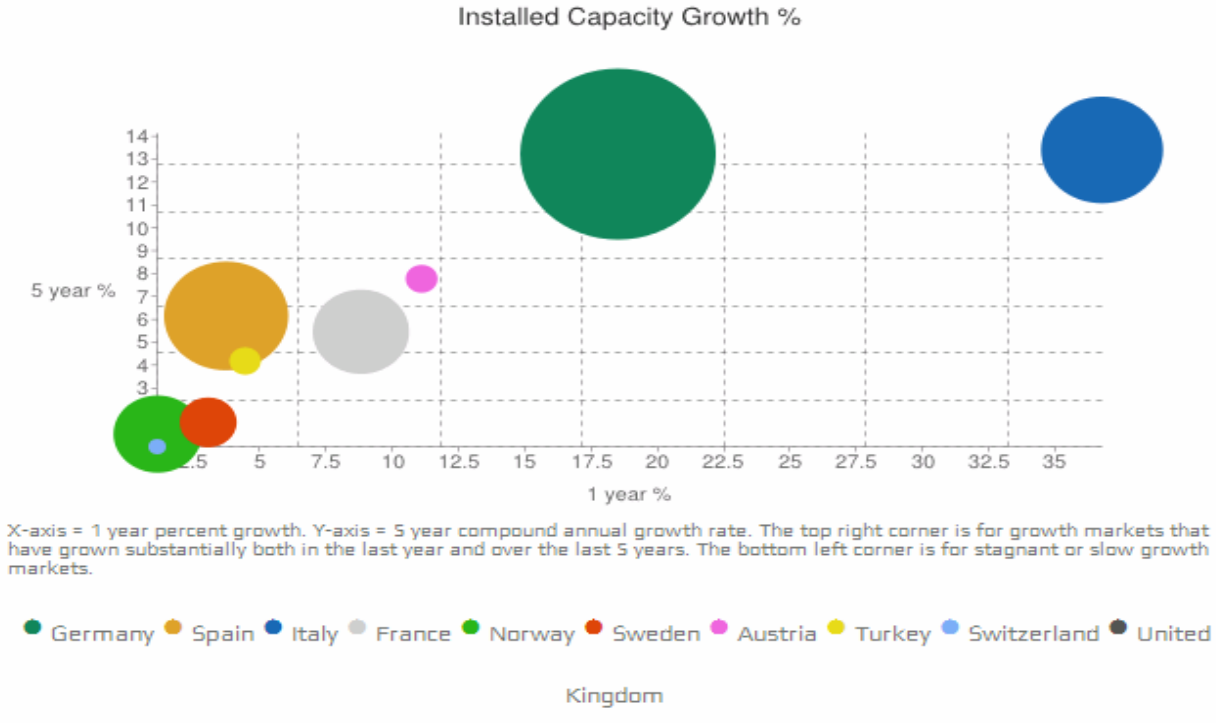



*Source: Energici, 2012*

The 22,182 megawatts of installed renewable capacity represented 62.61% of total installed energy capacity (all conventional + all renewable energy sources). Remove hydroelectricity from the equation and the remaining 6,119 megawatts of renewable energy capacity accounted for 17.27% of total installed capacity.

The Swedish renewable energy market has grown year on year (x-axis) by 3.06% and on a 5 year compound basis (y-axis) by 1.5%. However, this is slower than the regional compound annual growth rate for installed renewable capacity of 7.12% (Figure 5).

**Figure 5. Installed capacity growth (%)**




*Source: Energici, 2012*

In 2011, Sweden had a total installed biomass and waste capacity of 3,200 megawatts, a decrease of -23 megawatts (or -0.7%) on the previous year. Over the previous 5 years, the total installed biomass and waste capacity has decreased by -8 megawatts or -0.05% on a 5 year compound growth basis.

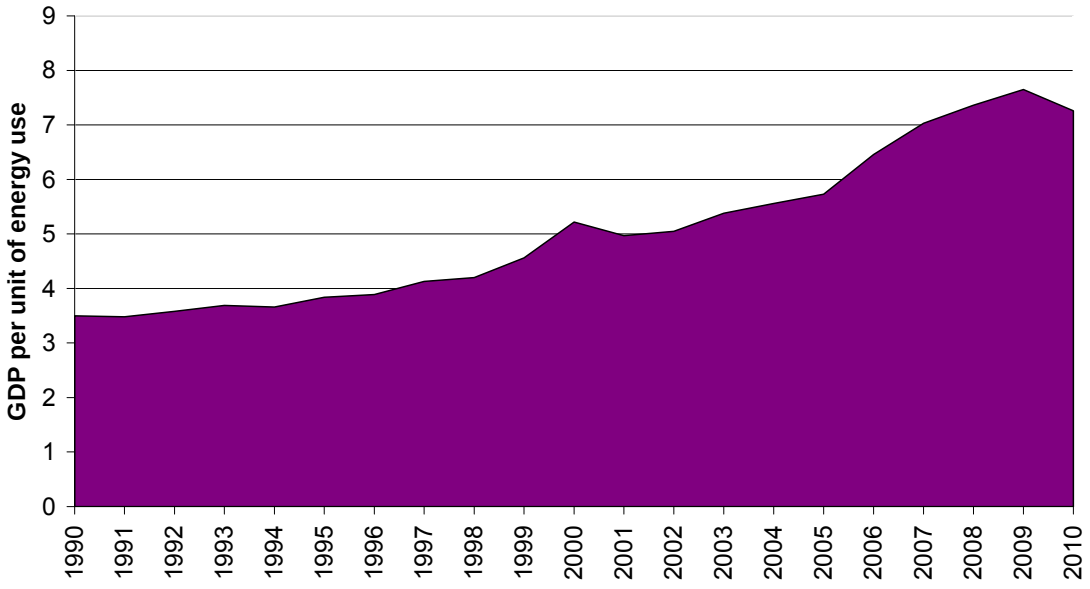
Globally, the Swedish biomass and waste energy market ranks at 8th for total installed biomass and waste capacity, behind India (3,482 MW) and ahead of the United Kingdom (1,856 MW). The world leader for total installed biomass and waste capacity in 2011 was the United States with 13,473 megawatts, 4.21 times larger than Sweden.

Globally, the Swedish renewable energy market ranks at 13th for total installed renewable capacity, behind Norway (29,788 MW) and ahead of Austria (16,908 MW). The world leader for total installed renewable capacity in 2011 was China with 301,440 megawatts, 13.59 times larger than Sweden.

The GDP per unit of energy use (constant 2005 PPP dollar per kg of oil equivalent) in Sweden was last reported at 6.28 in 2010, according to a World Bank. GDP per unit of energy use is the PPP GDP per kilogram of oil equivalent of energy use. PPP GDP is gross domestic product converted to 2005 constant international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as a U.S. dollar has in the United States.

In long term the Energy use per unit of GDP has decrease. However, despite strong finances and underlying fundamentals, the Swedish economy slid into recession in the third quarter of 2008 and growth continued downward in the fourth as deteriorating global conditions reduced export demand and consumption. This caused also the decrease of the GDP per unit of energy use, as economy decreased, but energy consumption did not, at least not the same magnitude.

**Figure 5. GDP per unit of energy use in Sweden**




*Source: World Bank, 2012*

Subsequently the renewable energy sector size and employment will be described.

# 3. Renewable energy sector

As shown previously, compared to the country size, the renewable energy sector of Sweden is rather big. However, only part of the renewable energy producers is supported by Sweden's Green Electricity certificate scheme that is a market-based support system to assist expansion of production of electricity in Sweden from renewable sources and from peat. In the table 1 is shown the size of this renewable energy sector.

This includes close to two and a half thousand electricity plants, producing mainly hydro and wind power. The supported installed capacity is almost six thousand MW, that makes electricity production more than 15 million MWh annually. If we compare the average installed capacity of the plant, the biofuel and peat plants are by far bigger than the others (25 MW), followed by wind (1.3 MW) and hydropower (0.5 MW). The solar power plants are rather small with average installed capacity (0.03 MW). The similar trends appears with electricity production, being by far highest among biofuel plats (68 200 MWh); however, being almost the same for hydro and wind power plants (2100 vs 2300 MWh) and smallest for solar power plants (19 MWh).

The turnover of renewable energy sector in Sweden in 2011 was 10 158 million €, from what biomass 5986, biofuels 2052, geothermal heat pumps 1000, windpower 725, small hydropower 295 and photovoltaic, and solar power 100 million €, respectively (http://www.eurobserv-er.org).

**Table 1. Production and installed capacity of the green electricity, by type of production, 2004-2009**

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| **Number of plants** | 1 759 | 1 848 | 1 909 | 2 075 | 2 219 | 2 419 |
| Hydro | 1 040 | 1 060 | 1 075 | 1 094 | 1 120 | 1 144 |
| Wind | 613 | 668 | 706 | 846 | 948 | 1083 |
| Biofuels, peat | 105 | 118 | 125 | 131 | 142 | 156 |
| Solar | 1 | 2 | 3 | 4 | 9 | 11 |
| **Installed capacity [MW]** | 4 161 | 4 471 | 4 765 | 5 066 | 5 123 | 5 935 |
| Hydro | 504 | 517 | 540 | 558 | 598 | 602 |
| Wind | 472 | 530 | 583 | 831 | 1 074 | 1 440 |
| Biofules, peat | 3 185 | 3 424 | 3 643 | 3 676 | 3 451 | 3 892 |
| Solar | 0.008 | 0.011 | 0.036 | 0.043 | 0.309 | 0.369 |
| **Electricity production-renewable and peat [MWh]** | 11 048 438 | 11 298 378 | 12 156 855 | 13 255 913 | 15 036 828 | 15 569 665 |
| Hydro | 1 968 325 | 1 799 446 | 2 018 577 | 2 195 320 | 2 607 348 | 2 441 624 |
| Wind | 864 546 | 939 125 | 988 340 | 1 431 644 | 1 995 846 | 2 490 409 |
| Biofules | 7 670 770 | 7 925 790 | 8 593 538 | 9 049 308 | 9 599 311 | 9 765 983 |
| Peat | 544 791 | 634 012 | 556 380 | 579 622 | 834 194 | 871 437 |
| Solar | 6 | 5 | 20 | 19 | 129 | 212 |

*Source: Energy in Sweden, 2010*

Since 2000, Statistics Sweden has developed a database of the Swedish environmental sector. In the database each establishment is classified by environmental area and by environmental share, i.e. how much of its total activity is considered to be environmental. The environmental sector is defined and the data collection is conducted in accordance with the Eurostat manual "*The environmental goods and services sector – a data collection handbook*".

Currently in 2010, more than 15 000 companies employing around 70 000 persons (or less than 2 % of the total employment) were operational in the environmental sector (Table 2). Companies in the Swedish environmental sector have been growing fast both in terms of turnover, exports and the number of people employed (. Between 2003 and 2008, exports and employment in the Swedish environmental sector increased at a faster rate than exports and employment in Sweden as a whole Anxo, 2009). In 2008 this trend for exports levelled out and was at a similar level as in 2007, over SEK 42 billion. Employment in the environmental sector fell by about 2.5 %, from nearly 73 000 persons in 2007 to over 70,000 persons in 2008, while the total employment in Sweden over the same period was almost unchanged.

Thus, due to economic crisis there have also been setbacks in environmental sector. Even there has been increase in number of companies during the whole period on 2003-2010, the other indicators have been fallen in 2008 or 2009. In turnover there was decrease of 11% in 2009. The decrease was caused by domestic consumption, as the same period these was increase in export. In 2010 the domestic consumption recovered with 8% increase, while the same period export countries struggled with economic recession that cause decrease in export in 2010. Due to economic downtown, there was also decrease in number employed, but this cannot be fully connected to financial crisis as there was also decrease in 2008, while the turnover still increase. Thus this can be the combination of effect of unemployment raise and increase of economic efficiency.

**Table 2. Environmental sector in Sweden, number of companies, turnover, export and employed, 2003-2008**

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| **Companies** | 12 436 | 12 505 | 13 336 | 13 494 | 13 929 | 14 275 | 14 655 | 15 393 |
| **Turnover (mil SEK)** | 165 446 | 169 241 | 187 839 | 216 766 | 233 898 | 243 155 | 216 395 | 233 165 |
| **Export (mil SEK)** | 25 705 | 28 553 | 32 920 | 37 778 | 42 160 | 38 049 | 39 600 | 36 989 |
| **Employed, total** | 63 218 | 67 133 | 68 784 | 71 616 | 72 400 | 70 543 | 68 972 | n.a. |
| **of which women** | 14 464 | 15 412 | 15 959 | 17 430 | 17 444 | 17 545 | 17 112 | n.a. |
| **of which men** | 48 754 | 51 721 | 52 825 | 54 186 | 54 956 | 52 998 | 51 859 | n.a. |

*Source: SCB, 2012*

Regarding the employment in environmental sector, waste management and renewable energy conduct the largest part, constituting 22% and 20%, respectively (Table 3). Among the employees in renewable energy sector, almost half are hired in sector connected to electricity and heat production. Other bigger sectors are wind power, hydropower and manufacturing of biofuels. There are more men among the employees that can the explained by as characteristical for industrial sector.

**Table 3. Number of employed men and women on the RE sector by technologies, 2007**

| Environmental area | Employed women | Employed men | Total Employed |
|---|---|---|---|
| **Renewable energy**, *of which* | 3 170 | 11 232 | 14 402 |
| *Electricity and heat from renewable fuels* | 1 415 | 4 862 | 6 277 |
| *Wind power* | 348 | 1 289 | 1 637 |
| *Solar* | 227 | 515 | 742 |
| *Hydropower* | 411 | 955 | 1 366 |
| *Manufacturing of biofuels* | 209 | 1 032 | 1 241 |
| *Renewable transport fuels* | 117 | 394 | 511 |
| Geothermal heat and others | 443 | 2 185 | 2 628 |

*Source: Swedish Government, 2009*

In recent decade the greenhouse gas emissions intensity of energy consumption has decrease in Sweden that has largely been due to increase of proportion renewable energy (Figure 6). However, due to economic downtown in 2009, there was also increase in greenhouse gas emissions per used energy quantity.. In 2010, the GHG emissions saved due to the use of the RES was 89 Million of tonnes CO2 equivalent (57 in electricity sector, 31 in heating&cooling and 0.9 in transport sector).

**Estimated GHG emissions savings due to use of renewable energy sources in Sweden (Mtonne CO2eq)**

| Environmental aspects | 2009 | 2010 |
|---|---|---|
| ***Total estimated* theoretical *net reduction in GHG savings from the use of energy from renewable sources***[114] | *84 (13)* | 89 (14) |
| - Estimated net GHG saving from the use of renewable electricity | 54 (1.5) | 57 (1.3) |
| - Estimated net GHG saving from the use of renewable energy for heating and cooling | 29 (11) | 31 (12) |
| - Estimated net GHG saving from the use of renewable energy for transport[a] | 0.8 (0.8) | 0.9 (0.9) |

*Source: Government offices of Sweden, 2011.( Sweden's first progress report on the development of renewable energy).*

*Note that the renewable electricity for transport is not included in this item but is instead included in the estimation of the net GHG emissions savings from the use of renewable electricity*

# 4. Overview of available renewable energy support instruments before the crisis

## 4.1. Types of support schemes and relevant policy and legal framework

Sweden has promoted renewable energy through various incentives, the most important of them being the **quota system**, which is based on a certificate trading system. Furthermore, tax regulation mechanisms and a grant scheme have been introduced.

First, the green electricity certificate system is a market-based support scheme for the expansion of electricity production based on renewable energy sources and peat (Swedish Energy Agency, 2011). The system was put in place in Sweden 2003 and has been a national system up until 2011.

In 2010 the Swedish Parliament (Riksdag) decided on a higher target for the green electricity certificate system and on the extension of the scheme to the year 2035. The current target will increase the production of renewable and peat-based electricity production with 25 TWh by 2020 compared with 2002 years production. So far it has been biomass based electricity which has got the largest share of green electricity certificates, followed by wind power and small scale and refurbished hydro power. Wind power is increasing rapidly from a production of 1 TWh 2006 to a production over 6 TWh 2011.

Electricity producers whose electricity production meets the requirements of the Electricity Certificates Act receive one electricity certificate unit for each megawatt-hour (MWh) of electricity that they produce. Demand for certificates is created by the fact that all electricity suppliers, and also certain electricity users, are required to purchase certificates corresponding to a certain proportion (quota) of their electricity sales or electricity use. The quantity of certificates to be purchased is adjusted from year to year in step with progressive changes of the quota proportion, thus generating an increasing demand for the certificates. In turn, this increases the incentive to produce more electricity from energy sources approved for production of certificate-entitled electricity. The producers of electricity from renewable sources can receive additional revenue to complement their sale of electricity by selling their certificates. The certificate system thus encourages the expansion of production from renewable energy sources.

Producers of electricity in approved plants are allocated one certificate unit for each megawatt-hour (MWh) of electricity that they produce and meter from renewable energy sources or from peat. Electricity from the following energy sources entitles its producers to certificates:

- Wind power
- Solar energy
- Wave energy
- Geothermal energy
- Biofuels, as defined in the Ordinance (2003:120) Concerning Electricity Certificates
- Peat, when burnt in CHP plants
- Hydro power:
  - small-scale hydro power which, at the end of April 2003, had a maximum installed capacity of 1500 kW per production unit,
  - new plants,
  - resumed operation from plants that had been closed,
  - increased production capacity from existing plants,

– plants that can no longer operate in an economically viable manner due to decisions by the authorities, or to extensive rebuilding.

Second, electricity generated from wind energy is eligible for tax privileges consisting in a reduction of the real estate tax as defined in the Act on the Federal Real Estate Tax, and a reduction of the energy tax as authorised by the Energy Tax Act.

Third, besides general and market based instrument some other measures as subsidies have been used in Sweden in order to increase the use of renewable energy. For example financial subsidies for research and development support for the physical planning of wind power, financial support for wind power projects which has special relevance for bringing down establishment costs and gaining experience and support for the installation of PV installations.

There are all together 27 measures there have been declared in “The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009” (Government Offices of Sweden, 2010). Some of these measures as energy tax and pollutants emission taxes (Table 4) have been implemented decades ago. However, in recent decade the number on plans and measures promoting renewable energy utilization has been extensively increased.

**Table 4. Some most historic plans and measures in Sweden's National Renewable Energy Action Plan**

| Name and reference of the measure | Type of measure | Expected result | Targeted group and or activity | Existing or planned | Start and end dates of the measure |
|---|---|---|---|---|---|
| Energy tax | Financial | Fiscal and steering tax for more efficient energy consumption and increased share of renewable energy | Households, enterprises | Existing and planned adjustments | Energy tax on petrol 1924, most other carbon fuels 1957, LPG 1964, natural gas 1985- |
| Sulphur tax | Financial | Environmental tax to reduce sulphur emissions | Industry and power plants, the transport sector, heating | Existing | 1991- |
| Carbon dioxide tax | Financial | Environmental tax to reduce sulphur emissions | Households, enterprises | Existing and planned adjustments | 1991 |
| Nitrous oxide tax | Financially regulatory | Steering towards reduced emissions, no direct promotion of renewable fuels | Industry and power plants, at least 25 GWh per year | Existing | 1992- |
| Exemption from energy and carbon dioxide tax for $CO_2$-neutral fuels and for vegetable and animal oils and fats and biogas as a heating fuel | Financial | Promotes the use of bioenergy | Biofuels | Existing | 1991- |

*Source: Swedish Government, 2010*

In Annex 1 the measures where there have been changes in last two years, have been listed. This is the period, where these could have been influence of economic downtown. In general, when compare the differences between the Swedish National Action Plan for the promotion of the use of renewable energy and instruments, and measures that have been changed or added in the past two years, the adjustments in

policy practices have been mostly structural initiated by technological modifications not due to restructuring and cease of resources.

In addition to the instruments described above (and in Table 5 in the Action Plan), there are in Sweden a number of soft instruments in the form of information campaigns, plans and programmes. These are in addition an important part of Sweden's energy policy. For example, the county administrative boards have been tasked on behalf of the government with developing regional strategies for energy and climate issues in their respective counties. These strategies are an important part of Sweden's national energy and climate policy in being able to achieve the targets at the local and regional levels. Among other things, the purpose of these strategies is to increase the share of renewable energy. These strategies are to be formulated in cooperation with other regions and local actors and are to ensure that all are pulling in the same direction in the county. This work is supported by the Swedish Energy Agency.

In conclusion, the quota system, is the main incentive for the use of renewable energy sources is a quota system in terms of quota obligations and a certificate trading system. The Electricity Certificates Act obliges energy suppliers to prove that a certain quota of the electricity supplied by them was generated from renewable energy sources. Energy suppliers shall provide this evidence by presenting tradable certificates allocated to the producers of electricity from renewable sources.

Electricity generated from wind energy is also eligible for tax privileges consisting in a reduction of the real estate tax as defined in the Act on the Federal Real Estate Tax, and a reduction of the energy tax as authorised by the Energy Tax Act.

And there are also Sweden grants subsidies for photovoltaic installations.

With respect to support mechanism for renewable heating, there are tax reductions for households. The installation of renewable energy devices and the replacement of conventional heating sources with renewable ones may be deducted from tax.

## 4.2. Effectiveness evaluation

As most of the support schemes are relatively new, it is hard to say about effectiveness of support measures. As the proportion of renewable energy has increased in Sweden in recent years and is the largest currently, the schemes must work relatively well. However, some of the aspects of the instruments have also got critics. Ragwitz and Resch (2011) have pointed out that there are no rules for priority dispatch, technology neutral support ignores innovative RES technologies and many of the procedures are too complex.

# 5. The economic crisis effects financing RE

## 5.1. General description about the economic crisis in the national economy

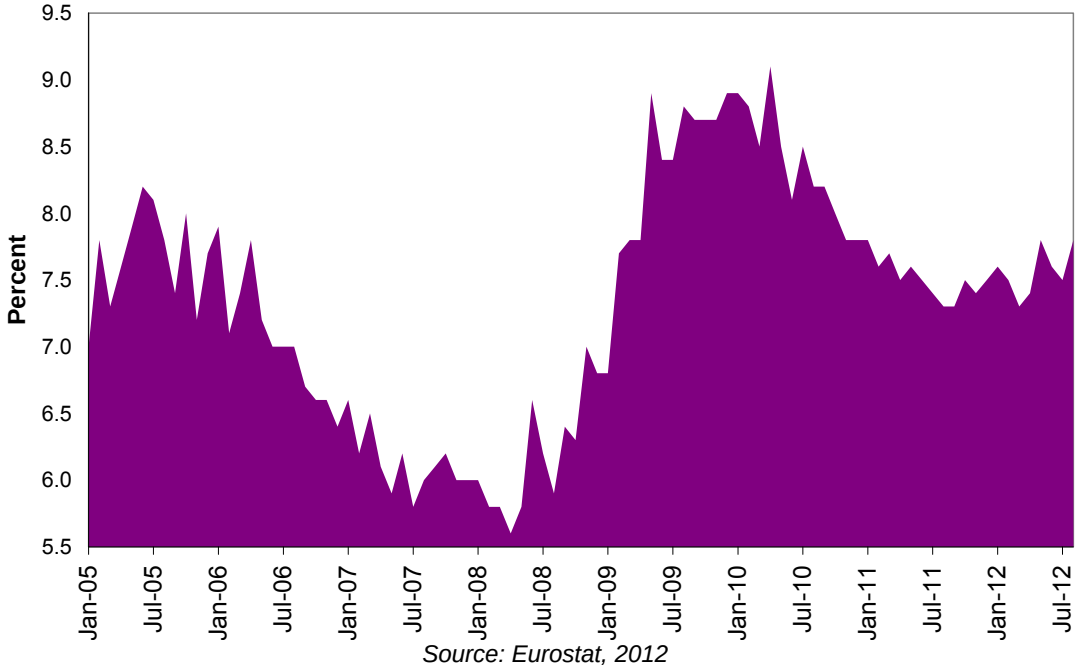
2009 was marked by the financial crisis and the world-wide global downturn that occurred in the second half of 2008. The OECD countries were the countries most severely affected by the economic crisis, and it was in them that use of energy declined the most. Non-OECD countries are thought to account for 90 % of the increase in energy use during 2009. The economic crisis affected energy use to the extent that it probably fell for the first time since 1982.

Nevertheless, there has been growth of global energy supply since 1990. In 2008, fossil fuels accounted globally for over 81 % of energy supply: the greatest contribution is from oil, with 33 % of supply, followed by coal (27 %) and natural gas (21 %). Including hydro power, the proportion of energy supply from renewable sources during the last ten years has amounted to 13 %. Nuclear power accounts for the remaining 6 % of energy supply.

Comprehensive statistics of the total supply of renewable energy in Sweden are not yet available for 2009. Nevertheless, despite the economic crisis, initial data show that the quantity of renewable energy delivered continues to increase in Sweden (SCB, 2012). During 2008, the supply of renewable energy increased by 3 % in comparison with 2007.

As the financial crisis continues to hold much of the world in a vice-like grip, Sweden has become one of few pockets of resistance, where the impact of the recession has been felt less than elsewhere, having learnt vital lessons from its own recent past. However, although government bail-outs, high unemployment and irresponsible consumption have been more rare in Sweden than in many of its European counterparts. The unemployment rate was lowest in Sweden in April 2008 and started to increase since then (Figure 4). It has been decreased since beginning of 2010. Currently in 2011-2012 it has been stable, but it is expected to increase in 2013 (Berglind et al., 2012).

**Figure 4. Unemployment rate (monthly average) in Sweden, 1990–2009**




*Source: Eurostat, 2012*

Crucially, the state acted swiftly and support, and ongoing consensus has been a contributing factors in the stability of the economy ever since. The government has avoided a serious fiscal crisis which is very important. Sweden went into the crisis in 2008 in a stable and reasonable shape with quite a large fiscal surplus and that has given room for manoeuvre (Calmfors, 2012). There has been no need for fiscal tightening during the crisis as in many of the Eurozone countries with high government debt. Sweden is traditionally highly dependent on exports, leaving the economy at the mercy of the fluctuations in global markets. The labour market will be a problem looking ahead, We already have an unemployment problem. Long-term unemployment, which is already high, will certainly rise even more now when output growth falls due to the downturn in the European economy. It looks like there will be a European downturn, which will inevitably affect Sweden, with unemployment set to go up and GDP will barely grow this year, so we are in recession, but hopefully it will not be that deep.

## 5.2. Instruments/measures that have ceased to apply since the Action Plan

Looking into details in “The Swedish National Action Plan”, only some of the instruments and measures have been ceased recently (Table 6). Nevertheless, these measures have been rather substituted with other instruments. This indicates that the action plan has been rather good implemented. Moreover these instruments have been partly implemented. Those who applied for “Planning aid for wind power” and received aid are now working on the implementation of their planning efforts. The Swedish National Board of Housing, Building and Planning is monitoring this work. Up until the beginning of December 2010, 212 municipalities and 13 county administrative boards had been awarded grants. In total 48 municipalities or joint action groups of municipalities had submitted their final accounts, and 4 county administrative boards. This “Investment aid for conversion from direct-acting electro heat in dwelling houses” was provided for the replacement of direct-acting electro-heating systems to district heating, geothermal from a downhole heat exchanger, ocean thermal heat pumps or shallow geothermal, or biofuel and the installation of waterborne heating systems. This aid applied for measures implemented during the period 1 January 2006-31 December 2010 and has ended currently. The Swedish Environmental Protection Agency has been the responsible authority for “Grants to fuel retail outlets for investments in pumps for fuels other than ethanol”, which ceased at the turn of the year 2010/2011. In total SEK 114 million was distributed in investment aid.

**Table 6. Overview of instruments/measures that have ceased to apply since the Action Plan**

| Name and reference of the measure | Type of measure | Expected result | Targeted group and or activity | Existing or planned | Start and end dates of the measure |
|---|---|---|---|---|---|
| Planning aid for wind power, ordinance on aid for planning initiatives for wind power | Financial contribu-tion | To support the planning process | Municipalities, county administrative boards, municipal and regional joint action bodies | Has ended | 2007−2010 |
| Investment aid for conversion from direct-acting electro heat in dwelling houses. Ordinance on aid for conver-sion from direct-acting electro heat in dwelling houses | Financial | Conversion from direct-acting electro heating to district heating, bioenergy, heat pumps | Owners of dwellings or dwellings attached to premises | Has ended | Investment aid may only be used for mea-sures begun at the earliest on 1 January 2006 and completed by 31 December 2010 the latest |
| Grants to fuel retail | Financial | In 2009, 114 retail | Retail outlets for | Has | 2007-2009, grants |

| | | | | | |
|---|---|---|---|---|---|
| outlets for investments in pumps for fuels other than ethanol, Ordinance on government aid for measures to promote the distribution of renewable fuels | | outlets had been awarded grants for the installation of biogas pumps (on average around SEK 1 million per application) | fuel | ended | may still be applied for works begun before the end of 2009 and concluded before the end of 2010 |

*Source: Government Offices of Sweden, 2011*

## 5.3. The future of the RE sector by 2020 in Sweden

Speaking about the future of the renewable energy sector by 2020 in Sweden, the level of ambition of the 49% renewable energy target is relatively low splitting into 62.9% RES-Energy, 62.2% RES-Heating&Cooling, and 13.8% RES-Transport. The Swedish Energy Agency has made a prediction based on existing incentives and arrived at 50.2% RES by 2020, which is not a goal that needs any kind of effort to be met. On the contrary, the 2020 target is even below the trend of RES since 1996.

In fact, the share of RES was already 48% in 2009, according to the Swedish Energy Agency. The Swedish Energy Agency's forecast for 2020, has calculated an increase to 50.2%, with the current support policies, but no strengthened support schemes. They also calculate with a 15.5% higher energy use than 2009, which is a very unlikely development, considering the EU targets of energy use reductions by 2020.

Green electricity purposes to increase new renewable electricity production in Sweden with 25 TWh between 2003 and 2020. The sectoral target for RES in electricity is therefore likely to be fulfilled. However, the certificates support scheme is currently positive for bioenergy, less so for wind power and negative for the remaining RES (). Conditions for renewable heating are quite good. Within the heating and cooling industry, bioenergy is the major source of energy and plans to use more biomass for heating are in place, but there are no policy measures to increase the use of RES in heating and cooling. Though, solar and geothermal installations are insufficiently supported. There are some policy measures to increase RES fuels in transport, but meeting the target relies to a large extent on quota legislation. In conclusion, the targets for Sweden are easily achievable; nevertheless, even more challenging targets could be possible.

# 6. Social debate about green energy

The trade unions role in regulating jobs in environmental sector in Sweden has been discussed by Räthzel and Uzzell (2011). Their paper focusing on climate change suggests that in the context of "green economy" a win-win situation appears for politics, industry, and the environment; however, the inevitable question is why have industries and governments been so reluctant to engage in a green transformation that includes also many renewable energy technologies. Technological innovation appears as a solution that combines the best of both worlds: it protects an industry by modernising it and protects the environment by reducing emissions. Although the trade union campaign for "Green Jobs" and a "Green Economy" is targeted towards green modernisation, it focuses on pressurising industry and government to invest in renewable energies and create new, 'green' industries (Räthzel and Uzzell, 2011). However, Räthzel and Uzzell suggest that campaigns for "green jobs" lag behind in consideration of worker's (lack of) demand for such jobs. The authors suggest that campaigns for "green" jobs, if they are to be successful, need to consider how envisaged new jobs will challenge collective representations of work, images of masculinity/femininity, manual/mental work, of worthwhile and empowering jobs.

In general in Sweden, unions are proud of their success in negotiating high salaries and good working conditions in cooperation with business and governments (Elevander, 2002). Räthzel and Uzzell (2011) have added that the interest in environmental issues is less likely to develop, since efforts are concentrated on workers' interests at the workplace, and less on their interests as citizens outside the workplace, and concluded that the conflicting relationship between jobs and environment is conceptualised by unionists.

To find out the administration's, employer's and union organizations' view on renewable energy issues the representatives of each party were interviewed.

### Renewable energy situation

First the opinions on the role of renewable energy in the energy supply and in the energy mix were asked.

The administration representative found renewable energy in comparison with alternatives a sustainable solution for the energy supply. He specified that the goal of the energy politics is a sustainable system that is achievable with renewable energy mix. The employer's and union's organizations also emphasized the importance of renewable energy in energy supply, especially its central position in Sweden. The union's organization also highlighted the potential for increasing biomass use. He pointed out that increasing biomass use could even broaden the share of renewable energy in deployment in energy Swedish portfolio. Furthermore, employer's representative saw a big potential for renewable energy use in specific sectors. For example, in transport sector in Sweden, currently the proportion of renewable energy deployed is relatively low.

Second, the interviewees were asked to evaluate the renewable energy deployment before and after the crisis as well as the future scenarios were requested.

None of the interviewees saw significant change in renewable energy deployment after the crisis, when compared to the previous situation. They specified that as Swedish economy at large has not suffered from global financial crisis, this has not really affected the renewable energy deployment. Only the administration representative marked that for Sweden, the financial crisis has mostly affected the investments targeted for Research, Development and Demonstration in renewable energy field. In comparison to many other countries, the funding sources for RDD have been

minimised considerably. He explained that as the RDD activities are highly dependent on private investments, due to the uncertainties in market situation, the investments in these so-called soft spheres are under more pressure.

Third, opinions about renewable energy targets, the degrees of their ambitiousness and the extent of potential were asked.

In general all three interviewees agreed that Sweden has no problems with achieve the targets set for renewable energy deployment. However, the union's representative supposed that targets could even be even more ambitious. The employer's representative pointed out that in some sectors such as electricity or heating, the available potential is used rather well, and working under current conditions, the targets will be achieved in time. From the employers' representative point of view, in some sectors such as transport, renewable energy targets could be even more ambitious in long term. He specified that taking into consideration the potential created by rapid technological developments in transport sector, the existing targets are not strong enough.

**Support schemes and funding**

First the usefulness of support schemes and implementation of other, additional schemes was asked. Also the question if these instruments are the main driver or the main barrier for the renewable energy promotion was raised.

The administration organizations representative said that the green electricity certificate system is the most important driver for investments in renewable electricity. Furthermore, the $CO_2$-tax together with the certification system is an important reason for the shift from fossil fuels to bio energy use in district heating. The employer's organizations representative concluded the same, but rose also the importance of support schemes for renewable energy research and development companies as well as private persons. The unions organization's representative expected to see some additional support mechanisms targeted at renewable energy production related industries. All in all, the instruments package was seen as the main driver, not a barrier for the renewable energy promotion.

Second the administration, employer's and union's organizations were asked if the support schemes and public funding have changed due to the recent economic crisis?

In general none of the interviewees have seen significant change in support schemes and public funding due to economic crisis. The employer's organizations representative was more critical about instrument that have ceased during that period, as this has influenced especially the developing activities in renewable energy sector and some of the investments in more energy efficient technologies.

Third the impression about renewable energies in the future was asked? How will be the future of support schemes and what are their recommendations about support mechanism targeted at promoting renewable energies in the future?

The administration organizations representative was rather careful regarding the renewable energy support schemes in the future. He said that it needs to be a dynamic process, where the adaptation will occur at the receivers end as well as at the scheme administrators' side as well as on the RDD side. This is also the main reason for changes in couple of recent years. He suggested that it needs to further investigation if and how these schemes need to be amended. The employer's and union's organizations representatives expect further diversification in support mechanisms in the future as to be tailored for specific needs among the receivers and energy end users. This would further strengthen and develop the green sector.

**Employment**

First the administration, employer's and union's organizations were asked on how do they think the renewable energy employment is going to evolve and are the green jobs a possible way out of the economic crisis?

All the interviewees pointed out the importance of the green jobs enhancing the economic activities, supporting economic growth while granting environmental sustainability. The union's organizations representative emphasized investment schemes in emerging technologies that could further support the creation of green jobs in the future. The establishment of such technology in the field of biogas, solar cells etc on the market could potentially mean additional green jobs in the future. In general Sweden, has put a particular focus on all the measures proposed to move towards 'green' jobs, being one of the leading players at international level.

The other three questions involved only union's organization representative.

In general the level of union membership in Sweden is very high; however it slightly varies among the different sectors in renewable energy sector, as different sectors are affiliated into different trade unions. It varies also if it is renewable energy production or activities related to renewable energy e.g. production of biomass. In general the affiliation is higher in larger companies and lesser in smaller companies, as there is a number of small companies in the field of renewable energy technologies research, development and demonstration.

The quality of the jobs in terms of salary is rather satisfactory being largely above the average and the qualification is rather high, as quantities of people are involved in research and development. Due to economic crisis there has also been a turndown, especially in turnover, that has influenced the renewable energy sector; especially the number of hired people has decreased. Nevertheless, there have not been collective bargains at renewable energy sector.

# 7. Conclusions and key messages

The share of renewable energy in Sweden is the largest in the EU. Currently over 47 % of all energy is renewable, and the target for 2020 according to EU's Directive is 49 % and the national target is 50 %. The projections foresee to fulfil these targets even earlier than 2020. To fulfil these targets, several supporting schemes are implemented. Compared to two decades ago, the share of renewable energy has increased by half as only one third of energy was renewable in 1990. This has plausible been due to supporting politics in the field of renewable energy.

The renewable energy sector n Sweden is dominated by biomass (mostly wood fuels), followed by hydro power, organic waste and biobased motor fuels. Recently also the capacity of wind power, as well as solar power has enlarged rapidly due to support and technological improvement. However, the capacity of solar power compared to other renewable sources is rather marginal.

There are large number of companies (around 15,000) operating in green sector in Sweden. The number of these companies has increased over last years; even there was small decrease in turnover in 2009. The reason for that has been economic downtown that has influenced the export in Sweden's green sector. Most of the companies in green sector are small, on average around 5 employees. Due to economic crisis also the employment in green sector has decreased being relatively highest in 2007. However, in 2010 the situation has improved compared to 2009.

According to 2009 data, 20% on employees in green sector are employed by renewable energy segment. Almost half of these people are involved in production of electricity and heat from renewable fuels, followed by hydropower production. Compared to capacity, relatively a lot people are working in sector connected to solar power, indicating large proportion of employees involved in research and development. When analyze the gender balance, the majority of the employees are men.

The promotion of renewable energy in Sweden is widespread and the mechanisms are targeted to public sector, green sector companies and private persons. Among the instruments, the most important is green electricity certificate system. There are also tax privileges for electricity generation from wind energy as well as from other energy modes. Moreover, there is large number of subsidies to increase the use of renewable energy and financial subsidies for research and development support. These include energy efficiency investments, solar power technology development, biofuels, and green cars and small size renewable energy equipment.

When we analyzed the change of these support schemes in recent years, the number of mechanism has been increased, largely to fulfil the targets in renewable energy field. The indirect reason has also been supporting green companies and stimulating the export. This has also seen as one of the methods getting out from the crisis. We could see that some instruments or measures have ceased during couple of recent years since the Action Plan, but these have mostly been due to restructuring, not restricted resources due to economic decrease.

Even the financial crisis hit most of the world; Sweden was affected less than most other countries. It has been said that Sweden has weathered well thanks to strong economic institution, and fundamentals and strong fiscal position. Nevertheless, the unemployment rate increased also in Sweden, being highest beginning of 2010. Currently in 2011-2012 it has been stable, but it is expected to increase in 2013, due to problems elsewhere that influence Sweden's export market. This could influence also the turnover of renewable energy technologies. The key issues in labour market is limiting long-term unemployment, increasing the use of training, increase work efficiency in parallel with investments in green sector.

In spite of the economic crisis, public opinion and the social partners have been positive towards the development of green technologies and the measures undertaken to facilitate the transitions towards a sustainable economy.

According to administration, employer's and union's organizations opinions, renewable energy is in comparison with alternatives a sustainable solution for the energy supply. For Sweden, the financial crisis has mostly affected the money for Research, Development and Demonstration (RDD). In comparison to many other countries, the RDD are highly dependent on private investments that has made situation more difficult. In support schemes the $CO_2$-tax together with the certificate system is an important reason for the shift from fossil fuels in district heating to bio energy. And Sweden is rather likely to achieve its target. Moreover, despite to the recent economic crisis, the support schemes and public funding have not significantly changed and is neither believed to be significantly changed in the future. The green jobs have been seen one of the possibilities stimulating the economy. In general the renewable energy workers have rather good level of affiliation and the quality of jobs is sufficient so as there have not been collective bargains.

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# Annexes

## Annex 1. Overview of instruments and measures that have been changed or added in the past two years

| Name and reference of the measure | Type of measure | Expected result | Targeted group and or activity | Existing or planned | Start and end dates of the measure |
|---|---|---|---|---|---|
| Revision and changed levels of energy taxes | Financial | Fiscal and steering tax designed primarily to reduce energy consumption but also to guide the choice of energy carrier | All types of operations | Complements<br><br>Existing and planned adjustments of tax levels | 2011 Broadening of the bases for the taxes and uniform tax level for heating fuels. 2011, 2013 raised level for diesel |
| Changed levels in $CO_2$ taxes | Financial | Environmental tax | All activities | Complements<br><br>Existing and planned adjustments of tax levels | 2010<br><br>Raised level 2011, 2013, 2015 decreased reduction |
| Changed rules for energy and carbon tax exemption for renewable fuels | Financial | Promotes the use of bioenergy | All activities | Complements. Planned change in tax exemption up to a certain level of blending | 2011 limit on tax exemption for biofuels |
| Raised level of ambition in the electricity certificate system | Financial regulatory | 25 TWh of new renewable electricity generation by 2020 compared with 2002 (previously 17 TWh by 2016) | Quota-bound electricity suppliers/consumers and producers of renewable electricity | Complements existing<br><br>Adjustment of quota levels (decided 2010) Clarification of rules and expansion of the system (decided 2011) | From 2013, adjusted quota levels to achieve the raised target. From 1 January 2012, clarification of rules and a single Swedish-Norwegian market for electricity certificates |
| EU-ETS. Emissions Trading Act | Financial regulatory | Fuels conversions to renewable energy | Facilities within the ETS | Complements existing<br><br>Planned adjustments | New period from 2013 |
| Extension of the Programme for Improving Energy Efficiency in Energy Intensive Industries (PFE) | Financial regulatory | Refers primarily to energy management systems for energy efficiency, but has positive spin-off effects in the form of a greater share of renewable energy | Energy-intensive industry | Complements existing<br><br>Existing state aid approved from 2004 also applies for a new period 2009–2014 | From 2005−2009. New period 2009−2014 |
| Investment aid for solar photovoltaic cells connected to the grid. Ordinance on state aid for solar photovoltaic cells | Financial | Target is that the number of players will increase in Sweden, that the system costs will be reduced and that electricity from solar photovoltaic cells will increase by 2.5 GWh during the period | Companies, public and private organisations, as well as private individuals. Refers to solar photovoltaic cell systems connected to the | Complements existing.<br><br>Supplemented with more funding from 2012 | 1 July 2009−31 December 2012. After 2012, this funding will be reviewed |

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| | | | electricity grid (also entitled to electricity certificates) | | |
| Investment aid for solar heating. Ordinance on aid for investments in solar heating | Financial | Increased installation and use of solar thermal collectors, that is, solar heating for space heating/ cooling and water | Both private individuals and companies can apply for aid for the installation of solar heating system | Complements existing | 2009−2011 (the aid will be discontinued after 2011) |
| Vehicle tax exemption for green cars. Act with special provisions concerning vehicle tax | Financial | Promotes green cars | Vehicle owners, the automotive industry | Existing<br><br>Planned change | 2010, retroactively from 1 July 2009 – 2009−2011 |
| Reduced taxable benefit value for green cars, replaced by continued but reduced benefit value for certain green cars | Financial | Promotes green cars (equates the taxable benefit value of a green car with the equivalent alternative, even if the green car is more expensive to purchase) | Company car sector, vehicle owners and the automotive industry | Existing<br><br>Decision on change made | Changed variant introduced from 1 January 2012– 31 December 2013 |
| Investment aid for biogas and other renewable gases, Ordinance on state aid for measures for the production, distribution and use of biogas and other renewable gases | Financial | Aid to projects that contribute to increased production, distribution and use of renewable gases | Producers, distributors and users of biogas and other renewable gases | Complements existing<br><br>Additional funds allocated for 2012 in 2013 | 1 November 2009 − 2013 |
| Investment aid for climate and renewable energy projects, special funds allocated within the Swedish Rural Development Programme | Financial | Reduced environmental impact from rural businesses and increased production and use of renewable energy in rural areas | Business and project aid | Existing (has not been changed since the Action Plan, but is included because it lacks a description there) | 2010−2013 |

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| Aid for energy mapping for SMEs. Ordinance on state aid for energy mapping | Financial | Aid for energy mapping in businesses that have energy consumption in excess of 0.5 GWh (limited to SEK 30,000 per business) | Small and medium-sized enterprises (energy-intensive enterprises are mainly included in the PFE and certain agricultural holdings | Existing. Final year not specified in the Action Plan (but is included because it lacks a description there) | 2010−2014 |
| Delegation for Sustainable Cities | Financial | Grant for the development of sustainable cities. During 2009 and 2010, a total of SEK 320 million has been distributed to nine investment projects and 28 planning pro-jects. During 2011 and 2012, a total of SEK 40 | Primarily municipalities, but also economic activities, consultants, universities and other colleges of advanced education and organisations have received aid (for planning measures) | Complements existing | 2009−2010 and extension until December 2012 |

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| | | million will be distributed primarily in the form of planning aid | | | |
| Implementation of the Renewables Directive's sustainability criteria | Regulatory | The use of biofuels and bioliquids, which leads to significant reductions in carbon dioxide and which otherwise have low environmental impact | This Act targets suppliers and users of biofuels and bioliquids | New. Existing. (Following Riksdag decisions, changes in the law come into force on 1 November 2011 and 1 January 2012, respectively | Act on Sustainability criteria for biofuels and bioliquids applies from 1 August 2010. The tax exemption for certain biofuels is conditional on the players holding a sustainability notification from 1 February 2012 |
| Introduction of the Renewables Directive's rules for guarantees of origin. Act on guarantees of origin for electricity | Financial regulatory | The goal is reliable marks of origin for electricity and that the electricity consumer will have clear information about the origin of the electricity | Covers the generation of electricity and affects both electricity producers and suppliers | New. Existing | SFS 2010:601 applies from 1 December 2010 |
| New law concerning the environmental requirements when purchasing vehicles and contracting public transport. Act on environmental requirements in the procurement of vehicles and certain public passenger transport services | Regulatory | The promotion of clean and energy-efficient road transport vehicles | Authorities | New. Existing (decided 16 June 2011) | 1 July 2011 − |
| Changed rules of procedure for accounting of alternative fuels | Regulatory | Promotion of renewable fuels | Enterprise | New. Existing. | 1 January 2011 – |
| New laws on exhaust emission controls and fuels | Regulatory | Reduced emissions of greenhouse gases and the promotion of renewable fuels | Fuel suppliers and car manufacturers | Replaces existing | 1 May 2011 – |
| Super green car premium | Financial | Promotes green cars, renewable fuels and electricity for transport | Vehicle owners, the automotive industry | Planned | Introduction planned from 1 January 2012– 2014 |

*Source: Government Offices of Sweden, 2011*