CHAPTER 5
IMPORTANCE OF RENEWABLE ENERGY SOURCES IN THE NETHERLANDS

The Netherlands

Policy Background
A European energy policy must pursue the objective of a sustainable, competitive and secure supply of energy. If the EU continues on its present course, this key objective will not be attained. In January 2007, the European Commission adopted an energy policy for Europe. This was supported by several documents on different aspects of energy and included an action plan to meet the major energy challenges Europe faces. Each European citizen must be informed of these challenges and the role they should play in meeting them.
Renewable energies help combat climate change while increasing security of supply.
Key Issues
After a period during which support was high but markets quite open, a system was introduced (in 2003) that installed sufficient incentives for domestic RES-E production. Although successful in encouraging investments, this system (based on premium tariffs), was abandoned in August 2006 due to budgetary constraints. Political uncertainty concerning renewable energy support in the Netherlands is compounded by an increase in the overall energy demand. Progress towards RES-E targets is slow, even though growth in absolute figures is still significant.

A competitive, reliable and sustainable energy sector is essential for an economy, and this has been put under the spotlight in recent years by a number of issues, including the volatility in oil prices, interruptions to energy supply from non-EUmember countries, blackouts aggravated by inefficient connections between national electricity networks, the difficulties of market access for suppliers in relation to gas and electricity markets, and increased attention to climate change. These issues have pushed energy towards the top of national and European political agendas.
The use of renewable energy sources is seen as a key element in energy policy, reducing the dependence on fuel from non-member countries, reducing emissions from carbon sources, and decoupling energy costs from oil prices. The second key element is constraining demand, by promoting energy efficiency both within the energy sector itself and at end-use.

In January 2007 the European Commission adopted a communication (COM(2007) 1) proposing an energy policy for Europe (1), with the goal to combat climate change and boost the EU's energy security and competitiveness. This set out the need for the EU to draw up a new energy path towards a more secure, sustainable and low-carbon economy, for the benefit of all users. Based on the European Commission's proposal, in March 2007 the Council endorsed the following targets which the Dutch government fully supports:

- reducing greenhouse gas emissions by at least 20 % (compared with 1990 levels) by 2020;
- improving energy efficiency by 20 % by 2020
- raising the share of renewable energy to 20 % by 2020
- increasing the level of renewables (such as biofuels) in transport fuel to 10 % by 2020

In a Communication in November 2007, the European Commission put forward a strategic energy technology plan (SETplan)'Towards a low carbon future' (2). This aims to support decarbonised energy technologies, such as off -shore wind, solar technology, or second generation biomass, by accelerating their development and implementation. In January 2008 the European Commission proposed a package of measures (3) related to energy and the climate, to supplement the existing measures for achieving the agreed targets. The European Council, on 11 and 12 December 2008 (4), reached an agreement on the energy/climate change package which should enable this package to be finalized with the European Parliament by the end of 2008. This decisive breakthrough will enable the EU to honour commitments entered into during 2007 and to maintain its leading role in the search for an ambitious and comprehensive global agreement at Copenhagen in 2009.

CHAPTER 6
CURRENT STATUS OF RENEWABLE ENERGY IN THE NETHERLANDS

Current national RES target

In its climate policy, the Netherlands set a global target of 5% renewable energy by 2010, and 10% by 2020. According to the EU Directive, the RES-E share of the Netherlands should reach 9% of the gross electricity consumption in 2010. The national biofuel targets are in line with the EU Directive, meaning 2% by energy content in 2005 and 5.75% in 2010.

Progress towards meeting national targets

Between 1997 and 2004, progress has been made towards the RES-E target. In 1997, the RES-E share was 3.5%, and by 2004, it had risen to 4.60%.
The biofuel target for 2005 was not met, since the biofuel share by energy content in that year was 0.02%. The targets set for 2006 and 2007 are the same as the one set for 2005 (2%).

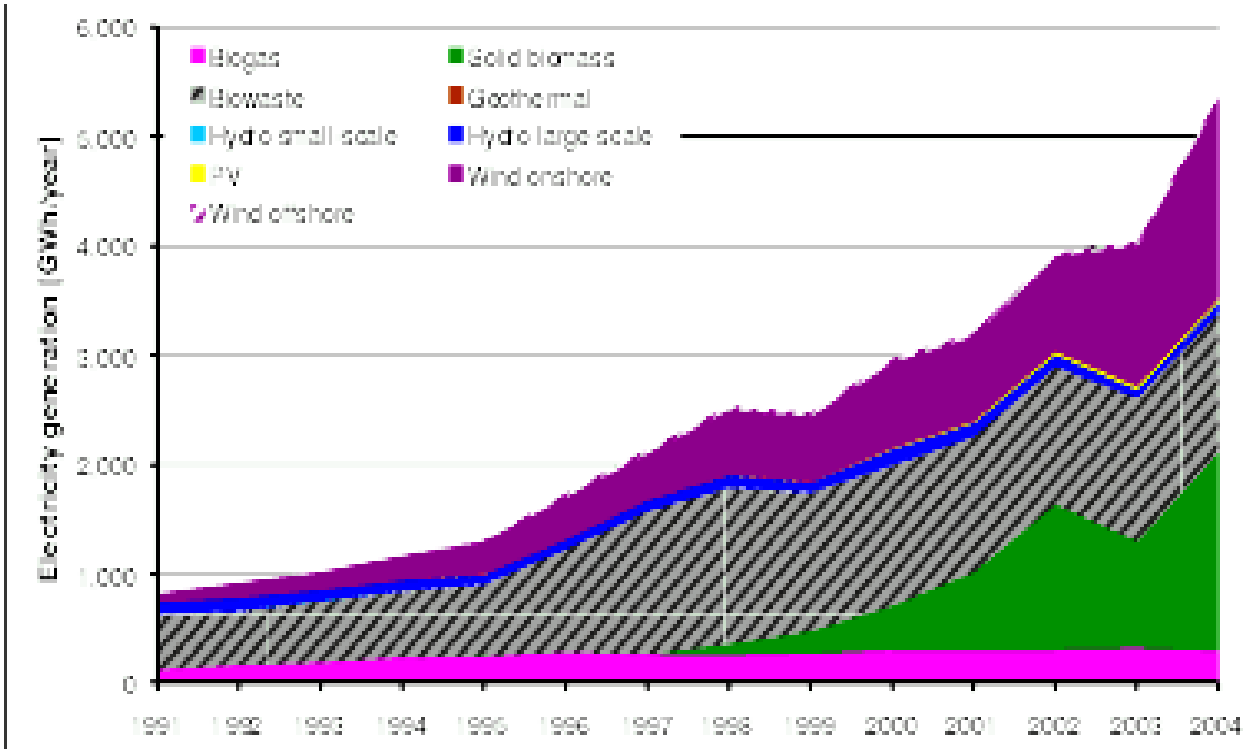
Main supporting policies

RES-E policy in the Netherlands is based on the 2003 MEP policy programme (Environmental
Quality of Power Generation), and is composed of the following strands:
o *Source specific premium tariffs*, paid for ten years on top of the market price. These tariffs were introduced in 2003 and are adjusted annually. Tradable certificates are used to claim the feed-in tariffs. The value of these certificates equals the level of the feed-in tariff. Due to budgetary reasons, most of the feed-in tariffs were set at zero in August 2006.
o *An energy tax exemption* for RES-E was in place until 1 January 2005.
o *A Guarantee of Origin system* was introduced, simply by renaming the former certificate system.
In the Netherlands, biofuels have traditionally been supported by means of R&D funds. To this date, technological innovations in this field are encouraged by means of financial support.
In 2006, a tax relief system was introduced. The mechanism that was chosen links the quantity of biofuels to the national targets, by requiring of suppliers that regular fuels contain a 2% share of biofuel from 2007 onwards, and a 5.75% share from 2010 onwards.
Limited investment subsidies are available for RES heating and cooling activities.
Feed-intariffs (see above) are also applied to CHP.

Key renewable energy statistics

Electricity from RES: In the Netherlands, a key resource for RES-E is biomass. Taken together, biogas, solid biomass (co-firing), and biowaste accounted for more than half of the RES-E market in 2004. Between 1997 and 2004, solid biomass is growing at an average rate of 140% per year. The only other resource with a sizable market share is wind. Already, the Netherlands are ranked fourth highest in Europe in terms of wind power production. This means that wind power is used to a larger extent than in for instance the UK, who ranks fifth highest. Initially, wind farms were placed onshore, but since 2006, they can be found offshore as well. PV experienced strong growth between 1997 and 2004 (average growth rate of 70% per year between 1997 and 2004), but has seen a reduction of its installed capacity by half in 2005 (2 100 MWp) compared to 2004 (5 660 MWp).

Electricity generation from renewable energy sources by type (GWh)



Source: European Commission
http://ec.europa.eu/energy/res/legislation/share_res_eu_en.htm

***Biofuels*:**

Contrary to other EU countries, bioethanol is the dominant variety of biofuel in the Netherlands. In 2004, the total production of 4 ktoe referred exclusively to bioethanol. Strong growth is expected in both the biodiesel and bioethanol production.

Heating and Cooling:
Biomass provides most of the RES-H in the Netherlands, and in 2004, this meant a level of production of 382 ktoe. This sector is still showing growth (average growth rate of 4% per year between 1997 and 2004), but not as much as what is seen in the solar thermal and geothermal sectors.

	Penetration 1997 (ktoe)	Penetration 2004 (ktoe)	Av. Annual growth [%]
Biomass heat	296	382	4%
Solar thermal heat	6	15	15%
Geothermal heat incl. heat pumps	0	31	-

Source: European Commission
http://ec.europa.eu/energy/res/legislation/share_res_eu_en.htm

Good example: Project "SUNCITIES in the Netherlands"
The project has been implemented by environmentally ambitious municipalities, dedicated project developers, utilities, architects, and urban planners. It consists of 3 local projects of new housing developments of building-integrated PV power. The project in the Netherlands includes 1 410 zero energy houses, with a 2.45 MW PV power; the project has been accomplished in two phases. The dwellings contain energy saving measures to reduce electricity and heating consumption and other renewable energy options. The work consists of fitting PV into the urban planning process, the energy infrastructure planning, the architectural design, and the electrical grid layout by the project developers involved. The implementation
of the proposition is to be achieved by joint tendering of PV systems and roof integration (turn-key) open to European PV suppliers to minimise costs. The innovative aspects of the projects are the achievement of zero-emission buildings (with PV) on this scale, the integration of PV in the urban planning and energy planning approach, the joint tendering, the cost reductions achieved by this approach and scale and the interactive dissemination strategy.

For further information
To find out more about renewables, go to: http://ec.europa.eu/energy/res/index_en.htm
http://ec.europa.eu/energy/intelligent/index_en.html
To find out more about the current situation of renewables in the Member States, go to
http://ec.europa.eu/energy/res/legislation/electricity_member_states_en.htm
http://ec.europa.eu/energy/res/legislation/share_res_eu_en.htm
To find out more about support measures, go to
http://ec.europa.eu/energy/res/legislation/support_electricity_en.htm
To find out about a project or contact an energy agency in your region, go to
http://www.managenergy.net/emap/maphome.html
Further fact sheets on the Netherlands and other Member States can be found on:
http://ec.europa.eu/energy/energy_policy/facts_en.htm

What is meant by…..?
RES: Renewable Energy Sources
RES-E: Electricity production from renewable energy sources
RES-H: Production of heat and cold from renewable energy sources
Biofuels: Mainly includes biodiesel and bioethanol
Biomass: Includes solid biomass, biowaste and biogas
CHP: Combined Heat and Power
GWh: gigawatt-hour
MWp: peak megawatt
ktoe: Thousand tonnes of oil equivalent
PV: Photo-voltaic technology for the production of electricity from solar energy

CHAPTER 7
FUTURE PROJECTIONS OF RENEWABLE ENERGY IN THE NETHERLANDS

Policy Background
The EU is working to reduce the effects of climate change and establish a common energy policy. As part of this policy, European Heads of State or Government agreed in March 2007 on binding targets to increase the share of renewable energy. By 2020 renewable energy should account for 20% of the EU's final energy consumption (8,5% in 2005). To meet this common target, each Member State needs to increase its production and use of renewable energy in electricity, heating and cooling and transport.
Although renewable energies are an integral part of our fight against climate change, they also contribute to growth, job creation and increase our energy security.

Country targets
The renewables targets are calculated as the share of renewable consumption to gross final energy consumption. Renewables consumption comprises the direct use of renewables (e.g. biofuels) plus the part of electricity and heat that is produced from renewables (e.g. wind, hydro), while final energy consumption is the energy that households, industry, services, agriculture and the transport sector use.
The denominator for the RES share includes also distribution losses for electricity and heat and the consumption of these fuels in the process of producing electricity and heat.
Dutch target: 14% (2005 = 2.4%)

Key issues
After a period during which support was high but markets quite open, a system was introduced that installed sufficient incentives for domestic RES-E production. Although successful in encouraging investments, this system (based on premium tariffs), was abandoned in due to budgetary constraints. Political uncertainty concerning renewable energy support in the Netherlands is compounded by an increase in the overall energy demand. Progress towards RES-E targets is slow, even though growth in absolute figures is still significant.

Main supporting policies
RES-E policy in the Netherlands is based on the MEP policy programme (Environmental Quality of Power Generation), and is composed of the following strands:
o Source specific premium tariffs, paid for 10 years on top of the market price. These tariffs were introduced in 2003 and are adjusted annually. Tradable certificates are used to claim the feed-in tariffs. The value of these certificates equals the level of the feed-in tariff. Due to budgetary reasons, most of the feed-in tariffs were set at zero in 2006.
o An energy tax exemption for RES-E was in place until 1 January 2005.
o A Guarantee of Origin system was introduced, simply by renaming the former certificate system.

Biofuels have traditionally been supported by means of R&D funds. To date, technological innovations in this field are encouraged by means of financial support. In 2006, a tax relief system was introduced. The mechanism that was chosen links the quantity of biofuels to the national targets, by requiring of suppliers that regular fuels contain a 2% share of biofuel from 2007 onwards, and a 5.75% share from 2010 onwards.
No resources are specifically allocated to biomass production, but there are instruments for RES-E such as a tax bonus.
Limited investment subsidies are available for RES heating and cooling activities.

An Energy Policy

The Netherlands as part of the European Union (EU) faces serious energy challenges concerning sustainability and greenhouse gas emissions as well as security of supply, import dependence and the competitiveness and effective implementation of the internal energy market. A European Energy Policy is acknowledged as the most effective response to these challenges, which are faced by all Member States.The EU intends to lead a new industrial revolution and create a high efficiency energy economy with low CO2 emissions. To do so, it has set itself several important energy objectives.An internal energy market has been developed on a Community level to ensure that consumers have the opportunity to choose a supplier, at a fair and competitive price. Nevertheless, as highlighted by the Communication on prospects for the internal energy market and the inquiry into competition in the gas and electricity sectors, there are obstacles which continue to prevent both the economy and European consumers from fully benefiting from the advantages of opening up the gas and electricity markets. Ensuring the effective implementation of the internal energy market thus remains crucial.

Renewable Energy

The use of renewable energies (wind power, solar and photovoltaic energy, biomass and biofuels, geothermal energy and heat-pump systems) undeniably contributes to limiting climate change. Furthermore, it plays a part in securing energy supply and creating employment in Europe, thanks to the increase in the production and consumption of local energy. Renewable energies, however, remain on the fringe of the European energy mix as they still cost more than traditional energy sources. To increase the use of renewable energy sources, in its Renewable Energies Roadmap the EU has set itself the objective of increasing the proportion of renewable energies in its energy mix by 20% by 2020. This objective requires progress to be made in the three main sectors where renewable energies are used: electricity (increasing the production of electricity from renewable sources and allowing the sustainable production of electricity from fossil fuels, principally through the implementation of CO2 capture and storage systems), biofuels, which should represent 10% of vehicle fuels by 2020, and finally heating and cooling systems.

Develop Energy Technologies

Energy technologies play a central role in offering both competitiveness and sustainability in the energy sector while increasing security of supply. They are likewise crucial for attaining the other energy objectives. The EU, today a global leader in the renewable energy sector, intends to consolidate its position and play an equally leading role in the rapidly growing market for low carbon energy technologies.The EU must therefore develop existing energy-efficient technologies as well as new technologies, in particular those devoted to energy efficiency and renewable energies.Even if the EU considerably diversifies its energy mix, it will still be highly dependent on oil and coal and must thus also pay particular attention to low carbon-output fossil fuel technologies, especially carbon capture and storage systems. Investment in these emerging technologies will directly contribute to the Community strategy for increasing employment. The Commission proposes an outline for a European Strategic Energy Technology Plan which will cover the entire innovation process, from the initial research to entry onto the market. This strategic plan will support the Seventh Framework Programme for Research, which foresees a 50% increase in spending on research in the energy sector, along with the Intelligent Energy for Europe programme.

CONSIDER THE FUTURE OF NUCLEAR ENERGY

Faced with increasing concerns with regard to security of supply and CO2 emissions, nuclear energy has the benefit of being one of the low-carbon energy sources offering the most stable costs and supply.

The decision whether or not to use nuclear energy is made by Member States. Nevertheless, the illustrative nuclear programme emphasises the need to have a common and coherent approach with respect to security, safety and non-proliferation as well as concerning the dismantling of installations and the management of waste.

CHAPTER 8
POLICIES AND LAWS SUPPORTING RENEWABLE ENERGY IN THE NETHERLANDS

As part of its Third Energy Bill, the Netherlands has set a target that 10 percent of all energy consumption in 2020 must derive from renewable sources (Ministry of Economic Affairs, 1995). Under a coalition agreement between the CDA, PvdA and the Christenunie, this target has now been raised to 20 percent. In conjunction with the EU, a binding target was set of 14 percent renewable energy for the Netherlands in 2020 (European Parliament and the Council, 2009). However the calculation method applying to the EU target is different from that for the national target (see also 2.4).

Developments

The share of renewable energy in national energy consumption increased to 3.4 percent in 2008 (table 2.1.1). This is mainly due to an increase in the production of renewable electricity from wind energy and biomass.

The most important sources of renewable energy are the co-firing of biomass in electricity power stations, wind energy, municipal waste incineration plants, and – since 2007 – also the use of biofuels for road transport. Together, these four sources account for 71 percent of the renewable energy consumed.

Besides breaking it down by source-technology combination, it is also possible to classify renewable energy by the form of energy. Table 2.1.1 identifies four forms of renewable energy: electricity production, heat and cold production, use as gas (landfill gas converted into natural gas, and the final consumption of biogas) and biofuels for road transport. In 1990, heat production was still the most dominant form. However, the rise in renewable electricity production has been much stronger than renewable heat production. As a result, renewable electricity production is now the most important energy form.

In 1990 the percentage of avoided CO2 emissions (compared to total CO2 emissions) was still the same as the percentage of avoided primary energy (compared to total energy consumption). However, in recent years the percentage of avoided CO2 has clearly been higher than the percentage of avoided primary energy. The explanation for this is that the share of renewable electricity has increased within total renewable energy. Electricity generation in the reference situation produces relatively large amounts of CO2 per consumed amount of primary energy, through the use of coal; this is because the combustion of coal produces a relatively large amount of CO2 per unit of primary energy.

Method
The avoided use of fossil primary energy was calculated according to the Renewable Energy Monitoring Protocol (SenterNovem, 2006). For renewable electricity production the avoided use of fossil primary energy and the avoided emission of CO2 was calculated by using a reference: all conventional Dutch electricity production plants. The reference efficiencies and emissions factors were calculated from the Dutch Energy Balance Sheet and the CO2 emissions calculations related to it (table 2.1.2).
One exception to this is installations in which fossil fuels and biomass are fired at the same time (Protocol). For these installations it is assumed that 1 Joule of biomass replaces 1 Joule of fossil fuels. The avoided emission of CO2 is then calculated by adopting the main fossil fuel at the installation concerned.

Renewable electricity
The Dutch government has set a target for renewable electricity: 9 percent of electricity consumption in the Netherlands in 2010 must come from renewable sources. This objective stems from the European directive on renewable electricity (Directive 2001/77/EG). In this respect imports may only be counted if the exporting country agrees explicitly with this (Renewable Energy Monitoring Protocol, 2006 and European Commission, 2004). To date, no such agreements have been made by the Netherlands. This section describes domestic production, subsidies, imports, and renewable electricity certificates.

Domestic production
In 2008, national net renewable electricity production was 7.5 percent of net electricity consumption (table 2.2.1). That is considerably more than the 6.0 percent achieved in 2007. This is the result of an increase in electricity production from wind energy and biomass. Electricity production from wind energy has been growing strongly for years, with the installation of new turbines on land and at sea, and the replacement of smaller turbines with larger models with a higher capacity (chapter 4).
The rise in electricity production from biomass was mainly the result of an increase in the co-firing of biomass in electricity power stations (section 7.2), and the introduction of new medium-sized plants for burning waste wood and chicken manure (section 7.5). Electricity production from biogas produced on farms also increased (section 7.8).

Subsidies
Producing renewable electricity is in many cases a lot more expensive than producing conventional electricity. In order to get projects off the ground, the government subsidises production. The most important scheme is the Environmental Quality of Electricity Production Law (MEP – Wet Milieukwaliteit Electricitysproductie). Using the MEP, the government subsidises the additional costs of renewable electricity production compared with conventional electricity. This difference is called the ‘financial gap’.
In 2008, 550 million euro was paid in MEP subsidies for renewable electricity (excluding subsidies for cogeneration (CHP), EnerQ, 2009).
After the implementation of the MEP in mid-2003, its popularity grew strongly. To keep costs under control, in May 2005 the scheme was closed to new applications from the two largest-scale technologies: co-firing of biomass in power stations and offshore wind. In August 2006, the Minister for Economic Affairs closed the MEP completely to new applications. The reason given for this was a large influx of applications, which led to a considerable overshoot of the estimated costs. The minister’s estimation now is that the targets for 2010 will be achieved with the current subsidised and unsubsidised projects.

As a follow-up to the MEP in 2008, the Ministry of Economic Affairs set up a new subsidy for renewable energy: the renewable energy stimulation scheme (SDE – stimuleringregeling duurzame energie). This is broader in scope than the MEP; it also includes projects for green gas. Another important difference is that the number of new projects per year is limited by budget caps per category. Moreover, the subsidy varies annually, depending on the price of electricity.
In 2008 the SDE subsidy was requested for many new projects. But a considerable amount of time can pass between applying for the subsidy and the relevant installation becoming operational. As a result, the impact of the SDE on renewable electricity production in 2008 was very limited. The MEP is closed to new projects; for existing projects the subsidy continues until their time limit expires (usually ten years). For now therefore, the MEP remains an important support for renewable electricity production.
Besides the MEP and the SDE, the Energy Investment Allowance Scheme (EIA – Energie-investeringsaftrekregeling) is also available to investors in renewable electricity installations. Using the EIA, investors can get a tax allowance. Many investments in installations producing renewable electricity also fall under the 'green investment' tax regulation. This makes lending money to investors somewhat cheaper.

Renewable electricity certificates
Through CertiQ, national and foreign producers can obtain renewable electricity certificates for their renewable electricity (see also chapter 1). This certificate is necessary to be able to make use of the subsidies for renewable electricity, and it also serves as a guarantee to consumers that the renewable electricity they use is actually 'green'. Under the Renewable Energy Monitoring Protocol it is agreed that imports of renewable electricity are defined as imports of certificates.
Demand for renewable electricity certificates increased to 21.5 thousand GWh in 2008. This is 5 thousand GWh more than the year before, and the equivalent of 18 percent of total electricity consumption. The increased demand is possibly linked to media coverage of climate change and sustainability. Energy suppliers also use the certificates to attract new customers. In addition, there is increasing interest among governments and companies in making their electricity use cleaner (CertiQ, 2009).
The increase in national production of renewable electricity was considerably smaller than the rise in national demand for renewable electricity certificates. For this reason imports of renewable electricity certificates also rose strongly.
From an international perspective there is probably still a surplus of renewable electricity certificates. This is visible in the considerable quantity of expired certificates, and the fact that renewable electricity is not, or is only slightly, more expensive than non-renewable electricity. The reason for the surplus is that in many other countries only the supply side of renewable electricity is stimulated, whereas in the Netherlands the demand side also gets attention by means of offering renewable electricity to end-users. The increase in demand for renewable electricity in the Netherlands has probably not led to an increase in renewable electricity production in the Netherlands or elsewhere in Europe, but only to an increase in the number of existing installations requesting certificates. The question of whether the consumption of renewable electricity also contributes effectively to an increase in production is called the question of 'additionality'.
In 2008 this additionality was discussed several times in the media, against the background of the political process surrounding the new European Directive on renewable energy, which once again set out the rules for renewable electricity certificates. In December 2008 the European Parliament and the European Council (for which read the governments of the EU countries) reached political agreement over this

new directive (European Parliament and the Council, 2009). With regard to renewable electricity certificates it was agreed that these would continue to exist, in order to give end-users the chance to make their electricity consumption greener. However, the international trade in certificates will play no role in determining whether or not each country achieves its obligatory targets. Under certain conditions however, it is possible for countries to trade in renewable electricity (statistical transfers). This happens at national level, and is separate from the certificates.
The quantity of renewable electricity certificates issued for national production (table 2.2.3) has, up to and including 2005, always been lower than the total national production of renewable electricity (table 2.2.1). In 2005, the difference was still 1,000 GWh. This occurred largely because most waste incineration plants did not request renewable electricity certificates, whereas their renewable electricity production was counted in the renewable energy statistics. However, in recent years a large number of municipal waste incineration plants have requested certificates, and the difference between the certificates for national renewable electricity production (9,000 GWh in 2008), and actual total national renewable electricity production (8,988 GWh in 2008) has almost disappeared.
Besides this, differences between the renewable electricity certificates system and renewable electricity production also originate from the time difference between effective production and the issue of the certificate. This explains why the production according to the certificates is sometimes a little higher than effective production, and sometimes a little lower. Another cause of the differences is that certificates are mainly issued based on gross production, whereas the renewable energy statistics refer to net production (Renewable Energy Monitoring Protocol, SenterNovem, 2006). The difference between net and gross production can be several percent

Renewable heat
In previous renewable energy annual reports, renewable heat was always expressed in avoided primary energy. This calculation method made mutual comparison of renewable sources possible. It was, however, not possible to calculate the share of renewable heat in the total heat supply. With the help of the Dutch National Heating Expertise Centre (Nationaal Expertisecentrum Warmte) and in consultation with the Energy Research Centre of the Netherlands (ECN) Statistics Netherlands has developed a method for calculating the share of renewable heat (Segers, 2009b). It was decided to calculate renewable heat as useful heat production, in accordance with the calculation method for the percentages of renewable electricity and renewable fuels for road transport. Useful heat is the heat available after conversion losses in boilers, transport losses outside the home or business property, and that is used for heating.
The renewable share of useful heat production in recent years was approximately 2 percent. That is less than the proportion of renewable electricity, which grew from 6.5 percent of consumption in 2006 to 7.5 percent in 2008. An important difference with renewable electricity is that there are fewer subsidies available for renewable heat. That partly explains why the production of renewable electricity grew faster.
The biggest contributions to renewable heat come from wood-burning stoves in households (almost a quarter), heat pumps (almost a fifth) and municipal waste incineration plants (one sixth). Renewable heat production has grown in recent years largely as a result of an increase from heat pumps.

International renewable energy statistics
International energy statistics are compiled by Eurostat, the International Energy Agency (IEA) and the UN. They are based on data that member states send to these organisations. In European energy policy, renewable energy statistics play an important role in whether or not targets are achieved.

Targets
The European Union set its first target for renewable energy in 1997: 12 percent of primary energy consumption in 2010 must come from renewable sources (European Commission, 1997). This target was not set out in formal legislation.
Later, a specific target was set for renewable electricity (European Parliament and the Council, 2001). This is an indicative target for the proportion of electricity that should come from renewable sources. For the entire EU this was set at 21 percent of total gross electricity consumption, to be achieved in 2010. There are separate individual targets for each country, because geographical circumstances can vary enormously
There is also a separate target for biofuels in road transport (European Parliament and the Council, 2003). This is expressed as the proportion of biofuels in the total energy content of all petrol and diesel on the market. The target percentages are 2 for 2005, and 5.75 in 2010.
In March 2007 the heads of government agreed that in 2020, 20 percent of the overall energy supply should come from renewable energy, and that this target would be defined with binding legislation. In early 2008 the European Commission published a proposal for this legislation (European Commission, 2008). In 2008, the Council (for which read the governments of the EU countries) and the European Parliament debated this proposal and formulated amendments. At the end of 2008 they reached a political compromise over the amendments. In June 2009 the renewable energy directive was officially published (European Parliament and the Council, 2009).
In the renewable energy directive, separate targets have been agreed for each country, just as in the directive for renewable electricity. This distinction was made because of differences in geographical circumstances, differences in wealth, and differences in efforts made towards renewable energy in the past. For the Netherlands, the European agreement is that in 2020, 14 percent of gross final energy consumption must come from renewable sources.
For renewable energy use for transport, the renewable energy directive has set a separate target: namely 10 percent of the total consumption in 2020. This is the same for every country. There was a great deal of discussion about this target (see also 7.10).
As a result, the directive outlines sustainability criteria which liquid biomass must satisfy. These criteria apply both to the target for total renewable energy, and to the target for energy use in transport. At this time it is not yet clear exactly how the sustainability criteria will be measured. A balance must be made between administrative costs on the one hand and accuracy on the other.
For renewable electricity no separate targets have been set. However, the member states are obliged to draw up action plans in which renewable electricity must explicitly be taken into account. This also applies to renewable heat.
There are several ways to calculate the proportion of renewable energy. For the 2010 targets set in 1997, it was decided to use primary energy consumption as defined in the Eurostat and IEA energy statistics. The 2009 renewable energy directive has opted for gross final energy consumption. Calculations using this method lead to higher renewable energy percentages. There are two main reasons for this. Firstly, hydropower (an important source of renewable energy) and wind energy give a relatively

low figure using the primary energy method. Secondly, in the gross final energy consumption method of the directive, non-energetic use of energy (for example in the production of plastics) is excluded from the calculation. As a result the denominator in the calculation becomes smaller, whereas the numerator does not, because non-energetic use of renewable energy does not exist within the definitions of the energy statistics.
There has been a great deal of political discussion about the target for transport fuels (10 percent in 2020). The result of those discussions is a complex calculation method for the proportion of renewable energy in transport energy consumption. Elements of this target are an extension of the base to include the use of electricity for transport (now primarily trains), where in the numerator, part of the electricity used is counted as renewable, a bonus factor of 2.5 for the use of electricity in road transport, and (iii) the double counting of certain renewable biofuels.

Developments
The contribution of renewable energy to European energy supplies has been increasing slowly for years. Since 2003 this rate of growth has increased, but it is clear that at the current rate, the 2010 targets will not be achieved (figure 2.4.1).
The contribution to electricity from renewable sources is relatively the largest in the electricity, heat and transport sectors. The share of renewable sources in electricity was approximately 16 percent in 2007. This is mainly accounted for by hydropower, which has been a very important source of electricity production in some countries for many years (table 2.4.1). Hydropower is responsible for almost two-thirds of renewable electricity production in the EU. The increase in renewable electricity production has not, however, come from hydropower, but from wind energy and biomass. Many new wind turbines have been installed, especially in Germany, Spain and Denmark. Solar electricity is mainly generated in Germany and Spain. In Germany the contribution of solar electricity to the total electricity supply is 0.5 percent.
In the Netherlands renewable electricity production is approximately half the European average. This is mainly due to an almost complete lack of hydropower. If hydropower is not taken into consideration, the contribution of renewable sources to electricity supplies is above the European average. Renewable electricity production in table 2.2.1 is lower than that in table 2.4.1, mainly because Eurostat does not yet count the biomass content of municipal waste. See also the further explanation in the ‘methods’ section, below.
In terms of gross final energy consumption, heat is a lot more important than electricity. The contribution of renewable energy to total heat supplies is a lot lower than to electricity, and was 11.5 percent in 2007 in the EU. More than half of renewable heat comes from the combustion of wood in households, something that is relatively insignificant in the Netherlands (table 2.4.2). That is therefore the main reason why the proportion of renewable heat in the Netherlands is low compared to the rest of Europe.
Petrol and diesel are the most important fuels in the transport sector. In the EU the contribution of renewable sources to these transport fuels is small compared to electricity and heat supplies. Only in recent years has the use of biofuels for road transport had some significance. This is mainly due to biodiesel in Germany and France (table 2.4.3).
Total gross final consumption of renewable energy is the sum of gross final consumption for electricity, heat and transport (table 2.4.4). Heat is the main factor in this, and biofuels for road transport still play a limited role. As outlined above, sustainability criteria are also important in the renewable energy directive. At this time it is not yet clear what the consequences of these criteria will be. It could be that a portion of the biofuels used does

not count. For this reason two gross consumption percentages have been calculated: a percentage with biofuels for transport and a percentage without. In addition, the sustainability criteria also apply to liquid biofuels that are used outside the transport sector. For the time being, for simplicity, these have been counted in the calculation of the total proportion of renewable energy in gross energy consumption in table 2.4.4. Sweden leads the EU in terms of the proportion of renewable energy in its gross consumption. It is a country with large areas of woodland and large amounts of hydropower for relatively few people. The same applies to Finland, Latvia and Austria. In Germany the consumption of renewable energy has grown strongly in recent years. Even so, the proportion of renewable energy in this country is still below the EU average. In the Netherlands the contribution of renewable energy to the total energy supply is relatively small. In the largest sector in particular, heat, there is little use of renewable energy.

Methods

Internationally, the choices made with respect to definition and presentation style differ from those made nationally in the Renewable Energy Monitoring Protocol (SenterNovem, 2006). As a consequence the international figures for the Netherlands deviate from the national figures.

International renewable energy statistics are part of a unified system of international energy statistics (IEA/Eurostat, 2004). These are based on common surveys by the International Energy Agency (IEA), Eurostat and the United Nations. Statistics Netherlands participates in these surveys for the Netherlands according to the IEA and Eurostat definitions. IEA and Eurostat traditionally use the so-called primary energy method, also called the input method. Because this has some disadvantages, the European Commission, in its proposal for a renewable energy directive (European Commission, 2008), looked for an alternative, and as a result has developed the final energy method. The substitution method is used in the Netherlands, and a so-called life cycle analysis (LCA) is frequently carried out for biofuels. All methods are explained in detail below. First of all, we discuss the question of which forms of renewable energy count.

Heat pumps, heat and cold storage, and household waste

Cold is not viewed internationally as an energy carrier. For this reason cold storage is a form of energy saving, and therefore only appears indirectly in international energy statistics as reduced electricity consumption, such as in the Dutch Energy Balance Sheet. Storage of ambient heat possibly falls under geothermal energy. Official documentation (IEA/Eurostat, 2004 and explanations in the surveys) gives no definite answer to this. For the time being, following consultations with Eurostat, it has been decided not to include it because the heat comes not from the ground, but from the atmosphere. In the new European renewable energy directive, geothermal energy is defined as all energy that comes from under the surface of the earth. Using this definition, heat storage clearly does count.

Heat from heat pumps only appears in IEA and Eurostat statistics if it involves heat that is sold. According to the IEA and Eurostat, this heat currently does not fall under renewable energy. In the Netherlands the bulk of heat pumps are owned by the users of the heat they produce. Statistics Netherlands has no data about heat from heat pumps

that is sold. For this reason Statistics Netherlands does not declare this to the IEA and Eurostat. In the new European renewable energy directive however, heat pumps are taken into account, irrespective of whether the heat is sold or not (European Parliament

and the Council, 2009). However, it has been agreed that heat pumps only count if they meet a requirement for energy efficiency. Eurostat is currently investigating how heat pumps can be incorporated into energy statistics. It is discussing this with statisticians from the member states, the energy department at the European Commission (DG TREN), and European trade associations.
A big difference between Eurostat and the IEA is that Eurostat also includes the non-biomass share of municipal waste that is combusted in municipal waste incineration plants, whereas the IEA does not include this. The reason Eurostat includes the non-biomass part, is that many countries do not split their declaration about the quantity of waste combusted in waste incineration plants into biomass and non-biomass. In such cases the IEA itself makes an assumption about the split, whereas Eurostat does not. Eurostat is urging member states to make this distinction (Eurostat, 2008).

Substitution method and primary energy method
The Dutch method for calculating renewable energy is called the substitution method. This looks at what the primary energy consumption would be in a reference situation if no renewable energy was used. The IEA and Eurostat do not use this method.
Instead, the IEA and Eurostat count the first useful form of energy for end users, which they treat as primary production (IEA/Eurostat, 2004). This is called the primary energy method, or the input method. For wind energy, hydropower and solar electricity therefore, this means electricity production. For biomass combustion it means the energy content of the biomass, and for biogas it means the energy content of the usefully consumed biogas (thus excluding flaring). For solar thermal energy it means the heat available to the heat distribution medium, minus optical and collector losses. The Renewable Energy Monitoring Protocol (SenterNovem, 2006) provides key figures for calculating solar thermal energy according to this definition.

Final energy consumption method from the EU directive for renewable energy
In the draft of the renewable energy directive (European Commission, 2008), the Commission chose a third method: the so-called final energy method. This is also used in the final version of the directive (European Parliament and the Council, 2009). In this method the gross final energetic energy consumption is taken as a starting point (the denominator), and it looks at what part of this comes from renewable sources. It is important to know here that at Eurostat and the IEA, the term final consumption is limited to meaning final consumption outside the energy sector. The difference between ordinary final consumption and gross final consumption is that the gross figure also counts the consumption of heat and electricity for electricity generation, and transport losses.
For heat this primarily concerns the final energetic use of biomass, and for transport it concerns the use of biofuels. The gross end use of renewable electricity and of sold renewable heat is not explicitly available in the energy statistics. For this reason this is defined as the production of renewable electricity and of sold renewable heat, possibly then corrected for trade between member states.
An important point in the EU directive is that liquid biomass can only count if it meets the sustainability criteria formulated in the directive. These criteria are connected to the production method and origin of the liquid biomass, and do not depend on the liquid biomass itself. An administrative system is therefore needed to review whether the liquid biomass used meets the conditions in the directive. This system is still in development. At this moment therefore it is not yet clear whether or not the liquid biomass used meets the criteria. There is also still a great deal of uncertainty regarding heat pumps. The directive says heat pumps do count, and that the input of heat from the ground, surface water or air

counts as renewable energy. Therefore the conversion losses during the production of the electricity consumed by the heat pumps are not taken into account. On the other hand, heat pumps only count if the so-called Seasonal Performance Factor (SPF, a measure of energy performance) meets a certain condition. There are several ways to define and measure this SPF. This also applies to the energy production of the heat pumps. The directive stipulates that the European Commission will establish a method for determining the SPF and the heat production of heat pumps by 2013 at the latest. During the last stage of the political decision-making regarding the EU renewable energy directive, the definition of gross final consumption was again slightly modified. Countries with a relatively high energy consumption for air transport need not count the portion of this that lies above a certain limit in their gross final energy consumption. In the directive this limit has been set at 4.12 percent for Cyprus and Malta, and 6.18 for the other countries. The Netherlands has a relatively large amount of air transport, and thus in 2007 it qualified for this 'aircraft discount'. This was approximately 1 percent of gross consumption. The gross consumption of countries with relatively little air transport is not adjusted upwards. As a result the air transport discount makes it easier to achieve the targets.

LCA method

In addition to primary energy, substitution and final energy, there is a fourth method to calculate renewable energy: life cycle analysis (LCA). This goes a step further than the substitution method, in the sense that it compares not just the end use of renewable energy carriers to conventional energy carriers, but the complete production processes of renewable and conventional energy carriers. For biofuels for road transport in particular it is usual to make this type of analysis ('well to wheel'), because at least half the CO2 emissions saved can be lost during the production process of the current generation of transport biofuels. LCA studies are certainly useful. However, for statistical purposes the method is still cumbersome to apply, because LCA efficiency depends strongly on the individual production process. Therefore using the LCA situation can be more difficult than the substitution method when defining an objective, acceptable reference

Outcomes by method

What is notable is that for wind energy, hydropower and solar electricity, renewable energy is much higher using the substitution method widely applied in the Netherlands. For municipal waste incineration plants and household stoves, renewable energy is much higher according to the primary energy method.

These differences are explained by differences in definition.

Wind energy, for example, is calculated in the substitution method using a fictitious input, based on an electricity power station that requires two to three units of primary energy to make one unit of electrical energy. However, in the primary energy method, wind energy is measured directly as the electricity production. For municipal waste incineration plants and household stoves, the substitution method takes the difference in efficiency between these installations and a standard installation into account, whereas the primary energy method does not. Because of the relatively low efficiency of waste incineration plants and household stoves, there are large differences between the figures derived with the substitution method and the primary energy method. The differences in definition had little overall impact in 2008. The calculation of the renewable share in both methods is divided by the total primary energy consumption. The consequences of definition differences in this case are small.

What is immediately noticeable is that the denominator is considerably smaller than with the other methods. This occurs because conversion losses are omitted, both in the numerator and the denominator. Another fundamental difference is that non-energetic

energy consumption is also omitted, such as in the manufacture of plastics. By contrast, renewable electricity counted in the numerator is much lower than in the substitution method.
Because of the uncertainties in the EU directive regarding heat pumps and biofuels, two alternative final energy methods have been developed, a (high) variant with heat a pumps and biofuels, and a (low) variant without. In the low alternative, the proportion of renewable energy comes to 2.6 percent; in the high alternative to 3.7 percent. Precisely how the directive develops in the coming years is therefore very important. Moreover, in the high alternative it is important to realise that the energy production of heat pumps could be far too high (see also section 6.1), because of the margin of error in estimating the full-load hours.

Advantages and disadvantages of the different methods
The advantage of the substitution method is that it is a reasonable approximation of the avoided use of fossil fuels, and the associated avoided CO2 emissions. These are two important reasons why renewable energy is stimulated. There are, however, also disadvantages to this method (IEA/Eurostat, 2004). Firstly, according to this report the substitution method has limited significance if renewable electricity production is the dominant form of electricity production (in countries with a lot of hydropower). Secondly, the reference efficiencies are difficult to determine objectively. Thirdly, the substitution method leads to artificial conversion losses if the attributed consumption of primary energy is also incorporated into the energy balance sheet. The first and third disadvantages do not apply to the Dutch situation since the renewable energy calculation is separate from Statistics Netherlands' Energy Balance Sheet. The second objection is overcome by letting the involved parties choose using the Renewable Energy Monitoring Protocol.
Although the desire for international comparability is increasing, the advantages of the substitution method for the Dutch situation clearly outweigh the disadvantages. The situation is different internationally: on the one hand because there are countries in which hydropower is an important source of electricity production, and on the other because it is difficult for a group of countries to agree on a reference. This explains why the IEA and Eurostat do not use the substitution method.
The advantage of the final energy method is that all forms of electricity generation are compared in the same way. A disadvantage, however, is that 1 joule of electricity counts as the equivalent of 1 joule consumed for heat or transport. An example will make this clear. Take 1 joule of biomass. If this was used for electricity production, it would lead to approximately 0.4 of a joule of renewable energy. This same joule of biomass used directly for heating however leads to 1 joule of renewable energy. This is a difference of a factor of 2.5, whereas in both cases the quantity of fossil fuel replaced is approximately the same. In the final energy method therefore, renewable electricity is undervalued and renewable heat and transport are overvalued. One consequence of this could be that countries will invest more in heat and transport, whereas in terms of the avoided use of fossil fuels it could be much more efficient to invest in renewable electricity.
Omitting non-energetic use (just 10 percent of the total final energy consumption in the EU (Eurostat, 2007)) from the denominator of calculation, has the effect of increasing the percentage of renewable energy, because the renewable non-energetic consumption in

the denominator of the calculation, according to the definition of the energy statistics, is zero. An alternative to omitting this is to define certain forms of non-energetic consumption as biomass. The advantage of this would be that the replacement of fossil resources with sustainable resources is stimulated in the same way as the replacement of fossil energy with renewable energy. A similar argument goes for the use of fuels for international sea transport. In international energy statistics this counts as a form of export and not as consumption. The article: 'Three options to calculate the percentage of renewable energy: an example for a EU policy debate" (Segers, 2008) discusses the different methods in more detail.

Differences in release policy

Besides methodological aspects, the differences between national and international figures also have another cause: the time lag between the moment Statistics Netherlands supplies the figures to the international organisations, and the moment they are published by those organisations. Thus the figures for 2007 in the IEA (2008) were based on the so-called mini-survey that Statistics Netherlands sent to the IEA in May 2007. The data in this survey correspond roughly to the second provisional figures that Statistics Netherlands published in June 2007. The second provisional figures deviate slightly from the definite figures for 2007, published in November 2008. The data which now appear on the Eurostat website run up to and including reporting year 2007, and were based on the declarations of member states in autumn 2008.

Method, renewable electricity

For renewable electricity, domestic production is always used as the basis, both nationally and internationally. Imports of renewable electricity do not appear at all in international statistics. Under the terms of the new renewable energy directive, it will be possible in the future for member states to trade mutually in renewably produced electricity. This is separate from both the effective physical flow of electricity and the international trade in renewable energy certificates.

The first difference is that internationally, gross electricity production is always the basis, whereas nationally it is net electricity production. The main consequence of this is that, internationally, municipal waste incineration plants appear to contribute more to renewable electricity because the relatively large internal electricity consumption of these installations is not discounted.

In addition, there are three different definitions in use internationally. The IEA uses renewable electricity production as a percentage of total electricity production as its leading indicator (IEA, 2008). Eurostat on the other hand uses renewable electricity production as a percentage of total electricity consumption (Eurostat, 2009). This conforms largely with what is usual at a national level, with the definition of renewable electricity in the EU directive (2001/77/EG), and with the new renewable energy directive (European Parliament and the Council, 2009). The difference between the definition in the directives and the Eurostat definition is that Eurostat also counts electricity production from the non-biomass portion of incinerated municipal waste in municipal waste incineration plants as renewable electricity. The reason for this is that data are only available for a few member states regarding the split between these biomass and non-biomass portions. The IEA has solved this by estimating the split for the countries where these data are lacking. Eurostat is more reserved about this.

A new element in the EU renewable energy directive as from 2009 is the standardisation procedure for electricity from hydropower (15 years) and wind energy (5 years). This is designed to filter out the influence on the figures of annual fluctuations in the quantities of

wind and precipitation. For wind energy, this procedure has the effect of making Dutch electricity production much lower in 2008. There are several reasons for this. Firstly, it was 5 percent windier in 2008 than the average over the past 5 years. Secondly, the rise in the average number of full-load hours (3 percent in the past 5 years) by offshore wind farms and higher masts was slowed down. Thirdly, the standardisation procedure uses the installed capacity of wind turbines at the end of the year. That causes some noise.
International figures for renewable energy on the internet

The address of the Eurostat website is http://epp.eurostat.ec.europa.eu. The Statistics tab at the top of the page gives access to the figures. Then select the topic Energy at the bottom of the page. On the left-hand side at the top you have a choice of more options. Under Main tables you will find pre-defined summary tables. Publications gives access to pdf versions of several publications. The detailed figures are found via Databases, as in Statistics Netherlands' StatLine database. The figures for renewable energy are found via Databases under Energy statistics – quantities, and then under Energy statistics – supply, transformation and consumption.

The address of the IEA website is www.iea.org. The IEA's standard publication about renewable energy is called Renewables Information. It is not freely available, but is available for purchase as a hardcopy or as a pdf. Besides compiling statistics the IEA also has an umbrella function for diverse technology-oriented collaborations. These are called technology agreements or implementing agreements. A number of these collaborations exist for renewable energy, and frequently have their own publications. Information about these collaborations can be found via the IEA homepage: click on the Energy Technology Agreements tab (top left) and then on Renewable Energy. SenterNovem coordinates the Dutch participation in these collaborations, and provides information about this via www.senternovem.nl/kei.

Official publications from Eurostat about renewable energy appear relatively long after the end of the reporting year. Nevertheless, to get a quick overview of developments, the European Commission has contracted out the task of swiftly creating publications by renewable energy sector (Observ'ER). The publications can be found on the website www.eurobserv-er.org, and are available relatively rapidly after the end of the reporting year. Sometimes they are compiled using estimations, which can have a negative impact on the quality of the figures. On the other hand Observ'ER publications are generally useful to get a quick indication of developments in the most important countries.
Lastly, some European trade associations also produce statistical information. The European Wind Energy Association (www.ewea.org) generally publishes figures around 1 February on the sale of wind turbines (in MW) by country during the previous year. Likewise, the trade associations for bioethanol producers (www.ebio.org), biodiesel (www.ebb-eu.org), solar thermal energy systems (www.estif.org) and heat pumps (ehpa.fiz karlsruhe.de) all publish figures by country.