Evidence of steps towards a sustainable energy system in other countries

November 2006

Role of Regulators in Delivering Sustainable Energy Systems
SDC in-depth review

Evidence of steps towards a sustainable energy system in other countries

Report prepared for the Sustainable Development Commission

By

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Introduction

Note that although this report aims to deal with electricity, gas and heat markets, in many countries policies have been directed solely or mostly at the electricity market and therefore this is what is covered in these cases. The report deals mainly with policies to promote energy efficiency, renewables, CHP and decentralised generation in an energy market context – i.e. policies that are designed to have an impact on the market or market participants. It does not aim to cover comprehensively the broad range of policies to promote sustainable energy such as building codes, appliance standards, government grants and so on, except to deal with them where they interact with energy market issues, or to provide brief background to a country's energy policy stance. So the main areas covered are :

- support mechanisms and changes in network regulation to incentivise renewables and CHP (e.g. feed-in, RPS, connection and use of system charges)
- measures to promote a heat market to use waste heat from power stations and industry
- obligations or incentives on energy companies to promote energy efficiency (e.g. DSM, white certificates, public benefits funds)

- the roles of government departments, energy regulators and other agencies, plus the roles of the market participants (energy companies) in these various mechanisms

Decentralised energy

The report aims in particular to examine the impact of policies on decentralized energy. A wide range of terms are used to describe decentralized and distributed energy and power (see Appendix). Established systems mainly consist of large generating stations that produce and transmit electricity through high voltage transmission systems then, at reduced voltage, send the power through local distribution systems to consumers. Distributed or decentralized generation (DG) plants by contrast connect to the local distribution network. They can either produce power on a customer's site (from micro generation in single home to a large plant on an industrial site) where some is consumed and some is sent to the local distribution network; or generating facilities (e.g. wind turbines) that send all their power output to the local distribution network .

The term "generation" implies a focus just on electricity. The term "decentralised energy" encompasses systems that produce heat or electricity or both and is thus preferred and used in this report. Technologies for decentralized energy can include : large, small and micro CHP (using gas, oil, coal or renewable fuels such as biomass); wind turbines; Solar PV and solar thermal; fuel cells, ground source heat pumps.

Policies that affect penetration rates for decentralised energy can thus include policies that focus on renewable energy (whether decentralised or not); policies that focus on combined heat and power; policies that focus on district heating; and some policies that focus on energy efficiency/ demand side management. There are few examples of policies that aim specifically to promote decentralised energy. This report therefore deals with policies under the general headings of : renewables; district heating and CHP; and energy efficiency/demand side management, highlighting the decentralised energy aspects of each.

Energy Service Companies (ESCOs)

The report also includes specific consideration of the role of ESCOs. The appendix contains a review of the varying definitions of ESCOs but the main differences are summarised here. The term "ESCO" is most usually, in the UK EU and US, applied to companies which finance and install energy efficiency measures, paid for out of the client's energy bill savings, but which are not necessarily involved in energy supply. However, the term "ESCO", can also mean complete energy services - i.e. energy supply and measures concerned with end-use. Such ESCOs aim to maximise efficient and cost-effective supply and end-use of energy for their customers and thus will encompass competitive purchasing of various fuels plus at least one of the following : CHP, end-use efficiency measures, consumption monitoring and management, etc. We can therefore distinguish this type of ESCO from energy supply companies - whose main role is supplying units of gas, electricity or heat - and from the more energy management based ESCOs whose main pre-occupation is supplying energy efficiency services.

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Executive Summary

General findings

The UK has similar energy policy goals to many other countries and similar policy instruments to facilitate sustainable energy. However, although most countries tend to have the same three goals – economic efficiency, security and environment – in the US and most of Europe there has been a tendency to place security of supply and/or environmental considerations ahead of economic efficiency . This manifests itself in being more cautious about liberalisation and a greater willingness to use forms of planning that in the UK have been limited since privatisation. In particular, although the US and a number of EU countries have liberalised their wholesale markets, many have been much slower to liberalise retail markets, particularly for smaller consumers. Even where retail markets have been liberalised, price control remains in most cases.

There are significant differences between Europe and the US in terms of the experience of independent energy regulation. Whereas the US energy regulators are long established those in most of the EU have only been established within the last ten years. For this reason the California regulator has had a much more substantial role than the Dutch and Danish ones in the development of regulatory mechanisms that determine the sustainability of the energy system. To date the role and impact of the Dutch and Danish regulators in decisions that affect the sustainability of the energy system has been rather marginal although there are some relevant decisions.

In California regulatory discretion has been used over more than 20 years to mandate a range of actions to facilitate sustainable energy, even where they have imposed up-front costs on customers. In Denmark and the Netherlands the energy regulators seem to have been established with relatively narrow remits that focus on economic regulation tasks and allow less scope for discretion.

In some European countries and some US states (and in all three case studies) there also energy agencies or commissions, with varying degrees of autonomy from government, that influence policy development. Many of these agencies/commissions have been given a specific remit on climate change/ renewables/ CHP/energy etc. Energy regulators in many US states and EU countries therefore, work alongside other state institutions with a role in policy formation and implementation.

Liberalisation has thus tended to follow the establishment of significant use of decentralised energy in many EU countries and US states, or liberalisation has been designed specifically to incentivise sustainable energy – e.g. the PURPA legislation in the US. This is in contrast to the UK where liberalisation started early and decentralised energy thus had to fit into a system not designed for it.

Another factor that differentiates much of Europe and the US from the UK is the role of local authorities and co-operatives in energy markets. In much of Europe local and provincial/state authorities have been major owners of electricity and district heating companies. Organisations under local control can be expected to have somewhat different motivations from companies without such strong local ties.

An important difference between the European case studies and California is the issue of fuel poverty. In California, as in the US generally, there are state and federal level programmes to help low income households with energy costs and energy efficiency, similar to the UK. The regulator in California, like Ofgem, is centrally involved in action to assist low income households. In contrast, in Denmark and the Netherlands like most of Europe, fuel poverty is not recognised. This is partly explained by its lack of prevalence due to better housing standards, insulation and heating provision and more generous welfare benefits.

Achievements in California, Denmark and the Netherlands

In Denmark, by 2004, 28% of electricity was from renewables and 60% from CHP, with 60% of homes heated by district heating. In the Netherlands, by 2005, 54% of electricity was from CHP and 6% from renewables. In California, in 2005, 17% of electricity generation was from CHP and 11% from renewables.

Denmark is unusual amongst IEA countries in having reduced its total final consumption - in 2004 it was 3.5% lower than in 1980 and is the lowest in the EU. CO2 emissions have also fallen – from 61 Mt in 1990 to 51 Mt in 2004, although they are relatively high as 50% of electricity is still produced from coal.

In the Netherlands, although energy intensity has declined since 1980 it remains higher than the EU average – partly due to energy intensive industry. Total final consumption was higher in 2005 than in 1980, in common with most other IEA countries, including the UK. Greenhouse gas emissions in 2005 were back to the 1990 level after having risen for some years.

Electricity use per capita and per unit of GDP is lower in California than in all other US states and has remained almost flat for the last 30 years whereas in the rest of the US it increased by 45%. Greenhouse gas emissions increased about 1% from 1990 to 1999- in the US as a whole, emissions increased 12% over the same period.

Looking at the key measure of carbon emissions, the UK compares relatively well. The UNFCCC receives and publishes data on total emissions for countries that are parties to the Convention on climate change. (UNFCCC, 2006) These show that from 1990-2004 total emissions :

- For Denmark fell by 1.1%
- For the US increased by 15.8%
- For the Netherlands increased by 2.4%
- For the UK fell by 14.3%

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The IEA has 1998 data[1] that covers the following countries :

- 0.6 kgCO2/US$ for the US
- 0.4 kgCO2/US$ for the UK
- 0.38 kgCO2/US$ for Denmark

Denmark

In Denmark the two key policy instruments have been the heat planning law that has promoted CHP and district heating and the feed in law that has promoted renewables and CHP. These have both been long term policies – since the late 1970s and early 1980s. Denmark had a strong motivation to reduce dependence upon imported oil that led to the heat planning law, which gives local authorities the power to designate zones in which only district heating can be used and to oblige buildings to connect to it. The feed in law pays CHP and renewables generators a fixed price for the output they feed into the grid, higher than the market price for other electricity, and obliges network operators to connect them at relatively low cost.

Local authorities and co-operatives have had important roles in the development of renewables and decentralised energy in Denmark and still mostly control local distribution and supply of electricity and heat. They saw this as a means of generating additional revenue and recognised the value of keeping income within the local area.

The IEA found that it would have been cheaper to achieve emission reductions through energy efficiency rather than renewables. However, that does not take into account other benefits such as diversity of supply. Furthermore the costs of support are reducing and the policies may have helped to reduce costs. The prices paid through feed in tariffs for onshore wind fell from 10 eurocents per kWh in the 1980s to 5 eurocents per kWh in 2004. In 2005, the cost of support for renewables was approximately 3% of the household consumer's final bill and 9% for businesses. This is similar to the Renewables Obligation in the UK in percentage terms - 3% for household consumers and 7% for industrial consumers – although as energy bills are higher in Denmark the money impact is greater.

Most of the costs of CHP and district heating have been paid by the heat consumers, although they have been subsidised through tax exemptions and grants for households to convert from electricity. Households who use district heating pay lower heating bills than those using other forms of heating. The prevalence of district heating (60% of households) in urban areas, where most low income households live, is one reason why fuel poverty is not a problem in Denmark despite high energy taxes.

[1] IEA. 30 years of energy use in IEA countries. IEA 2004.

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Denmark deals successfully with wind intermittency, but relies heavily on its connections to other countries to do so. There is overcapacity in the Danish electricity generating sector and the historically open-ended support for renewables and CHP has contributed to this. Changes to policies in recent years are designed to help reduce overcapacity as well as costs to consumers.

Netherlands

In contrast to Denmark, the Netherlands does not make extensive use of citywide district heating – about 3% of homes are served by it. The major use of decentralised energy has been on-site CHP in the industrial, commercial and public sectors that feed surplus electricity into the electricity distribution network. CHP has grown substantially since the 1980s through a combination of policies. In addition to some favourable market rules on connection charging, imbalance charges and more recently, credits for reducing grid losses, these have included: subsidies and tax deductions, (since 2005 a form of feed in tariff); exemptions or reductions in energy and environmental taxes (ended in 2005)

Other factors have also been important. High heat load demands in industry, agriculture and horticulture make CHP particularly cost effective in the Netherlands and CHP was a way to deliver commitments to CO2 reduction covenants agreed with the Government. With controls on developing large-scale generation, plus the fact that their largest customers could, from 1989, buy electricity directly from generators, build their own CHP or import electricity, energy suppliers started offering CHP to customers, providing financing where necessary.

The Netherlands has a long tradition of the Government reaching formal agreements with industry as an alternative to more regulation and /or taxes. These agreements have been very effective, as political consensus means industry can be sure the policy will persist and the Government will resort to regulation and/or taxes if the agreement is not adhered to.

For a time in the late 1990s, growth in CHP created so much overcapacity that central generation had to be curtailed. According to the IEA, although there were some initial problems, network operators have largely been able to cope with high levels of CHP without compromising reliability.

Netherlands policies to date for renewables have had limited success and some undesirable consequences. The policies which encouraged consumers to buy green energy, led to increased imports because production in the Netherlands did not rise enough to meet demand due to lack of investor confidence in the stability of the regulatory and fiscal framework and delays in obtaining permits and licences. Green tariffs were often little cheaper than standard tariffs, even though suppliers could claim tax exemptions. The extra imports also led to congestion of the transmission system increasing congestion rents for transmission system operators.

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The Netherlands Government is close to deciding to proceed with smart metering for all residential customers based on a detailed cost benefit study undertaken by the energy agency, SenterNovem.

California

There are more parallels with the UK, in terms of the role of the California regulator in policies to facilitate renewables and energy efficiency, than in the two European case studies. However, whereas Ofgem has administrative responsibilities for EEC and the RO, the CPUC can decide how much should be spent on similar initiatives.

Political leadership has been significant in California, with consensus across political parties - regulators reflect state political preferences. Environmental and security concerns - particularly following its 2001 energy crisis, when full retail competition was abandoned - have tended to take precedence over competition.

The lack of competition combined with continued vertical integration means that some policies that can be applied in California would not be so easy to adopt in the UK, even if they were considered desirable. The CPUC can and does require the utilities to adopt rising block tariffs designed to discourage consumption and provide help to low income households. The CPUC can still require the companies to undertake integrated resource planning (IRP)– to compare the costs of meeting energy needs through a range of resources including demand side response. IRP would be much more complex to undertake in an unbundled market with full retail and wholesale competition.

Support for renewables and CHP has been provided in California through a mixture of federal and state level initiatives, since the late 1970s. The 1978 PURPA legislation has operated effectively as a feed-in tariff, providing guaranteed prices and long term contracts for non-utility owned CHP and renewables.

With the electricity market restructuring in 1998, the regulator (California Public Utilities Commission - CPUC) established the public goods charge (PGC) - a levy on retail charges, which has provided substantial funds for energy efficiency and renewable energy - including household level renewables. The California Solar Initiative begins in January 2007 and will raise $2.9 billion over ten years to subsidise renewables of less than one megawatt, on new and existing buildings.

The Renewables Portfolio Standard, established in 2002, requires the three main electricity utilities to source a minimum percentage of renewable energy, building up to 33% by 2020. Although it sounds similar to the RO it operates in a different way due to the continued level of regulation in the market. The utilities run a competitive bidding process to procure renewable energy, based on methodology laid down by the CPUC including price benchmarks that must reflect the long-term market price of electricity they would require to meet capacity needs from conventional fossil fuels. A similar Portfolio Standard now applies for energy efficiency

California's net metering law was established in 1995 and applies to customers who install small solar, wind, biogas, and fuel cells (1 MW or less). Consumers on "time of use" pricing can have meters that value electricity at different prices during different periods of the day (the retail rates that apply at those times). Market rate metering (where retail prices are related to wholesale prices) will be implemented in California starting in 2006 (as part of the smart metering roll-out) for photovoltaic and wind systems.

Lessons for the UK

It is clear that there are advantages and disadvantages of the policy and regulatory frameworks in other countries and that they do not necessarily fit easily with one of the four objectives of UK energy policy – competitive markets. Despite these caveats there are some lessons for the UK. These fall into five main areas : the importance of political leadership; institutional framework; the role of local authorities and community ownership; specific incentives for decentralised energy; energy efficiency, including ESCOs and smart metering.

The importance of political leadership

Firstly, it is worth noting that many of the key decisions in the case study countries have not been taken by regulators – they have been political decisions and illustrate the importance of a lead from government. Another important factor in Denmark and California is the role of political consensus, so that overall policy has remained reasonably consistent despite changes in political control. Whilst it is clear that intervention (regulation and/or incentives) is required to encourage renewables, CHP and energy efficiency, it is not always the energy regulator that has or should have the main role in some key policies. There is a need to avoid placing too much emphasis on changing the role of the regulator - it may be as, if not more, important to change policy or institutional capacity within government .

Institutional framework

In each of the case studies there are energy agencies or commissions that have important duties and responsibilities. Ofgem's duties have been changed to encompass sustainable development only relatively recently. One option would therefore be to pursue further incremental change within those duties, to build on recent progress in taking on board greater consideration of environmental and social concerns in major decisions. However, new circumstances may mean that institutional change is required to enable the UK to develop and implement new policies, particularly to tackle climate change. In this case options would be : to change the role and duties of the regulator; to give some more functions to the Environment Agency; to establish an energy agency; or to bring DEFRA and DTI energy functions together, to build critical mass of expertise and greater policy co-ordination. However, major institutional change would be time consuming and disruptive – disruption can be positive, but is not something to be embarked upon lightly – it needs a problem in search of a solution rather than the other way around.

The role of local authorities and community ownership

The role of local authorities does offer some potential for the UK and there is already experience that could be built upon. Similarly, the role of co-operatives and other forms of community ownership is also worth looking at. Local authority and community ownership could make an effective contribution to all four of the UK's energy objectives. Many local authorities have a strong commitment to the environmental and affordability objectives, with initiatives to reduce carbon emissions and fuel poverty. The local approach could help contribute to security of supply and bring new entrants into the energy market helping to increase competition. The Climate Change and Sustainable Energy Act 2006 provides new powers for the Secretary of State to promote community energy projects, which could address some of the barriers limiting their role at present.

In the Netherlands, local authorities can reach agreements with local companies on the contribution they can make to local climate policy (e.g. through an energy saving plan) and enforce it through licensing powers . This may be an option also worth considering in the UK.

Specific incentives for decentralised energy

The key policy that has driven high levels of renewables in Denmark, (also Germany and Spain) has been the feed in mechanism that has provided predictable prices and encouraged investment. The main downside of the feed in mechanism is the difficulty of determining prices, which means that the system historically has been costly. However, the costs of feed in have been reducing as prices of technologies have fallen. Feed in laws have been more conducive to small participants than quota systems, such as the renewables obligation, which tend to favour participants with broad generation portfolios (who can manage the risks of market prices), and/or have substantial supply businesses and therefore do not need to negotiate contracts to sell the power. Some changes have been made to the RO in recent years to make it easier for smaller participants but there may still be need for more action here. It may be that newer forms of metering could help to ensure that small generators can more easily receive RO credits.

Regulatory issues - licensing (supply and generation), connection policies and technical standards and the value placed on distributed generation are also important. The new actions that Ofgem has been taking since 2000 do show progress - for example new incentives for network operators to connect distributed generation and increased incentives to reduce electricity losses and gas leakage. However, there are still improvements to be made in these areas and some useful lessons might be learnt from Denmark and the Netherlands.

Forms of "net metering" are used in a number of countries to enable small distributed generators to sell their surplus power. The term "net metering" is usually taken to mean that the generator is paid the retail rate for the power that they sell. However, the value of surplus power to the network will vary according to the time of day, season and location but as the California case shows, metering can enable an appropriate price (however defined) to be paid for distributed generation. Given the current review of metering in the UK there is an opportunity to explore options that will provide incentives to distributed generation but also take into account different values and thus be applicable in a UK market context.

Energy efficiency, including ESCOs and smart metering

In terms of incentives for energy efficiency provided through the energy market, the UK's EEC is similar to the PGC funded schemes in California and various initiatives that have been taken in recent years in Denmark and the Netherlands. The Energy Efficiency Portfolio approach in California, which is being used in a number of other US states, probably has limited applicability to the UK. Like the Renewables Portfolio standard, it is based on a vertically integrated utility model with limited retail competition.

The Baseline Allowance scheme used in California may be worth exploring as a contribution both to energy efficiency and reducing fuel poverty. In the absence of retail price controls Ofgem could not mandate this but it could be linked into the development of smart metering or the proposed move from EEC to a demand reduction obligation. However this would require careful analysis of the impacts on different consumer groups, as some low income households need to use a lot of energy and so could be penalised unless their homes were made more energy efficient before using such a tariff.

It is notable that the role of ESCOs is still fairly limited worldwide. They have mostly operated in the public sector - sometimes set up by utilities (as in the Netherlands) and sometimes mainly by independent companies. The lessons for the UK are thus relatively limited. It is also important to note that ESCOs are a delivery vehicle for energy efficiency and CHP – a means to an end not an end in themselves.

California has decided, on the basis of a cost benefit analysis, to mandate smart meters for all customers to be installed over a 5 year period. The Netherlands is close to reaching a similar decision also based on a cost benefit analysis. Ofgem's decision was that it would remove some barriers, but would otherwise leave it up to the market. The Government is considering whether it needs do more to meet the requirements of the EU Energy Services Directive. Widespread installation of smart meters would be costly and intervention may not be needed if suppliers install the meters themselves - although how far and how quickly this will develop remains to be seen. The trials in 2007-08 will help to show how effective smart meters are in terms of encouraging energy saving or shifting demand from peak to off peak periods. Some further action to accelerate progress, if metering competition will not deliver, or would only do so over a very long timescale, may therefore prove desirable. This could be a national geographic roll-out or could involve obligations on suppliers to smart the meter stock over a given period.

Conclusion

This international review and particularly the case studies of Denmark, the Netherlands and California have demonstrated that a range of policies can be used to increase the sustainability of the energy system. Policies clearly vary in terms of cost and how effective they have been in terms of stimulating new decentralised energy and greater take up of energy efficiency. They also vary in terms of how much of a contribution they have made to reducing greenhouse gas emissions. Given the UK's economic and social context, some policies are clearly more replicable or adaptable than others. Nevertheless, there are some useful lessons from these case studies for the UK and some ideas for policy development.

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Chapter 1 : World wide review

Introduction

1.1 This chapter starts with an overview of energy policy, markets and support for sustainable energy – energy efficiency; combined heat and power/district heating; renewable energy - worldwide. It then goes on to consider these issues in the EU and US. Within this it covers particularly the impacts of policies on penetration rates of decentralised energy and to some extent, ESCOs. Its also briefly examines policies for and penetration rates of decentralised energy in Australia and Canada.

Energy policies and markets

1.2 As the IEA says, all IEA countries, "strive to achieve the three E's of energy policy: economic efficiency, energy security and environmental sustainability" (IEA, 2005). To that extent therefore they all have the same goals, although some place more emphasis on one or more goals than the others. However, for all countries, security of supply has to be the main priority, followed by economic considerations and environment. Even countries with strong environmental policies and outcomes have tended to do so mainly for energy security and economic reasons.

1.3 Electricity industry structures vary widely from country to country. The main variations are in terms of:

- level of competition
- degree of integration (vertical or horizontal)
- ownership (public or private)
- degree to which the system is established or developing

1.4 There are essentially four functions in the electricity supply industry, generation, transmission, supply (often called retail) and distribution. Any or all of these functions may be privately or publicly owned; two or more of them may be contained within the same company; generation and supply may be undertaken on a monopoly basis or subject to competition – transmission and distribution are considered natural monopolies. (see glossary for definitions of the various terms)

1.5 Regulatory and energy market reform is worldwide – in developed, transition and developing countries but developed countries have most similarity to the UK in terms of market structure and energy policy goals. The countries chosen for this review are therefore those within Europe (EU primarily) and the US – i.e. some of the main IEA member countries. There is also briefer information on Australia and Canada, looking specifically at decentralised energy in those countries.

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1.6 The International Energy Agency has observed (IEA, 2004), that significant market growth has always resulted from combinations of policies, rather than single policies, and that local and state/provincial authority and involvement are important. Although a wealth of experience exists for older policies, the IEA suggests that it is still too soon to assess the impacts of policies that have been established since 2000.

Renewables and CHP policies

1.7 Renewables and CHP policies primarily consist of a combination of targets and support mechanisms, with some action in some countries also on transmission and distribution network access. Many more countries have targets and support mechanisms for renewables than for CHP. In most cases fossil fuel CHP (mostly gas-fired) support policies are part of a broader mechanism that is mainly designed to support renewable energy (including renewable sources of CHP such as biomass).

Targets

1.8 By mid-2005, at least 43 countries had a national target for renewable energy supply, including all 25 EU countries and 10 developing countries (including Brazil, China, India, South Africa) The EU also has Europe-wide targets: 21 percent of electricity and 12 percent of total energy by 2010. Neither the United States nor Canada has a national target, but 18 U.S. states and 3 Canadian provinces have targets based on renewables portfolio standards - ranging from 3.5% to 15% of electricity in Canada and 5-30% in the US . An additional 7 Canadian provinces have planning targets. Australia has a target of 9.5 TWh of electricity annually by 2010. Most national targets are for shares of electricity production, typically 5–30 percent. Other targets are for shares of total primary energy supply, specific installed capacity figures, or total amounts of energy production from renewables, including heat. Most targets aim for the 2010–2012 timeframe. (REN 21, 2006)

Support mechanisms

1.9 The main types of support mechanism (see Appendix for details) are :

- Feed in tariffs (such as those in Germany and Denmark)
- Quota mechanisms (such as the Renewables Obligation in the UK and the Renewables Portfolio Standard in the US)
- Tender schemes (the former NFFO in the UK and the current scheme in Ireland)
- Voluntary mechanisms such as green certificates (many countries)
- Various hybrid schemes involving two of the above mechanisms (e.g. Spain which has a mix of feed-in and quota)

The main choice tends to be between feed-in or quota type mechanisms both of which imply mandatory action.

1.10 A key difference between quota and tariff systems, is that in quota systems the Government sets the desired level of output, and allows the market to decide the price that will be paid for it, whereas tariff systems set the price and may or may not limit the quantity. In the IEA'S view, depending on the pace of cost reduction of wind turbines, carbon prices and oil/gas prices, wholesale market prices may become sufficient for cost recovery without any premium, which indicates how difficult it is to ensure an appropriate support level through administratively determined prices (or premiums).(IEA, 2006) Quota schemes using green certificates, priced according to the difference between the market price and production cost could theoretically solve the problem of over subsidisation. Green certificate systems are relatively new and the experiences in other countries are mixed, but in theory they should induce long-term cost reductions through competition between and within technologies. (IEA 2006) However, tariff systems provide more certainty for developers and thus so far have tended to stimulate more renewables and to enable more participation by smaller developers including co-operatives.

1.11 Whether a quota or tariff mechanism is used however, the success of such schemes can depend on:

- Access charges to the grid – transmission or distribution
- The ease of siting projects – i.e. getting approvals through planning systems

1.12 Policies to promote renewable energy and CHP existed in a few countries in the 1980s and early 1990s, but emerged in many more during the late 1990s and early 2000s. At least 48 countries worldwide now have some type of renewable energy promotion policy (which in some cases includes fossil fuel CHP), including 14 developing countries. The most common policy is the feed-in law, which was first implemented at national level in the United States (PURPA), in 1978. By 2005,at least 32 countries and 5 states/provinces had feed-in policies, more than half of which have been enacted since 2002. (REN 21, 2006)

1.13 Feed-in tariffs vary in design. Some policies apply only to certain technologies or have capacity limits. Most set different tariffs for different technologies, usually related to the cost of generation, for example distinguishing between offshore and onshore wind power. Some policies also differentiate by location/region, year of plant operation, and operational season. Tariffs for a given plant may decline over time, but typically last for 15–20 years. Some policies provide a fixed tariff while others provide fixed premiums added to market- or cost-related tariffs (or both, as in Spain).

1.14 Renewables portfolio standards (RPS) originated in the US, first implemented in Texas in 1999. At least 32 states or provinces worldwide have enacted RPSs, half of these since 2003, and six countries have enacted national RPSs since 2001. Most RPS policies require renewable power shares in the range of 5–20 percent, typically by 2010 or 2012. (REN 21, 2006)

1.15 Tender schemes (competitive bidding of specified quantities of renewable generation), originally used in the UK in the 1990s (NFFO), now exist in: Canada, China, France, India, Ireland, Poland, and the United States. Utilities in many countries use competitive bidding to meet RPS requirements. (REN 21, 2006)

1.16 There were more than 4.5 million green power consumers in Europe, the United States, Canada, Australia, and Japan in 2004. The three main mechanisms are utility green-pricing programs, retail sales by third-party producers and tradable renewable energy certificates. Tradable certificates are often used in conjunction with obligations under renewables portfolio standards. Eighteen European countries are members of RECS, a renewable energy certificates system founded in the late 1990s to standardize and certify renewable energy certificates and trading. As markets expand, the price premiums for green power over conventional power have declined in many cases. In the United States, retail green power premiums are now typically 1–3cents/kWh. (REN 21, 2006)

Other support for renewables

1.17 There are many other forms of policy support for renewable power generation, including subsidies or rebates, tax incentives, sales tax and VAT exemptions, green certificate trading and net metering. Some type of capital investment subsidy, grant, tax credit or rebate is offered in at least 30 countries. Tax incentives and credits often work alongside feed-in laws and RPS mechanisms. Some countries or states/provinces have established renewable energy funds to provide low-interest loans or facilitate markets in other ways,. The largest such funds are the "public benefit funds" in many U.S. states that also support energy efficiency (see under energy efficiency below) .

1.18 Net metering laws exist in at least 7 countries, 35 U.S.states, and several Canadian provinces. Most recently, a 2005 U.S. federal law requires all U.S. electric utilities to provide net metering within three years. Net metering has been particularly instrumental in facilitating grid-connected solar PV markets in the United States and Japan. (REN 21, 2006)

Energy efficiency support

1.19 Since the early 1970s governments have intervened to ensure energy saving measures are taken up more widely, through regulation, taxation, information, exhortation and incentives. Since the 1980s many governments and energy regulators (at national or state/provincial level) have intervened in energy markets to encourage or compel electricity and gas companies to promote energy efficiency, recognising that the actions of these companies has an impact on the take-up of energy efficiency, but also for the pragmatic reason that action by the companies reduces the need for governments to fund energy saving from taxation revenue. Utility investment in end use energy efficiency tends not to happen without government or regulator intervention to facilitate it.

1.20 The ways in which regulators and governments have intervened in energy markets to promote energy efficiency fall mainly under the following headings :

- tariff design to discourage consumption
- demand side management programmes
- Public Benefits Funds
- Energy efficiency obligations and “white certificates”

Tariff design

1.21 Where the prices or tariffs charged to final consumers are regulated, regulators can require them to be designed to discourage consumption – for example to rise as consumption increases or to reflect different costs at different times of day. However, when retail markets are considered sufficiently competitive regulators may abolish price control and hence will have no scope to set tariffs. Government and /or regulators may encourage retailers to set tariffs in this way for environmental reasons, but retailers will set prices primarily according to market factors.

1.22 Generally, tariffs that rise with increasing consumption will be socially progressive, as better off consumers tend to consume more than those on lower incomes. Indeed, these tariffs have often been introduced primarily for social rather than environmental objectives – notably with a free or lower priced allocation of units to meet basic needs (some US states, South Africa and Belgium are examples). However, some lower income consumers have relatively high levels of consumption – poor thermal efficiency, older heating systems, or high needs for heating or cooling due to ill health. There may be ways of mitigating the effect on low income high users – through action by the regulator or by the government (e.g. welfare benefits). Part of this action may be ensuring that energy efficiency measures are installed to help reduce the need for high consumption – hence the interaction with other programmes that may be operated by the regulator or a government department.

1.23 Typically tariffs that seek to reduce consumption operate with a first block (per month or quarter) charged at a low rate, followed by further blocks charged at progressively higher rates. Italy, for example has operated such a tariff in the household sector at which rates rise to 30 eurocents per kWh for each unit consumed in excess of 220kWh per month.

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Demand side management

1.24 Demand side management/least cost planning/integrated resource planning have all been used to describe options for reducing demand alongside increasing supply as a means of meeting energy needs (see glossary for an explanation of the different terms). DSM originated in California in the 1970s as part of the response to rising oil prices and increasing public hostility to new power stations on environmental grounds. Lobbying by environmental groups helped to secure changes to regulation and during the 1980s and early 1990s, DSM programmes were implemented in many US states, Canada and a number of European countries.

1.25 DSM was made attractive for utilities through changes to the incentives set by regulators. Before these changes were made, the utilities lost income if they sold fewer kWh and energy efficiency investment was not added to the asset base on which the regulators calculated the allowed rate of return, so it offered no reward for shareholders. The solution was to make utility profits less dependent upon the numbers of units sold and to enable the utilities to earn profits on DSM activity. DSM became a major activity in the US and was also taken up by a number of other countries (e.g. Denmark, Australia) in the 1990s, or was the inspiration for other initiatives to involve electricity and gas companies in energy efficiency (e.g. the gas E factor in the UK). The main activity undertaken under DSM programmes was to subsidise the cost of energy saving measures such as efficient heating systems, appliances, lighting and insulation.

1.26 DSM as operated in the 1980s and early 1990s worked in the context of vertically integrated monopoly electricity utilities. It is more complicated to use it where companies are not vertically integrated and/or where competition has been introduced and particularly where retail price control is abolished. As electricity market reform was introduced from the mid-1990s spending on DSM fell and many programmes were wound up altogether. Nevertheless it is possible to use it where electricity reforms have taken place, particularly in the distribution side, where network-driven DSM can be particularly useful – it has been applied to some extent in this context in Australia and the US and in some developing countries.

Public benefits funds

1.27 When the US electricity industry was liberalised in the mid-1990s a number of regulators established a non-by passable levy on retail rates charged by all suppliers to fund energy efficiency, renewables and some other schemes of public benefit (e.g. financial assistance for low income consumers). There are various names for these funds, including public goods charge (PGC) public benefits fund (PBF) and system benefits charge (SBC). The most commonly used term is PBF. Within the US, a PBF for energy efficiency will typically be set at around 2.5% of retail electricity sales revenue. In other countries the amounts set have been more variable, although typically in the 1-3% range. Many of the US PBFs have been set with no fixed timescales – where these have been set they are typically for 5-10 years.

1.28 Other countries with initiatives that have one of the key features of a PBF (i.e. a charge on electricity and/or gas distribution or retail) to fund energy efficiency (though not all still operate in 2006) include : Belgium, Brazil, Denmark, Netherlands, NSW Australia, Norway, Thailand. (Wiser et al, 2003**)** The EESOP scheme (1994-2002), in the UK was also effectively a PBF, though EEC is an obligation system.

Energy efficiency obligations

1.29 The alternative to a PBF is to impose an obligation on actors in the energy market to achieve a certain amount of energy saving or reductions in greenhouse gas emissions. This may be met by the actors either taking action themselves or by paying others to do so, hence the need for a mechanism such as a certificate to track measures undertaken. Obligation/certificate mechanisms can be seen as comparable to the "green certificate" systems used to promote renewable energy. The term "white certificates" is being used for energy efficiency mechanisms. The obligation/certificate route tends to be seen as market-based, with market features such as the potential for trading. The PBF route is seen as more analogous to a tax raising mechanism. However, both schemes can also be seen essentially as a means of subsidising energy efficiency to increase its take up. A key difference between the two is that the PBF approach determines the amount of money to be raised, whereas the obligation route determines the volume of savings to be achieved and energy companies are then free to achieve that as cost-effectively as they can.

1.30 To date the best examples of the obligation/certificate mechanisms are the UK and the state of New South Wales in Australia. Both Italy and France are also developing white certificate schemes. Italy began preparing theirs in 2002 and it sets a savings obligation, on gas and electricity market participants, of 33 TWh/year over 5 years. France passed the law to set up its scheme in 2004 and it came into effect in 2005. The French scheme applies to gas, electricity and heat market participants and sets a savings obligation of 18 TWh/year. The EU energy services directive will establish mandatory energy savings targets for member states and hence pave the way for more widespread establishment of obligations/white certificates schemes in EU countries. The International Energy Agency has a project to explore in more detail the role of "White Certificates" systems to promote energy efficiency.

1.31 Within the US, although the PBF is the most common mechanism for supporting energy efficiency via the energy utilities, a number of states are attempting to move more down a variation of the obligation route. The term "Energy Efficiency Resource Standard" (EERS) (Nadel, 2006) is being applied to these newer approaches. States that are adopting this include Texas, Colorado, California, Vermont, Nevada, Pennsylvania. Texas requires its energy companies to offset 10% of demand growth through energy efficiency. Some states have a PBF and an EERS – in which case the former is the way the costs of the EERS is funded. States with an EERS but no PBF allow energy companies to recover the costs of meeting the EERS in their rates.

Fuel poverty

1.32 Fuel poverty is a problem resulting from a combination of low income and property that is difficult or expensive to heat and/or cool. The actual term "fuel poverty" is not used much outside the UK, but the concept of energy inaffordability and policies and programmes to tackle this problem are found elsewhere. However, these are largely restricted to the English speaking developed countries (Australia, Canada, Ireland, UK, US), Eastern Europe and the former Soviet Union. In developing countries, the issue tends to be more about energy access as many people lack connection to mains electricity or other fuel sources. Fuel poverty tends not be recognised as an issue in most of the EU, although some of the problems associated with affordability are recognised in some EU countries.

1.33 Policies to tackle fuel poverty, that are instigated by governments, energy regulators and energy companies tend to be of the following types :

- financial help with fuel costs via a regular or occasional supplement to welfare benefits (US)
- financial help to pay off fuel debts via the welfare benefits or from trust funds (US)
- special tariffs to reduce energy prices – e.g. to provide some energy at a lower rate to all consumers (baseline allowances) or to provide energy at a lower price to defined groups of consumers (social tariffs) (US and some European countries)
- restrictions on disconnection for debt and/or use of special arrangements to help people pay off debts (including prepayment meters) or to write off debts (US and some European countries)
- assistance with measures to improve heating and/or insulation standards (energy efficiency), targeted at individual households such as grants, low cost loans etc (Australia, Canada, US)
- programmes or projects to upgrade heating and/or insulation in social and other group housing (Australia, Canada, US)

United States

US Energy supply

1.34 The US is the world's largest energy consumer, with more than 25% of worldwide consumption of oil, natural gas, coal and nuclear energy. In 2003, it imported nearly 30% of its energy needs, and 60% of its oil. The share of oil in TPES was 40%, followed by coal (23%), natural gas (23%), nuclear (9%) and renewables (4%). In 2002, TFC was 1 557 Mtoe, 1.2% up from 2001 and growing at a 2.5% annual rate since 1990. Transport represents the largest energy-consuming sector (40%) followed by the residential/commercial sector (31%) and industry (30%). (REEEP web site)

1.35 While coal remains the nation's major fuel for electricity generation at 52%, natural gas is growing in importance and represents 17%; 20% of electricity is generated from nuclear power, 8% from hydro and 3% from oil. Most forecasts envisage that the largest number of power plants to be built in the next 20 years will be gas-fired. Natural gas is also likely to be a primary fuel for distributed power generators. (REEEP web site)

1.36 Renewable energy represented 4.4% of the TPES in 2003, including 3.0% for combustible renewables and wastes, 0.9% for hydro, 0.4% for geothermal and 0.1% for solar, wind and others. This is equivalent to 99 Mtoe in 2002, against 91 Mtoe in 2001. The growth came essentially from combustible renewables and wastes, whereas hydro and geothermal capacity has either stagnated or regressed since 1990.(REEEP web site)

US Energy policy

1.37 Energy policy in the United States is determined both by individual states and at the federal level.

1.38 Growing reliance on imported oil was a major consideration in the development of the government's National Energy Policy (NEP) issued in May 2001 and in the Energy Policy Acts of 2002 and 2005. The Energy Policy Act 2005 sets out the policy goals as follows :

- Improve the nation's electricity transmission capacity and reliability.
- Promote a cleaner environment
- Promote clean coal technology, facilitate LNG storage and provide incentives for renewable energies such as biomass, wind, solar and hydroelectricity.
- Provide leadership in energy conservation
- Decrease America's dependence on foreign oil by increasing domestic oil and gas exploration and authorizing expansion of the Strategic Petroleum Reserve(SPR)
- Encourage more nuclear and hydropower production.

The Energy Policy Act 2005 included the following measures relevant to renewables and energy efficiency :

- measures to promote demand response including a requirement that electricity customers be given a choice to be on time-based rates using advanced meters .
- mandatory efficiency requirements for federal buildings, and efficiency standards and product labelling for battery chargers, commercial refrigerators, freezers, heaters, and other household appliances.
- The Renewable Energy Production Tax Credit, - a 1.5 cent/kWh tax credit for electricity produced from wind, "closed loop" biomass (organic material from a plant used exclusively for producing electricity), and poultry waste - was extended for another two years,
- Clean Renewable Energy Bonds (for public power).

The NEP includes :

- $10 billion of tax incentives for energy conservation and renewable energy
- $1 billion for developing methane fuelled electricity generation from landfill
- Tax credits of up to $2 billion for households that install solar panels.

Energy efficiency goals include :

● Reduce energy consumption in federal facilities by 30% in 2005 and 35% in 2010, compared to 1985.
● Between 1991 and 2010, contribute to a 20-25% decrease in energy intensity by energy-intensive industries
● Improve the energy efficiency of the 1.3 million new homes built each year and the 100 million existing homes.

1.39 Although the US signed the Kyoto Protocol to the U.N. Framework Convention on Climate Change (UNFCCC) in November 1998, it has not ratified it. In February 2002, the government set a national goal to reduce greenhouse gas emissions intensity by 18% in 2012. The Administration has worked to engage industry in voluntary partnerships – such as the Climate VISION (Voluntary Innovative Sector Initiative) Program in 2003 – to decrease growth in emissions, develop improved standards for measuring reductions, promote energy efficiency and create incentives.

Energy market structure and reforms in the US

1.40 In the US, electricity generation, transmission, distribution and supply (retail) has always been undertaken by a combination of private sector (investor owned utilities - IOUs) local and regional vertically integrated monopolies, plus municipal companies and co-operatives (the latter two being engaged mainly in retail and distribution, although some have generating capacity). The IOUs own almost three quarters of the US's installed capacity and produce more than three quarters of the electricity sold to retail customers. Federal "power marketing authorities" (PMAs) – e.g., Bonneville Power Administration, Tennessee Valley Authority are primarily wholesalers, but sell some power directly to large industrial consumers. Rural electric cooperatives were created in the 1930s to serve customers that IOUs considered uneconomical. There are more than 900 cooperatives serving 37 million people in 47 states.

1.41 The US does not have a national electricity transmission grid and transmission between states is limited. This causes differential reliability and security issues – for example, while California was suffering rolling blackouts in 2000/2001, Texas was producing an electricity surplus. The Administration is exploring the possibility of a national grid, to allow for more power sharing between states and imports from Mexico and Canada. In July 2003, the Federal Energy Regulatory Commission (FERC) issued rules to ensure non-discriminatory interconnection and access to transmission grids and hence to ensure competition in the wholesale market.

1.42 The first attempts to introduce competition into the energy market were made under the Public Utility Regulatory Policies Act, 1978 (PURPA). Non-utilities were permitted to enter the wholesale generation market, without being subject to the rate regulation applied to utilities, provided that they used either co-generation or small-scale generation including renewables. Utilities were obliged to purchase the output from such facilities located within their franchise areas, usually at the avoided cost of the most competitive alternative source of supply – PURPA was therefore the first application of a feed-in tariff support mechanism for renewables and CHP. As a result of PURPA the number of non-utility generators grew rapidly during the 1980s and early 1990s, although by 1994 they still accounted for only 7% of installed capacity. By the early 1990s this had begun to slow down and the Energy Policy Act 1992 was designed to provide a stimulus to further competition. Firstly it lifted remaining ownership restrictions on power generation. Secondly, it increased the power of FERC to require utilities to provide third party access for other generators to their grid system, even if the grid would have to be expanded. Thirdly, it paved the way for the state governments and utility regulators to liberalise the market further at the state level. California's Public Utility Commission (PUC) led the way by proposing, in April 1994, to allow competition for all customers by 2002.

1.43 States are in various stages of restructuring their electricity markets – including separation of generation, transmission and distribution functions, and encouraging wholesale and retail competition. By February 2003, twenty-four states had enacted enabling legislation or issued a regulatory order to introduce retail competition. Twenty-seven states were not actively pursuing restructuring, and the process has been delayed or halted in six states (Arkansas, Montana, Nevada, New Mexico, Oklahoma and California). Other than FERC's efforts to implement transmission access, further US power market reforms generally remain on hold. The power shortages in California in 2001 and minimal consumer interest in retail competition have caused other states to revisit their strategies.

1.44 Gas production is carried out by the major private sector oil and gas companies and 10,000 smaller producers. Private sector companies own and operate 23 major interstate pipelines. Local distribution/supply is on the basis of monopoly franchises for over 1000 municipal companies and 100 private sector companies, but the latter cover all the major urban areas and account for 95% of gas sold.

US Institutions in the energy field

1.45 The US Department of Energy (DOE) has energy, scientific, environmental, and national security goals. These include developing and deploying new energy technologies, reducing dependence on foreign energy sources, protecting the US nuclear weapons stockpile, and ensuring that America remains competitive in the global marketplace. The Office of Energy Efficiency and Renewable Energy (EERE) takes the lead within DOE on sustainable energy policy development and implementation. EERE's priorities are to :

- Dramatically reduce or even end dependence on foreign oil.
- Reduce the burden of energy prices on the disadvantaged.
- Increase the viability and deployment of renewable energy technologies.
- Increase reliability and efficiency of electricity generation, delivery and use.
- Increase the efficiency of buildings and appliances.
- Reduce the energy intensity of industry.
- Lead by example through government's own actions.

The EERE develops and institutes appliance and equipment standards and provides technical support for local building codes. Both the Department of Energy (DOE) and the Environmental Protection Agency (EPA) provide consumer information and develop and oversee regulations. The EERE runs the Weatherisation Assistance Program for low income households (see section on low income households below)

1.46 The Department of Housing and Urban Development oversees energy performance standards for new housing. The role of state governments varies considerably. Many states have State Energy Offices. States like California and New York have activist governments on energy efficiency and renewables, but these are exceptions, not the rule.

Energy regulation in the US

1.47 Energy market regulation functions are divided between the federal and state level.

1.48 The Federal Energy Regulatory Commission (FERC) regulates the interstate transmission of natural gas, oil and electricity, including transmission prices. FERC also regulates wholesale sales of electricity and oil. FERC licenses and inspects hydroelectric projects and approves the construction of interstate natural gas pipelines, storage facilities, and Liquefied Natural Gas Terminals. FERC also monitors the energy markets and conducts investigations. FERC has five members appointed by the President of the United States, with the consent of the Senate. Commissioners serve five-year terms. To insure independence, no more than three members of the Commission may belong to the same political party. There is no review of FERC's decisions by the President or Congress, thus the Commission is insulated from pressure by the branches of government. FERC is further protected from Presidential or Congressional influence through its funding system – it recovers costs directly from the industries it regulates through fees and annual charges.

1.49 All states have Public Utility Commissions (PUCs) that regulate the state's investor owned utilities (IOUs) in energy, water, telecommunications and transport. Wisconsin and New York were the first states to regulate electric utilities. By 1914, 43 more states had followed their example. The commissions see their duty as balancing the interests of consumers with those of the utility shareholders. Where retail prices remain regulated, this is the responsibility of the PUCs, who also regulate service standards and monitor safety. Municipal utilities – about 5% of total US generating capacity – are controlled by city governments, but in some cases state regulatory commissions have some level of oversight. State PUC commissioners are appointed by the State Governor and have a considerable degree of independence.

1.50 Most state PUCs consider energy efficiency and environmental requirements as part of their review of utilities' rates but the extent to which PUCs are sympathetic to environmental concerns varies widely, depending on : the policy of the state government and relationship of the PUC with the state government, views of appointed Commissioners, availability of local energy resources (e.g., coal) and a host of other factors. New York, California and Wisconsin have traditionally been among the most progressive PUCs with respect to environmental concerns, although a number of others have also been particularly active in certain areas (e.g. Vermont on energy efficiency and Texas on renewables).

US Renewables support

1.51 Much of the policy support for renewables comes from state policies. Several states actively implemented PURPA, which was, in effect, the first application worldwide of feed in tariffs, after 1978. Many PUCs determined the 'avoided cost' rate to be the prevailing high oil prices, resulting in highly favourable guaranteed payments to small CHP and renewable generators and stimulating development (IEA 2004a). A further stimulus to deployment was given by the Investment Tax Credit, implemented in 1979. Feed in however was largely discontinued in the US in the 1990s due to the growing emphasis on competition in wholesale and retail markets brought about by the 1992 Energy Policy Act.

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1.52 A response to the end of feed-in was the development of renewable portfolio standards (RPS) - first implemented in Texas in 1999. By 2005 nineteen states had Renewable Portfolio Standards (RPSs), which require electricity utilities to have a minimum amount of renewables in their generation mix. The RPSs have worked alongside the US federal production tax credit (PTC) that has supported more than 5,400 MW of wind power installed from 1995 to 2004. Indexed to inflation, the credit started at 1.5 cents/kWh in 1994 and increased, through several renewals, to 1.9 cents/kWh by 2005, and has now been extended to 2007.

1.53 The Texas RPS is generally considered one of the most successful in the US, with targets for 2005 met several years early and generation contracted for less than 3c/kwh (Langniss and Wiser, 2003). However, as Butler and Neuhoff (2004) say, these results have been dependent on a range of conditions that will not necessarily be met in future years. Utilities have been willing to sign long-term contracts for 10-25 years since the cost of wind generation at present is comparable to that of new natural gas facilities. However, the competitive price for wind is in large part due to the PTC, which was due to expire in 2005 and so developers brought projects forward whilst it was still available. It would therefore appear unlikely that the rate of deployment can be sustained under the RPS alone. (Butler and Neuhoff, 2004)

1.54 Public Benefit Funds (PBFs) in 15 states are collecting and spending more than $300 million per year on renewable energy. It is expected that they will collect upwards of $4 billion for renewable energy from 2002 to 2012.

1.55 Green power purchasing began around 1999. By 2004, more than 600 utilities in 34 states offered green-pricing programs and at least 2 GW of additional renewable energy capacity has been built to accommodate this market. There were an estimated half-million green power consumers purchasing 4,500 GWh of power annually. Most of these products are voluntary, but regulations were enacted in five states between 2001 and 2003 that require utilities to offer green power to their customers. The federal government is the largest single buyer of green power, with the U.S. Air Force purchasing 320 GWh annually. Some large companies are also buying green power, encouraged by initiatives such as the U. S. Environmental Protection Agency's "Green Power Partnership", which had 600 partners by 2005, purchasing 2,800 GWh of green power annually. (REN 21, 2006)

Decentralised energy in the US

1.56 The introduction of PURPA in 1978 encouraged CHP. With high purchased-power prices, and low gas costs, large units were built under this law. The 1992 National Energy Policy Act then allowed non-utility companies to compete in wholesale markets. CHP / DE markets experienced resurgence from the late 1990s until 2002, when gas prices tripled. A number of states, notably California, New York and Texas have been reducing barriers for interconnection and backup charges. The Energy Policy Act of 2005 includes requirements that all states consider their interconnection standards, and includes other provisions favourable to distributed generation. In addition to the renewables policies outlined above, which support some forms of decentralized energy ,many states have specific policies to encourage fuel cells and greater use of landfill and sewage treatment gases.

1.57 The US Department of Energy has set a target for 92 GWe CHP by 2010; this is considered likely to be exceeded. The level of installed CHP capacity by the end of 2005 was in excess of 82 GWe. This compared to 10 GWe in 1980, 28 GWe in 1990 and 60 GWe in 2000. (WADE, 2006)

Energy efficiency support in the US

1.57 There are many federal policies specifically intended to encourage energy efficiency, including appliance and equipment standards, federal facility targets for reduced energy use, and product labelling requirements. There are also many state programs and policies to promote energy efficiency.

1.58 DSM became a major activity in the US in many states in the 1980s with utilities spending $2.8 billion on it by 1993 (Hadley & Hirst, 1995). However, as electricity market reform was introduced in the US from the mid-1990s spending on DSM fell – by 50% from 1994-97. (Crossley, 2005).

1.59 Public Benefits Funds (PBFs) were introduced as a replacements for DSM and are being used in 22 states to support energy efficiency programs, collecting and spending nearly US$1 billion per year. Many states also support low income consumer assistance and some research and development using PBFs. With a few exceptions, PBFs have amounted to less per annum than was spent on efficiency under DSM . The PBFs have in some states become a target for state budget officials as a source of general revenue – this has even included parts of PBFs that were being used to support energy bill assistance for low income households .

ESCOs in the US

1.60 In the US from the late 1970s/early 1980s, a number of companies started making capital investments in energy saving measures, for industrial and commercial customers, to be repaid out of the savings achieved. The US boom in ESCOs was built on an expectation of rising energy prices. The fall in energy prices in the mid-1980s led to many of these companies folding as the contracts were only economic if energy prices remained high. There was a resurgence from the late 1980s, due to the rise of regulator mandated least cost planning and DSM initiatives by the electricity utilities as many utilities contracted out the purchase of end-use efficiency programmes to these energy service companies.

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1.61 With the end of DSM, ESCO activity declined but has been increasing in some states, such as through the PBFs. Following the start of restructuring in the 1990s a number of utilities bought ESCOs or started their own. New entrants also started to offer industrial and commercial users energy efficiency technologies ; onsite generation; load management; electricity and gas supply; end use services (Chilled water, steam); other services(e.g., building maintenance) By 2000 the ESCO Market in the US was valued at $1.8-$2.1B – a 24% annual growth rate from 1990-2000 (Goldman, 2003) By 2000 one third of ESCOs (by revenue) were owned by the established utilities or their affiliate companies; one third by other energy companies and one third by equipment suppliers/manufacturers and engineering companies (Goldman, 2003) . 75% of market activity is in the public sector (government buildings, schools and hospitals (Goldman 2003) As retail competition stalled in U.S. some utility-owned ESCOs have grown, but many smaller ESCOs have gone out of business or been sold.

1.62 The typical ESCO project consists of multiple measures but particularly:
- High-efficiency lighting - over 80% of projects
- HVAC equipment (boilers, chillers, cooling towers, air handling units),

energy management systems - 68% of projects (Goldman 2003)

1.63 46 states have adopted laws and/or procurement guidelines designed to remove barriers to performance contracting for schools, universities and state/local government buildings . Many State energy offices promote performance contracting and educate customers on working with ESCOs. Executive Orders (EO) signed by the President directing Federal Agencies to reduce building energy consumption have also stimulated the ESCO market. The current goals are to achieve a 30% reduction by 2005 and 35% by 2010. Energy savings performance contracts (ESPCs) were authorized in 1986 and 1992 as mechanisms to finance and implement energy efficiency improvements. $1.2 Billion has been spent on ESPC projects under the Federal Energy Management Program (FEMP)since 1988. (Goldman, 2003)

1.64 New York has long been a strong market for ESCOs where a substantial proportion of the $150 million per year PBF budget goes on ESCO type activity. ConEdison, as part of a recent rate case settlement, will spend $225 million, over and above PBF programs, to procure 300 MW of energy efficiency, demand response and distributed generation resources in the next three years to offset expected load growth in New York City and Westchester County. The Western Governors' Association in 2004 agreed to reduce energy use by 20 percent by the year 2020. Its Energy Efficiency Task Force recommended a “best practices” approach in which the participating states would spend about $2.3 billion annually for energy efficiency, with performance contracting playing a key role. (NAESCO web site)

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Support for low income and vulnerable households in the US

1.65 Much of the support available is provided at state level via the public benefits funds and through other initiatives of the utilities and Public Utility Commissions. However there are two long standing federal programmes in the US :

- the Low Income Home Energy Assistance Program (LIHEAP) run by the Department of Health and Human Services (DHHS)
- the Weatherization Assistance Program run by the EERE of the DOE.

1.66 Under the Low Income Home Energy Assistance Program (LIHEAP) the federal Department of Health and Human Services (DHHS) provides a block grant to the state governments. Eligible low-income households, via local governmental and non-profit organizations, can receive help via three program components:

- The Weatherization Program provides free insulation services, including loft insulation, draught stripping, minor housing repairs, and related measures.
- The Home Energy Assistance Program (HEAP) provides financial assistance to eligible households to offset the costs of heating and/or cooling dwellings.
- The Energy Crisis Intervention Program (ECIP) provides payments for weather-related or energy-related emergencies.

1.67 The Weatherization Assistance Program was created under the Energy Conservation and Production Act of 1976, to cut heating bills and save imported oil. The EERE provides funding to the states (more than $5 billion since 1978); sets guidelines for eligibility; sets technical standards ; documents energy savings; provides technical training to weatherization service providers. The states: make the rules and set standards for eligibility in each state.; contract with local weatherization agencies. monitor agency work to ensure quality. The allocation for 2006 is $228 million. Weatherization service providers install energy efficiency measures in the homes of qualifying homeowners free of charge —the average expenditure limit is $2,826 per home. Measures installed include cooling measures - air conditioner replacements, ventilation equipment, screening and shading devices - which are more important in some states than heating appliances. By 2001 more than 5 million homes had benefited.

European Union

1.68 EU Energy supply – key facts

- Conventional thermal power stations dominate electricity production, accounting for 58% of installed capacity in the EU;

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- Nuclear power accounts for 19% (half of it in France alone); hydropower 18%, and wind turbines 5%;
- Wind power has made the strongest progress since 2000. It increased its installed capacity by 154%. Wind power is especially well developed in Denmark (23%), Germany (13%) and Spain (12%) (EU web site)

EU Energy policy

1.69 In general energy policy is determined by each member state, with the EU setting framework policies in specific areas. However, a proposal for a European Energy Policy, based on the three core objectives of : sustainable development, competitiveness, and security of supply was set out by the European Commission in a Green Paper published in March 2006. A wide public consultation is taking place : based on this and the conclusions of the European Council and Parliament, the Commission will present a Strategic Energy Review focusing on external and internal aspects of EU energy policy by the end of 2006. EU heads of states and governments should adopt an Action Plan on a common European energy policy in March 2007.

The Green Paper sets out six specific priority areas.:

- To complete the internal energy market**,** new measures such as: a European energy grid code, a priority European interconnection plan, a European Energy Regulator and further unbundling.
- Security of supply. possible revision of existing Community legislation on oil and gas stocks to ensure they can deal with potential supply disruptions.
- A more sustainable, efficient and diverse energy mix. A Strategic EU Energy Review, that could lead to EU objectives on overall energy mix to ensure security of supply, whilst respecting the right of Member States to make their own energy choices.
- A series of measures to address global warming. Including : an Action Plan on energy efficiency, for the EU to save 20% by 2020; a Road Map for renewable energy in the EU, with possible targets to 2020 and beyond.
- A strategic energy technology plan to ensure that European industries are world leaders in the new generation of energy efficient and low carbon technologies technologies and processes.
- Finally, the Green Paper stresses the need for a common external energy policy, in order to react to the challenges of growing demand, high and volatile energy prices, increasing import dependency and climate change.

1.70 Although all member states are agreed in principle that there should be an EU energy policy there are differences of views on what should be in it and the extent to which an EU policy should impinge on national sovereignty. The idea of the European energy regulator has already been rejected as premature.

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Energy market structure and reforms in the EU

1.71 Historically, gas and electricity companies have been mostly state owned vertically integrated monopolies but there has also been a strong role for municipally owned companies in generation, distribution and supply (heat and electricity) in many EU countries (notably, Denmark, Sweden, Finland, Germany, Austria) and consumer co-operatives for generation and supply (particularly Denmark and Austria).

1.72 The Commission and member states adopted in 1996 and 1998, electricity and gas directives designed to open up the markets to competition. In 2001 the Commission concluded that further measures were necessary and the second gas and electricity directives were adopted in June 2003 - the deadline for transposing them into national law was 1 July 2004**.** They require both markets to be fully open, while maintaining high standards of public service and a universal service obligation, for all non-household gas and electricity customers by July 2004 and for all customers by July 2007**.** The main elements of the directives are:

- Unbundling: Incumbent companies, state-owned or private, have to unbundle the distribution and transmission/transportation sides of their business and have them operated by legally separate entities.
- Tariffs: Transmission tariffs must also be applicable to all system users on a non-discriminatory basis.
- Services of public interest: common minimum standards for public service requirements, such as a universal service obligation, security of supply, environmental protection.

EU member states are also requested to appoint an independent national regulator to monitor market developments and prevent discrimination between operators.

1.73 However, the preliminary findings of a competition enquiry in November 2005, revealed some "serious malfunctions" in the market for industrial consumers including market concentration, lack of unbundling and fair access to networks. Ten member states had opened their markets completely by September 2005: Denmark, Germany, Spain, Ireland, the Netherlands, Austria, Portugal, Finland, Sweden and the UK. Cross-border trade in electricity remains limited by the capacity of the interconnectors. The European Renewable Energy Council (EREC) says that unless the existing distortions are overcome, there will be no effective internal market for renewables to compete in. According to Greenpeace, the liberalisation process has worked in favour of Europe's ten largest established utilities and new, green utilities, have little chance to compete as the 'big ten' have enough influence to control prices. It said the situation is likely to continue "because there is still no fair access to the [electricity] grid" (Euractiv, May 2006)

Energy regulation in the EU

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1.74 Independent energy regulators, similar to the UK's Ofgem or the PUCs in the US are a relatively new development in most EU countries, which reflects the fact that most have introduced energy market reform only relatively recently. Most EU energy regulators have been established for less than ten years and many only since 1999. Prior to establishing energy regulators, the industry was directly regulated in most EU countries by the relevant Ministry (in terms of setting prices and determining network access rule) plus there would be a role for the generalist competition authority in relevant areas. The degree of independence of the regulators varies - some are specialist energy regulators whereas others are broader utilities regulators with responsibilities covering one or more of : communications, energy, water and transport. Most have commissions or boards of 3-5 members but there are some with more members and one or two examples of a single regulator.

1.75 A number of EU countries also have more long established energy agencies, to which a number of responsibilities related to implementation (but also in some cases policy advice and development) have been delegated from the relevant Ministry. These agencies have varying degrees of autonomy from the ministries that sponsor them and varying degrees of power and influence. Regulators when established, therefore, have had to develop a working relationship with the agency, which may previously have had some role in areas that become part of the regulator's role. Alternatively, it may be that the regulator is not expected to have a significant role in some areas as this is the role of the agency. This can have particular relevance in sustainable energy issues – energy efficiency, renewables and CHP - in which a number of energy agencies have developed strong roles (e.g. Denmark and Germany). Several EU countries also have powerful environmental agencies, which have also been in existence for much longer than the energy regulator.

Renewables and energy efficiency support in the EU

1.76 The actual policies and support mechanisms for sustainable energy are largely determined at the member state level although a number of EU wide directives set the context for some of the national policies.

Energy efficiency in the EU

1.77The buildings sector accounts for 40% of the EU's energy requirements. The European Commission has estimated that more than one-fifth of the present energy consumption and up to 30-45 MT of CO_2 per year could be saved by 2010 by applying more ambitious standards to new and refurbished buildings. (EU web site) Community legislation for the sector includes the Boiler Directive, the Construction Products Directive and the buildings provisions in the SAVE Directive. The Directive on the energy performance of buildings, in force since January 2003, aims to secure an ambitious increase in the energy performance of public, commercial and private buildings in all Member States.

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1.78Energy demand in households accounts for 25% of the final energy needs in the EU. (EU web site) Electricity used for domestic appliances shows the sharpest increase. EU legislation covers energy labelling (electric refrigerators, freezers, ovens, air conditioners, dishwashers, washing machines, tumble driers) and minimum efficiency requirements: electric refrigerators, freezers and gas boilers.

1.79 The End-use Efficiency and Energy Services Directive was adopted by the European Council on 14 March and entered into force on 17 May 2006. Member States have to transpose the Directive into national law by May 2008. Member States must achieve a minimum annual energy savings target of 9% by the ninth year in the period from 2008 to 2016. Each national government will have to produce energy efficiency action plans (EEAPs) in 2007, 2011 and 2014. Although the targets are indicative and thus not mandatory, Member States have a clear legal obligation to adopt and aim to achieve the target. Besides the energy efficiency targets, the Directive sets the framework for activities in a number of areas, such as financing, metering, billing, promotion of energy services, and obligations for the public sector. These will include requiring smarter forms of metering, that provide consumers with more information, where it is practical and cost effective to install them.

1.80 For the first time, Member States are required to place energy efficiency obligations on energy distributors or retailers although there are a number of options, ranging from direct involvement through to letting the energy distributors and/or suppliers contribute to funds for energy efficiency. These obligations therefore do not necessarily require activities on the part of energy companies, which may be carried out by other market actors on their behalf. The Directive may therefore lead to more Member states adopting obligations schemes or public benefits funds.

ESCOs in Europe

1.81 In Europe, particularly France and Belgium, a number of specialist heat service companies grew up from the 1960s onwards, providing district heating (mostly coal or oil fired) to housing estates, blocks of flats and commercial developments. Some companies also provided process steam to industry on a similar basis. However, in most cases, these companies were concerned only with selling heat and paid little attention to efficient use - it was in their interest to sell as much heat as possible.

1.82 The European Commission has been promoting the ESCO industry for a number of years. National ESCO policies account for the differences in ESCO development between European countries. ESCOs exist in most EU countries with significant presence in Italy, France, Spain, Finland, Austria and Germany – the latter two being the leading EU countries for ESCOs. (Bertoldi and Resezzy, 2005) Currently the European energy service market consists mainly of large multinational companies that provide facility management and have large engineering and project management skills. Energy industry restructuring has given a further impetus in some countries (e.g. Netherlands) as the ESCO approach has been seen as a good way for new entrants to enter the energy market. This has stimulated projects in combined heat and power (CHP) for large commercial centres, hospitals, and industrial facilities; and public lighting projects, where municipalities tendered lighting operation, including the supply of electricity.

1.83 The majority of ESCO projects in Europe have been in the public sector, focused on CHP, street lighting, heating, ventilation, and air-conditioning, and energy management systems. The public sector focus arises for three reasons : firstly ESCOs perceive it as having 'safer' clients that do not normally go out of business; secondly in some cases (e.g. Germany and Austria) there have been initiatives by energy agencies to promote energy saving in the public sector; thirdly there have been initiatives by national government or local authorities to reduce energy consumption in their own buildings.

ESCOs in Germany

1.84 Germany, together with Austria, constitutes the most developed ESCO market in Europe. By the end of 2000, more than 70,000 contracts had been concluded, at 120,000 sites, primarily public buildings, resulting in total investment exceeding 5 billion Euro (Bertoldi and Rezessy, 2005). In Berlin more than 900 public buildings have been upgraded since the start of the Energy Saving Partnership programme in 1995. The total savings are more than €7.8 million and the total investment is around €32 million (Bertoldi and Rezessy 2005). Other large projects have been undertaken in Hamburg, Munich, Leipzig, Bremen. About 500 ESCOs are active on the German market with an annual turnover of about €3 billion.

1.85 The sector attracting most attention is public buildings primarily due to the support of energy agencies and a move towards outsourcing of energy-related operational tasks. The success of the German ESCO market has also been driven by the financial and technical support for energy efficiency projects provided by governmental action (federal and regional government loan and grant schemes, incentives for renewable energy, efficiency checks by energy agencies, boiler replacement by utilities) and loans from eco-banks. (Bertoldi and Rezessy, 2005).

ESCOs in Austria

1.86 To date the energy efficiency of about 500 to 600 buildings has been improved; representing 4-6 % of all public and service sector buildings. The main customers are the federal government; large city authorities (Graz, Salzburg); and other municipalities. In Austria, as in Germany and Spain, the regional and the national energy agencies played a crucial role in the development of ESCOs. Public money has mainly been used for information and marketing and for advice by the energy agencies at the national, regional and local level (Bertoldi and Rezessy, 2005). The projects in small and medium-sized municipalities have been supported by regional programs, e.g. in Styria, Upper Austria, and Tyrol. The Austrian Energy Agency, together with several partners has started a programme targeting private sector buildings (office buildings, shopping centres, hotels, etc.).

Renewables in the EU

1.90 The Directive on the Promotion of Electricity from Renewable Energy Sources in the Internal Electricity Market (2001/77/EC), (the Renewables Directive), requires each member state to set targets consistent with reaching the Commission's target of 22 per cent of electricity from renewables by 2010.

1.91 At the member state level, the main form of support for renewables has been the feed-in tariff. Feed-in policies have been adopted in Austria, Denmark, France, Germany, Greece, Italy, Netherlands, Portugal, Spain,. Some states, such as the Netherlands, combine green certificates with a feed-in tariff. The greatest impact of feed-in tariffs has been in Germany, Spain, and Denmark. (REN 21, 2006)

1.92 The quota or RPS mechanism has not been used so widely in the EU. To date its main application has been in the UK, Sweden and Poland . Austria has used it for some technologies. Sweden's RPS requires consumers, or electricity suppliers on their behalf, to purchase a given annual percentage, which increases yearly, through either electricity purchases or renewable certificate purchases. Poland's RPS will reach 7.5 percent by 2010. (REN 21, 2006)

1.93 Feed-in policies have had the largest effect on wind power, but have also influenced biomass and small hydro development. Most laws set a limit on maximum size of eligible hydro, for example 5 MW in Germany. Most recently, Spain's feed-in tariff has supported solar thermal power generation. (REN 21, 2006)

1.94 Countries in Europe with retail green power markets (green tariffs) include Finland, Germany, the Netherlands, Switzerland, and the United Kingdom. Germany has more than 600,000 consumers purchasing 2,000 GWh in 2004. (REN 21, 2006)

Decentralised energy in the EU

1.95 Policies are mainly developed at the member state level although some EU level policies are relevant. The Commission's cogeneration strategy of 1997, sets an indicative target of doubling the share of electricity production from cogeneration to 18% by 2010. Meeting this target is expected to lead to avoided CO_2 emissions of over 65 Mt CO_2/year by 2010. (WADE, 2006)

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1.96 By 2001 the share of electricity produced by CHP within the EU had increased to 10%. Large differences exist between Member states - between 2% and 60%. The 2004 Co-generation Directive aims to provide a framework to overcome barriers. The Directive does not include targets but urges Member States to analyse their potential for high efficiency cogeneration. (WADE, 2006)

1.97 Examples of policies and penetration rates are given below for Austria and Germany.

Decentralised energy in Austria

1.98 Some of the support for decentralised energy comes via renewables support schemes. Austria has always used a substantial amount of renewable energy thanks to its abundant hydroelectric power. However, until Austria's Green Electricity Act 2002 came into force in January 2003, support for renewable energy and CHP was provided through a complex system of national and state laws and regulations, and approximately 100 different tariffs for various renewable energy sources Through this Act, feed in tariffs for renewables and CHP, which varied from state to state, were replaced with a uniform fees throughout Austria for electricity generated by combined heat and power plants, renewable sources and small hydro power plants. The total cost of aid for green energy is much lower than it would have been for attaining the objective individually in each federal state (the government agreed to provide a maximum of € 275m/yr, down from € 400m/yr). Within that sum, payments to fossil fuel CHP were set to decline from €76 m in 2003 to €69 m a year in 2006. (IEA database)

1.99 The targets in the Green Electricity Act are to generate 9 % of electricity from small-scale hydroelectric plants and 4 % from other qualifying plants by the year 2008 so that the overall objective of 78 % of electricity from renewable sources can be reached (the rest being generated from large scale hydro). (IEA database)

1.100 As a result there has been a boost in the development of "new" renewables, especially wind power. The installed capacity of wind power tripled from 139 MW in 2002 to approximately 420 MW by the end of 2003. By 2007, installed capacity should be between 710 and 770 MW, equal to a "new" renewable share of 2.9 – 3.3 %. (REEEP web site) Due to longer lead times, the development of biomass has not been as fast, an increase is expected from 60 MW in 2003 to 350 – 400 MW in 2007. The tariffs vary according to factors such as type, size and age of plant, and range from €0.03 for co-firing and landfill gas to €0.60 per kwh for PV. (REEEP web site)

1.101 Amendments in 2005 to the 2002 Act raised the target for renewable energy and capped the subsidies available. Under the revised Act, Austria's target for renewable energy rises from 4% to 10% by 2010 and annual subsidies for new wind, biogas, biomass and solar energy plants are capped at € 17 million. These subsidies will now be distributed on a first-come, first-served basis and new producers will receive full subsidies for ten years only. The amended act directs funds to industrial CHP for the first time, providing € 60m up to 2012. (REEEP web site)

1.102 The Government has also set a target to achieve 9% of electricity produced from CHP by 2008 although on current projections this will be exceeded and about 12% from come from this source (Rodgarkia–Dara, 2006) .

Biomass district heating and CHP in Austria

1.103 Forests cover 46 percent of Austria and since the mid 1970s, Austria has seen a revival in the use of wood as an energy source. Biomass accounts for 12 percent of Austria's primary energy supply. (globenet) Several factors have contributed to this development: higher oil prices, decreasing wood costs due to productivity gains in forestry, and increased use of wood wastes for producing heat.

1.104 Close to one third of Austria's biomass use of approximately 120 PJ per year generates heat in combined heat and power plants. The most important sectors are forestry, saw-mills, the paper, wood pulp and woodworking industries, all of which use biomass in-house and sometimes also supply housing in surrounding areas. Austria's largest biomass power plant is being installed at an existing power station in the Simmering district of Vienna by the municipally owned WienEnergie.

1.105 The most prevalent type of biomass energy use in Austria is residential open fires or stoves with logwood, but this is decreasing as households modernize. Financial incentives in a number of Austrian provinces stimulate installation of modern wood boilers. However, a more convenient option for domestic heating (because the household does not have to buy wood and stoke the boiler themselves) is district heating. Approximately 1720 GWh of district heating are produced in 501 district heating plants (as at 2000) . About 300 small and very small systems (below 100 kW), operating so-called micro grids, have also been built particularly in the last few years. (eva) As well as the wood and paper industry the owners of these schemes also include agricultural co-operatives. Dedicated political support, the active role of provincial energy agencies and agricultural chambers and substantial subsidies from provincial governments (30-50% of investment costs) have been vital for this success. (energytech)

1.106 The share of co-generated electricity (fossil and renewable) in Austria increased by 22% to 14.3 TWh (equivalent to 24.8% of total electricity generation)from 1990 to 1995. (Eurostat 2001).

Decentralised energy in Germany

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1.107 As in Austria, much of the support for decentralised energy comes from general renewables and CHP support programmes. The original renewables policy (1991) required energy suppliers to buy power from renewable generators at 90% of the average price of electricity charged to final consumers. A decline in electricity prices, and thus in payments to renewable generation, prompted the introduction of a fixed tariff, effective from 2000 onwards. For wind energy, this was set at 9.1c/KWh for the first five years of operation and for the subsequent 15 years 6.19 c/KWh. To take account of technological progress and incentivise early investment, the tariffs were reduced by 1.5% for each year the investment occurred after 2002. Power from eligible forms of renewable generation under Germany's feed-in law more than doubled between 2000 and 2004, from 14 TWh to 37 TWh. (IEA database)

1.108 The 2004 law on feed-in tariffs provides guaranteed minimum prices for renewable energy over a 20-year period. Benefiting technologies are grid-connected PV (700 MW installed by the end of 2004) and local wind, but renewable CHP is also growing due to the support provided for biofuels. (IEA database)

1.109 The German net metering system pays customers for any electricity they generate from renewable energy on their premises, at roughly 3 times the market price per kWh for residential customers.

CHP and district heating in Germany

1.110 Between 1970 and 1995, the share of industrial cogeneration fell from 18% to 7% of total generation. However, from the 1970s to the 1990s municipal cogeneration district heating systems rose to 4%, due to government subsidies for coal-fired cogeneration. Low electricity prices for large industrial customers led to a 20% decline of co-generated electricity in German industry between 1995 and 1999.(Madlener and Jochem, 2001) The decline of co-generated electricity was also influenced by structural changes towards less energy-intensive industries.

1.111 Germany has therefore used a number of incentives in recent years specifically to encourage district heating and CHP, particularly using gas and renewables. The Federal Government in 1999 introduced an Ecological Tax that included exemptions and/or reductions for highly efficient co-generation and gas turbine equipment. In addition, a law enacted in 2000 required network operators to pay a minimum price for electricity produced by cogeneration systems. This started at 4.6 Cent/kWhe and was reduced by 0.26 Cent/kWhe in each subsequent year. The law applied only to cogeneration schemes that were installed before 1st January 2000 and was in operation until the end of 2004. (WADE, 2006)

1.112 The 2002 Act on CHP was passed within a context of falling wholesale electricity prices in the German market that had led to a downturn in CHP installation and in some CHP capacity not running. The Act set a target for CO_2 reduction through CHP of 10 million tones per annum until 2005 and 23 million tones of CO_2

per annum until 2010. The Act also established declining time limited (until 2010) bonus payments to CHP operators for electricity in addition to the market price :

- to maintain and modernise cogeneration capacity (1.74 – 0.56 ct./kWh)
- to encourage investment in small units (2.56 – 1.94 ct./kWh)
- to aid the commercialisation of fuel cell CHP units (5.11 ct./kWh)

German electricity consumers pay 0.3 ct./kWh to finance the CHP bonus. (WADE, 2006)

1.113 Further encouragement for CHP comes through the Energy Saving Ordinance for buildings (2002). If CHP supplies more than 70% of a buildings´ heat demand, the primary energy consumption of the building is not restricted by the ordinance.

1.114 12% of heat demand was supplied by district heating in 2001 (28% in Eastern Germany). The main fuels were coal (40%)and gas (40%). However, district heating has been in decline in Eastern Germany as rather than renew inefficient systems there has been a greater tendency to remove them and opt for individual gas fired heating. (WADE, 2006)

1.115 For the future the German government's emphasis will be on smaller scale CHP and local heat networks rather than the large CHP stations and city wide district heating networks of the past, as greater efficiencies of conversion to useful heat and electricity are achieved through smaller scale CHP. An example is a new gas fired CHP plant in Berlin supplying a complex of large new buildings in the city centre (Potsdamer Platz) with electricity, heating and cooling. The energy efficiency of this system is 92%, one of the most efficient plants in Europe (the average for small scale CHP/DH is 87% and for larger scale CHP/DH is 75%). (Brischer, 2004)

1.116 Electricity and decentralised energy data Germany (2004)

Total electricity generation 609.0 TWh
Total electricity capacity 125.0 GWe
DE generation 125.0 TWh
DE capacity 45.0 GW e

(WADE, 2006)

Decentralised energy in Australia

1.117 Energy policy is determined partly at national (federal) level and partly at state level. There is no comprehensive subsidy scheme for DE and no national objectives for cogeneration / DE. However, some support for DE comes through the national Renewable Energy (Electricity) Act, introduced in 2000 as a contribution to reducing greenhouse gas emissions. The legislation set a mandatory renewable energy target (MRET) of 9500 GWh (2% of electricity generation) to be achieved by 2010. MRET requires wholesale purchasers of electricity to proportionately contribute to the target. The Office of the Renewable Energy Regulator (ORER) administers the legislation.

1.118 A review of MRET in 2004 found that the targets for its first two years of operation were exceeded. Initial growth in renewable energy generation primarily resulted from the hydro and solar hot water sectors, with growth in the wind sector increasing from a small base. Generation of energy from biomass, including co-generation bagasse, had not been as significant as expected. By 2007, sufficient capacity was expected to have been installed to meet the MRET target of 9500 GWh for 2010. As a consequence, after 2010 investment was expected to fall away rapidly unless some amendment to the measure was introduced. The review also found that, in 2010, the cost of abatement through MRET was expected to be about AUS$32 per tonne CO2. Concerns about costs led the Government to decide in 2005 that the target should not be increased so it remains at the 2% level to 2010 although changes were made to encourage biofuels along with some new initiatives including a "solar cities" programme that will support decentralised energy schemes.

1.119 At state level there are also no specific initiatives to encourage DE although the New South Wales Greenhouse Gas Abatement Scheme (GGAS), which commenced in January 2003, provides some support. GGAS established annual statewide greenhouse gas reduction targets, and requires electricity retailers and certain other parties who buy or sell electricity in NSW to meet mandatory benchmarks based on their share of the electricity market. Assessing abatement projects, accrediting parties to undertake projects and create certificates, and monitoring compliance with GGAS is the responsibility of the energy regulator, the Independent Pricing and Regulatory tribunal (IPART). Activities that qualify for abatement certificates include: reducing the greenhouse gas intensity of electricity generation; generating low emission intensity electricity; demand side activities to reduce, or increase the efficiency of electricity consumption; carbon sequestration. Projects supported through the GGAS include renewables and on-site CHP in industry.

1.120 Australian electricity production is mainly from coal, gas and oil-fired centralised generation. DE accounts for about 9% of total capacity. Industrial cogeneration represents over 60% of DE capacity (2.5 GWe), mainly in the aluminium, sugar, paper and nickel industries. 18% of the country's 151 cogeneration projects are renewable, mostly bagasse-fired. Installation of solar technologies has been steadily rising, and reached 45.6 MW in 2003, 87% of which was off-grid. Electricity prices have fallen over the last few years, slowing the uptake of DE technologies and renewables. Current policy favours centralised generation, focusing on clean coal technologies and fuel-switching to natural gas. However, DE is increasingly considered a solution to demand growth, energy security and carbon emissions. The government's National Priorities 2003 include DE as an important part of Australia's future energy supply. (WADE, 2006)

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1.121 According to WADE (2006) prospects for DE in Australia are improving, despite existing unfavourable economic and regulatory circumstances, because energy prices are expected to rise and there is interest in emission trading. The nature of electricity demand in Australia, with its large industrial component, high summer peaks, and some remote communities, mean DE technologies could play a larger role in meeting future energy needs.

1.122 Electricity and decentralised energy data Australia (2005)

Total electricity generation 213.0 TWh
Total electricity capacity 45.0 GWe
DE generation 11.5 TWh
DE capacity 4.0 GW e

(WADE 2006)

Decentralised energy in Canada

1.123 Hydro electricity accounts for about 60% of total generation in Canada. Because energy is under provincial jurisdiction the policy landscape for decentralized energy varies by province. There are no national objectives for cogeneration /DE or renewables and limited incentives in some provinces, but Ontario has recently adopted several reforms that should favour DE such as the aim to phase out large scale coal, the requirement to install smart meters for all users and a generous feed-in tariff for onsite power producers, including biomass CHP.

1.124 Due to plant retirements there was a small decline is installed CHP in Canada in 2005, to about 6.8GW. In October 2005 natural gas prices rose to CDN $10-11/GJ, putting a damper on the development of CHP. Although little of the capacity is decentralized, 239 MW of new wind energy capacity was installed in 2005 bringing the total to 683 MW. Hydro-Quebec signed contracts for 995 MW of wind power while the Ontario government approved 975 MW of renewable energy projects. According to WADE (2006), prospects for DE in Canada remain good. Supply of natural gas is rising as are electricity prices. Concerns over the 2003 blackouts and the increased activities of a DE promotion group should also help.

1.125 Electricity and DE data Canada (2003)

Total electricity generation 568.0 TWh6
Total electricity capacity 117.0 GWe
DE generation 65.0 TWh
DE capacity 14.0 GW e

(WADE, 2006)

Assessment of impacts of policies for sustainable energy

1.126 This section looks at how much the use of renewable energy and decentralised energy has been increasing in recent years worldwide. Whilst some of this might have happened anyway, it is likely that specific policies will have stimulated much of the uptake given that these technologies tend to be more expensive that their conventional alternatives. In the case of energy efficiency worldwide information on uptake of measures is not available. This is dealt with in the country case studies for those countries . Thus for energy efficiency, this section considers the range of options that might be used to assess progress. It is not considered useful to try to assess outcomes in terms of emissions on a worldwide basis but this is examined in the country case studies in relation to targets that the countries have set.

Renewables

1.127 Renewable energy generated as much electric power worldwide in 2004 as one-fifth of the world's nuclear power plants, not counting large hydropower (which itself was 16 percent of the world's electricity). The latest authoritative data on renewable energy worldwide is contained in the REN 21 "2006 Global Status Report" (REN 21, 2006) and can be summarized as follows :

- Large hydropower increased by an estimated 12–14 gigawatts (GW) in 2005, led by China, Brazil and India. Small hydro increased by 5 GW to total 66 GW worldwide, with 38.5 GW in China.

- Wind power capacity grew by 24 percent to reach 59 GW. The leading countries for added capacity were : the United States (2.4 GW), Germany (1.8 GW), and Spain (1.8 GW). Offshore wind grew by at least 180 MW.

- Large and small scale biomass power generation and heat supply continued to increase, bringing total capacity to about 44 GW. Annual increases of 50–100 percent in biomass power production were registered for 2004 in several OECD countries, including Germany, Hungary, the Netherlands, Poland, and Spain. Other increases of 10–30 percent were registered in Australia, Austria, Belgium, Denmark, Italy, South Korea, New Zealand, and Sweden.

- Geothermal power saw continued growth with contracts for an additional 0.5 GW in the United States and plants under construction in 11 countries.

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- Grid-connected solar photovoltaic (PV) continued to be the fastest growing technology, with a 55 percent increase in installed capacity to 3.1 GW in 2005. More than half of the increase occurred in Germany. Including off-grid applications, total PV capacity worldwide increased to 5.4 GW

- Overall, renewable power capacity expanded to 182 GW, up from 160 GW in 2004, excluding large hydropower. The top six countries were China (42 GW), Germany (23 GW), the United States (23 GW), Spain (12 GW), India (7 GW), and Japan (6 GW). Including large hydropower, renewable power capacity reached 930 GW in 2005.

- Solar hot water capacity increased by 14 percent to reach 88 gigawatts-thermal (GWth). China remained the world leader, with over 60 percent of the global installed capacity. Solar hot water in Europe increased by 1.3 GWth.

Decentralised energy

1.128 WADE estimates that DE held an 8-9% share of the world's power market at the end of 2005 - compared to 7% at the end of 2004 (WADE, 2006) .The countries with the highest proportions of decentralized energy (measured as share of TWh of generation) are : Denmark (53%), Finland (38%), the Netherlands (37%); Latvia (36%); Czech republic (26%). At current growth rates, WADE estimate that capacity could reach 20% by 2025, representing annual DE capacity additions of around 120 GWe – about eight times current market activity.

Energy efficiency

1.129 It is more difficult to measure the impact of energy efficiency policies than those supporting renewable and decentralised energy such as CHP. With renewables and CHP the outcome is clear – a change in capacity – and the role of policies in stimulating that is also relatively easy to assess – albeit that there will be other factors to take into account. For energy efficiency policies there is first of all a difficulty in choosing what to measure. Clearly it is possible to measure outputs – i.e. measures (e.g. wall and loft insulation, condensing boilers, CFLs, efficient appliances) sold and installed. There are two problems with this however. Firstly, unlike for renewables and decentralised energy where the REN 21 and WADE data are fairly authoritative, there is no authoritative source of data on energy efficiency measures installed worldwide and it is only a few countries that have such data at the country level. Secondly, counting energy efficiency measures is not strictly comparable to measuring changes in renewable and CHP capacity. Although assumptions can be made about the impact that energy efficiency measures will have on demand, this can be affected by behavioural factors that do not apply to energy supply side interventions. So it is not straightforward to say that x measures produce y reduction in demand; whereas it is possible to predict with a greater degree of certainty (albeit that there are intermittency issues for some sources) the output from renewable energy and CHP and the impact on emissions through displacement of conventional sources.

1.130 Other alternative measures of the impact of energy efficiency are energy intensity or total demand. However, there are so many factors that affect energy intensity and total demand that it becomes rather more complicated to separate out the role of energy efficiency measures and, even when this has been done, to assess what measures would have been installed anyway given that some would be economically rational (in a way that installing renewable energy may not without subsidy). So, for example, US energy consumption in the household sector was so much higher than many other countries in 1973 that it could be argued it was a relatively easy job to improve energy efficiency there. Countries like the UK and Japan with low levels of household space heating comfort in the 1970s were therefore more likely to increase demand in those sectors (or at least to see efficiency gains offset by rises in indoor temperatures). Structural change is also important – IEA countries have seen shifts in their economies from heavy manufacturing to light industry and services – this is particularly true in Japan which has pursued a policy of structural change to high technology and low energy use to reduce its dependence upon imported oil. Changes in energy intensity may thus have little to do with energy efficiency policy.

1.131 Bearing in mind these caveats, performance worldwide shows there is still room for improvement. Energy intensity (i.e. the amount of energy needed to produce a unit of GDP) has improved markedly – total primary energy supply (TPES) per unit of GDP in IEA countries fell by one third between 1973 and 2000. However TPES as a whole (i.e. not the ratio to GDP) in IEA countries, increased by 37% between 1973 and 2000. Total final energy consumption also rose in IEA countries in all sectors from 1973 to 2000, except manufacturing. Households, the commercial sector and transport have all seen significant increases in demand. For example, household energy use increased by 17%, including a doubling in electricity consumption due to much greater use of a wider range of appliances. (IEA, 2004) Undoubtedly the installation of energy efficiency measures will have had some impact on demand at the micro level – e.g. substitution of older appliances with newer more efficient ones – but overall demand is rising despite efforts to improve energy efficiency.

1.132 However, performance does differ between countries. Japanese energy consumption increased by 44% from 1973; while in the US it increased by 79% and in a group of 8 European countries for which the IEA has detailed data (Denmark, Finland, France, Germany, Italy, Norway, Sweden, UK) it increased by only 12%. Without the reductions in energy intensities, the IEA estimates that consumption would have been 43% higher in Japan, 49% higher in the US and 53% in the European countries. (IEA, 2004)

Conclusion

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1.133 Worldwide a wide range of policies to promote renewable energy, CHP, decentralised energy and energy efficiency have been put in place. Some policies started as early as the 1970s but most have started since the early 1990s and the major growth has come since the late 1990s.

1.134 In terms of renewables and other decentralised energy such as CHP, the most success has come in countries that have adopted feed in tariff schemes, in contrast to those that have used quota type schemes such as the Renewables Obligation in the UK. This is largely because feed in provides guaranteed prices over long periods and hence is less risky for investors. However, feed in policies have been in operation for longer than quota schemes and thus it is perhaps too early to say whether the former are inherently more effective. In addition to support mechanisms another important factor in the success of decentralised energy has been connection regimes and connection charges. Other important forms of support have been tax incentives.

1.135 Energy efficiency is being promoted in energy markets either through public benefits charges that create funds or through obligations on energy suppliers. There is no obvious difference in the success of these two types of scheme which both effectively create subsidies for energy saving measures.

1.136 State level energy regulators have been in existence for decades in the United States and with considerable independence and wide ranging duties they have had considerable impact on the shape of energy markets within their states – albeit within the context of political frameworks set by state governments. Many US regulators have adopted a range of measures to incentivise energy efficiency and renewable energy. In contrast energy regulators in most of Europe are relatively new, hence they have so far had limited impact on the shape of the energy markets and the extent to which sustainable energy is incentivised.

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Chapter 2 : Denmark

Energy supply

2.1 In 2004, oil, natural gas, and renewable energy accounted for around 50 per cent of fuel consumption in electricity production. Coal's share declined from 90% in 1990 to just under 50%. On the basis of the existing overcapacity, the DEA's basic projection indicates that it will be around 2015 when need for new electricity capacity arises in Denmark. (DEA 2005).

2.2 Denmark still relies on coal for much of its energy and so has relatively high greenhouse gas emissions on a per capita basis. The proportion of Danish electricity consumption from renewable energy was 29%, and wind turbines accounted for 19% of total consumption. Electricity from CHP (all fuel sources) accounted for 60% in 2004. (Danish Ministry of Energy and Transport, 2005) There is natural gas supply to most of the country except South Zealand and Djursland.

Energy policy

2.3 Denmark is a small country with 2.5 million households (2005 figures).

2.4 Three key features about the Danish energy policy and political system are worth noting as they help to set the context for the policy that has developed over the years. Firstly the tradition of consensus building, a key manifestation of which is the system of "political agreements". Over many years, successive Danish governments have reached political agreements with opposition political parties and the energy companies regarding plans for the energy sector, which have provided a considerable degree of policy stability. In the last twenty years these agreements have covered market liberalization, nuclear power, support for renewables, energy saving etc. There was however, some break in consensus with the election of a new Conservative government in 2001, which questioned much of the previous emphasis on the environment and support for renewables and wanted to increase the emphasis on market liberalization and market mechanisms as opposed to subsidies and obligations. This has resulted in some changes in policy as will be seen below, although the changes have been perhaps less marked than was initially expected, due again to the consensual nature of Danish policy making.

2.5 Secondly the substantial role that local authorities have traditionally had. Local authority ownership and control of major utilities (e.g. electricity, district heating, gas and water) – either solely or in partnership with consumer co-operatives or the private sector - was the preferred approach in Denmark in the first half of the 20th century rather than nationalisation. The role of local authorities has continued since market liberalisation, although this may start to change as the Government has signalled its intention to make it easier for local authorities to sell their interests in energy utilities and for others to take them over.

2.6 Thirdly the key role of planning in government policy. Planning has four key features in Denmark : it is designed to achieve social objectives and an economic balance across the country; environmental considerations, especially the avoidance of pollution, are emphasised; a commitment to public participation especially at the municipal level; a strong sense that the government defined public interest, as opposed to private individual interests, will prevail where conflicts arise. There is no national plan as such, but national policy is expressed in the form of an annual Ministry report or statement submitted to parliament. Regional plans must reflect national policy and in turn provide the framework for the municipal plans. In this context therefore, Denmark has been willing to undertake a degree of planning and imposition of rules in its energy sector that would seem unusual in many other countries.

Energy 2000, Energy 21 and Energy Strategy 2025

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2.7 In 1990 the Danish Government issued its action plan “Energy 2000" (Danish Ministry of Energy, 1990) which placed firm emphasis on renewable energy, CHP and energy efficiency, not only for environmental reasons but also because Denmark expected to move from being a net exporter to a net importer of oil and gas within 10-15 years. Energy 2000 was followed up by Energy 21, published in 1996, which outlined three priorities : renewable energy, energy efficiency (including CHP) and opening up of the electricity market. Energy 21 reiterated the national objective to stabilise CO_2 emissions at 1990 level by 2000, and to reduce them by 20% from the 1988 level by 2005.

2.8 Energy Strategy 2025, published in June 2005 (Danish Ministry of Transport and Energy, 2005a) , is the government’s latest long term strategy on energy policy. It indicates a similar mix of goals seen in many other countries, but, in comparison to previous statements places more emphasis on economic and market issues as the principles and goals outlined below illustrate.

“The Government's energy-policy principles

- Future energy policy must be cost-effective, market-based and internationally oriented. It must be balanced with respect to security of supply, growth and the environment.
- Energy policy must be based on market-oriented instruments, on the development and use of new technologies with significant commercial potential and on active international efforts to further Denmark's energy-policy interests.
- Energy prices must be competitive. Public service obligations must be formulated and implemented at the lowest possible cost.

The Government's general energy-policy goals:

- **Economic robustness:** a high degree of security of supply must be maintained in the long term and contribute to general economic robustness vis-à-vis unstable and possibly high oil prices.
- **Environment:** the use and production of energy and the development and introduction of new energy technologies must comply with national environmental priorities and support the fulfillment of Denmark's current and future international environment- and climate obligations.
- **Well-functioning markets:** electricity and natural gas must be available on well-

functioning, competitive markets with real choices for consumers and equal competition conditions for enterprises in the European Union.

- **Development of new technologies:** Danish technological positions of strength in the energy field must be transformed into growth and jobs and must support the development of an effective and environmentally friendly Danish energy sector.

- **Electricity infrastructure:** future expansion of the overall electricity-transmission grid must support security of supply, well-functioning markets and enable the introduction of more renewable energy."

((Danish Ministry of Transport and Energy, 2005a)

2.9 Energy Strategy 2025 also set out the Government's desire to reduce subsidies for public service obligations (PSOs) that support renewables and decentralised CHP. The reduction will also reflect that the technologies are becoming more competitive with less need for subsidy.

Energy and CO2 taxes

2.10 Denmark uses taxation to maintain high stable energy prices and the economic base for natural gas and CHP. Taxes on oil and electricity were introduced in 1977 and on coal in 1982. Renewable energy is exempt from energy taxation as is the electricity produced in CHP schemes. The service and production sectors in Denmark are exempt from energy taxes and, whilst all consumers have to pay VAT on fuel, most businesses can reclaim VAT paid. The effect of taxation thus falls mainly on the domestic sector where taxes account for 18% of the price of gas, 53% of the price of electricity and 60% of the price of oil.

2.11 In May 1992 the CO_2 tax was introduced for domestic customers; in January 1993 it was extended to industrial and commercial customers. The rate is 100 DKK per ton of CO_2, so it increases the price of coal relative to that of gas. It is applied to final energy supplied to customers, rather than to primary energy use. VAT at 25% applies also and whilst industrial and commercial customers get VAT refunded in full, most (except some energy intensive companies) only get a refund of 50% of the carbon tax. However, the higher refunds to energy intensive industry are conditional on them reaching monitored agreements to install energy saving measures (e.g. CHP) with the Danish Energy Authority. (DEA web site)

2.12 The Government intends to modernise and simplify the Danish energy- and CO_2 tax system in light of the EU emissions trading scheme. One issue is overproduction of electricity. Despite low electricity prices, the costs of co-production of electricity and heat are often more than offset by the taxes saved (taxes on heat from CHP plant are lower than on separate district heating and electricity) thus leading in some cases to over-production.

2.13 The average domestic electricity price in Denmark for small consumers in 2003 was €0.2558/kWh after tax, making it the most expensive in the European Union. The pre-tax price of €0.134/kWh is comparatively low for the EU. (Eurostat 2003)

Institutional framework

2.14 There are two key government departments : The Ministry of the Environment and the Ministry of Transport and Energy. The Ministry of Energy was established in 1979 . In 1994 the Ministries of Energy and Environment were merged to form the Ministry of the Environment and Energy. The 2005 re-organisation resulted in the environment and energy functions being split.

2.15 There are two key organisations other than the departments themselves: the Danish Energy Authority (DEA) - an agency within the Ministry of Transport and Energy; the Danish Energy Regulatory Authority (DERA) - an independent authority whose members are appointed by the Danish Minister of Transport and Energy. There are also two other relevant bodies : the Energy Supplies Complaint Board and the Energy Board of Appeal.

Danish Energy Authority

2.16 The Danish Energy Authority (DEA - Energistyrelsen), is responsible for energy policy formulation and implementation. It was formed in 1976 (as the Danish Energy Agency) and was initially in the Ministry of Energy, then the Ministry of Environment and Energy when those two departments were merged. Since 2005 it has been based in the new Ministry of Transport and Energy. It is therefore formally part of the Ministry rather than being an independent authority but represents a substantial centre of expertise on energy within the government, with divisions responsible for energy supply, energy resources and energy policy – energy efficiency sits within the policy division. The Authority (as it was renamed in 2003) drafts and administers Danish energy legislation and translates the government's policy principles into actual programmes.
"By establishing the correct framework and instruments in the field of energy, it is the task of the Danish Energy Authority to ensure security of supply and the responsible development of

energy in Denmark from the perspectives of the economy, the environment and security." (DEA web site)

2.17 In particular, the DEA performs the following functions:

- Overall planning of power, heat, and natural gas.
- Licensing of activities. – including electricity transmission and distribution
- Implementation of environmental policies that apply to the sector.
- Emergency preparedness
- International co-operation on energy

2.18 The DEA administers and supervises oil and gas exploration, geothermal energy and storage. It prepares the resource and financial forecasts for oil and gas production, approves development plans and production profiles for the oil and gas fields and prepares and implements licensing rounds. It is responsible for the three main Acts in energy supply: the Electricity Supply Act, the Natural Gas Supply Act, and the Heat Supply Act. The Authority also administers the legislation for the CO2 emissions trading scheme and subsidies for renewable and CHP electricity production.

2.19 The Danish Electricity Supply Act gives the DEA the key role in licensing new electricity generation. A licence is required to produce electricity from plants with a capacity in excess of 25 MW and prior permission of the DEA is required to establish new plants and make major changes to existing plants. Plants over 5 MW are required to meet specific conditions which including complying with greenhouse gas emission limits. In addition the approval from the DEA may lay down conditions for grid connection.

2.20 The DEA has the lead role on energy efficiency to ensure coordination of the various activities and the efficient use of State funds. It undertakes research and makes recommendations for energy saving policy and also implements the policies for households, public, commercial and industrial sectors. Energy intensive industries can, for example, receive partial reimbursement of the CO2 tax by entering an energy efficiency agreement with the DEA.

Danish Energy Regulatory Authority

2.21 The Danish Energy Regulatory Authority (DERA - Engeritilsynet) supervises monopoly companies in electricity, gas and district heating. It was created in 1999 (as the Energy Supervisory Board), to replace the Electricity Price Committee and the Gas and Heat Price Committee. The initial staff consisted of officials of both the Danish Energy Agency and the Competition Authority. The members of DERA are appointed for a period of four years. DERA operates day to day as a division of the Danish Competition Authority, with the DERA secretariat being managed by the Deputy Director of the Competition Authority.

2.22 DERA's mission is set out as follows : "DERA works to secure efficient and transparent energy markets in Denmark… The Authority must help ensure that consumers – households and enterprises – are charged reasonable and transparent prices under reasonable, uniform and transparent terms of supply. This includes environmental considerations." (DERA web site)

2.23 DERA was created through the Electricity Supply Act and its powers and duties are defined by provisions in the three energy supply acts - the Electricity Supply Act (Consolidated Act No. 151 of 10 March 2003), the Natural Gas Supply Act (Consolidated Act No.130 of 27 February 2003) and the Heat Supply Act (Consolidated Act No. 772 of 24 July 2000). DERA's activities in the field of electricity supply are also defined in a Statutory Order (No. 163 of 26 February 2000). Further powers and duties are set out in the Energinet.dk Act.

2.24 The Electricity Supply Act sets the framework for how consumer protection, environmental concerns and security of supply can be achieved in the liberalised electricity market. The object of the Electricity Supply Act is to promote efficiency in the electricity sector, partly by using benchmarking. DERA regulates the prices and terms for access to transmission and distribution networks. For the supply obligation electricity companies, the Authority is also responsible for price control. To promote transparency, DERA regulations can also apply to areas subject to competition, e.g. publication of prices and terms.

2.25 The Natural Gas Supply Act is the foundation for regulation of the gas sector. Regulation covers transmission, storage and distribution companies. For companies that have an obligation to supply customers who do not want to switch, DERA supervises that they supply gas at reasonable prices and on reasonable terms. DERA also supervises access to the transmission grid and that access to gas storage facilities is at reasonable prices and on reasonable terms. Since early 2005, the gas distribution companies have been subject to revenue cap regulation, which puts a ceiling on their income. The companies are also subject to efficiency requirements which aim to lower distribution prices.

2.26 There is no competition in the district heating sector. According to the District Heating Supply Act, district heating must be sold at the cost of production and distribution; the "non-profit" principle. DERA decides which necessary costs can be included in heating prices to ensure supplies are at reasonable and transparent prices and on reasonable terms..

2.27 DERA also supervises some of the activities of Energinet.dk, (the state owned electricity and gas transmission and system operator company).

The Energy Board of Appeal (EBA)

2.28 The EBA is an independent board under the Ministry of Transport and Energy. The decisions made by the DEA and DERA may be appealed to the EBA. Decisions by the EBA are final – i.e. cannot be appealed to other authorities - although they can be challenged in the courts.

The Energy Supplies Complaint Board

2.29 The Energy Supplies Complaint Board was set up in November 2004, under the Consumer Complaints Act, to deal with customer complaints about electricity, gas and district heating companies. It is effectively an alternative dispute resolution (ADR) body or ombudsman service, and involves participation of the Danish Consumer Council[2] and the energy industry . The Board has a neutral chairperson (a city court judge) and four members. The Consumer Council appoints two members, and two members are appointed to represent the energy suppliers. The Danish Competition Authority serves as secretariat to the Board.

Energy market

2.30 There was a considerable degree of consensus in Denmark over the established structure of the electricity and gas industries, until the late 1990s, with even non-socialists supporting the strong local authority role. Whilst Denmark was not opposed to the EC plans for a single energy market it was a sceptic about the benefits and had concerns about the potential impacts on its system of environmentally driven planning. However, the consensus began to break as industrial users recognised that they could gain access to cheaper power through

[2] The Danish Consumer Council, founded in 1947, represents consumers' interests, to Government, Parliament, public authorities and the business community. It also acts as an umbrella body for national and local consumer groups It is funded by individual members who subscribe to its equivalent of Which? Magazine, and also receives a government grant under the Finance Act.

liberalisation. The following sections set out the brief history and current state of the electricity, gas and district heating markets.

Electricity market

2.31 Denmark is divided into two electricity systems. West Denmark (Jutland and Funen) is in phase with the European continent, while East Denmark (Zealand and Lolland- Falster) is in phase with the rest of Scandinavia. (DERA, 2006)There is no cable link between West and East Denmark, but a link is part of Energy Strategy 2025, planned for 2010.

2.32 Prior to the 1999 reforms the electricity industry was mainly owned by companies in which the majority shareholders were local authorities and consumer co-operatives, with some private sector involvement. Local authorities and the consumer co-operatives owned the distribution/supply companies (around 100) which had monopoly franchises for specific areas; these distribution companies owned the nine regional generating companies; and the generating companies owned the two transmission companies. Thus the Danish electricity industry, up to the level of local distribution/supply, operated as if it consisted of two vertically integrated companies - Elkraft and Elsam - covering West and East Denmark. They were largely responsible for long term planning of the transmission systems and generating capacity, control of the electricity pools and hence all trading, and, in effect, co-ordinated the activities of the nine regional generating companies.

2.33 Plans to reform the electricity industry were approved in 1999 and came into force in 2000. There is regulated third-party access for generators to the network and all consumers have had a choice of supplier since 2003. In addition to the unbundling required by the EU Directive on energy market liberalisation, the different functions (transmission, distribution, generation, retail) have to be performed by separate legal entities. (DERA web site)

Current electricity market structure

2.34 There are three groups of grid companies:

- Energinet.dk owns the 400 kV grid - more than 6,000 km
- 12 regional transmission companies own grids with a capacity of 150 – 30 kV - around 9,000 km,
- About 120 local distribution companies, own grids with a capacity of 20 – 0.4 kV- a total length of more than 150,000 km.

2.35 During 2005, Gastra A/S (the gas transmission company) and the electricity-transmission companies Eltra, ElKraft Transmission and El-kraft System merged to become Energinet.dk, a state-owned company responsible for overall system operation, long-term planning of the transmission network and ensuring sufficient electricity in the grid. Energinet.dk can require the owners of the regional and local grids to make specific investments. In return for this, Energinet.dk pays the owners of the grids for making capacity available for the system operators. Energinet.dk performs its functions within overall frameworks laid down by the Government and Parliament.

2.36 The 12 regional transmission companies transport electricity from the main transmission grid to the distribution grid. The 120 distribution companies are the final link to the consumers and are also responsible for metering. For customers of supply obligation companies the distribution company collects the total bill. Customers who receive electricity from a company without a supply obligation will usually receive two separate invoices, one from the supplier and one from the distribution company.

2.37 The majority of local distribution companies and regional transmission companies are still owned by municipalities or co-operatives, although this is starting to change (see under gas).Until late 2005 the municipal distribution companies also owned the two large generation companies, Elsam (Jutland and Funen) and Energy E2 (Zealand, etc.) when they were acquired by the state owned gas company DONG, which now has 49% of the generation market. (DERA web site)

2.38 Electricity trading takes place on the Nordic Electricity Exchange, Nord Pool, which, according to the IEA, is one of the most competitive and transparent electricity markets in the world. Electricity is also imported and exported to/from Denmark.

2.39 Electricity is supplied, either with a supply obligation or on commercial terms. Large users have been able to switch supplier since April 2001. Retail competition was opened for all customers (including households) in January 2003. Companies with a supply obligation licence have a duty to supply electricity (at regulated prices) to all customers in their area who have not taken advantage of the open electricity market. The supply obligation companies are mainly still in the same ownership as the local distributors (local authorities and co-operatives), although they are obliged to have separate companies. Customers buying supply obligation electricity are primarily households and smaller enterprises. As of 2005, there were 37 supply obligation companies with 97% of customers (by number) and 50% of the market for electricity supply (by volume). There were 17 other suppliers with 3% of customers and 50% of the market by volume. (DERA, 2006)

Gas market

2.40 The Danish natural gas sector includes production, transport and trading. Danish gas reserves are under state control, with licences issued by the DEA. The state owned company

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Dansk Olie og Naturgas (DONG) until recently was responsible for exploration, production, transportation to the distribution/supply companies and supply to some large customers. When gas was discovered the government decided it should not be vertically integrated but that distribution/supply should be undertaken by five regional companies (each having a monopoly franchise for a specific area), owned by regional groupings of local authorities.

2.41 Opening the market has required restructuring. Ownership of the regional gas companies has not changed but they have been divided into : distribution companies; supply obligation companies, responsible for supplying customers not wanting to change to a new supplier; and other supply companies. From the beginning of 2004, all Danish natural gas customers have had a choice of gas supplier. There are currently about ten suppliers on the Danish gas market. DONG separated its transmission activities into the Gastra company, now part of Energinet.dk, The gas activities of the new DONG Energy now cover production, distribution and storage services in separate companies.

2.42 In 2005, DONG acquired Elsam and Energi E2 and three electricity distribution companies NESA, Københavns Energi and Frederiksberg Forsyning. The majority (73%) of DONG Energy is owned by the Danish Government with the rest of shares owned by the former Elsam (16%) and Energi E2 (11%) shareholders (i.e. the local authorities). (DEA web site) According to a political agreement, the Danish Government shall maintain a majority in the company until 2015. Reduction of the ownership below 50% would require a futher political agreement.

2.43 Danish production of natural gas exceeds domestic consumption, and therefore a proportion is exported to Germany and Sweden and some suppliers and large consumers buy gas from Germany.

District heating sector

2.44 The liberalisation in gas and electricity has not taken place in the district heating sector which is still run by local vertically integrated monopolies that own the heat network, heat production and undertake sales to consumers. It is uneconomic to transport district heating over long distances so there is no interconnected heat network, except in the Copenhagen, Aarhus, Esbjerg, and Vejle-Fredericia-Kolding area (TVIS). Local authorities are the central players in district heating as they develop heating plans and have responsibility for expanding district heating and for implementing the regulations in the Law on Heat Supply. Municipalities can specify the type of fuel to be used and oblige consumers to link up to the district heating network.

2.45 Competition is possible for heat production although it is not common. The Government has said it wants to examine the long term possibilities of more competition in areas with major

district heating systems – for example more than one heat producer supplying the network - but so far no action has been taken on this. (DEA web site)
In smaller areas district heating is often run by a consumer-owned company (co-operative) , while in larger towns it is often owned by the municipality alongside electricity distribution. Most companies generate both electricity and heat through CHP. There are more than 430 district heating companies, of which 15% are owned by municipalities, responsible for approx. 66% of heat sales, and 85% are consumer owned companies with approx. 37% of total heat sales (Owen, 2004) Total sales of heating amount to about DKK 13- 14 bn. per year.

2.46 The DEA sets the general conditions for district heating to ensure that both cost-effectiveness and consumers' heating costs are taken into consideration. DERA and the Energy Supplies Complaint Board monitor the district-heating sector and handle complaints regarding prices and conditions. All district-heating and co-generation plants are obliged to notify DERA about consumer prices and conditions.

Low income consumers and energy

2.47 Concerns about fuel poverty barely register in Denmark, despite high levels of energy taxation. The lack of concern about fuel poverty is due to a combination of relatively small income differences in Denmark, relatively generous welfare benefits, better housing standards, better insulation and the types of heating used by most lower income households. Energy bills are higher in rural areas that do not have access to district heating and gas heating, so low-income households in rural areas are a group that is specifically exposed to Denmark's high levels of energy taxation. (Jacobsen 2003) However, although rural populations have higher energy bills compared to income, there is no income inequality between rural and urban areas, largely because low income households are mainly concentrated in urban areas with access to district heating and gas (Jacobsen 2003) It is therefore not surprising that no specific concerns about them appear to feature in the work of the DEA, DERA and the Consumer Complaints Board and that there have been only limited energy efficiency programmes targeted to low income households

Energy efficiency

2.48 Government energy conservation programmes during the 1970s and 1980s concentrated on space heating as this is where the largest proportion (40%) of energy is used. In 1981, the

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Danish parliament passed the "Act on reduction of energy consumption in buildings", which aimed to bring all buildings built before February 1979 up to the standard of the 1979 building code. Government subsidy schemes for insulation measures and heating systems ran from 1976 until the late 1980s. The maximum grant payable was around £700, and over the scheme, around £300m was spent leading to around £1000m worth of investment. (Owen, 1999) Since January 1997 energy labelling has been mandatory for all housing, commercial and public buildings.

DSM in Denmark

2.49 DSM had its beginnings in 1986 when the Government and the Social Democratic Party reached an agreement to promote DSM and greater use of CHP. In response the distribution companies developed a number of electricity saving pilot projects, including promoting the take up of CFLs; energy efficient freezers; and energy efficient lighting for commercial/industrial and public sector customers. In 1994 the 1976 Electricity Supply Act was amended to oblige electricity utilities to adopt integrated resource planning (IRP). Under IRP the distribution companies had to assess the demand for electricity and conservation potential within their areas, and how it could be realised via energy efficiency. Elsam and Elkraft also had to produce IRP plans, in collaboration with the distribution companies, for their supply areas, taking account of : security of supply; competitiveness of industry; social costs and benefits; environmental protection, including national targets on emissions. The utilities had to submit their plans (and progress reports) to the Danish Energy Agency, once every two years. (Owen, 1999) The utilities made three DSM plans. The first in 1995, the second in 1997,and the third in January 2000.

2.50 The introduction of competition meant that Denmark had to revise its use of DSM. In May 2000, the Danish government passed a new Act on the promotion of energy conservation. The Act set the framework for energy-saving; enabled the appointment of local energy conservation committees to co-ordinate local work, and established new initiatives for energy conservation in the public sector. The Act complemented requirements in the Electricity Supply Act, the Natural Gas Supply Act and amendments to the Heat Supply Act. These Acts require the companies responsible for electricity, gas and district heating distribution to promote energy saving measures.

2.51 The DEA lays down guidelines, on an annual basis, for planning, implementation and monitoring; the companies are responsible for implementing their activities. Electricity, district heating, and gas distribution companies must cooperate, and assist the local energy savings committees to become a forum for coordinating energy-savings initiatives. 32 local energy savings committees have now been established in Denmark. Distribution companies are statutory members of the committees, but many also have municipalities, counties, and other parties (e.g. business councils, residents associations, green organisations, etc.) as members. The range of activities and effectiveness of the committees is variable. (DEA, 2003) Many of the utilities have joined forces to establish Energy Centres, which provide advice and consultancy on energy savings. The Minister presents an annual report to the Danish Parliament on the implementation of energy savings.

Energy saving agreement 2005

2.52 The 2005 Agreement between the Danish Government (the Liberal Party and the Conservative People's Party) and the Social Democrats, the Danish People's Party, the Social Liberal Party and the Socialist People's Party on future energy-saving initiatives (DEA web site), sets the framework for energy-saving initiatives for the next several years and follows on from the Action Plan produced by the Government in 2004. Increased energy saving initiatives are expected to deliver an annual average saving of 7.5 PJ from 2006-2013 - approximately 3 times higher than currently The main responsibility for the increased savings lies with the electricity, gas, district-heating and oil distribution companies. Each company is allocated an amount of demand reduction that they must achieve but is free to do this in whatever way they wish. The companies can buy and sell demand reductions among themselves. The money they receive to achieve this demand reduction is fixed and thus they have incentives to reduce costs. A status report will be included in the annual energy saving reports, starting in the autumn 2006. The expenditure is financed through charges included in tariffs for electricity, gas and district heating distribution and totals around DKK 327 million annually. (Danish Ministry of Transport and Energy, 2005b)

2.53 With liberalisation and the establishment of the electricity trading market, Danish electricity consumers can theoretically purchase electricity on an hourly basis and reduce expenditure by focusing their consumption on the times of day when the price for electricity is low. However, consumers are reacting to market prices to only a limited degree. Industry's electricity consumption has the most obvious potential for being moved to other parts of the day. The Government recognises that consumer response will depend on electronic measuring and regulating equipment such as “smart meters” being sufficiently commercially developed. (Danish Ministry of Transport and Energy, 2005a)

Danish Electricity Saving Trust

2.54 The Danish Electricity Saving Trust was established in 1997 to promote electricity savings in the household and public sectors. The Trust's resources can also to be offered to business if they are ”spin off” effects of initiatives for the housing and public sector. (DEA web site) The Trust is led by a Board consisting of a Chairman and eight other members appointed by the Danish Ministry of Transport and Energy. The Trust currently (2006) has an annual budget of approximately DKK 96m (£9 million), which is financed by an electricity savings charge, collected from households and the public sector, of DKK 0.006 per kWh. Its task is to make it, simple, safe, and cheap for consumers to acquire and use energy-efficient appliances and systems, or to convert from electric heating to district heating and natural gas. The conversion of electrically heated buildings was expected to account for 90% of the Trust's funds when it was established. (DEA web site) The Trust compiles an action plan every year based on a framework set out by the DEA.

2.55 Grants for conversion to district heating are conditional upon customers with electric heating being given favourable connection conditions from the district heating companies and financial savings significantly larger than the subsidies from the Trust. These conditional subsidies have been the 'carrot' that has persuaded district heating companies and the plumbing trade to reduce their prices to consumers. In recent years the Trust has dealt with approximately 2,000 conversions per year. DKK 65 million (£6 million) was used to fund conversion grants in 2005. (DEA web site)

2.56 In recent years the Trust has increased the emphasis on voluntary agreements with manufacturers and retailers of electric appliances for development, market maturing and advisory programmes. By 2004 the Trust had discontinued the scheme to convert from electricity to gas. The grants for conversion to district heating continue but are likely to be phased out over the next few years as much of this task has been completed. A new area of activity is promoting equipment to reduce standby power consumption and feedback devices including smart meters. Products being trialled include the 'SparOmeter' (SavOmeter) electricity meter and the USB 'Elspareskinne' (auto power saver plug).

2.57 Summary of the main instruments to promote energy saving in Denmark

Households

- Energy and CO2 taxes on all energy consumption
- Energy labeling mandatory on the sale of the building
- Energy labeling of appliances (A-G) is compulsory
- The Danish Electricity Saving Trust - advises customers, grants subsidies; market analyses and campaigns focusing on the price and energy efficiency of appliances
- Government subsidy for energy saving measures for low income pensioners
- Electricity, gas, and district heating companies - organise campaigns and consumer-oriented activities to promote energy savings

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Public sector

- Energy and CO2 taxes apply to all energy consumption
- Energy labels and an energy plan must be prepared regularly for all large buildings
- Danish Electricity Saving Trust –municipalities, counties, and government institutions commit themselves to only procuring equipment with low electricity consumption
- Electricity, gas, and district heating companies offer free energy consultancy

Commercial sector

- CO2 taxes apply to all energy consumption
- Energy labels and an energy plan must be prepared regularly for all large buildings
- Electricity, gas, and district heating companies offer free energy consultancy

Agriculture and industry

- CO2 taxes on all energy consumption
- Energy intensive companies entering into an agreement receive significant CO2 tax rebates.
- Electricity, gas, and district heating companies offer free energy consultancy

(DEA 2003)

District heating and CHP development

2.58 The origin of district heating in Denmark was in 1903 in Frederiksberg, where the local council established a waste incineration plant to stop disposing of waste onto the land, which was causing disease. The waste heat was originally used to heat municipal and other public buildings. This example was copied by a number of other municipalities, using waste incineration or waste heat from the diesel fuelled electricity generating stations that some had established to supply themselves with electricity. District heating was thus seen as a way of earning further income by the municipalities and the agricultural co-operatives who ran some of the electricity utilities in rural areas. District heating grew steadily in the 1920 and 1930s to supply new areas of housing. However before World War II district heating networks were mainly small due to the small size of many of the heat production sources. During WWII diesel supply was hard to maintain so many municipalities established coal heat only boilers as back up, but when oil supply was normalised after the war there was excess district heating capacity thus creating the basis for expanding the networks. After the war more centralised power plants were developed and the older smaller ones were closed, so many new heat only plants had to be built. Development of district heating continued at a relatively slow rate until the oil crisis of 1973. (DBDH web site)

2.59 By 1972, with 94% of the country's energy needs being met by imported oil and coal Denmark was highly vulnerable to world price fluctuations. The oil crisis thus gave Denmark a strong reason to diversify and increased the pressure to plan and regulate the energy market. In 1976 the Department of Trade published a major policy statement on its aim to reduce dependence on oil through building up energy reserves, developing a multi-source system of supply and reducing the growth of energy consumption. The Electricity Supply Act of 1976 gave the state considerable powers to oblige the electricity utilities to burn specific fuels and to build power stations in areas where district heating could be used. (Owen, 1999)

Heat Planning

2.60 The heat planning programme was thus embarked upon primarily to reduce dependence upon imported oil by switching to gas and waste heat from power stations and industries. The Heat Supply Act 1979 divided the country into three types of region: areas to be heated by CHP/district heating; areas to be heated by natural gas; areas which could be heated in other ways. The aim was thus to encourage the use of gas and district heating, especially where based on CHP and to discourage the use of electricity except in sparsely populated rural areas where it is not feasible to supply district heating or natural gas.

2.61 Under the Act, kommunes (district councils), in co-operation with regional public utility companies, were required to map present and future energy needs at the local level. The kommunes submitted their proposals to the county council which prepared a county-wide heat plan for ministerial approval. Kommunes powers included :

- to approve new district heating plant or major changes in existing plant;
- to require that a district heating plant use a given type of energy;
- to require that existing and new buildings be connected to a district heating system, if necessary to make the project viable.

2.62 An amendment to the Heat Supply Act in 1990, aimed to promote the conversion of district heating plants in areas with natural gas to small scale gas fired CHP plants. A number of measures were introduced including: investment grants for conversion of coal-fired district heating plants to CHP and for the construction and renovation of district heating networks to be supplied by CHP. In 1997, the Electricity Saving Trust was created to provide subsidies for conversion of electric heating in the gas and district heating areas.

2.63 The heat planning programme has resulted in a much wider use of district heating . In 1975, 70% of space heating requirements were met by individual heating (gas, oil and electricity), 20% from non-CHP district heating and 10% from CHP district heating. By 2004 60% of homes were supplied by district heating (75% from CHP and the rest from heat only schemes); 13% individual gas; 18% individual oil and 7% electricity. (DBDH web site).

2.64 The Government intends "to maintain the valuable flexibility and efficiency of district heating". (Danish Ministry of Transport and Energy, 2005a) Heat planning – with its key goal being to discourage use of electricity for heating in favour of district heating and gas - still remains in place as a policy but Energy Strategy 2025 hints at some possible changes. "In the future, …more flexible use of electricity for heating, could facilitate an increase in the amount of renewable energy in the energy system." The Government is supporting research and development into energy-efficient technologies for the heat supply system recognising that newer buildings will have less need for heating. (Danish Ministry of Transport and Energy, 2005a) Support for CHP is also provided through the PSO – see next section.

Renewables and CHP

Public Service Obligations (PSOs)

2.65 Public Service Obligations (PSOs) is the term used in Denmark to describe the subsidies to fund public interest schemes. The subsidies support : wind ; biomass ; biogas ; waste; natural gas CHP; solar energy; wave power. The PSO applies to the transmission system operator and distribution grid owners and all costs are passed on to consumers as a tariff on total consumption. In 2005 the PSO tariff was approximately 11 øre/kWh. In 2003, the costs of the PSO amounted to almost DKK 4 billion (£360 million) divided between :

- renewables and CHP – DKK 2,960 million (£266 million)
- security of supply (capacity payments) – DKK 370 million
- research and development – DKK – 410 million

(DEA web site)

Development of the wind industry

2.66 The modern wind industry owes much to Danish farmers and rural enthusiasts who developed community owned wind turbines in the late 1970s, boosted by the oil crisis and supported by positive Danish government policies. The initial small machines were built by agricultural equipment manufacturers who evolved into major wind turbine manufacturers such as Vestas, Bonus, NEG Micon and Nordex. Wind turbines are now Denmark's third largest export industry. (Owen, 2004) Today's main trend is for large turbines, installed in wind farms by large developers and utilities. However, 75% of wind power is still produced by turbines owned by local associations and individuals - more than 100, 000 families are shareholders. The average size of community based projects is 2-5 MW.

2.67 In 1978 twelve owners of small turbines formed themselves into the Association of Wind Turbine Owners, the Danske Vindkraftvaerker (DV). DV faced a lot of opposition from the electricity utilities, conservation bodies, local councils and government departments, but won the support of socialist and green MPs and environmental organizations and through intense lobbying efforts secured a number of legislative changes. Initially the electricity distribution companies refused to accept surplus power, but DV won the support of Parliament and the Minister of Energy for turbine owners to be paid 85% of the price of electricity for their power(the remaining 15% covering the cost of distribution), and that they would buy the power they needed at the full price. From 1984, wind turbine owners were given a subsidy of 1.5p for every kilowatt-hour supplied, which brought the price of wind energy to 6.5p per kWh, allowing a 15% return on capital invested, and encouraged many new investors. (Owen, 2004) Other legislative changes allowed owners to live further away from the wind turbines, thus enabling city dwellers to become investors. Thus a strong and large lobby of turbine owners and manufacturers has developed in Denmark that has continually guided policy development.

2.68 The planning system in Denmark has also been favourable with regional authorities required to designate areas for wind turbines in regional plans – these are areas that are less sensitive and thus creates a presumption in favour of approval when developers put forward specific schemes.

Law for Wind Turbines 1992

2.69 The Law for Wind Turbines, enacted in 1992, set a fixed rate to be paid by the distribution companies for wind generated electricity at 85% of that charged to a local, average retail consumer with an annual consumption of 20,000 kWh. This amounted to €0.044/kWh, but turbines received up to €0.081/kWh by the end of the scheme in 2000 due to the addition of a CO2 tax compensation and energy tax compensation. This compares with the price of €0.028/kWh that electricity could attract on the Nordic power exchange in 2003. (REEEP 2004)

2.70 The Act also made turbine owners responsible for costs of network connection, with the distribution utilities responsible for strengthening the network. This set up a system of "shallow" connection charging with distribution companies (and hence all customers) having to bear the majority of the cost burden. While the agreement originally applied only to turbines under 150kW, then under 250kW, it was later relaxed to apply across the board. Finally, the distribution companies were obliged to take all electricity generated by wind turbines. These measures thus have provided a high degree of security to wind energy developers as they have a guaranteed market at a guaranteed price, making it relatively easy and risk-free for small-scale developers to take part. (REEEP, 2004)

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Changes in Danish renewables and CHP support policy

2.71 Energy21 set targets for onshore wind energy of 1500MW by 2005 and an offshore wind target of 4G (Danish Energy and Environment Ministry 1996). Denmark has the world's largest offshore farm, 160MW at Horns Rev and has granted contracts for a number of others to be constructed. (DEA web site)

2.72 In January 2000, fixed price tariffs were to be replaced by a Renewable Portfolio Standard (RPS). However, the attempted adoption of the RPS undermined the perceived security of investment in wind energy in Denmark. Sales of turbines dropped to zero in 2000, threatening both Danish targets for renewables and Danish manufacturers The government readopted the tariff mechanism in 2001 albeit with some changes to reduce the rising level of costs. The subsidies available from 2001 were 30% lower for new turbines than for older turbines. (ECN 2003) The result of the return to the tariff mechanism was a further boom in installation, with over 400MW of increased wind capacity in 2003.

2.73 Since 2001, the reformed support mechanism has provided an environmental premium per kWh on top of the market electricity price to establish a fixed price per kwh. In addition to wind power, subsidies are provided for electricity from straw, wood, biogas and biomass, waste and gas-fired CHP (in the latter case only plant below 10 MW reducing to 5MW in 2007). The premium for renewables and CHP is financed through the PSO. (DEA web site)

2.74 The subsidy to renewable energy and CHP was further adjusted following the energy policy agreement of 29 March 2004, to counteract the rise in the PSO costs to consumers. The premium will be gradually reduced depending on the year of installation. For waste and gas-fired CHP the price is now tiered to reflect different values of electricity according to demand. (22 øre/kWh at low demand, 46 øre/kWh at high demand and 59 øre/kWh at peak demand) and the subsidy is not available to plant built since 2005. Biomass, wood and straw plants receive 60ore/kwh for 10 years and then 40 ore/kwh. Older wind turbines receive 36 ore/kwh but those built since 2005 receive 10 ore/kwh. Most of the older wind turbines subsidies will be phased out over the next 10 years. New offshore wind is supported through a competitive tendering system. (DEA web site)

2.75 Thus the prices paid for onshore wind power have fallen substantially since feed in support started in the 1980s – from 10 eurocents per kwh in the 1980s, to 7.5 eurocents per kwh in the 1990s to 5 eurocents per kwh in 2004. (IEA, 2006) The Government's view is that further reductions in subsidies will be feasible as technologies become more competitive compared to fossil energy sources.(Danish Ministry of Transport and Energy, 2005a)

2.76 Due to the current overcapacity of electricity generation, government scenarios suggest it may not be until around 2015 that a market driven expansion of new capacity can be expected. It is the Government's view that it would be socio-economically costly to force expansion of wind energy before the market demands greater capacity and wind energy has become more competitive. (Danish Ministry of Transport and Energy, 2005a)

Decentralised energy – connection regime

2.77 Denmark has adopted a shallow connection policy, for "environmentally benign" electricity and CHP plants - the plant owner is only required to pay the cost of connection to the 10-20 kV grid system, regardless of whether the grid owner selects another (higher voltage) connection point. The grid owner meets all other costs, including grid upgrade and expansion. If, however, the generation plants themselves choose to be connected at a higher voltage then they meet the costs of connection at this higher voltage level. In this case any costs associated with grid upgrade and expansion will still be borne by the grid owner.

2.78 Denmark is therefore deliberately tilting connection policy to favour low and no carbon forms of decentralized energy. The shallow cost allocation approach provides access to the network and electricity market at (relatively) low cost, enabling grid reinforcement costs to be recovered through the tariff system. The main regulatory issue that arises from this approach is whether the relative ease of generator access to the network and market leads to the most optimal overall electricity delivery system, both in terms of efficiency and cost. To a degree this has been recognised in respect of the wind turbine planning zones that are implemented in Denmark, but it is also understood that electricity transmission limitations, caused by the high penetration of renewable energy and CHP, are creating operational difficulties for the transmission companies. (Knight et al 2005)

Transmission issues

2.79 While renewables can enhance energy security given their domestic nature, they can also diminish security, at least in the case of wind, which has a highly intermittent generation profile compared to fossil fuel plants. Denmark typically has a spinning reserve of around 20% and this has generally been sufficient to cope with any fluctuations in the output of wind power. Interconnection with Norway and Sweden, both with large amounts of hydropower, has complemented the Danish system. Nevertheless Denmark has had to be at the forefront of developing new technology to deal with balancing the distribution and transmission grids with high levels of intermittent generation. (Neilsen 2002). Thus while Denmark deals successfully with wind intermittency, it relies heavily on neighbouring countries to do so.

2.80 The Government will support the further expansion of wind power by expanding electricity transmission capacity, including an electricity link between the eastern and western part of the country to transport electricity both within Denmark and to neighbouring countries. This is of particular importance to Western Denmark, which has a very large wind-energy capacity. Due to congestion in the transmission grid, wind-energy production sometimes results in fluctuating prices, with electricity prices in Western Denmark differing considerably from neighbouring areas. (Danish Ministry of Transport and Energy, 2005a)

2.81 It is estimated that a 600MW link would cost just under DKK 1.2 billion, plus annual operational and maintenance costs of up to DKK 10 million. The advantages of security of supply, stronger competition and reduced costs for physical and operational reserves have also been estimated, although they are subject to considerable uncertainty. Overall, it is estimated that a link under the Great Belt, which begins operation in 2010, will result in a socio-economic surplus of more than DKK 400 million over the link's lifetime. (Danish Ministry of Transport and Energy, 2005a)

Transmission issues for offshore wind

2.82 Energinet.dk, has responsibility for long-term planning of the Danish electricity system. Energinet.dk meets all costs for bringing electricity onshore whereas the wind farm owner finances the connection to the offshore transformer platform. Wind farm owners are paid for all the power they could supply, even if Energinet.dk can not take it all, but the owner has to meet the costs of balancing if the wind farm does not deliver its forecast production. This provides owners with an incentive to develop reliable wind forecasts.

2.83 The DEA runs the tender procedure for new offshore wind farms and requires Energinet.dk to assess the socio-economic costs and benefits of investments in the system. This has recently been done for two new offshore wind farms - Horns Rev II and Rødsand I where new connections will be required. New high-voltage connections, may prove controversial and will typically pass through several local authorities. Therefore the planning law has been revised to enable national planning directives on the “most optimal socio-economic solutions” to prevail as a means of dealing with differing interests. (Danish Ministry of Transport and Energy, 2005a)

Assessment of impact of policies for sustainable energy

2.84 Costs of policies for decentralised energy

There are three main policies that have been used to incentivise CHP and renewables :

- **Subsidies for households to convert from electricity** – i.e. to subsidise costs of radiators and pipes in house and heat exchanger (via the Electricity Saving Trust) DKK 65million in 2005. From its inception in 1998 to 2004 the Trust's total budget was DKK 0.72 billion about 90% of which was spent on the subsides for conversion. (DEA web site)
- **PSO subsidies** – The total net costs of RE electricity in 2003, collected through the PSO in addition to the market value of the electricity produced was about DKK 2.3 bn., while the corresponding support for decentralised cogeneration of heating and power from natural gas and waste amounted to DKK 0.8 bn. (Danish Ministry of the Environment, 2005) Subsides in some previous years would have been higher than this but figures are not available.
- **Exemptions from CO2 taxes** - these apply to heat and electricity produced together and renewable electricity. Figures for costs of the exemption not available.

There is also the heat planning initiative that stimulated growth of district heating. Some subsidies were provide directly for conversion of older district heating plant to gas and some renovation of older networks, but the Act mainly made it a requirement that in certain areas district heating had to be used. Most of the investment and operating costs of district heating, as well as lost electricity production (with CHP electricity production falls although overall efficiency increases), have been paid by the heat consumers, although these costs have effectively been subsidised through tax exemptions and allowances and grant schemes. (Hammar, 1999) as outlined above.

District heating and CHP

2.85 District heating is widespread in Denmark as in other Scandinavian countries, fired by various fuels - coal, gas, oil - or by waste heat from power stations or industry. where there are many biomass plants generating heat.. About 75 per cent of district heating production is at CHP plants. In total there are 665 CHP plants and 230 DH plants. (DBDH web site)

2.86 Denmark's ten major cities all have citywide district heating schemes as do a number of smaller towns and cities. District heating in cities and towns (usually owned by the local authority) is made up of : 16 large scale CHP; 285 small scale CHP; 130 small-scale DH plants. In some rural areas (typically 250-500 inhabitants) there are small CHP networks serving buildings with heat and electricity generated from several small plant using a range of fuel sources such as gas, wood, straw and biogas. These networks are connected to the distribution system for import and export of electricity. There are also around 380 CHP and 100 DH plants delivering heat only to the company, institution or residential block that owns them. Approximately half of these private, local plants use biomass as a fuel. Denmark thus has an extensive and varied heat sector.

2.87 Fuel sources for district heating and CHP (2005)

Natural Gas 29%
Waste 24%
Coal 23%
Biomass 18%
Oil 7%
(Source : Danish Board of District Heating web site)

The split amongst non fossil fuel plants is as follows :

- 120 biomass-based DH plants - half straw-based and half wood-based
- 10 straw or wood-chip-fired decentralised CHP
- 30 waste-incineration (18 CHP and 12 DH only)
- 6 large scale centralised CHP which use biomass, among other fuels,
- 30 CHP using biogas as the main fuel

(DBDH web site)

2.88 There are around. 1.5 million Danish district heating consumers, including 1.2 million households- almost 60 percent of Danish households use district heating. The efficiency of plants rose from 50% in 1980 to approximately 70% in 2000, due mainly to greater use of CHP. The average annual cost of heating a house of 130 m2 with annual consumption of 18.1 MWh from 2000-05 was between DKK 12,700 and 13,000. (£1,200 - DBDH website) District heating is usually cheaper than individual heating - only 2% of customers pay more than it would cost to use oil boilers and 8% more than the cost of heat from an individual gas boiler. (DBDH web site) These positive prices for district heating are partly the result of heat from CHP being exempt from CO2 taxes.

2.89 According to the IEA there is scope for improved efficiency in the district heating sector, where prices are currently regulated with cost-plus tariff methodology. The IEA recommends that some form of benchmarking should be introduced and some larger cities could introduce competition into heat supply as there is more than one operator of plant feeding into the network. It is interesting to note that Finland, which also has high levels of district heating (50% of the space heating market) does use heat source competition, aims to use more market based pricing and has not used the mandatory zoning that Denmark has through its heat planning system. Average Finnish district heating prices are 40% lower than those in Denmark before VAT, but its energy intensity is higher than Denmark's. (Douraeva, 2004 **)**

Renewables

2.90 The renewable energy share of gross energy consumption increased from 3% in 1980 to 6% in 1990 and 14% in 2004. Renewables share of electricity production increased from 6% in 1994 to 28% in 2004 (DEA, 2005) Biomass-produced energy amounted to 43% of the renewable energy produced, energy from waste and wind power amounted to 32.5% and 17% respectively. The number of wind turbines increased from 69 in 1980 to 5,404 in October 2003.

2.91 According to the IEA "Renewable energy brings numerous benefits to Denmark. In 2004, renewables reduced carbon dioxide (CO_2) emissions by 6.5 million tonnes of CO_2 ($MtCO_2$), or about 10% of that year's emissions. .. Renewables also contribute to security of supply since they are a domestic resource that represents supply diversity. While this is not an immediate concern in Denmark given its oil and gas reserves, it will become increasingly so as those reserves are depleted. In addition, the Danish renewables industry, benefiting substantially from government policy, is now the world leader in wind turbine manufacturing, creating substantial employment and export revenue." (IEA, 2006)

2.92 However, the IEA also notes that the renewable support policies did not come without a cost. In 2005,the renewable component of the Public Service Obligation (PSO), was equal to approximately 3% of the household consumer's final bill when all taxes and grid charges are included, and approximately 9% of the electricity bill for businesses. Danish customers directly paid a total of DKK 2 billion in 2004 to support renewable energy - equal to around 0.2% of the country's gross domestic product (GDP) or DKK 390 per person. Apart from the direct subsidy payments from customers, there are additional costs arising from the obligation on distribution companies to accept all wind power, because mandated must-run plants of a certain technology, size and timing can make the electricity system less efficient and thus more costly to run. (IEA, 2006)

2.93 According to the IEA, considering just the most easily measured benefit (GHG reduction) and the most easily measured cost (direct subsidies from consumers), the costs of supporting renewable energy, to date, are not justified. Estimates from the Danish Economic Council and the Danish Energy Authority, as well as the IEA, show that the cost of reducing each tonne of CO_2 emissions has historically been substantially higher through renewables than could have been achieved through energy efficiency, or international mechanisms. The historical cost of reducing each tonne of CO_2 emissions through renewables policies of the 1990s was roughly between EUR 35 and EUR 50 per tonne. This is well above the current (and forward) price of emissions in the EU Emissions Trading Scheme (EU-ETS) and assumptions on the cost of emissions reductions assumed when formulating the country's climate change strategy. (IEA 2006)

2.94 However, as the IEA goes on to say, other factors should also be considered beyond this narrow analysis, including the decreasing cost of renewables over time. The Danish Energy Authority (DEA) has calculated that all-in costs of onshore wind turbines fell from around 10 eurocents per kWh in the 1980s to 7.5 eurocents per kWh in the early 1990s to 4.9 eurocents per kWh in 2004 and will drop to 3.7 eurocents by 2020. In the IEA's view "Such advances not only make any future renewable support more attractive but also vindicate previous policies to a degree since they clearly had a role in accelerating the cost reductions. In addition, as market prices for electricity rise, comparative prices for renewables, paid through either feed-in tariffs or a capped premium, are less costly for Danish consumers. In addition, the price for CO_2

reduction allowances in the EU-ETS, as well as for oil and gas, could rise thereby making renewables more attractive." (IEA, 2006)

Energy efficiency

2.95 Denmark's impressive record on energy efficiency has come from "a concerted effort by the government and not from any inherent characteristic of Denmark itself. Furthermore, these efficiency measures have in no way detracted from the country's quality of life or economic performance; Denmark has both a higher GDP per capita and lower unemployment than the EU-15 countries on average." (IEA 2006)

2.96 Energy efficiency programmes seem to have been significantly more cost-effective so far than renewable energy programmes in reducing emissions. Evaluations of the Electricity Savings Trust, indicate that the cost of reducing CO2 through its efficiency programmes is around DKK 55 (EUR 7.38) per tonne. The Association of Danish Electricity Distribution Companies, reports that its efficiency efforts in 2003 resulted in CO2 emissions reductions at a cost of DKK 40 (EUR 5.37) per tonne. However, these results come with two caveats according to the IEA. Firstly , technology and energy prices can change significantly over time, thus altering the relative attractiveness of efficiency and renewables. Secondly, the figures cited from the Electricity Savings Trust and the electricity distribution companies are derived from the groups themselves and thus might be subject to a degree of bias. The IEA recommends that the government needs to develop an objective system for assessing the costs and benefits of its energy efficiency programmes.(IEA, 2006)

Energy consumption and emissions

2.97 Energy consumption and CO2 emissions data suggest that Denmark's sustainable energy policies have had an effect, although clearly there will be other factors such as changes in types of economic activity (away from industry to services). Total final energy consumption in the domestic sector, agriculture and industry, commerce and service and the public sector in 2004 was about 3.5% lower than in 1980. At the same time, GDP grew by about 50%, and this means that energy consumption per GDP unit (intensity) fell by 34%, corresponding to an average 1.9% per year. (source (Denmark's 4th national communication on climate change 2005). Denmark's energy intensity is the lowest in the European Union (EU) and 35% below the IEA average (IEA 2006) Denmark has had particular success in reducing energy consumption in the household sector. This is unusual as most other countries have seen increases or no change in this sector. A key factor in this is that fuel use for space heating requirements per inhabitant in 2003 was 50% of the 1973 level.

Gross energy consumption by fuels (Adjusted PJ)	**1980**	**1990**	**2004**
Oil	548	356	347
Gas	0	83	197

Coal	241	326	165
Renewable energy	27	55	128
Total	816	820	836

(DEA, 2005)

Final energy consumption by sector	**1980**	**1990**	**2004**
Adjusted PJ			
Non-energy use	16	13	12
Transport	145	170	209
Industry & agriculture	168	158	162
Trade and service	79	78	86
Households	203	186	189

(DEA, 2005)

(Note : adjusted means adjusted for climate and fuels for net electricity exports)

CO2 emissions	**1990**	**2000**	**2004**
Observed emissions (million tonnes)	52.7	52.5	52.7
Adjusted emissions (million tonnes)	60.9	54.4	51.2
Emissions per capita adjusted (tonnes)	12	12	9
Emissions per kwh sold (grammes per kwh)	1034	937	526
Emissions per consumed unit of district heating (kg per GJ)	87	64	35

(DEA 2005)

Conclusion

2.98 The Danish Energy Authority (DEA) has a longstanding and key role. It brings together functions that in the UK are split between two government departments and two agencies (EST and Carbon Trust). It is not an independent authority but has a higher profile than a division within a government department would have. The DEA is responsible for a number of functions that in some other countries are the responsibility of the energy regulator – e.g. licensing of distribution, transmission and generation. In contrast, the Danish Energy Regulatory Authority (DERA), has a very specific role to administer rules. Key decisions – e.g. on connection rules and transmission issues for offshore wind tend to be taken by the DEA. It is the DEA and not DERA that sets down guidelines for and monitors the distribution companies' DSM obligations. DERA, being much newer than the DEA, has therefore been slotted into a long established framework for sustainable energy.

2.99 DERA does not have any significant role in relation to consumers. The consumer complaints function is handled by the Energy Supplies Complaint Board, whereas consumer information on things like energy efficiency and renewables is the responsibility of the Electricity Saving Trust and the local energy saving committees.

2.100 During the 1970s, 1980s and 1990s there was a coincidence of several factors which helped Denmark to develop and implement its energy policies and programmes in ways that favoured decentralised energy and energy efficiency. Energy supply was under the control of municipalities who have seen the value of decentralised energy and efficiency in the broader community interest. The well developed planning system, involving regional and local authorities, gave these key players control over an essential element of Denmark's' conservation strategy - the heat planning programme. The need to reduce dependence upon imported oil provided a strong sense of purpose towards conservation. Since the early 1990s Denmark has faced new challenges : from the need to reduce greenhouse gas emissions (given the country's still rather heavy reliance on coal); from its rising electricity consumption in household and office appliances; and from the requirements of energy market liberalisation.

2.101 The Danish support mechanisms for CHP and renewables have led to substantial development and its use of feed-in type mechanisms (with guaranteed prices and connection agreements) also favoured small-scale development much of which was undertaken through community ownership. This role for small players has been crucial to the development of policy as they have formed a large policy community willing to lobby for supportive policies and engage other such as MPs in such lobbying. Clearly the costs have been high in the past but they are now reducing. According to the IEA, the new premium system combined with market prices aims to incorporate market elements and the current support level is lower than in other countries guaranteeing prices.

Chapter 3 : The Netherlands

Energy supply

3.1 The Netherlands energy economy is unique amongst IEA countries due to the pre-eminent role of natural gas - virtually every home, office, farm and factory is connected to the gas system. Gas provides 60% of fuel for electricity generation and satisfies 52% of TPES (the highest proportion in the world). (Boot et al, 2003)

3.2 In 2004 centralised generation accounted for 60% of electricity generation; decentralised, 25% and imports, 15% (Van Damme 2004) In 2005, the use of the two main fossil fuels (natural gas and coal) for generation dropped by 30 petajoule (PJ) to 768 PJ and generation of electricity from biomass increased by 19 PJ to 59 PJ. The capacity of renewable energy grew by 13 percent to 1.3 GW. Electricity produced by the nuclear power station in Borssele accounts for over 3 percent of total Dutch electricity consumption. (Statistics Netherlands web site)

Energy and environmental policy

3.3 The Netherlands population was 16.4 million in 2005 and there were 7 million households. (Statistics Netherlands web site)

3.4 Dutch government is usually coalition government between the Christian Democrats and the Liberals or the Christian Democrats and Social Democrats. Below the national level there are 12 provinces each with their own directly elected legislatures and governments, however, their impact on policy is limited except in environmental protection and physical planning. Municipal government is more important - until the early 1990s there were 700 local councils but a process of amalgamation has been reducing this significantly. Decentralisation is mainly to interest groups, advisory boards and government departments rather than to provincial or municipal government. Dutch interest groups, representing local authorities, major industry and trade unions participate in government working groups and get involved in policy development. The Dutch policy process reflects the consensual nature of Dutch society and government, thus employers organisations and trade unions are viewed as "social partners" rather than pressure groups. This results in closely knit policy networks of government departments and their relevant interest groups.

Policy development since the 1980s

3.5 Concerns about climate change began to feature in energy policy debates in the Netherlands from 1988, leading to a National Environmental Policy Plan (NEPP), agreed by Parliament in 1990. The NEPP proposed that reductions in emissions would come from three sectors : recycling and waste management (10%); transport (15%); and energy (75%). Two thirds of the energy sector's savings should come from energy efficiency, and the remainder from lower coal consumption, by using more gas for electricity generation and district heating. (see under energy efficiency for details of action resulting from the plan)

3.6 The Netherlands signed the Kyoto Protocol along with the other member states of the EU in 1998. The Netherlands' commitment is to reduce emissions of greenhouse gases by an average of 6% per year by 2008-2012, relative to 1990.

3.7 Objectives for Dutch energy policy are set out in the government's regular Energy Reports (most recent : 2002, 2005). The Electricity and Gas Acts provide the legal basis for the Energy Reports. The objectives are :

● Promoting competition in the energy sector.

● Promoting an efficient and sustainable energy system..

● Using national energy resources in a sustainable way.

3.8 The 2005 Energy Report sets out the current priorities : "Now that the deregulation has been completed… This Energy Report focuses on two major, above all international tasks: to guarantee the security of supply and to address the global climate problem. The magnitude of the problems calls for more leadership from the government…Of course the market parties have their own responsibilities. But where the market falls short and public interests such as security of supply and environmental quality are not sufficiently assured, the government has to intervene." (Ministry of Economic Affairs, 2005, p.3 +7)

3.9 As the government does not expect a sustainable energy system to be delivered by market forces alone, it has launched a Transition Management process so that the short- and long-term actions of the government and social partners reinforce each other. The more specific objectives for a sustainable energy system are:

• Maintaining the high level of security of supply for electricity and gas.
• Achieving an annual CO2 reduction of 9.4 Mt in 2008 to 2012 as part of the Kyoto obligations.
• Improving energy efficiency by 1.3% per year from 2008 and 1.5% from 2012..
• Increasing the share of renewables in electricity supply to 9% of TPES by 2010 and 10% by 2020.

3.10 An evaluation of climate change policies carried out in 2005 concludes that the Netherlands is on course to achieve its Kyoto commitment. Much progress has been made with contracting emission reductions aborad through Joint Implementation and the Clean Development Mechanism. Reserve measures are being prepared to enable the Netherlands to make good any shortfalls that may occur.

Energy taxes and prices

3.11 VAT at 19 % is charged on coal, oil, electricity and gas, however, as VAT registered commercial and industrial users can reclaim VAT, the tax is mainly felt by households and some smaller non-VAT registered users. There are also the regulatory energy tax (EB) and the environmental tax on fuels ("ecotax"), Since 1999, all energy taxes and excise duties have been indexed to inflation.

3.12 The objective of the EB is to shift from taxing labour and profits to taxing the use of environment. More than 80% of the revenues are recycled to taxpayers in the form of relief from other taxes. The rest are used to finance subsidy schemes for renewables and energy efficiency. Large consumers are exempt, as they have agreed to the Benchmarking Covenant (see later). EB revenue increased from about €1.5 billion per year to about €3.1 billion per year over the period from 1999 to 2001. In 2002 and 2003 the only increases of EB were due to indexing, but a 10% increase was decided for 2005.

3.13 The environmental fuel tax (ecotax) is levied on all fossil fuels. It is based 50% on the energy content of fuels and 50% on their carbon content. Its revenue is part of the general budget. For electricity producers, it is an input tax levied on coal and natural gas, but not on imported electricity. There is no refund for exported electricity. The uranium tax was introduced in 1997 to ensure that nuclear electricity is treated similarly to fossil generation.

3.14 As a result of VAT, EB and the ecotax, a considerable part of the household energy bill consists of taxes - nearly 50% of gas and electricity bills for a household with average consumption. (IEA, 2004)

3.15 Since January 2006, the average Dutch household has faced a 7.5 percent higher energy bill in comparison to December 2005. Energy distributors claim the increase is the result of increases in oil prices on the global market. The average household's annual energy bill is around 1,800 euro.

Institutional framework

Ministry of Economic Affairs

3.16 The Ministry of Economic Affairs has the primary responsibility for energy policy in the Netherlands. One of its key tasks is ensuring a reliable, affordable and clean supply of energy. It also encourages companies to develop and use technologies that use less energy. Until 2000 the Ministry of Economic Affairs was responsible for all energy efficiency and conservation policies, when the primary responsibility for some sectors was transferred to the ministries responsible for these sectors in other policy areas. Consequently, the Ministry of Agriculture became responsible for conservation in agriculture and the food industry, and the Ministry of Housing, Spatial Planning and the Environment (VROM) for buildings. The responsibility for overall energy conservation policy, the generic instruments and the energy conservation policy in the industrial, services, education and health care sectors remained with the Ministry of Economic Affairs.

Ministry of Housing, spatial planning and the environment (VROM)

3.17 VROM was established in the 1940s to create adequate housing but in the 1960s emphasis shifted towards land-use planning. In the 1970s and 1980s urban renewal and growth were high on the agenda. By that time the government began to delegate several of its former tasks to provinces and cities. Since 1982 VROM has been responsible for environmental management when its current name was adopted.

Senter Novem

3.18 Until 2004 there were two agencies of the Ministry of Economic Affairs with a role in energy. The Netherlands Agency for Energy and Environment (Novem) managed most of the energy and environmental programmes. Senter's role was to provide subsidies for technological innovation and energy efficiency projects. To encourage energy-intensive sectors of Dutch industry to become more energy efficient without creating new regulation, the Dutch government in the early 1990s introduced voluntary long-term agreements. Novem managed and guided the process.

3.19 The government merged the energy and environmental operations of these two organisations into one large agency called SenterNovem in 2004. SenterNovem promotes sustainable development and innovation, both within the Netherlands and abroad and retains a lead role in working with companies a who sign up to long term agreements. It is responsible for policy implementation in Innovation; energy and Climate ; Environment and Spatial Planning.

ECN

3.20 The Netherlands Energy Research Centre (ECN) receives government funding but also undertakes work for other clients on energy policy research. It focuses on the knowledge and information the government needs to develop and evaluate energy policy and technological innovation. ECN also undertakes education work. It has a particular focus on sustainable energy issues – renewables and energy efficiency.

Office of Energy Regulation (DTe)

3.21 The Office of Energy Regulation ((*Directie Toezicht Energie* - DTe) was established under the 1998 Electricity Act. DTe was an independent Office until July 2005 when it became a Directorate of the Netherlands Competition Authority (NMa), which has been an autonomous administrative authority since that date. The most important change in the relationship of DTe with the Ministry of Economic Affairs since July 2005 is that the Minister cannot issue instructions about the way in which NMa should act in individual cases. The Minister of Economic Affairs remains politically responsible for policy and legislation in relation to the energy sector and competition policy and has the power to issue NMa with general directives.

3.22 The Director of DTe is responsible for implementing policy, regulating the market and advising the Minister on the development of new policy. DTe's (formal) advice to the Minister is published to promote transparency. In 2004 DTe gave advice, for example, in relation to the heating market and the independence of electricity grid and gas network managers. (DTE, 2005)

3.23 The implementation of the Electricity Act of 1998 and the Gas Act and supervision of compliance with these Acts is a task assigned to DTe. DTe's mission is ' to make the energy markets work as effectively as possible and to protect consumers." DTe's main tasks and duties are :

- taking regulatory and tariff decisions in relation to electricity and gas;
- determining tariff structures and technical conditions for electricity transmission;
- determining guidelines for tariffs and conditions for access to gas transmission pipelines and gas storage installations;
- granting licences for the supply of electricity and gas to captive customers;
- issuing binding instructions and imposing interdicts;
- advising the Minister of Economic Affairs on granting consent to the appointment of an electricity grid or gas network manager, on granting exemption from the obligation to appoint an electricity grid manager and on decisions on applications for privatisation;
- providing public information.

3.24 Chapter 5 of the 1998 Act (on DTe web site) contains specific duties relating to the "Sustainable provision of electricity". This :

- Requires generators and suppliers to promote the efficient and environmentally responsible production or use of electricity by their own companies and by customers. Every generator or supplier that supplies an average of 10 GWh or more per year is required to report once every two years to the Minister on the way in which it has carried out this duty.
- Requires suppliers to offer net metering for customers with CHP and some forms of renewables and gives the DTe a role in administering this.
- Enables the Minister to provide incentives for sustainable electricity

3.25 The Intervention and Implementation Act amending the 1998 Electricity Act and the Gas Act came into force on 14 July 2004. DTe was given the power to impose fines, monitor the marketing practices of energy suppliers, and to resolve disputes between buyers of energy and electricity grid and gas network managers. For the first time in its history, DTe supervised the introduction of an extensive bill and the process of its implementation. DTe enabled energy companies to obtain information on the practical changes resulting from the Act and have an opportunity to comment including at a consultation session which DTe organised together with the Ministry of Economic Affairs. (DTE , 2005)

Consumer representation/links

3.26 The 1998 Electricity Act does not define a specific role for consumer protection organisations or consumer committees. However, Article 33, requires the network managers to hold consultations with stakeholders about tariff structures and conditions. Conclusions made about the views raised by such organisations must be forwarded to the DTe in the form of a joint statement attached to their proposal on tariff structures. In addition, the Director of DTe is obliged to consult with "organisations representing captive customer', as well as the licence holders, in regard to the setting of the discount to promote efficient operations under the price cap mechanism" (Art. 58(3)). There is some uncertainty about whether this requirement will persist now that full retail competition has been introduced.

3.27 DTe deals with individual consumer complaints and provides information on the performance of individual energy companies. DTe publishes a quarterly scorecard on its website that shows : the timeliness with which invoices are sent following a change of address or a switch; the timeliness with which annual settlements are dispatched.

3.28 NMa, Opta (the post and telecommunications regulator) and the Consumer Authority have established a joint information desk: ConsuWijzer that gives practical advice on consumer rights and duties. The Consumer Authority was only established in 2006 and is the first time the Netherlands has had an official consumer body (it links to the Ministry of Economic Affairs). This lack of an official consumer body was due to a perception that one was not needed due to the strong emphasis on self-regulation involving close cooperation and dialogue between the social partners, which is characteristic of the Dutch cultural approach of reaching agreement by consensus. Consumer interests up until 2006 were represented by the member organisation Consumentenbond (equivalent to the Consumers Association in the UK)

3.29 There are also alternative dispute resolution (ADR) boards linked in to the Ministry of Justice funded 50% by the Ministry and 50% by the industry.

Energy market

3.30 The gas, electricity and district heating industry in the Netherlands have traditionally been owned mainly by local authorities or by local authority/private sector partnerships. Increasing integration between electricity, gas and district heating distribution and supply meant that by the late 1990s, 70% of these companies supplied and distributed two or all three of these. Central government's role was limited to approval of major investment plans of the electricity generators plus setting maximum tariffs for electricity consumers. The major responsibility for siting power stations and other environmental matters rested with local government - municipal and provincial.

Electricity market

3.31 Until 1988 the electricity companies were directly owned by the municipal and provincial authorities. In 1988 generation was unbundled and four separate electricity generating companies were formed. During the 1980s and early 1990s there was considerable re-organisation via mergers and horizontal integration of gas, electricity and district heating distribution/supply. In December 1991 the electricity, gas and district heating companies' trade associations - which co-ordinate their activities and prepared long-term plans - entered into an agreement with the Government to consolidate energy distribution and merged to form a single association called EnergieNed. By 1995 there were only 31 distributors compared to 158 in 1986.

3.32 The structure as of the mid-1990s was therefore : distribution/supply companies (for gas, electricity and heat) all owned by municipal or provincial authorities; four generating companies, two owned by the local distribution companies, two owned directly by municipal and provincial authorities. Electricity generation and dispatching was co-ordinated by the company SEP (Samenwerkende Elektriciteits-Produciebedrijven) (owned by the four generators), which also owned the transmission grid. Thus the industry was still largely owned by local and provincial government. There was some independent electricity generation - mainly CHP and wind energy - undertaken by the distribution companies and industrial users.

3.33 The Energy Law 1998 paved the way for electricity market liberalisation. It required unbundling of transmission from generation and legal separation of supply and distribution. It set out plans for liberalisation of generation and supply – the latter initially for larger businesses, with smaller businesses by 2002 and all customers by 2004. Three of the four generating companies were sold to foreign owners and one remained Dutch owned – Nuon.

3.34 The Law also established the transmission company and system operator, TenneT. TenneT's core role is to provide an effective, sustainable and reliable supply of electricity. The government is required to monitor TenneT's fulfilment of this and assigns key tasks to the Office of Energy Regulation (DTe). For example, DTe has to approve the tariffs for system services and transmission services each year.

3.35 SEP stopped coordinating the centralised market after the establishment of TenneT in October 1998. However, SEP continued to own TenneT until November 2001 when TenneT, together with its transmission assets, was purchased by the State and SEP was dissolved. Despite market reform , a few generators still dominate the domestic market. Three of the four centralized generators were acquired by foreign utilities.

3.36 Before market reform, there were 23 electricity distribution companies with seven million consumers. All of them also distributed natural gas and eleven distributed district heat. Following the 1998 Electricity Act, the distribution companies divided their network and supply activities into different companies. There are at present 20 regional grid companies which, along with the supply companies, have mainly remained under the ownership of provincial governments or municipal councils.

3.37 In April 2006, the Second Chamber of the Netherlands parliament adopted the proposal on unbundling of energy companies. Once the Act comes into effect, energy companies will either have to be a “commercial” company, i.e. involved in the sale or production of energy or a “network” company, i.e. operating a gas and/or electricity network. All Netherlands companies that currently engage in both activities will therefore be required to spin off either their energy networks or their assets and activities relating to the commercial energy business. The implementation period will be two years and six months after the Act comes into force. The Act, at the instigation of the Second Chamber, prohibits the passing on of the reorganisation costs to customers. The debates around the Act very much focused on privatisation. Transfer of ownership of a network requires the consent of the Minister of Economic Affairs and will not be possible, other than to an entity which is government owned. Privatisation has been forbidden because many members of parliament consider networks to be natural monopolies that should remain in public ownership. There is no restriction on private ownership of energy companies that do not own or manage energy networks, although the Second Chamber requested that the government discourage the sale of commercial energy companies to private parties.

Gas market

3.38 The *Gasgebouw* (the Dutch gas structure) was instituted after the discovery of the Groningen gas field in the 1960s. The national gas company, Gasunie, was established, jointly owned by the State, Esso and Shell. Gasunie owned and operated the gas transportation network and sold gas to the local energy distribution companies who sold on to final users. Gasunie also sold gas directly to some large industrial consumers.

3.39 The path to gas market liberalisation was established in the Gas Act 2000. An independent transmission system operator (TSO) for gas was set up in July 2004. Gasunie Trade and Supply is being split into two competing companies.

3.40 There are about 30 gas distribution companies. Following the Gas Act in 2000, their retailing activities were legally separated into sales companies, although ownership of the distribution and retailing companies has for the most part remained the same. All distribution companies are private-law joint stock companies, but in nearly all cases their shares are held by the municipalities.

3.41 Large gas customers were allowed to choose their supplier as from 2000, corresponding to a 45% market opening. In January 2002, the threshold was lowered corresponding to a 65% market opening. The act set the date for full market opening at January 2007, subsequently brought forward to July 2004. Estimates suggest that between 30-50% of the largest customers have switched supplier and about 20% of the next tier have switched (IEA 2004)

Gas and Electricity Supply

3.42 On 1 July 2004, the supply market for gas and electricity was fully liberalised. All suppliers of small end-users (consumers and small businesses) must have a supply licence. Since full liberalisation, energy tariffs are no longer determined by DTe. The three largest suppliers have a market share exceeding 80% for both electricity and gas. In addition, there are approximately 20 independent suppliers. (DTE web site)

3.43 The market for green electricity was liberalised on 1 July 2001 and a number of new suppliers entered the market. These new suppliers, who have also been allowed to supply grey electricity since 1 July 2004, have a market share of approximately 7%. Almost 37% of consumers have opted for green electricity, helped by tax incentives to do so, although most have done so by switching to a green tariff offered by their incumbent supplier rather than switching supplier. (DTE web site) (see below).

3.44 From 1 July to 31 December 2004 approximately 385,000 small consumers switched electricity suppliers and approximately 185,000 switched gas suppliers. This amounts to 5% of connections for electricity and 3% for gas. Consumer perception that the savings from switching suppliers are limited may explain the low switching rates. However, surveys carried out by the energy regulator in 2005 show that a household with an average energy consumption can save up to €100 per annum by switching to the cheapest supplier. (DTE, 2005)

District heating

3.45 There has been no liberalisation of district heating distribution and supply. These companies remain mostly owned by local authorities alongside ownership of gas and electricity distribution.

3.46 The Heat Law 2005 set out new rules for supervision of prices to ensure that DH remains affordable, as until that date it had not been regulated. On average about 90% of heat comes from CHP and 10% from heat only boilers.

Policies for CHP and renewables

3.47 A number of different policy instruments have been used since the 1990s that have provided incentives for renewable energy and CHP. As most of these instruments have applied to both of these sustainable energy options, they are described in general in this section. Specific applications of them to CHP and renewable energy are then covered in those sections.

3.48 Small renewable and CHP plants that sell their output directly to the local distributor, were assisted during the late 1980s and 1990s by an obligation on distributors to buy it. This however was abolished once the electricity market was fully liberalized. The main support scheme now is the MEP.

MEP (Milieukwaliteit Elektriciteits Productie, Quality Environmental Electricity Generation).

3.49 MEP is a support scheme (effectively a feed in tariff), introduced July 2003, for renewables and some CHP plant built since 1996. The MEP replaced the ecotax exemption which was abolished in 2005. The subsidies depend on the difference in costs between the new plant and conventional units and each generator receives a guaranteed fixed payment per kWh for up to ten years. The maximum is set at the difference between the production cost of the technology and the average selling price of fossil-fuel power, on average €c 2.7 per kWh. The payment levels are fixed for 2-3 years , taking into account falling costs, but new lower rates are applied to new plants only. As of 1 January 2007 the MEP will be available only for new plants - the subsidy for existing plants will cease on 31 December 2006. (Cogen Europe, 2005)

3.50 The technologies eligible for subsidies are CHP, wind energy, bioenergy (including waste incineration, landfill gas and digestion), hydropower, photovoltaics and wave and tidal energy. The subsidy is granted on the basis of CHP certificates (blue certificates) or renewable electricity (including renewable CHP) certificates (green certificates). CHP certificates are issued once the plant has received a CHP declaration on the *Regeling Kooldioxide-index WKK* (Regulation on the CO_2 Index for CHP production). This index represents the quantity of carbon dioxide-neutral CHP electricity - the extra electricity that the CHP system produces with the same emissions of carbon dioxide compared to the separate generation of heat and electricity. In 2005 the subsidy for CHP was set at 2.2 Eurocent/kWh. ECN has recommended that the Ministry of Economic Affairs set the subsidy for 2006 at 2.6 Eurocent/kWh. (Cogen Europe, 2005)

3.51 The MEP scheme had a budget of €129 million for July to December 2003, of which €70.5 million was used for renewables and the rest for CHP. In 2004, the MEP budget increased to €281 million and in 2005 to €298 million of which €164 million (2004) and €181 million (2005) was used for renewables and the rest for CHP. The MEP tariffs are financed through an annual MEP levy, determined by the Ministry of Economic Affairs, on all connections to the electricity grid in the Netherlands – i.e. it is paid by all electricity consumers. It is collected by the distribution network operators and passed on to the TSO. The levy amounted to €34 per connection in 2003 and is to be increased to €40 in 2006. The MEP is financially neutral to electricity consumers because their contribution is compensated by an equivalent reduction in annual ecotax charges. (Cogen Europe, 2005)

EIA (Energie Investeringsaftrek, Energy Investment Deduction)

3.52 EIA is a tax relief for investments in qualifying energy-saving equipment, renewable energy and CHP that started in 2002 at 55% but in January 2005 was lowered to 44%. Thus 44% of the annual investment costs of such equipment are deductible from profits in the year in which the equipment was procured. The budget for the EIA was €161 million in 2003 and 2004 and 137 million euro in 2005. In 2002, the total investments in projects eligible for EIA amounted to €803 million. SenterNovem runs the EIA programme. (Cogen Europe, 2005)

EB (Energiebelasting, Energy tax) exemption

3.53 EB is charged on both gas and electricity. From 2001-2005 small consumers (less than 10,000 kWh) could switch to a green tariff that was eligible for exemption from the EB (until July 2003) and then the 50% reduced rate (3,49 eurocent/ kWh, excl. VAT)until 2005. As a result there was a large growth in green tariffs offered by energy suppliers. Household and small business customers were able to switch to green tariffs before the market was fully liberalised in 2004. Since 1 January 2005 the EB exemption for green energy has been abolished and it is now taxed at the same rate as 'grey' energy - 0.0699 euro/kWh (excl. VAT). (Ministry of Economic Affairs web site) However, the extent to which consumers actually benefited from these green tariffs has been questioned (see later).

CO_2-reductieplan (the CO_2-reduction plan)

3.54 The CO2 reduction plan supports large investments that make significant contributions to the reduction of national CO_2 emissions. The overall aim is to achieve an annual reduction of 4-5 Mt CO_2 by 2010. SenterNovem is in charge of this initiative. Over the years several CHP projects have been supported. (Cogen Europe, 2005)

Energy market rules that support decentralised energy

3.55 Market rules include some advantages for decentralised energy . These relate to imbalance charges, connection charges, reduction in grid losses and net metering.

3.56 Rules regarding imbalance charges have been adjusted to help decentralised energy. The new electricity trading arrangements from January 2001 penalised power producers that could not predict their output accurately (two hours in advance of delivery). This led to a review by the system operator, which decided to allow producers to make final adjustments to their predicted output only one hour in advance, effective at the end of March 2001.(Knight et al, 2005)

3.57 Connection charges are defined in the Network Code set up by the Dutch energy regulator. They depend on the capacity of the connection and are split into two different categories. Connections up to 10 MVA are shallow, regulated and averaged, while connections with a capacity over 10 MVA are negotiated on a case by case basis and follow a deep charging philosophy. The shallow, regulated and averaged type of connection charging that exists in the Netherlands for connection capacities up to 10 MVA has proven to be one of the best examples in the EU with respect to barrier removal for decentralised energy. (Knight et al 2005)

3.58 However, deep connection charging has represented a barrier to the development of larger projects. (Knight et al, 2005). Many operators of generation plants exceeding 10 MVA have split the total capacity into several smaller elements in order to avoid the deep connection charges. Because of this, the Dutch regulator is presently studying the possibility of reducing the capacity limit of shallow connection costs from 10 MVA down to 1 MVA, which clearly would be less favourable to decentralised energy.

3.59 The Dutch government intends to change the current regulatory framework in order to allow decentralised energy projects' promoters to develop and build their own connections to the network. This is expected to increase competition and decrease costs. (Knight et al 2005)

3.60 DTe has decided that from 2006 onwards, operators of decentralised electricity generation, which feed electricity into regional grids (with a voltage of 110 kV), will receive compensation for savings on transmission costs. Electricity supplied directly to the regional grids does not have to be transmitted through TenneT's national high-voltage grid, avoiding loss of electricity during transmission. The difference in costs between centralised and decentralised generation was previously reflected in the National Uniform Producer Transmission Tariff [Landelijk Uniform Producenten transporttarief (LUP)] under which producers with centralised installations paid a transmission tariff while decentralised generators were exempted. When the National Uniform Producer Transmission Tariff was set at zero on 1 July 2004, this distinction no longer applied. This difference in costs will now be reflected in the Grid Loss Savings Scheme. [Regeling Uitgespaarde Netverliezen(RUN)], which will be included in the Electricity Tariff Code. (DTE web site)

3.61 DTe emphasises that the Grid Loss Savings Scheme is not intended as a means of subsidising decentralised electricity. The purpose of the Scheme is to reflect the difference in costs between centralised and decentralised electricity production, as a result of which the costs of the grid can be allocated better to the various users. DTe will amend the Tariff Code after consultation with market participants, TenneT will determine the level of compensation and the regional grid managers will pay the compensation. Since the Grid Loss Savings Scheme is based on present market conditions, DTe intends evaluating it after three years. (DTe web site)

3.62 Net metering for household renewables has been available since 2004. (Cogen Europe, 2005)

District heating and CHP

3.63 The first district heating system in the Netherlands was started in Utrecht in 1923. District heating penetration is quite low – 250,000 households (3% of housing) (IEA,2004). Much more substantial is the role of on-site CHP in industry, agriculture, horticulture and the public sector, with surplus electricity fed into the distribution networks and some larger scale CHP.

3.64 A number of initiatives were taken during the 1980s to promote CHP, which meant that by 1987, there was 1400 MW of CHP and 14% of the country's electricity came from this source. The stimulation programme launched in 1987, aimed to increase the amount of CHP capacity by 700-1000 MW by 1995. (Owen, 1999)

3.65 The 1989 Electricity Act strongly encouraged market entry by decentralised CHP for environmental reasons. A variety of incentives included:

- government investment subsidies of up to 17.5% (until 1995);
- an obligation by generating companies to purchase surplus power generated from these facilities at the estimated full cost of new central generation facilities (also until 1995);
- favourable natural gas prices from the 50% state-owned gas supplier Gasunie to help gas secure a higher share of electricity generation (until 2000);
- an exemption (until 1997) from paying for reserve capacity or ancillary services. (Cogen Europe, 2005)

3.66 As a result of these incentives, in the late 1980s and early 1990s a significant number of customers in the industrial, commercial, public and residential sector (apartments, nursing homes, swimming pools, hospitals) installed CHP systems. A further incentive to CHP for industrial users was that, from 1990 onwards, many industrial sectors agreed energy conservation covenants with the Ministry of Economic Affairs, as their contribution to the country's CO_2 targets - CHP was seen as cost-effective way to deliver their commitments. (Owen, 1999) Some industrial CHP producers formed their own "power parks" whereby the CHP producer has connection to the grid, and also supplies power to other sites that are not connected to the grid. (Cogen Europe, 2005)

3.67 For the energy distributors/suppliers there was also an incentive to develop CHP. With their generation assets removed and controls on them developing large scale generation, plus the fact that their largest (and often most profitable) customers could, from 1989, buy electricity directly from generators, build their own CHP (the distributors had to buy the surplus electricity at favourable rates) or even import electricity, one solution to the potential threat to revenue was to start offering CHP to customers, providing financing where necessary. From 1987 onwards, the number of CHP units installed by the distributors grew dramatically, particularly under the subsidies provided through the MAP initiatives (see energy efficiency section), which resulted in an extra 2300 MW of CHP being installed between 1991 and 1994. (Owen, 1999) Much of Dutch distributed generation is therefore the result of investment by electricity distributors in joint ventures with industry – essentially an ESCO approach.

3.68 By 1995 the Netherlands had over 4500 MW of CHP, (25% of electricity generation capacity) around 75% of it in industry. Growth in CHP created so much overcapacity that central generation output had to be curtailed to accommodate its surplus power. (IEA 2004) The large share of distributed generation in the Dutch system before the 1998 electricity sector reform meant that the design of the electricity market had to take it into account from the outset. According to the IEA, although there were some initial problems, the network operators have largely been able to cope with high levels of CHP without compromising reliability. (IEA, 2004)

3.69 The early years of market liberalisation had a number of effects on the market for distributed generation, particularly CHP. Electricity prices fell due to overcapacity and lower prices from imported electricity in neighbouring countries with excess capacity. CHP plants, which formerly received favourable natural gas tariffs, now purchase natural gas competitively. (IEA, 2004) The government responded in late 2000 with measures to support CHP further, including:

- An increase in the Energy Investment Allowance (EIA - tax credit) for new CHP.
- Exemption of CHP electricity consumption from the regulatory energy tax. (abolished in 2005)
- Financial support to CHP output up to 200 GWh of EUR2.28 per MWh.

These measures were supplemented by an accelerated depreciation programme (known as VAMIL) for CHP investments that met certain efficiency targets.

3.70 Since 2003 the main support for CHP has been through the MEP (see section above) and the EIA.

3.71 Projections undertaken for the Government by ECN suggest that CHP capacity should expand by 30-40% until 2010 and by 40-70% until 2020. (ECN web site)The 2005 Energy Report says that "The maintenance and further expansion of CHP capacity is essential to achieving the energy efficiency and CO2 emission reduction targets. Therefore, it is very important that the increase in CHP capacity is actually realised."(p. 46)

Renewables

3.72 Current policy commitments are expected to ensure that around 9% of electricity will be generated from renewable sources by 2010. (Ministry of Economic Affairs, 2005)

3.73 Households and housing corporations can obtain a subsidy (40 to 50% of costs) if they invest in renewable energy (heat pumps and solar in particular). In 2002, these subsidies (financed from revenues of the EB and called the Energy Premium Regulation – EPR – see energy efficiency section) had a budget of €24 million for renewables - €16 million for photovoltaics and €5.5 million for solar water heating. The budget for renewables for 2004 was €12 million. Most utilities and some cities provide additional subsidies. (Ministry of Economic Affairs, 2005)

3.74 Between July 2001 and July 2003, renewable energy consumption up to 10 MWh per year was exempted from the energy tax (EB) and consumers could choose "green electricity" suppliers. The number of green electricity customers increased from 250 000 in July 2001 to over 1.5 million in 2003 (20% of households). However, the exemption led to large renewable electricity imports to meet demand resulting in a considerable loss of tax revenues. The production of renewable electricity in the Netherlands did not rise enough to meet demand because the industry considered the regulatory and fiscal framework too unstable and because of the difficulties and delays in obtaining permits and licences, especially for wind turbines. (IEA, 2004)

3.75 The problems caused by the exemption led to it being reduced in 2003 and abolished in 2005. The main support for renewables now is the MEP (see above).

Energy efficiency

3.76 Energy conservation first became a policy issue in the wake of the 1973 oil crisis when the key policy goals of reducing dependence upon imported oil and making the Dutch economy less sensitive to fluctuations in energy prices were established. The government introduced a range of subsidies for energy saving. From 1973 to 1985 energy efficiency in the Netherlands improved at the rate of 2% a year and, as in many other countries, there was a shift towards less energy intensive industry. Economic growth however, meant that by 1985 total energy consumption was about the same as in 1973. The annual energy efficiency rate of improvement from 1985 to 1990 was only half what it had been from 1973 to 1985. (Owen, 1999)

NEPP and MAP

3.77 The NEPP in 1990 introduced a levy on energy consumers (up to 2% on the unit price of gas and electricity) to fund energy saving and challenged the energy distribution sector to devise plans to achieve CO_2 savings, using the levy. The energy distribution companies published their first plan - MAP-I - in spring 1991. Parliament approved a second National Environmental Policy Plan in spring 1994 to achieve a 3% reduction in emissions by the year 2000. The energy distribution companies published MAP-II in March 1994. (Owen, 1999)

3.78 The MAP initiative was a good example of Dutch neo-corporatism with each of the plans based on formal written agreements signed by the Minister of Economic Affairs and the Director of EnergieNed (the association of distribution companies). The agreements set out specific targets for reductions in CO_2 emissions and energy consumption, the types of measures which would be encouraged, how the measures would be funded (including the levy) and monitoring arrangements. (Owen, 1999)

3.79 MAP I -1991-94 - involved subsidies and information to promote measures including : compact fluorescent lamps (CFLs); high efficiency boilers; efficient electrical appliances; CHP; insulation. The greatest successes in the period 1991-94, were in CHP and energy saving in the household sector. High efficiency boilers (500,000), water saving showerheads (750,000) and low energy light bulbs (5 million) were the measures most likely to be installed in the household sector. As a result of measures installed by the end of 1996, it is estimated that CO_2 emissions in 2000 were 7.2 million tonnes lower than they otherwise would have been and that the resultant energy saving was 27 PJ. (Ministry of Economic Affairs, 2005)

3.80 The MAP-II package, from 1994-2000, was funded by a levy on consumers (310 million guilders a year), the companies' own resources (60 million guilders) and the government (150 million guilders). The consumer levy was limited to a maximum of 2.5% - the average was 1.8% over the period. The bulk of the consumer levy was used for consumer subsidies (insulation; high efficiency boilers; lighting in non-residential buildings), information and promotional campaigns, whilst the government money was mainly used for subsidies for CHP/heat distribution and renewable energy (wind, biomass, solar and small-scale hydro). A number of companies also ran pilot projects testing out intelligent metering. In general, however, there was less use of subsidies than in MAP-I and more effort to stimulate the market for energy saving products and foster lasting changes in consumer behaviour. (IEA, 2004)

3.81 The MAP initiative came to an end in 2000 as it was felt that it would not be appropriate in a liberalised market. It was replaced by increased taxes on energy and fossil fuels, the recycling of some of those revenues to support energy saving measures, plus tax incentives for investment in energy efficiency, CHP and renewables. (IEA, 2004)

Industrial sector initiatives

3.82 The Long-term Agreements on Energy Efficiency (LTAs) are covenants between companies and the government, as result of which the government agreed not to impose additional CO2 reduction measures on the participants. The agreements do not remove the possibility of more general measures, such as generic energy taxes, but when making new legislation, the government will take into account the efforts that have been made by these companies to improve energy efficiency, use CHP or renewables. Other incentives for the participants are simplified environmental permit procedures, fiscal incentives (e.g., through the EIA) and technical assistance from SenterNovem. SenterNovem assists trade associations and individual companies to develop and implement their conservation plans and monitors energy savings.

3.83 The first generation of LTAs covered large and small industries from1990 to 2000. The target was to improve energy efficiency in the participating companies by 20% - the improvement achieved was 22%. LTAs remain the main measure for industry. The Energy Efficiency Benchmarking Covenant is a LTA for large industries, whereas the second generation LTAs (LTA2) are for smaller industries, services and agriculture. Virtually all large companies have joined the Benchmarking Covenant. (Senter Novem web site)

3.84 LTA2 assigns an important role to provincial and municipal authorities, as the Competent Authorities for the Environmental Management Act, enabling them to reach agreements with LTA2 companies on the contribution they can make to local climate policy. Municipal and provincial authorities deal with the energy consumption of companies within their boundaries through licensing and licence enforcement procedures. Under the Environmental Management Act, energy efficiency requirements are imposed when environmental licences are granted. Each company that takes part in the LTA2 must draw up an Energy Conservation Plan (ECP) and this fulfils the energy requirements of an environmental licence. The ECP has to be approved by the Competent Authority and SenterNovem. Municipal and provincial authorities can also impose the LTA2 requirements on those that have not yet joined the LTA2, as an equivalent alternative. SenterNovem provides advice to local authorities on whether the plan complies with the requirements of the covenant. (Senter Novem web site)

ESCOs

3.85 In the 1980s and 1990s the Netherlands did a lot to encourage the development of an energy services industry, with action co-ordinated through the energy agency, NOVEM. NOVEM provided information; model contracts; a scheme of subsides; and set up a register of ESCOs eligible for subsidies encouraging those on the register to share information, thus acting as a network of ESCOs in the Netherlands. From 1988 to 2000 NOVEM provided 50% of the cost of technical audits and 25% of the cost of energy efficiency projects (including CHP) undertaken by registered ESCOs. (Bertoldi and Rezessy, 2005) Apart from industry, many CHP and end-use energy efficiency investments were stimulated in public housing, nursing homes and hospitals. By late 1989 many of the electricity distribution companies in the Netherlands had also entered this market, mainly through providing third party finance for CHP (as noted in CHP section above).

Recent residential and service sector initiatives

3.86 For the residential and services sectors, the principal measures are improving energy efficiency in new and existing buildings via performance standards , labeling and minimum efficiency standards for appliances, and voluntary agreements. The Energy Premium Regulation (EPR), was first implemented in 1999 by giving tax incentives but was converted into a subsidy scheme in January 2003. Under the EPR €54 million of subsidies each year help consumers buy energy-efficient household appliances, and promote energy-saving technologies and renewable energy in homes built before January 1998. Subsidies are financed from the revenues of the regulatory energy tax. In 2003, some of these activities were reduced due to concerns that part of the budget went on measures which would be implemented without the subsidy – e.g. because a majority of the appliances already have an A-label. The implementation cost of the policy was also regarded high (24% of the subsidies). (IEA 2004)

3.87 For those sectors not covered by the European emission trading system, the government is considering a system of tradable energy efficiency certificates (‘white certificates). Under this system, the energy supply companies would be obliged to save a certain amount of energy. They could meet this obligation by implementing energy efficiency measures for their customers and the resultant savings would entitle them to an energy efficiency certificate. The proposal has been developed following examination of EEC in the UK and the Greenhouse Gas Abatement scheme in New South Wales. (Ministry of Economic Affairs, 2005)

Smart meters

3.88 In 2005, SenterNovem, on behalf of the Ministry of Economic Affairs, co-ordinated a study into the potential for smart meters for residential customers in the Netherlands. A key driver of government interest is the potential for smart meters to enable customers to switch supplier more easily (and to be more interested in doing so in response to new service offers made possible by smart meters) thus stimulating more competition and hence lower prices. The study involved consultation with market players, a review of the need for standardisation and a cost benefit analysis by KEMA(the Dutch energy sector’s research body).

3.89 The Senter Novem study concluded that the Government should define functionality to facilitate large scale introduction of smart metering. For the cost benefit analysis the assumptions were a 10 year transition period, in-house customer display, two way communication, both gas and electricity meters converted. The costs would be spread over a 30 year period and the assumed internal rate of return was 7%. They also assumed a 2% energy saving and reductions in electricity and gas prices due to improved competition (€0.0025/kWh for electricity and € 0.0050/m3 for gas) . The cost benefit analysis (meters for 7 million households) produces a positive outcome of €1.2 billion with the following main costs and benefits:

Costs :

Purchase and installation of smart meters	€798M
Monthly billing energy consumption by supplier	€437M
Data infrastructure via PLC/internet/GSM	€354M

Benefits :

Easier switching – more price competition – price reduction	€1,353M
Less complaining via call centre	€927M

(Dijkstra, 2005)

3.90 The government is now likely to legislate to introduce smart metering in autumn 2006. The plan is that, starting in 2008, all residential customers will get a smart meter over 6 years. Minimum requirements for these meters are currently being established. It has been agreed that, to avoid stranding issues, when customers switch suppliers, the new supplier has to take on the old supplier's smart meter.

3.91 In the mean time some pilot projects are being developed. The Dutch grid operator Continuon started a pilot in 2006 in which 50,000 smart meters will be installed to build experience with operational aspects. The smart meter (Metripoint) registers both electricity and gas. A new energy supplier and certified metering company , Oxxio, has started to offer smart meters to its customers as a solution to administrative problems they were experiencing with their billing partners. Oxxio's smart meter registers both electricity and gas and customers have access to a personal website that shows their actual energy use and energy costs.

Low income households

3.92 As in most European countries, fuel poverty is not a recognised issue in the Netherlands. This is probably due to housing standards, effective heating and insulation and relatively high welfare benefits. However, the high levels of energy taxation might be expected to raise some concerns and indeed the effects on income distribution of fiscal measures are an important issue in Dutch politics. There is an annual assessment of the effects of fiscal policy on the purchasing power of households with different incomes and it is known that expenditure on heating and electricity is regressively distributed over income groups. Some of the regressive impact was counteracted by allowances/tax credits within the energy tax for people in smaller properties. However, the major attempt to reduce the regressiveness of the tax was through adjusting other tax allowances as part of the commitment to make the tax fiscally neutral. So, for example, the tax allowance for elderly people was raised. (DEFRA, 2005)

Assessment of impact of policies for sustainable energy

3.93 Costs of policies for decentralised energy

MAP subsidies for CHP and renewables, 1994-2000 – 150 million guilders

MEP subsidies for CHP and renewables, 2003-05 - €129 million in 2003 (€70.5 million for renewables and the rest for CHP); €281 million in 2004 (€164 million for renewables); €298 million in 2005 (€181 million for renewables).

EIA tax relief for energy efficiency, renewable energy and CHP - €161 million in 2003 and 2004 and €137 million in 2005

Energy tax exemption - The Netherlands General Accounting Office has calculated that over the period 1999-2004, the subsidies provided for renewables and CHP cost the Dutch taxpayer € 1.56 billion, of which almost € 0.7 billion (44%) was in consumer subsidies (i.e. the tax exemptions for consumers who bought green power). (van Damme, 2005)

CHP

3.94 In 2004, 42 percent of centrally generated electricity was produced in CHP systems. Total CHP capacity in the Netherlands has exceeded conventional capacity since 2004. Electricity generated in CHP installations increased to 10.6 gigawatt (GW) in 2005 whilst conventional capacity remained at 9.9 GW, (Statistics Netherlands, July 2006) The table below illustrates the growth of CHP and the sectors where it is most prevalent.

Combined heat and power capacity in the Netherlands, including district heating, 1998-2002

		1998	1999	2000	2001	2002*
		MW				
Total		4 704	4 816	4 864	5 230	5 233
Energy transformation companies [1)]		434	438	436	436	436
Industry		2 578	2 607	2 589	2 905	2 893
of which	Chemical industry	1 521	1 543	1 513	1 829	1 828
	Food, beverages and tobacco	543	545	557	554	549
	Paper	412	416	416	419	413
	Other industry	102	103	103	103	103
Other		1 692	1 771	1 839	1 889	1 904
Agriculture and horticulture		872	932	984	1 021	1 036
Distribution companies		323	325	326	326	326
Other [2)]		497	514	529	542	542

Source: Statistics Netherlands - CBS (2003). CBS/EDC/Oct03/0387

1) Refineries and primary producers
2) Health care and other producers

3.95 CHP's large share of Dutch power generation is partly due to large and continuous heat loads – a precondition for the competitiveness of CHP –in industry and agriculture, but the financial and fiscal support was a key factor in the rapid increase in CHP use in the 1990s. This led to cheaper existing baseload lying idle because of overcapacity. CHP capacity reached its peak in 1999 and then slightly declined as some units faced financial difficulties owing to reductions in electricity prices and increases in gas prices. Given these difficulties, the government introduced new incentives that will take into account the actual emissions reductions arising from each installation. However, the IEA recommends that the government should evaluate how cost-effective supporting CHP is compared to other means of emissions reduction.(IEA, 2004)

Renewables

3.96 The share of renewable energy in total Dutch energy consumption is increasing although it remains small. In 2004, the share coming from renewable domestic energy sources was 1.8 percent; in 2005, the share had risen to

2.4 percent. The increase is mainly the result of a twofold increase of biomass incineration in power stations.

3.97 Approximately three quarters of renewable energy is converted into electricity and the remainder is used as heat. Domestic production of renewable electricity rose from 4.3 percent of electricity consumption in 2004 to 6.2 percent in 2005. This increase is also mainly due to an increase in biomass incineration in power stations. In spite of the fact that 2005 was less windy, the amount of electricity produced by wind turbines increased by 10 percent compared to 2004, due to the erection of new wind turbines. Imports of renewable energy fell slightly from 9.1 to 8.7 percent of total electricity use, but still exceed domestic production.

3.98 Van Damme (2005) has examined the distribution of benefit from the consumer subsidies (exemptions from the EB for green tariffs) in 2002, when they amounted to € 215 million. The subsidies were not paid directly to consumers but were claimed by electricity suppliers in relation to the number of customers taking up green tariffs. Hence the benefit of the subsidies could be split between consumers (lower tariffs), generators (price paid by suppliers in the purchase of green certificates) and suppliers (the difference between the benefits to customers and generators and total cost). Most consumers who switched to green energy stayed with their incumbent supply company but switched to the green tariff . van Damme estimates that consumer benefits were limited since, despite the subsidies, the incumbents' prices for green electricity were only slightly less than the prices they charged for grey electricity. Some new entrants provided discounts on green energy (10 €/MWh to 40 €/MWh), but they only had a small market share. By 2004 only 6% of consumers had switched to a different company and not necessarily all to a newcomer offering a better deal. "If we assume that, in 2002, 3% of the households had switched to a cheaper supplier and saved 10 €/MWh in doing so, we see that consumer benefits were about € 10 million, a tiny fraction of the cost to the government."

3.99 The price for green certificates was between 10 €/MWh and 20 €/MWh, so generators benefited only marginally from the subsidy (€55 million). Consequently, the major beneficiaries were the electricity suppliers who received around 70%, or € 150 million.(van Damme, 2005) Summing up van Damme (2005) says : "the stimulation policy for green energy, was an interesting experiment, but was very costly and did not lead to substantial investment in renewable energy sources"

3.100 The IEA has also commented on the costs of renewables policies to date, that "substantially increased renewable electricity demand but not domestic generation. Instead, renewable electricity imports increased without any significant additional investments in the Netherlands or abroad. Increased imports, in turn, led to the congestion of the transmission system bringing power to the Netherlands, increasing congestion rents for the TSOs in both the Netherlands and Germany. One estimate is that the rent for this congestion could exceed €100 million annually, thus increasing cost for electricity consumers." (IEA, 2004)

3.101 The stipulation applying in Germany that wind energy must have preferential access to the grid means that sometimes the Netherlands has to deal with huge unplanned import flows of electricity from northern Germany. Most of the wind energy produced in northern Germany is consumed further south. However, the German electricity grid cannot cope with these flows, which is why the Dutch grid is used to transmit this electricity to consumers in southern Germany. The governments of both countries are looking for a solution to this problem, in which the grid administrators and regulators will also play a role. (Ministry of Economic Affairs 2005 Netherlands)

Energy consumption and emissions

3.102 The amount of electricity used by Dutch consumers annually grew by an average 1.5 percent from 2000-2005. In 2005, it was 344 PJ, as against 321 PJ in 2000. The use of natural gas by energy consumers was 3 percent down in 2005 as compared to 2000. (Statistics Netherlands web site)

3.103 Total electricity consumption in 2005 hardly changed compared to the previous year but total energy consumption decreased in 2005. This is mainly due to a reduction in the amount of energy used by power stations. Energy consumption by end users, on the other hand, increased in 2005. (Statistics Netherlands web site)

3.104 In 1980, the average household consumed some 3,145 cubic metres of gas per year. By 2000 average consumption had fallen to 1,965cubic metres. High prices due to the energy tax (EB) have clearly contributed to this. Between 1980 and 1985, the net price of gas rose from 13.85 eurocents to 25.23 cents per m^3. Net prices fell in the 1990s but the EB helped to keep the price of gas in real terms in 2000 at the 1990 level. Additional factors are the use of gas with a higher calorific value and greater use of high-efficiency boilers, together with public awareness campaigns. (DEFRA, 2005)

3.105 Average electricity consumption per household tells a very different story to that of gas. The average family used 3,152 kWh in 1980 and this figure remained more or less constant over the next two decades, being 3,220 kWh in 1999. The net price per unit remained remarkably stable throughout: 19.32 cents in 1980 and less than one full cent higher in 2000. In real terms, the price can thus be seen to have fallen. Since the late 1990s the EB has started to reverse this price reduction but any effects on consumption are still feeding through. A key factor in electricity consumption is growth in use of electrical appliances – a factor seen in most western countries that means electricity demand is proving difficult to reduce. (DEFRA, 2005)

3.106 From 1990 to 2002 greenhouse gas emissions rose by 1.2%. (IEA, 2004) As the IEA points out " Even though the Netherlands has followed an active climate policy for several years and has introduced many effective measures, CO2 emissions have increased." (IEA, 2004) Unusually compared to many European countries, emissions increased in the industrial sector largely due to economic growth in that sector, whereas they fell in the residential sector. GDP grew by 35% and population by 8% from 1990-2002. Emissions have however been falling since the late 1990s and in 2005 were back to the 1990 level (Statistics Netherlands web site) The main reason for falling emissions in recent years has been a switch from fossil fuels to renewables in electricity generation. In 2004 the amount of fossil fuels used to generate electricity was reduced; the use of natural gas dropped by 6 percent, and coal used fell by 9 percent. The use of biomass, on the other hand, doubled to approximately 30 petajoules (PJ). (Statistics Netherlands web site)

Conclusion

3.107 The Netherlands has had considerable success in increasing use of CHP although policies to boost use of renewables to date have been less successful. After various other forms of policy the main instrument now is a form of feed in tariff. The Netherlands has a long tradition of the Government reaching formal agreements with industry as an alternative to more regulation and /or taxes. These agreements have been very effective, as political consensus means industry can be sure the policy will persist and the Government will resort to regulation and/or taxes if the agreement is not adhered to. These agreements have helped promote energy efficiency and CHP in industry.

3.108 SenterNovem's role is important but limited mainly to implementation – it is not a policy making body – but it is interesting that it had the key role in work on smart meters rather than the regulator, DTe.

3.109 The DTe is mainly focused on core economic regulation tasks and its duties and powers reflect that. Within the overall framework set by government energy policy it has implemented a number of changes to network regulation to facilitate distributed generation and renewables. But it is worth noting that many of the changes to the system were implemented before DTe was established and thus it has had to work within that framework. The fact that much decentralised energy existed before full market liberalisation has meant that the nature of the reforms had to take it into account. The energy regulator has thus had a relatively limited role in the policies that the Netherlands has adopted to promote energy efficiency, CHP and renewables and to move its system towards decentralised energy.

Chapter 4 : California

Energy supply

4.1 The state generates 81% of its own electricity supply, with the remainder being imported from neighbouring states. The main sources of generation in California are :

Natural Gas = 41.9%
Nuclear = 12.9%
Hydro = 14.8%
Coal = 19.8%
Renewable = 10.6% (Source: California Government web site)

Energy policy

4.2 California has a population of 36 million(2004) and has 13 million households (2004). It is a large state geographically – some 156,000 square miles. (California Government web site)

4.3 California has a long history of some of the most ambitious policies in the US for renewable energy and energy efficiency with decades of bi-partisan legislative and gubernatorial support. The 2003 Energy Action Plan (EAP) and the greenhouse gas targets and policies set in 2005 are the main current policies. The EAP was jointly adopted by the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), and the Consumer Power and Conservation Financing Authority (CPA) and endorsed by Governor Schwarzenegger.

4.4 The Action Plan proposes a "loading order" of energy resources (i.e. a hierarchy of energy supply or demand reduction options for meeting energy needs) to guide decisions made by the agencies. The loading order requires resources to be used in the following order : "first acquire cost-effective energy efficiency and demand response, followed by distributed generation and renewable resources, and finally, clean fossil fuel power plants. " (CPUC, 2004) Specific actions include :

- A voluntary dynamic pricing system to reduce peak demand by 1,500 to 2,000 megawatts by 2007 (see section on smart metering)
- Improve new and refurbished building efficiency by 5 percent.
- Improve air conditioner efficiency by 10 percent above federal standards.
- Make every new state building a model of energy efficiency.
- Provide customer incentives for energy demand reduction (i.e. using the PGC)
- Provide utilities with demand response (e.g. smart metering) and energy efficiency investment rewards comparable to the return on investment in new power and transmission projects (see Energy Efficiency Portfolio Standard section)
- Increase local government conservation and energy efficiency programs.
- Incorporate distributed generation or renewable technologies into energy efficiency standards for new building construction. (CPUC, 2004)

4.5 In December 2004 the CPUC adopted Long-Term Procurement Plans for California's three major electric utilities and authorized them to enter into long- and short-term contracts for electricity following the Energy Action Plan loading order. (CPUC web site)

4.6 A number of new policy initiatives are designed to meet the state's 3% annual energy consumption growth rate (1.5% with renewable energy, 1.5% with energy efficiency). In 2005, the California legislature increased the state's Renewable Portfolio Standard (RPS - see below for more details) from 20% by 2017 to 2010. Governor Schwarzenegger has proposed an increase in the RPS to 33% by 2020, which would make California the leader in the country of percentage of energy from non-large hydro renewable energy.

Greenhouse gas targets

4.7 On June 1, 2005.Governor Schwarzenegger established the following greenhouse gas targets (California Governor's web site):

- By 2010, Reduce to 2000 Emission Levels
- By 2020, Reduce to 1990 Emission Levels
- By 2050, Reduce to 80 percent Below 1990 Levels

The Secretary of CalEPA (California Environmental Protection Agency) will lead a Climate Action Team, made up of representatives from the Business, Transportation and Housing Agency, Department of Food and Agriculture, Resources Agency, Air Resources Board, CEC and CPUC, to implement emission reduction programmes. The Team will report to the Governor every 2 years on progress toward the targets.

4.8 In February 2006 the CPUC said it would develop a load-based cap on greenhouse gas (GHG) emissions for the Investor Owned Utilities and the non-utility companies that provide electricity to customers. Imported energy and power produced within California will be treated equally. The Commission will explore various approaches to flexible compliance, including banking, offsets and trading and work with the Governor's Climate Action Team implement a cap and trade system. In September 2006 Governor Schwarzenegger announced that California would establish the first U.S. cap on greenhouse gas emissions in a plan to reduce the state's emissions by 25 percent by 2020. In October 2006 the Governor also agreed to explore ways to link his state's efforts with the Northeast partnership's Regional Greenhouse Gas Initiative (RGGI). The RGGI (members : New York, Connecticut, Delaware, Maine, New Hampshire, New Jersey and Vermont). aims to cut emissions of carbon dioxide by 10 percent by 2019 through a trading scheme. (California Governor's web site)

Institutional framework

4.9 In the US, much energy policy is determined at state rather than federal level. In California the State Government delegates most energy policy development and implementation to two key agencies – the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC). However, the Governor of the State sets the overall policy direction and appoints the Commissioners to the CEC and CPUC. The role of the State Legislature (Assembly and Senate) is also key. The California Environmental Protection Authority also has a role.

California Energy Commission

4.10 The California Energy Commission (CEC) is the state's primary energy policy and planning agency. Created in 1974, the Commission has five major responsibilities:

- Forecasting future energy needs and keeping historical energy data
- Licensing thermal power plants 50 MW or larger
- Promoting energy efficiency through appliance and building standards
- Developing energy technologies and supporting renewable energy
- Planning for and directing state response to energy emergency

Since the Electric Industry Deregulation Law in 1998 the Commission's role has included overseeing funding for public interest energy research and providing market support to existing, new and emerging renewable technologies.

4.11 A key task for the CEC is production of a biennial integrated energy policy report, prepared via a12 month process that involves stakeholder submissions, workshops, hearings and draft papers for comment. The report assesses trends and issues facing California's electricity, gas and transportation sectors and provides policy recommendations "to conserve resources; protect the environment; ensure reliable, secure, and diverse energy supplies; enhance the state's economy; and protect public health and safety."(CEC, 2002) The report also assesses of the environmental performance of electricity generation facilities in the state. The report is made to the Governor and Legislature and contains recommendations for them plus for the CPUC.

4.12 The 2003 Energy Report called on the state government to reduce demand, secure additional energy supplies, give consumers more energy choices, and make infrastructure improvements to protect California from future supply disruptions and high prices. The 2005 report notes "the state has made some limited progress toward the goals in the 2003 Energy Report and the 2004 Energy Report Update, primarily in utility efficiency programs and natural gas infrastructure." The 2005 Energy Report also contains recommendations to further the state's 2003 Energy Action Plan. (CEC web site)

California Consumer Energy Center

4.13 The California Consumer Energy Center is the CEC's main method of outreach to individual consumers. It was set up by the CEC in 1995 to offer households, small businesses and schools a one-stop site on the Internet for the latest information about energy resources and how to use them wisely. It contains seasonal consumer tips, "how-to" videos for the consumer and energy professional, and information about incentives and rebates for renewable energy and energy efficiency.

California Public Utilities Commission (CPUC)

4.14 The California energy market is regulated mainly by the California Public Utilities Commission (CPUC), although the Federal Energy Regulatory Commission (FERC) regulates the interstate transmission of natural gas, oil and electricity, including prices for electricity transmission. FERC also regulates wholesale sales of electricity and oil and monitors the energy markets. Siting and construction permits are issued by the CEC.

4.15 CPUC started life as the Railroad Commission in 1911 and became responsible for regulating other utilities in 1946. CPUC is responsible for "ensuring that customers have safe, reliable utility service at reasonable rates, protecting against fraud, and promoting the health of California's economy." (CPUC web site) It regulates the rates and services of investor-owned utilities (IOUs) in electricity, gas, water, steam, sewer, pipeline, local telephone and transportation. It does not regulate municipal or mutual utilities although some of the rules and obligations it sets for the IOUs are adopted voluntarily by them, particularly in the environmental field. CPUC's jurisdiction in the electricity and gas sectors covers distribution and retail sales. It sets rates (tariffs); regulates service standards and monitors safety. CPUC has a general mandate in the context of electricity restructuring, to develop rules and other measures needed to implement reform.

4.16 The Commission consists of five commissioners appointed by the governor, and approved by the senate, for terms of six years. The five commissioners as a whole make all final decisions on policy and procedures. The staff includes more than 800 people, including approximately 72 that work for the Energy Division. CPUC is primarily funded with fees paid by the utilities it regulates. Some additional revenue comes from fees charged for services. Fees are set so as to equate the total budget approved by the State Legislature.

4.17 It is not a simple task to set out the duties and powers of the CPUC as these are based in numerous Acts passed over decades. Legislation is changed or added frequently via Senate or Assembly Bills or propositions. A California ballot proposition is a method of amending either the California Constitution or California statutory law. The process of allowing the public to propose legislation or constitutional amendments is called an Initiative. The process of the state legislature proposing Constitutional amendments is called a Referendum. For Initiatives to be put to the electors of California a minimum number of registered voters must sign a petition in support. The Initiative process exists in some other US states and some other countries (e.g. Switzerland)

4.18 Various pieces of legislation therefore either set a framework for the CPUC's approach to the energy market or require it to undertake specific actions and where these are relevant to sustainable energy they are dealt with at relevant places in this report.

The CPUC's Division of Ratepayer Advocates

4.19 The Commission's Division of Ratepayer Advocates (DRA) represents utility ratepayers (consumers) in Commission proceedings and related activities. DRA's mission, (defined by Senate Bill 960 in 1996 and the California Public Utilities Code, Section 309.5) is to "obtain the lowest possible rate for service consistent with reliable and safe service levels." (CPUC web site)

4.20 Public Utilities Code 309.5 requires the Commission to provide sufficient resources for DRA to represent consumer interests in all significant proceedings. DRA advocates on behalf of consumers when the Commission considers utility proposals to increase prices, adjust service quality, or undertake major projects. DRA has had a major focus and some success in getting energy prices to consumers reduced. It has also participated in proceedings on Electric Utility Resource Planning (R.04-04-003) to ensure adequate supplies of energy generation resources at reasonable cost. DRA has generally supported funding for energy efficiency, renewables and low income programmes but has sought to ensure that such programmes are cost effective and that the utilities are not allowed unnecessarily generous rate increases to fund them. DRA is currently active, with a number of external consumer groups, in trying to protect PBF revenues, as the CPUC has proposed that utilities be able to offer large customers discounts off the PBF surcharge as part of "economic development rates" (EDR).

The CPUC's Consumer Service and Information Division (CSID)

4.21 The Consumer Service and Information Division (CSID) helps consumers resolve billing and service disputes and identifies patterns of consumer problems, fraud, and other abuses assists consumers. It also provides information to the public.

4.22 CSID's Public Advisor's Office advises consumer organizations on how to participate in formal proceedings and provides outreach to local government and community groups. The CPUC administers an Intervenor Compensation program, which provides monetary compensation to parties that intervene in and contribute substantially to Commission decisions. The Public Advisor's Office assists those who wish to apply for compensation.

The CPUC's Low Income Oversight Board (LIOB)

4.23 The Low Income Oversight Board (LIOB) was established by the legislature to advise the CPUC on the energy low-income assistance programs of utilities under the jurisdiction of the Commission and serve as liaison for the Commission to low-income ratepayers and their representatives.

Electricity Oversight Board (EOB).

4.24 The EOB acts as a market monitor, overseeing the state's electricity market. EOB is governed by a board of three appointees of the Governor and one member appointed from each of the California Senate and Assembly, although currently, there is no quorum and EOB staff report to the Governor's office. The primary duties of EOB are:

- Monitoring electricity markets to prevent manipulation and anticompetitive behaviour and initiating relevant proceedings at the Federal Energy Regulatory Commission (FERC)
- Representing the state in ongoing litigation at FERC and in the courts related to the 2000-01 energy crisis.

California Power Authority (CPA).

4.25 The CPA was created to assist in the development of new electricity resources in the state, by providing revenue bond supported financing. The CPA has not financed any electricity generation projects and is currently inactive; CPA's bonding authority will expire in January 2007.

California Environmental Protection Authority (Cal/EPA)

4.26 In 1991 the Cabinet level, California Environmental Protection Agency (Cal/EPA), was created. This brought together agencies concerned with air quality, water, waste management and other environmental issues. The Legislature also gave Cal/EPA's Office of the Secretary several specific responsibilities, including : enforcement, environmental justice, environmental protection indicators for California.

Agency overlap

4.27 There have been a number of concerns raised about duplication, accountability for policy formation and the ability of the various energy institutions to work together to implement the state's energy policies. Some observers have also noted that the current decentralization of energy policy making means that the state does not always present a "unified front" when working with the federal government and other parties. The concerns are summarised in this quote :

"The current energy organizational structure includes a mix of department and commission structures, and this mix creates its own set of accountability problems. The independence of a commission can be beneficial under circumstances in which decision makers should be insulated from outside pressure, such as ratemaking. However, because commissioners are generally appointed to fixed terms and cannot easily be dismissed by the Governor or the Legislature, the independence of commissions can also reduce accountability to the Governor and the Legislature. To some extent, this allows commissions to make policy independent of the policy-making processes of the Legislature and the administration." (LAO, 2006*)*

4.28 Governor Schwarzenegger recognised concerns about the overlapping roles of the different agencies in energy policy and his Governor's Reorganization Plan

(California Governor's web site) submitted to the Legislature in May of 2005 proposed to:

- Create a single Department of Energy, with a department head - the "Secretary" -who would be a member of the Governor's cabinet.
- Abolish CEC, EOB, and CPA and transfer their functions to the new department.
- Create a new California Energy Commission within the new department, with responsibilities limited to permitting new power plants, permitting electricity transmission and natural gas infrastructure (responsibilities transferred from CPUC), and approving energy efficiency standards. Most of the current functions of the Energy Commission would have been assumed by the new Department of Energy, including its energy analysis and strategic planning functions.
- Make the Secretary chair of the new Energy Commission. The remaining Energy Commission members would be appointed, as now, by the Governor subject to confirmation by the California State Senate. The president of the CPUC and the president of the California Independent System Operator (CAISO) would sit as ex-officio non-voting members of the reformed Energy Commission.
- Designate the new department as the exclusive state representative before FERC.

4.29 On August 25, 2005 the California State Senate rejected the Governor's plan. Both the California Attorney General and the Legislative Counsel of California concluded that several elements of it were illegal. California statute prohibits the use of the reorganization process to transfer any function conferred by the state constitution on an agency created by the constitution. The Energy Reorganization Plan would have transferred from the California Public Utilities Commission (CPUC), to the proposed new State Department of Energy, significant energy price setting powers and other energy functions conferred on the CPUC by the California Constitution.

4.30 The Governor resubmitted a revised proposal to the Legislature in bill form, (AB 1165, Bogh) in autumn 2005. The three main changes were : :

- The Secretary would be a member (not the chair) of the new California Energy Commission.
- Natural gas permitting functions would stay at CPUC.
- Although the new department would take the lead before FERC, other state entities would also be able appear.

4.31 In the view of the Legislative Analysts Office (LAO[3]) “While the Governor’s proposal would consolidate policy making with the Secretary of the new department, we note that there is no specific provision in his proposal requiring CPUC (which would still retain energy-related functions under his proposal) to abide by those policy decisions. ..We think that any proposal to reorganize the state’s energy entities should explicitly address CPUC’s policy-making role. This is because CPUC has interpreted its duty to protect ratepayers broadly, and has made significant energy-related policy decisions under this authority.” (LAO, 2006) The LAO says that CPUC’s “independence … is useful for the regulation of utility rates. We therefore recommend that utility rate-setting regulatory authority be retained in CPUC, under its commission, in any energy reorganization plan.” (LAO, 2006)

4.32 The LAO also comments on the role of the CEC : “Currently, CEC’s appointed commissioners oversee all activities of the commission, including developing and adopting policy, presiding over regulatory functions, and implementing non-regulatory programs. We recommend that under a reorganized department, the duties of a new California Energy Commission be limited to making regulatory decisions, namely the permitting of new power plants and the adoption of energy efficiency standards. We would also recommend that the development and adoption of policy and the oversight of the implementation of non-regulatory programs be the responsibility of the Secretary.” (LAO, 2006)

4.33 The review of agency roles is still under debate at the time of writing.

Energy market

4.34 The market is comprised of investor owned, municipal, and cooperative utilities. The major investor owned utilities (IOUs) include Pacific Gas & Electric, Southern California Edison, Southern California Gas Company and San Diego Gas & Electric and account for 80% of the customers. The larger municipal utilities include Los Angeles Department of Water and Power (LADWP) and Sacramento Municipal Utility Department (SMUD). Prior to restructuring, the three electricity IOUs were completely vertically integrated.

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3 *The Legislative Analyst's Office (LAO), overseen by the bipartisan Joint Legislative Budget Committee (JLBC), provides advice to the Legislature and nonpartisan analyses of the state's budget. The LAO ‘s “*Analysis of the Budget Bill”*, includes recommendations for legislation. A companion document,”* Perspectives and Issues”*, identifies major policy issues. These documents help set the agenda for the work of the Legislature's committees in developing a state budget. Staff of the LAO work with these committees throughout the budget process.*

Electricity

4.35 California led the way in the US in restructuring the electricity industry, passing legislation in 1996 and implementing it early in 1998. The three IOUs were required to divest themselves of power generating assets but allowed to retain ownership of the distribution, transmission and supply (retail) functions. Although the IOUs retain ownership of transmission, control of access has been transferred to a non-profit "Independent System Operator" (CAISO). The primary duties of CAISO are:

- Oversight and operation of the electricity transmission system in the state.
- Planning for transmission needs and ensuring the reliability of the system.
- Operation of a "spot" market for electricity (where electricity providers can buy electricity in the short term to supplement existing resources).

4.36 Generation assets were mainly sold to major companies such as Dynegy, Mirant, Duke and AES. A nonprofit "Power Exchange" or "PX" was created as an auction market for the buying and selling of electricity. This feature was discontinued when it was found that a reliance on "spot market" pricing was contributing to the high cost. Now utilities contract with generators directly and are able to structure contracts that provide more price stability.

4.37 Direct access for retail (i.e. supply competition) was introduced in 1998, allowing ***all*** electricity customers to buy "bundled service" from the utility distribution company or switch to an independent electric service provider (ESP). The customer remained with the local utility, the "default provider" or "provider of last resort" unless they chose to move to an ESP. For bundled service utility customers, the total bill included charges for all services, including retail, distribution and transmission as well as electricity. A direct access customer received distribution and transmission service from the utility, but purchased its electricity from its ESP – so such customers received two bills. A bundled customer could choose to become a direct access customer and later revert to bundle customer status with the utility. Less than one percent of residential customers chose alternative providers, mainly green energy providers, during 1998 and 1999.

4.38 As part of the trade-off under the restructuring legislation, for consumers paying the utilities' stranded costs, the utilities had agreed to a rate freeze that lasted until March 2002 or when the stranded costs were paid off. PG&E, SCE, and SDG&E were required to buy all of their power through the CalPX and were not allowed to enter into forward long-term contracts. During 1998 and 1999 energy costs were well below the frozen rates but during 2000 spot market wholesale prices increased because of power shortages. California's generation capacity decreased 2 percent from 1990 to 1999, while retail sales increased by 11 percent and no new capacity was built for over a decade. The high voltage transmission line connecting southern California to northern California also became congested at times, reducing the flow of surplus electricity capacity in southern California to meet shortages in northern California. Another factor was the increase in natural gas prices and the high costs of meeting California's power plant emissions requirements. (US EIA web site)

4.39 The three IOUs were thus unable to pass on high wholesale costs because retail prices were frozen, resulting in them accumulating enormous debts. By January 2001 many independent generators were reluctant to sell power to PG&E, and SCE because of the uncertainty of receiving payment. When wholesale prices increased during the autumn and winter of 2000-2001, most new retailers (unable to compete with the price controlled utilities) withdrew from the market and returned their customers to the local default provider utilities thus exacerbating their problems.

4.40 The Governor's Proclamation of January 17, 2001, found that an emergency existed in the electricity market threatening "the solvency of California's major public utilities", On February 1, 2001; an Act was passed ending the right of customers to direct access. (Assembly Bill 1X) The Legislature then authorized the California Department of Water and Power (DWR) to purchase electricity for utility customers with the utilities acting as billing agents for DWR. Customers who switched to an ESP before September 2001 have been allowed to remain with them and to switch to other ESPs if they wish, but no new customer switching has been possible since then. Under existing law, the suspension of direct access will continue until long-term electricity contracts signed on behalf of the IOUs by the Department of Water Resources (DWR) expire. The last of the contracts expires in 2015. There has been some discussion about reinstating direct access before 2015 but no actual proposals to do so to date.

Gas

4.41 Prior to the late 1980s, California's regulated utilities provided virtually all gas services. Since then, the CPUC has gradually restructured, to give customers the option to purchase gas from independent suppliers, while assuring regulatory protection for those customers that wish to continue to buy from the utility. There are four main gas utilities - Pacific Gas and Electric Company (PG&E), Southern California Gas (SoCalGas), San Diego Gas and Electric Company (SDG&E), Southwest Gas - and several smaller gas utilities. The CPUC regulates the utilities' rates and services, including in-state transportation over the utilities' transmission and distribution pipeline systems, storage, procurement, metering and billing. Most of California's 10.5 million gas customers are residential and small commercial - "core" - customers, who accounted for approximately 40 percent of the gas delivered by California utilities in 2003. Electricity generators and industrial customers ("noncore" customers), accounted for the other 60 percent. Most core customers still purchase gas directly from the regulated utilities, but most noncore customers buy gas from producers or marketers.

4.42 Most of the natural gas used in California comes from out-of-state basins and only 18 percent from within California. Most of the gas transported via the interstate pipelines, as well as some of the California-produced natural gas, is delivered into the PG&E and SoCalGas intrastate gas transmission pipeline systems ("backbone" natural gas pipeline system). Natural gas on the backbone pipeline system is then delivered into the local distribution pipeline systems, or gas storage fields. In 1997, the CPUC unbundled backbone transmission costs from noncore customer transportation rates, and gave customers and marketers the opportunity to obtain capacity rights on PG&E's backbone pipeline system. PG&E are required to set aside a certain amount of pipeline capacity to deliver gas to core customers. In

December 2001, the PUC adopted a market and regulatory structure for SoCalGas similar to the structure for PG&E.

4.43 California's regulated utilities do not own any natural gas production facilities. All of the gas sold by these utilities must be purchased from suppliers and/or marketers. PG&E and SoCalGas own and operate several natural gas storage fields in northern and southern California. These storage fields, and two independently owned storage utilities help meet peak seasonal gas demand. In 1993, the CPUC removed the utilities' storage service responsibility for noncore customers and adopted storage reservation levels for the utilities' core customers.

4.44 FERC regulates the transportation of natural gas on the interstate pipelines, but the CPUC often participates in FERC proceedings to represent the interests of California gas consumers. The CPUC has regulatory jurisdiction over the utility-owned natural gas pipelines, which transport 85 percent of gas delivered to California's gas consumers. The price of natural gas sold by suppliers and marketers was deregulated by the FERC in the mid-1980s and is determined by "market forces". However, the CPUC decides whether California's utilities have taken reasonable steps to minimize the cost of natural gas purchased on behalf of their core customers.

Community Choice Aggregation

4.45 Assembly Bill 117 (passed in 2003) permits cities and counties to purchase and sell electricity on behalf of utility customers in their areas once they have registered with the CPUC. The legislation came about because cities and counties had become increasingly involved in implementing energy efficiency programmes, advocating for their communities in power plant and transmission line siting cases, and developing distributed generation. The CCA program was designed to take these efforts one step further by enabling communities to purchase power on behalf of the community. As of January 2006 there were no local governments that had implemented CCA, although the City and County of San Francisco (CCSF) and the City of Chula Vista (San Diego) had stated their intent to do so and a number of others had expressed interest. (CPUC web site)

Renewable Energy and CHP

4.46 Support for renewables and CHP has been provided through a range of policy and regulatory initiatives including : PURPA, the public goods charge (PGC), the Renewables Portfolio Standard.

4.47 Under the 1978 federal PURPA legislation, which aimed to open up competition in electricity generation, utilities were required to purchase power from "qualifying facilities " (CHP and renewables) owned and operated by third parties. Following the enactment of PURPA, the CPUC developed standardized power purchase contracts that set the terms under which qualifying facilities sold their excess electricity to utility companies. The price that each power plant is paid under these contracts is based on the "avoided cost" of generation – i.e. what it would cost the utility to produce the electricity itself, using standard assumptions for making such calculations developed by the CPUC. These took into account the high costs of oil in the late 1970s and early 1980s and hence have tended to be favourable to CHP and renewables. Many of the contracts were signed for long periods – 10-25 years.

4.48 With the electricity market restructuring in 1998, the CPUC established the PGC to run until 2012. The PGC is a non-by passable levy on retail charges, to provide funds for public purposes including energy efficiency, renewable energy and support for low income consumers.

4.49 From 1998-2002 the PGC collected $540 million for the Renewable Energy Program from the three major investor-owned utilities (Southern California Edison, Pacific Gas and Electric Company, and San Diego Gas & Electric). The Renewable Energy Program components from 1998-2002 were :

- **Existing Renewable Facilities Program** - to help existing renewable technologies (biomass, waste tire, solar thermal, wind, geothermal, small hydro, digester gas, landfill gas and municipal solid waste) via a production incentive, with a cap of 1.5 cents per kilowatt-hour. Funds decreased annually from January 1, 1998, to January 1, 2002. The program was initially allocated $243 million.
- **New Renewable Resource Account** - $161 million was allocated to support new renewable electricity generation projects built after September, 1996. Funding was augmented with an additional $40 million in November 2000 and $40 million in 2001, - a total of $241 million. Funds were distributed through a production incentive, with a cap of 1.5 cents per kilowatt-hour, and paid over a five-year period. By May 2005, there were 81 projects with more than 1,300 MW
- **Emerging Renewable Resources** - rebates to purchasers of on-site renewable energy generation such as photovoltaic, wind turbines, solar thermal electric and fuel cell technologies that use renewable fuels. This programme continued but is now being subsumed into the California Solar Initiative.
- **Customer Credit Program**- $75.6 million for rebates to consumers who purchased eligible renewable electricity from suppliers registered with the CEC. Consumers choosing "green power" were credited with up to 1 cent per kilowatt-hour of electricity consumed (limit of $1,000 in rebates for industrial customers). In September 2001, consumers' right to switch was suspended so consumers can no longer choose a company that provides "green power." Customers already signed up prior to September 2001, continue to receive the credit. The programme was discontinued due to uncertainty in the retail market, as well as a lack of evidence that it would increase renewable energy supply. The market peaked in August 2000, at 216,372, customers purchasing 261.7 million kWh. By the summer of 2001, fewer than 71,000 residential customers were receiving customer credits.

Self generation incentive program

4.50 Legislation passed in 2001 required the CPUC to set up the Self-Generation Incentive Program (SGIP) to provide incentives for renewable and clean generation. The SGIP provides rebates for systems up to 5 MW to customers of IOUs who install certain types of distributed generation to meet all or a portion of their energy needs. The programme is scheduled to continue through to the end of 2007.Generation technologies include photovoltaic (solar) systems, small scale CHP, fuel cells, and wind turbines. The programme is aimed mainly at businesses rather than households. The incentives for solar will be modified as a result of the introduction of the California Solar Initiative, but the incentives for other technologies will not change. (CPUC web site)

Renewables Portfolio Standard (RPS)

4.51 Legislation was passed in 2002 (Senate Bill 1078, 2001-2002 session) to establish the California Renewables Portfolio Standard (RPS), which requires an annual increase in renewable generation by the utilities of at least 1 percent of sales, with a goal of 20 percent by 2017. The 2004 Energy report update recommended increasing the target to 33 percent by 2020 and the state's Energy Action Plan supported this. (CPUC web site)

4.52 The CPUC is required to work with the CEC to implement the RPS and the legislation assigns specific roles to each commission. The CPUC is required to "establish a methodology to determine the market price of electricity for terms corresponding to the length of contracts with renewable generators." The "market price" must reflect the long-term market price of electricity a utility would need to purchase to meet its capacity and energy needs from conventional fossil fuel resources instead of the renewable resources proposed under the RPS bidding process. The Market Price Referent (MPR) developed by the Commission considers "the value of different products including base load, peaking, and as-available output." The CPUC approved a competitive process for the utilities to obtain renewable energy. This includes a “least-cost best-fit” methodology for the utilities to employ in ranking the bids, standard contract terms and conditions, and market price benchmarks. (CPUC web site)

4.53 According to the CEC’s Energy Report 2005, the process for procuring renewable resources has been overly complex and cumbersome, and could impede the state's ability to achieve its renewable goals. It recommended that the CPUC and the CEC should simplify and streamline the RPS process and allow limited trading of renewable energy certificates. (CEC, 2005)

California Solar Initiative

4.54 In 2005 the Governor asked the CPUC to implement his Million Solar Roofs plan, which includes $2.9 billion in incentives to building owners who install solar electric systems over ten years from January 2007. The target is 3,000 MW by 2018. The Plan will cover customers of Pacific Gas and Electric, Southern California Edison and San Diego Gas and Electric and customers of the municipal-owned utilities such as SMUD and LADWP. Developers of more than 50 new single family homes will be required to offer the option of a solar energy system to all customers beginning January 2011.

4.55 To implement the Plan, the CPUC created the California Solar Initiative (CPUC ruling - R.04-03-017, January 2006) funded through the PGC. This moves the consumer renewable energy rebate program from the Energy Commission to the utility companies under the direction of the CPUC. (CPUC web site)

The CSI program:

- Provides incentives to customer-side photovoltaics (PV), other renewable fuel projects, and solar thermal electric projects less than 1.0 megawatt capacity.
- Sets initial PV incentive levels at $2.80 per watt, to be reduced by an average of approximately 10 percent annually. Incentive levels for solar thermal electric projects and solar heating and cooling are currently being determined.
- Allocates 10 percent of programme funds for low-income and affordable housing.

Connection issues for decentralised energy

4.56 In the United States, there are no nationwide standards for connecting decentralised energy into the distribution system, although FERC does set common standards for renewables connecting to transmission networks.

4.57 California was one of the first states to adopt a standard practice for connection of decentralised energy to the distribution network, in October 1999 This "Rule 21" as it is known, specifies standard connection, operating, and metering requirements for decentralised generators. The CEC oversees the continuing work of the Rule 21 Interconnection Working group. Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Edison Company (SCE) have now replaced their former Rule 21 with the approved Model Tariff, Interconnection Application Form, and Interconnection Agreement. (CEC and CPUC web sites)

Net Metering

4.58 Net metering is defined as the difference between the electricity supplied through the electricity network and the electricity generated by an interconnected decentralised energy unit. A single electricity meter may be used to register the flow of electricity in both directions. Electricity supplied by the electricity network causes the meter to spin in a positive direction. Electricity generated by the decentralised energy unit may be fed back into the network, causing the meter to spin in reverse.

4.59 California's net metering law was established in 1995 (Section 2827 of the California Public Utilities Code). There have been many modifications over the years including 3 separate bills enacted in 2005. In general, the current rules allow on-site energy projects (solar, wind, biogas, and fuel cells) of up to 1 MW access to net metering. The combined capacity of net-metered systems may not exceed 2.5% of any utility's peak demand. (CPUC web site) The customer receives a financial credit, offset against their electricity bill, for power generated fed back to the utility. The utility does not pay for excess power above the amount of electricity the customer consumes from the utility.

4.60 California uses "time of use" net metering - a specialised reversible meter programmed to value electricity at fixed values during different periods of the day, which may also vary with differing seasons. This is highly favorable to systems where the user's demand can be managed so that there is net production of electricity during high cost periods. This can be done for example, by chilling water during off peak times for air conditioning use during high demand periods, or by pre-cooling the thermal mass of the building during low cost periods. Market rate metering (where retail prices are related to wholesale prices) will be implemented in California starting in 2006 (as part of the smart metering roll-out) and will be applicable to qualifying photovoltaic and wind systems.

4.61 Net metered projects are exempt from some of the charges paid b y larger distributed generators. Although they do pay the Department of Water Resources surcharge and the Public Goods Charge, they do so based on net rather than gross consumption. As of March 2005, there were 600 net metered projects totalling 25.1 MW. Most of the projects were using solar photovoltaic technology. (DSIRE website)

Transmission issues

4.62 In June 2006 the CPUC reached a decision on the transmission infrastructure necessary to meet its Renewable Portfolio Standard (RPS). For example, the Tehachapi area in Southern California has over 4,000 MW of wind energy potential, but to access this new transmission lines are needed, at a cost of up to $1 billion. The June 2006 decision gives utilities the assurance that investments in new transmission facilities will be recovered in customer rates. Without such assurances, utilities have been hesitant to develop new renewable resources. Transmission facilities that meet one of the following qualifying criteria are eligible for cost recovery: new high-voltage, bulk-transfer, transmission facilities that are designed to serve multiple RPS-eligible projects; or transmission network upgrades that are required to connect an RPS-eligible resource.

CHP issues

4.63 The effect of PURPA, combined with other policies has resulted in about 770 co-generation plants in California producing 9,000 MW, representing approximately 17 percent of state-wide generation. Most of these systems are larger than 5 MW. The California Environmental Protection Agency says CHP helps California reduce its greenhouse emissions by more than 26 million tons a year.

4.64 Many of the PURPA contracts were signed in the 1980s and 1990s for 15-25 years and so are coming up for renewal. 73 contracts between CHP generators and the state's two largest utilities came to an end and were not renewed between 2000 and 2005, resulting in the loss of 251 MW of electricity. The California Energy Commission (CEC) estimates that as much as 2,000 MW of co generated power could be lost between 2006 and 2010 if project owners are unable to renew their contracts with utility companies. (Caseworks, 2006) The utilities have been keen to get rid of these contracts because they say they require them to buy electricity at relatively high prices compared to some other forms of generation – the co-generators themselves often dispute this.

4.65 The CEC (CEC, 2005) said that current state policy must change for California to retain existing CHP and expand its use "so critical to reliable operation of the state grid". It found that the unwillingness of utilities to renew contracts affects sales at the wholesale level and the state's suspension of direct access is hampering their ability to sell their excess power at the retail level. Due to their inability to sell excess electricity, some operators have removed their CHP systems entirely and rely on less efficient boilers to meet their heating needs. The Commission concluded that "there will be serious adverse consequences for electric reliability, natural gas demand, and air quality if this trend is allowed to continue." The CEC made a number of CHP recommendations:

- The CPUC and the Energy Commission should establish annual utility procurement targets for CHP facilities by the end of 2006.
- The CPUC should require investor-owned utilities to purchase electricity from CHP facilities at prevailing wholesale prices.
- The CPUC should explore regulatory incentives that reward utilities for promoting customer and utility-owned combined heat and power projects.
- The CPUC should require that investor-owned utilities provide CA ISO scheduling services for these facilities and be compensated for doing so.

4.66 The CPUC is currently reviewing the basis on which CHP is incentivised in future, including the role of PURPA, and is due to make a decision before the end of 2006.

Energy efficiency/DSM

4.67 California was the first state to adopt demand side management in the late 1970s, under which the CEC and CPUC set spending targets for energy conservation for the state's electricity IOUs. Demand side management programmes increased through the 1980s and early 1990s. However, plans for market liberalisation meant that DSM activities that were suited to vertically integrated monopolies had to be ended. The solution was the public goods charge (PGC). Legislation, passed in 1996 and revised in 2000, established the PGC to run until 2012. The PGC is a non-by passable levy on retail charges, to provide funds for public purposes including energy efficiency, renewable energy and support for low income consumers. The gas surcharge for public purposes, including energy efficiency, began in 2001.

4.68 The CPUC approves each utility's plan for efficiency programmes, allocates the funds and oversees programme implementation by the utilities. A number of programmes are also coordinated on a state-wide basis. The utilities' programmes cover: lighting and appliances; heating, ventilating and air conditioning systems; motors; retrofits and renovations and new buildings and are designed to provide a fair distribution of funds among residential and non-residential customers. There are special programmes overseen by the LIOB to provide energy efficiency services for low-income households.

4.69 In 2004, the CPUC set goals intended to double annual gas savings by 2008 and triple them by 2013. In September 2005 the CPUC authorised energy efficiency plans and funding for 2006-2008. CPUC President Michael R. Peevey said, "$2 billion is a significant expenditure, but the benefits clearly outweigh these costs and consumers gain in a multitude of ways. These programs will cut energy costs for homes and businesses by more than $5 billion, eliminate the need to build three large power plants over the next three years, and reduce global warming pollution by an estimated 3.4 million tons of carbon dioxide by 2008, which is equivalent to taking about 650,000 cars off the road." (CPUC web site)

Energy Efficiency Portfolio Standard

4.70 State Energy Efficiency Portfolio Standards (EEPS) have been developed in a few US states and either require or recommend that regulated electricity IOUs meet a specific portion of their electricity demand through energy efficiency. An EEPS may be part of a renewable or broader portfolio standard.

4.71 The CPUC has translated the Energy Action Plan into an EEPS (GWh/therm savings targets) for electricity and natural gas for the state's four largest investor-owned utilities. (CPUC web site) Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), Southern California Edison Company (SCE) and Southern California Gas Company (SoCalGas) are set a target to achieve 70% of the economic potential and 90% of the maximum achievable potential energy efficiency available. Electricity and gas savings from programs funded through the public goods charge (PGC) and procurement funds will contribute to these goals, including those achieved through the low-income energy efficiency (LIEE) program. The actions that the utilities are required to undertake to fulfill this obligation include :

- Demonstrate that their proposed level of electric and natural gas energy efficiency programme activities and funding is consistent with the Commission's electricity and gas savings goals
- Submit an analysis of options to remove barriers to the rapid deployment of energy efficiency with the 2006-2008 programme plans, including enabling customers to pay for energy efficiency measures alongside energy supplies on the same bill.
- In any application in which they present projections of supply-side resource needs, or otherwise utilize projections of energy demand, they have to demonstrate that they fully reflect the energy savings goals.

Measuring cost effectiveness of energy efficiency policies

4.72 PUCs in the US have developed various tests to measure the cost-effectiveness of energy efficiency (and many renewables) investments. The three main tests are : society as a whole (Total Resource Cost - TRC); all customers of the utility (Utility Cost - UC); and the price impact on non-participant ratepayers (Rate Impact Measurement - RIM). The choice of cost-effectiveness tests determines the extent of the programmes, with the RIM test being the most stringent. States with the most extensive programmes have used TRC as the primary test. California primarily uses the TRC test and avoided cost methodology (e.g.. avoided costs of energy supply) (CPUC web site and E3, 2004).

ESCOs

4.73 According to the US National Association for ESCOs (NAESCO) market opportunities for ESCOs have become especially robust in California, following CPUC’s approval of the $1.8 billion in energy efficiency programs proposed by the three investor owned utilities for 2006-2008. The Standard Performance Contracting program as well as other ESCO friendly programs will provide almost $750 million in incentives for ESCOs and their customers. In addition, NAESCO and a group of member ESCOs have been actively working with the California Department of General Services (DGS) to re-start the state buildings performance contracting program. (NAESCO web site)

Smart metering

4.74 The key driver for smart metering in California is the need to reduce peak demand, particularly after the power cuts experienced in 2001. Peak demand is largely driven by air conditioning use during the summer and a quarter of capacity is used for less than 100 hours a year. The peak energy uses considered most amenable to price response are : commercial air conditioning; residential air conditioning; commercial lighting; residential miscellaneous; agriculture and water pumping. The residential load contributes 25% to peak demand on a cool day and just over 30% on a hot critical peak day.

4.75 A statewide pilot, authorised by the CPUC, involving 2500 residential and small commercial customers, was run in 2003 and 2004 to study demand response to critical peak pricing with smart meters. To help customers understand the concept of demand response and conservation, the Commission also approved demand response marketing and customer education programs.

4.76 Some in the trial had automated response (the meter was linked to appliances and could change thermostat settings or switch them off) others were given information about when prices were high. The effects ranged from 27% reductions (with automated response at the highest critical peak prices) to more typical 5-10% reductions without automated response. One group of households was just given information about peak periods without a price signal and no discernible response was found in these cases – so the price signal seems to be important. There was no impact on overall demand – it was merely shifted to off-peak periods. However, Charles River Associates' analysis (2005) of 16 other time of use programmes found an average conservation effect of 4%. Another potential benefit of reducing peak demand is the effect on energy market prices as relatively small changes in load can produce lower market clearing prices and lower volatility.

4.77 Critical Peak tariffs will allow the utilities to decide, on up to 15 days a year, when the power is too short and let customers decide how much power they want to buy. On a normal day the power may be priced at 15 cents per KWH during peak times; on a critical day that same power may cost as much as $1 per kwh. In July 2005, extreme temperatures in the Southwest States coupled with 2,000MW missing on the network as a consequence of some local power plants tripping brought the Californian Independent System Operator very close to a major crisis. The "stage II" alert issued by the California operator prompted several utilities to invoke demand-response programs to reduce load. Thousands of customers, including both large and small customers, reduced their energy usage, and a crisis was avoided. (CapGemini, 2005)

4.78 Based on the outcome of the pilot, the CPUC has agreed to state-wide installation of smart meters for all small commercial and residential IOU customers by 2011, with cost recovery based upon plans submitted by the IOUs. Agreement on cost recovery was required because the benefits to the utilities (in terms of savings on operational costs) would be significantly lower than the costs of introducing smart metering. For example, in the case of Pacific Gas and Electric (PG&E), over a 15 year period, the NPV of costs to deploy advanced metering infrastructure and meters for all of its customers below 200 kW has been estimated at $1.8 billion, whereas the corresponding operational benefits (excluding demand response benefits) are approximately $0.8 billion. However, the statewide pilot helped to establish that when the societal benefits are added, the cost benefit case is positive due to the value of the reduction in peak demand. Customers will pay a surcharge of between $0.50-$1.00 per month for at least five years to cover the costs of the smart meters. (CPUC web site)

Support for low income and vulnerable consumers

4.79 There have been programmes to support low-income households since the early 1980s. Currently all four utilities administer both California Alternate Rates for Energy (CARE) and Low Income Energy Efficiency (LIEE) Programs. The LIEE Programs consist of energy efficiency (including replacing or repairing heating equipment) and energy education. CARE provides fuel bill assistance. Eligibility for CARE and LIEE is based upon household income at or below 175 percent of the federal poverty guidelines Older and disabled households qualify for LIEE at 200 percent of the guidelines.

4.80 Both CARE and LIEE are funded by the public goods charge (PGC). Each year, CPUC prescribes a set level of LIEE funding for each utility, which includes the utility's administrative budget - any unspent funds are added to the next year's budget. CARE funding is somewhat different from LIEE, because it is never clear ahead of time how many customers will need the subsidy or how high their subsidies will run. Thus, CPUC do not prescribe a budget for CARE but do set budgets for the IOUs' CARE administrative costs. The budgets for LIEE in 2005 for the four IOUs in total were $129 million. The total expenditure on CARE in 2005 over the four utilities was $484 million.

4.81 Families whose income slightly exceeds the guidelines for CARE and LIEE may qualify for discounted rates on their energy bills under the Family Energy Rate Assistance Program. Most of the utilities also have shareholder funded trusts that provide emergency help for people in hardship.

4.82 In the light of rising gas prices during 2005 the CPUC, in October 2005, increased eligibility to 200% of the poverty guidelines for all types of household. The CPUC also directed the utilities to take other steps to mitigate the effects of rising prices on low income consumers, including banning disconnections over the winter if customers pay at least 50% of their bills and to accelerate the provision of heating improvement measures to the most vulnerable.

4.83 Assistance for low income consumers (energy bills and energy efficiency) is also provided via two federal sources – the Weatherization Assistance program (WAP) run by the federal Department of Energy and the Low Income Home Energy Assistance Program (LIHEAP) run by the federal Department of Health and Human Services (DHHS). Total funds from these programmes amounted to $91 million, of which about $24 million was spent on energy efficiency. These are administered by the Community Services and Development Department of the State Government.

4.84 A further initiative that assists low income households is the Baseline Allowance scheme. Most California residential electricity rates have four or five rate levels and those for gas have two levels. The first level for both electricity and gas is called the baseline and it provides customers with an energy allowance for basic needs at a lower rate. The rate is designed to promote conservation such that the greater the usage, the higher the rate. Baseline allowances account for 50% to 70% of the average residential consumption. The size of the allowance is set by the CPUC and depends on what climate zone the property is in and whether it is the utility's "winter" or "summer" season. Extra allowances of gas and electricity are billed at the lowest rate for customers with certain serious medical conditions.

Assessment of impact of policies for sustainable energy

Costs of policies

4.85 Expenditure on California's energy efficiency programs under DSM activities rose to $400 million in 1993 and 1994.

4.86 From 1998-2002 the electricity PGC was set to collect : $248 million for the Public Interest Energy Research Program (PIER); $540 million for the Renewable Energy Program; and about $912 million for energy efficiency programmes, from the three major investor-owned utilities.

4.87 In 2004, the CPUC increased 2005 funding for gas efficiency programs by $19.8 million and set goals intended to double annual gas savings by 2008 and triple them by 2013.

4.88 In addition, the CPUC allocates a portion of each utility's procurement budgets to efficiency programs

4.89 Current funding sources and amounts for energy efficiency are :

Funding Sources for 2004-2005 Energy Efficiency Programs	
Funding Sources	Millions
Electric Public Goods Charge (PGC)	$460 m
Procurement Funds	$245 m
AB 1002 Gas Surcharge	$91 m
Unspent/uncommitted PGC& Gas Funds (1998-2003	$24 m
Interest for PGC & Gas Funds	$3 m
Total	**$823 m**

(CPUC web site)

4.90 In September 2005 the CPUC authorised energy efficiency plans and $2 billion in funding for 2006-2008 for the state's utilities.

4.91 In September 2000, the legislature adopted the Reliable Electricity Service Investments Act (RESIA), which mandated the three investor-owned utilities to collect $135 million annually for 10 years from 2002, as part of the PGC to support the Renewable Energy Program. The surcharges comprised approximately 1.0% (electricity) and 0.7% (gas), of each customer's bill and have to be itemised on the bills.

4.92 The California Solar Initiative will raise $2.9 billion over 10 years via the PGC from 2007 to fund subsidies for microgeneration (mainly solar).

4.93 The costs of achieving the Renewables Portfolio and Energy Efficiency Portfolio standards over and above the costs funded via the PGC are not quantified.

Achievements

4.94 Demand response programs have failed to deliver their savings targets for each of the last three years and appear unlikely to meet their targets for next year. (CEC 2005)

4.95 Energy Savings reported by utilities from PGC programmes (CPUC web site) :

Savings	2001	2002	2003	2004*
Electricity (MWh)	1.6 million	1.2 million	1.3 million	1.9 million
Natural Gas (Therms)	17.8 million	20 million	34.2 million	39 million
Demand Reduction (MWh)	436	355	291	375

4.96 Renewable deliveries in 2005 under the RPS (the target is 20% by 2010):

- PG&E – 13.5 % (9,801 GWh)
- SCE – 17.7% (13,195 GWh)
- SDG&E - 5.5% (830 GWh) (CPUC web site)

The CPUC has concerns about whether the 2010 target will be met due to increasing costs of wind turbines, contractual issues and transmission constraints.

4.97 California renewables as a percentage of electricity generation in 2005 was 11% and CHP was 17% (CEC website) CHP generation has declined from 23% in 1997 – largely due to PURPA contracts coming to an end. Most CHP is gas-fired. There are no statistics available on how much of the renewables and CHP capacity actually qualifies as distributed energy. A lot of the CHP is distributed generation, based on industrial sites, agriculture and horticulture etc, although some is larger and connected to the transmission system. Much of the renewable energy is wind power in large wind farms connected to the transmission system and so would not count as distributed energy.

4.98 While energy use per person in the US as a whole has increased by 45 percent over the last 30 years, California's per capita use has remained relatively flat. (CEC website) California is not the only state to have achieved this. An earlier review (Geller and Kubo, 2000) found that the best states (Hawaii, New Mexico, Arizona, California, and Utah) cut their energy use per capita about 10-20 percent, compared to a 5 percent increase on average nationwide. The CEC says this is due to the energy efficiency policies pursued although at least part of the explanation lies in other reasons. Geller and Kubo say that scores for the absolute level of energy and carbon intensity and decline in intensity over the past thirty years tends to improve as average energy price increases, but that two other factors—degree of urbanization and presence of energy-intensive industries—also influence the overall score albeit to a lesser extent. One factor that does not appear to affect the overall score is climate.

4.99 Geller and Kubo also say that there is evidence that the top states have done more to promote energy efficiency improvements than low-ranking states. Utility energy efficiency programs in the top ten states produced electricity savings equal to 2.9 percent of electricity sales in 1998, compared to program-induced savings of just 1.3 percent of sales in the remaining 40 states. The two large states scoring the best in this overall ranking—New York and California—have implemented a wide range of energy efficiency initiatives over the past 25 years. (Geller and Kubo, 2000)

4.100 Geller and Kubo also found that the five least carbon-intensive states per capita (Vermont, Oregon, New York, California, and New Hampshire) were about 45 percent less carbon intensive than the national average, during 1970-97.

4.101 Gross greenhouse gas emissions increased about 1% from 1990 to 1999. The increase is much lower than for the US as a whole where emissions increased 12% over the same period. (CEC web site)

4.102 Electricity use per capita and per unit of GDP is lower in California than for the US as a whole (Lawrence Berkeley Laboratory, 2001)

Conclusion

4.103 California has pursued a range of policies over thirty years to increased the uptake of energy efficiency and use of renewable energy. More recently these policies have been stepped up further with ambitious goals for the coming years. Compared to the rest of the United States, where energy use and emissions have risen, California has managed to stabilise its energy use and carbon emissions over the last decade and the state is one of the least energy and carbon intensive.

4.104 The regulator – the CPUC has had a significant and long term role in the energy market in California, alongside that of the California Energy Commission. Consumer representation and complaint handling are based within the CPUC rather than there being an official external energy consumer organisation. The CPUC has links to low income consumers and their representatives via the Low Income Oversight Board. Information to consumers on energy use, energy efficiency, renewables etc is provided through the CEC's Consumer Energy Center – a wholly internet based resource. The regulator therefore does not have major role in terms of information to consumers on sustainable energy.

4.105 The CPUC has interpreted its remit broadly and taken an active role to promote energy efficiency and renewables – it has used its discretion to determine that promoting sustainable energy fits with its general duties to protect consumers. Also important is the role of the CEC – a powerful body that makes policy – that also has adopted policies that favour renewables and energy efficiency. Finally, and perhaps most importantly there is the positive political framework in which successive state governors of both parties, reflecting voter preferences in the state, have placed environmental concerns high up ion the agenda. However, as the above account demonstrates, the roles of the CPUC and CEC in policy making have raised concerns, even though in general the decisions they have made have been broadly in tune with the policy goals set down by successive state Governors. The Legislative Analysts Office (LAO) has specifically cited the large amounts of energy consumers' money approved by the CPUC to be spent on renewable energy, as an example of a major policy decision that may not be appropriate for the CPUC to make.

Chapter 5 : Assessment and conclusions

5.1 This chapter considers the advantages, disadvantages and risks associated with the policy and regulatory frameworks in other countries, particularly those adopted in the three case studies, with those in the UK. It also considers the potential fit of the different policy and regulatory frameworks with the four objectives of UK energy policy, as well as Government targets for renewables, CHP, energy efficiency and fuel poverty.

General findings

5.2 The UK has similar energy policy goals to many other countries and similar policy instruments to facilitate sustainable energy. However, although most countries tend to have the same three energy policy goals – economic efficiency, security and environment – in the US and most of Europe there has been a greater tendency to place security of supply and/or environmental considerations ahead of economic efficiency . This manifests itself in being more cautious about liberalisation and a greater tendency to use forms of planning that in the UK have been limited since privatisation. In particular, although the US and a number of EU countries have liberalised their wholesale markets, many US states and EU countries have been much slower to liberalise retail markets, particularly for smaller consumers. Even where retail markets have been liberalised, price control remains in most cases. Whether the UK has the balance right or they do is a matter of opinion – there are clearly advantages and disadvantages in either approach - but the difference is worth noting.

5.3 There are significant differences between Europe and the US in terms of the experience of independent energy regulation. Whereas the US federal and state level energy regulators are long established – more than 50 years in most cases - energy regulators in most of the EU have only been established within the last ten years and many only since 2000. This reflects the fact that whilst the major electricity and gas companies in the US have traditionally been private sector monopolies, those in Europe have been state owned (national and/or local government). Independent regulation was, until relatively recently, not considered necessary for state owned monopolies. Indeed, even in the US, the regulatory commissions have not had jurisdiction over the municipally owned utilities that exist in many US states, although this is now changing in some states with the advent of retail and wholesale competition. Thus regulation has tended to be considered necessary in cases of privately owned monopolies or where competition is introduced (even if state ownership persists).

5.4 Another factor to consider is the role of energy agencies or commissions in some European countries and some US states. These bodies have varying degrees of autonomy from government – some are executive agencies within departments, some more independent but mainly focused on implementation and a few have considerable independence and important policy making roles – but all will have role in influencing policy development. In Europe these agencies have mostly been in existence much longer than the energy regulators and have a mission that often stresses security of supply and/or environment more than economic goals. In the US, these state level commissions have existed in a number of states alongside the regulatory commissions (the latter covering all utilities whilst the former are focussed on energy). Many of these agencies/commissions have been given a specific remit on climate change/ renewables/ CHP/energy etc. Energy regulators in many US states and EU countries therefore, work alongside other significant state institutions with a role in policy formation and implementation.

5.5 Yet another factor that differentiates much of Europe and the US from the UK is the role of local authorities and co-operatives in energy markets. This is particularly significant in many countries in Europe where local and provincial/state authorities rather than central government have often been the major owners of electricity and district heating companies in terms of supply, local and regional distribution and some generation. In the US too there are many municipal electricity utilities, although they usually have control only of distribution and supply. Co-operatives in the US tend to run distribution and supply in many rural areas; in a number of European countries, co-operatives have roles in supply, distribution and generation and have taken a particularly strong role in the development of renewables.

5.6 Finally a very important general finding is that liberalisation has tended to follow the establishment of significant use of decentralised energy/renewables/CHP in many EU countries and US states, or forms of liberalisation have been designed specifically to incentivise sustainable energy – e.g. the PURPA legislation in the US. This is in marked contrast to the UK where liberalisation started before much decentralised energy had been established. Therefore, although liberalisation often changes policy towards decentralised energy, the forms of liberalisation and specific features such as wholesale market design have in many countries had to accommodate decentralised energy. In the UK in contrast, decentralised energy has had to fit into a system not designed for it.

Findings from the case studies

5.7 There are some key differences in the findings from the two European case studies as compared with those from California, particularly because the regulator has been long established in California whereas the Danish and Dutch regulators are relatively new. For this reason the California regulator has had a much more substantial role than the Dutch and Danish ones in the development of regulatory mechanisms that determine the sustainability of the energy system. To date the role and impact of the Dutch and Danish regulators in decisions that affect the sustainability of the energy system has been rather marginal although there are some relevant decisions. The Danish and Dutch regulators have had to fit into a system already established, where the prime drivers were not economic efficiency but security of supply and environmental protection. However, the establishment of regulation is providing some challenges to the established system in Denmark and the Netherlands, along with the challenges from the EU liberalisation agenda and political change.

5.8 The duties given to regulators are clearly important as they are creatures of statute. Regulation in the UK tends to be characterised as more discretion based than in the US and Europe, where regulatory duties are considered more tightly and narrowly drawn (Moran, 2003). However the utility regulatory commissions in the US do have a considerable degree of discretion to balance duties similar to the tradition in the UK.

This is seen clearly in the case of California where regulatory discretion has been used over more than 20 years to mandate a range of actions to facilitate sustainable energy, even where they have imposed up-front costs on customers. In Denmark and the Netherlands the energy regulators seem to have been established with relatively narrow remits that focus on economic regulation tasks and allow less scope for discretion. It is notable also that they have been set up as divisions of the generalist competition authority rather than as stand-alone regulators as in the UK.

5.9 The relationship with consumers is also different in the case studies than in the UK . None of the case studies has an energy consumer body like Energywatch and indeed this is not a common model in other countries. More common are generalist consumer advocacy bodies plus alternative dispute resolution (ADR) bodies or ombudsmen to deal with complaints. The government's proposal to merge Energywatch with other consumer bodies and the establishment of the energy ombudsman service will thus make the UK more like most other countries. It may be a feature of their being only recently established, but the regulators in Denmark and the Netherlands do not seem to have much interaction with consumers or environmental and consumer organisations. The UK is much more similar to California in this respect.

5.10 A final important factor of difference between the European case studies and California is the issue of fuel poverty. In California, as in the US more generally, the problems faced by low income households are well recognised and there are state and federal level programmes to help with energy costs and energy efficiency, similar to the UK. The regulator in California, like Ofgem, is centrally involved in action to assist low income households. In contrast, in Denmark and the Netherlands like most of Europe, fuel poverty is not recognised as an issue. This is partly explained by its lack of prevalence compared to the UK and the US due to better housing standards, levels of insulation and heating provision and more generous welfare benefits. However, the high levels of energy taxation in Denmark and the Netherlands would suggest that energy prices are likely to be more of a problem for lower income households, but there appears to be only limited recognition of this. Given this context, it is not surprising therefore that specific concerns of low income consumers do not feature in the work of the energy regulators in Denmark and the Netherlands.

Energy use and CO2 emission levels in California, Denmark and the Netherlands

5.11 In Denmark, by 2004, 28% of electricity was from renewables and 60% from CHP, with 60% of homes heated by district heating. (DEA 2005) In the Netherlands, by 2005, 54% of electricity was from CHP and 6% from renewables.(Statistics Netherlands, 2006) In California, in 2005, 17% of electricity generation was from CHP and 11% from renewables. (CEC, 2006)

5.12 Denmark is unusual amongst IEA countries in having managed to reduce its total final consumption - in 2004 it was 3.5% lower than in 1980, even though GDP increased over the same period by 50%. Denmark's energy intensity is the lowest in the EU and 35% below the IEA average. (IEA, 2006) CO2 emissions have also fallen – from 61 Mt in 1990 o 51 Mt in 2004. However, emissions are still relatively high due to the high percentage of electricity still produced from coal – 50%. (Danish Ministry of the Environment 2005)

5.13 In the Netherlands, although energy intensity has declined since 1980 it remains higher than the EU average – partly due to a substantial proportion of energy intensive industry still in the Netherlands. (IEA, 2004) Total final consumption was higher in 2005 than in 1980, in common with most other IEA countries, including the UK. Greenhouse gas emissions in 2005 were back to the 1990 level after having risen for some years. (Statistics Netherlands, 2006)

5.14 Electricity use per capita and per unit of GDP is lower in California than in all other US states and has remained almost flat for the last 30 years whereas in the rest of the US it increased by 45%. Gross greenhouse gas emissions increased about 1% from 1990 to 1999. The increase is much lower than for the US as a whole where emissions increased 12% over the same period. (CEC,2006)

5.15 The UNFCCC receives and publishes data on total emissions for countries that are parties to the Convention on climate change. (UNFCCC, 2006) These show that from 1990-2004 total emissions :

- For Denmark fell by 1.1%
- For the US increased by 15.8% (California probably 2-3% increase)
- For the Netherlands increased by 2.4%
- For the UK fell by 14.3%

The IEA has 1998 data[4] that covers the following countries (not for the Netherlands):

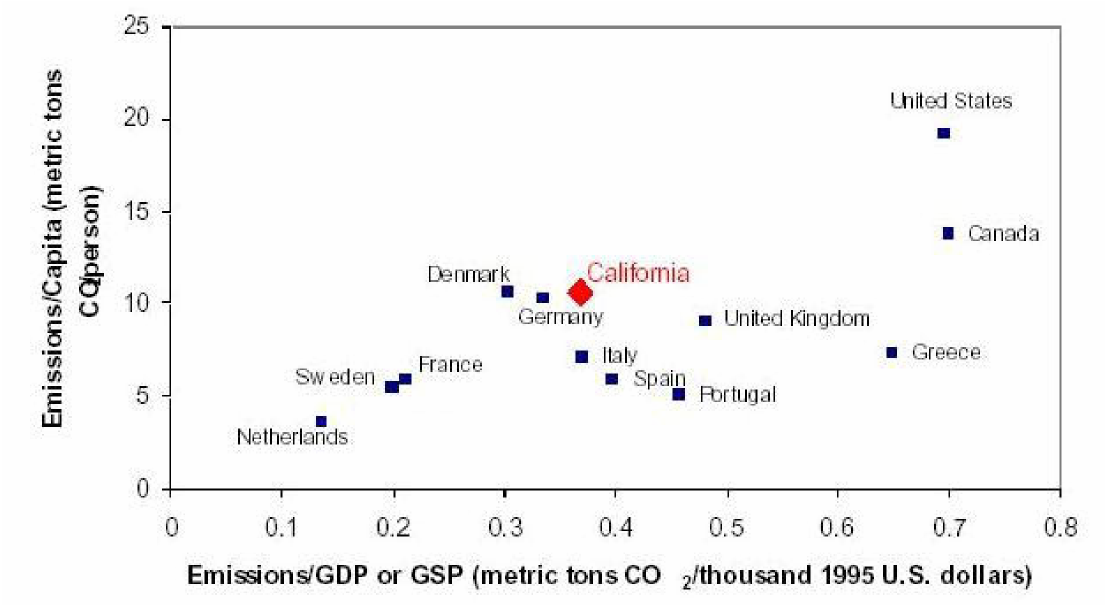
- 0.6 kgCO2/US$ for the US
- 0.4 kgCO2/US$ for the UK
- 0.38 kgCO2/US$ for Denmark

The diagram below provides a useful comparison that includes California, Denmark, the Netherlands, the UK and the US, but it is based on 1995 data.

5.16 These various measures of emissions show the complexities in comparing performance between countries. It is worth noting however that most countries have not yet made their energy systems sustainable – whether or not they have liberalised their energy markets. Although energy intensity has fallen since the 1970s, virtually all IEA member countries use more energy now than they did in 1970 and have higher greenhouse gas emissions. (IEA, 2004). Energy saving rates in IEA economies have slowed since 1990, as has the decline in emissions relative to GDP (IEA, 2004) Denmark has done considerably better than most countries in terms of energy use and CO2 emissions, but the UK has also done rather better in terms of reducing CO2 emissions than most other IEA countries.

[4] IEA. 30 years of energy use in IEA countries. IEA 2004.

Comparison of CO_2 emission levels, per unit of GDP, 1995[5]



Denmark

5.17 Denmark has significant achievements in terms of renewables and decentralised energy. The two key policy instruments have been the heat planning law that has promoted CHP and district heating and the feed in law that has promoted renewables and CHP. These have both been long term policies – since the late 1970s for heat planning and early 1980s for feed in – thus demonstrating the value of long term policy stability. The heat planning law gives local authorities the power to designate zones in which only district heating could be used and to oblige buildings to connect to it. The feed in law pays CHP and renewables generators a fixed price for the output they feed into the grid, higher than the market price for other electricity, and obliges network operators to connect them.

5.18 There are a number of factors that have enabled Denmark to develop and deliver successful policies for sustainable energy. The key ones are : a strong political will and consensus; effective institutional framework; the role of local authorities and co-operatives.

5.19 Denmark had a strong motivation to reduce dependence upon imported oil that led to the heat planning law. Over many years, successive Danish governments have reached political agreements with opposition political parties and the energy companies regarding plans for the energy sector, which have provided a considerable degree of policy stability. In the last twenty years these agreements have covered market liberalization, nuclear power, support for renewables, energy saving etc. The Conservative government elected in 2001, did question much of the previous emphasis on the environment and support for renewables and wanted to increase the emphasis on market mechanisms as opposed to subsidies and obligations. This has

[5] CEC web site www.energy.ca.gov

resulted in some changes in policy although the changes have been less marked than was initially expected, due to the consensual nature of Danish policy making.

5.20 On the institutional side, Denmark has had an energy agency (now authority – the DEA) since the 1970s. Although it is part of the Ministry rather than being an independent authority, it nevertheless represents a substantial centre of expertise on energy within the government, with divisions responsible for energy supply, energy resources and energy policy. It has developed into a “champion” for energy efficiency – which sits within the policy division – and renewable energy over the years. In contrast the energy regulator (DERA), is new (established in 1999) and many of the functions that Ofgem has in the UK, in Denmark rest with the DEA rather than DERA – for example, licensing of transmission and distribution. For example, decisions about how to deal with the need for new transmission capacity to facilitate offshore wind have been taken by the DEA, which runs the tender procedure for new offshore wind farms and can require Energinet.dk (the state owned transmission system operator) to assess the socio-economic costs and benefits of short-term or long-term investments to bring the power into the system. Whilst the DEA therefore has the task of cost benefit analysis of policies, DERA’s role in some areas is more one of cost effectiveness analysis – i.e. to regulate companies to ensure they minimise the costs of pre-determined policies.

5.21 Most of the key decisions and policies that have supported the development of decentralised and renewable energy in Denmark thus were take before DERA was established and the market framework and key rules also pre-date DERA, whose role is more focused on price control.

5.22 Local authorities and co-operatives have had important roles in the development of renewables and decentralised energy in Denmark. Until market liberalisation local authorities ran or controlled the entire electricity industry and the district heating sector, along with consumer co-operatives that ran some companies. Local authorities and consumer co-operatives still mostly control local distribution and supply of electricity and heat and have had a key role in development and ownership of wind turbines. This reflects a long tradition of local ownership and control in Denmark - for example, agricultural and housing co-operatives. Organisations under local control can be expected to have somewhat different motivations from companies without such strong local ties. Local authorities began selling otherwise wasted heat from power generation before the second world war as an additional source of revenue. The fact that they had control of local planning made it easy for them to build the networks in areas where housing was expanding. The co-operatives grew out of established agricultural and housing co-operatives who also saw this as a means of generating additional revenue and benefits for members – cheaper heating. Local authorities and co-operatives also saw the value of keeping income within the local area for economic development reasons. The heat planning law thus accelerated a trend rather than representing something entirely new.

5.23 The role of co-operatives has been particularly important in the development of wind power. The pioneers in wind energy in Denmark were largely rural and agricultural co-operatives and individual farmers, who through securing political support, have become an important lobby for favourable policies. The feed in law that they helped secure has given a degree of stability (long term guaranteed prices and guaranteed connection to the network), thus being more conducive to small scale participants than quota systems such as the renewables obligation. Quota systems tend to favour larger participants with broader generation portfolios who can better manage the risks of market prices and those who have substantial supply businesses and therefore do not need to negotiate contracts to sell the power. However, things are now changing in Denmark as most new wind farm developments are larger scale and undertaken by major developers – although even some of these may have some co-operative involvement.

5.24 The costs of support for sustainable energy have been significant and the IEA found that it would have been cheaper to achieve emission reductions through energy efficiency rather than support for renewables. (IEA, 2006) However, that does not take into account other benefits of support for renewables such as the contribution to diversity of supply. It is also important to note that the costs of support are reducing and the policies may well have helped bring about a reduction in costs. For example, the prices paid for onshore wind power have fallen substantially since feed in support started in the 1980s – from 10 eurocents per kwh in the 1980s, to 7.5 eurocents per kwh in the 1990s to 5 eurocents per kwh in 2004. This could show the value of upfront investment in terms of technology development and economies of scale. Whilst similar achievements may not be replicable for onshore wind, as other countries may already have benefited from the reductions that Danish policy has helped to bring about, policy support for other newer technologies might help to bring about similar cost reductions.

5.25 Fuel poverty is not a problem that is recognised in Denmark. To a large extent this is because well insulated houses, low cost heating through district heating, and high levels of welfare benefit, mean that many of the factors that contribute to fuel poverty in the UK (and the US) are not prevalent in Denmark. So to that extent housing, energy and welfare benefits policies have obviated the need for fuel poverty policy. However, given high levels of energy taxation in Denmark it seems likely that low income households will face more difficulty paying for energy than will the better off and so there may be a problem at least for some households even though government departments, the regulator and consumer bodies do not seem to recognise it as an area that requires action.

Netherlands

5.26 Market liberalisation started earlier than many other countries in Europe although full liberalisation is quite recent. The Netherlands energy regulator has been established since 1998 - longer than many of the other EU regulators. The energy and environmental agency – SenterNovem – is implementation and programme management oriented and is thus more similar to a combination of the EST and Carbon Trust than to the Energy Authority in Denmark.

5.27 The CHP support policies have favoured on-site schemes for the industrial, commercial and public sectors and may thus have broader applicability to the UK than Denmark's city wide CHP/DH schemes. Most of the CHP schemes that have been developed in the UK have started on a relatively small basis, often with a public sector base – local government offices, hospitals, universities, prisons, plus social housing – from which they can be broadened to include other buildings or can just remain site specific. Separate sites can be developed independently and then connected by a network later.

5.28 CHP support policies have been successful and according to the IEA, the high level of CHP in the Netherlands electricity system has not caused significant reliability problems. Netherlands policies to date for renewables however, have not been so successful and have produced some undesirable consequences. Notably, the policies that encouraged consumers to buy green energy, led to increased imports without any significant additional investments in the Netherlands or abroad and " led to the congestion of the transmission system bringing power to the Netherlands, increasing congestion rents for the TSOs in both the Netherlands and Germany. One estimate is that the rent for this congestion could exceed €100 million annually, thus increasing cost for electricity consumers." (IEA, 2004)

5.29 For similar reasons to those in Denmark (and most of Europe except Ireland) fuel poverty is not a problem that is recognised in the Netherlands. However, as in Denmark, high levels of energy taxation might suggest that at least some households could face some problems even if not to the extent of the UK.

5.30 The Netherlands energy regulator has implemented policies to tackle disadvantages created for decentralised energy by the energy trading system –e.g. action to reduce the impact of imbalance charges. The Netherlands like Denmark has connection charging policies that favour small generators, although the regulator is currently reviewing these policies due to some concerns that developers are getting round this rule by building multiple smaller plant.

5.31 The Netherlands is also close to making the decision to proceed with smart metering, based on a detailed cost benefit study undertaken for the Government by SenterNovem, with support from the energy industry's research body. By the end of 2006, it is likely to be agreed, that from 2008, smart meters will be installed for all residential customers over a period of six years. Minimum requirements for these meters are currently being established. It has already been agreed that, to avoid stranding issues, when customers switch suppliers, the new supplier has to take on the old supplier's smart meter.

5.32 The Netherlands has a long tradition of the Government reaching formal agreements with industry as an alternative to more regulation and /or taxes. These agreements have been very effective, as a considerable degree of political consensus means industry can be sure the policy will persist and industry also knows that the Government is serious enough to resort to regulation and/or taxes if the agreement is not adhered to. So, for example, such agreements have been very effective in getting industry to invest in energy saving technology, particularly CHP.

5.33 The latest version of these long term agreements enables local authorities to reach agreements with companies on the contribution they can make to local climate policy. Municipal and provincial authorities deal with the energy consumption of companies within their boundaries through licensing and licence enforcement procedures - energy efficiency requirements are imposed when environmental licences are granted. Each company that takes part in the energy long term agreement must draw up an Energy Conservation Plan, approved by the local authority and SenterNovem to fulfil the energy requirements of an environmental licence.

California

5.34 In many ways there are more parallels in terms of the role of regulator in California with the UK than in the two European case studies. The California regulator is long established and as in the UK has a range of duties to balance that include environmental and social as well as economic ones. There has been a significant and long term involvement of the regulator in policies and mechanisms to facilitate renewables, DE and energy efficiency that has parallels with the UK (indeed the UK took some ideas from the US - e.g. the gas E factor introduced in 1992, which was the precursor to EEC), although the mechanisms are different. However, whereas in the UK Ofgem has administrative responsibilities in relation to EEC and the RO, the CPUC has also had the power to decide how much should be spent on similar initiatives - this has been expressly ruled out in the UK where it is the government that decides on the level of the obligations.

5.35 The activist role of the CPUC on environmental issues is replicated by a number of other state utility commissions in the US, although not by the majority of state regulators. Political leadership has been significant in California, with consensus across political parties in favour of environmental protection . This is not based on formal political agreements like in Denmark but tends to persist as it reflects voter preferences in California. The regulators in US states reflect state political preferences – they are political appointees. It should also be noted that security of supply is always a key issue in the US and particularly in California following its 2001 energy crisis. Environmental and security concerns have thus tended to take precedence over economic efficiency and competition in California and a number of other states.

5.36 The whole energy market in much of the US is still more planned and regulated than in the UK. Most states still do not have full retail competition and it was abandoned in California following the 2001 energy crisis. The lack of competition combined with continued vertical integration means that some policies that can be easily applied in California would not be so easy to adopt in the UK, even if they were considered desirable. The CPUC can and does, for example, require the utilities to adopt rising block tariffs designed to discourage consumption and provide help to low income and vulnerable households. The CPUC can still require the companies to undertake integrated resource planning (IRP)– to compare the costs of meeting energy needs through a range of resources including demand side response. IRP would not be impossible in an unbundled market but it would be much more complex and the complexities increase when unbundling is combined with full retail and wholesale competition.

5.37 The roles of the CPUC and CEC are currently under discussion in California against a backdrop of concern about the extent of policy making power that these two organisations have. In the case of the CPUC this has been summed up as a concern about the breadth of regulatory discretion : "We think that any proposal to reorganize the state's energy entities should explicitly address CPUC's policy-making role. This is because CPUC has interpreted its duty to protect ratepayers broadly, and has made significant energy-related policy decisions under this authority." (LAO, 2006) The proposal is to create an Energy Secretary and department that would be part of the Governor's Cabinet and to limit the CPUC and CEC to decisions on rate setting and licensing. This thus highlights the concerns that can arise when independent regulators and other independent agencies are given broad policy making powers.

5.38 Fuel poverty is an issue in the US and there are programmes to tackle it at state and federal level as the California case study illustrates. Like the UK, the US has a lot of poor quality housing with inadequate heating (and cooling) systems and inadequate insulation that is occupied by low income and other vulnerable households. The income side of the problem is worse in the US than the UK due to the inadequacy of welfare benefits compared to the UK. The term "fuel poverty" however is not used widely in the US and the problem often tends to be seen more as one of temporary "hard times" (Power, 2006) rather than systemic. Hence more of the funding directed specifically to low income households tends to be devoted to reducing debt rather than improving energy efficiency.

5.39 The Baseline Allowance (a lower price for the first x units of electricity or gas per month) scheme is intended to help low income households and also encourage energy saving. Higher Baseline Allowances are also set for households with medical needs for more heat or air conditioning. The CPUC can determine this in California as it still regulates retail energy prices – in the UK the regulator could not mandate this without new legislation as price control ended in 2002.

Lessons for the UK

5.40 It is clear that there are advantages and disadvantages of the policy and regulatory frameworks in other countries. It is also clear that some of the policies adopted in the three case study countries would not necessarily fit easily with all of the four objectives of UK energy policy – particularly the competitive markets objective. Despite these caveats there are some lessons for the UK. These fall into five main areas : the importance of political leadership; institutional framework; the role of local authorities and community ownership; specific incentives for decentralised energy; energy efficiency, including ESCOs and smart metering.

The importance of political leadership

5.41 Firstly, it is worth noting that many of the key decisions in the case study countries have not been taken by regulators – they have been political decisions and illustrate the importance of a lead from government. So the main policies that have incentivised renewable energy, CHP and energy efficiency have often been ones that would not conceivably fall within the decision making responsibility of an energy regulator – e.g. feed in laws, heat planning, tax incentives. Another important factor seen in Denmark and California is the role of political consensus, so that overall policy has remained reasonably consistent despite changes in political control.

Although the regulator is important, there is a need to avoid placing too much emphasis on changing the role of the regulator - it may be as, if not more, important to change policy at government level or institutional capacity within government. Furthermore, many decisions much more properly sit directly with government than with regulators.

5.42 Policy changes may involve new forms of regulation, incentives or market mechanisms, but one area that may merit further attention is the negotiated agreement approach used extensively in the Netherlands between industry and the Government. In the Netherlands they have been particularly effective because a degree of political consensus makes them generally long lasting, thus giving policy stability, and there is clear political will to regulate if they do not deliver. There have been some examples of similar agreements in the UK although not as extensive as in the Netherlands. Clearly, such agreements are not a complete substitute for other policies but they might be useful in a number of areas, for example as a means of moving ahead more rapidly than would be possible where legislation may otherwise be required. on smart meters, demand reduction objectives or new initiatives to tackle fuel poverty . Ofgem could have a role in making such agreements work and/or monitoring them.

Institutional framework

5.43 In each of the case studies there are energy agencies or commissions that have important duties and responsibilities. Whilst the Californian regulator has had a key role in sustainable energy, the roles of the Danish and Dutch regulators to date have been more limited. California also shows some of the accountability concerns that arise when regulators and agencies have considerable independence and broad roles. There is no ideal institutional structure that the UK could copy from these case studies, although they illustrate that there is more than one solution. The Danish Energy Authority illustrates the value in building critical mass for policy development and co-ordination. This can be contrasted with the split in energy functions between the DTI and DEFRA, the EST and Carbon Trust in the UK.

5.44 The new actions that Ofgem has been taking, due to changes in duties arising from a series of Acts since 2000, do show progress in taking on board greater consideration of environmental and social concerns in major decisions. For example these include new incentives for network operators to connect distributed generation and increased incentives to reduce electricity losses and gas leakage. However, it is clear that the UK will need to step up its current range of interventions (regulation and/or incentives) to encourage renewables, CHP and energy efficiency, to meet its climate change obligations. The contribution that Ofgem can make to this is therefore an important consideration.

5.45 Ofgem’s duties have been changed to encompass sustainable development only relatively recently and so an option would be to pursue further incremental change within those duties, on issues such as access to networks for decentralised energy, demand reduction etc. Some specific areas for consideration are detailed in sections below. However, the increasing importance and urgency of dealing with climate change and security of supply concerns may mean that institutional change (that goes further than the new Office of Climate Change) is required to enable the UK to develop and implement new policies and changes to the market and regulatory framework. One option would be to change the role and duties of the regulator. However, if new responsibilities would sit better elsewhere, then the current broad set of duties for Ofgem may be sufficient. Other options for institutional change would be : to give some more functions to the Environment Agency, to mirror its role in the water sector and in relationship to Ofwat; to establish an energy agency, incorporating the EST and Carbon Trust (Helm, 2004, 2006); or to bring DEFRA and DTI energy functions together to build critical mass of expertise and greater policy co-ordination.. However, it is worth noting that major institutional change would be time consuming and disruptive. Disruption can be positive as well as negative, but is not something to be embarked upon lightly – it needs a problem in search of a solution rather than the other way around.

5.46 The support provided within the regulator in California for consumer intervention in rate making and other major decisions is interesting and may be worth considering, particularly in view of plans to merge Energywatch with other consumer bodies. Assistance in terms of expertise (and funding to hire experts) might enable more consumer and environmental organisations to play a greater role in regulatory decision making.

The role of local authorities and community ownership

5.47 The role of local authorities in electricity and heat supply does offer some potential for the UK, particularly given that there is already some experience here that could be built upon. In addition to the case studies, this key role for local authorities is also widespread in many other European countries – e.g. the rest of Scandinavia, Austria and Germany. Similarly, the role of co-operative and other forms of community ownership is also worth examining. Local authority and community ownership could make an effective contribution to all four of the UK's energy objectives. Many local authorities already have a strong commitment to the environmental and affordability objectives, with policies and programmes to reduce carbon emissions and fuel poverty. The local approach could help contribute to security of supply and the involvement of more local authorities and co-operatives could also bring new entrants into the energy market helping to meet the competition objective.

5.48 Local authorities in Europe have a much greater ability to become involved in local energy supply than do those in the UK due to their broader powers to raise finance (e.g. through bonds and pension funds) and a general power of competence – i.e. a general ability to do anything not prohibited by statute, whereas in the UK local authorities can only do those things that are specifically provided for in statute. There is also a lack of expertise in many local authorities that would need addressing. More support would also be needed to boost community ownership. The Climate Change and Sustainable Energy Act 2006 provides new powers for the Secretary of State to promote community energy projects that could address some of the issues.

5.49 The Government has a target for CHP but limited policies to help deliver it. Denmark and the Netherlands have high levels of CHP brought about by a range of policies over many years. In the case of Denmark, local authorities and consumer co-operatives have had a particularly strong role in developing CHP and district heating. In the Netherlands key policies have helped to stimulate the use of CHP in the industrial sector. Local authorities could have a particular role to play in the development of CHP in the UK – as have a number to date including Sheffield, Southampton and Woking. CHP could play an important role in delivering affordable heating to low income tenants in tower blocks. Clearly, the key role here is for action on government policy but Ofgem also has a role to play (see regulatory issues below).

5.50 The role that has been given to local authorities in the Netherlands, in relation to the long term agreements with local companies on energy efficiency, could also be worth considering in the UK.

Specific incentives for decentralised energy

Renewables Obligation versus feed in law

5.51 The key policy that has driven high levels of renewables in Denmark, (and also Germany and Spain which are two other world leaders) has been the support mechanism that has provided predictable high prices that have encouraged investment. These have been policies decided at government level – not policies instituted by energy regulators. Denmark and Germany have used the feed in scheme and Spain has used a hybrid system combining elements of feed in and an RO type mechanism. The Netherlands has moved to a feed-in scheme after a number of years of using other incentives that have been ineffective – although it is important to note that these schemes were not similar to the RO. The main downside of the feed in mechanism has been the difficulty of determining prices, which means that the system historically has been costly. However, the RO has not been particularly cheap either whilst costs of feed in have been reducing as prices of technologies have fallen.

5.52 The above market prices paid to renewable generators and CHP in Denmark under the feed in law are funded through the Public Service Obligation (PSO) levy on electricity consumers. ,In 2005, the renewable component of PSO was approximately 3% of the household consumer's final bill and 9% of the electricity bill for businesses. This is similar to the impact of the Renewables Obligation in the UK in percentage terms - 3% for household consumers and 7% for industrial consumers (Hansard, May 2004 Col. 1671) –although as energy bills are higher in Denmark the money impact is greater Danish customers directly paid a total of DKK 2 billion (about £180 million) in 2004 to support renewable energy. In comparison the National Audit Office (NAO,2005) estimated that public support for the renewables industry in the UK would average £700 million per annum between 2003 and 2006, with around two thirds of this coming through the Renewables Obligation,. As Denmark has only 10% of the households that the UK has, clearly the cost per household and business consumer is much higher in Denmark. However, the NAO has estimated that the cost of the RO will reach up to £1 billion per annum by 2010 (equivalent to a 5.7 per cent increase in the price of electricity).

5.53 A benefit that could be claimed for the Danish feed in policy over many years is that it has driven technology development and innovation and economies of scale.

Whilst similar achievements may not be replicable for onshore wind, as other countries may already have benefited from the reductions that Danish policy has helped to bring about, policy support for other newer technologies might help to bring about similar cost reductions. The current proposals for banding of the RO may be one option for providing extra support for newer technologies, although there are concerns that the form of banding proposed might reduce the overall level of renewable capacity brought on stream.

5.54 Another benefit of feed in has been that it has been better suited to smaller participants. Some changes have been made to the RO in recent years to make it easier for smaller participants but there may still be need for more action here and Ofgem could play a role in this. It may be that newer forms of metering could help to ensure that small generators can more easily receive RO credits.

Regulatory issues

5.55 Regulatory issues - licensing (supply and generation), connection policies and technical standards (distribution networks) and the value placed on distributed generation (including what on-site generators are paid for surplus power) are also important. The new actions that Ofgem has been taking since 2000 do show progress in taking on board greater consideration of environmental and social concerns in major decisions. For example these include new incentives for network operators to connect distributed generation and increased incentives to reduce electricity losses and gas leakage. However, there are still improvements to be made in these areas and some useful lessons might be learnt from California, Denmark and the Netherlands. Even with the introduction of shallower connection charging, some consider that the connection system in the UK is still problematic for decentralised energy given the potential for significant degrees of exposure to network reinforcement costs and Distribution Use of System Charges. (Knight et al 2005)

5.56 Forms of "net metering" are used in a number of countries to enable small distributed generators to sell their surplus power. The term "net metering" is usually taken to mean that the generator is paid the retail rate for the power that they sell back and thus has this credited to their electricity bill, reducing what they pay for the power they buy. This form of simple net metering in effect works by the meter running backwards when power is exported from the site to the grid. However, the value of surplus power from small distributed generation to the network will vary according to the time of day, season, location etc and therefore it is often argued that simple net metering does not ensure an appropriate price. Clearly what is an "appropriate" price depends upon what the objectives are – e.g. to avoid cross subsidy and create an efficient market; to balance peak demand and supply; to reduce emissions etc. The main reason that some countries pay the retail price (which is usually higher than wholesale price) is because a high value is being placed on the assumed potential for such power to contribute to environmental objectives such as reduced emissions by displacing other electricity sources.

5.57 However, as the California case shows, metering, particularly with new forms of smart meters, can enable an appropriate price (however defined) to be set and paid for distributed generation. Given the current review of metering more generally, there would seem to be a key opportunity to explore ways of metering surplus power that will provide incentives to distributed generation but also take into account different values according to peak and off-peak periods, location etc and thus be applicable in a UK market context.

Energy efficiency, including ESCOs and smart metering

Energy efficiency

5.58 In terms of incentives for energy efficiency provide through the energy market, the UK's EEC is similar to the PGC funded schemes in California and various initiatives that have been taken in recent years in Denmark and the Netherlands. There is a question of scale – in California the current level of spend is around £435 million per annum, compared to around £400 million for EEC 2 per annum. As California has around half the number of households in the UK and prices of energy saving measures are probably lower in the US, it could be argued that the UK should be spending more, although it should be noted that the PGC funds are collected from and spent on industrial and commercial customers in California as well as households. Clearly, there are ambitions for spending to increase under EEC 3 from 2008. Perhaps therefore the main option for the UK to consider would be to extend EEC (or have some other initiative) for the industrial and commercial sectors. Various proposals are under consideration for larger businesses but there may be merit in looking at an EEC type initiative for smaller business consumers.

5.59 The Energy Efficiency Portfolio approach in California, which is being used in a number of other US states, probably has limited applicability to the UK. Like the Renewables Portfolio standard, it is based on a regulated vertically integrated utility model with limited retail competition.

5.60 The Baseline Allowance scheme used in California and some other US states (and indeed some other countries) may be worth exploring as it might make a contribution both to energy efficiency and reducing fuel poverty. In the absence of retail price controls the regulator could not mandate this but it could be linked into the development of smart metering or the proposed move from EEC to a demand reduction obligation. The Government and Ofgem could encourage suppliers to develop tariffs that vary with total usage as well as time of day. A Netherlands style agreement between suppliers and the Government could be an option for implementation. However this would require careful analysis of the impacts on different consumer groups, as some low income households need to use a lot of energy and so could be penalised unless their homes were made more energy efficient before using such a tariff.

5.61 It is notable that the role of ESCOs is still fairly limited worldwide and in the case studies. They have mostly operated in the public sector and have sometimes been set up by utilities (as in the Netherlands) and sometimes are mainly set up by independent companies. ESCOs do not really exist in the household sector anywhere and the full ESCO concept of energy supply and energy efficiency measures is not common - most ESCOs undertake energy performance contracting (e.g. installing a

CHP system in place of a heat only boiler) and often leave energy purchase with the client. The lessons for the UK are thus relatively limited and it does need to be noted that ESCOs are a delivery vehicle for energy efficiency and CHP – a means to an end not an end in themselves.

Smart metering

5.62 California has decided, on the basis of a cost benefit analysis, (conducted by the energy regulator, CPUC) to mandate smart meters for all electricity and gas customers to be installed over a 5 year period. The Netherlands is close to reaching a similar decision also based on a cost benefit analysis, conducted not by the energy regulator but by the energy agency. In California the meters will be installed as part of the regulated businesses and the costs recovered in the allowed regulated prices. In the Netherlands this is still being sorted out within the context of retail competition, but an agreement has been reached that suppliers will accept each other's meters to avoid the stranded assets problem. Ofgem's decision on smart metering was that it would remove some barriers to suppliers installing meters, but would otherwise leave it up to the market, metering having been opened to competition.

5.63 The Government is still considering whether it needs do more to encourage smart meters to meet the requirements of the EU Energy Services Directive. There is no definitive cost benefit case for mandating a major roll-out in the UK (Owen and Ward, 2006; Ofgem, 2006). Furthermore, intervention may not be needed if suppliers install the meters themselves as they can now do through metering competition – a number of suppliers are now proceeding to install smart meters for some customers, although how far and how quickly this will develop remains to be seen. The trials in 2007-08 will help to show how effective smart meters are in terms of encouraging energy saving or shifting demand from peak to off peak periods. Some further action to accelerate progress, if metering competition will not deliver, or would only do so over a very long timescale, may therefore prove desirable. This could be a national geographic roll-out or could involve obligations on suppliers to smart the meter stock (and to accept each others smart meters) over a given period. This therefore may be a decision that the Government needs to make to go beyond what Ofgem has done.

Conclusion

5.64 This international review and particularly the case studies of Denmark, the Netherlands and California has demonstrated that a range of policies can be used to increase the sustainability of the energy system. Policies clearly vary in terms of cost, how effective they have been in terms of stimulating new decentralised energy (renewables and CHP) and greater take up of energy efficiency. They also vary in terms of how much of a contribution they have made to reducing greenhouse gas emissions. Regulators in most of Europe to date have not had a significant role as they are relatively new, but in the US they are longer established and have had a substantial role. In many other countries there are also energy agencies or commissions and these often have as important (and sometimes more important) a role as the regulators. Given the UK's economic and social context, some policies and some examples of action by the regulators or other agencies are clearly more replicable or adaptable than others. Nevertheless, there are some useful lessons from these case studies for the UK and some ideas for policy development.

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Power source disclosure : http://www.energy.ca.gov/sb1305/documents/index.html

Energy Efficiency Portfolio Standard. CPUC web site - Decision 0409060, September 2004

Self generation incentive programme : http://www.cpuc.ca.gov/static/energy/electric/051005_sgip.htm

Connection of decentralised energy :

The following are links to the key CPUC interconnection documents:

D.02-03-057 (3/21/02) - CPUC Opinion Interpreting PUC Section 2827
D.01-07-027 (7/12/01) - CPUC Interim Decision Adopting Standby Rate Design Policies
D.00-12-037 (12/21/00) - CPUC Decision Adopting Interconnection Standards
D.00-11-001 (11/02/00) - CPUC Interim Decision Adopting Interconnection Standards

Plus the following are links to information on the web sites of the three electricity utilities :

PG&E: Rule 21 - Generating Facility Interconnections

SDG&E: Rule 21 - Interconnection Standards for Non-Utility Owned Generation

SCE: Rule 21 - Generating Facility Interconnections

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Useful US web sites :

For state by state information about energy efficiency and renewable programs in general, see DOE's *SEP Projects in the States and US Territories* www.doe.gov

For information about DOE programs, see www.eere.doe.gov; for EPA programs specifically related to energy efficiency see www.energystar.gov