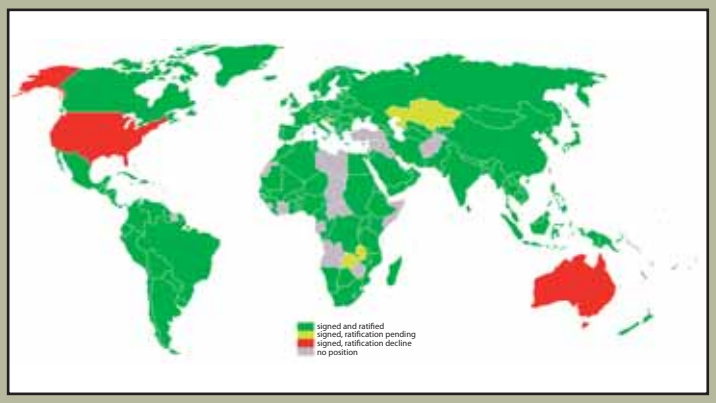
Power Quality and Utilisation Guide

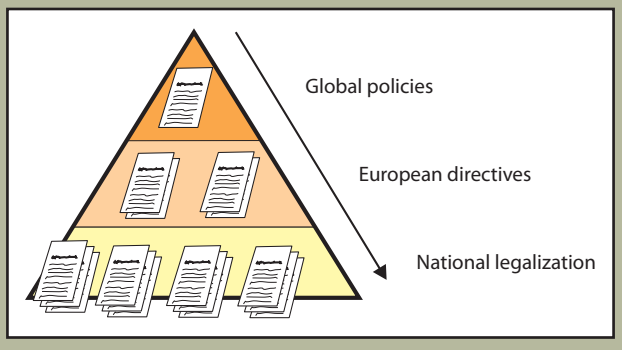
Leonardo ENERGY

Distributed Generation

Policy and Incentives on Distributed Generation



Peter Vaessen
and ***Davy Thielens***
KEMA Consulting
May 2007



COPPER

Distributed Generation

Introduction

The purpose of the Application Guide is to inform the reader and to help him to make choices regarding implementation of decentralized generation (DG), make usage of incentives and to provide practical information. After reading this Application Note, the reader will have a clear view on global and European policies and national incentives for specific countries regarding DG and will easily be able to find regional specific policy and incentives.

Background

Distributed Generation is hot! Every company, organization and nation is developing new tools or uses for DG to solve a variety of energy related problems. To steer the transition of the power market, governments and regulators are trying to set the course of the transition with incentives in order to achieve their goals.

The tools available for the authorities to increase the amount of DG and to obtain their preferred mixture of different DG technologies are policies (legislation) and incentives (financial). Although the desires of most governments agree which each other, the variety of policies and incentives is vast. If an organization or party wants to invest in DG, it is vital for them to know which policy applies, to know what incentives can be favoured from and to know their conditions and terms.

Distributed Generation[i]

Distributed generation is a latest trend in the generation of electrical power, sometimes combined with generating heat. The Distributed Energy Resources (DER) concept permits „consumers" who are generating heat or electricity for their own needs to send surplus electrical power back into the power grid or share excess heat via a distributed heating grid.

Distributed generation systems can be divided in two segments, as shown in Figure 1:

- Combined Heat and Power (CHP)
- Renewable Energy Sources (RES)

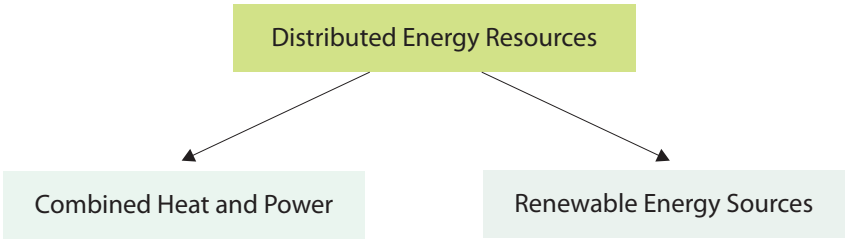


Figure 1 Split up of Distributed Energy Sources

CHP is the use of a power generator to simultaneously generate both heat and electricity. Conventional power plants emit the heat created as a by-product of electricity generation into the environment through cooling towers, as flue gas, or by other means. CHP captures the excess heat for domestic or industrial heating purposes, either very close to the plant, or - especially in eastern Europe – distribute it through steam pipes to heat local housing („district heating").

RES capture their energy from existing flows of energy, from on-going natural processes, such as sunshine, wind, flowing water (hydropower), biological processes such as anaerobic digestion and geothermal heat flow. The most common definition is that renewable energy is from an energy resource that is replaced by a natural process at a rate that is equal to or faster than the rate at which that resource is being consumed.

DG is typically connected directly to the distribution network or on the customer side of the meter. Most of these power plants are quite small scale, and because of their size, are often not required to contribute to the system balance. For instance, the grid code of the Netherlands excludes generation units of less than 60 MW from the obligation to offer system balancing capacities to the transmission system operator.

More in-depth information regarding DG and CHP can be found on website of „The World Alliance for Decentralized Energy (WADE)", www.localpower.org and at the sites of Cogen Europe, www.cogen.org and Dispower, www.dispower.org.

Global energy agenda

While during the 50's and 60's of the previous century, our stock of energy sources seemed endless, it is of great concern nowadays how to feed our hunger for energy. As energy and sustainability is a global problem, most countries in the world participate in world-wide organisations or committees to tackle these problems.

It is important to note that these word-wide bodies can set out policies, protocols and directives, but they cannot dictate laws for individual countries. Instead, these global policies are refined per region, such as the European Union or the United States. But the real implementation and legalisation will have to be carried out by their members, on a national level, as displayed in Figure 2.

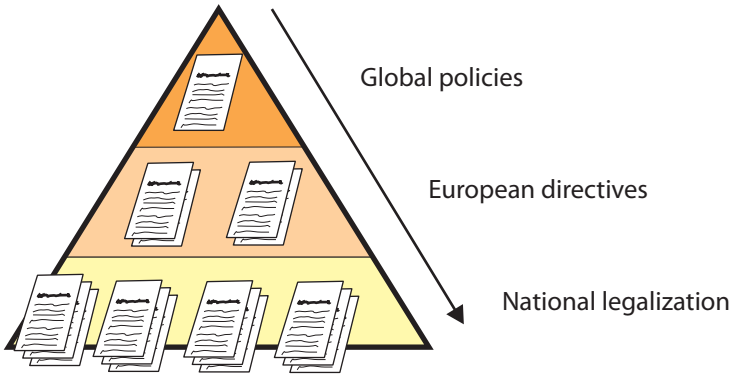


Figure 2 From global policies to national legalization.

Three items dominate the global energy agendas from e.g. the United Nations, the World Summits and the G8. Our energy should be:

- clean,
- affordable,
- secure.

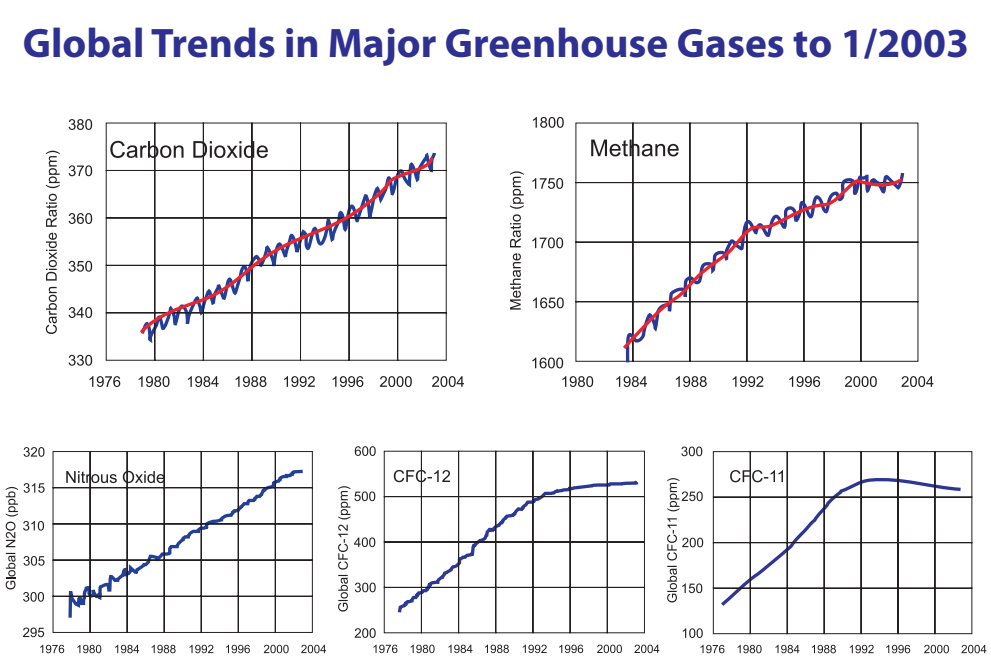
Each of these global items will be discussed below.

Cleanliness

One of the largest global strategies on energy is the Kyoto Protocol, which is an agreement under which industrialized countries will reduce their collective emissions of greenhouse gases (GHG) by 5.2% in 2010 compared to the year 1990. Note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this target represents a 29% cut.

As of April 2006, a total of 163 countries have ratified the agreement (representing over 61.6% of emissions from developed countries, officially referred to as Annex 1 countries). Notable exceptions include the United States and Australia, as shown in Figure 4. Other countries, like India and China, which have ratified the protocol, are not required to reduce carbon emissions under the present agreement (referred to as Non-Annex 1 countries).

The goal of the protocol is to lower overall emissions of five greenhouse gases - carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFC), and perfluorocarbons (PFC) – as stated in Figure 3.



Global trends in major long-lived greenhouse gases through the year 2002. These five gases account for about 97% of the direct climate forcing by long-lived greenhouse gas increases since 1750. The remaining 3% is contributed by an assortment of 10 minor halogen gases, mainly HCFC-22, CFC-113 and CCl

Figure 3 Global trends in the 5 major greenhouse gases

The Protocol reaffirms the principle that developed countries have to pay and supply technology to other countries for climate-related studies and projects. This was originally agreed in the United Nations Framework Convention on Climate Change (UNFCCC).

Kyoto includes „linking mechanisms", which allow Annex 1 economies to meet their greenhouse gas (GHG) targets by purchasing GHG emission reductions from elsewhere. These can be bought either from financial exchanges (such as the new EU Emissions Trading Scheme, EU ETS) or directly from Non-Annex 1 economies on a private basis. This is seen as a means of encouraging Non-Annex 1 developing economies to reduce GHG emissions since doing so is now economically viable because selling their Certified Emission Reductions (CER)[1] generates a large cash flow.

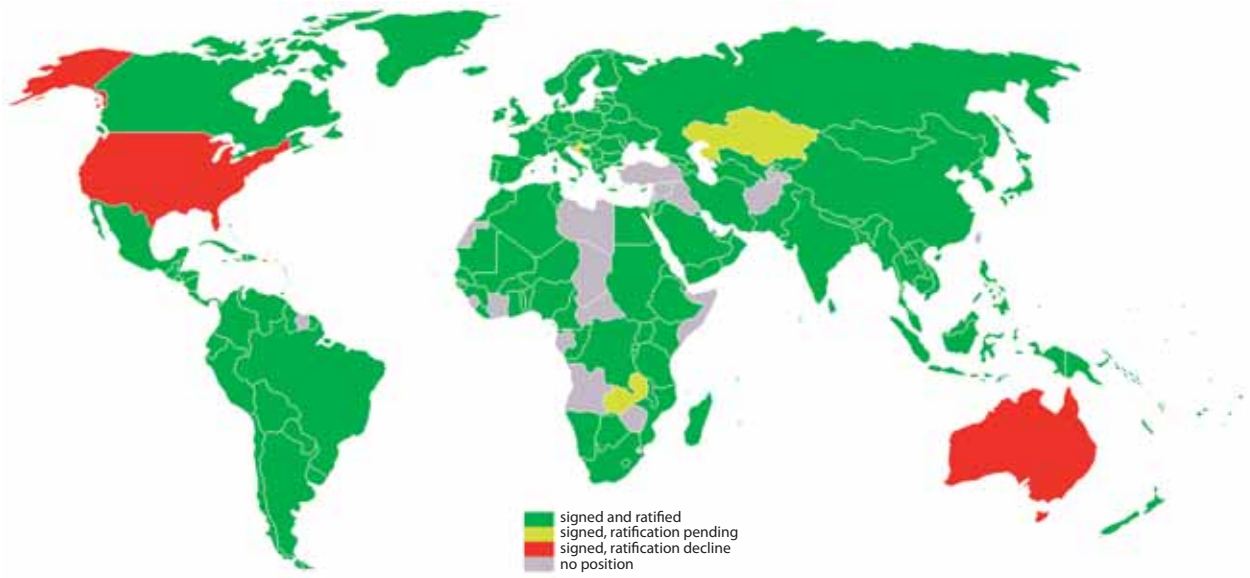


Figure 4 Countries involved with the Kyoto Protocol

[1] Also known as Carbon Credits (CC)

All the Annex 1 economies have established Designated National Authorities to manage their GHG portfolios under Kyoto. For instance[ii], in the Netherlands this role is performed by the Ministry of Housing, Spatial Planning and the Environment and in Germany by the Umweltbundesamt - Deutsche Emissionshandelsstelle.

These government organizations facilitate and regulate a national trading market for CER while working closely with their major utility, energy, oil & gas and chemicals.

Besides the Annex 1 economies, virtually all of the Non-Annex 1 countries have also set up their own Designated National Authorities to manage the trade market. The objectives of these opposing groups are quite different. Annex 1 entities want CER as cheaply as possible, whilst Non-Annex 1 entities want to maximize the value of CER generated from their domestic GHG Projects.

Affordability

Modern economies are critically dependent on affordable and reliable electricity services. As laws of economics dictate that a free market will offer the best price versus quality, most capitalism-based countries have pursued market-based reforms to improve electricity sector efficiency, to help strengthen its essential contribution to economic performance, international competitiveness and community prosperity.

Case studies performed by International Energy Agency (IEA)[iii] show that when electricity markets are relatively effective, market players respond to the real needs of the sector, such as adding new investments in regions where prices are high. The traditionally strong focus on the supply side in this industry seems to become more balanced in liberalised and competitive markets, where more attention is devoted to the actual needs of the consumers.

Security of Supply

Ensuring a secure electricity supply is an important policy objective in virtually all modern economies. According to the IEA[iv], in the long term, security of electricity supply depends on the adequacy of investments in terms of providing:

- enough generation capacity to meet demand;
- an adequate portfolio of technologies to deal with variations in the availability of input fuels, and
- adequate transmission and distribution networks to transport electricity.

Although most power is produced in large central generation plants, the demand for small „distributed" generation is higher than ever, as it can meet up to all three items above. During the latest G8 Summit in St. Petersburg (2006), the G8 members state that diversification of the energy mix reduces global energy security risks. They will work to develop low-carbon and alternative energy, to make wider use of renewables and to develop and introduce innovative technologies throughout the entire energy sector.[v]

IEA[vi] also has the opinion that the growing need for a secure energy supply is driving power users to invest in distributed generation, using technologies such as small engines or turbines, fuel cells or photovoltaic systems. These technologies already play a key role for applications in which reliability is crucial, as a source of emergency capacity additional to the public grid. With distributed generation, customers can not only increase the reliability of their electricity supply, but reduce their energy costs (main objective), because of a lower need for costly grid reinforcements (a residential customer notices this only indirectly in the transmission tariff). In some markets, this generation method is actually displacing more costly grid electricity.

Present EU policy and directives

Given the global agenda items and looking ahead to the next 2 or 3 decades, the European Union and its Member States will have to come up with institutional, social and environmental responses to the challenges of its energy supply. Key priorities for the European Union energy policy, as stated by European Commission in 2004, are, not surprisingly, the same as the global agenda items.

Cleanliness

The cornerstone of the European policy on cleaner energy is of course the Kyoto protocol. To achieve their own targets on reduced GHG emissions, whilst the demand for energy is still rising, the Member States have to (i) make their production and consumption processes more energy efficient, and (ii) decrease their emissions by replacing old generation sites with renewable energy sources.

Energy efficiency

During the European Commission meeting of 22 June 2005, the Member States have highlighted housing and transport as the sectors where the energy savings potential is greatest, but are also implementing measurements in other sectors. On the distributed generation side, a Directive[vii] promoting the combined generation of heat and power is already in force.

In the short term the intention of this Directive is to support existing CHP installations and create a level playing field in the market. The Directive provides harmonisation of definitions of CHP, efficiencies, micro/small scale CHP etc. and it establishes a framework for a scheme for a guaranty of the origin of electricity. Furthermore the Member States are obliged to ensure objective, transparent and non-discriminatory procedures for grid access, tariff criteria and administration.[viii]

In the medium and long term the intention of the Directive is to ensure that High Efficiency CHP[ix] is taken into consideration whenever new capacity is planned. It sets a number of criteria for an obligatory analysis of the national potential for high efficiency CHP (including small scale) in each Member State. Support schemes based on useful heat demand and primary energy savings may be continued or established in the Member States to support the realisation of the potential. Furthermore guidelines for the calculation of CHP ele ctricity, including harmonised reference values for separate production, will be issued, to make it accountable.

Renewable energy sources

The main means of supporting renewables at a European Union level is through the Directive on the Promotion of Electricity from Renewable Energy Sources in the Internal Electricity Market[x], also called the Renewables Directive, which requires each country to commit to specific targets for renewable energy.[xi]

The Directive defines renewable energy as all non-fossil sources, including biogas, biomass, geothermal, hydro-power, landfill gas, sewage treatment plant gas, solar and wind. Electricity is classified as being produced from RES if it is obtained from plants using solely renewable energy sources, as well as the proportion of electricity produced in hybrid plants that use conventional energy sources.

The Directive follows on from the European Union White Paper, 'Energy for the Future: Renewable Sources of Energy 1997'. The promotion of electricity from renewable sources of energy is a high priority in the EU for several reasons in addition to combating climate change. These include security and diversification of energy supply, environmental protection, and social and economic development.

The directive also requires that Member States ensure that a guarantee of origin is issued on request in respect of electricity generated from eligible renewable energy sources, as defined by the directive.

Under the Renewables Directive, member states are required to adopt national targets for renewables that are consistent with reaching the Commission's target of 22 per cent of electricity from renewables by 2010. For instance, the indicative target that the proposal sets for the UK is 10 per cent of electricity by that date. Although many member states are struggling to reach their national goals, the European Parliament and environmental groups have now called for even more ambitious targets for 2020.

Renewable energy production is a relatively young market compared with the conventional energies such as oil, gas, coal and nuclear, and the right political framework is needed to guarantee fair access to the market. Policy mechanisms to support RES include financial incentives, industry standards and increasing public acceptance.

Furthermore, national regulations governing the access of renewable electricity to the power grids are a key success factor and member states have to ensure that the operators guarantee this. Grid owners can be reluctant to connect DG due possible high costs (DG is often situated in remote areas) and the shorter financial horizon of the investments.

Two main types of regulatory policies have been used to open the grid to renewables:

- Feed-in pricing system: electric utilities are obliged to enable renewable energy plants to connect to the electric grid, and they must purchase any electricity generated with renewable resources at fixed minimum prices. These prices are generally set higher than the regular market price, and payments are usually guaranteed over a specified period of time. This system is used in some of the EU's biggest renewables producers such as Germany and Spain.
- Quota system ('green certificates'): governments set a minimum share of power to be produced from renewable sources. The share required often increases gradually over time, with a specific final target and end-date. The mandate can be placed on producers, distributors or consumers.

Affordability

Europe opened its internal market for trading in 1992, but unfortunately, the EU's energy market was not included. But as the opening of the energy markets was seen as a key factor in improving Europe's competitiveness and welfare, the Commission and member states tackled this problem quickly.

As a result, in 1996 and 1998, the first electricity and gas directives were adopted, representing an important step towards the creation of an internal market in these sectors. The objective of the directives was to open up the electricity and gas markets through the gradual introduction of competition, thereby increasing the efficiency of the energy sector and the competitiveness of the European economy as a whole.

By September 2000, most member states had implemented the electricity and gas directives. However, in its communication 'Completing the internal energy market', published in 2001, the Commission concluded that further measures were necessary in order to complete the internal energy market and to reap its full benefits. It therefore tabled a proposal to amend the directives.

The second gas and electricity directives were adopted in June 2003 and transposed into national law in 2004. These directives stipulated an opening of both markets for all non-household gas and electricity customers by July 2004 and for all customers by July 2007, while maintaining high standards of public service and a universal service obligation. After these dates, businesses and private customers should be able to choose their power and gas suppliers freely in a competitive market place.

Here are the most important elements of the directives:

- Unbundling Energy transmission networks have to be run independently from the production and supply side. This means that large incumbent companies, state-owned or private, have to split up ('unbundle') the distribution and transmission/transportation sides of their business and have them operated by legally separate entities. This measure is designed to avoid preferential access to transmission systems and gas networks for energy companies.
- Tariffs Transmission tariffs must also be applicable to all system users on a non-discriminatory basis and third party access to gas storage facilities must be guaranteed.
- Services of public interest The directives also set common minimum standards regarding public service requirements, which take into account the objectives of common protection, security of supply, environmental protection and equivalent levels of competition in all member states.

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

However, the preliminary findings of a competition enquiry in the electricity sector, published in November 2005, revealed some „serious malfunctions" in the market for industrial consumers. Competition Commissioner Neelie Kroes highlighted the following outstanding market flaws in a press conference[xii]:

- Market concentration The market still reflects the „old market structure of national or regional monopolies". In the gas sector, „incumbents tend to control imports and/or domestic production".
- Vertical foreclosure From integrated incumbents who operate simultaneously at network, wholesale, and distribution levels, thereby preventing new entrants from entering the market.
- Market integration Gas and electricity markets are still largely national.

- Transparency issues Characterised as „endemic" by Kroes, who considers access to information as „crucial for establishing a level playing field". She says market participants need „more information on technical availability of inter-connectors and transmission networks. They want to know more about generation, about balancing and reserve power, and about load."
- Price formation Although Kroes recognises the many contributing causes for the „dramatic rise in prices for gas and electricity over recent months", she says „anti-competitive practices" may be one of them.
- „grandfathering rights" of incumbents, allowing them to reserve capacity on bottlenecks such as pipelines, are a further significant barrier to entry.
- Market bundling of generation, supply, pipelines or grids, and distribution. Owners and operators of critical networks often compete with companies that need to have access to these same networks.

Security of supply

The external dependence on energy of the European Union (EU) is constantly increasing. The EU imports 50% of its energy requirements and if no measures are taken within the next 20 to 30 years this figure will rise to 70%. This external dependence has economic, social, ecological and physical risks for the EU. Energy imports represent 6% of total imports, which means in geopolitical terms that, 45% of oil imports come from the Middle East and 40% of natural gas comes from Russia. The EU does not yet have all the means possible to change the international market. This weakness was clearly highlighted at the end of 2000 by the strong increase in oil prices.

According to the Green Paper „Towards a European strategy for the security of energy supply" [xiii], the main objective of an energy strategy should be to ensure, for the well-being of its citizens and for the proper functioning of the economy, the uninterrupted physical availability of energy products on the market at an affordable price for all consumers, whilst respecting environmental concerns and looking towards sustainable development. It is not a question of maximising energy self-sufficiency or of minimising dependency, but one of aiming to reduce the risks linked to such dependency. Energy resources that are being used right now must be taken into account in the debate. The EU itself relies heavily on fossil fuels such as petroleum (the dominant resource). The EU recognized the fact that action is required in order to remedy this problem.

Present National policy and incentives

Within the European Union, each Member State has its own sovereignty, which means that each member can choose how to implement global and European policies in to legalization, all of course within the framework set out in the Directives of the EU. Not all targets can be reached by law, as this would be in conflict with the ideas of a liberalized market. What governments can do is to set out incentives in order to steer the market.

The variety of legalization and incentives within all the member states is vast and is changing constantly. In order to keep track of the current policies and incentives, three prominent public internet databases are presented below [xiv].

The Global Renewable Energy Policies and Measures Database

The Global Renewable Energy Policies and Measures Database is an initiative led by the International Energy Agency, and is being implemented in collaboration with the European Commission and the Johannesburg Renewable Energy Coalition.

The Database features over 100 countries and offers renewable energy market and policy information in one format in one location for countries that together represent almost total global renewables supply. Visitors can search for information according to country, policy instrument, renewable energy technology, renewable energy target and other criteria.

Web address: www.iea.org/textbase/pamsdb/grindex.aspx

Dealing with Climate Change policies and measures database

The Dealing with Climate Change Policies and Measures Database offers access to information on energy-related policies and measures taken or planned in IEA Member countries to reduce greenhouse gas emissions. With over

2000 records collected over seven years (1999-2006), it provides a comprehensive annual update of the policy making process in place since 1999.

Web address: www.iea.org/textbase/envissu/pamsdb/index.html

USA: The Database of State Incentives for Renewable Energy

The Database of State Incentives for Renewable Energy (DSIRE) is a comprehensive source of information on state, local, utility, and selected federal incentives that promote renewable energy and energy efficiency.

Web address: www.DSIREusa.org

Future developments

Policy is always in a liquid state and will continuously be subject to change, especially on a national level, as the developed policy quite often depends on the political flavour of the elected government. On an international (European) level the followed course is more stable and some future trends can be spotted.

The fate of Kyoto

While uncertainty about the fate of the Kyoto Protocol has not been dispelled entirely, IEA member countries have taken various climate change mitigation measures such as fiscal measures, regulatory instruments, voluntary agreements, policy process and outreach, RD&D and tradable permits to reduce their GHG emissions. Several countries, for example France and the United Kingdom, have also set ambitious long-term greenhouse gas emissions reduction targets towards 2050.

Whatever happens to the Kyoto Protocol, during the upcoming conferences many governments are starting to consider objectives for the future, beyond 2012, in order to provide clear signals to those investing in long-term capital projects with GHG implications [xv].

Technologies

New innovative technologies are being developed to aid governments to reach their energy and environmental goals. Two examples of technologies that are about to leave the nursery and are seriously being investigated and piloted by several European countries are Smart Metering and provision of Ancillary Services.

Smart Metering is one of the innovations used by energy suppliers to balance the energy demand and generating by matching the consumption to the available generation. Traditional electrical meters only measure total consumption and as such provide no information of when the energy was consumed. Smart meters provide an economical way of measuring this information, allowing price-setting agencies to introduce different prices for consumption based on the time of day and the season.

Electrical pricing usually peaks at certain predictable times of the day and the season. In particular, if generation is constrained, prices can rise significantly during these times as more expensive sources of power are purchased from other jurisdictions or more costly generation is brought online. It is believed that billing customers the amount of consumption and at what time of the day will force consumers to adjust their consumption habits to be more responsive to market prices, lowering the overall energy bill for consumers.

Besides power, traditional (bulk) generation also provides Ancillary Services (AS) to the Transmission System Operator (TSO). These are services which are required to ensure the secure operation of the transmission system and enable the maintenance of satisfactory voltage and frequency levels, as well as the restoration of power supplies after a transmission system total or partial blackout.

So far, small scale DG is excluded from the legal obligation (written in the Grid Code) to provide AS to the TSO, for example, in the Netherlands, power plants smaller than 60 MW do not need to offer these services. But with an increasing penetration of DG into the grid, there is a tendency to compel larger scale DG, such as wind farms, to provide these services, requiring more advanced power converters.

Roadmaps

Policy-makers need to be fed with information, developments and outlooks. For this purpose many roadmaps (e.g. technology, policy, economic) were and are being written. One of the larger European projects is SUSTELNET[xvi], an organization which analyses the long term technical, socio-economic and institutional dynamics of the European electricity infrastructure and markets. With these analyses, they develop medium to long-term transition road maps for network regulation and market transformation. With this knowledge, they lay the foundations for and map out a regulatory process on for distribution networks in the EU, involving distribution and supply companies, national regulators and national and EU policy makers.

Web address: www.electricitymarkets.info/sustelnet/

References

[i] *Parts from Wikipedia.org and „Innovations in Electricity Networks", Kunneke, University of Technology Delft.*

[ii] *For the other national parties, visit http://cdm.unfccc.int*

[iii] *www.iea.org, „Lessons from Liberalised Electricity Markets and Learning from the Blackouts", 2005*

[iv] *www.iea.org, „security of supply in electricity markets", 2002*

[v] *en.g8russia.ru, Global Energy Security, 2006*

[vi] *www.iea.org, „Distributed Generation in Liberalised Electricity Markets", 2002*

[vii] *Directive on promotion of cogeneration based on a useful heat demand in the internal energy market (2004/8/EC)*

[viii] *Parts from www.opet-chp.net*

[ix] *High efficiency CHP: primary energy savings of at least 10% compared to separate production.*

[x] *Renewables Directive 2001/77/EC*

[xi] *Parts from www.dti.gov.uk*

[xii] *Neelie Kroes, Member of the European Commission in charge of Competition Policy, „Towards an Efficient and Integrated European Energy Market – First Findings and Next Steps", European Commission Conference, Energy Sector Inquiry – Public Presentation of the Preliminary Findings Brussels, Thursday 16th February 2006*

[xiii] *europa.eu, Green Paper „Towards a European strategy for the security of energy supply", 29 November 2000*

[xiv] *Database summaries are derived from their websites.*

[xv] *„overview of energy policy and market developments", IEA, 2004*

[xvi] *http://www.electricitymarkets.info/sustelnet*