CHAPTER VI

CLIMATE CHANGE AND ENERGY TRANSFORMATION:
THE POLICIES OF THE EU
Introduction

Global climate change is accelerated by the burning of fossil fuels which restrict the decision making freedom of future generations and immediate endeavours are required to tackle on the backdrop of a growing international energy demand. EU has identified strategy for growth, political priorities on energy and climate change as the main pillars of a general sustainable development policy. In 2007 the European Council adopted ambitious energy and climate change objectives for 2020 to reduce greenhouse gas emissions by 20 percent, rising to 30 percent if the conditions are right, to increase the share of renewable energy to 20 percent, and to make a 20 percent improvement in energy efficiency which marked a turning point for the European Union's climate and energy policy. EU’s sustainable energy policy has given fundamental importance to the endeavours of minimizing damage to the environment. Now the European Union stands at the global leadership to tackle climate change, to face up the challenge of secure, sustainable and competitive energy, and to make the European economy a model for sustainable development in the 21st century.

Energy Security to Mitigate Climate Change

In 1827, the French scientist Jean-Baptiste Fourier traced the phenomenon of greenhouse effect in which atmospheric gases trap solar energy, which increases Earth’s surface temperature (ICLEI et al. 2009: 10). In addition to this in 1896 the Swedish chemist Svante Arrhenius blamed the burning of fossil fuels for generating carbon dioxide liable for climate change. The temperature variation on earth in the 21st Century lies between a minimum of 1.4°C and a maximum of 5.8°C depending on the level of stabilization of carbon releases, the swiftness of decarbonisation of the international economy and the model of demographic and economic growth (Betsill 2011: 112). Global climate change is accelerated by the burning of fossil fuels which restrict the decision making freedom of future generations and immediate endeavours are required to tackle on the backdrop of a growing international energy demand. Far reaching actions are vital to ease carbon emissions into the atmosphere so as to maintain climate change within a range that the nature can adapt and to meet already existing impacts of climate
change with glaciers melting, sea ice disappearing, deserts advancing, wildfires stripping vast areas and rolling extreme climate events. This might lead to a sea change in the way we live and the way governments regulate our activities, particularly in relation to industry, transport and buildings. To achieve the designed target on the issue of climate change countries and markets should be equipped to stimulate opportunities in low carbon and energy efficient investments across the globe and requires a massive hike on investment in renewable and clean energy sector (Levi et al. 2010: 112).

Climate change and energy security have emerged to become two of the chief navigators of energy policy on various countries in the last few years. D. Jhirad, the then Vice President for Science and Research at the World Resources Institute, uttered the observation that energy security and climate change would need intertwined solutions. He put across the analysis that energy is the life force of rural areas and vital to economic development as it impulses health care utilities, education and telecommunication. At the same time to abscond just about two billion people in poverty is not a recipe for the political, energy and ecosystem stability that would overcome through ensuring energy security by opening up means that reduce unhealthy emissions. For instance in India energy security is the core element for shifting from fossil fuels to carbon free fuels because India currently imports 70 percent of its oil and over the next 15 years that would grow to nearly 100 percent. The focal point is to find out realistic lanes that the global community can work to control carbon emissions without hindering the economic progress of developing nations, to pick up energy security and build up ways to acclimatize and mitigate the effects of climate change (Warner et al. 2006: 4).

The phenomenon of climate change is mainly due to the constantly increasing atmospheric concentrations of the key greenhouse gases such as carbon dioxide (CO$_2$), methane (CH$_4$), halo-carbons, tropospheric ozone and nitrous oxide (N$_2$O) in the last 250 years since the beginning of the industrial revolution (Bolin 1998: 350). The United Nations Framework Convention on Climate Change adopted at the Rio Earth Summit of 1992, and the Kyoto Protocol signed by more than 160 countries
in 1997 both called for major reductions of greenhouse gas emissions which are caused largely by energy use. The sector of electrical power production accounts for about 27 percent of global anthropogenic CO\(_2\) emissions and constitutes the fastest growing source of greenhouse gas emissions. On the basis of government policies and measures enacted or adopted by mid 2009, World Energy Outlook 2009 of IEA estimates that in 2030 world primary energy demand will be 40 percent higher than that of 2007 and 77 percent of the worldwide energy demand increase will be based on using fossil fuels despite the fact that 1.3 billion people still lack access to electricity in 2030. Whereas it suggest that energy related CO\(_2\) emissions need to peak globally by 2020 at 30.9 gigatonnes (Gt) and then decline to 26.4 Gt in 2030 to avoid irreversible damage to global climate and ecosystems (UNDP 2010).

The two principal human caused troubles associated with climate change operating at the global scale are: the energy-related emanations of heat trapping greenhouse gases with long atmospheric residence times and the depletion of stratospheric ozone as a result of discharges of chlorofluorocarbons and related compounds. Regional patterns of temperature variation across Earth’s surface and vertical patterns of temperature disparity in the atmosphere endow with further evidence of human induced global warming. Climate change and the resulting sea level rise can have a number of downbeat blow on energy, industry, and transportation infrastructure, human settlements, the property insurance industry, tourism and cultural systems and values. Energy systems generate two-thirds of human caused greenhouse gases and climate change is feared to bring about noteworthy direct impacts on human health as well as on Earth’s ecosystems (Holdren and Smith 2000).

According to Asian Development Bank (ADB 2009) energy efficiency is essential for slackening growth in fossil fuel demand and upward pressure on energy prices, enhancing energy security, tumbling emissions of greenhouse gases, easing fossil fuel consumption, improving public health and inducing commercial savings. This can be achieved by improved vehicle efficiency, better urban planning, increased use of new and renewable energy sources, use of alternate fuels and greater emphasis on demand
side management. It is one of the most effective ways of meeting energy demand and increasing the efficiency of energy use and supply which will yield more service value from each primary energy unit consumed as well as huge environmental and economic benefits. It is the fact that there is no energy production or conservation technology without risk or without waste. Burning of fossil fuels for electricity and heat generation, transport and industry is the main source of greenhouse gas emissions and easing the global greenhouse gas emanations is the remedy for the effects of climate change (Augutis et al. 2011, 6).

The use of fossil fuels coal, oil and natural gas can be made more climate friendly through two primary means: carbon dioxide capture and storage (CCS) at power plants and industrial facilities, and substitution to lower-carbon fuels in power plants and industry. Carbon dioxide capture and storage (CCS) is the mechanism applied to reduce CO$_2$ emissions from the use of fossil fuels which has two approaches- CO$_2$ is captured directly from the industrial source, concentrated into a nearly pure form, and then pumped deep underground for long term storage and the captures of CO$_2$ directly from the atmosphere by enhancing natural biological processes that sequester CO$_2$ in plants, soils, and marine sediments (Benson and Orr 2000: 303; Demirbas et al. 2004: 194).

Energy security concerns have led to an increased interest in coal due to its availability and proven reserves of coal are enormous and widely dispersed. It is also easy to transport and store and is not affected by weather changes. However, coal and its use have a number of serious environmental implications, including the highest CO$_2$ emission rates among fuels used to generate electricity. Measures to reduce pollutants, coal mine safety, coal-bed methane extraction, and environmental safeguards in coal extraction are controversial issues. China would become the world’s leading market for advanced clean coal technologies, including gasification and liquefaction, and eventually carbon dioxide capture and storage. But these technologies are deployable on a large scale for decades and by then China will likely have used up much of the world’s remaining carbon budget. China’s coal-fired power plants are the main cause of
the rapid increase in its greenhouse gas emissions, now the world’s second largest after United States (Lester and Steinfeld 2006: 12).

The objectives of augmenting energy security and mitigation of climate change are frequently conflicting on the pretext of world’s dependence on fossil fuels as the foremost source of energy. In some countries tension occurs between assuring energy supplies to meet growing energy needs and reducing the share of fossil fuels to mitigate climate change. Such a conflict can be alleviated through policies and measures aimed at reducing demand for fossil fuels, using cleaner fossil fuels, promoting diversification of fuel types and sources by using renewable sources of energy, improving energy efficiency, incentives for the development of clean technologies and international cooperation for climate friendly investments. Keeping up social and economic development along with energy policy goals and actions to address climate change have seemed to be a global challenge (Koakutsu and Watanabe 2006, 17; Atmanand et al. 2009, 130). At present energy security can be treated as a competition and a zero sum game between developed and developing countries since they are competing for same resources and that will influence the choice of future paths of climate change abatement strategies.

**Climate Change and Energy Transformation in the EU**

European Union stands at the global leadership to tackle climate change, to face up the challenge of secure, sustainable and competitive energy, and to make the European economy a model for sustainable development in the 21st century. Simultaneously, public opinion has also shifted decisively towards the imperative of addressing climate change, adapting Europe to the new realities of cutting greenhouse gas emissions and developing renewable as well as sustainable energy resources (CEC 2008:2). The European Environment Agency is the authority gathering and disseminating national and international information relevant to all environment-related EU policies including climate change, transport, agriculture and energy. It published its latest five yearly statement called European State of the Environment Report (SOER) in 2010 which covers the state of, trends in and prospects for the environment. This report
has been supplemented by indicator reports focusing upon specific issues (Laconte 2011: 10).

In 2007 the European Council adopted ambitious energy and climate change objectives for 2020 to reduce greenhouse gas emissions by 20 percent, rising to 30 percent if the conditions are right, to increase the share of renewable energy to 20 percent, and to make a 20 percent improvement in energy efficiency which marked a turning point for the European Union’s climate and energy policy (European Commission 2011: 5). Furthermore it has also given a long-term commitment to the decarbonisation path with a target for the EU and other industrialised countries of 80 to 95 percent cuts in emissions by 2050 (Skea et al. 2011: 156). The programme of ‘Europe 2020 Strategy’ and the flagship initiative ‘Resource efficient Europe’ have incorporated EU energy and climate goals for smart, sustainable and inclusive growth (European Commission 2011: 5).

The 28 EU member countries are responsible for around 14 percent of global GHG emissions (Figure 5.1) in which more than 80 percent of EU emissions come from the production and use of energy and from transport. The European Union has the opinion that the international community must take urgent and strong action to prevent global warming from reaching 2°C that is technologically feasible and economically affordable with the cost estimated at around one percent of world GDP. Comparatively, this is far less than letting climate change take its destructive course, which is expected to cost at least 5 percent of global GDP and could reach 20 percent or more in the long term with an economic impact equivalent to the world wars of the 20th century (European Commission 2009).

Most of the EU Member States took on a target of cutting their collective emissions to 8 percent, each member country according to its capacity to curb emissions by 2012. The European Union is in the vanguard of international efforts to tackle climate change committed to becoming a highly energy-efficient, low carbon economy along with the world’s most ambitious climate and energy targets for 2020 and beyond. At the same time the EU has put in place the policies and measures to achieve them. It also
proposed that the developed countries should do its fair share as a first step to reduce their collective emissions to 30 percent below 1990 levels by 2020 (EU 2008; Giddens 2007: 193). Many of the EU emission targets are applied to production based emissions, whereas consumption based emissions which are sometimes higher are left out of the consideration for the time being. In reality, the EU appears to be leading the world in the energy intensity of its imports. On several occasions the European Council has confirmed its goal of reducing GHG emissions by 80 percent to 95 percent compared to 1990 levels by 2050 (Wettestad et al. 2012: 67).

Figure 5.1

EU-27 GHGs Emissions

Source: European Commission, 2012

The Treaty on the Functioning of the European Union (TFEU) obviously records combating climate change among its environmental policy objectives. Article 191(1) of the TFEU requires EU policy to promote measures at the international level to deal with regional or worldwide environmental problems particularly combating climate change. The progressive regulations of climate change at the EU level are further manifested in the European Commission’s climate and energy package which became law in 2009. This package includes legally binding targets to reduce GHG emissions as well as
deploy renewable energy and nonbinding provisions that create pressure to improve energy efficiency (Pielow and Britta 2011: 155).

The TFEU gives a clear direction to EU climate policy and provides the legal basis for a shared EU energy policy. Article 194 establishes a common market for energy with recognition of the need for environmental protection. It lists four specific goals: a) ensure the functioning of the energy market, b) ensure security of energy supply in the EU, c) promotion of energy efficiency plus energy saving and the development of new and renewable forms of energy, and d) promote the interconnection of energy networks. Thus the fight against climate change has become the most important driver of EU energy policy (Nowak 2012: 407-408).

The Green Paper on Adapting to Climate Change of 2007 established climate change adaptation as a core feature of the EU’s climate change policy. Climate change mitigation aspires to reduce possible future impacts by dealing with the drivers of climate change that is reducing greenhouse gas emissions (Rademaekers et al. 2011: 19). Member states of the EU hold on the right to decide how to exploit their own energy resources and to choose between different energy sources. Even though the TFEU gives effect to member states’ sovereignty over energy matters, it nevertheless lends the European Commission legitimacy in proposing a strategy for the long-term development of EU energy policy. For the reason that the Commission recognizes the cross-border nature of climate change that cannot be addressed solely on the national level and has acted promptly to promote measures on energy efficiency (Larragán 2012: 243). The European Commission’s Energy Efficiency Plan and Roadmap to a Resource Efficient Europe have sited energy efficiency at the core of EU energy and climate-change policy (Axelrod et al. 2011: 230). Energy efficiency is one of the most cost effective ways to enhance energy security, promote competitiveness, trim down overall GHG emissions to mitigate climate change and make energy consumption more affordable for consumers as well as create employment, including those in export industries (European Commission 2011: 8).
The 2006 Energy Services Directive sought to remove market barriers and promote further development of market for energy services to boost the cost effective upgrading of energy end use efficiency by member states. Though the member states had discretion over the measures to be implemented but required to publish national energy efficiency action plans explaining their strategies, which were subject to the Commission’s review. The Energy Efficiency Plan has suggested a two-stage approach: first, the Commission will monitor developments and might propose a legally binding target if the target is unlikely to be achieved and latter, proposes to make legally binding a number of key measures, while leaving much freedom to member states to choose how to comply with their targets (Larragán 2012: 245).

It is obvious that energy efficiency is a complex task which demands new policy instruments and changes in technology, investment, and incentives related to such varied areas as public and private buildings, transport, industry, and appliances. EU Member States have already agreed to a number of EU Implementing Measures that is minimum standards and labelling which covers a range of household and non-domestic products in order to improve their energy efficiency (DECC 2010: 18).

The EU has recognised the urgent need to pull together a number of strands in a single integrated climate and energy policy for Europe as a response to the alarming impact of climate change cautioned by the scientists. This policy will provide energy supplies that are competitive, sustainable and secure, and integrated with good environmental practice which will reduce emissions of CO₂ and other greenhouse gases. The key elements of the EU’s energy policy in delivering these targets are as follows: 1) more efficient power and gas markets, 2) diversification, 3) an ambitious renewable energy policy, 4) intelligent energy behaviour, and 5) international cooperation (European Commission 2007: 13).

It is hopeful to see that the Greenhouse gas emissions in the EU-27 declined between 2000 and 2009. In the same way, the EU is on the way to reach the target of 20 percent share of renewables in gross final energy consumption by 2020. Constructive improvements can also be seen for the greenhouse gas intensity of energy consumption,
the use of renewable energy in transport, and combined heat and power. The EU’s dependence on energy imports has grown considerably since 2000 as a result of about 54 percent of energy consumption being met by imports from outside the EU (Umpfenbach and Krista 2011: 216).

There is a consensus that the challenges of climate change and energy security demands the centralization of European energy community and formalization of the community through a treaty. The targeted energy community should include the necessary legal powers and instruments to achieve the following goals: 1) a well-functioning energy market, 2) an integrated and smart network, 3) price-stabilization measures to promote crucial investments and protect vulnerable consumers, 4) a diversified European energy portfolio, 5) the power to raise levies and allocate Europe’s own resources, 6) adequate crisis management and strategic reserves for the benefit of all Europeans, and 7) external powers allowing Europe to protect and secure its goals on the international scene. Yet this is an ambitious agenda aimed at long-term results whereas confronting these issues is necessary to achieve a deep integration between climate and energy policy (Larragán 2012: 247).

The EU adopted the Climate and Energy Package in 2008 for putting the EU’s ambitious energy and climate policies into effect (CEU 2009b: 10). EU’s climate and energy policy package of 2009 includes a revised EU Emissions Trading System (ETS) and a new Directive on Renewables (RES). This aims cited at these policies are for improving security of energy supply and finalizing the internal market to ensure efficient implementation of new policy targets (Wettestad et al. 2012: 67). A Covenant of Mayors was signed in 2009 on behalf of more than 1000 municipalities at the initiative of the EU Commission. It is a promise by signatory towns and cities to go beyond the present objectives of EU energy policy in terms of reducing CO\(_2\) emissions through enhanced energy efficiency and cleaner energy production as well as use (Laconte 2011: 10) (Figure 5.2). In its efforts to mitigate climate change the Commission proposes expensive initiatives and the key elements of this package include the extension of the Emissions Trading System, known internationally as Cap and Trade, the Clean
Development Mechanism, an international extension of ETS, a framework for carbon capture and storage which is not yet operational on an industrial scale, strict renewables targets and a directive on CO\textsubscript{2} emissions from cars (Helmer 2009: 10).

**Figure 5.2**

Energy Efficiency and Energy Intensity of all fuels in EU (toe)

![Energy Efficiency and Energy Intensity of all fuels in EU (toe)](image)

Source: European Commission, 2012

The impact assessment on the commitment to climate change accompanies three key policy proposals implementing the agreed energy and climate package: a) a proposal for a Directive on the promotion of renewable energy, b) a proposal for amending the EU Emissions Trading Directive reviewing the EU emissions trading system (EU ETS), and c) a proposal relating to the sharing of efforts to meet the Community’s independent greenhouse gas reduction commitment in sectors not covered by the EU emissions trading system such as transport, buildings, services, smaller industrial installations, agriculture and waste (EU 2008).

The European Council approved a directive setting up a regulatory framework for the geological storage of carbon dioxide. The new act is intended to make the deployment of carbon capture and storage technology in the EU if possible which could
help to mitigate climate change. The directive sets out conditions for the assessment of storage sites, for authorisation procedures and for the closure of such sites in the member countries who wish to use this technology. Towards this purpose the Commission will review draft storage permits and draft decisions on closure prepared by national authorities before their final approval to ensure a harmonized application throughout the European Union (CEU 2009a: 8). Around 80 percent of energy consumption of EU members is from fossil fuels such as oil, natural gas and coal, all of them are major sources of CO$_2$ emissions (Figure 5.3). Thus a reduction in the use of fossil fuels contributes to improving energy security as well as helping to limit climate change in the EU. At the same time efficient markets are making energy more affordable as well as helping to remove barriers in achieving the intension of lower greenhouse gas emissions and assist the industry to retain its competitive edge (European Commission 2007: 14).

**Figure 5.3**

**EU CO2 Emissions in the Energy Sector (Mt)**

Source: Capros et al., 2010
Energy consumption is responsible for 80 percent of total EU GHG emissions and reducing the sector’s carbon footprint is thus a key challenge. Addressing the adverse effects of energy production such as air pollution and land consumption is another challenge. Ensuring energy supply at competitive prices at the time of declining oil and gas production within the EU and increasingly volatile world market prices for fossil fuels is a third challenge. To deal with these challenges, the EU promotes the use of renewable energies and energy efficiency as one of five headline targets of its Europe 2020 Strategy. The low-carbon technologies present an economic opportunity for the EU despite being costly compared to fossil fuels. Green technology development is a major field of innovation and the relevant industries will employ a growing number of people (Umpfenbach and Krista 2011: 217).

Given the seriousness now accorded to climate protection in the EU, gas is seen as the best among all fossil fuels for combining reduction of greenhouse gas emissions with future energy supply security. According to IEA, worldwide demand for gas will increase to 66 percent by 2030. It is estimated that in the world’s total natural gas reserves, some 73 trillion cubic metres are thought to be located in the Middle East, with a further 15 trillion cubic metres in Asia. A total of 64 trillion cubic metres of natural gas deposits are attributed to the states of the former Soviet Union, above all in Russia. Russia, Iran, and Qatar are the world’s three leading producers of natural gas that holds 56 percent of the world reserves. Industry calculations suggest that only 18 percent of the probable worldwide reserves are currently being exploited. It is expected that the obtainable total natural gas reserves worldwide will last far into the next century (Warnig 2009: 513).

The expansion of energy efficiency and renewables and the accelerated development of CCS and nuclear power can reduce import dependence of the EU that indirectly strengthens its climate policy. Moreover the EU budget could play a crucial role in supporting the agendas of climate policy and energy security (Spencer et al. 2011: 31). It is the fact that a low-carbon economy will stimulate growth and fulfilling Kyoto commitments is an important stepping stone towards a low-carbon society. The use of
cleaner energy sources will have a positive effect on the quality of water, air and health. While an investment in energy efficiency and renewable energies will increase energy security. So the European Commission strives to increase energy efficiency in all sectors of the European economy and promote the use of renewable energy (Barroso 2008: 14-15).

There is an opinion that the Commission has to analyze the possible leakage of greenhouse gas emissions in countries not participating in international schemes and explore potential solutions in that respect to prevent harm on participating states. In its multifaceted activities to trim down climate change and ensure energy security, the European Union is committed to expanding its strategic partnerships and bilateral activities with third countries, in particular in relation to energy efficiency and renewable energy, as well as to emerging technologies, such as carbon capture and environmentally safe sequestration and to engaging more closely with international financial institutions and the private sector (CEU 2007: 7). The ongoing climate policies and actions of the EU also address the promotion of biofuels, renewable energy, the energy performance of buildings, combined heat and power production, the use of fluorinated GHGs, energy efficiency and energy services, CO₂ emissions of cars and energy taxation (Oberthur 2008: 44).

It can be summarized with the assumptions of the Council of the European Union (CEU 2007: 2-3) which are: 1) the growing global demand for energy, the increase in energy-related emissions and the likelihood of rising energy prices are existing realities that should be tackled, 2) the stimulation of substantial improvement in energy efficiency on both the supply and demand side and expansion of renewable energies will enhance energy security and reduce greenhouse gas emissions, 3) a mutually supportive EU climate and energy strategies to tackle climate change and create synergies with a view to strengthened energy security, improved EU competitiveness and sustainability are significant, for instance through reduced air pollution and better health, 4) ‘Limiting Global Climate Change to 2°C- the way ahead for 2020 and beyond’ and ‘An Energy Policy for Europe’ are the ambitious communications presented by the
European Commission towards the end of climate change mitigation and energy security, 5) attaining the 2°C objective will require global greenhouse gas emissions to peak within the next 10 to 15 years, followed by substantial global emission reductions of up to 50 percent by 2050 compared to 1990 and 6) lastly, it is declared that there is an urgent need for a global and comprehensive post-2012 agreement to bring about the necessary emission reductions, while supporting sustainable development and poverty reduction.

The Council of the European Union recognizes that the above declared realities should be implemented through national and Community climate policies, action in the context of the EU’s energy policy, limiting transport emissions, reducing greenhouse gas emissions in residential and commercial buildings, strengthening the European Union Emissions Trading Scheme (EU ETS), including extending the global carbon market and using project-based mechanisms such as JI and CDM, tackling emissions from non-CO₂ gases, and enhancing natural sinks linked with biodiversity protection. At the same time it has the view that this approach will allow the EU to reduce its energy consumption, improve Europe’s competitiveness, reduce dependence on external sources of energy supply, demonstrate international leadership on climate issues, guide the implementation of the EU ETS beyond 2012, and encourage investment in emission reduction technologies and low-carbon alternatives (CEU 2007: 5).

EU Emissions Trading System

EU Emissions Trading System (EU ETS) is the cornerstone of the EU’s strategy for combating climate change which was introduced in 2002 and implemented in 2005. By being the world’s first and biggest international greenhouse gas emissions trading system it has made climate change a boardroom issue for companies with a price on their carbon emissions. It is also the world’s largest company level system that was developed by the EU to reduce emissions cost effectively for trading in allowances to emit greenhouse gases (European Commission 2009). The ETS lays down limits on firms in the amount of carbon dioxide that can produce in energy intensive industries, electricity generation refineries and offshore, iron and steel, cement and lime, paper,
glass and ceramics. The System is also called Cap and Trade as it allows firms that exceed their emissions limits to buy extra allowances from firms whose emissions are under target levels and those that emit less can sell their surplus allowances (Laconte 2011: 11). The ETS covers about forty five percent of the EU’s CO$_2$ emissions, including energy sector emissions (Larragán 2012: 244).

The EU ETS was launched with a pilot phase from 2005-2007 as the first step, then by the Kyoto Protocol’s commitment period 2008-2012 as the second step. Initially ETS was a decentralized system as the key decisions about the amount and allocation of allowances were in the hands of member states through the National Allocation Plans (NAPs). Thus the overall cap on emissions then became the aggregate of national caps (Kakaras 2011: 168). On the other side most allowances of the ETS were handed out free of charge and the scope of the system was quite narrow with respect to the coverage of sectors such as power producers as well as some large energy-intensive industries and mainly included CO$_2$ releases of the greenhouse gases emissions (Figure 5.4 and 5.5). And the system has allowed the import of credits from third countries primarily via the Clean Development Mechanism (Skjaerseth and Jorgen 2010: 102).

In 2008 the Commission proposed a revised ET Directive for the post-2012 period that is from 2013-2020 based on the experiences of previous phases and the ETS reform is part of a broader EU climate and energy package (Ekins et al. 2011: 48). Finally, a modified version of the proposal was adopted by the European Council and the Parliament together with the rest of the EU climate and energy package. The revised system accomplished ETS in becoming much more centralized, doing away with NAPs completely, auctioning allowances as the general principle, and establishing more restrictive rules on import of credits from third countries (Skjaerseth and Jorgen 2009: 101-102). In addition, the EU climate change package added aircraft emissions from airline flights to and from EU airports to the ETS (Laconte 2011: 11). From 2013 onwards the revised system will play a central role in achieving the Union’s climate and energy targets for 2020 and beyond (European Commission 2009).
In order to achieve greater emissions reductions in energy-intensive sectors the European Council adopted the revised Emissions Trading System (ETS) for greenhouse gases. The EU anticipates that during this period heavy industries will contribute significantly to the overall target of cutting GHG emissions by one-fifth compared to 1990 levels by 2020 (CEU 2009a: 3). At the earlier phases the system could effectively limit emissions from large emitters in the power generation industry and in other energy-intensive industrial sectors across the EU-28 Member States plus Iceland, Liechtenstein and Norway (European Commission 2009). It sets a declining limit on emissions and allows participants to trade the right to emit with each other while enabling emissions cuts to be made where they are cheapest. The main incentive in this mechanism for emissions savings is the gradual tightening of the cap as well as a resulting carbon price (DECC 2011: 24, 61).

The concept of carbon trading (Houghton 2009: 299) was accepted reluctantly by the international community particularly the EU at the outset of the discussion about the use of market mechanisms for carbon trade (Betsill 2011: 120). Before the Kyoto Protocol of 1997 the governments, firms and environmental groups in the EU were the leading
skeptics of international GHG emissions trading. Since the instrument was publicly perceived as a permission to grant a license to pollute the industry and to allow industrialized countries to escape domestic emission reductions. But later, the EU reversed its position on carbon trade by developing the first cross-border trading scheme for GHG emission permits known as the EU ETS (Meckling 2011: 26, 35).

Figure 5.5

![CO2 Emissions in the EU ETS](image)

Source: Capros et al., 2010

The EU has switched over its position on emissions trading mainly because of three reasons such as the Kyoto Protocol’s commitments as well as provisions for international emissions trading, the attractiveness of the instrument itself and the entrepreneurial behaviour of the European Commission. The Commission succeeded in taking the initiative, building up independent knowledge and crafting support among stakeholders. The motivation behind the rapid establishment of the system were twofold: first, the Commission proposed a decentralized ET directive in line with the diversity of the member states’ interests and latter, the US exit from the Kyoto Protocol led to a crisis that served to unify the positions of the EU actors and institutions (Skjaerseth and Jorgen 2009: 118). Tradable Emission Permits (TEPs) is creating markets
for environmental goods and the negative externality of carbon emissions becomes a normal market good. And EU ETS, the first system currently implemented for inter-firm trading of carbon dioxide emissions, is the European Union’s version of TEPs. At the international level, TEPs would be seen as a way to avoid international carbon taxes and as their major political advantage because TEPs directly control the amount of GHG emissions, the prices only indirectly (Wagner 2004: 11-12).

The ETS has given various options to member states for its operation in their countries: 1) respective countries are able to provide free allocation for installations for electricity production though that is subjected to certain conditions, 2) they have the freedom to push more strongly for CCS demonstration projects with revenues received from auctioning allowances, 3) each country can use revenues received from auctioning allowances to modernize energy infrastructure, support the use of renewable energy, and fund research and development for climate-change adaptation 4) they are largely free to decide how to comply with their targets and may transfer up to five percent of their annual allotted emissions to other member states, 5) nations has the choice or opportunity to bank or borrow up to five percent of their allotted emissions to a preceding or subsequent year, and 6) states can make use of credits from project activities carried out abroad, provided that they are supplemental to action taken within the EU (Larragán 2012: 244).

Energy Security for Sustainable Development

The term sustainable development is getting ever growing attention all over the world in the present scenario. And the global energy sector is facing the challenge of meeting its demands in a sustainable way to cope up with the climate change threats. Energy should be need-oriented, self-reliant and environmentally sound for the sustainable development even though there are many contradictions between the current energy path and the ideal of a sustainable world. The World Commission on Environment and Development in 1987 in its Brundtland Report titled ‘Our Common Future’ defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs (Sankar 2011;
Wang 2000). The report furnished the necessity of integrated and sustainable solutions to a wide range of issues pertaining to population, agriculture, biodiversity, industry, energy security and more.

In 1992, Rio Conference\(^1\) on Environment and Development succeeded in bringing the commitment of international community on sustainable development. There onwards energy got the recognition as a burning issue. The UN Development Programme has undertaken the groundwork of World Energy Assessment with the prop up of Sweden, UN World Energy Council and the UN Department of Economic and Social Affairs in 2000 with an appraisal of current world energy situation and its implications for the poor and environment. The World Energy Assessment became one of the major contributions to the deliberations of the ninth session of the United Nations Commission on Sustainable Development held in 2001 which recognized the major energy issues that contribute to attain sustainable development objectives. The UNDP discontinued its work to promote an understanding of the World Energy Assessment in the World Summit on Sustainable Development of 2002 held in Johannesburg even though it devoted emphasize on various issues including energy efficiency, renewable energy, advanced and cleaner Technologies. Specified targets were not fixed on renewable energy but a section on Small Island Developing States (SIDS) pledged to maintain the availability of adequate, affordable and environmentally sound energy services by strengthening ongoing, and supporting new efforts on energy supply and services by 2004 and developing and promoting efficient use of sources of energy (Skanavis and Sarri 2004; Stracha and Maryse 2003).

Rio+20 Conference, the United Nations Conference on Sustainable Development (UNCSD) took place in Rio de Janeiro in June 2012 after 40 years of the first conference on the Human Environment at Stockholm in 1972. The focal point of the Summit is on a green economy in the context of sustainable development and poverty eradication and the institutional framework for sustainable development. The main outcome of the event seems the plan to set up Sustainable Development Goals (Pisano et al. 2012: 13; Peake 2010). The United Nations Summit of 2005 has referred energy in the context of
sustainable development. The international level follow-ups on energy for sustainable development are going on since the 14th session of the United Nations Commission on Sustainable Development in 2006 (IAEA 2007). Each nation has an energy law or policy evolved since the years of industrial revolution and an integration of energy law with other policies like environmental law could do with the goals for sustainable development envisioned at the 1992 UN Conference on Environment and Development.

Restructuring of energy laws will be a pivotal facet of the changeover to attain sustainability within national and global energy systems. Energy laws ensure an adequate supply of energy and make use of available technology for the development of an energy system (Bradbrook and Ottinger 2003). It naturally paves the way for sustainable development in the energy system.

The European Council has espoused the EU sustainable development strategy (SDS) at Gothenburg in 2001 where limiting climate change and increasing the use of clean energy obtained top priority. European Union strived to raise its sustainable development standards at the global level to reconcile economic augmentation, social cohesion, and environmental protection (Tschakert and Olsson 2005). As a regional organization, EU is keen to secure energy security to the region by keeping sustainable development. During the World Sustainable Development Summit of 2002, South African civil society argued for the inclusion of climate and energy in the agenda. And also the energy sector should be sustainable and that the government should guarantee universal access to energy, eliminate energy poverty, establish targets for renewable energy and provide funds for hasty diffusion of renewable energy technologies. The indicators towards energy sustainability can be analysed by using the elements like per capita carbon emissions, particulate concentrations, cleaner energy investment, energy trade exports, energy intensity and renewable energy (Davidson et al. 2002).

The Clean Development Mechanism (CDM) is one of the apparatus related to the climate change and sustainable development established under the Kyoto Protocol of 1997 (Sanchez 2010: 81) and an important feature of CDM projects is that the recipient country can determine the contribution of a project to sustainable development. In the
initial stages of CDM projects, around 137 projects dealt with energy in a total of 157 projects distributed among EU new Member States, Latin American countries, Asia and Africa with twin obligations of reducing GHG emissions and contributing to sustainable development (AGECC 2010). The use of the Clean Development Mechanism assisted India to accelerate the adoption of clean energy technologies and the outcome is that the diminution of more than 27 million tones of certified CO\textsubscript{2} emissions and an investment of new technologies in renewable energy and energy projects (Government of India 2007). CDM opened up the way for developing countries such as Mozambique to align with international practices for efficient energy utilization.

In 2000, the United Nations announced Millennium Declaration for plummeting extreme poverty in its numerous aspects by a target of 2015 but, no energy targets are specified in the Millennium Declaration even if access to modern energy services are indispensable to reduce poverty. Later, the UN Millennium Project conducted a workshop to identify possible energy targets in support of the Millennium Development Goals (MDGs), which accomplished that energy services overtly address within the planning for poverty reduction and for meeting the broader MDGs. The group’s recommendations of major energy targets for 2015 took account of measures to increase sustainable biomass production also (GTZ 2002; Ramani 2004)).

The developing world has many prospects for the achievement of sustainable development by directing its energy demands in a sustainable manner at the early stages of economic development which is less expensive in the long run (Victor 2006). For instance, India and China stimulates their economic development with fossil energy and researches show that the developing countries’ emanations are expected to rise above the world average at 2.7 percent annually between 2001 and 2025 and will exceed the giving out of industrialized countries near 2018. In 1997, global emissions from fossil fuel burning including liquid and solid fuels were accounted for 77.5 percent in which natural gas accounts for 18.3 percent. The reports of Organization for Economic Cooperation and Development, International Energy Agency and World Energy Outlook 2004 unveils that by the next 30 years global primary energy demand will grow
by 1.7 percent per annum from 9.20 billion tons to 15.30 billion tons of oil equivalent, and that this demand will be met primarily by conventional fossil energy sources.

In 2000, the global population was roughly 6 billion up from below 1.4 billion in 1900 and by 2020 global population is likely to reach around 7.7 billion with an 80 percent of this growth taking place in developing countries. Economic development and population growth led to an increase of world wide energy demand over one half between now and 2030 hence energy poverty is a barrier to sustainable development for many countries. As a result of escalating energy demand and trend to ensure energy security, high-speed expansions are monitored at the investment in sustainable energy by $70.9 billion of new investment in 2006 and continued in 2007, which was 43 percent more than that of 2005. OECD’s Development Assistance Committee provides billions in bilateral assistance to developing countries to reduce their own Green House Gases emissions as a by-product. It contributes to the sustainable development in the energy sector (Sarkar 2010; UNIDO 2008; Kapoor 2010).

A sustainable energy system is mainly based on its energy efficiency, reliability and environmental impacts. The fundamental requirement of an energy system is its ability to generate enough power for everybody’s need at an affordable price and to help supply the clean, safe and reliable energy. Energy security of supply and availability, energy intensity and efficiency, energy pricing and internalization of externalities, renewable energy sources etc facilitates a sustainable energy future (Augutis et al. 2011). Unsustainable energy activities are chief emanates of indoor air pollution, urban air pollution, acidification and global warming, they give off 85 percent of anthropogenic emissions of sulphur dioxide and small particulate matter and they give out 78 percent of CO₂ and 23 percent of methane of greenhouse gas emissions. Assuring modern clean cooking fuels to those who are deprived of it, to satisfy the cooking requirements of the two billion people will be amount 1.3 percent increment of global commercial energy equivalent to 3 percent of global oil consumption. Optimists view that, by the second quarter of this century technologies such as photovoltaic power, fuel cell cars, hydrogen derived from fossil fuels with sequestering of carbon dioxide in geological reservoirs
and dimethyl ether (or similar synthetic fuel) derived from biomass, become as common as gasoline cars and coal-fired power plants used in the present day life (Goldemberg et al. 2001).

Globalization accelerated the need to implement programmes for renewable energy, energy taxation, technical regulations related to energy efficiency, international regulation of energy and natural resources policies to promote social and economic growth and sustainable development. Local production and utilization of energy is better than moving it around the country and this will make energy a visible part of the local community thus reconnect people with source of their energy to make it more precious. The recent events in the Middle East and Japan highlight the significance of the diversion from the reliance on the finite fossil fuels and nuclear generated energy to a spontaneous supply of 100 percent renewable energy. This underlines the importance of moving away from a few centralized suppliers to the participation of the public sector, enforcement of the regulatory regime, involvement of the private sector, the move towards corporate responsibility and the strong mobilization of civil society in the energy system for the sustainable development. In the case of the private sector, it should be provided with the freedom to operate its own generating system, offer electricity to surrounding communities, sell its energy surplus to the state power utility and vice versa (Chambal 2010; Davenport 2011).

Sustainable, competitive and secure energy at affordable prices from indigenous renewable energy sources such as wind, solar, biomass and biofuels, micro hydro systems and enhance energy efficiency of coal as well as nuclear are crucial for sustainable development in the energy sector. World energy demand and CO₂ emissions are expected to go up to 60 percent by 2030 and oil consumption has increased 20 percent since 1994 and global oil demand is projected to grow 1.6 percent per year. Greater energy efficiency and innovations are needed to meet up the mounting global demand for fossil fuels, stretched supply chains and increasing dependence on imports, high prices for oil and gas. In the new energy landscape, world’s economic regions are dependent on each other for ensuring energy security and stable economic conditions,
and for ensuring effective action against climate change. Sustainable development in the energy sector can be achieved through developing competitive renewable energy sources, deployment of new energy technologies and invention of other low carbon energy sources and carriers, especially alternative transport fuels; co-benefits are rein in energy demand, halt in climate change, promise in energy security and improvement in local air quality (EEA 2006).

**Sustainable Development and Energy: Policies of the EU.**

Traditional energy policies of the European Union have concentrated on security and diversity of supply, energy efficiency, prices and competitiveness especially since the oil crises of the 1970s. The 1998 Cardiff meeting of European Council introduced the principle of integrating environmental concerns into broader policy with a particular emphasis on energy. Thus EU’s sustainable energy policy has given fundamental importance to the endeavour of minimizing damage to the environment (IAEA 2005: 9).

The European Council has integrated the Cardiff Process into a new and wider programme called EU Sustainable Development Strategy (SDS) at the Gothenburg meeting of 2001. This Strategy is based on the rationale that the economic, social and environmental effects of all policies should be considered in a coordinated manner in all decision making. Sustainable Development Strategy has addressed energy issues under several themes such as in the case of climate change. It aims to reduce greenhouse gas (GHG) emissions by increasing the use of renewable forms of energy and on the issue of public health, air pollution from the burning of fossil fuels is an important concern (Agyeman and Bob 2009: 286).

The European Union has built the main pillars of a general sustainable development policy. The first pillar comprises the Lisbon agenda or strategy for growth and the other pillars of Europe’s sustainable development policy are political priorities on energy and climate change. The Europe has sized up the challenges and adopted a highly ambitious strategy for sustainable development that addresses two inseparable issues: energy and the fight against climate change. The strategy has three aims known as sustainable development, security of supply and competitiveness and has set three
main targets: a 20 percent cut in greenhouse gas emissions, 20 percent energy efficiency gains and a 20 percent share for renewable energies by 2020 (Barroso 2008: 11, 14).

Promoting sustainable, competitive and secure energy for Europe is one of the European Union’s strategic priorities. Therefore renewable energy and energy efficiency are at the heart of Europe 2020 strategy, initiated by European Council in 2010 to support sustainable growth and resource-efficient economies (Giddens 2007: 193). European Investment Bank joins with EU in its efforts to achieve these goals by focusing its energy lending on five priority areas: 1) Renewable energy 2) Energy efficiency 3) Research, development and innovation in energy 4) Diversification and security of the energy supply, especially trans-European energy networks and 5) External energy security and economic development (EIB 2011: 2).

Sustainable development is defined in the EU Treaty as the overarching long-term goal of the European Union. Besides the Sustainable Development Strategy of the European Union (EU SDS) is a framework for a long-term vision of sustainability in which economic growth, social cohesion and environmental protection go hand in hand and are mutually supporting. In the last decades, the EU has demonstrated its clear commitment to sustainable development and has successfully integrated this sustainability dimension into many policy fields. The EU’s climate change and energy policies are the clear evidence of the impact that sustainable development strategy has had on the political agenda (CEC 2009: 1-2).

Article 3(3) of the Treaty on European Union (TEU) set out provisions for Sustainable development as an overarching and long-term goal of the EU. The Sustainable Development Strategy makes up a long-term vision and a dominant policy framework providing guidance for all EU policies and strategies with a time frame of up to 2050. On the basis of a Commission report every second year the European Council will review progress and priorities and provide guidelines on policies, strategies and instruments for sustainable development in accordance with the SDS. It has been entrusted to SDS to provide clear and coherent policy guidance to all relevant short and medium-term decision processes and strategies in the EU, specifically the new EU 2020
strategy. This has envisioned that earlier tackling of unsustainable trends could contribute to enhance overall benefits and reduce costs (CEU 2009b: 2, 6).

The Sustainable Development Strategy has also became the major official document of the EU in its efforts to be a key player at the attempt to face the global climate change and to introduce the mechanisms that tend to more sustainable management of natural resources. But the first significant international success of the EU policy in this trend was achieved when the Kyoto Protocol of 1997 was promised to be ratified by Russia in 2004. Another example is the EU’s introduction of first emission trading system and tries to hold a high climate policy profile as being the second largest greenhouse gases emitter, second only to the United States (Rudischhauser 2008: 129).

Energy is the primary navigator of economic development as well as social progress at the same time energy sector is the biggest greenhouse gas emitter in the EU. So, the measures to transform energy sector are at the centre of climate change mitigation efforts and securing access to energy resources at competitive and socially acceptable prices. These are the prerequisites for ensuring sustainable development both within and outside the EU. The phenomena of climate change and energy theme are connected to other areas of sustainable development in many ways because energy is virtually used in every economic activity. Climate change and energy policies have an impact on a wide range of economic activities from transport to production and consumption. In this manner many climate change mitigation measures can create benefits for other areas of sustainable development for example, by creating health benefits through reduced air pollution. Likewise adaptation to climate change will alter infrastructure and city planning as well as management of forests, water and coasts (Umpfenbach and Krista 2011: 217).

The EU has amended its first SD Strategy and introduced the Renewed Sustainable Development Strategy (Renewed Strategy) in 2006 as a reflection of enhanced global competition, continuing deterioration of the environment as well as the serious disorders of the developing countries. The EU is aware of sustainable development as the state when the needs of the present generation should be met
without compromising the ability of future generations to meet their own needs in conformity with the UN approach. To achieve the long standing sustainable development goal the Renewed Strategy stressed the value of an international cooperation with the partners outside of the EU, especially with the dynamic developing countries whose impact on the global environment is more or less underestimated. The noteworthy meaning of the Renewed Strategy can be seen in its attempt to find and strengthen the synergies between the sustainable development and the Lisbon Strategy for Growth and employment. The Renewed Strategy is considered as the ultimate and foremost one while the Lisbon Strategy brings an important contribution towards the ability of the EU to adjust its policies to the pressure of a changing world economy and therefore enable to achieve the objectives of the Renewed Strategy more efficiently (Rudischhauser 2008: 135). Sustainable development remains a fundamental objective of the European Union under the Lisbon Treaty. The EU has again reviewed Sustainable Development Strategy in 2009 which emphasized that the strategy will continue to provide a long term vision and constitute the overarching policy framework for all Union policies and strategies (EC 2009: 8).

Energy has become one of the main priorities for EU action in the international sphere. In its external policy, Europe is fully and very actively engaged in the global partnership for sustainable development; for instance the Johannesburg summit on sustainable development, the UN millennium development goals, the Monterrey consensus on financing for development and the Doha development agenda. The EU conceives that multilateralism is more necessary and an appropriate response to the global challenges brought about by climate change, trade, development as well as migration and to pursue global sustainable development (Barroso 2008: 12). The European Commission has adopted a Communication in 2011 known as ‘Increasing the impact of EU development policy: an Agenda for Change’ that concentrated on EU development policy on sustainable and inclusive growth in line with the objectives for the green economy and the agenda for sustainable development. The Commission has highlighted that the aim of Agenda for Change as the access to sustainable energy
services as a key factor to reduce poverty and foster sustainable development, while contributing to climate change prevention as well as adaptation and environmental protection in developing countries (European Union 2012: 16, 29).

At the World Summit on Sustainable Development (WSSD) in 2002 at Johannesburg proposed the Johannesburg Plan of Implementation (JPOI) which called for enhanced energy efficiency and greater use of advanced energy technologies. World Summit on Sustainable Development (Fortman 2009: 112) and the Johannesburg Plan of Implementation stepped up EU’s commitments on energy into primary importance for sustainable production plus consumption and for global partnership as well as good governance. The Agenda 21, the major outcome of World Summit on Sustainable Development and various European Union treaties highlighted the magnitude of energy efficiency and the rational use of energy (Schrijver 2009: 68). Article 174 of the Treaty Establishing the European Community in Nice 2001 provides for the prudent and rational utilization of natural resources and the Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects in Lisbon 1994 offer options for improved energy efficiency. These show the change over to cleaner forms of energy (IAEA 2005: 43, 52) in the EU’s energy sector.

The European Union has launched EU Energy Initiative for Poverty Eradication and Sustainable Development (EUEI) as a notable event at the Johannesburg World Summit on Sustainable Development. It is a mutual assurance by EU Member States and the European Commission to give priority to the vital role of energy in poverty alleviation and in achieving the UN Millennium Development Goals and to act as a catalyst for action. It also raises political awareness among high-level decision-makers, encourages coherence and synergy in energy related activities, and attracts new resources such as capital, technology as well as human resources from the private sector, financial institutions, civil society and end users. In addition the EUEI aims at ending limited access to adequate, affordable and sustainable energy services worldwide by maximising energy efficiency, including more efficient use of fossil fuels and traditional biomass, and increasing the use of renewable energy to fulfil the major development
goals of health, education, agriculture, transport and communications within the global framework for policy dialogue and partnership with the developing countries. The policy discussion paper on ‘Secure, competitive and sustainable energy for Europe’ published in 2006 sets a vision for a common EU energy policy that aims to reduce environmental impact, boost competitiveness and enhance security of supply. The external energy policy of EU is a part of this vision to enable it to tackle common problems more effectively with energy partners worldwide (European Commission 2006).

The European Union undertakes actions at local, national, regional and global level to streamline energy in its development cooperation work through its geographical and thematic instruments. In this initiative special focus is given to Africa. The ACP-EU Energy Facility established in 2000, revised in 2005 as a co-financing instrument to support projects giving poor people in rural and peri-urban areas. Greater access to sustainable and affordable energy services is one of European Commission’s flagship activities. Thus the EU could involve with more than 140 projects in African and Caribbean countries by bringing modern energy services to millions of people and also the ACP-EU Energy Facility committed to invest millions of Euro in the process for the period of 2006-2013 (Schrijver 2009: 69). The EUEI-Partnership Dialogue Facility (EUEI-PDF) supports the development of policies and strategies for the promotion of access to energy at national and regional level. The Global Energy Efficiency and Renewable Energy Fund (GEEREF) is investing primarily in regional funds which reinvest their assets in projects plus companies involved in energy efficiency as well as renewable energy. The Infrastructure Trust Fund (ITF) is supporting infrastructure projects with a regional or transnational dimension in Sub-Saharan Africa especially in the field of energy infrastructure with the Eastern region to achieve greater convergence of energy markets, improved energy security, sustainable energy development and more investment in energy projects of common and regional interest. These are the significant complementary initiatives and programmes working specifically on energy along with ACP-EU Energy Facility (European Union 2012: 17).
The EU’s design and performance of national, regional, and global energy systems strongly influence issues of major societal concern and sustainability which include matters related to population, economic growth, poverty, peace, security and environment that incorporate climate change, resources management, technology, urban infrastructure, financial issues as well as trade. Energy systems defending national and international objectives in these arenas are referred as energy for sustainable development or in short, sustainable energy (Johansson 2008: 70). With the objective of achieving universal access to energy by 2030 the EU is committed to supporting the Sustainable Energy for All initiative with three interlinked goals: 1) ensuring universal access to modern energy services, 2) doubling the rate of improvement in energy efficiency, and 3) doubling the share of renewables in the global energy mix (European Union 2012: 16).

The European Union has identified six major essential dimensions of the sustainability challenge that are linked to energy: first is to secure energy supplies because Europe is importing increasing quantities of primary energy creating concerns about security of supply. Second is climate change mitigation. Third is access to modern forms of energy for the reason that about 1.5 billion people lack access to electricity and about 2.5 billion people have no access to clean cooking fuels. Fourth is affordability of energy services as affordability obviously has a different meaning in different contexts for households, corporations, and nations for example, increase in the price of oil does not have a major impact on families and nations in Europe as they do on families and nations in the developing world. Fifth is local and regional environmental challenge which includes indoor and urban air pollution, and acidification, affecting human and ecosystem health. And lastly, ancillary risks linked primarily to nuclear energy, including nuclear weapons proliferation, nuclear reactor safety and waste, and terrorist issues (Johansson 2008: 71). Moreover all these dimensions must be addressed simultaneously, adequately, and timely which necessitates riveted attention and action on the relevant energy related investments to come both at the demand and the supply side.
Renewable Energy Resources in the Energy Transformation of the EU

Sustainability means the utilization of energy and commodities in an urban area is in balance with the supply of the region continuously through natural process such as photosynthesis, biological decomposition and biochemical processes that support life (Pezzoli 1997). The concept of sustainability has its roots in ancient times though the fear of the depletion of the crucial energy sources like wood, coal and oil boost up the consciousness of the need to use resources in a sustainable way. Sustainability has been featured in the declaration of the United Nations Conference on the Human Environment, held in Stockholm in 1972, which is the first in a series of international conferences on the ecological crisis. It was realized that development should be sustainable not only on economic and social affairs, but also on matters allied to the use of natural resources (Du Pisani 2006).

Renewable energy comprises a wide range of technologies including self-renewing energy sources, such as sunlight, wind, flowing water, the earth’s internal heat, and biomass which are utilized in the production of electricity for all economic sectors, transportation fuels, and heat for buildings and industrial purposes. Renewable energy sources are tantalizing in comparison with conventional energy sources like fossil fuels whereas every region in the world has the reserve of various renewable energy sources and they complement each other. If the nations combine these resources together, they could contribute to economic development and energy security to the country thus decreases the dependence on foreign energy sources subject to political instability and manipulation. Wind, solar, or geothermal energy sources emit with zero or almost zero waste and pollutants which causes acid rain, urban smog, and health problems are noteworthy (Bull and Billman 2000).

Solar energy is usually regarded as a clean and renewable source of energy and an attractive path of generating electrical power than thermal or nuclear power plants. Most of the nations have innovations and technology development in the arena of trapping solar energy for example solar cells which converts light from the sun directly into electrical power. But these are excruciatingly slow and expensive in comparison
with conventional sources of electrical power although a fast growing progress is seen during the last few decades in order to trim down its costs (Raghuram 2011).

Tandon (2011) puts across another thought about solar energy in which the industrial revolution reallocated the energy system of the earth from the open solar system to the closed energy system based on fossil fuels. The closed energy system consists of fossil fuels and nuclear energy and the emissions of fossil fuels are trapped in the atmosphere while nuclear waste disposes on the deep soil for millions of years. Most of the post industrial technological innovations are founded on the closed system from transport to house construction to industrial and agricultural development. On the other hand, sun powered open energy system is based on the free flow of cosmic energy that lights, heats and burns consequently forms an open cycle of the energy used dissipated and returned. All these reveal that the time has reached to go back to the exploitation of centuries long sources of whole energy. Bloomberg New Energy Finance statement reveals that global investment in clean energy rose from $186.5 billion in 2009 to $243 billion in 2010, doubled the 2006 figure as a part of environment friendly stimulus packages and research and development in renewables.

Modern energy services, renewable energy, and energy efficiency are the key elements of global energy system to provide sustainable energy supply for the humankind in the 21st Century. The cost effective energy supply and development are linked together because the lack of dependable energy supply cannot bring socio-economic development which encompass social infrastructure, education, health, communication, transport, small-scale business development, inter-island transportation and power generation. The employment of local energy resources instead of imported fuels could enable the rural populations to develop their own sustainable energy supplies and provide sustainable livelihoods for their people. An honest assessment and open conversation over energy challenges is consistent with and supportive of sustainable development is needed for the world to meet its energy demand with reliable, affordable, and environmentally sound energy supplies (Verrastro and
Ladislaw 2007; Mace 2006). Unsustainable energy supplies bring hardships and economic burden to a large section of the world’s population.

The energy supply sector is able to press on sustainable development through the production and distribution of secure and eco-friendly sources of energy and through swelling the competence of energy use. Fuel diversity, supplier diversity, sound transmission and distribution infrastructure, efficient conversion and delivery technologies and low or zero-carbon technologies are various ways of sustainable development for ensuring 3E’s-energy security, economic development and environmental protection. There are chances and obstacles for developing and deploying more sustainable energy supplies in the energy system which are influenced by an assortment of factors such as availability, affordability, security, reliability, safety, investment assistance in energy services, environmental friendliness and access to alternative technologies and energy sources. Adequate supplies of clean energy operates as a source of advancing living standards of the people, improving the quality and quantity of human capital, enhancing the business and natural environment, and increasing the efficiency of government policies (OECD 2007).

Biomass energy contributes to the major share of primary energy supply in the under developed and rural areas of developing countries on the pretext of its accessibility, low cost and storage capacity. According to World Health Organization, the use of traditional biomass energy for cooking causes indoor air pollution which leads to the death of 1.5 million people every year. But the recycled process involved in the sustained biomass energy utilization enables the atmosphere to absorb greenhouse gases released during combustion as biomass regrows. It has the potential to contribute to sustainable development and rural livelihoods while the agricultural expansion, logging activities and the absence of resource management etc threatens the sustainable supply of biomass energy (Enskat and Holger 2005). The U.S President Barak Obama said in his State of the Union address in February 2010, ‘We know the country that harnesses the power of clean, renewable energy will lead the 21st Century.’ Thus rapid deployment of renewable energy technologies that holds the promise of energy
generation free of greenhouse gas emission with domestically available infinite inputs in an extent throw away the threat of manmade climate change and supply security concerns which challenge the relative competitiveness of fossil fuels in terms of cost, environmental impact, energy output and access (Froggatt and Lahn 2010, 17).

The European Council took over climate energy legislative package comprising measures to fight climate change and promote renewable energy. This package is designed to achieve the EU's overall environmental target of a 20 percent reduction in greenhouse gases and a 20 percent share of renewable energy in the EU's total energy consumption by 2020 (CEU 2009a: 1) (Figure 5.6). Further the EU Heads of State or government agreed to boost the share of renewable energy in EU energy supply to 20 percent and the contribution of biofuels in transport to 10 percent by 2020 (Oberthur 2008: 45) (Figure 5.7).

It has been recognized that diversification into more home-grown energy will need a greater use of low or zero carbon technologies based on renewable energy sources, such as wind, solar, hydro power and biomass in view of the fact that the EU is short of fossil fuel resources of its own (European Commission 2007: 13). Greater use of energy from renewable sources constitute an important part of the package of measures needed to reduce greenhouse gas emissions and comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and with further European and international greenhouse gas emission reduction commitments beyond 2012. It can play a crucial role in promoting security of energy supply and providing opportunities for employment and regional development especially in rural and isolated areas while it needs technological development and innovation (European Parliament 2008).

In the European Union, Renewable Energy Directive gives guidelines for the effective utilization and promotion of renewable resources in the energy sector which was adopted via the climate and energy package. The RES Directive attempts to impose mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. It aims to set up a common framework to promote renewable energy. The
Directive reflects political compromise by setting binding national targets while giving member states the freedom to decide how to achieve them. States are free to use a combination of measures on energy efficiency and energy demand to comply with their legally binding targets. This is mainly to address the public opposition to large scale renewable-energy projects thereby easing the task for member states. On the other hand they are free to decide which mechanisms they prefer for supporting renewable energy (Nilsson 2011: 12-13).

**Figure 5.6**

**EU Primary production of renewable energy in 2008 (%)**

![Chart showing EU Primary production of renewable energy in 2008 (%)](chart)

Source: Eurostat, 2011

The RES Directive requires member states to develop national renewable energy action plans which are liable to Commission reviews so their plans are considered as recommendations on their content. In the case of inadequate measures of the member states, the Commission has the authority to propose corrective action. The Directive consents member states to engage in public-private cooperation akin to the flexible mechanisms established under the Kyoto Protocol. Furthermore it creates an optional
guarantee of origin that specifies, for instance, the source and type of energy, and information on the particular installation from which the energy was produced. It also establishes sustainability criteria for biofuels, requiring that materials with high value in biodiversity not be used in their production. In an increasingly integrated energy market, decisions taken by one EU member state inevitably impact others so ensuring effective coordination should be done at the EU level (Larragán 2012: 245).

Figure 5.7

RES Share of the Gross Final Energy in EU (%)

Source: European Commission, 2012

Nuclear Energy Development in the EU

The idea of nuclear power as a legitimate and viable alternative source of energy is always a sparking theme of political debate in the international arena despite the fact that there were long-term strategies for developing nuclear energy and plans to build new reactors in the United States, Russia and France. Furthermore the 1990s marked the nuclear rush of Asia particularly in China, India as well as Korea and Japan’s dependence on nuclear energy with 55 reactors. But the nuclear reactor accidents at Three Mile Island in the US in 1979 and Chernobyl in the former Soviet Union in 1986 and the latest at Fukushima Dai-ichi in 2011 raised fear and even panic on the part of the
world’s population and its leaders. Review of the safety systems in the functioning reactors and those under construction are entailed to avoid casualties and develop an internationally acknowledged action plan for close to zero-possibility accidents. The thrust for energy resources of their own compels the countries to opt for nuclear energy. Since the energy crises of the 1970s, alternative sources, including nuclear energy became part of global agenda. Energy security was a priority at the G8 summit of 2006 in St Petersburg where Russian host tried to push through nuclear energy as an environment friendly option and gracious for sustainable development. The work of relevant departments of the International Atomic Energy Agency should be strengthened in developing atomic energy, technical cooperation and so on for the sustainability of nuclear energy (Panova 2011).

Resurgence of interest in developing nuclear power was observed together in developed as well as developing countries. In India, the 2005 new and renewable energy policy has outlined three different fuels-mix projections for 2051-52 which included the share of nuclear energy ranged between 5.52 percent and 5.26 percent. For this purpose, the Expert Committee recommended a comprehensive Research and Development plan to make India self-sufficient by making breakthroughs in clean energy and a coordinated research efforts were suggested for the development of nuclear technology including fusion power. The India-US deal on civilian nuclear programme accelerated the growth of nuclear energy and the US helped India to gain international market access to uranium for its energy programme. The US business community has estimated a $100 billion worth new opportunities in India’s energy sector by considering it as one of the fastest growing nuclear energy markets of the world even if nuclear power contributes a very nominal percent of energy to the total energy mix (Dey 2006).

More than a few factors seem to be driving the renaissance of interest in nuclear power for instance, a global desire to diversify fuel sources, reduce dependence on fossil fuel imports, greenhouse gas emissions, air pollution, volatile fuel costs and develop immunity to power disruptions to meet rising energy demands etc. The virtual rationale is that the absence of air pollutants from nuclear plants, the potential of nuclear power,
its role as a relatively secure and largely carbon-free alternative to fossil fuels must be weighed against its technical risks. Accordingly more than forty developing countries, ranging from the Gulf to Latin America, have approached United Nations officials to express interest in starting nuclear power programs. The design improvements of atomic energy reactors fall into two broad categories: evolutionary known as Generation III and III+ reactors and revolutionary known as Generation IV. The evolutionary power reactor’s innovative features include safer operations, competitive costs, and environmentally sustainable development and add incremental improvements to proven designs. Revolutionary reactors spot a sweeping exodus from the designs that dominate the nuclear industry today and offered much larger benefits in terms of safety, cost, and sustainability.

People of countries planning to install or expand nuclear power units are entitled to ask questions regarding sustainable energy (extended fuel availability, positive environmental impact), competitive energy (low costs, short construction times), safe and reliable energy (inherent safety features, public confidence in nuclear energy safety), and proliferation resistance (does not unduly add to unsecured nuclear material) and physical protection (security from terrorist attacks) for the safety of nuclear energy in the context of sustainable development. The sustainability of nuclear power compared to conventional resources can be assessed with the demand for them and nuclear power with fuel recycling and breeding based on available resources and innovations is a long-term sustainable technology (Adamantiades and Kessides 2009).

The increased awareness of climate change over the past years has gained supporters for nuclear energy on its alleged contribution to climate protection due to low CO₂ emissions. But in reality indirect CO₂ emissions from nuclear power plants will increase considerably due to the use of fossil energy to mine uranium and the emission of radioactive isotopes such as tritium or carbon 14 contributes to climate change. In view of this trend, nuclear power plants will not have any advantage over modern gas fired power plants as well as in comparison to the advantages offered by increased energy efficiency or greater use of renewable energies. These facts could not
overcome the assertion that nuclear energy is needed to promote climate protection and not received any attention in international climate protection negotiations (Mez 2011: 20).

The largest part of the installed nuclear capacity in the world is in United States, Europe, and East Asia. Presently, nuclear power generation accounts for about 16 percent of the world’s electricity production although nuclear power use faces considerable challenges: soaring capital costs, problem on waste management, acquiring weapons capability and adoption of safety measures in design, construction, and operation. Effective utilization of nuclear energy could be possible within the frameworks of efficient procedures such as assuring international guarantees for nuclear fuel supplies, encouraging supplier states that are willing to take back spent fuel, strengthening the International Atomic Energy Agency’s (IAEA) inspection regime and launching a consortium among nuclear supplier nations with existing technologies and financial instruments. These measures will be capable of offering nuclear power to developing nations at reasonable cost and without proliferation risk (Deutch et al. 2007: 48).

Nuclear energy has an exceptional position in the history of the European Union and the apprehension on nuclear energy matters was one of the founding motivations of the European project. P.H. Spaak, the Belgian Minister for Foreign Affairs proposed the creation of an atomic energy community. The European Atomic Energy Community, better known as Euratom has been established in 1957 that consistently promoted the peaceful development of nuclear energy (Nuttall 2009: 1). The Euratom framework has marked a slow progress but now a days it helps to pool knowledge, infrastructure as well as funding for nuclear energy, ensures the security of nuclear energy supply and progress in nuclear installation safety plus radioactive waste management through the centralized monitoring system. Again, Euratom is providing assistance to non-EU countries to improve nuclear safety, radiological protection, and efficient safety controls through its mechanism of Instrument for Nuclear Safety Cooperation (Euinsight 2011).
In the European Union, the use of nuclear power demonstrates a large difference among the member countries. While 12 of the Members do not use nuclear power at all, in the remaining 15 states nuclear power contributes from 4 percent up to almost 80 percent of the electricity production (Rademaekers et al. 2011: 25). Countries such as Austria and Italy have even today no plans to build nuclear power capacity and others like Germany and Sweden are officially committed to gradually phase out domestic nuclear energy supply. Recent policy directions in other countries among which the Netherlands and the United Kingdom show that nuclear energy is reappearing on the political agenda and some governments for example Finland and France decisively continue to preserve a significant part for nuclear energy in their national electricity generation (Checchi et al. 2009: 28).

According to the European Commission’s Green Paper 2001 entitled ‘Towards a European Strategy for the Security of Energy Supply’, the enhancement of energy security and the reduction of dependency over the imports of fossil fuels, especially natural gas from the Middle East and Russia are among other key reasons for maintaining or expanding nuclear power capacity in Europe (Euratom 2003: 5). As stated in the Green Paper 2006 titled ‘A European Strategy for Sustainable, Competitive and Secure Energy’ (Special EB 2007: 3), the EU’s dependency on imported energy would amplify from 50 percent today to about 70 percent in the next 20 to 30 years (Hoogeveen and Wilbur 2007: 476). So the member states must develop a robust policy response based on the framework of collective energy security to secure a viable energy future for the EU as a whole (Lynch and Angela 2012: 40). It is presumed that nuclear energy makes a positive contribution to the energy-independence of the EU and to the security of supply in unison it produces only a negligible quantity of CO$_2$ that facilitates the fight against climate change and thereby contribute to the goal of sustainable development (Special EB 2007: 3).

CO$_2$ emission credits enacted through the Emissions Trading System (ETS) gives a cost advantage to nuclear energy comparative to fossil-fuelled power production. It is expected that in the longer run a sustained and stable ETS may lead to renewed
investments in the construction of nuclear power plants. ETS CO\textsubscript{2} prices variation already have a market impact and electricity prices will be truly affected by CO\textsubscript{2} prices that eventually are prospected to increase by an order of magnitude in favour of nuclear energy (Zwaan 2008: 9).

Organization of Petroleum Exporting Countries (OPEC) imposed constraints on production along with the decision of quadrupling the oil prices in the 1970s (Calvert and Susan 1999: 37). This incident constituted a traumatic shock on the economic and political system of EU member states as well as to the EU as a whole, due to the lack of cooperation and solidarity among member states (Hoogeveen and Wilbur 2007: 476). From this period onwards concerns regarding energy supply security drove the investments in nuclear power in Europe even while Europe does not possess large domestic uranium resources. Events of these kinds in the future could pave the way to an invigorated interest in nuclear energy and an associated impulse to the construction of new nuclear power plants. In addition, the presence of domestic natural uranium resources is hereby not a necessary condition for enhancing energy security through nuclear power because that is widely available, easily storable and cheaply acquirable (Euratom 2003: 6).

Public in Europe has the opinion that nuclear energy still provides insufficient safety guarantees since there exists the possibility of large nuclear accidents and the manifold problems related to the handling of nuclear materials from mining to the processing of nuclear materials as well as the management of nuclear waste (Matthes et al. 2011: 10). Especially after the potentially pervasive scale of a reactor meltdown accident experienced at the Chernobyl accident in 1986 several countries in Europe abandoned large nuclear energy expansion programmes, and produced a shock to the nuclear industry from which it still has not recovered (Calvert and Susan 1999: 31). However it is noticeable that over the past decades reactor safety has picked up significantly, both in and outside Europe as a result of improvements in safety culture, reactor technology, peripheral equipment, operation practices and man-machine interactions in plant operation. This can be perceived in the European reactors which are
equipped with confinement domes to ascertain that in the occurrence of an accident radioactive material would not be released to the external environment and consequences are controlled to a minimum (Checchi et al. 2009: 29).

In 2007 the European Commission initiated European Nuclear Energy Forum (ENEF), a platform within the EU for debating the opportunities and risks of nuclear power (Spencer et al. 2011:17). It creates a regulatory framework for EU states to undertake concrete and timely action for the development of permanent, underground and aboveground, disposal facilities. Thus the public is expected to become less sceptical once the first geological repositories become operational and disposal technologies are demonstrated in practice (Zwaan 2008: 11). EU is a large multinational nuclear industry of nuclear reactors, technology, and related equipments thus has a particular interest in ensuring peaceful uses of nuclear energy with highest standards of nuclear safety, security, and non-proliferation (Euinsight 2011). The expansion of market demand may generate mutual spread out of learning effects and produce economies-of-scale and increasing returns to R&D expenditures, which may also reduce the fixed costs on the total bill of nuclear power production in Europe. In the same way, economic development in other parts of the world will matter for the fitness of the European nuclear industry and the prospects of its own nuclear energy capacity (Zwaan 2008: 16).

The idea of a nuclear renaissance and the expansion of nuclear energy are enjoying a comeback in policy making and industry circles. In Europe, countries that had turned their backs on the idea of nuclear power are having a major change in their attitude. In 2009 Italy announced that it is going to restart nuclear production after banning it in the wake of the Chernobyl disaster. In the same year, the Spanish government granted an extension to its oldest civilian nuclear plant despite having previously committed to phasing out nuclear power by 2006. Sweden has overturned its moratorium on new nuclear power stations and has even offered to provide a nuclear waste repository for the rest of the world. Germany is also on the way of restarting the nuclear industry even as the British government has made a major commitment to the expansion of commercial nuclear power (Ebinger and Massy 2010: 77). Extensively, the
come back of nuclear energy is justified for reasons of energy security and the approach recommended is a globally cooperative one (Pant 2010: 40).

Regarding nuclear energy, there is an assumption that the extension of the life spans of existing nuclear energy stations and all the more the building of new plants would act as a massive brake on the development of renewable energies. The claim that nuclear energy and renewable energies complement each other is a myth since they compete for exploding amount of investment capital as well as nuclear plants limit the growth potential owing to their inflexible continuous operation (Thomas 2010: 5). In addition nuclear energy is highly water intensive and nuclear plants use 25-50 percent more water per unit of electricity generated than fossil fuel plants with equivalent cooling systems that will act as a curse during drought because many nuclear facilities either cannot operate or induce water shortages. Tones of spent nuclear fuel is discharged each year from existing nuclear facilities since nuclear plants convert almost all of their fuel to waste and estimated that by 2050 nuclear electricity will have the same carbon footprint as natural gas (Sovacool 2011: 7).

There are manifold cogent reasons in favour of higher utilisation of nuclear energy in the European Union which includes its relative ecological harmlessness, the abundance and accessibility of nuclear material, its cost effectiveness, and its high efficiency. On the other hand, there are serious concerns inhibiting the creation of a Europe-wide nuclear energy policy because of the problem of nuclear waste storage, security provisions for the power plants, and the unpopularity of nuclear energy among some European citizens. However, the European Commission supports a greater role for nuclear energy within the European energy mix and supports individual member states to rely more heavily on nuclear energy as a means to decrease dependency on only one energy source or one energy supplier (Neuman 2010: 352-53).

Fresh investments of nuclear capacity will be needed for the coming decades. The challenge is that pursuing non-nuclear energy policy can compensate the loss of nuclear power and reduce CO\textsubscript{2} emissions without creating problems to energy security.
So the advocates of nuclear power recommend large scale constructions though it may increase the risk of nuclear terrorism and weapons proliferation. In their conclusion the perils from failing to trim down atmospheric CO$_2$ levels overshadows the consequences of nuclear terrorism or a regional nuclear war (Barnham 2007: 45).

**Conclusion**

Energy security and climate change are two global challenges that are directly linked together. The growing concerns about climate change around the world particularly in Europe have invoked both governments and people to re-evaluate their energy use and how this contributes to GHG emissions. EU Emissions Trading System is the cornerstone of the EU’s strategy for combating climate change. It is the world’s first and biggest international greenhouse gas emissions trading system which has made climate change a boardroom issue for companies with a price on their carbon emissions. The EU model constitutes a remarkable example of how the agendas of climate change and energy security can be brought together by reframing the principle of sovereignty at the regional level rather than at the national one.
Endnotes

1. Solar energy is solar radiation exploited for hot water production and electricity generation, through flat plate collectors mainly of the thermosyphon type for domestic hot water or for the seasonal heating of swimming pools, photovoltaic cells and solar thermal electric plants. Passive solar energy for the direct heating, cooling and lighting of dwellings or other buildings is not included (OECD et al. 2005: 190).

2. In 1997, the Kyoto Protocol of United Nations Framework Convention on Climate Change was signed. This international agreement commits developed nations to reduce GHG emissions to at least 5 percent below 1990 levels during 2008-2012. The protocol includes three market-based mechanisms: emissions trading, joint implementation and the Clean Development Mechanism (CDM) as instruments to support countries in achieving their commitments. The CDM has two main objectives: to reduce emissions and to support sustainable development within developing countries (www.kyotoprotocol.com/, The Kyoto Protocol).

3. Clean coal technologies are innovative technologies designed to enhance the efficiency and environmental acceptability of coal extraction, preparation and use. Among the most promising technologies are fluidized bed combustion (PFBC), integrated gasification combined cycle (IGCC) and coal gasification (DGE 2009: 50).

4. Energy intensity is the amount of energy used per unit of economic activity or output and carbon intensity is measured by the quantity of carbon emitted per unit of energy consumed (DGE 2009: 50).

5. Energy intensive industries are iron and steel, non-ferrous, chemicals, non-metallic minerals, and paper and pulp industries (DGE 2009: 50).

6. Carbon trading is an innovative market based solution to the problem of reducing GHG emissions. Its main rationale is that by attaching a price to CO₂ emissions, trading schemes will generate powerful economic incentives to cut emissions and channel investment efficiently. Emissions trading works by setting limits on
total allowable emissions that are then converted into tradable permits to be distributed amongst participants (Houghton 2009: 299).

7. UN Conference on Environment and Development (UNCED or the ‘Earth Summit’ or ‘Rio Summit’) held in Rio de Janeiro in 1992. The conference resulted in several crucial developments: (1) the Rio Declaration (2) a set of international conventions, and (3) a document entitled Agenda 21 also known as the ‘Rio action plan’. Agenda 21 is until today the most comprehensive document on sustainable development that also provides a series of measures to be taken in implementing SD on the ground (www.un.org/geninfo/bp/enviro.html, United Nations Conference on Environment & Development).

8. In 2000 European leaders committed themselves to Lisbon Agenda. The EU at that point set itself a number of strategic goals for the next decade to become the most dynamic and competitive knowledge based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion and respect for the environment. Average growth has to reach 3 percent per annum and employment an average of 70 percent by 2010 (www.eapn.eu › ... › What we do › Issues we focus on, The Lisbon Strategy: A general overview).

9. EU Emission Trading System is a scheme for greenhouse gas emission allowance trading within the Community established by Directive 2003/87/EC in order to promote reductions of green-house gas emissions in a cost-effective and economically efficient manner. Installations included in the scheme are combustion plants, oil refineries, coke ovens, iron and steel plants, and factories producing cement, glass, lime, brick, ceramics, pulp and paper. Recent amendments (2008/101/EC and 2009/29/EC) have enlarged its scope, including aviation and further process emissions (ec.europa.eu/clima/policies/ets/index_en.htm, The EU Emissions Trading System (EU ETS)).

10. The Johannesburg Summit of 2002 delivered three outcomes: a political declaration, the Johannesburg Plan of Implementation, and the establishment of numerous partnership initiatives. The Johannesburg Plan of Implementation (JPOI) can be
regarded as a programme of action to guide government activities, negotiated and agreed between governments covering key commitments and targets in the areas of sustainable consumption and production, water as well as sanitation, and energy (Stracha and Maryse 2003).

11. Geothermal energy is the energy available as heat emitted from within the earth’s crust, usually in the form of hot water or steam. It is exploited at suitable sites for electricity generation using dry steam or high enthalpy brine after flashing and directly as heat for district heating, agriculture, etc (OECD et al. 2005: 187).

12. Nuclear power plant is a plant in which a nuclear fission chain reaction can be initiated, controlled, and sustained at a specific rate (DGE 2009: 50).

References


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