



EUROPEAN
COMMISSION

European
Research Area



Towards a Post-Carbon Society

**EUROPEAN RESEARCH
ON ECONOMIC INCENTIVES
AND SOCIAL BEHAVIOUR**

Interested in European research?

Research*eu is our monthly magazine keeping you in touch with main developments (results, programmes, events, etc.). It is available in English, French, German and Spanish. A free sample copy or free subscription can be obtained from:

European Commission
Directorate-General for Research
Communication Unit
B-1049 Brussels
Fax (32-2) 29-58220
E-mail: research-eu@ec.europa.eu
Internet: <http://ec.europa.eu/research/research-eu>

EUROPEAN COMMISSION

Directorate-General for Research
Directorate L — Science, economy and society
Unit L.2 — Research in the economic, social sciences and humanities – Prospective

Contact: Domenico Rossetti di Valdalbero

*European Commission
Office SDME 7/34
B-1049 Brussels
Tel. (32-2) 29-62811
Fax (32-2) 29-62137
E-mail: domenico.rossetti-di-valdalbero@ec.europa.eu*

*<http://ec.europa.eu/research/social-sciences>
http://cordis.europa.eu/fp7/cooperation/socio-economic_en.html*

EUROPEAN COMMISSION

Towards a “Post-Carbon Society”

*European research on economic incentives
and social behaviour*

**Conference proceedings
Brussels, 24 October 2007**

***EUROPE DIRECT is a service to help you find answers
to your questions about the European Union***

Freephone number:

00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers
or these calls may be billed

LEGAL NOTICE

Neither the European Commission nor any person acting on behalf of the European Commission is responsible for the use which might be made of the following information.

The views expressed in this publication are the sole responsibility of the author and do not necessarily reflect the views of the European Commission.

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server (<http://europa.eu>).

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 2008

ISBN 978-92-79-07622-0

© European Communities, 2008

Reproduction is authorised provided the source is acknowledged.

Printed in Belgium

PRINTED ON WHITE CHLORINE-FREE PAPER

TABLE OF CONTENTS

FOREWORD	7
BACKGROUND	9
ENERGY, ENVIRONMENT AND SOCIO-ECONOMIC CHALLENGES	13
THE ROLE OF POLITICS AND SOCIAL ACTORS	25
CITIZENS' INTERACTIONS WITH LAND-USE AND ENERGY DEMAND	33
A NEW GOVERNANCE TOWARDS A POST-CARBON SOCIETY	39
CONCLUSIONS	47
ACKNOWLEDGEMENTS	49
GLOSSARY AND ACRONYMS	50



FOREWORD

The European Union and the world beyond have to face two major challenges on the way towards a "Post-carbon society": adoption of new forms of energy and adaptation to the climate change that is already taking place. Measures from both the supply and demand sides are needed to address these challenges.

The ambitious 2020 European Union targets for reducing greenhouse gas emissions, improving energy efficiency and increasing the share of renewable energy sources require strong research efforts in order to develop new and sustainable technologies.

But new technologies alone are not sufficient. A lot more is necessary if we are to have answers to the issues of energy security of supply, availability of natural resources and increasing oil prices.

Political initiatives, economic incentives and social behaviour should make a difference. Worldwide agreements to reduce greenhouse gas emissions, market mechanisms to push for the implementation of clean technologies and local action to change the way of producing and consuming are needed.

To move towards a "Post-carbon society" will require time and effort. End-use technologies - from cars to light bulbs - will have to be made and used in a new way. Infrastructure and land-use (organisation of cities) will have to be

shaped differently. Public policies and private initiatives will have to be adjusted.

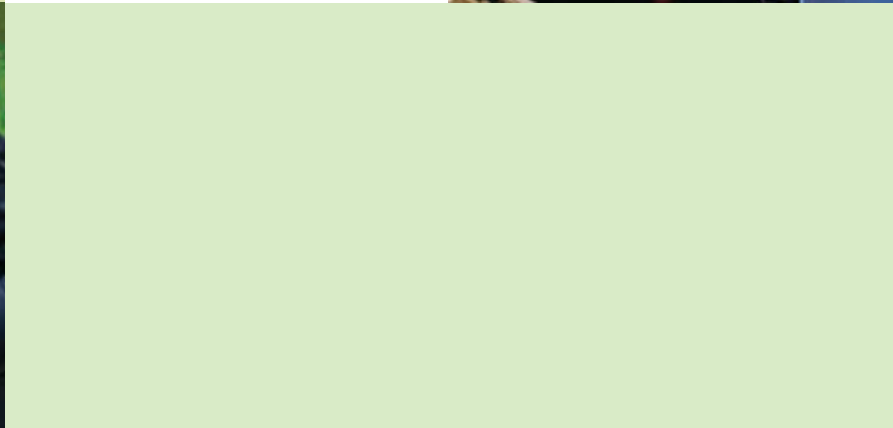
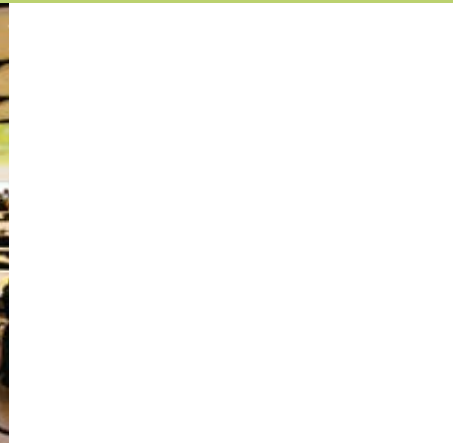
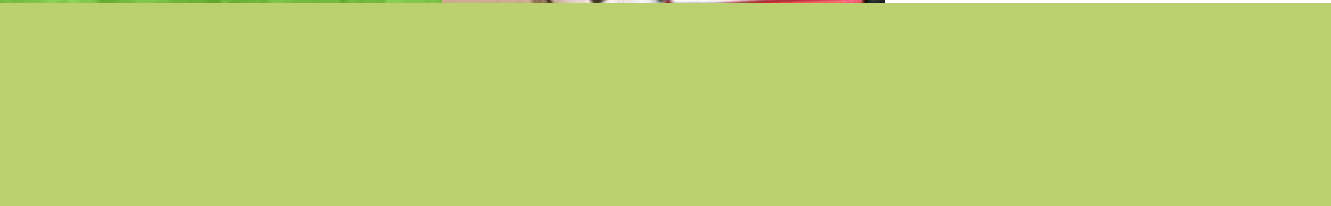
To face these new challenges, businesses and trade unions will have to cooperate. Industry and NGOs will have to work together. Natural scientists, engineers and social scientists will have to find - in a multidisciplinary way - the best solutions taking into consideration their technical potential and economic feasibility through a true dialogue with society.

The European Union has an uncontested world political leadership in social and environmental protection. The EU is today the first-ranked power in the sector producing technologies that do not emit greenhouse gas emissions. The EU is now seriously looking at economic growth "beyond GDP".

Anticipation is a prerequisite to action. If we want our children to live in a "Post-carbon society", we need to continue to reinforce our policies, mechanisms and measures in order to turn this concept into a genuine reality.



Janez Potočnik
Commissioner
for Science and
Research



BACKGROUND

The scientific evidence of anthropogenic climate change is overwhelming; it is happening and it is accelerating. What we see today is only the beginning and the result of past greenhouse gas emissions. Present trends will continue whatever we do. Society must cope with twin challenges:

- **To cope with the effects of climate change that we cannot, or choose not to, prevent.**
- **To adapt economic and social development to cope with the need to mitigate further change.**

These challenges must be met whilst simultaneously meeting as far as possible the expectations of society for a better quality of life and the correction of inequalities across countries and groups. The loss of welfare brought about by climate change is enormous; the Stern Report*, while recognising the immense uncertainties, estimates that a 3 – 4 degree centigrade rise in temperature could reduce per capita welfare by between 5 – 20%.

The scientific evidence for climate change has been compiled thanks to intense research and development in climate science all over the world with the cooperation of many institutions**. Much remains to be done, but the science of climate change is well engaged and its importance is no in doubt. Mitigation depends on technology. In the main, the

relevant technological areas are not marked by rapid innovation. The technologies of power generation, thermal comfort and transport proceed through incremental improvement rather than radical advance. The technologies at our disposal to cope, either exist now or are visible, although very substantial research is still needed to get many of them to market. The provision of energy services is associated with immense and costly infrastructures with lifetimes of 50 to 100 years. These infrastructures pose heavy constraints on the ability to change. It is probable even so that the technologies that we have, or are likely to have, will be sufficient to mitigate a large part of climate change if society can adjust to their potential.

Understanding of the science and provision of the technological solutions is not in itself enough. Society must adapt according to the potential of the technology to cope with climate change and in accord with the aspirations of people, especially where economic development is still not adequate. The challenges for social scientists are complex and wide in scope. This conference on the Post-Carbon Society brought together politicians, officials and academic experts to help define an agenda for research in social sciences in this field and in particular to identify some concrete research opportunities on the topic “Socio-economic factors and actors that shape the post-carbon society” within the seventh Framework programme. Stakeholders from both public

* The Economics of Climate Change, Nicolas Stern, Cambridge University Press, 2007.

** Fourth IPCC Evaluation report, UNFCCC, 2007.

and private sector, from business and trade union, and from different disciplines were well represented. Most of the Commission services were involved with an active contribution from DG Research and DG Energy and Transport.

Less formally, this can be construed as putting our own house in order, persuading others, working to understand the problem and its solutions and getting society involved. These ideas were fully explored in the conference.

Many ideas for how to change and adapt are examined in the EU Green Paper on adaptation published in June 2007*. This paper proposes a strategy based on four pillars:

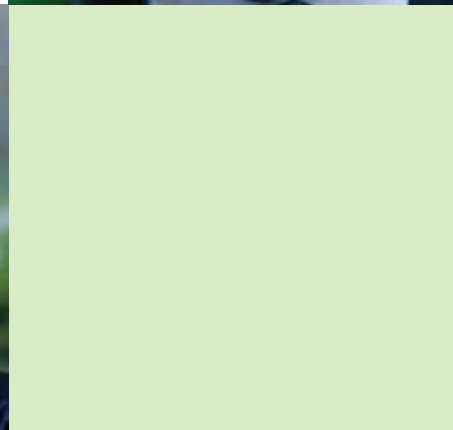
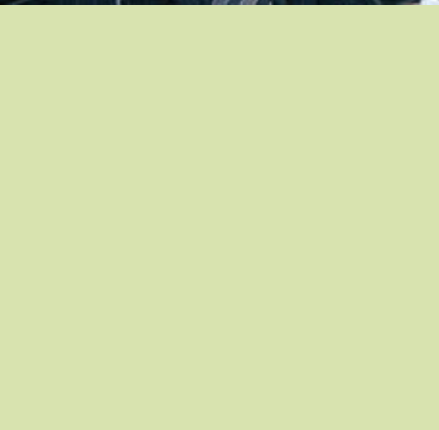
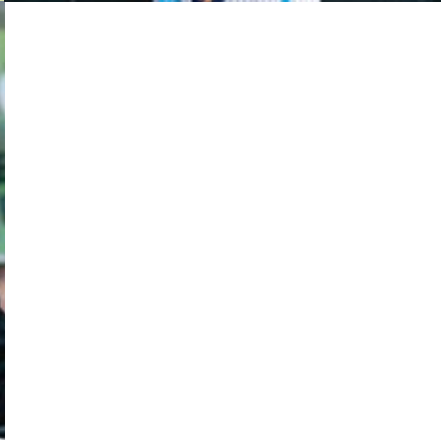
- **Early action in the EU.**
- **Integrating adaptation into EU external actions.**
- **Reducing uncertainty by expanding the knowledge base through integrated climate research.**
- **Involving European society, business and public sector in the preparation of coordinated and comprehensive adaptation strategies.**

* European Commission, *Adapting to climate change in Europe*
– options for EU action, COM(2007)354, 29.6.2007.

Large factors of growth: The last 200 years

	1800	2000	Factor
Population (billion)	1	6	x6
GDP PPP (trillion 1990\$)	0,5	36	~x70
Primary Energy (EJ)	12	440	~x35
CO ₂ Emission (GtC)	0,3	6,4	~x20
Mobility (km/person/day)	0,04	40	x1000

Source: IIASA – TU Vienna



ENERGY, ENVIRONMENT AND SOCIO-ECONOMIC CHALLENGES

The energy-environment nexus is determined by three factors: climate change, secure energy supply and development. The sustained growth across the globe since the Second World War has been due in part to the availability of low cost, convenient sources of hydrocarbons. The affluent society is very much linked to the availability of cheap energy. Some of the world has now reached a level of development at which it can with some equanimity consider slogans such as "grow better, not grow more". There remain many people living in poverty for whom development appears to be inextricably linked to the resource-intensive development patterns followed by countries that developed earlier. As noted by Fatih Birol of the IEA, 1.6 billion people, mostly in the Indian sub-continent and sub-Saharan Africa, have no access to electricity*. The use of traditional fuels, biomass and dung, mainly in the same regions leads to deforestation and indoor pollution and discriminates against women because it is their job to collect it and they are exposed to the smoke from cooking with these fuels. 1.6 million women and children die prematurely each year from indoor pollution from traditional fuels.

The energy consumption that has supported post-war growth has also a massive external cost, described by the Stern Review as "the greatest and widest-ranging market failure ever seen." Climate change is in large part a consequence of energy use; limiting climate change

in the future will depend critically on whether energy use can be greatly reduced, dissociated from carbon or both. This seems inevitably to impose costs on developing countries. Not only is climate change a massive market failure; it is massively inequitable. The carrying capacity of the atmosphere for greenhouse gases has been pre-empted by the developed countries; the adjustments needed in the future may limit their development. Often developing countries are most impacted, because they are in warm wet areas, exposed to temperature rise and highly variable rainfall, dependent on agriculture that is the economic sector most at risk from climate change and without the income and resources to adapt.

Industrialised countries, with some notable exceptions are conscious of the needs to limit climate change and the impact that has on energy policy. Other drivers of energy policy are short-term and sometimes dominant. Chief among these other drivers is security of supply. At the beginning of November 2007, the reference price for crude oil reached almost 100\$/barrel. Europe is especially vulnerable. Most energy used in Europe is imported and the dependence is expected to rise. Under a business-as-usual scenario, the EU's energy import dependence will jump from 50% of total EU energy consumption today to 65% in 2030. Reliance on imports of gas is expected to increase from 57% to 84% by 2030, of oil from 82% to 93%**.

* Global energy perspectives, Fatih Birol, Chief Economist, International Energy Agency.

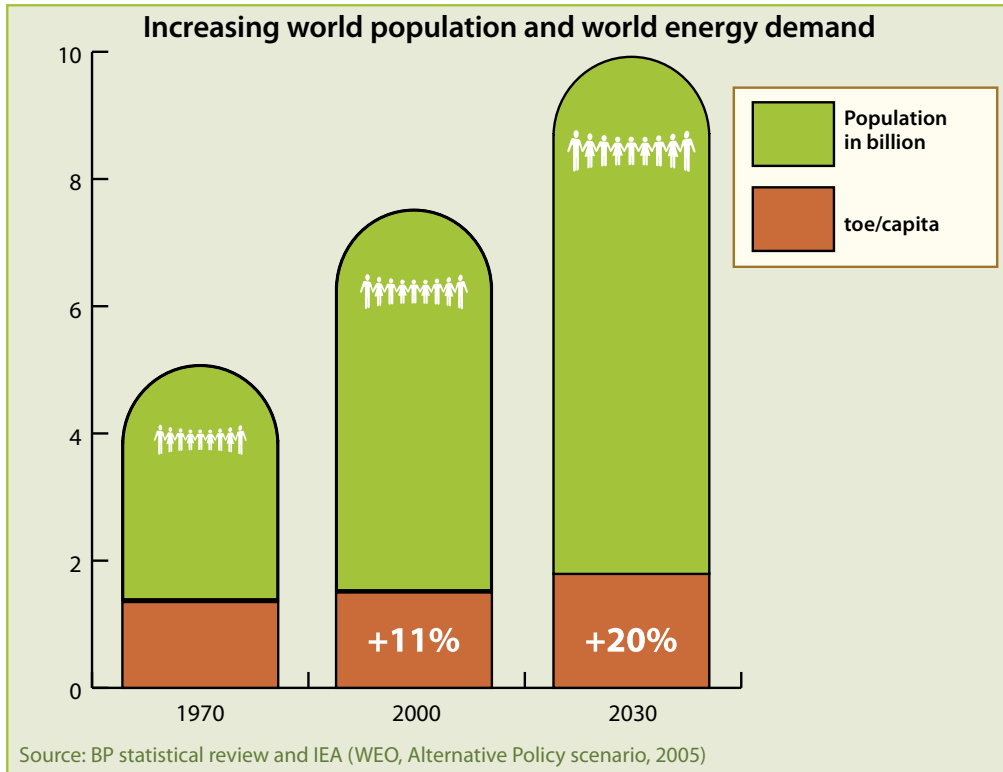
** European Commission, An energy policy for Europe, COM(2007)1, 10.1.2007.

Disruptions and uncertainties in the supply of oil and gas and the resulting price volatility lower economic growth and raise inflation and unemployment. Oil and gas resources are depleting and, in the view of some experts, peak production will soon be reached; what is certain is that the remaining resources are increasingly concentrated in a few countries to which political access is poor and constrained and security of supply will be an important problem for most industrialized countries and especially the EU.

There is some reinforcement and some conflict between policies for energy security and policies to limit climate change. Energy efficiency is win-win as are renewables and nuclear. Coal is ambiguous. Used in conventional technology it produces much CO₂. Carbon sequestration is possible, but undemonstrated and not obviously attractive to capital-limited developing countries such as China and India. Mr Birol drew attention to the significant role of developing countries and especially of these two giants. He acknowledged that the main issue for developing countries is security and development, not climate change. The IEA estimates that 70% of incremental growth in energy demand arises from China and India and that this percentage is likely to rise still further in the future as transport becomes more significant as a driver of economic growth. The potential is enormous. In Europe, there are 680 vehicles for every 1000 people; in China and India, it is 17 vehicles per 1000 people. Allowing access to legitimate aspirations for mobility whilst managing climate change will not be easy.

The IEA is pessimistic about non-OPEC production of oil. It expects non-OPEC production to peak and to decline in the next few years. The gap between demand and declining production will have to be met by a few countries in the Middle East, mainly Saudi Arabia, Iraq, Iran and the Gulf States for oil and Iran, Russia and Qatar for gas. The stability of the Middle East continues to deteriorate and small countries such as Qatar have problems in absorbing existing revenues and little interest in expanding production. Partly associated with the increasing physical concentration there is a radical structural change in the industry. Until now, most production of oil and natural gas has been in the hands of the industry, but in the future, it will lie in the hands of national oil companies in the producing countries. Mr Birol proposed a model of 3 x 75%; the US, Japan, the EU, China and India are responsible for 75% of global GDP; these countries will import 75% of their oil and natural gas and 75% will come from a handful of countries in the Middle East plus Russia.

The strong concentration of remaining resources and the massive imbalance in production and use has consequences for the management of climate change. It instils a mood of acquisitive panic to fuel existing structures that sits uncomfortably with the need for radical change. Time, it was stressed by many presenters, is short. If we do not change policy within the next 25 – 30 years then well-established trajectories indicate up to 6 degree centigrade increase in global temperature. In 2002, the IEA made a reference scenario for 2007. The outcome is actually worse than the reference. What we have seen in the period is much debate and no effective action. The biggest structural shift in



energy supply over the period has been towards coal. Coal is an attractive option for the power systems of developing countries; resources are less concentrated; it is cheaper than hydrocarbons and the technology is known. Coal is also the most carbon-intensive of fuels. Developing countries rarely have the capital and technology to use super-critical plants, let alone to attempt carbon sequestration.

We are neither running out of energy, nor of capital, but we are running out of time and the next twenty years are critical. The developing countries have reached the stage where the size of their economies and the rate of their growth combine to make them the largest contributor to incremental demand for energy and incremental emissions. China, India, Brazil and

other emerging countries are developing infrastructure for transport, buildings and power generation that may lock them into particular paths of growth and emissions for 60 years. Fifty percent of incremental construction is in China and its thermal performance is poor. Appliances also have poor performance; if the refrigerators and air conditioners purchased in China from now to 2020 were to be upgraded to European standards then it would save energy equal to that produced by the Three Gorges Dam. The same period is critical also in the developed world. Much infrastructure was built after the war and is now due for renewal; this is especially so for power generation – the technology exists if the will is there. Bigger problems arise with the built environment, because this is renewed more slowly - cities are a main

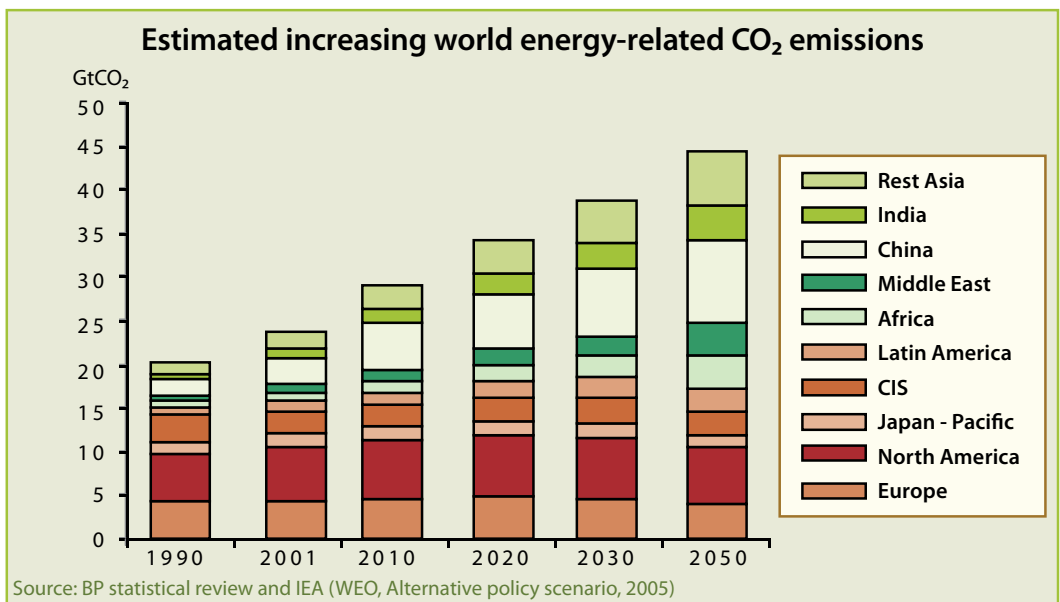
determinant of energy use; in the developed world they change slowly; in the developing world they can change very fast and often in a manner that conflicts with sustainability.

The cumulative emissions of the developed world since 1900 have greatly exceeded those of developing countries and therefore according to the "polluter pays" principle that underpins environmental policy, the financial burden of adjustment should fall primarily on the rich. This topic was addressed by several speakers and they mostly concurred that the main responsibility for action lays with the developed world. Whilst accepting that this argument was true for the present, Mr Birol argued that after 2020, developing country emissions would overtake those of the developed world. By 2030, their use of the carrying capacity of the atmosphere would be

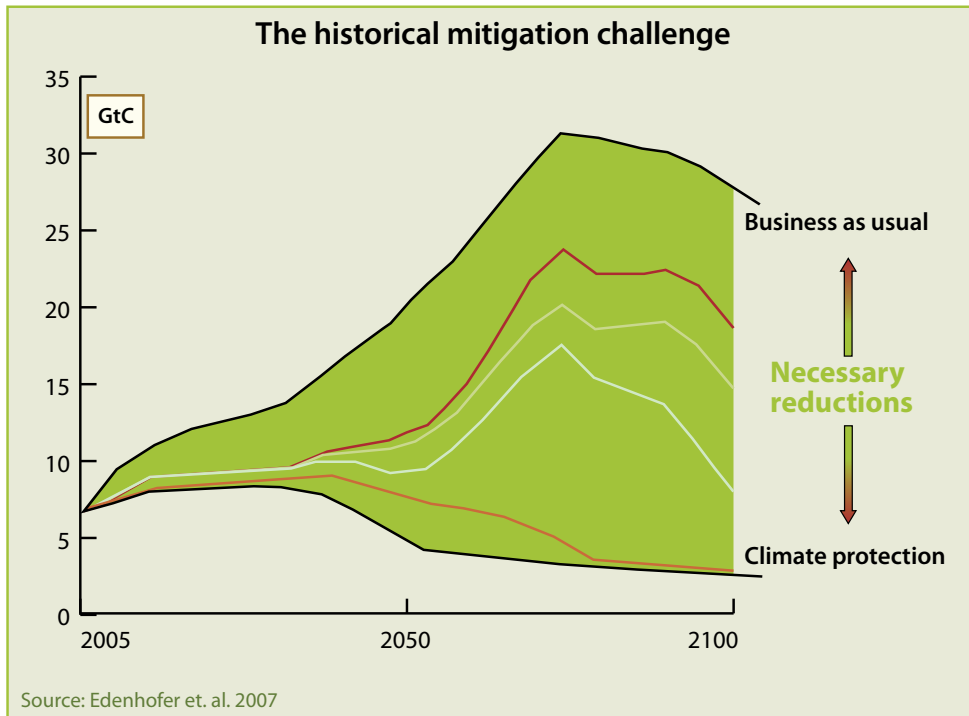
similar to that of the developed world both in volume and per capita.

The first decision in managing climate change is to decide how much to accept and how much to try to avoid. This was described by Hans Joachim Schellnhuber of the Potsdam Institute for Climate Research as the art of "avoiding the unmanageable and managing the unavoidable"*. The unmanageable in his view was the scenario of a 6 degree centigrade rise in temperature and the unavoidable was the 2 degree centigrade rise into which we are probably locked by past decisions and the momentum of present systems.

There was quite strong agreement among many speakers that 2 degree centigrade rise was the best that we could hope for and the biggest rise that probably would not trigger globally



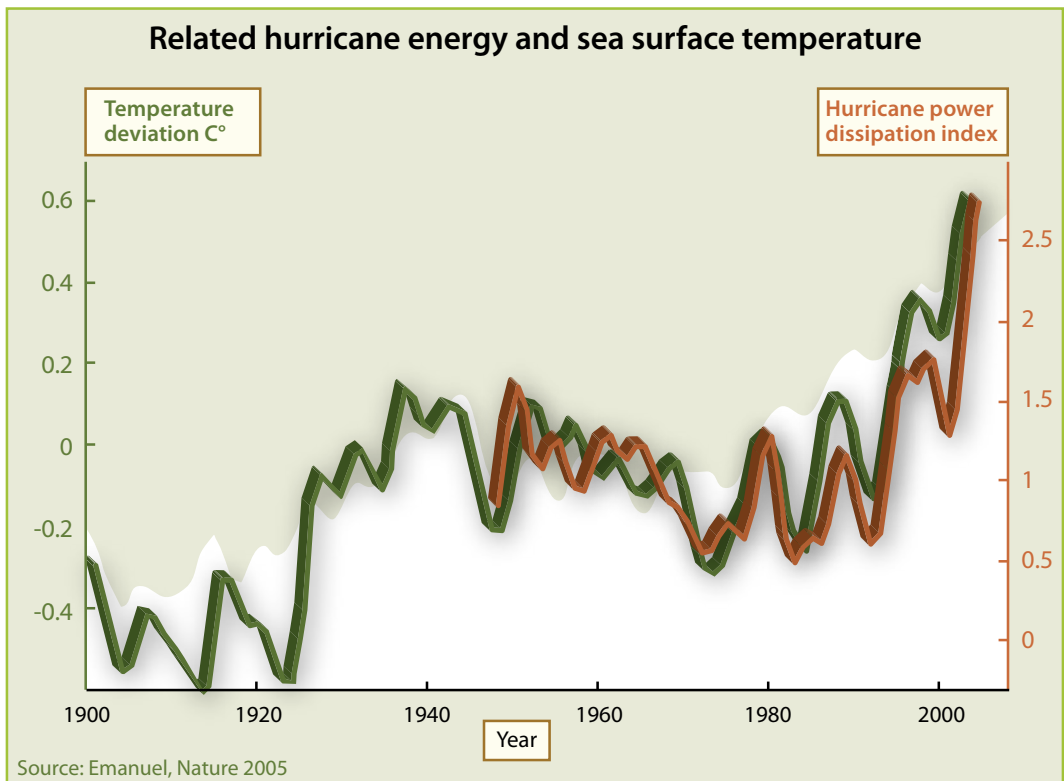
* Social adaptation to emerging energy and environmental models, Hans Joachim Schellnhuber, Director, Potsdam Institute for Climate Research.



catastrophic events. The logic of this decision was clearly described by Mr Schellnhuber. The reasons why climate change causes concern can be ordered according to the temperature at which they begin to be important. At an average global warming of 1 degree centigrade there is a loss of valuable systems such as coral reefs. At 2 degree centigrade, there is a serious increase in extreme events such as hurricanes. At 3 degree centigrade, there are grave economic impacts on the poorest countries reflecting, as noted earlier, that the poorest are the most vulnerable. At 4 degree centigrade, the impact on global production systems becomes dangerously negative; this mainly means agricultural production. Slight increases in temperature can improve agricultural yields in some parts

of the world, especially in the northern hemisphere. Above 3 degree centigrade, there is a strong decline and soon after that, the balance is clearly negative. At 5 degree centigrade, so called tipping elements become serious. They enter into the picture at 2.5 degrees, but they are especially uncertain – major accidents of unknown implications such as a collapse of the rainforest, the disappearance of the monsoon, the meltdown of ice sheets and the production of vast quantities of methane from the meltdown of sub-sea clathrates and the permafrost.

Against this catalogue of horrors must be set some notion of what is practicably achievable. Even if we stop all carbon emissions now, there would still be a rise of 0.5 degree centigrade



because of the thermal inertia of the earth. Given the momentum of existing demand, it is very unlikely that temperature rise can be kept below 1.5 degree centigrade unless we develop techniques of carbon extraction from the atmosphere that are not yet envisaged. The margin for manoeuvre therefore is roughly between 1.5 degrees – the best that could be hoped for and 2.5 degrees – the onset of uncertain events of potentially huge impact. The mean of these limits is 2 degree centigrade and is the target of the EU; it was recognised by several speakers as being the goal that we should strive to meet.

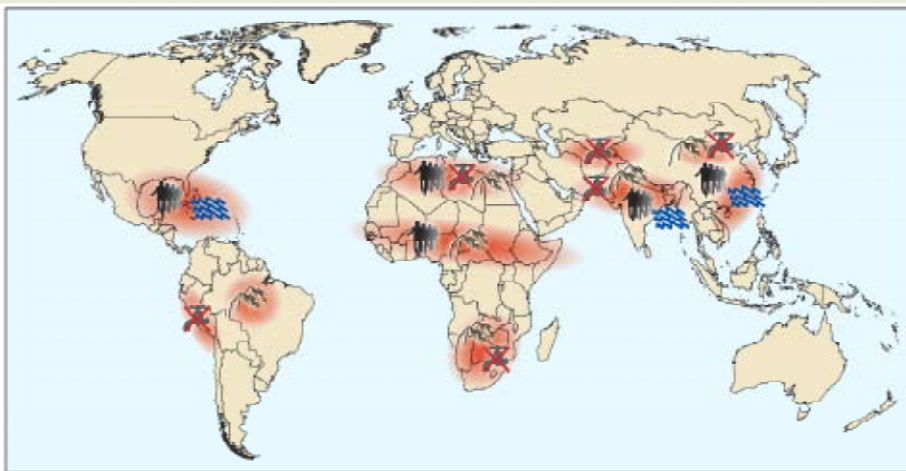
But it is not safe ground. There are still very important losses of output, equity concerns


and significant increases in extreme events; there is much adaptation to be done. And the target will not be easy to reach; there will be much mitigation required and although this may be technically feasible, it is a long, long way from being practical achievable. Social science is critical to both adaptation and mitigation.

Work is being done on adaptation of course, but Mr Schellnhuber suggested that existing work was too focused and limited in terms of scope and too dispersed methodologically to be effective. A massive effort is now needed and mainly aimed at the built environment and infrastructure. An agenda was proposed by Mr Schellnhuber covering the following.

- **Spatial and urban planning:** most of the world will live in cities; they need to be reconstructed.
- **Infrastructural development:** in a wetter world much of the infrastructure for sewage will not be adequate.
- **Nature and culture protection:** habitats will change; we need to facilitate the adaptation of species, for example through migration corridors.
- **Public services:** will need to adapt to changes in the nature and volume of demand; there will be more infectious diseases, spreading faster.
- **Disaster control:** e.g. rapid-response systems for heat waves, management of vulnerable bodies of water, forest fires, flooding.
- **Institutional design:** environmental agreements need to be consolidated and integrated; a global adaptation fund is needed to support developing countries; some arrangements are needed, but they are hopelessly inadequate.
- **Legislation:** an international legal regime is needed for climate change refugees and other migrations driven by climate change.
- **Insurance:** arrangements are needed to insure the vulnerable; maybe insurance for developing countries could be funded out of revenues from auction of permits.
- **Development policy:** climate change needs to be a priority of development policy


Security risks caused by climate change: Selected hot spots



 Degradation of Freshwater Resources

 Decrease of Food Production

 Hot Spot

 Increase of Storm and Flood Catastrophes

 Migration

Source: WBGU 2007

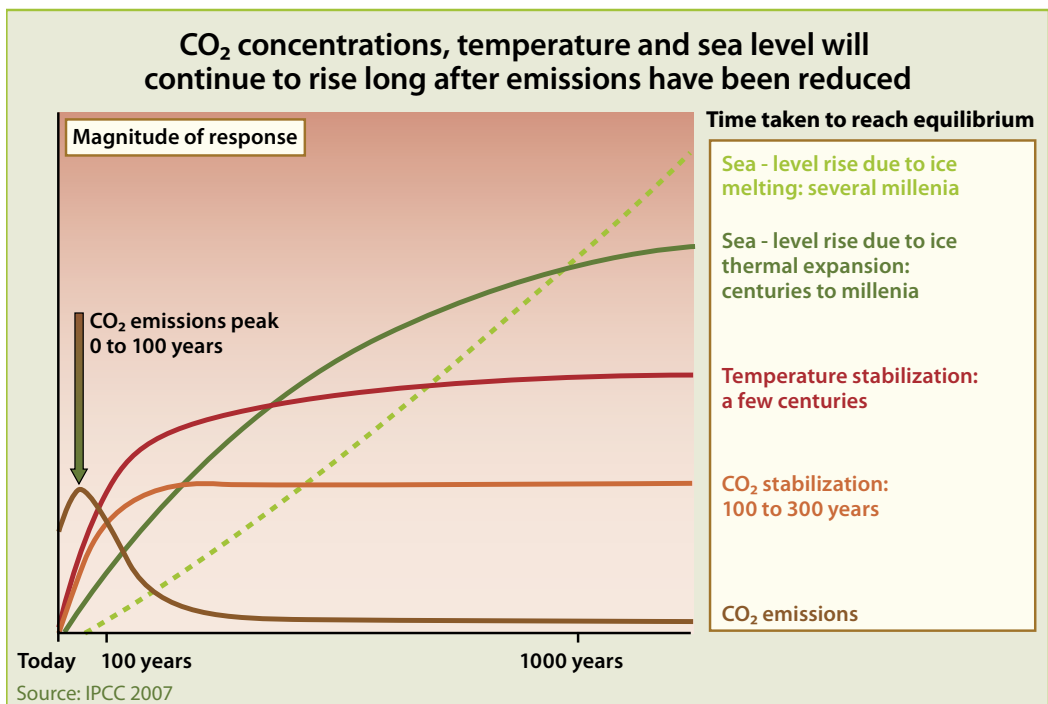
aimed at providing priority treatment for least vulnerable systems & structures.

- **Economic activities:** need to be reconfigured starting with agricultural strategies and policies.
- **Communication:** communities need to be sensitised by long-term awareness-raising programmes.
- **Social capital:** local community support networks need to be developed and fostered.
- **Individual behaviour:** individuals need to adapt values, expectations and behaviour.

Not only are the challenges immense, but as Jacqueline Mc Glade of the European Environment Agency pointed out, the trends are mostly in the wrong direction*. Patterns of behaviour

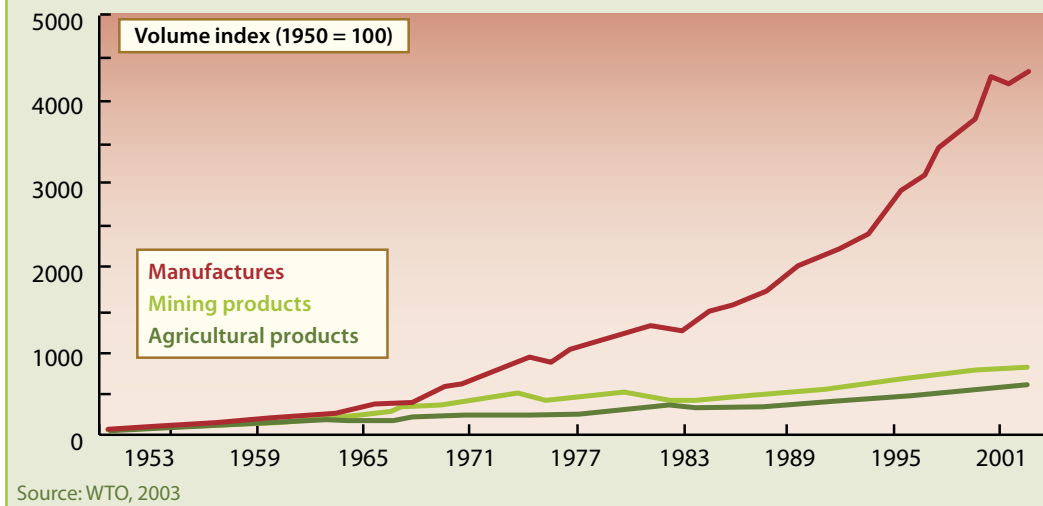
need to change and value systems need to adapt, aiming at quality of life rather than conventional GDP based measures. Society need to shift from seeking ownership of assets towards wealth based on access to services and this needs smarter measures of welfare. Social cohesion, Ms Mc Glade argued, is the most important factor in life expectancy.

Innovation and change will follow legislation and a comprehensive adaptation of legislation is needed to give to climate change the priority that it deserves. Legislation must cover the provision of fiscal incentives, adjustment of taxation to move the burden away from labour productivity onto material use. There must be a shift of employment towards environmental technologies and services.



* Economics, society and new challenges of climate change, Jacqueline Mc Glade Director, European Environment Agency.

World trade is a driving force in resource and energy consumption



Employment is the cornerstone of the Euro-pean social model. The European Employment Strategy is considered to be a critical component of the EU Lisbon strategy for making the EU the most competitive and dynamic knowledge-based economy of the world by 2010. The implications for employment of policies for sustainable development were developed by Mr Clini from the Italian Ministry for the Environment and Territory.

Corrado Clini examined the impacts of globalisation on the demand for labour internationally*. The first impact on the labour market is to increase insecurity of workers as they were challenged directly or through trade by cheaper labour. In his view, this was perceptible now in several countries in Europe and maybe in the US. The second impact is to change relations among the different stakeholders. The goal of business is to introduce

flexibility into industrial relations. Unions are focused on the security of those already in the labour market and under pressure from those outside the labour market, who are not supported by unions. Globalisation has changed the relationship between these three groups and affected the public sector in its function of supplying welfare to unemployed. The third factor is insufficient global demand because of over-production in developing countries with low costs and low exchange rates.

These issues require a proactive approach to social protection and rethinking of roles to ensure that the responsibility for maintaining high levels of effective demand in the global economy is fairly shared. At a general level, the solutions could be identified as:

- **Labour policies to protect workers while preserving market flexibility.**

* Employment in a new sustainable development context, Corrado Clini, Director General, Italian Ministry for Environment.

- **Favourable conditions for employment.**
- **Education.**
- **Increased international cooperation and coordination.**

The driver of sustainable development can enhance security of the labour market. In industrialised countries, new technical standards introduced into processes and products drive a transformation in the labour market with the creation of new jobs and activities. Pressure from consumers for green products is also driving new initiatives in the labour market. Somewhere between 1-3 per cent of jobs are related directly or indirectly to environmental protection. These jobs are in prevention, counselling and services, clean up of industry, research and development, construction and resource and waste management. The range of activities and the number of jobs is expected to increase. The potential is not as high as it might be because of protectionism in the industrialised countries.

There are also big opportunities in renewable energy. An EU-wide study estimated that renewable energy has the potential to create over 900,000 new jobs by 2020, including 515,000 jobs in agriculture and biomass fuel supply. Industry estimates endorse these levels of job creation. Sustainable development can create jobs in developing and developed countries, but we need to develop the correct institutional arrangements. A good example is biofuels. In the EU, the aim is to have 20% renewable energy by 2020 and 10% of biofuels. Even with a strong EU policy, this cannot be achieved from domestic production, but it can be done with imports from the developing world. The

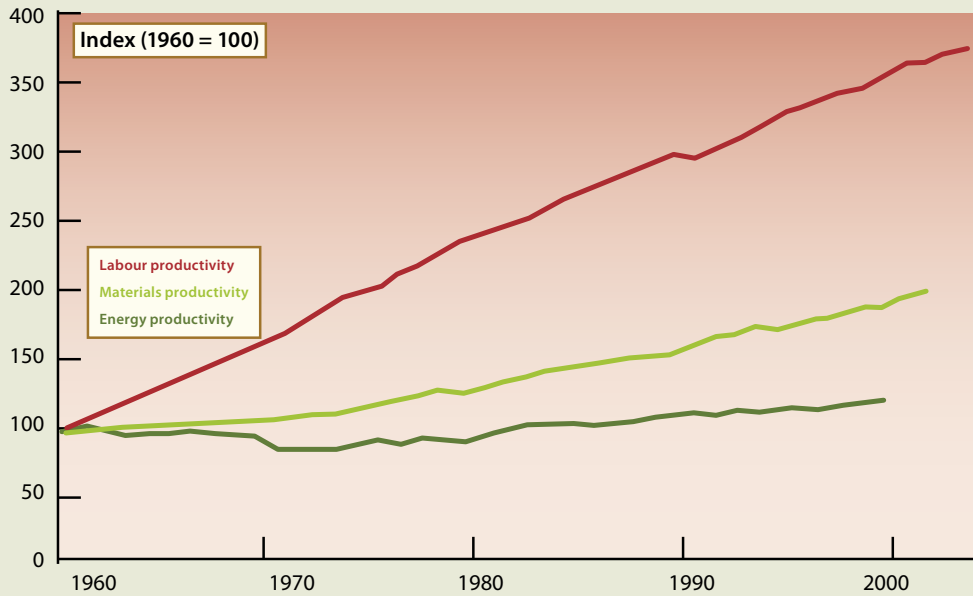
obstacles are the lack of capital in the developing countries and the poor environmental practices. These could both be addressed by a collaborative approach that provided funds and set standards to ensure that there was no conflict with food security or environmental damage. An obstacle identified by Mr Clini was the culture of subsidy across much of Europe, which is inefficient and in the long-run a threat to jobs.

A study by the European Trade Union Federation introduced by Joël Decaillon in a later session deals from a union perspective with the relationship between climate change and employment*. It comes to somewhat similar conclusions that the potential could be significant, but it will need coherent policies to ensure that the balance is positive. There is huge potential for job creation in transport. Mass transit concepts can replace private road vehicles and the building and construction sector has big opportunities, but it will need to undertake training in sustainable building practices. There will be job losses elsewhere and the balance for Europe within a global economy is not easy to ascertain. Enhanced coherence between climate policies and employment policies is needed to ensure positive effects on employment. It is also necessary if European policy on combating climate change is to achieve a broad social consensus.

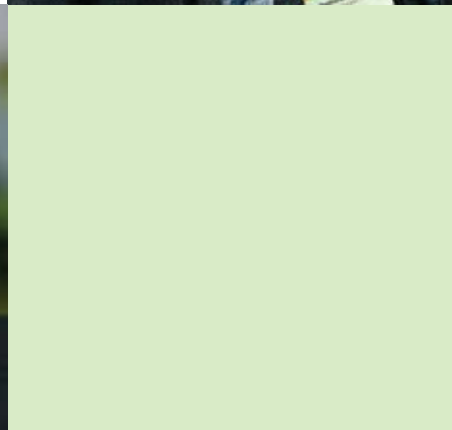
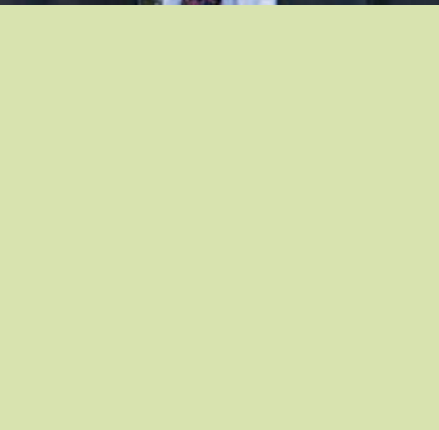
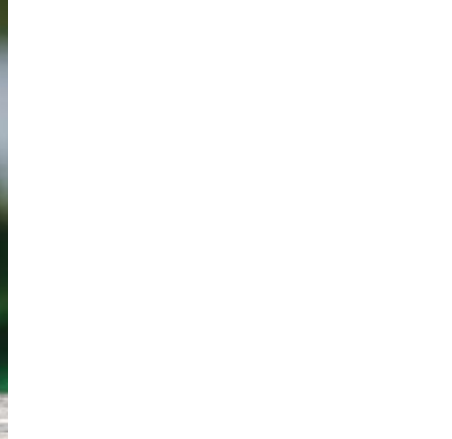
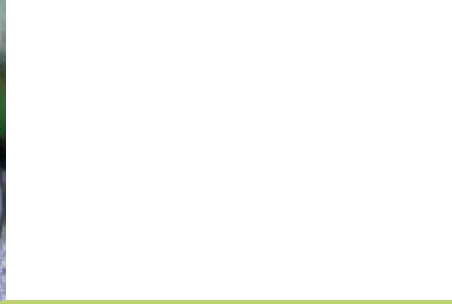
The general tone of this first session was that climate change is well established as a scientific question and to some extent as a requiring economic and political action. Its acceptance as a social challenge remains to gain wide acceptance; there is much to be done.

* Climate change and employment: Impact on employment of climate change and CO₂ emission reduction measures in the EU-25 to 2030, European Trade Union Confederation (ETUC).

Labour productivity has improved two times more than material productivity and three times more than energy productivity in the EU (1960-2002)



Source: EEA 2005



THE ROLE OF POLITICS AND SOCIAL ACTORS

The direction of society in such a manner as to combat climate change can only be achieved by political action. As Mona Sahlin (Leader of the Social Democratic Party in Sweden) expressed it, for politicians, to have the knowledge is never enough; you must also act and lead the way*. Politicians of the Western world must do the radical reforms that we all know are needed, whether popular or not. For democratic politicians who wish to be elected, this is a challenge. The efforts required to contain climate change will radically affect our way of life and living and most politicians do not want to discuss this with voters. Yet even this is changing. In the view of Ms Sahlin, there are signs that voters can also be ahead of politicians and are demanding, albeit in an unstructured fashion, stronger policies and a greener economy. Ignoring environmental issues is beginning to be impossible for a company or political party.

Ms Sahlin echoed sentiments expressed earlier, that there is little time, that the burden falls first on the rich countries, but there are also opportunities. We need new technology, research and development, new investment and a new order of international relations. Managing climate change can be a stimulus to growth. New technologies and investments have always been a condition for economic development. New technology and investments to improve sustainability will bring new potential for economic growth. It is a global issue, but

rich countries are largely responsible for the problem to date and must shoulder the heavier load. The Western world is guilty of the changes in climate, but the developing countries will be struck worst. This injustice makes our obligation in the EU to act even stronger.

Radical programmes of energy efficiency, research and development, economic controls, environmental taxes, and local commitments have been running in Sweden for many years. Since 1990, Swedish GDP has increased by more than 40 per cent but emissions have fallen by 7 per cent. Electricity production from wind energy will be quintupled by 2010. In 1996, few cars in Sweden ran on bio-fuel. Today, every tenth new car sold is a green car. One of the main reasons why Sweden was able to achieve these results was the local investments programmes. These focused on efficient use of energy and other resources, the increased use of renewable raw materials, and increased recycling. The investments were nearly €3 billion, including local co-financing.

The most audacious initiative of the Social Democratic government was the target to end Sweden's dependence on oil, gas and coal by 2020. The government established the Commission on Oil Independence, from the automobile industry, environmental interests, farmers and workers, scientists and politicians; it was chaired by the Prime Minister and published in June 2006**.

* Feasibility of an oil-free economy, Mona Sahlin, Member of the Swedish Parliament.

** Making Sweden an oil-free society, Commission on Oil Independence, government of Sweden, June 2006.

The Commission on Oil Independence's targets were:

- **The road transport sector must reduce oil use by 40-50 per cent by means of efficiency enhancement and new fuels.**
- **Homes and business premises must be heated without oil.**
- **Industry must reduce its oil use by 25-40 per cent.**

This experience brought home the constraints on how far one country can act alone. Ms Sahlin concluded by proposing to draw upon European institutions, upon the common market and common environmental policies to break dependence on oil, by establishing a European Post-Carbon Commission. It would identify where existing regulation conflicts with the post-carbon society and propose new policies to support its introduction.

Many studies have been made of how society might change over the very long-term to provide an acceptable economic future and to meet legitimate aspirations without unmanageable damage to the environment. Recently, the Very Long-term Energy Environment Model has examined sustainable development up to 2100 and the World Energy technology Outlook-Hydrogen has proposed scenarios up to 2050 that drastically reduce emissions of carbon dioxide*. These studies show that current life styles of industrialised countries are neither sustainable nor achievable on a global scale. Sustainability has to become a social priority if individual behaviour is to change. It is not sufficient to rely on spontaneous adaptation. At the heart of the problem is the question

of how society can organise itself to achieve long-term behavioural change.

Mr Chateau of Enerdata identified two aspects of this basic question**:

- **How can life-styles in industrialised countries change?**
- **To what extent will developing countries and industrialised countries converge through globalisation?**

Technological innovation and implementation is essential, but the interaction with life-styles needs to be better understood. Behaviour often exhibits interesting trade-offs between time and energy. At low levels of income, the time spent in collecting food is considerable, but falls as income increases without a great incremental expenditure on energy because practice is more efficient. At a certain point, when reliance develops on energy for processing, preserving, storage, transport and kitchen appliances, the time budget is very low and the energy budget is high. Technology has a similar determinant effect in mobility. It appears that throughout the industrial world, urban citizens spend roughly one hour a day in travel. The time budget is remarkably similar, but the distances travelled, the energy used and the environmental impacts differ widely. The average distance travelled in this time is 3 km in China, 35 km in Europe and 74 km in the US. The energy use increases rapidly because it is affected by both the increase in speed and the increase in distance.

Energy use is not only a function of available technologies, but also of individual decisions based on individual values determined mainly

* VLEEM (www.vleem.org) and World Energy Technology Outlook - WETO H2, Directorate-General for Research, EU Commission, Brussels, 2006.

** Long-term behavioural changes, Bertrand Chateau, Director, Enerdata.

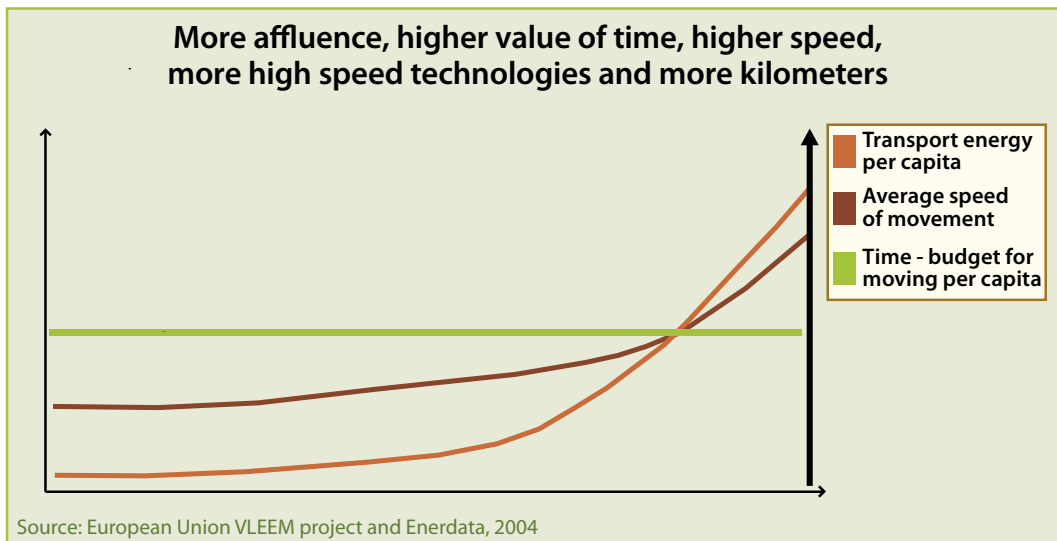
by cultural heritage and social context. They can therefore be changed, but not necessarily easily. The question arises as to the role of economic incentives in stimulating change. Behavioural change is not primarily an economic question; it is a function of values. But behind that, there is a robust economic behaviour that must also be affected. What is needed is change parallel to affect social behaviour by education and economic behaviour by prices. The challenge is to maintain coherence between these.

The momentum of demographic change is not conducive to rapid behavioural change, certainly in industrialised countries. Life-style changes generally occur between generations; it is a slow process that starts in schools; change within a generation is rare. In industrialised countries with aging populations and low birth rates, values are likely to be determined by those of older

people. A trend that affects developed and developing countries is the shift to smaller families. In developing countries, it is mainly the movement away from large extended families and in industrialised countries, it is mainly the shift to single or two-person households. Smaller households tend to mean more space per unit area, higher equipment levels, and lower utilisation.

Mr Chateau concluded with an agenda for research on what post-carbon societies might demand of social behaviour.

- **Better understanding of what could comprise the daily life of people living in post-carbon societies as enabled by appropriate technologies.**
- **Better understanding of the infra-structures, organisation and production modes consistent with these life-styles.**
- **Assessments of how to make the**



transition to these post-carbon societies; the roles of social actors and the risks.

- **Quantitative scenarios of post-carbon societies and how they linked to energy and resource use.**

Social change, like any other sort of change will impose costs and benefits and their allocation will not be even. There will surely be differentiated allocation in many ways, but one principal divergence is likely to be between capital and labour. As noted earlier, globalisation leads to insecurity in the labour markets, but there can be opportunities for job creation if policies are right. There are also unresolved and major social choices between work and leisure that will inevitably be disturbed by radical social change and actors can be expected to fight to defend acquired benefits and obtain new ones. There will be very unequal distribution of costs even from a 2-degree temperature rise that would be very serious for southern Europe and possibly less for the north. These social struggles and the need to organise social dialogue can make the search for solutions more difficult.

A central element of EU policies towards social change is the Lisbon strategy. This is intended to stimulate economic, social and environmental renewal and to increase European competitiveness by investing in a knowledge-based and highly productive society. Unions tend to see the strategy as an opportunity to reinforce the European social model and are concerned by what they see as a tendency to adopt a narrow agenda of structural reform and competitiveness, which could be seen as an attack on workers' rights and protection.

In the view of Mr Decaillon, of the European Trade Union Confederation, there needs to be an open debate in Europe on the location of systems of production in a global world and the nature of economic growth*. He identified two important areas of ignorance that need to be corrected if we are to make sensible decisions about the future. One is to understand the future location and nature of industrial systems; this is necessary if we are sensibly to assess the needs for exchange and transport. He stressed, as did others, that time is critical. We need to understand better the adjustment processes of the great industrial enterprises that control the economy and shape its future. They have little interest in long-term investment and sustainability, but are motivated mainly by short-term profitability.

Based on such a better understanding, economic forecasting can be improved. Better forecasting is needed to support better and more normative ideas about the future and to provide a more reliable basis for political decisions. Shaping of the future will require constraints on key sectors and a shift of taxation towards the use of resources rather than productive activity was rational, but market-based instruments need to be carefully examined to ensure that they do not create a less equal society. Taxes on resources are generally retrogressive.

Consensus on a new social model can only be achieved through at least a tripartite debate with labour, business and government. Whilst recognising that many big enterprises had responded at least partially to sustainable development by seeking out new products and

* Energy and environment as a social challenge, Joël Decaillon, Political Secretary, ETUC.

processes, Mr Decaillon identified inherent contradictions between growth and sustainable development at the industrial level. He also detected incoherence between the needs for transparency if the debate has to be constructive and the confidentiality that tends to be a driving principle for industry.

Business tends to have a less nuanced view as to the importance of competitiveness. In the opinion of Fabrizio d'Adda, of Business Europe, the primary generation of wealth, from which any redistribution can take place, is industry*. European industry must remain competitive, for the well-being of the 20 million companies and 230 million employees in Europe. The affluent economy is a huge success; developing countries want it and the political forces are in favour of staying with it rather than abandoning it. He developed the argument that technical innovation within a competitive system is the key objective of industrial strategies of adaptation, a position reflected in a discussion paper published under EU auspices in 2006**. According to this analysis, profitability is the main driver for market introduction of eco-efficient innovations, but it faces several barriers:

- **Familiarity with and perceived lower risk of mainstream products and services.**
- **Difficulty in raising venture capital and credit for market introduction.**
- **Uncertainty about the consistency of middle and long-term government policies.**
- **Failure of the market to value the environment and resources correctly.**

If market failures and related barriers are addressed properly, business will grasp the opportunity that eco-innovations offer to increase the EU's competitiveness. Some of these barriers are existing investments that limit the penetration of new ideas. One way of addressing this issue would be to create circumstances where new products and services can be tested and adopted. Public procurement offers this possibility. 30% of services and goods are procured publicly. It would be quite proper for public authorities to make environmentally based decisions to support new technologies, allowing them to compete subsequently in the real market.

To support such practices and the adjustment strategies of most social and economic actors, it is necessary that the European Union and its Member States develop a clearer vision of the road to a post-carbon Europe. Public and private stakeholders should develop shared sector scenarios that set objectives and instruments in key sectors. There is only one chance at this; it cannot be repeated in five years if it goes wrong. They should work with developers, suppliers and consumers to develop shared scenarios for relevant sectors with specific ambitions and milestones, and well-defined roles and responsibilities for the different stakeholders. These scenarios should give highest priority to ensuring the convergence and coherence of the goals for competitiveness, job creation and resource efficiency.

There are many technologies available to support sustainable development. The technology we have now is mainly what we have to rely

* *Businesses anticipation and reaction*, Fabrizio d'Adda, Industrial affairs committee, BUSINESSEUROPE.

** *A will to compete: a competitive, clever and clean Europe*, Brussels, January 2006.

upon. Implementation will need political will, appropriate policy and huge financial resources. The elements are:

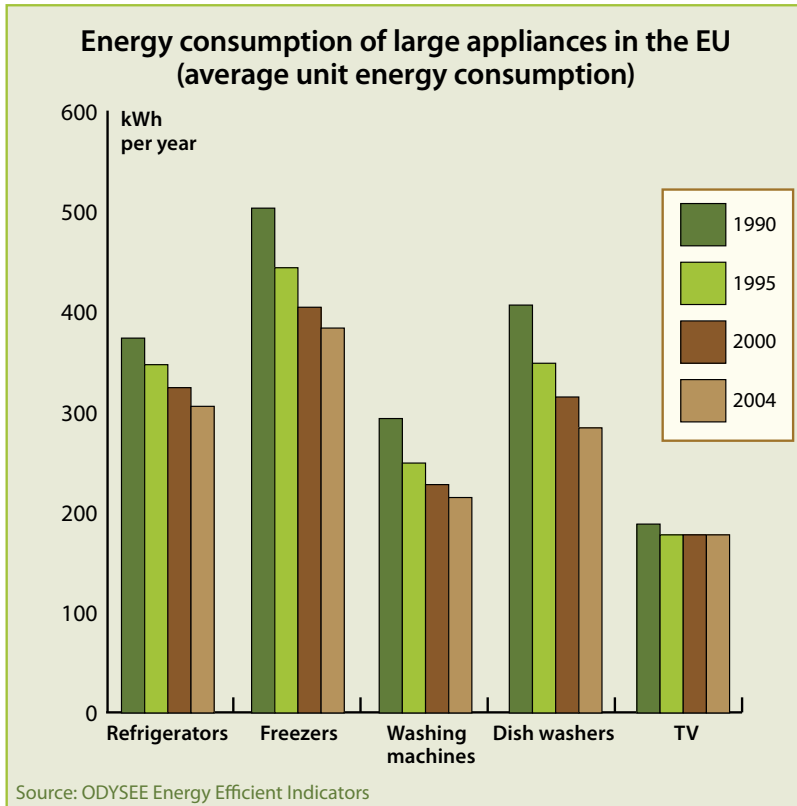
- **Improved energy efficiency.**
- **Carbon reduction and sequestration – super-critical plants and carbon capture and storage must be developed. The scope in developing countries is limited by financial constraints.**
- **Intelligent renewable policies – the present target of 20% by 2020 is high and difficult to reach. Public authorities should limit incentives to technologies that have high economic efficiency. It should be a priority to harmonise support systems, adopt certification approaches and to permit trading in certificates of origin including from countries outside of Europe.**
- **A new nuclear wave – it is unrealistic to talk of a post-carbon society without nuclear. There needs to be more harmonisation of the EU approach, including for safety, licensing.**

Ignacio Perez Arriaga, of the University of Comillas, also identified the transition from a prospective analysis to a normative analysis as a critical element of strategy*. Such a normative analysis would clearly identify the origin of the problem and the practical options available to deal with in, in turn supporting informed debate and the adoption of solutions that are understood and supported by citizens. This normative vision he proposed to implement through regulation covering cost-reflective pricing, command and control measures and financial incentives. To support these technical

and administrative measures he proposed a shift from the present paradigm of continued economic growth as currently measured, to a new paradigm of restraint and moderation.

There was surprising accord in this session on the need for normative scenarios as a basis for political, social and individual actions. In reality, there would be radical differences in the views of what those normative scenarios would comprise, where restraint should be practiced and how the burdens would be shared. Some conflicting emphases were visible in the presentations. How can the burden be shared between capital and labour, between north and south Europe, between developed and developing worlds, must we abandon the affluent society? The need for social scientist research to inform and moderate this debate is clear. Citizens live, for obvious reasons, in cities. Most of the world, on present trends, will live in cities in the near future. A great deal of energy is used to service urban buildings and to provide mobility within and between cities. Cities have great inertia and their form and function will be a strong determinant of the capacity to implement the policies and regulations designed to combat climate change.

* Technology and society, José Ignacio Perez Arriaga, Professor, Universidad Pontificia Comillas.





CITIZENS' INTERACTIONS WITH LAND-USE AND ENERGY DEMAND

Cities have a function that is not easily dismissed. They exist because of the increasing returns to scale inherent in large labour markets. In its extreme and simplest terms, this function means that all jobs should be easily accessible from all residences. Communities that are designed on the basis that jobs and homes are spatially co-located will be less economically efficient. Empirical evidence suggests that dominantly monocentric cities with well-defined central districts reduce journey times and therefore total volumes of pollution and green house gas emissions. Because the pollution is concentrated in a small space, the exposure to pollution may be greater. Over time, large cities tend to become less monocentric and journey times increase and the efficiency of public transport declines. Private transport becomes more attractive and this, combined with longer journeys, causes the use of energy to rise. Dense monocentric cities have high land prices that restrict the size of homes and reduce land consumption and energy use. As the city increases in size, land prices may fall, houses get bigger and energy use increases. This simple analysis leads to the conclusion that dense, monocentric cities are good for climate change and jobs whereas urban sprawl is economically inefficient and energy consuming. It poses questions as to whether this analysis holds for sustainable development, whether there is an optimal size and spatial organisation of cities to facilitate management of climate change and what tools are avail-

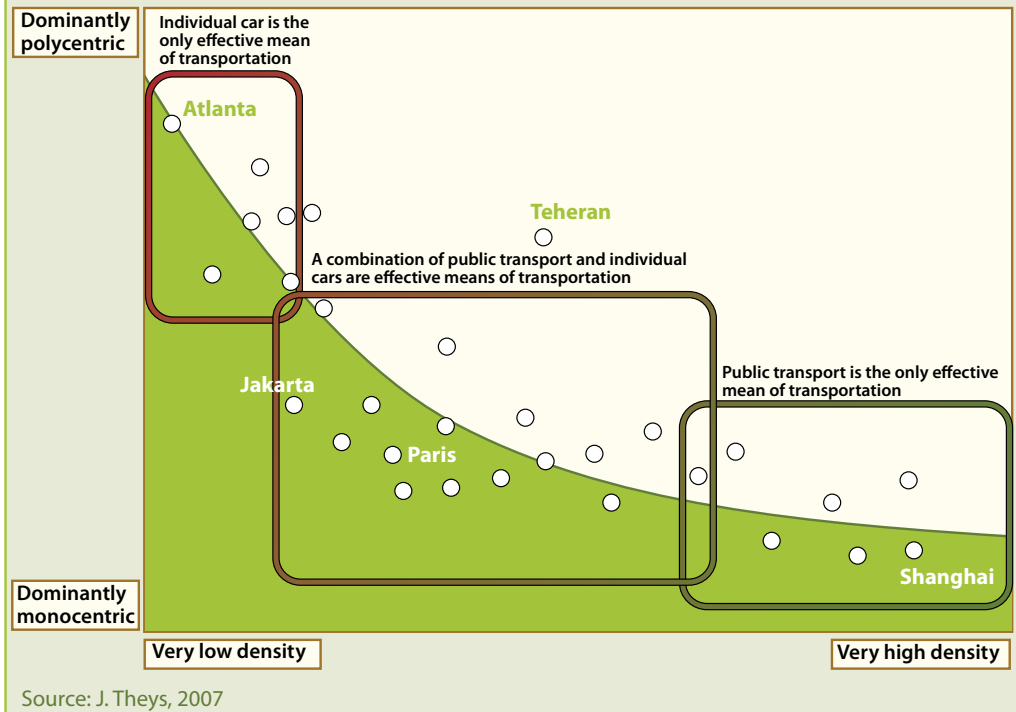
able to influence the spatial structure and size of cities. It does not address the fact that much of the existing built environment is extremely inefficient because of well known market failures that prevent energy efficiency. It also reiterates once more in an intriguing form the theme introduced by several previous speakers, notably Mr Chateau, that the adaptation of society has to be conceived within the capacity of the available technology. Rapid transit systems involving light rail and tramway can give large gains in energy efficiency and GHG emissions. What will be the influence of modern mass transit systems on the optimal size and viability of monocentric cities?

Jacques Theys, of the Centre de prospective et de veille technologique, noted that in the EU, towns are responsible for perhaps 50% of energy consumption, but their significance is overlooked, as demonstrated by a single page of attention in the Stern Review*. There are reasons to be optimistic that cities can be adapted better to cope with and mitigate climate change. There are reasons also for pessimism.

On the optimistic side of the balance, there are many interesting and promising experiments underway to demonstrate the potential for sustainable urban development. Many of these are implemented in developing economies experiencing a rapid urbanisation, often regarded as problematic for the environment.

* Re-thinking the city, Jacques Theys, Centre de prospective et de veille technologique.

Relations between energy consumption in transports, population density and urban structure (monocentric or polycentric)



A leading example is the Eco-City of Dongtan in Shanghai, conceived to demonstrate the idea of an "eco city". Dongtan is being built on the island of Chongming, off the coast of Shanghai, to which it is linked by bridge and tunnel with a high-speed rail link planned. The city will comprise low energy buildings making use of passive solar concepts and serviced by wind, solar and biofuels; waste will be recycled and composted. The spatial organisation of the city is compact, with mixed patterns of land use. Pedestrian and cycle routes are provided to reduce the demand for cars. The population should reach 25,000 by 2010 and around 80,000 after 2020.

On the pessimistic side, these experiments are in reality very limited. The inertia of existing city infrastructure is immense and possibly definitive. There is an absence of human resources for the huge design and reconstruction effort that would be required and an absence of a real scientific basis for the design principles. The most important element, for industrialized countries, might be the "fantastic" nature of a post-carbon city and the need for city-sized, green-field sites that do not exist in most of the EU and certainly not where present economic structures require mass labour markets.

Between these extremes, Mr Theys chose to steer a middle path. Based on three principles:

- **Rapid reaction.**
- **Massive renewal.**
- **Rethinking the planning of cities.**

The first principle of rapid reaction depends on limited interventions with a minimum disruption to the life of the city. Such interventions might include regulation that is more aggressive and the promotion of innovative transport solutions. The advantage, and indeed the principle, of this approach is that it is little disruptive. The undesirable consequences are that technologies cannot function to their full potential, because they are limited by pre-existing constraints; many interventions will increase costs and disadvantage the old, poor and handicapped.

The second principle is that of massive renewal. Such intervention is extremely expensive. It requires the rethinking and redesign of transport systems and the built environment. It is impossible to imagine that such an intervention would not have critical consequences for planning – the decision processes would be complex, difficult, and contentious and would require important interventions from qualified people at all stages. Such renewal will only be practical for dense urban structures and the impacts will be to some extent cancelled by increases in emissions from peri-urban developments.

The third principle is to rethink the planning. This must start from an analysis of the relationship between spatial configuration and energy

use. Transport use per capita in different cities can vary from 1 to 100. Atlanta leads the field for inefficiency, but cities in the USA generally have a monopoly of the top spots in this list with per capita consumptions typically 4 to 6 times higher than in Europe. Transport energy consumption in Asian cities is roughly half of Europe. The evidence suggests that the geographical distribution of economic functions is more important than simple spatial density.

Mr Theys addressed the argument that monocentric cities are more appropriate than polycentric cities for sustainable development. He identified three criticisms of this position:

- **Spatial redesign is even more difficult to achieve in monocentric cities – they are less flexible.**
- **Debate about city organisation is no longer relevant – we need to look at regional interactions between cities.**
- **There is a balance to strike among density, efficiency and cost and we cannot optimise single variables.**

The conclusions of this analysis are that:

- **There is movement – the function and impact of cities is recognised.**
- **To rethink the city presupposes a vision.**
- **There can be no ideal model – the variables are too complicated to balance.**
- **There is need to reconcile urgent needs and long-term benefits.**
- **Work requires intervention at multiple levels of governance. The governance of urban space is complex and research**

is needed to identify effective decision-making strategies in the multi-level environment.

- **A city is not just a matter of concrete and traffic – it is a way of life and research should focus also on how social needs interact with spatial organisation.**

Mobility is perhaps the most demanding of social preferences. Nebojsa Nakicenovic, from the International Institute for Applied Systems Analysis, noted that from 1800 to 2000, population across the world had increased by a factor of six*. GDP, as far as we can measure it, increased twelve-fold faster than population, but energy use increased only six-fold. Emissions of CO₂ increased only three times as fast. Mobility increased 1000 times absolutely and more than 300 times as fast as population. People like to move about.

The environmental impacts of mobility can be reduced by restricting mobility or by reducing its emissions. Hydrogen fuelled vehicles are the eventual goal, but the financial resource required to complete the R&D and especially to demonstrate viable systems are immense and certainly greater than those available to the recently agreed Joint Technology Initiative of the EU and the hydrogen industry.

Technology for mobility is one thing; primary energy supply is another. Important questions need to be addressed about how to stimulate production of renewable energy in a manner that is sufficient and cost-effective. Paolo Frankl, of the IEA, examined the effectiveness of subsidies to the production of renewable energy**.

His analysis suggested that money alone is not enough. Support policies in Italy and the UK had been expensive, but ineffective; social rejection of wind power and other renewable options had greatly increased the costs of support policies. The barrier is social acceptance and in his opinion, this was underestimated as an obstacle to the diffusion even of technologies generally seen as benign. Polls indicate that in Switzerland, for example, consumers want renewable energy, but they are exposed to excessive, poor quality information. What is needed is good information.

There is potential to deploy business in a catalysing role. There are clear signs that some business has identified consumer concern with sustainability as an important factor of choice and therefore as a potentially important contributor to sales and profit. This can find expression in statements of corporate responsibility, but also more proactively in attempts to create awareness and to involve stakeholders and consumers in decision-making.

Politicians need to size upon this awakening corporate understanding. They need to convince business that their interests lie in interpreting and anticipating the changes in consumer conduct that will be stimulated by long-term environmental and political trends. Politicians need in the short-term to set the appropriate framework for transition through a mixture of market and regulation-based policies. Thereafter they need to provide means of verifying claims by ensuring that proper methods are available to assess the full life-cycle of technologies and products and to assess the full

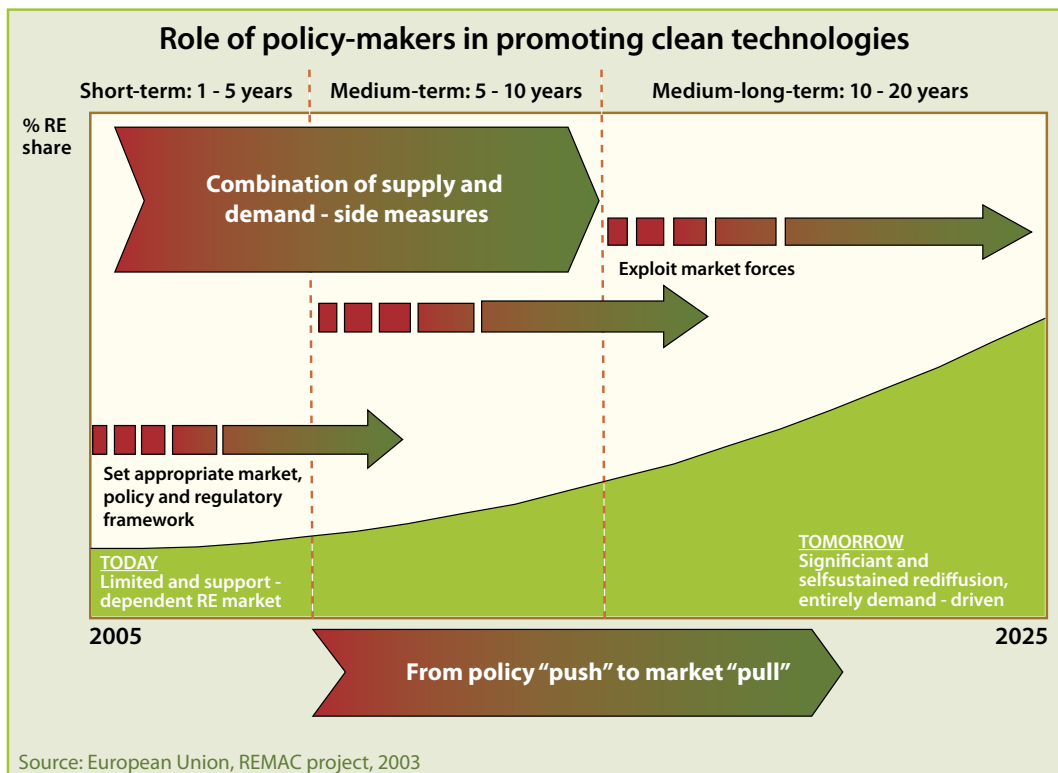
* Energy and environment as a global challenge, Nebojsa Nakicenovic, Professor, VUT and International Institute for Applied Systems Analysis.

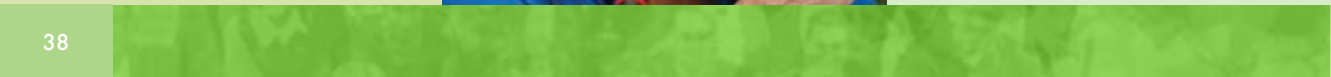
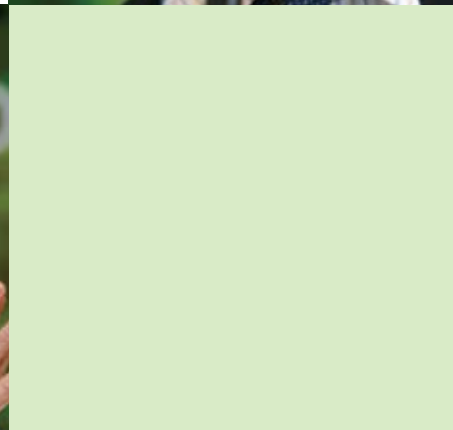
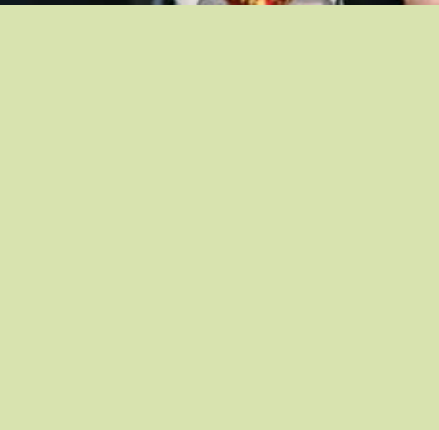
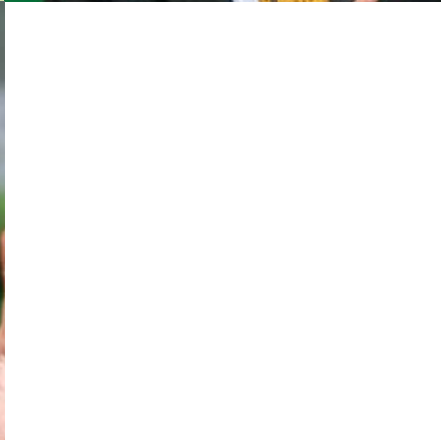
** Behavioural change and technological sustainability, Paolo Frankl, Head of Unit, International Energy Agency.

life-cycle costs and they need to preserve the long-term vision of where environmental, economic and social norms are leading consumerism. Some of the environmental concerns over bio-fuels, for example, are justified and we need techniques to address those concerns systematically.

In brief, the session indicated a need to empower the citizen. Decisions on city design and planning can only be founded on the preferences of citizens. Otherwise, they will fail. Mechanisms need to be found to ensure that citizens understand the issues and options can express their preferences.

Mobility is the key to city design and sustainability. Mass transit technologies can affect development, but they need to be supplemented and to draw upon, advanced propulsion systems with hydrogen as the eventual long-term goal. A great deal of social science research is needed to understand the interaction between city design, social preferences, the costs and performance of vehicles and infrastructure and policy incentives. If renewable energies are to form a significant part of the supply to cities then citizens need to be better informed and better involved. Business needs to be engaged to catalyse the relationship between politician and customer.





A NEW GOVERNANCE TOWARDS A POST-CARBON SOCIETY

Climate change has moved from the specialist domain to a political challenge and makes demand on governance at many levels, international, national, regional and corporate. There is within the European institutions much legislation and policy that bears upon the topic. The spring meeting of the European Council in 2007 undertook a fundamental consolidation of its aims in governance and policy for climate change, covering international cooperation, domestic objectives and energy policy.

Fabrizio Barbaso, Deputy Director General for Energy and Transport, presented the main elements of this strategy*, based essentially in:

- **Functioning of the market.**
- **Regulation.**
- **Sensibility of the citizens.**
- **Promotion of technology.**

At the spring meeting, the European Council recognised the vital importance of limit worldwide greenhouse gas emissions to an amount that would restrict global temperature increase to 2°C compared to pre-industrial levels**. The Council affirmed that developed countries should take the lead by committing to collectively reducing their emissions of greenhouse gases in the order of 30% by 2020 compared to 1990, with intent to reduce emissions by 60% to 80% by 2050***.

The Council recognised that the EU should have a leading role in seeking workable forms of international governance for climate protection. It rightly saw a need for a global and comprehensive post-2012 agreement, to build upon the Kyoto Protocol. It specified the essential elements of such agreement as:

- **A shared vision to reach the ultimate objective of the UN Framework Convention on Climate Change.**
- **The strengthening and extension of global carbon markets.**
- **The development, deployment and transfer of the necessary technology to reduce emissions, appropriate adaptation measures to deal with the effects of climate change.**
- **Action on deforestation and addressing emissions from international aviation and maritime transportation.**

The Council endorsed an EU objective of a 30% reduction by 2020 if other developed countries to commit themselves to comparable emission reductions and economically more advanced developing countries contribute adequately according to their responsibilities and capabilities. It invited proposals from these countries for their contributions to the post-2012 agreement. In any case, it set a firm independent goal to cut greenhouse gas emissions within the EU by 20 percent by 2020 in relation to 1990 levels.

* EU sustainable energy policy, Fabrizio Barbaso, Director General, EC, DG Energy and Transport.

** European Commission, Limiting global climate change to 2 degrees Celsius The way ahead for 2020 and beyond, COM(2007)2, 10.1.2007.

*** Presidency Conclusions – Brussels, 8/9 March 2007.

Energy accounts for 80% of all greenhouse gas (GHG) emission in the EU; reducing energy use is fundamental to managing climate change. Current energy and transport policies would mean that CO₂ emissions in the EU would increase by around 5% by 2030 and global emissions would rise by 55%.

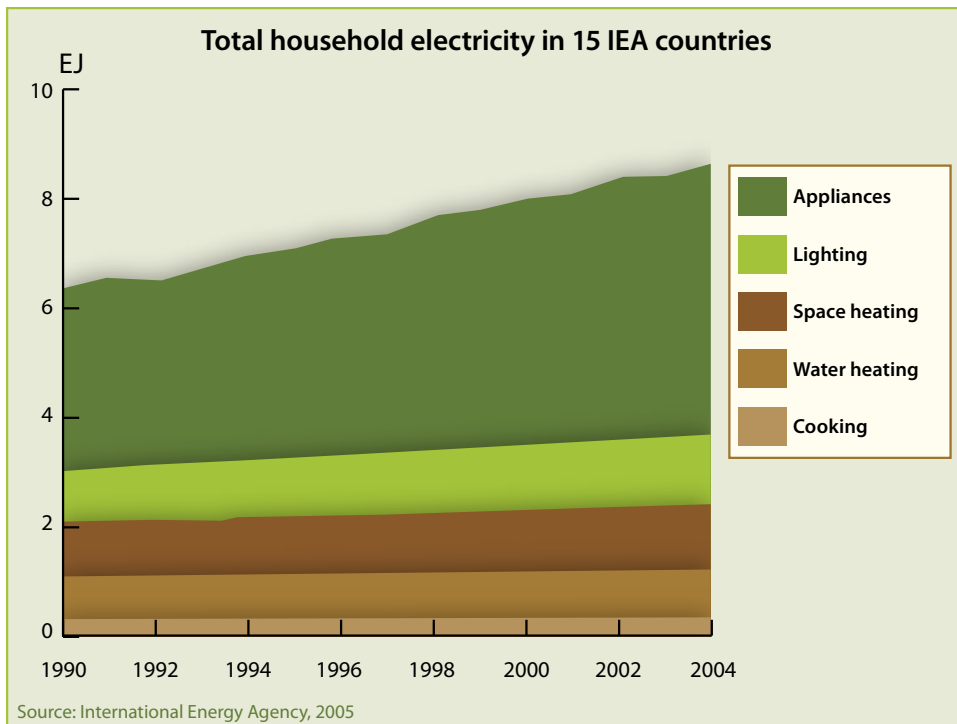
The present energy policies within the EU are not sustainable. This was recognised in new proposals for energy policy published by the Commission at the beginning of 2007 including an Action Plan with the three goals of security of supply, efficiency and environmental compatibility. The Council adopted this Plan and asked the Commission to prepare an overall coherent framework for further development of renewable energies. It endorsed ambitious targets for use of renewables, specifically:

- **A 20% share of renewable energies in overall EU energy consumption by 2020**
- **A 10% minimum target to be achieved by all Member States for the share of biofuels in overall EU transport petrol and diesel consumption by 2020, with some qualifications relating to the sustainability of production.**

The Council also endorsed the Action Plan on Energy Efficiency. The objective of the plan is that by 2020 the EU would use 13% less energy than today, worth €100 bn and reduce emissions of CO₂ by 780 millions tonnes each year. The plan contains seventy-five measures covering energy appliances, buildings, transport and energy generation. Stringent new energy efficiency standards, promotion of energy services and specific financing mecha-

nisms to support more energy efficient products are proposed. Minimum performance requirements for new and renovated buildings will be developed. Very low energy consumption buildings (or passive houses) will also be promoted. The plan recognizes the importance of changing transportation behaviour. It also addresses education and training and emphasises the need for energy efficiency issues to be treated globally through international partnerships. The Commission will establish a Covenant of Mayors of the 20-30 most pioneering cities in Europe and will propose an international agreement on energy efficiency.

Mr Barbaso recognised that most of the technologies on which we can depend are known; there will be few breakthroughs. The key is to find a means of accelerating their diffusion. This observation echoed the sentiments of many previous speakers that the practical challenge was to adapt social behaviour to the possibilities of the technology that we have or can reliably expect to have. The Commission is now working on a European Strategic Energy Technology Plan for sustainable energies, notably renewables, low carbon technologies and the further development of energy efficiency. It will be submitted to the 2008 Spring European Council. The 2007 Council urged in particular a focus on bringing environmentally safe carbon capture and sequestration (CCS) to deployment with by 2020, through strengthening R&D and developing the necessary technical, economic and regulatory framework. The Commission intends to establish a mechanism to stimulate demonstration in twelve commercial power plants by 2015.



It was also noted by Mr Nakicenovic, in an earlier session, that IASA scenarios suggest that even in the most favourable cases, it is necessary to sequester large amounts of carbon if temperature rise is to be kept within the 2-degree limit. If the cost of sequestration is €50 per tonne, then much mitigation can be economically justified. The cost of mitigation is surmountable, but technologies need to be developed and improved. There needs to be a much bigger R&D effort in this field.

Mr Gordon Adam, past Vice-President of the Energy, Research & Technology Committee of the European Parliament, elaborated on the factors determining technical choice*. In his view, if Europe is to give decisive international

leadership then it needs a clearer concept of viable strategies and of the policy priorities. There is a huge gap between scientific and public perceptions and many simplistic visions. In the UK, some believe that a €3,000 tax on four-wheel drive vehicles "would soon make Britain carbon neutral". Others see the solution in terms of reducing food-miles, restricting air flights, fitting energy efficient light bulbs and switching off electrical equipment when not in use or building carbon neutral houses. There is much interest in bio-fuel use, but concerns are growing about their contribution to reducing CO₂ emissions and their effect on food prices. Opposition to wind farms is growing in the UK as well as to the proposed Severn Barrage. Advances in nuclear reactor design over the

* EU in a future world context, Gordon Adam, Former Member of the European Parliament.

last 20 years are largely ignored, as are the operational final disposal systems for low and intermediate level radioactive material and the preparation for final disposal of high-level radioactive spent fuel that will be operating in Finland by 2020. It is a very confused picture.

In order to lead the rest of the world the EU must demonstrate beyond doubt that carbon emissions can be stabilised by 2020 and thereafter reduced. Mr Adam observed that he met few practitioners in the real energy world who believe that EU targets for renewables and energy efficiency can be met and still less that the emission trading scheme will deliver the desired reduction in carbon dioxide. There is an unresolved political conflict between those who see energy policy solely in terms of energy efficiency and renewables and those who believe that nuclear energy and carbon capture have an important contribution to make.

If we are to take seriously the threat that human induced climate change might bring and if the European Union is serious about giving a lead to the rest of the world, then among the key actions should be the following:

- **Energy strategy must be primarily focussed on sustainability and the reduction of CO₂ emissions.**
- **Greater precision is needed about objectives and policies. Clarity is essential for public understanding, acceptance and action. This is especially true for demand management by the individual.**
- **Energy efficiency measures should also be prioritised on the basis of**

their contribution to reducing carbon intensity.

- **All research, development and demonstration in the energy sector must be directed at reducing carbon intensity and achieving the greatest reduction in CO₂ emissions in the shortest possible time.**
- **The Commission should support additional nuclear generation.**
- **The targets for renewable energies should be replaced by a target for low carbon energies.**
- **Above all, many more scientists, technologists and engineers will be needed to have any hope of success.**

Europe has adopted, with more enthusiasm from some Member States than others, a market based approach to the governance of utilities. A proposal for a new round of legislation to strengthen liberalisation of gas and electricity markets was published by the Commission along with the energy strategy at the beginning of 2007. Draft legislation to clarify the separation of ownership and operator functions within network businesses was proposed to the Council in autumn 2007.

Progress in liberalisation has been slow, largely because the positions of Member States are not well aligned. There is a wide range of practice and opinion across Europe that is based in fundamental social, political and economic attitudes. The liberal economic models of Scandinavia and the UK tend to favour unbundling in some form. The deep involvement of the state in the economy of France tends to resist liberal models. The split reflects different conceptions of the role of

public service companies in European energy policy. The liberal idea of competitive, unbundled, pan-European companies, delivering policy objectives under market based instruments of regulation confronts the alternative of national champions, secure in their domestic markets delivering policy under direct political guidance. France has suggested that the state controlled EDF and the new GDF-Suez merged company with a blocking state share ownership is a template for European energy policy. Germany lies somewhere in between; the influence of large companies is strong and German practice is more to regulate their activity then to seek structural solutions.

This underlying tension in the political governance of the energy companies was explored by Jacques Percebois, of the University of Montpellier*. He identified the three great principles of public services as continuity, equality of treatment of customers and adaptation to technical progress. Within the public service, there exist regulated natural monopolies and unregulated businesses potentially appropriate for competition. To establish competition there are three main steps: to specify eligible consumers, to create non-discriminatory access by competing industries to infrastructure and to develop spot markets for trading.

Trading across international frontiers led to an equilibration of marginal costs and therefore to similar prices. The spot markets in France, Germany and Benelux were coupled in 2007 and since then spot prices in France have tended to track the marginal costs of coal-fired generation in Germany, creating rents for EDF and raising prices on the French market.

The main question addressed by Mr Percebois was whether market prices are in themselves a good long-term signal for investment and therefore by extension the interaction between price-setting through a competitive market and investments necessary to mitigate climate change. The purpose of a competitive market is not to lower prices; it is to lower rents. The increase in prices noted since liberalisation is not due to the behaviour of the electricity market, but simply to an increase in the input price of fossil fuels. Prices may not be good indicators of the risks and uncertainties inherent in the future and do contain external costs. Market-based instruments are needed to internalise these aspects.

Gas is an especially troublesome issue. Europe relies disproportionately on Russia for its supplies of gas. In 2006, the EU imported 62% of its gas requirements and 24% of supplies came from Russia. By 2030, dependence on imports of gas will rise to 84%. This has several consequences. Russia practices an export monopoly and is able to extract a considerable rent. There is in principle competition from suppliers in other countries, but most of them are also export monopolies. This structure raises prices for two reasons; firstly, because if there were competition among suppliers within a single exporter then prices would fall and secondly, because there is always a danger of covert or implicit collusion among producers to keep prices high – the possibility of a gas OPEC. Russia controls export pipelines within its territory, but has shown interest in acquiring infrastructure in Europe. Recent EU legislative proposals envisage that sale of energy assets to non-EU countries would be restricted

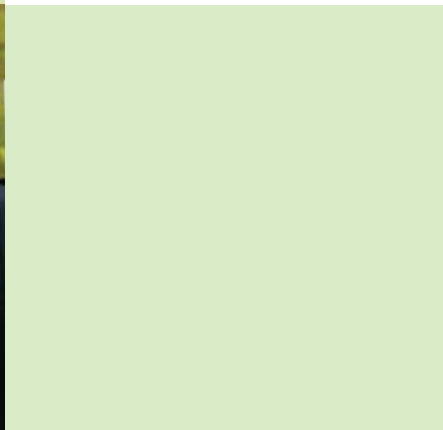
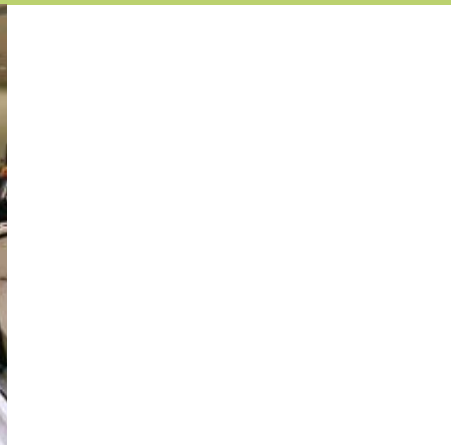
* The role of public services, Jacques Percebois, Director of CREDEN.

to those that had signed agreements and practiced similar open markets, but this principle of reciprocity is not thought adequate by all. Mr Percebois concluded that competition is compatible with vertical reintegration and consolidation and the creation of European champions.

Associated with this perception of the regulation of the market as the appropriate model for political governance of utilities is the view that market-based instruments, such as the EU Emissions Trading Scheme (ETS), are important in managing environmental impacts. Trading of emissions is a valuable tool to ensure that countries reach their targets for greenhouse gas reductions at lowest cost. The European ETS is the most advanced worldwide, although it is being studied by Australia and restricted schemes operate in some states of the US. An important aspect of the EU ETS is that it is open to developing countries that have accredited emissions reductions certified under the Clean Development Mechanism and Joint Implementation projects under the Kyoto Protocol. This enables developing countries to reduce emissions and helps fund technology transfer. It is desirable that the post-2012 framework should enable comparable domestic trading schemes to be linked with one another, with the EU ETS as the pillar of the future global carbon market.

The session showed convergence of opinion on the four pillars of the market, regulation, sensitisation of citizens and technology. Within this broad agreement lurk great differences in the choice of technologies and the place of the market in policy. On regulation and the need to inform, educate and sensitise citizens there is perhaps greater consistency.





CONCLUSIONS

Climate change is accepted as an important scientific topic and as a compelling political issue. The social implications are recognised, but comparatively under researched. A dialogue between the disciplines in this domain is still to be created.

The time available to cope is short and the next ten years are critical. Effective action depends upon shared normative visions of the future and agreement about the means to get there. Some of that vision is in place. There is some agreement that to limit warming to 2 degrees is the best we can do and is attainable.

There is less agreement on sharing the burden. Burden sharing is not a technical issue, but is social and political. There is a pressing need for social and economic science research to identify fair and practical arrangements and to advise on mechanisms to create consensus behind them.


Management of climate change requires adaptation and mitigation. In both cases, the technologies that we can deploy are either here now or visible on the horizon. The challenge is to work out how to deploy these technologies within the constraints imposed by climate change whilst meeting aspirations for welfare growth and equity. This will require massive investment in values, education and behaviour.

Business has an important catalytic function in promoting sustainable development as a mechanism to ensure long-term growth and profitability. Support from management science to the identification of new corporate visions and marketing is needed.

Adaptation is generally a less well-researched field than climate change and mitigation. It is intrinsically an exercise in social science because adaptation directly affects the way we live. It is not just a question of replacing one technology with another that is more efficient, but of changing our life-styles and behaviour. The technologies to be used are known; the obstacles are the limited capacity of social processes to manage rapid change in institutional design, planning and public services.

Cities loom large in any programme of adaptation and present special problems. An important research effort is needed in design principles, planning procedures, training, construction, infrastructure and sensitisation of citizens.

Effective governance of institutions for sustainability is vital. Many good ideas exist on paper. The EU is the most advanced of industrialising regions and has tended *de facto* to take the international lead. It must continue that function with the support of research in social science on how to broker international



political agreements and to improve the quality and speed of decision making.

Principles on paper have to be made real. This means agreement on what technologies are acceptable. Conflict between partisans of different technical approaches should be avoided. Research is needed to provide fair and reasonable measures of technical performance. There is also a need for more comprehensive study of support mechanisms to determine what interventions are effective, how much they will cost and how the burden will be shared.

ACKNOWLEDGEMENTS

This publication contains the results of a major conference held in Brussels, at the European Commission on 24 October 2007 in which participated more than 500 stakeholders from the public and private sector.

All the speakers quoted in this publication have to be thanked for the quality of their speeches and presentations: Mona Sahlin, Jacqueline Mc Glade, Janez Potočnik, Fatih Birol, Hans Joachim Schellnhuber, Corrado Clini, Bertrand Chateau, Joël Decaillon, Fabrizio d'Adda, Nebojsa Nakicenovic, Jacques Theys, Paolo Frankl, Fabrizio Barbaso, José Ignacio Perez Arriaga, Jacques Percebois and Gordon Adam.

Thank you very much to the European Commission chair persons of the four sessions that addressed the main issues and organised the debate with the audience: José Manuel Silva Rodríguez, Raffaele Liberali, Jean-Michel Baer and Manuela Soares.

The main initiator of the Conference was Jean-Michel Baer, Director of the Science, Economy and Society Directorate at the European Commission, DG Research. Pierre Valette, Head of Unit, and Domenico Rossetti di Valdalbero were in charge of the whole organisation.

Useful comments were provided by Paraskevas Caracostas, Pablo Amor, Dimitri Corpakis, Nicole Dewandre, Birgit de Boissezon, Angel Perez Sainz and their colleagues in their respective Units at the European Commission, DG Research. Many thanks also to Pierre Valette's Unit and in particular to Louisa Anastopoulou and Joëlle Moraïtis for their practical support in the organisation of the event.

This report has been drafted by Nigel Lucas and supervised by Domenico Rossetti di Valdalbero.

GLOSSARY AND ACRONYMS

- **Bl:** barrel
- **EC:** European Community(ies)
- **EJ:** Exajoule
- **ETS:** Emission Trading Scheme
- **ETUC:** European Union Trade Union Confederation
- **EU:** European Union
- **FP:** Framework Programme
- **GDP:** Gross Domestic Product
- **GHG:** Greenhouse gas
- **GtC:** Gigaton of Carbon
- **GtCO₂:** Gigaton of Carbon dioxide
- **IEA:** International Energy Agency
- **IPCC:** Intergovernmental Panel on Climate Change
- **Km:** Kilometer
- **KWh:** Kilowatt-hour
- **MJ:** Megajoule
- **Mt CO₂:** Million tonnes of carbon dioxide
- **Mtoe:** Million tonnes of oil equivalent
- **MW:** Megawatt
- **NGO:** Non Governmental Organisation
- **OJ:** Official Journal
- **OPEC:** Organization of the Petroleum Exporting Countries
- **PPP:** Purchase Power Parity
- **R&D:** Research and Development
- **RE:** Renewable Energy
- **Toe:** Ton of oil equivalent
- **UNFCCC:** United Nations Framework Convention on Climate Change
- **US:** United States
- **WTO:** World Trade Organisation



European Commission

**EUR 23172 — Towards a “Post-Carbon Society”
European Research on Economic Incentives and Social Behaviour**

Luxembourg: Office for Official Publications of the European Communities

2007 — 54 pp. — 25.0 x 17.6 cm

ISBN 978-92-79-07622-0

How to obtain EU publications

Our priced publications are available from EU Bookshop (<http://bookshop.europa.eu/>), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

Two major challenges will have to be addressed on the way towards a “post-carbon society”: the adoption of new forms of energy (cf. security of supply, availability of resources, oil price) and the adaptation to the climate change that is already taking place.

Most of the time, these issues are tackled from the supply side and the technological perspective. But the demand side is crucial. The political initiatives, the economic incentives and the social behaviour can make a difference.

This publication covers issues including in the long term such as globalisation, behavioural changes, market mechanisms, “rethinking the city”, social acceptability, job creation, land-use and public services. It also addresses the role of politics and social actors (businesses and trade unions) as well as the new governance for a post-carbon society.