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Securing Sustainable Energy Supply: Time to Act

8 November 2013

Review of the implementation of the OSCE commitments in the field of energy

Diversifying the energy mix through development of renewable energy

21st OSCE ECONOMIC AND ENVIRONMENTAL FORUM

"Increasing stability and security: Improving the environmental footprint of energy-related activities in the OSCE region"

CONCLUDING MEETING
Prague, 11-13 September 2013

The study was prepared for the Organization for Security and Co-operation in Europe and UNECE by Mr Craig Carp, consultant.

Table of Contents

1. Introduction

The purpose of this report is to review the implementation of the OSCE commitments in the economic and environmental dimension relevant to the theme of the 21st Economic and Environmental Forum (EEF), increasing stability and security by reducing the environmental impacts of energy-related activities in the OSCE/UNECE region.

The technical focus, in Part II will be on diversification of energy production, both existing sources, which are primarily fossil fuels, and renewable energy. It will also review possible next steps, with suggestions for action by the OSCE in this field.

1.1 Background

The Permanent Council of the OSCE in its Decision PC.DEC/1047 decided that the OSCE's Twenty-first Economic and Environmental Forum would take as its theme: **"Increasing stability and security: Improving the environmental footprint of energy-related activities in the OSCE region."**

> The Permanent Council further decided that the agenda of the Forum would include a "*Dialogue on the promotion of sustainable energy, including new and renewable as well as traditional energy sources; good governance and transparency in the energy field; energy efficiency; low-carbon energy technologies; and fostering of multi-stakeholder dialogue and co-operation between energy producers, consumers and transit countries"; as well as "Regional and sub-regional co-operation on sustainable energy and transport, and sharing of best practices and exchange of experiences in these fields*". (OSCE, 2012)

The agenda also was to include a review of the implementation of OSCE commitments in the economic and environmental dimension, and relevant to the theme of the 21st Economic and Environmental Forum.

1.2 The OSCE commitments with regard to energy

In the **OSCE Strategy Document for the Economic and Environmental Dimension** adopted at its Maastricht Meeting in December 2003, the Ministerial Council recognized "*that a high level of energy security require a predictable, reliable, economically acceptable, commercially sound and environmentally friendly energy supply, which can be achieved by means of long-term contracts in appropriate cases. We will encourage energy dialogue and efforts to* ***diversify energy supply****, ensure the safety of energy routes, and make more efficient use of energy resources. We will also support further development and use of new and renewable sources of energy*." (Paragraph 2.1.12) (OSCE, 2003.)

In 2009 at its Athens meetings the Ministerial Council (Decision Nº 6/09):

> underlined "*that the interrelated challenges of climate change, energy security and efficient use of energy resources are amongst the most important issues to be tackled in the strategic perspective of ensuring sustainable development";*
>
> encouraged "*the participating States, with a view to addressing energy challenges in the OSCE region, to promote awareness of the G8 St. Petersburg principles and objectives on strengthening global energy security, namely:*
> – *Increasing transparency, predictability and stability of global energy markets;*
> – *Improving the investment climate in the energy sector;*
> – *Enhancing energy efficiency and energy saving;*
> – ***Diversification of energy mix****;*
> – *Ensuring physical security of critical energy infrastructure;*
> – *Reducing energy poverty;*
> – ***Addressing climate change and sustainable development****".*
>
> and tasked "*the Office of the Co-ordinator for Economic and Environmental Activities [OCEEA], in co-operation with other OSCE executive structures, within their mandates and available resources, to continue providing assistance to participating States, at their request, to support the exchange of best practices and*

build capacity in the areas related to energy security, inter alia energy efficiency, energy savings and the development of and investment in renewable sources of energy". (OSCE, 2009)

In accord with the Maastricht and Athens taskings, the specific focus of the review this year is diversification of the energy mix and the growing use of renewable energy.

In 2010 the OSCE Secretary General in the Report concerning the Complementary Role of the OSCE in the Field of Energy Security* noted that:

> *"The OSCE should promote sustainable energy solutions, inter alia, by facilitating the dissemination of information and best practices regarding cleaner energy, energy efficiency, renewable energy sources, technology solutions, etc., as well as through holding seminars and conferences on these issues". (p. 4)*
>
> *"A potential area for dialogue could also be the creation of the necessary conditions for the equal access of all countries to new and effective energy saving technologies and the deepening of scientific, technical and investment co-operation in the energy sphere".*
>
> *"The OSCE could play a role in ensuring the access for the participating States to the new energy technologies and facilitating co-operation in the sphere of sustainable energy and energy efficiency." (p. 22)*
>
> *"The OSCE can promote increased awareness regarding the linkages between energy security and climate change as well as ambitious and visionary energy policies that also support endeavours to combat climate change. As countries look for solutions that address energy, economy and climate change issues simultaneously, it seems that energy efficiency provided an answer to all of these issues". (p. 23)* (OSCE, 2010b.)

**Not a consensus document.*

1.3 Methodology

This review covers the latest available data, but focuses for comparison purposes on the 10-year period from 2000-2010. Data after 2008 may be distorted by the impact of the economic and financial crisis, which generally depressed economic growth and energy consumption.

The primary sources of data are the US Energy Information Administration (EIA), which produces energy statistical series for most countries in the world, the International Energy Agency (IEA), BP, and a range of EU sources. Because their energy consumption is relatively small, there are no separate data for some of the OSCE participating States such as Andorra, the Holy See, Liechtenstein, Monaco and San Marino. In addition to the data presented in the main body of the report detailed data, including by country is presented on emissions, energy use and renewables in ANNEX II, the statistical annex.

This report owes a special debt to the excellent report on energy saving and efficiency prepared by the United Nations Economic Commission for Europe (UNECE) for the last EEF to focus on energy, the 19th EEF, held in 2011. For this reason, the crucial issues of energy use reduction and efficiencies in consumption are not addressed in this report, and there is only limited discussion of efficiencies in production and transport only where it is germane to the issue of diversification. Readers interested in this important issue are urged to consult that report.

Part I: ENERGY, ENVIRONMENT, AND SECURITY IN THE OSCE: Assessment of Progress in Fulfilling the Commitments

A. The energy landscape of the OSCE area at a glance

The OSCE/UNECE region includes the three largest countries by area in the world (Russia, Canada and the United States), and eight countries that have borders stretching beyond the Arctic Circle (the three mentioned above plus Denmark, Finland, Iceland, Norway, and Sweden.)
Around half of the OSCE/UNECE countries, 28 of them mostly in Central & Eastern Europe, were centrally planned economies until 1989-1991.
The OSCE/UNECE region accounts for a little below half of world energy consumption (primary energy supply), including nearly half of its oil consumption and oil imports. Some participating States are exporters, with Russia accounting for the bulk of these exports. The OSCE states use somewhat more than half of the world's natural gas, but nearly an equivalent share is extracted within the borders of participating States with Russia – the world's second largest producer behind the US – exporting the vast majority to Europe via pipeline. The OSCE region only consumed just under a third of world coal, marginally more than its share in world production, and the USA—the world's second largest producer behind China—accounted for about half of both OSCE totals.

B. Energy, Environment and Security Overview

As one of the leading energy consuming and producing regions in the world, the OSCE/UNECE region is characterized by strong linkages between energy use on one hand, and economic stability and overall political security on the other. Energy security, defined by stable and diverse sources of supply, is important to both political and economic stability. Sharp reduction of energy supplies or rapid price escalation have led to economic disruption and external or even internal political tensions. For example, in the United Kingdom, the disruptions of energy supply caused by disputes between labour and management and government in the early 1970's had significant economic impact and no small domestic political consequences. In a cross-border context, there have been energy/water disputes in Central Asia over contrasting priorities of hydroelectric generation versus timely irrigation. More widely, the gas supply disruptions in Eastern and Central Europe during the past decade caused immediate disruption and prompted significant long-term anxieties over both supply and markets, pushing energy security high up on the OSCE agenda.

Over the past two decades, global climate change, and the contributing factor of the emission of Green House Gases, particularly CO2, have become an increasing concern, growing in profile on global political and security as well as economic agendas. The looming threat of climate change has even prompted reconsideration of the use of nuclear power; aside from the threat of local catastrophe, many concerns about it lie farther in the future than the consequences of the on-going global warming. In the past few years, in the OSCE region as a whole, there have been broad reductions in emissions or the growth thereof, although a significant portion of that reduction has probably been due to general economic contractions during the great global recession, beginning in the latter part of the first decade of the millennium.

Fortunately, individual access to energy, one of the goals of the United Nations Sustainable Energy for All initiative, is an issue in only small parts of the OSCE region, mostly in Central Asia, with very isolated, mostly rural pockets elsewhere. Nevertheless, equitability and price remain key concerns in nearly all participating States, and has been particularly important during the economic difficulties since roughly 2008 and continuing to the present, particularly in some states in western and southern Europe.

In response to accumulated scientific evidence, the climate change has become the principal driver of energy policy, although still in practice subsidiary to economic and growth considerations. Several OSCE participating States have been among the world leaders in taking steps to respond to the climate change threat, focusing on efforts to reduce greenhouse gas (GHG) emissions to avoid a global temperature rise in excess of 2 degrees Celsius.

Several states have reduced their emissions, or at least reduced their energy intensities. This sometimes came at no small cost, using a range of economic and legal/regulatory/technical measures. Their economies have been strengthened and their energy security and overall stability and control enhanced. They have become examples for the rest of the world and provided a little breathing space for the accommodation of rapidly growing economies and emissions from developing countries in Asia and other parts of the world. Other participating States are making efforts to attain similar and greater reductions, in line with their OSCE commitments, as evaluated in this report. These efforts continue, moving the region in the right direction.

Fortunately, along with growing international awareness both at the level of state and individual, in recent years there have been some important technological developments, and increasing deployment of new technologies in all aspects of the energy issue. Finding energy resources, extraction, production, transport, and delivery, have all benefited from these advances. Similarly, consumption, while continuing to grow in most countries, has also benefited from energy saving from technology and increased efficiencies (to include gains from reduced or altered end usages of energy by changing practice and behaviour), which was the focus of the 19th EEF in 2011.

The expanding and enhanced efficiencies and reduced emissions in energy production include clean coal technologies and changes in the sources used. There has been increasing diversification in the mix of fossil fuels used for generation, still the largest source of energy in the OSCE, and the beginnings of production from combined combustion (mostly biomass and coal). Increased diversification is also due to the creation and deployment of new technologies in oil exploration and production and particularly in the extraction of natural gas through fracking. Rapid expansion of natural gas use, among other diversification measures, not only decreases emissions improving the environment, but this improvement in turn increases the security of supply for those countries, and ultimately regional and global stability. For example, the ever increasing dependence of the United States on hydrocarbon imports has recently reversed, with some analysts suggesting that the country could become energy self-sufficient in the not distant future, and even an exporter.

In Europe, the European Union and its member states, all participating States of the OSCE, have made major commitments to address climate change by reducing carbon emissions, leading to the goal of an eventual net carbon-free energy future. Substantial progress has already been made in a few member states, and significant institutional and knowledge base structures have been established. Most importantly, pan-European industry has also been engaged. Other EU members and most other non-member European participating States have access to these sources, along with possibilities for technical assistance. The climate change issue has also prompted a re-evaluation and reconsideration in Europe of nuclear power, whose advantages in GHG emissions are now being weighed against both the catastrophic and long-term radiation risks of this vitally important, if controversial energy source.

There also has been a rapid growth in the use of renewables, the fastest growing source of power generation, which were recently predicted by the International Energy Agency to attain 25% of generation by 2016. Prices are dropping and competitiveness with traditional fuels is increasing, particularly when externalities are considered. In many cases, the need for the subsidies that have driven the growth of non-hydroelectric renewables is decreasing. Both energy diversification and the expansion of renewables are the focus of the main body of this report.

The OSCE has provided collective encouragement including on good governance, guidance on new technologies, and technical support to participating States, particularly states in transition, to improve their environmental posture, ultimately furthering the security and stability goals of the organization. A key asset is the OSCE presence in the field in countries and sub-regions in transition. Many speakers in the two preparatory conferences advocated further efforts both by the Organization and its presence in the field.

The environmental protection, energy markets, and energy security are global issues that require global solutions. Recent experience in the UN climate discussions has shown increasing awareness, but disappointing progress. As one of the pre-eminent regional organizations of the world, the OSCE is uniquely positioned to engage in and facilitate dialogue and exchange best practices with other regional and functional organizations, many of whose membership overlaps with OSCE participating States. An important partner in such efforts is and increasingly can be the UN Economic Commission for Europe (UNECE), which is already collaborating in work within the OSCE region, especially on technical issues.

Meeting OSCE commitments on energy and the environment

Judging from a basic statistical analysis of the key variables of energy usage: gross consumption, the amount of energy used per unit of GDP (energy intensity), and a survey of the mix of types of energy used, in a broad sense, it can be said that the OSCE participating States, as a whole, have met their most important commitments with regard to energy and the environment. While not all participating States have significantly curbed emissions, on an absolute or relative basis, all have recognized the need to do so. States have taken, and continue to take, economic and regulatory steps, to include: seeking and receiving technical assistance; building administrative frameworks; reducing subsidies; enhancing efficiencies; installing, at least on pilot basis, renewables; etc.

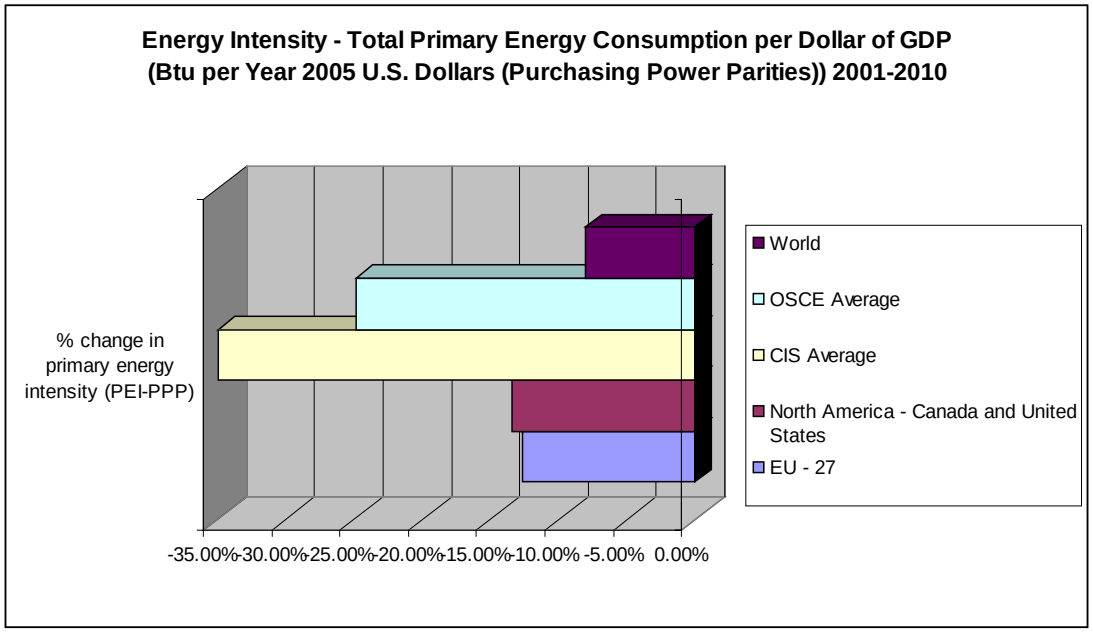
Total energy consumption 2000-2010

The data shows that the total energy consumption in the OSCE region has not increased while in some areas of the developing world consumptions continue to rise. China's primary energy consumption, for example, increased by two and a half time during this same period.

Energy Intensity

A review of several measures of production and productivity show that OSCE participating States continue to make progress on their energy goals. One measure of whether the OSCE as a whole has fulfilled its commitments in the realm of energy and the environment is to what extent participating States have managed to improve their use of energy. One measure of this is the energy intensity of production, in other words how much energy is used to generate a unit of GDP, regardless of the type of energy being used. Changes in energy intensity reflect two factors: First, increasing efficiency including altered patterns or reduction of consumption, including industrial efficiency, including production of new kinds of goods, or transport efficiencies, such as the increasing fuel efficiency of aircraft and motor vehicles. Second, the other major factor affecting intensity is the mix of production. As economies transition from high manufacturing, especially in energy intensive industries, to a more service economy, their overall energy intensity would drop. In the OSCE, and particular in the transitioning states in Eastern Europe and the CIS region both factors have been at work.

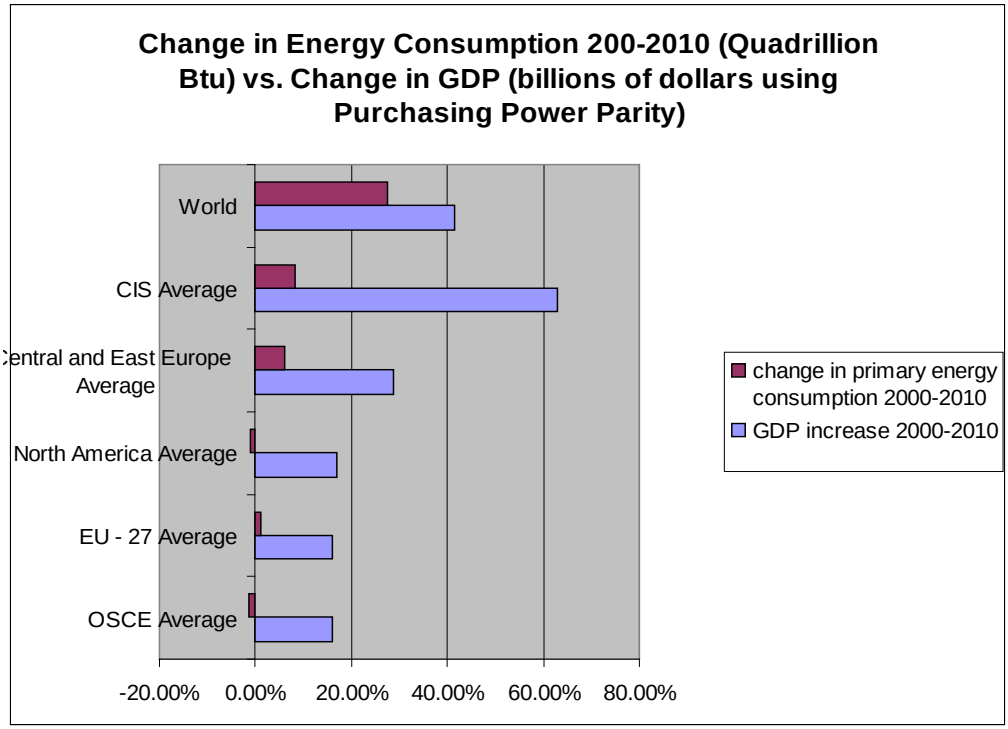
Moreover, in some states of the CIS region, GDP increases have been derived from exporting non-renewable energy sources, especially gas to the West and all types of resources to China. The continued build-up of energy transit infrastructure, especially pipelines, suggests this pattern will continue. Although they are still subsidised, domestic consumption of non-renewable fuels has decreased, with rising prices, while GDP has increased. But there is no question that efficiencies have continued to improve across the board, continuing the trend as noted in the Report for the 19th EEF. The OSCE on average has experienced decreasing energy intensity. In short, across the OSCE/UNECE region, with improved energy intensity, states have experienced increasing GDP and decreasing corresponding levels of energy consumption.



Source: EIA, International Energy Statistics

Change in Energy Consumption vs. Change in GDP

	GDP increase 2000-2010 (PPP)	Change in primary energy consumption 2000-2010
OSCE Average	16.02%	-1.50%
EU - 27 Average	16.10%	1%
North America Average	17.00%	-0.96%
Central and East Europe Average	28.80%	6.10%
CIS Average	62.80%	8.40%
World	41.60%	27.60%



Source: EIA (Total Primary Energy Consumption)/ IEA (GDP-PPP)

OSCE commitments encourage the use of renewable energy and in particular limiting the impact of Green-house Gases (GHG) emitted into the atmosphere.

Table 1: Carbon Dioxide Emissions per Unit of Energy Production – in OSCE and selected regions of the World:

Tonnes of Carbon Dioxide per Terajoule of Primary Energy	OSCE (average)	China	OECD Europe	OECD Americas	World (collated data)
1990	61.4	61.5	58.2	59.2	57.1
2000	55.4	66.3	54.1	58.8	56.1
2005	54.4	71.3	53.1	58.0	56.7
2009	53.4	71.1	51.5	56.3	56.8
2010	53.4	70.2	50.8	57.0	56.7

Source: IEA, CO2 Emissions from Fuel Combustion, 2012

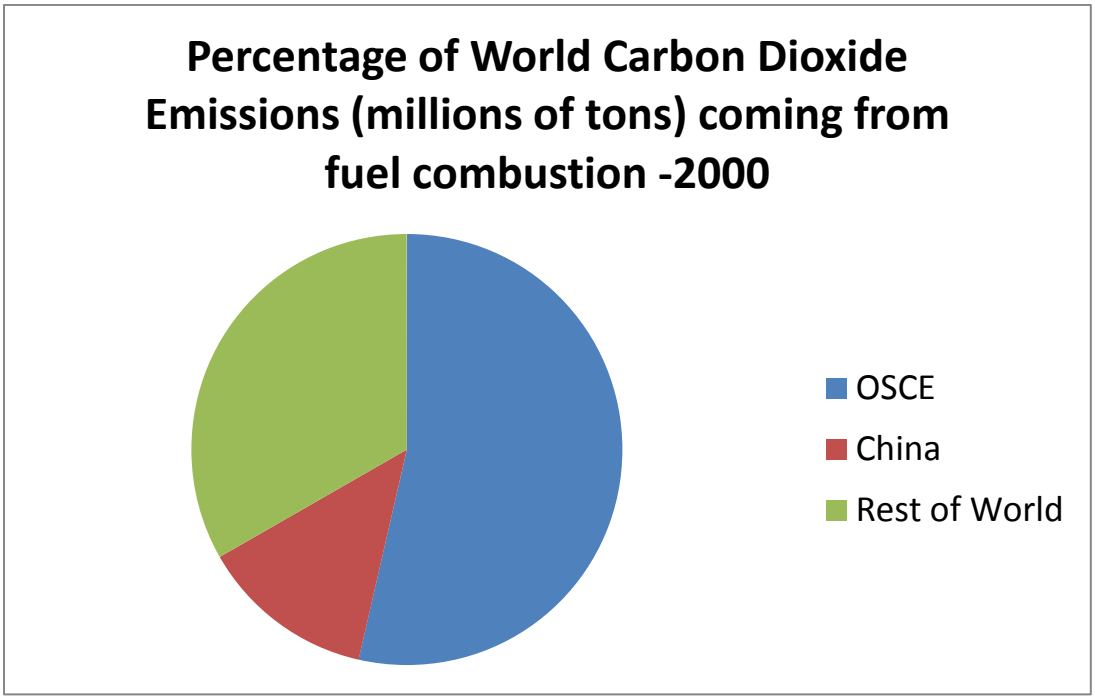
The data would suggest that the OSCE participating States (on the average) produced less carbon dioxide per Terajoule of primary energy than China (the largest emitter of GHG), the OECD Americas and the World average. The lowest carbon dioxide emissions from a global region – that of OECD Europe – can be generally attributable to the European Union's efforts on renewable energy and minimising the use of fossil fuels (including the aim to have 20% of EU energy provided by renewable sources by 2020 (OSCE EEF First Preparatory Meeting Vienna 2013, p. 6).

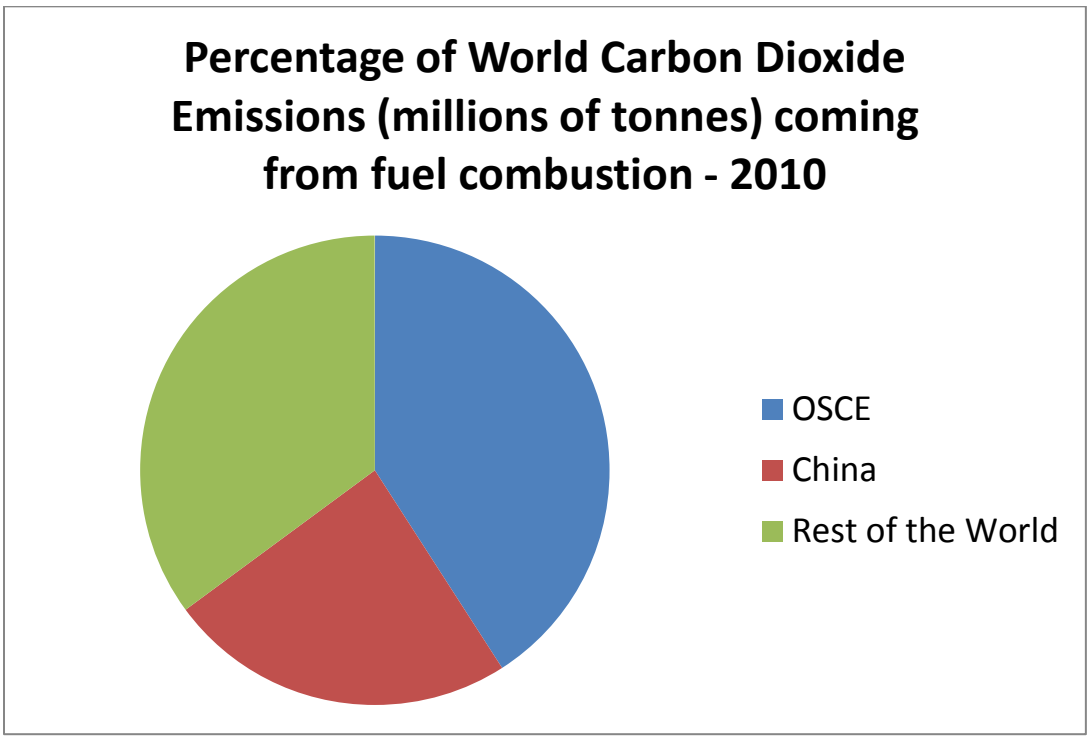
By means of comparison, the unprecedented economic growth of China particularly in the last decade led to greatly increased carbon emissions. Much of this increase in emissions is due to China's use of coal, with 38% of all electricity generated globally by coal coming from China (IEA, 2012 World Energy Statistics). China is the worlds' biggest emitter of carbon dioxide. Nevertheless, it is also the largest single investor in renewable energy, with $67 billion dollars invested in renewable energy in 2012 (The Economist, China and the Environment, 2013). It must be noted, however, that the all wide variety of goods imported by OSCE participating States from China and elsewhere carry the burden of the carbon emissions used in their manufacture and transport. The global calculus of this global problem needs to take into account that with the decrease in manufactures and import of goods in many states, they are in effect exporting their emissions.

Table 2: Carbon Dioxide Emissions from Fuel Combustion – Regional Variation:

Carbon dioxide Emissions from Fuel Combustion	% of world carbon dioxide emissions (millions of tonnes) coming from fuel combustion – 2000	% of world carbon dioxide emissions (millions of tonnes) coming from fuel combustion - 2010
OSCE	53.6	40.9
China	13.1	24
Rest of the World	33.3	35.1

As illustrated in the charts below, the reduction of carbon dioxide emissions from fuel emissions in OSCE/UNECE region over the period 2000-2010 is partially a result of participating States improving industrial efficiency and conforming to more stringent environmental guidelines regarding the combustion of fossil fuels, something the OSCE has repeatedly encouraged. In particular, the OSCE has asserted the need for increased cooperation and communication between legislators in each participating State and the private sector in ensuring economic efficiency and environmental protection are mutually reinforcing. The significant decrease in the OSCE's carbon emissions share between 2000 and 2010 is mostly due to the rise in global carbon emissions by 28.8%, meaning the actual fall of OSCE carbon emissions from fuel combustion was just 1.7%.

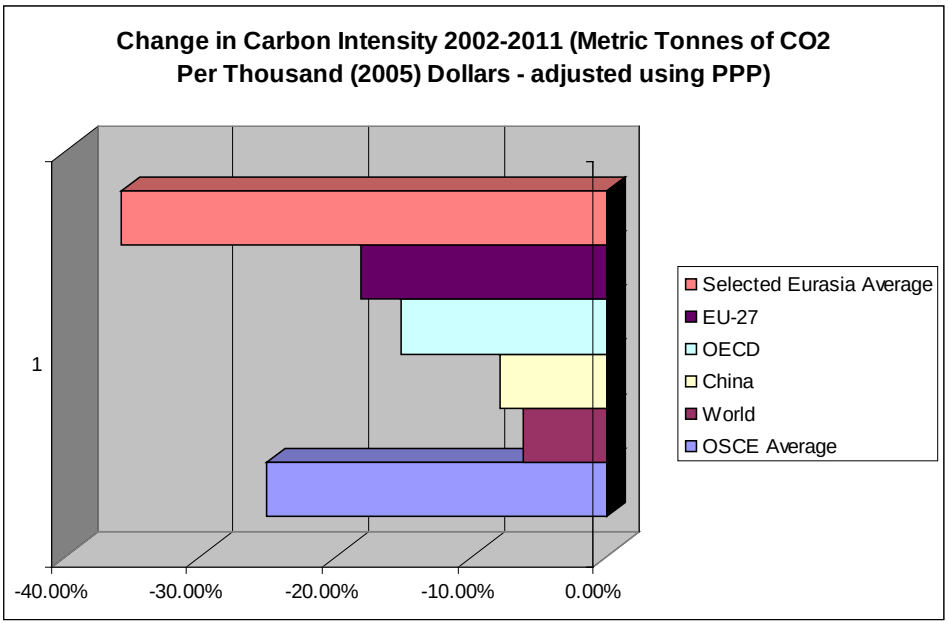




Source: IEA, Carbon Emissions from Fuel Combustion - CO2 Emissions by Sector 2012

Carbon Intensity:

The OSCE continues to have rapidly decreasing carbon intensity levels, as seen previously in the 19th OSCE Economic and Environmental Forum (UNECE, 2011, p. 19).

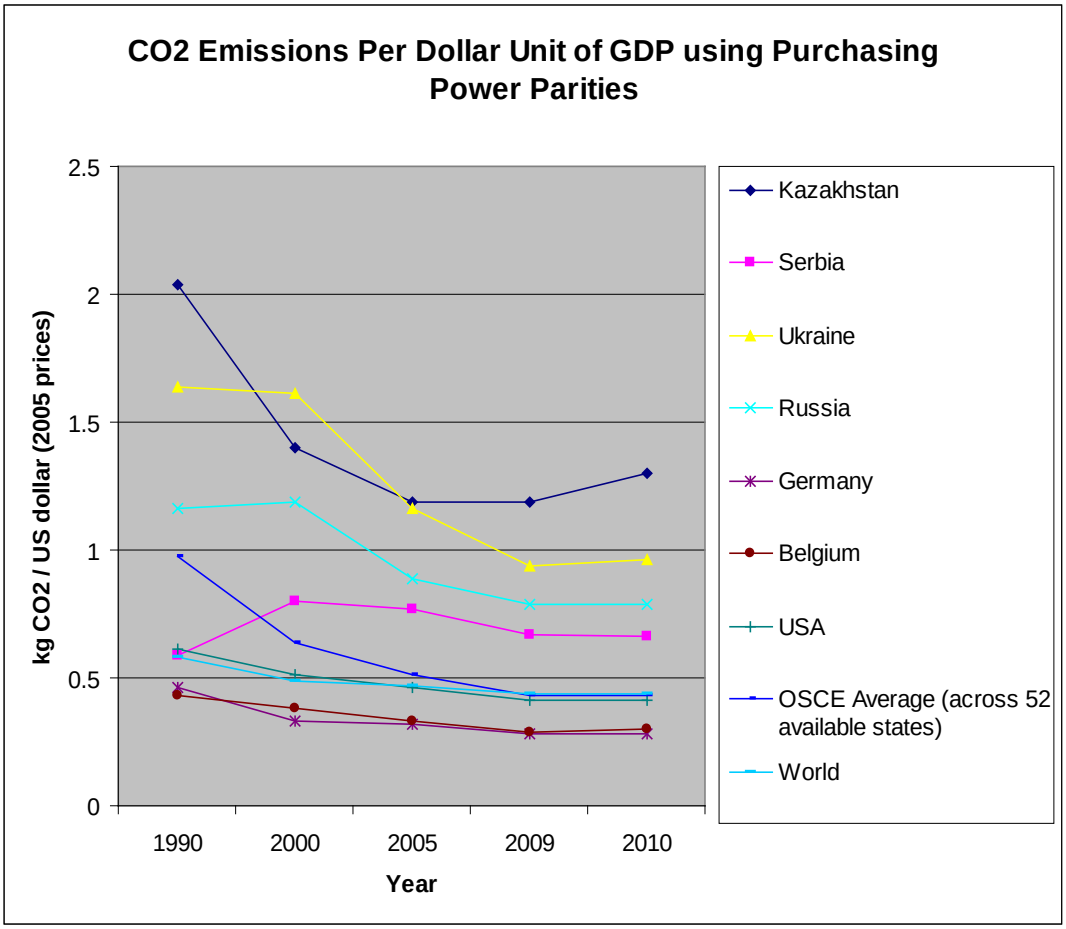


N.B. Selected Eurasia = CIS states: Russia, Kazakhstan, Uzbekistan and the Ukraine
Source: EIA, Carbon Intensity 2002-2011 Using PPP

In the CIS region, the introduction of market forces and the rise in energy prices encouraged the use of energy resources which emit carbon dioxide in a far more efficient way, an economic motivation with both economic and environmental benefits. The CIS average (of the countries noted above) shows a 35.9% drop in carbon intensity. The industrial sector (particularly the

extraction of natural gas, oil and mineral deposits) in CIS countries have benefited from OSCE region private sector and government assistance, and encouragement from the OSCE itself in reducing their carbon footprint and carbon intensity. Whilst the data suggests that the OSCE had the largest percentage reduction in carbon intensity, compared to other regions, the fact remains that the OSCE still has the largest share of carbon emissions from fuel combustion, more than 40% of the global total, as shown below.

Between 2002 and 2011, the OSCE's carbon intensity reduced 25.1%, as opposed to 6.2% for the world, 7.9% for China, 15.2% for the OECD and 18.2% for the European Union (EIA). In short, over the period 2002-2011, the OSCE has managed to decrease its carbon intensity by 25.1% for every unit of GDP generated. However, the OSCE still accounts for 40.9% of all carbon emissions from fuel combustion, and with the economic challenges facing many member states - of the OSCE, significant action is needed to ensure "absolute cuts in the amount of carbon emissions" (UNECE, 19th OSCE Economic and Environmental Forum, p. 19). Continued OSCE cooperation, particularly with the private sector, can help to ensure carbon intensity continues to reduce and the efficiency of energy generation is such that Green House Gas emissions are limited, while allowing for economic development.

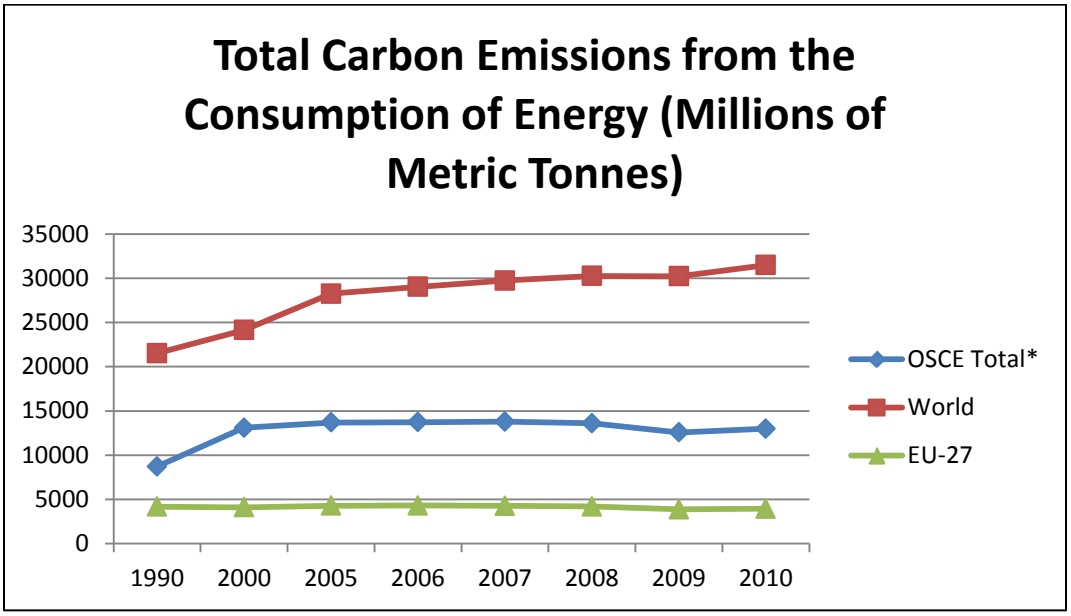


Source: IEA 2012

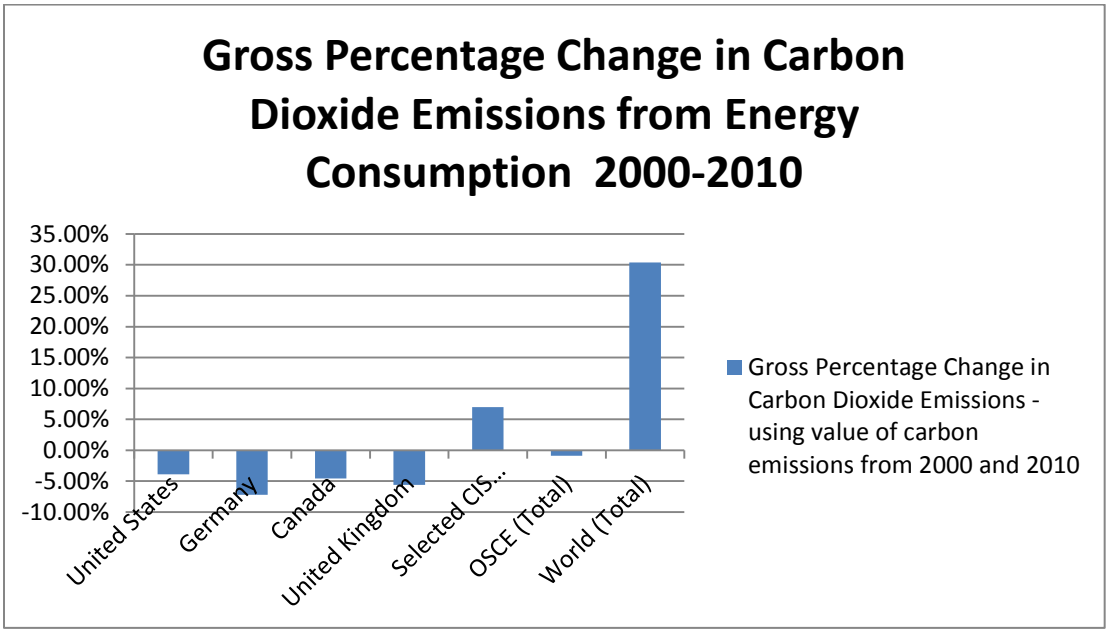
The data on Carbon Dioxide Emissions used to produce a dollar of GDP from 1990-2010 would suggest that there is generally a downward trend, which could reflect enhanced efficiencies, but could also be linked to changes in the nature of the economy. Across the OSCE, carbon dioxide emissions per unit of GDP using PPP decreased from 0.97 kg's per US dollar, to 0.43 kg's per US dollar. Another factor influencing the change would be a changed mixture of fuels that are used to produce the output. Across the OSCE there has been a 10.4% expansion in the use of natural gas, a less polluting fuel and reductions in the use of both coal and oil, although there is a wide diversification in patterns of consumption among states. The anomaly is the dramatic increase in coal use by Kazakhstan, which also increased its use of oil. This would appear to reflect both its expanded economic activity, as well as a decision to use plentiful domestic coal in place of hydrocarbons, which are a major export.

Total Emissions

The above charts describe growing efficiency in the use of energy among OSCE participating States, but a more important metric in examining progress toward fullilling environment commitments is the total amount of emissions. Total emissions of Green House Gases (GHG), mostly CO2, drive the threat of climate change. Limiting and ultimately reducing emissions is the key to limiting global warming to 2 degrees C, and thus avoiding the more serious climate scenarios.



*= total OSCE emissions from 51 OSCE states. Source: EIA, International Energy Statistics 2013



Sources for both charts: Country Data from EIA, International Energy Statistics 2013, Total Carbon Emissions from the Consumption of Energy. Data analyses and Graphs designed and prepared for this report.

As can be seen from the figure above, the OSCE has experienced generally consistent gross amounts of carbon dioxide emissions between 2000 and 2010 (a gross reduction of just -0.9% in carbon dioxide emissions in the period 2000-2010).

Total emissions declined almost certainly after 2008 due to the recession/financial crisis. Nevertheless, given the pre-crisis levelling off of emissions growth, there is good reason to believe that states actions to limit emissions have had some success. There is considerable variation throughout the OSCE in terms of the amount of carbon dioxide emitted from energy consumption. In general those states with rapid economic development—as with the Commonwealth of Independent States—that experienced on average a 62.8% increase in GDP between 2000 and 2010 (IEA) – saw the largest increase in carbon emissions.

Despite wide variations among states, in the aggregate and on the average these reductions are meaningful, particularly in light of the generally universal and steady growth in emission in the preceding years and decades. Both the relative and absolute data clearly show that the policy decisions taken by OSCE participating States, including fossil fuel taxes and subsidies of various kinds on renewable energy, along with informational and regulatory (i.e. mandatory feed-in tariffs) have meant significant practical accomplishments in reducing emissions. It can therefore be concluded that the OSCE and its participating States are making some progress towards fulfilment of their energy and environmental commitments regarding emissions, although some states have a long way to go. The following section will review the levels of energy diversification, both among the still dominant fossil fuels triad and the increasing diversification into renewables.

Part II: ENERGY DIVERSIFICATION AND RENEWABLE ENERGY

Among the key attributes of energy security are control and the diversification of supplies and sources. In the modern world, absolute control is not possible, for both technical and economic/financial reasons. One of the attractive aspects of renewable energy sources is that they enable increased control, both at the national level and for many technologies, to the local level. Indeed, it is one justification often cited to justify the subsidies offered the new technologies. Even that control is not necessarily absolute; for example, hydroelectric projects can be subject to the requirements of both upstream and downstream states, as is the case in Central Asia.

The need for primary fuel mix diversification

Diversification is therefore vital, for technical reasons as well as for security reasons. Any element of an energy production system may fail or fluctuate, requiring supply diversification. One of the key issues with solar and wind power is their intermittent nature: day goes to night and clouds rise; wind rages and dies down. The need to adapt electricity supplies to these fluctuations requires for the present that most large-scale non-hydroelectric power sources be conjoined with conventional sources of power, mostly fossil fuels. Existing power transmission grids are generally ill adapted to handle these fluctuations; while technological improvements can help, including "smart grids," conventional supplements are required.

Even in an entirely conventional system, diversification is essential. Most of the OSCE participating States are importers of at least one source of energy; most are highly dependent on imports. Imports can and have been disrupted for technical, economic and political reasons. Technological diversification of sources of energy, increases energy security and stability by providing hedges against supply disruption for any of those reasons. Diversification of geographical and market sources of necessary imports also provides crucial security, by ensuring that an interruption of supply from any single provider or set of providers will not be as disruptive as some states faced during the 1973 and 1979 oil crises.

The need for diversification cuts both ways, however. OSCE participating States that are exporters reasonably require diversification of markets and a means to get there, as insurance both against non-market disruptions and against monopsony practices. The Energy Charter Treaty, its Council and Secretariat were established in part to address the concerns of both exporters and importers, to facilitate a regular, steady flow of energy trade and investment, and especially of the transparent information flow that makes those commercial transactions more feasible. Since the Charter has not been ratified by all key parties, its impact has been limited. Nevertheless it remains a fruitful channel for dialogue, exchange of information and a possible channel for transferring important technical and other information. The Charter and its Secretariat and the OSCE have both continued to express interest in cooperation.

Technological diversification can also improve access, which in turn fosters stability. Isolated communities, off the grid for geographic, economic or other reasons, can receive power by own systems of renewable generation, particularly solar; wind and low-head hydro. This can save significant monies versus expansion of the grid to far-flung areas. Generation of bio-gas from local waste can even be used to power transport, as well as power; this is already a boon to many communities around the world, although it has only limited, if important, application in many OSCE participating States.

All of the above concerns are also fully consistent with the OSCE comprehensive security mandate. They are grounds for OSCE action among participating States and for interaction with both functional organizations such as ECE and the Energy Charter but also for interchange with international and other regional bodies (see Chapter IV, below for more details).

Chapter I – Primary fuel mix diversification and international cooperation and energy security

Energy Production and Consumption in the OSCE by Energy Source:

The tables below reflect the need of most OSCE participating States to import primary energy supplies. Only the sub-region of the CIS produced a surplus of each of the three major resources oil, natural gas and coal. Canada is also a major energy exporter, mostly to the United States, itself a major coal producer, and growing gas producer.

Oil/Petroleum:

Mtoe – 2012	Production	Consumption	Balance
Europe and Eurasia	836.4	879.8	-43.4
Canada and United States	577.5	924.2	-346.7
CIS region	670.9	205.9	465
European Union	73	611.3	-538.3
OECD	903	2072.8	-1169.8
OSCE (total)*	1394.7	1771.2	-376.5

Source: BP, Statistical Review of World Energy, 2013

Natural Gas:

Mtoe – 2012	Production	Consumption	Balance
Europe and Eurasia	931.9	975	-43.1
Canada and United States	760.1	744.7	15.4
CIS region	690.9	526.4	164.5
European Union	134.7	399.5	-264.8
OECD	1096.2	1433.6	-337.4
OSCE (total)*	1683.1	1705.1	-22

Source: BP, Statistical Review of World Energy, 2013

Coal:

Mtoe – 2012	Production	Consumption	Balance
Europe and Eurasia	469.0	516.9	-47.9
Canada and United States	551.1	459.6	91.5
CIS region	278.6	180.2	98.4
European Union	165.1	293.7	-128.6
OECD	973.4	1053.1	-79.7
OSCE (total)*	998.8	954.3	44.5

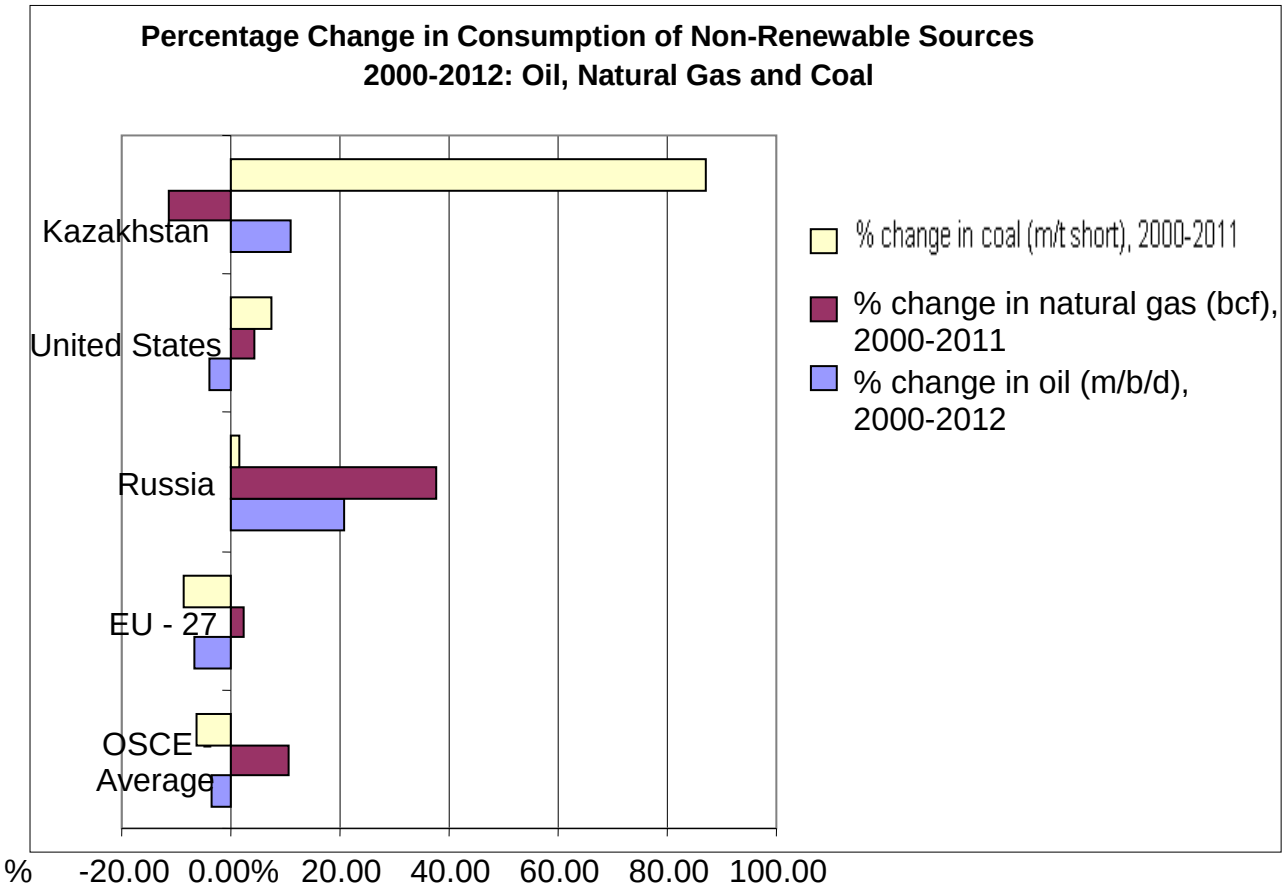
Source: BP, Statistical Review of World Energy, 2013

The OSCE/UNECE region is currently a net coal exporter and net petroleum and natural gas importer. The overall deficit masks the fact that there are several important oil and gas exporters in the CIS region: Russia, Azerbaijan, Kazakhstan and Turkmenistan, with Uzbekistan a natural gas exporter, and some coal exports from Ukraine. The composite figures mask very different situations among the different exporters and with the other former Soviet states, which are all net importers, sometimes with energy security implications. Norway and, as noted, Canada are also major hydrocarbon exporters.

The increase in demand for coal, and the increased intensity of extracting coal particularly in Central Asia to meet growing global demand now has meant the OSCE has an aggregate surplus of coal supplies much of which now goes to China. Again, within this surplus there is a wide diversity among individual countries, although coal is far more widely distributed than significant hydrocarbon resources. Many of the Western European countries, even though they have remaining resources, have heavily scaled back or even relinquished coal production. This was sometimes very disruptive, both politically and economically, for example first in the UK, then more recently in France, but it would not appear that any of those countries would wish to reverse the situation. Nonetheless, despite environmental concerns, particularly over CO2 emissions, coal will remain a fundamental source of energy for the OSCE for many years.

The Changing Energy Mix

In the decade 2000-2010, OSCE participating States, led by the EU-27 on the average reduced their consumption of both coal and oil, in effect substituting natural gas, use of which increased, resulting in lower emissions. Each country had different changes—coal use expanded dramatically in Kazakhstan, less so in the United States. Russia used more oil.



Change in Pattern of Consumption of Coal, Oil and Natural Gas

Country/Region	% change in oil (m/b/d), 2000-2012	% change in natural gas (bcf), 2000-2011	% change in coal (m/t short), 2000-2011
OSCE – Average	-3.50%	10.40%	-6.20%
EU – 27	-6.50%	2.30%	-8.70%
Russia	20.80%	37.60%	1.70%
United States	-3.80%	4.50%	7.50%
Kazakhstan	10.90%	-11.20%	87.00%

Source: IEA 2012

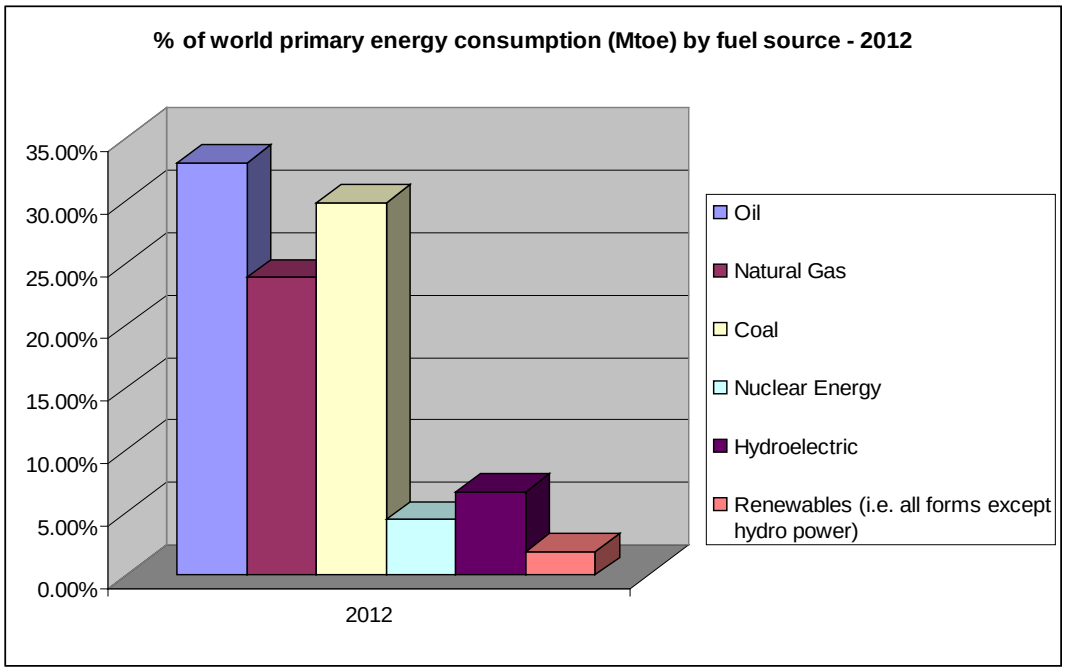
Degrees of diversification in the OSCE/UNECE region

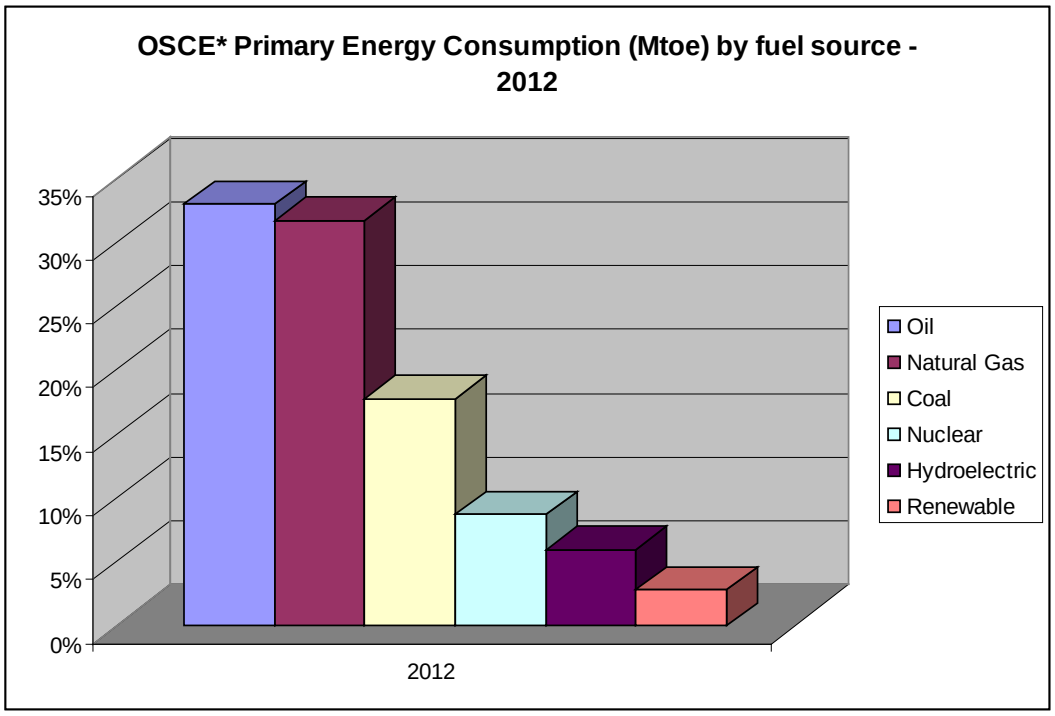
Compared to energy consumption patterns elsewhere, the OSCE participating States as a whole have a somewhat higher degree of diversification. The world gets nearly 85 per cent of its primary energy in fossil fuels (these figures may not include the use of traditional, often renewable fuels, principally biomass). World consumption is relatively evenly split among the three major fossil fuel categories: oil, gas, and coal. The OSCE, on the other hand is more diverse considering nuclear and, increasingly, renewables, but still gets over 80 per cent of its energy from fossil fuels. It uses little over half the amount of coal as the world and nearly 50 per cent more natural gas. Nuclear power use is almost double in the OSCE, but still represents barely 7 per cent of the load. World use of hydroelectric power is higher, but the OSCE used about twice as much non-hydro renewables.

Consistent with the above logic, despite the growing role of renewables, the preponderant role of combustion/heat in power generation and the near-exclusive role of fuel in transport underline the need for primary fuel diversification: Across the OSCE participating States there is great range of diversification of energy consumption and primary fuel mix, from Tajikistan with 90 per cent of power from hydroelectric sources and imported petrol for transport, to Kazakhstan, where 80 per cent of power is generated from coal, to France, where most of the electricity is generated by nuclear power, to Belgium where the mixture is half and half, to Switzerland with a highly diverse fuel supply, to Germany, where a diverse fuel supply is being supplemented by large and growing share of renewables.

Nuclear Power. It has become evident that nuclear power, a vital part of the OSCE energy mix (about 7%, according to BP), will remain an major source of OSCE energy for some time to come, even if its share is not likely to substantially increase. Concerns of the world-wide catastrophic risk associated with climate change and a rise in temperatures above 2 degrees C in the coming decades are beginning to cause re-evaluation of nuclear power world-wide. Impending global impacts of climate change are being balanced against the more dramatic local catastrophic risks of nuclear accident and the much longer-term environmental concerns about nuclear waste. Germany, based on the evidence of catastrophic events (Chernobyl, Fukushima), as well as the long-term environmental risk associated with nuclear power, decided it would phase out its nuclear plants by 2022. However, in the face of the substantial rise in hydrocarbon prices, and particularly in view of concerns about climate change, Germany has postponed implementation of this policy. Still, in the chart below, it is clear that OSCE and the world in general will not cross the threshold of 10 per cent power generation from nuclear resources and will still heavily rely on the consumption of the triad of fossil fuels, coal, oil and natural gas, in order to generate energy and drive forward economic growth.

Diversification in Energy supply 2012, the World VS the OSCE





Source: BP Statistical Review of World Energy 2013
* = of all available OSCE states

Just as in the rest of the world, OSCE participating States will continue to increase their production and use of electricity, but the rate of growth will slow. In some countries, particularly in Western Europe, efficiency gains and social evolution will likely produce a slackening in electricity demand.

Electricity interconnections in OSCE/UNECE region: challenges and opportunities

There is a highly diverse set of electricity interconnections in the OSCE. In the U.S., despite regular exchanges of power, interconnections are limited. Several times, local electricity problems have spread to encompass entire regions affecting tens of millions of people. In order to offset this risk the grid is established in a number of regions, still large but not national, separated by "firewalls," intended to prevent country-wide blackouts in case of service disruptions between their grids.

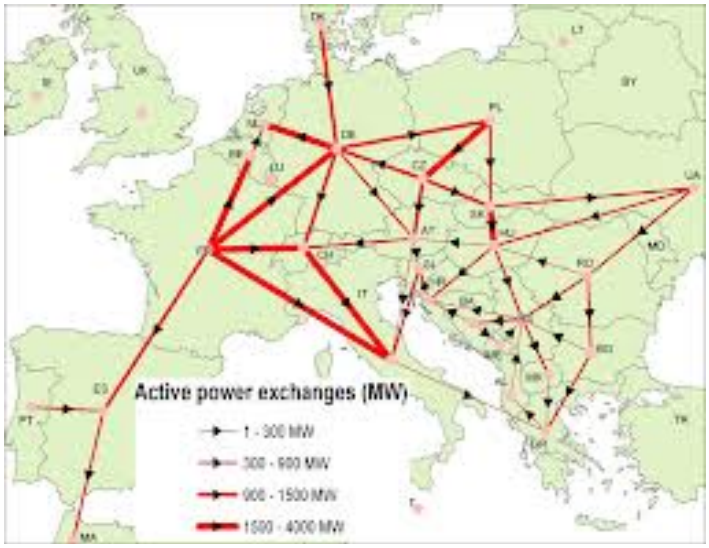
In the EU, and extending to most candidate countries, the grid is relatively integrated. Local or national grid operators/managers are associated under ENTSO-E, the European Network of Transmission System Operators for Electricity, representing 42 Transmission System Operators (TSOs) from 34 countries.

A partial rendering of the highly complex electrical grid in Europe. Source: ENTSO-e

Among the interesting initiatives currently underway in the sector, **European Electricity Grid Initiative (EEGI)** is one of the EU European Industrial Initiatives under the Strategic Energy Technologies Plan (SET-Plan), which supports European energy and climate policies through technology innovation and proposes a 9-year European research, development and demonstration (RD&D) programme to accelerate innovation and the development of the electricity networks of the future in Europe.
According to its organizers, the strategic objectives of the EEGI are to:

- Transmit and distribute up to 35% of electricity from dispersed and concentrated renewable sources by 2020 and a completely decarbonized electricity production by 2050;
- Integrate national networks into a market-based, truly pan-European network, to guarantee a high-quality of electricity supply to all customers and to engage them as active participants in energy efficiency;
- Anticipate new developments such as the electrification of transport;
- Reduce substantially capital and operational expenditure for the operation of the networks while fulfilling the objectives of a high-quality, low-carbon, pan-European, market based electricity system.

This effort, which is still in nascent stages, may be considered a "best practice." The sponsors of the program have indicated their openness to expand it beyond the current membership, through various level of association. Throughout the electricity sector the Initiative contemplates efforts to extend its communication, cooperation and best practice sharing to other states in the region.



Map: Electric Power Exchanges in the Center of Europe
Source: EU Joint Research Center –Institute for electricity and transport http://ses.jrc.ec.europa.eu

EU members are associated with the countries of south-central Europe, including non-members in the Balkans and some in the western CIS region, through the Energy Community (EC). The EU secured agreement of the Energy Community members to the EU *acquis communautaire* in energy. This means the acceptance of EU authority over the subjects designated in the *acquis*. The EC also provides a channel for technical assistance. Members from both sides of the Community appear to be generally satisfied with how it has worked. There may be possibilities for additional expansion, particularly eastward. The EC could be considered as a step toward an electricity system covering the whole of the OSCE/UNECE European region. This can be considered another best practice.

In Central Asia, the Caucasus, and the Eurasian states, throughout the CIS region, there is a legacy of extensive grid connections, dating from the energy intensive and extensive Soviet system. With the breakup of the

Soviet Union and the emergence of the independent states, authority over the parts of the grid devolved into the hands of each individual successor nation. Power that once freely flowed between these areas was now subject to cross border tariffs and decision making of separate national authorities, which sometime did not facilitate or actively blocked trade and exchanges. Tajikistan, for example would be willing to sell its summer excess of electricity to adjacent states including other Central Asian states and Afghanistan. In general, however, the power would have to transit through a third country. Unfortunately, there have been serious transit and transmission problems, including delays, which have rendered the transfers impossible or uneconomic, but whose origin may stem from political as well as economic disputes. Still Tajikistan could someday enjoy a future as a significant energy exporter, earning much needed foreign exchange. The Central Asian States have consistently sought assistance both on the technical and regulatory/policy side. Several regional and international institutions, including the UNECE, the EU and OSCE have responded. Additional efforts along these lines may be considered.

Chapter II – Fossil fuel-fired power plants in the energy mix

Fossil fuel-fired power plants will remain a critical part of the energy mix for the foreseeable future, but given their economic importance and environmental impact, they require a particular attention.

A. Recent trends and developments

The critical role of fossil fuels in electricity generation

Fossil fuels remain the principal source for electricity generation throughout the OSCE area, in North America, Europe/EU, Turkey, or in Russia and the CIS. While there may be some changes in the mix of fossil fuels, fossil fuels are likely to remain dominant for at least another decade

In the largest consumer of several sources of energy, the United States, the sources are highly diverse, but the proportions provided by the various components have changed over the years, including renewables. Gross electric power production doubled from 1973 to 2000 but has remained static since, growing about 1per cent per annum, according to 2010-2011 IEA figures. Coal plays the most significant role in the mix since the United States possesses one of the largest coal reserves in the world (although those reserve figures may be relatively higher than in other countries due to a greater degree of exploration and evaluation). Nearly half of electricity is produced from coal, although the growth in coal use has dropped below overall growth due to environmental concerns, only partially addressed by clean coal technology. Nuclear power use grew by 6 per cent a year to 1990 but has been stable for a decade, at about 20 per cent of the total.

Electricity production - United States

		1973	1980	1990	2000	2005	2009	2010	2011
Gross production	of which -	1965.5	2427.3	3218.6	4053	4294.4	4188.2	4378	4343.7
Terawatt Hours (TWh)	Nuclear	89.2	266.2	611.6	797.7	810.7	830.2	838.9	821.4
	Hydroelectric	265.4	278.8	289.0	280.0	297.9	298.4	286.3	350.6
	Coal	907.4	1242.9	1699.6	2130	2154	1892.7	1994	1873.8
	Oil	336.0	263.2	130.6	118.5	141.3	50.4	48.1	38.7
	Natural Gas	364.9	370.5	381.7	634.3	782.8	949.8	1017.9	1046.5
	Renewable (Non Hydro: Wind, solar)	2.3	5.2	19.7	21..	36.5	94.4	117.6	143.1
	Biofuels/Biowaste	0.3	0.5	86.4	71.7	71.2	72.3	75.4	69.6

Source: IEA Electricity Statistics (2012)

The US natural gas use, stable for decades, has rapidly grown at the rate of 6.5 per cent per year over the last decade. This trend has accelerated in recent years as the prices of natural gas dropped in response to increase of supply. New technologies such as the induced hydraulic fracturing technology (known as 'fracking') made accessible huge reserves of shale gas, sometimes called unconventional gas. Induced hydraulic fracturing was developed over the past several decades, but only became widespread within about the past decade. In the process of hydro-fracturing pressurised water is injected into wells drilled deep into shale-beds where large reserves of gas are locked; the gas is further accessed by another recent innovation, horizontal drilling. With the change in relative economics, oil has steadily declined as a source of electricity generation, due mostly to price concerns; its share is currently barely more than that of biofuels. Renewable energy generation (see below) is coming up fast and now comprise approximately 10 per cent of the total, more than half of which is longstanding hydro.

Unconventional oil is also contributing to the growing U.S. energy independence, although the declining use of oil and its derivatives for power production leaves what is left to North America's singular requirement, motor vehicle fuels. Unfortunately, at least as environmentally risky as unconventional gas, particularly even at its ideal, the technology requires the use of self-generated energy to release the resource. Some areas where these resources are found are experiencing economic booms, helping to revive depressed local economies. Canada has even more unconventional oil resources. The Alberta tar Sands and similar deposits put Canada into the category of largest petroleum reserve holding nations, and could help provide assurance regarding long-term energy security for North America, albeit at an environmental cost. Such issues

have been a major driver of the continuing public debate in the United States over the proposed construction of the XL pipeline from Alberta to the U.S. Gulf Coast and its refineries. A decision on the permit is still pending.

Natural Gas in OSCE EUROPE

In the EU part of the OSCE region, there has been a long period of increased use of natural gas, for growth in power generation and as a consistent substitute for coal. Natural gas produces barely half the CO2 of the lower emission forms of coal. Beginning in the 1970's much of the gas in Northern Europe came from the North Sea, but reserves are declining. In recent decades, most of the gas has come from imports – in Central and Eastern Europe, mostly from Russia, in Southern Europe from North Africa through a growing network of international pipelines (see map). In the past decade there has been the introduction of supplies from the Caspian sea sub-region and there is potential for additional supplies from this source.

MAP: European Gas grid.
Source : http://turkishcentralnews.com/wp-content/uploads/2013/04/natural_gas_network_03_en.jpg

There is significant potential for unconventional or shale gas extraction by fracking in Central and Western Europe, some from traditional coal mining regions that were the engine for the original industrial revolution. Exploration and production is already well underway in the United Kingdom. The U.S. Energy Information Administration believes that Europe's recoverable reserves are on a par with those of the U.S. Both Poland and Germany are frequently cited as countries with significant potential reserves, although efforts in the latter, particularly, as well as in other Western European countries has been delayed by environmental concerns. France and Bulgaria have banned the process altogether. As recently as 27 August 2013, however, the Financial Times reported that the government of the Netherlands had published a study showing that the environmental risks of from the process would be manageable, particularly as the resources in the Netherlands were much deeper, up to 3-4 km deep rather than 1.5 km in the U.S. The article noted that the Dutch government was interested in finding a replacement for currently exploited offshore gas reserves, which are declining, but plans a long process of testing before it authorizes industrial scale fracking. This approach could be characterized as a best practice. In general, the use of shale gas as a substitute for coal is a clear example of how environmental amelioration can be consistent with energy security enhancement through local supply.

Increasing conversion efficiencies through investment in advanced fossil fuel technology

Fossil fuel power plants produce the majority of electricity in the OSCE, frequently through pulverized coal (PC) combustion. But most pulverized coal plants are over 15 years old and are relatively inefficient. As fossil fuel power generation is the biggest contributor to carbon dioxide emissions, any gains in conversion efficiency would translate to substantial carbon dioxide savings. According to the EU Strategic Energy Technology Information Service (SETIS), even newer plants have using conventional technologies have efficiencies ranging from 32-40%, while the oldest plants may dip as low as half that. Newer, 'super critical' plants are 45% efficient. Using the best available technologies, such as 'advanced supercritical plants' (46-49%) and 'ultra-supercritical plants'(as high as 50-55%), can increase efficiency substantially by allowing higher steam conditions (higher temperature and pressure). Efficiency of power production from a given amount of coal could be increased as much as 45%, and possibly more using some of the new technologies.

Co-firing biomass in fossil fuel power plants: opportunities and constraints

Combined cycle plants using natural gas or biomass in pulverized coal power plants, and Integrated Gasification Combined Cycle (IGCC) plants, which turn coal into gas, can potentially reduce emissions even further, especially with CO2 capture. A biomass-fueled plant could be carbon negative, if it were coupled with carbon capture technologies (below). For the present however, co-firing is not yet efficient and additional research and development of the technology is needed.

In Kazakhstan, most of the electricity, approximately 80 per cent, is generated in coal-fired power plants, which are not efficient by today's standards. This situation is admitted and bemoaned by national leadership. Many plants are over 40 years old, at least 41% of installed capacity comes from plants over 30 years old, and barely 7 per cent comes from plants less than 25 years old, as noted in a report prepared for UNECE. Even without installation of the newest technologies, upgrading and retrofitting with technologies could produce substantial savings both in resources and in emissions, which would drop even more with some CO2 capture or conversion. The situation is the same in most of the states of the CIS. The percentage of installed generation capacity from plants over 30 years old in Ukraine is 36%, in Uzbekistan, 68%. More Western parts of the OSCE have far younger plants, driven by long exposure to world prices for feedstock. Nevertheless, older, less efficient plants still exist throughout the OSCE/UNECE region. It appears that enhancing productive efficiencies in these installations, coupled with the addition of some "clean coal" technologies, may be ton-for-ton the most cost-effective means of lowering Carbon emissions now available.

Russia, holder of the world's largest gas reserves, still finds it economically advantageous to secure the preponderance of its energy from coal, which frees up the more valuable and easier to transport natural gas for export. However, increasing conversion efficiencies through the installation of technology upgrades would improve both local and global environmental situations, while freeing up additional resources for export, perhaps to relatively newer markets in Asia.

After the power plant, transmission losses through the grid are only 10-12 per cent, e.g. 100 watts comes in and 90 comes out in 1000 miles of transit, according to UNECE experts. As a result, there is not much gain to be had from conventional grid upgrades, so most focus should be on enhancing production or improving efficiency of use. Again, efficiency issues were reviewed extensively in the excellent report UNECE prepared in 2011 for the 19th EFF, which may be reviewed in conjunction with the current report.

Recent development and challenges in carbon capture and storage

As fossil fuels are likely to remain the main source for electricity generation in Europe, at least in the medium term, necessary minimization and reduction of Carbon/GHG emissions will require other solutions. Carbon Capture and Storage (CCS) may be a promising technological option for reducing those CO2 emissions. CCS is a process consisting of the separation of CO2 from industrial and energy-related sources, called capture, transport to a storage location (such as a depleted hydrocarbon field or a saline aquifer) and long-term isolation from the atmosphere, or storage [see the Special Report on Carbon Dioxide Capture and Storage prepared by the Intergovernmental Panel on Climate Change, IPCC, 2005]. With due assessment of sustainability and resource efficiency, CCS could play a very significant role in the transition from a fossil fuel dependent economy to a low-emission future. Internationally, more than 20 pre-commercial implementation projects are aiming to demonstrate CCS technologies, with more projects in the construction and development phase. Briefly, the technology involves:

Capture: Currently there are three main methods for capturing CO2 in power plants:

- ***Post-combustion*** capture involves removing the CO2 from flue gases after combustion of the fuel. Currently, the favored technique is chemical solvent scrubbing. CO2 is then cooled and compressed, ready to be piped away. The technique can be applied to both pulverized coal and natural gas power plants, and can be retrofitted to existing plants. CO2 scrubbing techniques have been utilized for more than 60 years for natural gas purification and food-grade CO2 production;
- ***Pre-combustion*** capture involves removal of CO2 prior to combustion of hydrogen in a gas turbine, in an integrated gasification combined cycle (IGCC) plant. Solid, liquid or gaseous fuel is first converted to a mixture of hydrogen and carbon monoxide, which is then converted to CO2; the hydrogen is burned in a gas turbine. Another challenge is to achieve higher efficiencies from hydrogen combustion;
- In ***oxy-fuel combustion***, the air is separated prior to combustion, into nitrogen and oxygen. The fuel is then burned in pure oxygen. This process, which is currently being tested in the EU at pilot scale, promises high efficiency levels and offers major business opportunities, including the possibility of retrofitting existing plants. The main disadvantage is

the large quantity of oxygen required, which is expensive.

Transport: Carbon dioxide is already transported by road tanker, by ship and by pipeline, just like gas or oil. It may be possible to re-use existing but redundant pipelines. Large networks of CO2 pipelines, more than 4 000 km, most of them in the US, mainly associated to CO2 injection for Enhanced Oil Recovery (EOR, below). They have been in use since the early 1980s with proven safety and reliability records. Recently networks have started in Europe, mainly in the North Sea, e.g. 160 km pipeline for an LNG project in Norway, and in the Netherlands, about 80 km of pipeline from Rotterdam to Amsterdam to transport CO2 to greenhouses. Transportation by ship, like LNG, has advantages, including flexibility and potential for transport over longer distances, but liquefaction costs need to be added.

Storage: Geological storage is by far the cheapest and most promising option and industrial geological CO2 storage projects have already been initiated in Europe and worldwide. Different types of geological formations are being used and investigated, especially oil and gas reservoirs, deep saline aquifer formations and unmineable coal beds. Due to its possible environmental implications, the possibility of CO2 storage deep in the oceans is no longer considered an option. CO2 storage in oil and gas reservoirs is less expensive than in saline aquifers. Long term reliability of storage is yet to be tested.

Current status: Seven commercial projects with CO2 capture, transport and storage are currently running. The Canadian Weyburn-Midale project demonstrates CO2 storage using CO2 from a gasification plant producing synfuel. In Norway, CO2 removed from natural gas up-grading has been injected since 1996 and 2008, and in Algeria in the In Salah field, since 2004. Two large projects are currently on-going in Australia (Otway basin) and in the Netherlands (K12B). Altogether, about 3 million tons of CO2 are stored annually. In some cases, CO2 is already captured in ammonia production, in coal-to-chemicals, coal/gas-to-liquids operations, and at well heads at gas fields.

The world's first coal-fired oxyfuel CCS plant with power generation is Vattenfall's Schwarze Pumpe 30 MW pilot plant, which was inaugurated in September 2008 in Spremburg, Germany, and started operation in early 2009 [Vattenfall, 2011]. Part of the captured CO2 is being transported by road tanker and injected into a saline aquifer. Vattenfall announced in November 2009 that it was achieving nearly 100 % CO2 capture at Schwarze Pumpe.

Another 30 MW pilot, built by CUIDEN at Cubillos de Sil in Leon, Northwest Spain, will be commissioned very soon. According to the Global CCS Institute nearly 40 projects for demonstration of CO2 capture from power plants, based on a variety of storage techniques, are currently planned in Europe [Global CCS Institute, 2011]. Despite the longer-term need for further R&D to reduce costs and raise efficiency, CCS is widely considered ready for large scale demonstration. The European Commission has committed to support up to 12 projects to be operational by 2015.

In future scenarios in which renewables are projected to play an ever greater role in electricity production, fossil-fired CCS power plants, inherently flexible, could be used to balance changing demand and provide backup capacity for intermittent renewable generation. For example, there are specific opportunities to use carbon capture with biomass combustion for power generation, particularly when biomass is co-fired with pulverized coal. Carbon capture on a biomass-fired plant would allow for negative CO2 emissions, as the CO2 is first taken from the air in the biomass production process, and subsequently captured and stored.

Barriers to large-scale deployment: In addition to it being a still new and relatively untested technology, financial, regulatory, infrastructure, environmental and social issues could all present barriers to CCS demonstration and deployment. CCS will initially increase the cost of electricity by €25/MWh or more compared to a reference plant. Under current EU Emission Trading System (ETS} pricing, publicly funded incentives are needed to make the investment as commercially attractive as a non-CCS reference plant. Dependence on such publicly funded incentives entails additional policy risk on top of the uncertainty in the EU ETS. In addition, discussion continues within the EU about evolving the ETS system into a carbon tax or some sort of carbon pricing system, but its introduction does not seem imminent.

Carbon Utilization: Perhaps the most interesting development in recent years is the growing prospect that ways can be found not only to store CO2, but use it in industrial processes. For several years already CO2 has been used in the oil industry to enhance recovery of otherwise depleting reserves (EOR), In 2007, about 95 CO2-EOR projects worldwide, mainly in the USA, injected about 40Mt of CO2 into oil reservoirs.

More intriguing still is the prospect of the gas being used as an industrial feedstock, to produce fertilizers. There are numerous other products that could give an added value to CCS equipped plants operating in a poly-generation scheme based on gasification technology, potentially even producing other synthetic fuels, including synthetic natural gas. Thus in the longer term, the application of a number of promising new technologies in petrochemical, bio- chemical, urea, fuel and power energy sectors can be foreseen. There is already a nascent industrial private sector developing to take advantage of the opportunity to extensively replace natural CO_2 with anthropogenic CO_2 for applications such as Enhanced Oil Recovery. According to material prepared by organizers (Climeworks/ACI) for an upcoming meeting entitled CARBON DIOXIDE UTILISATION SUMMIT on the technology, in Brussels, in October. Companies and researchers are working on processes such as production of Renewable Methanol from CO_2 feedstocks, CO_2 fermentation to produce fuels & chemicals, electrochemical technologies for converting CO_2 to formates and oxalates, conversion of CO_2 into biochemicals, and utilisation of supercritical CO_2 as the heat transfer medium in electricity generation to generate power through a CO_2 turbine.

B. Environmental impacts of fossil fuel-fired power plants

When evaluating energy sources and their impact on the environment, it is important to take into account the full stream of energy consumption associated with each particular fuel For example, on coal there is not just the cost of the coal or the CO_2 that results from burning it in a power plant. Cost and emissions associated with mining, processing and transport of the fuel to the plant, in transport of the energy to the final consumer as well as emissions in final consumption all must be counted (See emission cycle diagram, below).

Recent emission trends: CO_2, NOx, SOx, PM.

As noted above, OSCE states, in general, have had some success in reducing all kinds of emissions. Detailed information about carbon emissions is provided in the previous section with fully detailed information in the annex.

In the United States, the U.S. Environmental Protection Agency (EPA) has set national air quality standards for six common air pollutants (also called the criteria pollutants): nitrogen dioxide (NO2), particulate matter (PM), sulfur dioxide (SO2), as well as carbon monoxide (CO), ozone (O3), lead (Pb), but not, at present, CO2. In general the U.S. has had some success in cutting emissions of these pollutants. In Europe, as well, ever tightening regulation has prompted reductions in the level of these emissions.

Some of these pollutants (CO, SO2, and lead) are emitted directly from a variety of sources. Although some industrial sources release ozone directly into the environment, most ground-level ozone forms in the air from chemical reactions involving nitrogen oxides (NOx), volatile organic compounds (VOCs), and sunlight. NO2 is formed in the air through the oxidation of nitric oxide (NO). PM, also known as particle pollution, can be directly emitted, or it can be formed when emissions of NOx, sulfur oxides (SOx), ammonia, organic compounds, and other gases react in the atmosphere. Excluding CO2, all of these pollutants tend to be locally persistent, i.e. they stay in close to where they are generated, hence the phenomenon of smog. They also will react with other atmospheric elements and eventually precipitate, a self-limiting factor. CO2, in contrast, disperses around the globe, so every country's Green-house gas (GHG) emissions affects every other country around the globe.

Another pollutant associated with coal is Mercury, a toxic emission. New technologies can allow for its capture, coal producers could have a profitable side venture in mercury production as a byproduct, according to research done for UNECE. Some of the highly efficient plants described above, which produce lower amounts of CO2 can produce higher levels of NOx, a factor which must be considered as these technologies are brought to realization.

Transportation is responsible for about half of the NOx and SOx emissions in Europe. Of particular concern is emissions from seagoing vessels, formally less subject to scrutiny.

After considering scientific studies and hearing concerns both at industry and at local level the effects of a trading system could pose problems in terms of endangering the achievement of the EU air quality objectives, the EU Commission has decided not to pursue a NOx/SO_2 trading system. Note: Data on every European country can be found at: http://www.emep.int/mscw/SR_data/sr_tables.html.

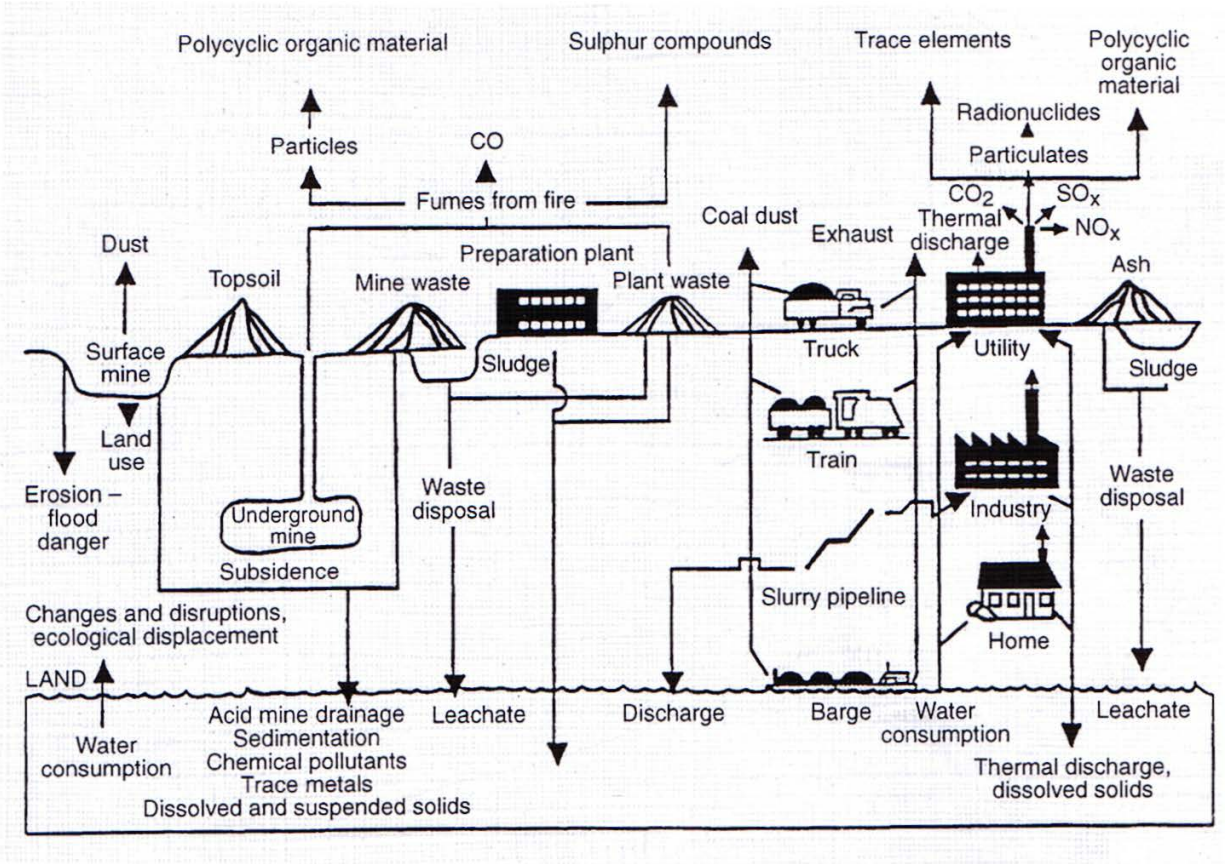
Other environmental risks: There is significant concern around the OSCE concerning catastrophic industrial accidents, such as the Chernobyl and Fukushima nuclear reactor crises. While fossil fuel combustion plants produce a number of emissions that are harmful to long-term health, they tend to be less vulnerable to such large –scale catastrophic accidents. One exception

involves the storage of hydrocarbon fuels for the plants. There can and have been explosions as such facilities, but they are not more dangerous than refinery accidents, and consequences tend to be locally confined. Long-range transport has so far been resistant to renewables, but there is a possibility that biofuels could be developed to use economically for both air and sea transport fuels.

Water quality is outside the scope of this report but it should be noted that spoilage of ground water is a key concern, as previously mentioned, in the development of shale oil and gas resources, as it already is with mining and other processing operations. These operations also affect the soil in nearby areas. See the below diagram for a comprehensive look at the various types of pollution generated by the full cycle of fossil fuel power generation.

Concerns about all these issues revolve around their effects on human health, and there is increasing research into the impact of various technologies or fuel combustion on health. In general, renewable energy tends to be without such noisome side effects, but there are some issues such as the release of gallium arsenide in the production of solar cells. Wind power has faced criticism due to the noise that it generates, considered a nuisance by those living in nearby areas. One positive externality factor should be mentioned, however. One by-product of biogas production from waste material or sewage can be high quality fertilizer, as long as the other deleterious components, such as heavy metals are removed in the process.

Pollution spinoff of the Energy/Power Generation full cycle



Source: IAEA: Methodology for Assessing the Impact of Energy-derived Emissions

C. Fuel supply dilemma: coal, natural gas, biomass, renewables…

Many observers argue that states should strengthen their reliance on domestically-available fuels. For the world as a whole, and for the region, in the current globalized economy, the greatest overall security lies in energy interdependence, and that has been accepted, at the level of principle, in the OSCE. At the same time, however, sourcing locally does enhance energy security, both at the local and national levels, for technical, economic, and also for geopolitical reasons.

In recent years, probably driven by high prices more than any other factor, the United States has begun extracting increasing amounts of oil. Some of this oil has become available due to enhanced means of surveying, but most due to deeper drilling, particularly in the offshore areas. Finally there is the development of shale oil, released by fracking and other unconventional oils such as tar sands. Regulatory flexibility, including on the leasing of rights on public property and offshore, has facilitated this trend, although there was a major setback due to the Deep Horizon oil spill in the Gulf of Mexico. In a relatively overlooked aspect of the Gulf oil spill situation, but germane to this report, the spill was also an example of how an incident involving an oil company based in another state, which also is in the OSCE, was managed by both the governments concerned and the company to minimize the potential for nascent nationalist tension. In part prompted by the major environmental impact, there was some initial public reaction of this nature, fed by some perception that the company was "foreign." The defusing of this line of thinking, and some minimal reflection in the other state, was helped by an overall responsible approach by the media, and an agile response by those concerned.

More important, due to the growing exploitation of shale gas resources through fracking, or pressure fracturing of deposits locked in shale rock underground reservoirs, U.S. natural gas production has significantly risen, and risen enough that it has prompted a reduction in price sufficient to trigger substitution of natural gas for other fossil fuels. From the stand point of the environment, this is a mixed blessing. While the global benefits in reduced CO2 and other emissions, compared to an alternative fossil fuel resource, coal, are considerable, and oil, somewhat less so, there have been reports of significant local environmental impacts, including spoliation of groundwater and release of methane, a very high impact Green House Gas (GHG) into the atmosphere. On balance, however, it appears that the GHG impact is net negative, particularly as increasing care is devoted to unintended emissions of methane.

Although rising in the United States, due to extensive use of emissions control as well as widespread plentiful supplies, the use of coal is declining in the EU. Coal is the world's most widely distributed fossil fuel, relatively plentiful and economically accessible. Counting both China and India, new plants are being built and opened it seems almost every few days. More advanced economies, concerned about climate and carbon, are much more hesitant to turn to coal, especially now that coal has a major challenger in natural gas, with growing unconventional supplies. At least in those countries, coal's future will be closely linked to continued progress on making it environmentally more benign, and some solutions are discussed below. Nevertheless, continued research into more efficient and cleaner uses for coal is highly desirable, and may benefit from strengthening global and regional mechanisms for promotion of new technologies and sharing of information. The OSCE as a platform for exchanges of ideas in its region, can have an important role as a facilitator, as it does in its Energy and Environmental Forums.

Biomass is reviewed in more detail in the renewables section. There have been continued advances in the technology and expanding varieties of feedstock. However, a few years back, a spike in biofuel demand caused world food prices to rise, with impact throughout the OSCE region, and dramatically affecting the lives of some of the world's poorest citizens. Governments have reacted and are working with private partnerships to promote non-food biomass, such as the fast-growing trees that may have great potential as a feedstock in south-eastern Europe.

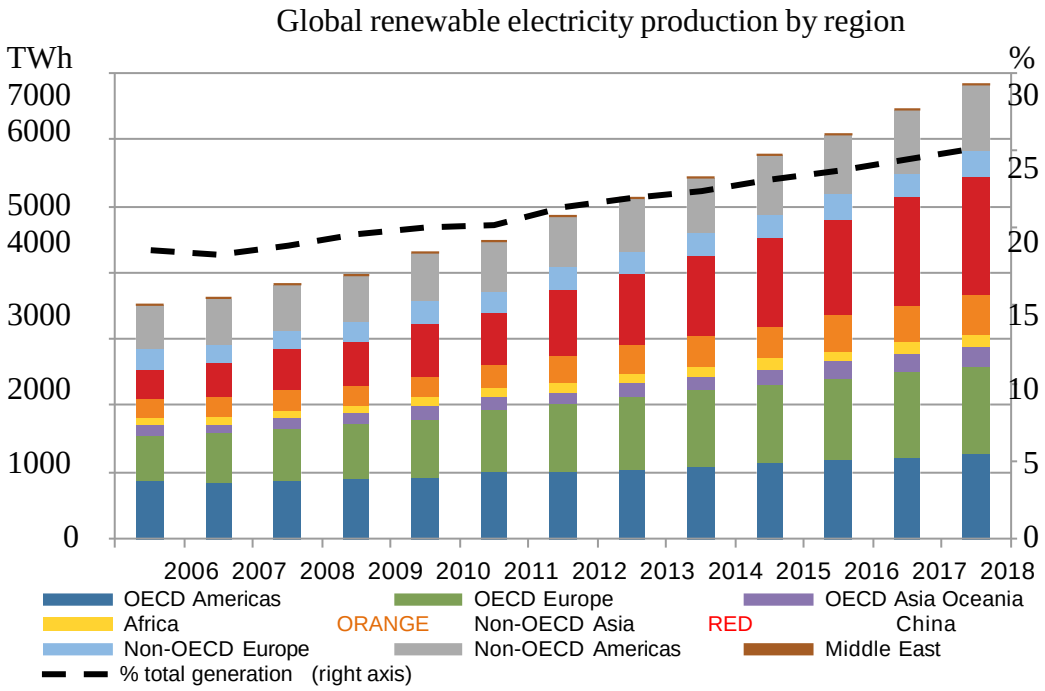
Long term relative pricing has been and likely will remain the preponderant consideration in determining choice of fuel for any particular project, although environmental/emissions considerations are a growing concern. Efforts have been made, such as the EU Emissions Trading System to monetise the negative externalities of emissions. Both the EU and other governments have heard proposals to take the additional step of adopting a carbon tax, but concerns over the impact on industrial competitiveness have so far stymied this effort.

The price of oil has been maintained at a high level for the past decade by OPEC quotas and in recent years by increasing demand from emerging markets. Barring a major security/political shock, it is likely to stay around $100 per barrel for some time, as this appears an equilibrium price that fosters the development of alternative sources or fuels, but not market-denting substitution. Despite progress with electric autos, oil will remain the preponderant source of motor vehicle fuel for many years, but has, generally for price reasons, been largely phased out of power generation in the OSCE area.

Chapter III: Enhancing the contribution of renewable energy to sustainable development

The benefits—economic, environmental, and even political ones—of introducing more renewable energy sources into the electricity generation sector have amplified in recent years as the pressure of climate change grows and as the costs of renewables decline. Implementing a system of renewable electricity generation which can be incorporated into national and regional grids has become a key goal in the region, in line with the environmental commitments taken on by OSCE participating States.

According to the IEA Renewable Energy Market Report, renewable electricity generation increased strongly worldwide in 2012, and deployment is occurring in a greater number of markets. However, the story of renewable energy development is becoming more complex. Short-term indicators in some regions of the globe have pointed to increased challenges. Despite remaining high, global new investment in renewable energy fell in 2012. Policy uncertainties, economic challenges, incentive reductions and competition from other energy sources clouded the investment outlook for some markets. Some countries and regions have faced difficulties in integrating variable renewables in their power grids. The renewable manufacturing industry, particularly solar and wind, entered a deeper period of restructuring and consolidation.



Note: TWh = terawatt hours. Source IEA Renewable Energy Medium Term Market Report, 2013

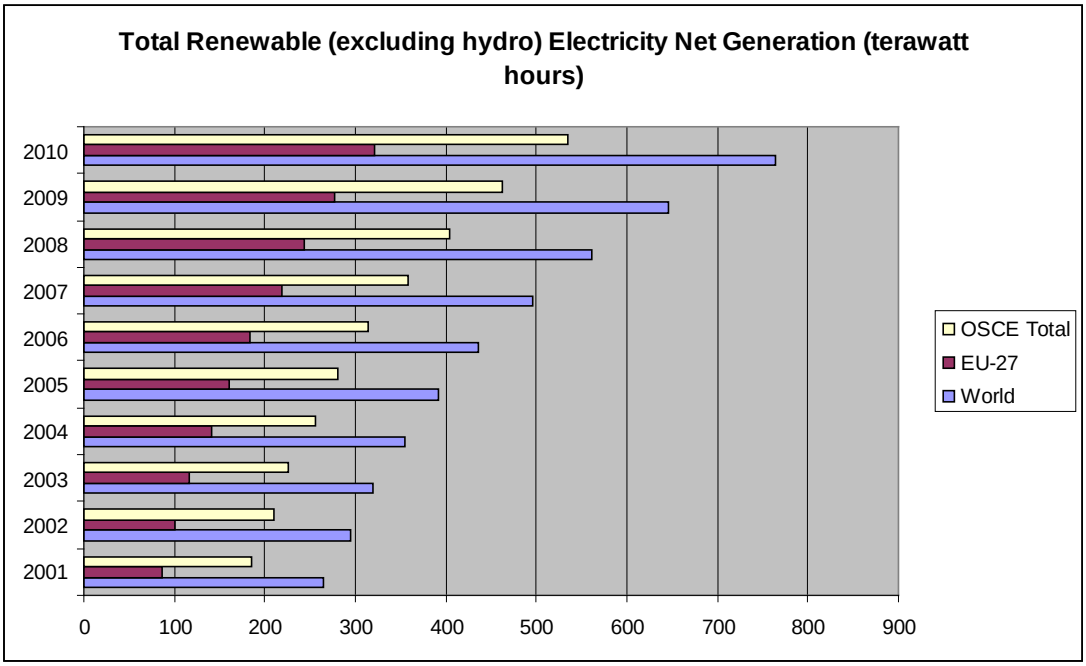
Unless otherwise indicated, all materials in figures and tables in this chapter derive from (IEA data and analyses).

Nevertheless, despite economic, policy and industry turbulence, the underlying fundamentals for renewable deployment remain robust. Even with challenges in some countries, more positive developments elsewhere continue to drive global growth. Competitive opportunities for renewables are emerging across traditional and new markets. While OSCE countries remain a driver of renewable power development, China and other non-European countries are increasingly accounting for overall growth. The roles of biofuels for transport and renewable heat are also increasing, though at somewhat slower rates than renewable electricity. In sum, the IEA predicts globally renewable output will continue to grow fairly robustly, and their share of global energy use will also grow, but not quite so rapidly, due to continued growth in fossil fuel use. Renewables are being increasingly deployed, achieving an increasing share of energy consumption, and continuing to add value through continued technological improvements. Thus, the IEA predicts that by 2020, if these trends continue to develop, the world will be on track to get enough energy from renewables to limit emissions to a level that will not force the Earth's average temperature over the 2degrees C threshold for more severe consequences.

A. Links to climate change mitigation and adaptation.

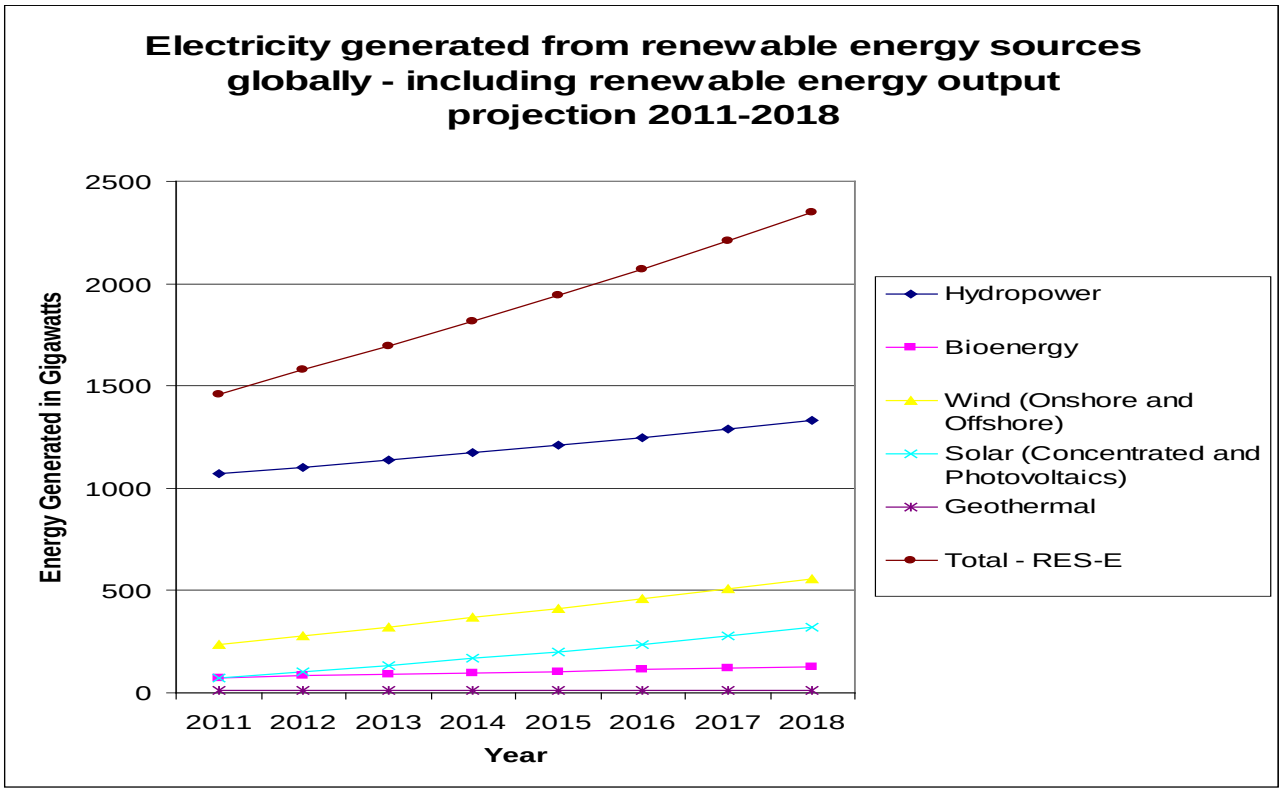
The advantages of a local source of power generation, locally maintained, is appealing for the employment opportunities it creates, both in maintenance and to some degree in local manufacturing. Moreover, there can be no more secure source of supply that the solar panel or windmill on the roof of a home, factory, office, farm or commercial building, or just outside of town. The increasing dependence of Europe on imported fuels has been another driver in the effort to find good renewable resources and technologies. The importance that many of the governments of participating States attach to this is underscored by the significant monies they have expended or revenues foregone in an effort to promote these new technologies. As this report points out, these investments have borne some fruit, with some OSCE participating States among the world leaders, particularly in technologies like wind, although there is a considerable way to go. This is doing well to do good. All renewables reduce the consumption of fossil fuels, limiting the production of Green House Gases, particularly CO2, and thus can play a major part in mitigating world temperature rise to more than 2 degrees C. As they play an increasing role in the power generation mix, the use of renewables will also help increase the awareness of average citizens, and thus promote energy saving actions by the public.

OSCE participating States are among the world leaders in renewable energy. From 2001-2010, the OSCE accounted for approximately 70% of global renewable electricity net generation (excluding hydroelectric), nearly tripling its use. The world total also tripled over this period.



Source: EIA, International Energy Statistics, 2001-2010

OSCE commitments to expand the use of renewable energy sources in electricity generation, and their success in implementation, are in line with the tremendous global expansion of renewable energy use in generation of electricity, led by China, the world largest implementer of renewable energy, and by some Middle Eastern fossil fuel producing states, who are investing in technologies, both for long term profit, but also to turn to when their oil runs out.



Source: IEA, 2013 Medium Term Energy Report, p. 10

Current projections of electricity generation from renewable energy sources globally suggest that within the next few years (2016) there could be:

- 24.2% increase in electricity generation from hydropower;
- 66.7% increase in electricity generation from bioenergy;
- 136.9% increase in electricity generation from wind energy (offshore and onshore);
- 350.7% increase in electricity generation from solar energy;
- 36.4% increase in electricity generation from geothermal energy;
- Only modest increases in hydroelectric power, due to long lead times and high cost.

Source: IEA, 2013 Medium Term Energy Report

Electricity Generation in the OSCE:

Electricity generation across 33 OSCE participating States measured 10021.6 terawatt hours (BP, Statistical Review of World Energy) in 2012.

From renewable sources of energy, without doubt the most prominent source of electricity generation is hydropower. The CIS region and a number of the Central Asian Republics in particular are intense users of hydro energy in electricity.

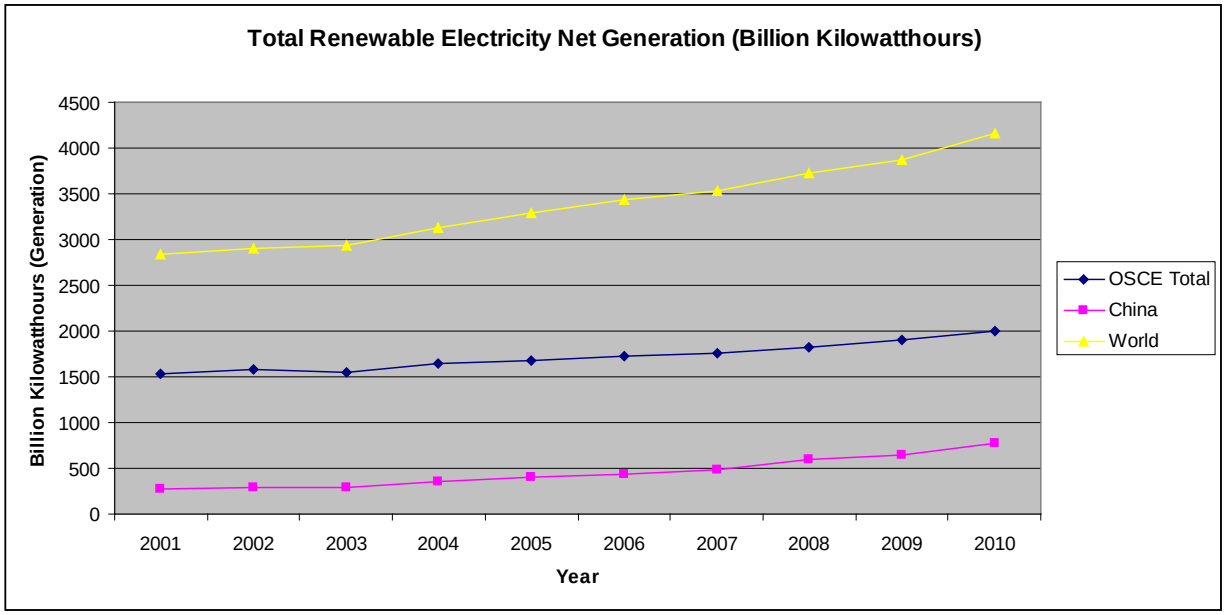
Country	Percentage of Electricity Generated (TWh) using Hydropower (%)
Russian Federation	16.2%
Tajikistan	96.6%
Kazakhstan	9.7%
Kyrgyzstan	91%
Uzbekistan	21%

Source: International Energy Agency, Electricity Information 2012

Despite the environmental and economic pressure of relying so heavily on fossil fuels in the electricity generation process, obtaining electricity from renewable sources remains in its infancy in much of the OSCE. A number of barriers remain. The electricity grid in most OSCE countries currently relies on non-renewable energy sources to provide electricity which is then transferred on the grid around each country. Non-Hydro renewables, principally wind and solar, tend to be intermittent and the grids were not designed to incorporate that kind of fluctuation on the supply side. This can, in part be accommodated for by the proposed "smart grids," computer governed transmission systems, but recent concerns about security has slowed the rush to their implementation. One advantage of wind and solar power is that they exchange potentially local sourced material and human resource inputs, in exchange for imported fossil fuels with conventional power.

The generation of electricity through renewable energy sources suffers from high start-up costs and has often relied on significant government subsidies. In recent years, however, the costs of some forms of renewables have plummeted. China's entry into and emphasis on the manufacture of solar panels, because of the vast scale involved, produced major economies of scale and pushed continuing technical breakthroughs, The cost of solar panels dropped so much that it had producers in the OSCE, particularly Europe and the United States calling foul, and countervailing tariff duties were imposed on Chinese-made panels.

Total Renewable Electricity Generation (Including Hydropower):



Source: EIA, International Energy Statistics, Total Renewable Electricity Generation

Country/Region	% increase in renewable energy electricity generation (2001-2010)
OSCE	30.1
China	177.4
World	47.1

Source: EIA, International Energy Statistics, Total Renewable Electricity Generation

The worldwide increase in renewable electricity generation is predominantly driven by the increasing technological advances in hydropower and in particular several types of renewable energy. The OSCE has affirmed its commitment to encouraging cooperation and the proliferation of technology and expertise regarding renewable sources of energy for electricity generation. However the OSCE could more actively encourage individual governments to do more to begin the transition of national electricity grids to a more sustainable renewably sourced future. In addition to this, some governments have encouraged, through the use of financial incentives and subsidies (including Feed in Tariffs), for individual households to invest in renewable sources of electricity, encouraging energy self-sufficiency and creating an environment of potential profitability for individuals who take up the schemes. The OSCE could therefore do more, firstly to encourage such schemes, and secondly to raise awareness of them, particularly in the public sector, but also encouraging cooperation with private sector suppliers.

The example of Spain:
Spain, poorly endowed with primary energy resources, has made a major effort to shift from fossil fuels, which currently are down to about half of the power generation sources, (see table below). Non Hydroelectric renewables, principally solar and onshore wind, have risen to some 15 per cent of total power generation. However, during the recent economic crisis, the solar power market in Spain was deeply shaken by the loss of expected government backing. This has undermined investor confidence in the renewable energy market (Forbes, Spain's Escalating Solar Crisis 2013)

Comparing some OSCE states on electricity generation by renewables:

Country	Percentage of electricity generated using renewable energy (incl. hydro power)
Spain	32%
Turkey	25.9%
United States	8.8%

Source: International Energy Agency, Electricity Information 2012 (IEN/OECD Energy Statistics of OECD countries)

Systems of support for renewable energy

Consumption:

In general the supply of renewable energy from within a state reduces the necessity to import other sources of energy and reduces the reliance on non-renewable energy sources. Across the world, renewable energy consumption increased by 15.2% between 2011 and 2012 (BP, Statistical Review of World Energy 2013). Of this increase, hydroelectricity accounted for the largest share of increasing electricity generation using renewable sources of energy. While there are significant potential hydroelectric sites ready to be built, in the long term there are limits to the amount of power it can theoretically produce, given the eventual exploitation of most high yield sites.

Wholesale replacement of the existing supply to the national grid requires significant cooperation and communication between government, the private sector and the general public, something the OSCE has committed to encourage.

Top Ten Major Producers of Hydroelectric Power, 2010 (OSCE countries):

Country	% of hydro in total domestic electricity generation
Norway	94.7
Brazil	78.2
Venezuela	64.9
Canada	57.8
China	17.2
Russia	16.2
India	11.9
France	11.7
Japan	8.1
United States	6.5

Source, IEA, Key World Energy Statistics 2012

Total OSCE Non-Hydro Renewable Energy Consumption and Growth (TWh):

Steadily growing production

Sector	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Wind	56.9	74.9	90.6	112.3	143.5	180.3	216	256.2	315.5	360.4
Solar	1	1.3	2.1	3.1	4.2	8.4	15.1	24.6	48.8	76.1
Other - Geothermal, Biomass etc	139.5	151	163	173.6	182.4	189.6	198	217.8	225.2	237.4
Total (TWh)	197.4	227	256	289	330.1	378.3	429	498.6	589.5	673.9
Percentage total growth		15	12	13	14	15	13	16	18	14

Average annual % growth of total 14.5%

Energy Source	**% increase in consumption across the OSCE 2003-2012**
Wind	533.4
Solar	7510
Other – including geothermal, biomass	70.2

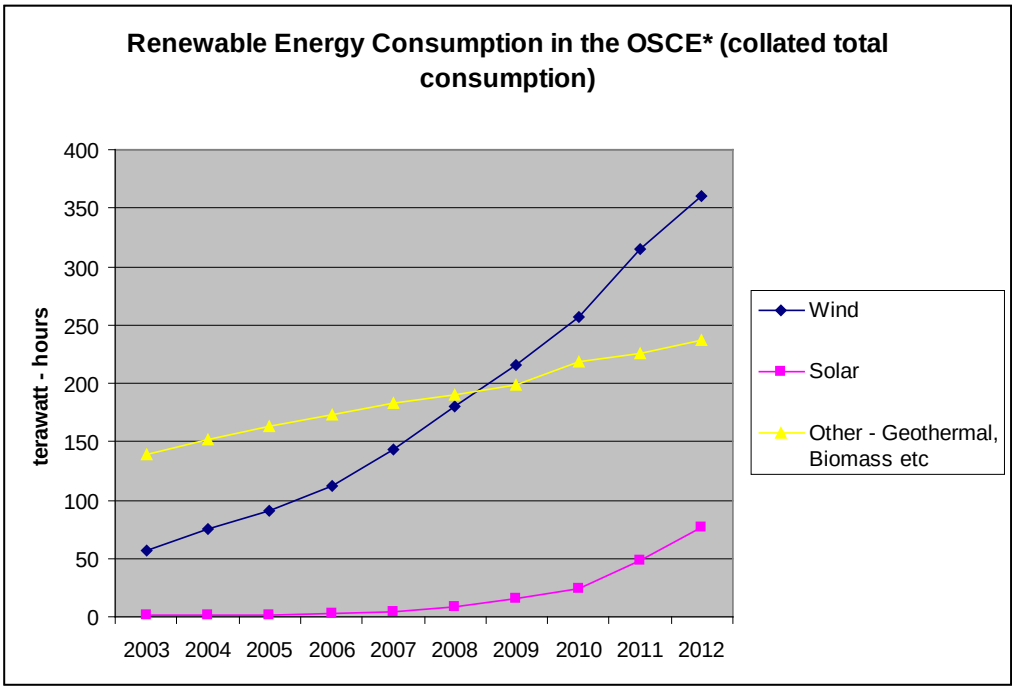
Source: BP, Statistical Review of World Energy 2013

Table: Total Non-Hydro Renewable Electricity Net Generation (Billion Kilowatt hours)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Canada	8.998	9.51	9.938	9.817	10.7	11.27	11.54	10.91	14.51	18.45
United States	82.675	92.64	93.53	97.3	100.15	109.5	117.5	137.9	156.2	180
Albania	0	0	0	0	0	0	0	0	0	0
Austria	1.998	1.891	2.329	3.288	4.233	5.552	6.66	6.806	6.879	7.188
Belgium	1.62	1.719	1.711	2.09	2.478	3.473	4.138	5.072	6.424	7.479
Bosnia and Herzegovina	0	0	0	0	0	0	0	0	0	0
Bulgaria	0	0.011	0.006	0.02	0.022	0.027	0.053	0.138	0.248	0.731
Croatia	0.001	0	0	0.006	0.024	0.03	0.043	0.061	0.079	0.172
Cyprus	0	0	0	0	0.001	0.001	0.003	0.014	0.01	0.121
Czech Republic	0.713	0.691	0.501	0.73	0.759	0.977	1.329	1.717	2.234	3.139
Denmark	6.41	7.38	8.725	10.15	10.605	10	11.07	10.93	10.8	13.13
Finland	8.453	9.168	9.639	10.75	9.849	11.09	10.3	10.82	9.221	11.47
France	4.996	5.389	5.808	6.15	6.523	7.665	10.13	12.03	14.61	17.87
Germany	23.013	28.56	33.9	42.1	45.1	54.27	71.86	74.23	80.8	89.37
Greece	0.938	0.885	1.267	1.385	1.489	1.839	2.028	2.457	2.83	3.191
Hungary	0.127	0.072	0.198	0.757	1.74	1.439	1.819	2.258	2.784	2.984
Iceland	1.451	1.433	1.406	1.485	1.662	2.633	3.581	4.039	4.553	4.465
Ireland	0.431	0.47	0.54	0.764	1.242	1.751	2.127	2.619	3.206	3.132
Italy	8.291	9.599	11.32	12.95	13.851	15.28	16.6	18.24	21.89	28
Luxembourg	0.084	0.086	0.09	0.125	0.146	0.17	0.188	0.191	0.202	0.205
Netherlands	4.391	5.097	5.255	6.535	8.784	9.363	8.986	10.89	12.25	12.66
Norway	0.369	0.401	0.655	0.711	0.891	1.105	1.365	1.397	1.279	1.405
Poland	0.78	0.952	0.865	1.323	1.884	2.485	3.309	4.662	6.541	8.214
Portugal	1.962	2.194	2.258	2.713	3.834	5.026	6.412	8.13	10.31	12.53
Romania	0	0	0.003	0.004	0.007	0.004	0.038	0.029	0.02	0.419
Slovakia	0.16	0.158	0.115	0.041	0.062	0.429	0.507	0.542	0.559	0.709
Slovenia	0.072	0.102	0.128	0.126	0.12	0.117	0.118	0.293	0.196	0.235
Spain	8.747	12.24	15.63	19.38	24.321	26.79	31.71	39.56	48.43	55.95
Sweden	4.505	5.049	5.517	8.851	9.295	10.34	12.09	13.23	14.7	16.91
Switzerland	1.847	1.902	1.922	2.01	2.136	2.372	2.346	2.443	2.447	2.546
Turkey	0.382	0.327	0.266	0.255	0.275	0.374	0.725	1.228	2.271	4.041
United Kingdom	8.013	9.205	10.24	11.47	14.57	15.9	16.43	18.19	21.71	23.58
Armenia	0	0	0	0	0.001	0.001	0.003	0.002	0.004	0.007
Belarus	0	0	0	0.001	0.03	0.094	0.089	0.082	0.144	0.211
Estonia	0.012	0.024	0.036	0.038	0.089	0.116	0.124	0.169	0.509	1.017
Latvia	0.006	0.021	0.072	0.087	0.088	0.088	0.095	0.103	0.099	0.115
Lithuania	0.002	0.004	0.007	0.007	0.009	0.038	0.16	0.201	0.26	0.371
Russia	2.962	2.963	2.141	2.218	3.055	3.208	2.489	3.014	3.111	3.283
Ukraine	0.016	0.022	0.031	0.033	0.038	0.035	0.045	0.045	0.043	0.051
Total Non-Hydro Renewable Electricity Generation - Collated Figures										
World	264.43	295	318.5	354.4	391.37	436.2	495.2	560.4	646.6	764.9
EU-27	85.724	101	116.2	141.8	161.1	184.2	218.3	243.5	277.7	320.7
OSCE Total	184.42	210.2	226	255.7	280.06	314.9	358	404.6	462.4	535.4

Percentage increases 2000-2010: World 289%; EU 372%; OSCE 290%

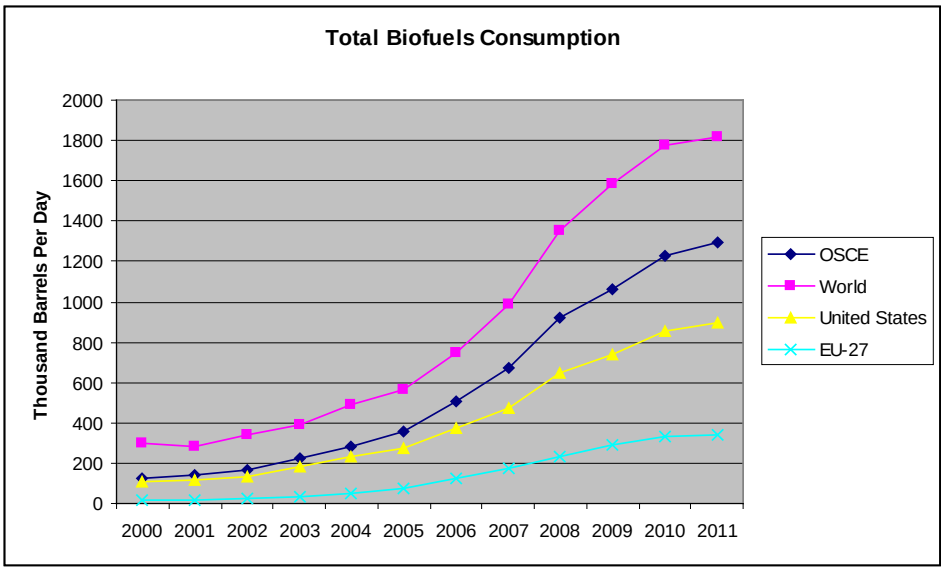
Source: EIA, International Energy Statistics, 2001-2010



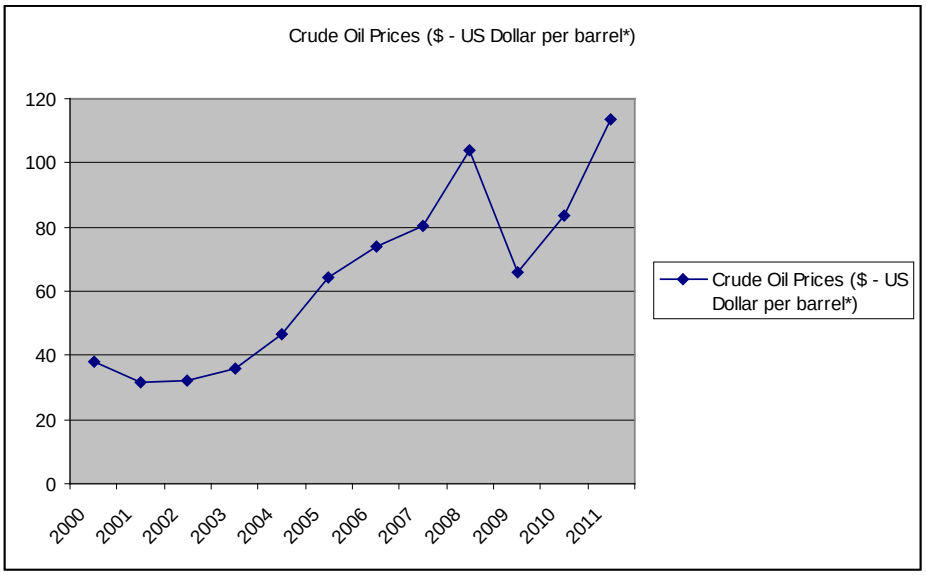
Source: BP, Statistical Review of World Energy 2013
* = all OSCE countries with data available

Renewable energy is growing in the OSCE, but most of it remains classic hydroelectric energy. The significant percentage increases in Non-hydroelectric renewable energy across the OSCE would suggest encouraging patterns, in particular the accelerating rates of growth for wind power, especially of the onshore variety and solar, whose curve, prompted by substantial recent price reductions, appears headed even higher. However, non-hydro renewable energy still only accounts for 2.8% of the OSCE's primary energy consumption (BP, 2013).

Biofuels:
A significant challenge facing OSCE participating States has been securing a reliable and stable oil supply while simultaneously reducing the OSCE's dependence on oil. Increasing technological advancements in the field of bio-fuels have increased consumption within the OSCE by over 900% in the period 2000 to 2011, however the fact remains for every barrel of biofuel consumed in the OSCE, 56.5 barrels of non-renewable oil are consumed (EIA, International Energy Statistics).



Source: EIA, International Energy Statistics, Biofuel Consumption
Commitments to investing in biofuel technology and production have generally been directly related to global crude oil prices.



Source: BP, Statistical Review of World Energy 2013, Crude Oil Prices
* = crude oil prices per barrel indexed by inflation to equate to value of dollar in 2011.

The increase in world crude oil prices between 2007 and 2008 of 29.4% (BP, 2013), induced a corresponding rise in consumption of biofuels of 37% (EIA, International Energy Statistics, Biofuel Consumption). The OSCE commitments to exploring alternatives to fossil fuels should therefore encourage more investment and technological research into biofuels, to ensure consumption and production does not simply depend on economic considerations (i.e. crude oil prices) but environmental considerations additionally.

As stated in the First Preparatory Meeting Report (OSCE, 2013), a consolidated OSCE approach to renewable energy in encouraging proliferation of technology, supporting participating States with renewable energy programmes and encouraging communication between the government and private sectors must take a regional approach, depending on the potential of renewable sources in different areas. In particular, attention was drawn to the potential of solar and hydropower sources in Central Asia.

B. The role of public policies in stimulating and supporting private sector commitments

The principal implementers of this renewable energy projects have often been the very power companies they were once imagined to displace. In the face of growing demand for power and constraints, often for environmental reasons, on the construction of new plants to produce it, utilities, both public and private, have become frequent facilitators of adoption of renewables, as well as promoting energy efficiency among their clients. One of the key enablers is feed-in tariffs, which allow households or other small producers to sell the electricity they produce when they don't need it. The feed-in tariff is a key element in the financial viability of small scale energy production, which must pay off the interest costs of the loans incurred for its purchase. The utilities must guarantee they will buy any such power. In most cases, private utilities were mandated to do this by government regulators, who will have an increasing role to play in converting to a low-carbon future.

C. Environmental impacts of renewables

Renewables are not without some environmental impact. Some may have potentially toxic chemicals in their manufacture, such as the gallic arsenide used in making some solar panels, which could sometimes wash off into groundwater. Construction of facilities including hydroelectric dams can leave behind detritus. More important, there is significant carbon emissions associated with the massive amounts of concrete used in modern dams. Such inputs and those associated with the transport of materials to sites have to be taken into account in a full impact assessment.

All renewables have land-use implications. The most significant are major hydroelectric dams which can uproot hundreds of thousands of local inhabitants, and flood areas of cultural and ecological importance, when the reservoirs are being filled. Wind power installations are known for their potential disruption of bird flight paths and other natural phenomena. For humans, they are criticized as being visually unpleasing, particularly offshore. A more serious complaint, for onshore wind installations is noise pollution of nearby areas. Residents have often complained about the disruption of sleep and other noise-

related disorders. Now greater efforts are made to locate large installations farther from populated areas. Finally, large solar installations, such as concentrated solar power, can occupy significant land areas, pre-empting other uses.

Chapter IV – Conclusions, recommendations, future steps

The world, the international community, and the OSCE and its participating States in particular, have begun to mobilize to meet the potentially existential challenge of climate change. The OSCE participating States took the lead in defining and taking on commitments in the field of energy and protection of the environment. As this report has demonstrated, although the situation in diversification of energy resources varies greatly among participating States, as a whole they have made a significant progress. Technological advances have made possible a significant expansion of renewables, short of what is still needed but far more than would have been contemplated only a few years ago.

Challenges and opportunities

One of the challenges impeding achievement of optimal emissions reductions, and greater energy security through diversification of supply is well known: it is a lack of awareness of the need to reduce emissions. Several participating States are affected by internal disputes that limit their ability to deploy technology and educate populations about the need for low carbon technologies. Those technologies downturn are inseparable from the green economy towards which the world is striving following the commitment made at Rio Summit in 2012. In addition, geopolitical rivalries or current disagreements between the OSCE participating States, or between OSCE and non-OSCE countries, can disrupt efficient energy transit, hamper the extension of electric grids and cause other difficulties that might best be resolved through dialogue, which could perhaps be facilitated by the OSCE.

The second major challenge is financial, in particular in the wake of the 2008 financial crisis and the on-going economic downturn. Deploying exiting emissions-reducing technologies, rolling out paradigm-shifting technologies (like carbon capture and storage), promoting the use of renewables and other carbon limiting strategies, requires significant investment. Regardless of the instruments used-subsidies or tax breaks—money is in short supply in many OSCE participating States. In addition, there is considerable opposition, for example, to the adoption of a carbon pricing scheme that, in Europe, would supplant the existing emissions trading system. Such opposition comes from commercial interests that believe—in many cases rightly so—that their businesses would be harmed and employment limited, due to the rising prices that such a scheme would impose on industrial production. There could also be significant administrative costs, which national budgets are not in good condition to absorb. Some participating States have had to postpone deployment of renewables or reduce subsidies, because of such fiscal pressures.

Yet, opportunities abound. With growing acknowledgement of the urgency to address environmental challenges, the public, the media, and, increasingly, businesses and governments of participating States are being galvanized. The vocal requests coming from participants from Central Asia for the OSCE to facilitate assistance (finance and technology transfer) to their countries in this field may serve as evidence to the above. This development is very encouraging. The OSCE, UNECE and other relevant organisations could do a fine job in articulating and formalizing such requests for assistance.

Technology continues its progress, fuelled by subsidies and other funding governments have provided. Technological developments are the driver of a large-scale production that has allowed manufacturers to deeply cut the cost and price of solar photo-voltaics. Solar power throughout the OSCE/UNECE region is becoming affordable for individuals. Likewise, developments of smart grids can enhance power source diversification and thus energy security. Both issues might be suitable for OSCE and UNECE engagement.

Surprisingly, the resource reserves in the OSCE/UNECE region have been increasing lately. This provides both a challenge and opportunity. Some experts, for example, believe the introduction and rapid growth of exploitation of shale oil deposits in Europe by fracking could, within a few short years, enhance both the environment by substitution for coal and reinforce national and regional energy security. On the other hand, in many OSCE/UNECE countries many point out possible environmental impacts that exploitation of shale gas may cause.

Roles for the OSCE in strengthening energy diversification and the implementation of environmental commitments

As the world's largest regional security organization that brings together the world's leading energy producers, exporters and consumers as well as key transit countries connecting Europe, North America, and Central Asia, the OSCE is uniquely positioned to develop comprehensive solutions to protect the environment, facilitate economic growth, and promote the sustainable use of energy resources. The OSCE must continue to act within the region and strengthen its efforts to assist those participating States that need and request it. The OSCE can continue to make its mark regionally by facilitating discussion and

dialogue on energy issues that affect all or a number of states and across sub-regions. Finally, it is advisable to increase its interactions with other similar organizations in different regions, as well as at the global level.

At the level of participating States, the OSCE has demonstrated capacity to provide advice and assistance to all the participating States on the implementation of commitments, inter alia, by implementing appropriate programmes and projects in areas where it can add value, and has or can obtain cost effectively the expertise and resources required. In so doing, it can reach out to effectively mobilize and facilitate deployment of the expertise and resources of other international organizations. A particular strength is assisting participating States, at their request, in developing appropriate legislation and institutions, including pilot/model capacity-building programmes. This can embody elaborating and organizing seminars/training for national, regional and local administrations, academics, business communities and NGOs.

The OSCE can also support participating States in securing assistance from other regional or global bodies to enhance conformity between national legislations and international legal instruments, standards and best practices, making laws and regulations accessible so that they can be read and understood in the same manner by users and state agencies. In the course of these efforts special care must be given to promote the inclusion of good governance and anti-corruption aspects in policies impacting on energy and the environment, in the spirit of the 2012 Dublin Declaration on Good Governance.

OSCE field operations have already had successes helping to build capacity for countries that are seeking to reduce the adverse environmental impacts of their energy systems and improve efficiencies. They can assist farmers and business entrepreneurs to increase their use of alternative energy resources and promote environmentally friendly activities through Aarhus Centers. Under the OSCE's multilateral framework, there is great potential for expanding clean energy technologies in Central Asia. Tajikistan is interested in small-scale hydro. In Uzbekistan, there is good potential for solar energy use. Turkmenistan sees opportunities in increasing solar and wind use and has been an active player in promoting regional cooperation and dialogue on energy issues in the OSCE. The High Level International Conference "Energy Security and Sustainability – The OSCE Perspective" held in Ashgabat on 17-18 October 2013 will be an opportunity to address these issues at the political level.

Within the OSCE region, the OSCE can contribute to efforts to overcome the identified challenges and seize the opportunities in the electricity sector, such as facilitating grid financing. The OSCE can facilitate discussions leading to grids interconnection. There are good prospects to further promote expansion of energy diversification in the region by integration of energy transmission and transport networks in Central Asia, South Caucasus, Russia, Eastern Europe and EU countries, including the Baltic and Nordic States.

Through its Permanent Council and its Economic and Environmental Committee as well as its annual Economic and Environmental Forum the OSCE is well placed to raise dialogue among its participating States on energy related activities and their environmental impacts.

The OSCE can increasingly promote regional and cross-border co-operation among interested participating States on sustainable energy, including but not limited to, the organization of regional seminars and conferences. The OSCE can work with other regional institutions, private networks, universities and research institutions and civil society to develop and support educational programmes that help increase the knowledge and raise awareness about the impact of energy related activities on the environment and its potential threats to security and stability. The OSCE could for, example, introduce this topic in the programme of the OSCE Border Management Staff College and the OSCE Academy in Bishkek.

The OSCE can help leverage the impressive advances in emissions reduction being undertaken in the European Union. There is possibility of cooperation with the Energy Community, which is attempting to enhance grid exchange in the South-Eastern European sub-region. This extends to the Black Sea Economic Co-operation, which, inter alia, promotes regional co-operation on sustainable energy issues. Both bodies' members are also participating States.

Beyond the OSCE region, the OSCE can work with the OSCE Partners for Cooperation to exchange best practices on sustainable energy with the goal of reducing dependence on fossil fuels, and ultimately reducing energy consumption. Avenues for such co-operation can include study visits, experts' workshops or conferences with OSCE Mediterranean or Asian Partners.

An additional field for potential interaction would be a deeper dialogue and engagement with organizations in adjacent regions. For example, several participating States are members of the Shanghai Cooperation Organization (SCO), along with what is already and will increasingly become the most important single country in terms of global emissions, China. Energy diversification as related to transit, and, ultimately energy security, could be subjects of an exchange. In addition, there is much the OSCE and participating States can learn from China and other members, such as the tremendous strides being made

in the installation of non–hydro renewables, particularly solar photovoltaic. An OSCE-China dialogue could also be envisioned.

Another potentially productive contact might be with the Economic Cooperation Organization (ECO), which covers all of the Central Asia countries, Azerbaijan, Afghanistan, and original members Pakistan, Iran and Turkey. Its related objectives, under the Treaty of Izmir, are:

- To intensify mobilization and utilization of the ECO region's natural resources, in particular energy resources;
- To facilitate cooperation in the fields of ecology and environmental protection within the region;
- To promote mutually beneficial interaction and cooperation between ECO and other regional and international organizations as well as financial institutions.

Given its extensive overlapping membership, the OSCE can offer a broad, transparent platform of dialogue which could provide a channel for productive discussions of the above fields, without raising bilateral issues that could inhibit dialogue.

The Permanent Council has already taken the important initiative by inviting all of these to participate in the 21st EEF, along with a large number of partner or potential partner organizations. The next step toward deepening engagement with organizations such as SCO or ECO could be informal OSCE discussions to explore potential areas of cooperation. Engaging other similar regional organizations could be envisioned.

Co-operation among International Partners

Of many international and intergovernmental mechanisms dealing with achieving security through diversification of energy mix and development of renewable energy, particularly relevant to OSCE are UNECE and the Energy Charter.

UNECE has a long-standing and well-recognized history of providing a neutral platform for delivering concrete results including in the form of norms, standards and conventions. Particularly relevant to OSCE is UNECE's work done under the auspices of its committees on sustainable energy, economic cooperation and integration, environmental policy, inland transport, housing and land management and their many expert subsidiary bodies. Technical and substantive expertise of UNECE can nicely complement OSCE political capacity, in particular in the field of energy security and economic-environmental consequences of energy diversification and deployment of renewable energy.

Since 2005 the UNECE Committee on Sustainable Energy has a mandate to focus on energy security. The Committee responded by launching the Energy Security Dialogue between governments, energy industries, financial institutions and international organizations. During the last five years the Dialogue has concentrated on a selection of key topics, including the impact of the financial crisis on energy security and the implications of gas infrastructure. The energy security dialogue undertaken at UNECE has clearly shown the need to include all stakeholders and hence discussions have involved direct engagement and participation of producer, consumer and transit countries from the outset. The UNECE energy security dialogue has for a number of years included a focus on international energy cooperation involving a range of major multinational energy corporations such as Eni, E.ON Ruhrgas, Gazprom, GDF Suez, Statoil, and Total.

The UNECE energy programme as a whole is well versed in cooperating and collaborating with non-UNECE member states. This could provide an avenue to OSCE to reach out to non-OSCE countries, in particular when the challenges are global in nature, such as, for example, climate change mitigation. Through its activities on energy security, natural gas, resource classification, energy efficiency, cleaner electricity production from coal and other fossil fuels and coal mine methane, UNECE has worked with, amongst others: Afghanistan, Algeria, Australia, Brazil, China, Colombia, Egypt, India, Islamic Republic of Iran, Japan, Libya, Republic of Korea, Kuwait, Mexico, Mongolia, South Africa, Syria, Qatar, Thailand and Vietnam. UNECE is structured to ensure its activities are conducted through an open and transparent process, with no formal limitations on participation. All United Nations member states can participate in UNECE's intergovernmental bodies or expert groups in accordance with the terms of reference and rules of procedure established for each.

UNECE services a number of global bodies such as the ECOSOC Committee of Experts on the Transport of Dangerous Goods. UNECE also produces global standards such as trade facilitation and electronic business (UN/CEFACT) and the World Forum for the Harmonisation of Vehicle Regulations. The Committee on Sustainable Energy has the Expert Group on Resource Classification operating under an ECOSOC Resolution to further develop and implement the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources (UNFC) for oil, gas, solid fuels and uranium. It has also recently launched the Global Energy Efficiency 21 Project.

A key advantage of UNECE as a partner to OSCE lies in its capacity to address the diversity of emerging energy security risks and other related issues with all parties concerned and in its ability to convey recommendations, when appropriate, to the attention of the governments of Member States, the Economic and Social Council and the General Assembly.

The **Energy Charter Treaty** aims at ensuring energy security through common rules and the promotion of transparency among its 47 signatory countries, 46 of which are also OSCE participating States. It has helped foster stability of energy supply lines in Europe, including for lower-carbon natural gas, and facilitates transparency and open information. Its Secretariat has a wealth of expertise in the patterns of energy trade and investment in the OSCE region. It is a promising potential partner in promoting diversification in primary energy supply.

ENVSEC

The Environment and Security Initiative (ENVSEC) is a partnership of six international organizations – the OSCE, Regional Environment Centre for Central and Eastern Europe (REC), United Nations Development Programme (UNDP), United Nations Economic Commission for Europe (UNECE), United Nations Environment Programme (UNEP), and the North Atlantic Treaty Organization (NATO) as an associated partner – with specialized, but complementary mandates and expertise, that provides an integrated response to environment and security challenges. The mission of ENVSEC is to promote sustainable resource management and environmental co-operation in order to contribute to the reduction of environment and security risks through strengthened cooperation among and within countries in four regions: Central Asia, Eastern Europe, Southern Caucasus, and South-Eastern Europe. The Initiative assists governments and communities to identify common solutions and develop joint projects for achieving them, and facilitates dialogue and collaboration among policy makers, environmental experts, and the civil society across the borders, including national experts ministries and national agencies, as well as NGOs and research institutes. ENVSEC is a practical effort which aims to provide or stimulate the provision of:

1. Vulnerability assessments, early warning and monitoring of environment and security risks, particularly with regard to catastrophic incidents;
2. Improved capacities of national institutions for more effective environment and security policies, and stronger institutional dialogue;
3. Technical expertise and financial resources mobilized for clean-up and remediation;
4. Increased knowledge and awareness about the linkages between environment and security risks, and enhanced participation of interested actors in activities that aim at preventing and reducing these risks.

ENVSEC assessments have been conducted for Eastern Europe, South Eastern Europe, the South Caucasus and Central Asia. ENVSEC focuses on issues such as trans-boundary natural resources, hazardous substances and practices, population pressure and climate change, information and participation.

Finance and public-private

European Bank for Reconstruction and Development (EBRD) works on energy and climate change, greenhouse gas assessment, among many other sectors. Its managing director for Environment and Sustainability stated during the first EEF preparatory meeting that energy efficiency was one of the key themes for EBRD as it operates in some of the most energy-inefficient countries. EBRD takes both economic aspects and the protection of the environment via environmental and social policy, including promotion of better access for women, into consideration in its project assessments, as well as evaluations and audits. In addition to its own capacity as a financing vehicle, the EBRD is in a position to facilitate public-private partnerships through its contacts in the financial industry and other parts of the business world.

The **OECD** has extensive but not comprehensive overlapping membership with the OSCE. It is, through the **International Energy Agency**, a key collator of information and data on the energy sector and has been a major source of data for this report. Participating States in need of financing for energy diversification or renewable energy projects may, depending on their memberships, turn to the **Asian Development Bank (ADB)** or the **World Bank** among other multilateral and regional financial institutions. There may be some prospect in OSCE interaction with these bodies, in terms of information exchange, or perhaps as a platform for facilitating regional projects.

Private sector interests in public-private partnerships

Since the financial crisis, and the adoption of low interest rates, major private investors have ventured widely in search of better returns on investment, including some projects in the global power sector that would be more efficient and thus reduce emissions. They are also more cautious, however, due to considerations of high risk. Large amounts of money have been already invested in wind and solar, but very little in projects related to energy efficiency. In addition to potential profit, investors in a project seek good governance, rule of law, transparency and accountability. Until adequate government policy reforms are put in place, investing in untested markets involves significant risks. To overcome these risks, public-private initiatives are needed as an interim solution; but always with the long-term focus of making projects self-sustaining. One possible role for regional bodies such as the OSCE could be to facilitate regional forums to address

issues which, in many cases, market participants cannot solve alone *e.g.* the bundling of small projects and the financing of complex projects related to energy efficiency, such as district heating, municipal lending, etc. It could also facilitate discussion of possible government-business agreements to address market failures, lower friction costs and avoid conflicts of interest.

Special considerations

Equal access: The **U.N. Sustainable Energy for All** initiative is a cross-cutting effort involving the U.N. system to help speed the transformation of the world's energy systems, pursue the elimination of energy poverty, and enhance prosperity. It has three objectives to be achieved by 2030: (1) ensuring universal access to modern energy services; (2) doubling the global rate of improvement in energy efficiency; and (3) doubling the share of renewable energy in the global energy mix. The initiative hopes to catalyze major new investments through new public-private partnerships built from dialogue on policy, investment, and market development by governments, businesses, and civil society. It brings together the global convening power of the United Nations, the ability to mobilize bold commitments and leverage large-scale investment, and a rapidly expanding knowledge network. As previously noted, access issues exist but are relatively minor in the OSCE region, and the initiative could help to address them. Moreover, the efficiency and renewable energy goals fit those of the OSCE, which could assist in establishing frameworks in its region for the investment that could be stimulated by the U.N.

Gender mainstreaming: In the energy sector as in others, the OSCE and all related institutions should consider how gender mainstreaming can contribute to economic growth and sustainability. The OSCE and its participating States are committed to promote efforts to support equal participation of women and men in the field of sustainable energy. This applies inter alia to support on the entrepreneurial side and working with other regional institutions to encourage a broader general mix among technical personnel and in related training.

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ANNEXES

ANNEX I

PC.DEC/1047
26 July 2012

Organization for Security and Co-operation in Europe
Permanent Council

Original: ENGLISH

922nd Plenary Meeting
PC Journal No. 922, Agenda item 4

DECISION No. 1047
THEME, AGENDA AND MODALITIES FOR THE TWENTY-FIRST ECONOMIC AND ENVIRONMENTAL FORUM

The Permanent Council,

Pursuant to Chapter VII, paragraphs 21 to 32, of the Helsinki Document 1992; Chapter IX, paragraph 20, of the Budapest Document 1994; Ministerial Council Decision No. 10/04 of 7 December 2004; Ministerial Council Decision No. 4/06 of 26 July 2006; Permanent Council Decision No. 743 of 19 October 2006; Permanent Council Decision No. 958 of 11 November 2010; and Permanent Council Decision No. 1011 of 7 December 2011,

Relying on the OSCE Strategy Document for the Economic and Environmental Dimension (MC(11).JOUR/2) and Ministerial Council decisions related to the environment, energy and water management,

Building on the outcomes of past Economic and Environmental Forums, as well as on the results of relevant OSCE activities, including follow-up activities,

Decides that:

1. The theme of the Twenty-First Economic and Environmental Forum will be: "Increasing stability and security: Improving the environmental footprint of energy-related activities in the OSCE region";

2. The Twenty-First Economic and Environmental Forum will consist of three meetings, including two preparatory meetings, one of which will take place outside of Vienna. The concluding meeting will be held from 11 to 13 September 2013 in Prague. These arrangements shall not set a precedent for future meetings of the Economic and Environmental Forums. The Office of the Co-ordinator of OSCE Economic and Environmental Activities, under the guidance of the OSCE Chairmanship for 2013, will organize the above-mentioned meetings;

– The agenda of the Forum will focus on the following topics: Addressing environmental challenges and risks stemming from energy-related activities and their security implications, including through sustainable management of energy resources;
– Improving the environmental footprint of energy production, transportation and consumption in the OSCE area including through strengthening the co-operation between the participating States on promotion of green economy, new and renewable sources of energy and energy efficiency, as well as good governance and transparency in energy field and public-private partnerships;

3. The agendas of the Forum meetings, including timetables and themes of the working sessions, will be proposed and determined by the OSCE Chairmanship for 2013, after being agreed upon by the participating States in the Economic and Environmental Committee;
4. Moreover, having a view to its tasks, the Economic and Environmental Forum will review the implementation of OSCE commitments in the economic and environmental dimension. The review, to be integrated into the agenda of the Forum, will address OSCE commitments relevant to the theme of the Twenty-First Economic and Environmental Forum;

5. The discussions of the Forum should benefit from cross-dimensional input provided by other OSCE bodies and relevant meetings, organized by the Office of the Co-ordinator of OSCE Economic and Environmental Activities, under the guidance of the OSCE Chairmanship for 2013, and deliberations in various international organizations;

6. Moreover, having a view to its tasks, the Economic and Environmental Forum will discuss current and future activities for the economic and environmental dimension, in particular the work in implementation of the OSCE Strategy Document for the Economic and Environmental Dimension;

7. The participating States are encouraged to be represented at a high level, by senior officials responsible for shaping international economic and environmental policy in the OSCE area. The participation in their delegations of representatives from the business and scientific communities and of other relevant actors of civil society would be welcome;

8. As in previous years, the format of the Economic and Environmental Forum should provide for the active involvement of relevant international organizations and encourage open discussions;

9. The following international organizations, international organs, regional groupings and conferences of States are invited to participate in the Twenty-First Economic and Environmental Forum: Asian Development Bank; Barents Euro-Arctic Council; Organization of the Black Sea Economic Co-operation; Central European Initiative; Collective Security Treaty Organization; Commonwealth of Independent States; Conference on Interaction and Confidence-Building Measures in Asia; Council of Europe; Council of the Baltic Sea States; Economic Cooperation Organization; Energy Charter Treaty; Energy Community; Eurasian Economic Commission; Eurasian Economic Community; European Bank for Reconstruction and Development; European Environment Agency; European Investment Bank; Secretariat of the Extractive Industries Transparency Initiative; Food and Agriculture Organization of the United Nations (FAO); European Investment Bank; Intergovernmental Commission TRACECA (Transport Corridor Europe- Caucasus-Asia); Gas Exporting Countries Forum(GECF); International Atomic Energy Agency; International Energy Agency; International Energy Forum; International Fund for Agricultural Development (IFAD); International Institute for Applied Systems Analysis (IIASA); International Renewable Energy Agency(IRENA); International Fund for Saving the Aral Sea; International Labour Organization; International Maritime Organisation; International Monetary Fund; International Partnership for Energy Efficiency Cooperation (IPEEC); International Rail Transport Committee; International Road Transport Union; International Road Federation; International Union of Railways; International Transport Forum; North Atlantic Treaty Organization; Organization of the Petroleum Exporting Countries (OPEC); OPEC Fund for International Development(OFID); Organisation for Economic Co-operation and Development (OECD); Organization for Democracy and Economic Development – GUAM; Organization of Islamic Cooperation; Regional Cooperation Council; Renewable Energy and Energy Efficiency Partnership(REEEP); Russian-German Energy Agency (RUDEA); Secretariat of the United Nations Convention to Combat Desertification (UNCCD); Southeast European

Cooperative Initiative; Secretariat of the United Nations Framework Convention on Climate Change; Shanghai Cooperation Organisation; United Nations Conference on Trade and Development; United Nations Development Programme; United Nations Economic Commission for Europe; United Nations Economic and Social Commission for Asia and the Pacific; United Nations Commission on Sustainable Development; United Nations Environment Programme; United Nations Human Settlements Programme (UN HABITAT);United Nations Industrial Development Organization; UN Women; United Nations Special Programme for the Economies of Central Asia; World Bank Group; World Health Organization (WHO); World Meteorological Organization (WMO); World Trade Organization (WTO) and other relevant organizations;

10. The OSCE Partners for Co-operation are invited to participate in the Twenty-First Economic and Environmental Forum;

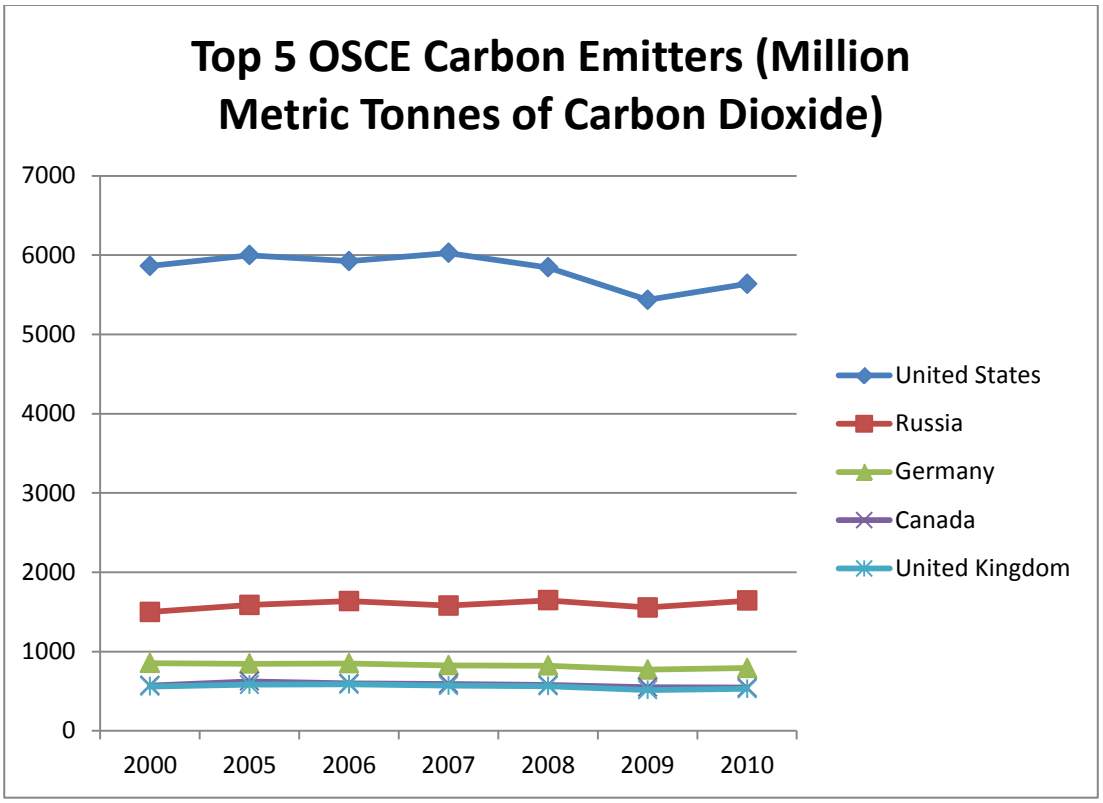
11. Upon request by a delegation of an OSCE participating State, regional groupings or expert academics and business representatives may also be invited, as appropriate, to participate in the Twenty-First Economic and Environmental Forum;

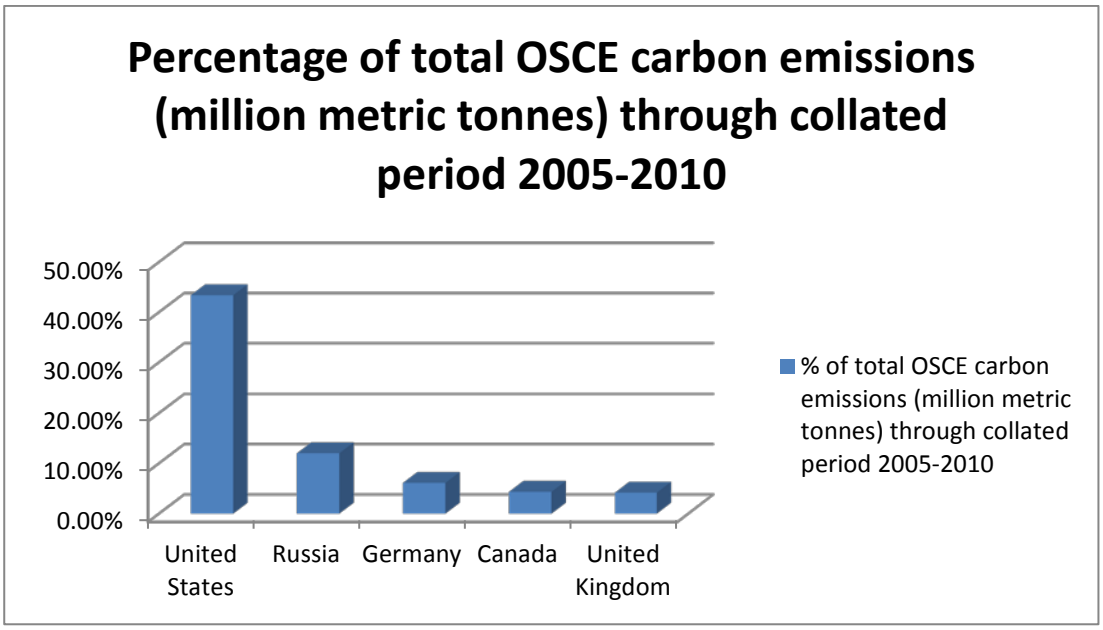
12. Subject to the provisions contained in Chapter IV, paragraphs 15 and 16, of the Helsinki Document 1992, the representatives of non-governmental organizations with relevant experience in the area under discussion are also invited to participate in the Twenty-First Economic and Environmental Forum;

13. In line with the practices established over past years with regard to meetings of the Economic and Environmental Forum and their preparatory process, the Chairperson of the Twenty-First Economic and Environmental Forum will present summary conclusions and policy recommendations drawn from the discussions. The Economic and Environmental Committee will further include the conclusions of the Chairperson and the reports of the rapporteurs in its discussions so that the Permanent Council can take the decisions required for appropriate policy translation and follow-up activities.

ANNEX II Country Statistics: OSCE – CARBON EMISSIONS 2000-2010

A: TOP 5 CO2 PRODUCERS





Source for both: US EIA International Energy Statistics, 2013, Total Carbon Emissions from the Consumption of Energy

B. OSCE Total Carbon Emissions from Consumption of Energy (Million metric tons

	1990	2000	2005	2006	2007	2008	2009	2010	Sum: 2005-2010
Albania	6.0747	3.2621	4.6226	4.5508	4.3874	4.3723	2.8158	3.8012	24.55009
Armenia	--	8.6115	10.361	10.354	11.439	11.176	10.108	10.584	64.02205
Austria	55.708	63.839	77.496	73.183	72.576	71.186	65.582	69.301	429.324
Azerbaijan	--	43.762	37.193	39.892	33.81	38.498	30.752	29.501	209.6454
Belarus	--	60.052	64.33	66.425	66.156	66.941	61.143	64.355	389.3501
Belgium	125.27	148.1	150.83	142.33	141.72	154.74	132.75	136.25	858.6173
Bosnia and Herze	--	15.127	18.379	19.083	18.639	21.037	21.442	21.933	120.5137
Bulgaria	76.188	49.026	52.252	52.905	51.899	50.614	42.523	45.583	295.7765
Canada	470.59	573.27	623.75	598.28	593.09	578.25	549.68	546.65	3489.703
Croatia	--	20.103	20.979	22.81	21.914	22.32	20.039	19.587	127.6489
Cyprus	5.0882	7.5315	8.8333	9.3587	9.3237	9.8045	9.2254	8.8667	55.41234
Czech Republic	--	94.595	93.913	96.832	103.55	99.101	92.098	94.687	580.1759
Denmark	57.107	54.498	51.868	59.313	56.875	54.215	49.307	45.877	317.4557
Estonia	--	16.277	18.948	18.682	19.997	18.862	16.138	19.348	111.9746
Finland	53.23	50.122	51.924	57.919	58.155	54.854	51.609	54.65	329.1109
France	367.68	401.65	413.96	416.37	423.06	428.55	386.15	388.66	2456.745
Georgia	--	4.6309	4.8634	4.8993	5.6927	5.7595	6.5068	6.3787	34.10041
Germany	--	854.66	847.36	850.62	826.72	823.31	772.42	793.31	4913.735
Greece	81.498	101.29	105.33	105.72	109.47	106.04	99.827	92.879	619.267
Hungary	66.75	55.352	59.499	58.512	56.628	56.052	50.947	51.317	332.9549
Iceland	2.3604	3.1746	3.3172	3.4052	3.8778	3.6956	3.3631	3.2692	20.92809
Ireland	25.734	40.682	44.539	46.072	45.131	45.486	39.315	38.242	258.784
Italy	415.41	447.72	471.89	467.49	459.53	449.75	407.63	416.82	2673.097
Kazakhstan	--	132.71	169.39	180.09	181.98	184.92	169.79	178.71	1064.885
Kyrgyzstan	--	7.2094	5.5181	5.4365	5.1247	5.1523	7.8834	7.4773	36.59226
Latvia	--	7.3764	8.6112	9.3188	8.5977	8.0538	7.9364	7.8451	50.36302
Lithuania	--	13.272	15.659	16.553	17.779	18.23	13.504	14.262	95.98666
Luxembourg	10.72	9.0222	12.622	12.452	12.145	11.961	11.437	12.155	72.77188
Macedonia	--	8.417	8.0041	7.9351	8.0824	8.671	8.012	7.6403	48.34499
Malta	2.3718	2.9141	3.0843	2.9423	3.1046	3.177	6.6823	8.0042	26.99471
Moldova	--	5.8882	6.838	7.2449	6.9338	7.2658	6.5665	6.6191	41.46821
Montenegro	--	--	--	1.7717	1.6165	2.1576	1.5496	2.03	9.12542
Netherlands	211.12	246.27	268.48	269.93	258.1	249.5	243.76	254.87	1544.634
Norway	34.784	41.258	42.059	41.044	42.159	40.029	44.717	45.103	255.1108
Poland	333.79	292.56	287.59	299.15	295.95	294.7	286.47	304.72	1768.577
Portugal	43.915	63.54	66.067	61.474	59.614	55.735	58.407	54.21	355.5077
Romania	176.1	93.277	97.137	99.298	98.73	93.922	78.466	76.341	543.8936
Russia	--	1498.8	1587.5	1635.9	1580.6	1645.6	1554.6	1642.3	9646.508
Serbia	--	--	--	57.591	55.05	56.019	54.825	55.358	278.8421
Slovakia	--	36.399	39.605	39.681	37.727	37.418	34.45	35.573	224.4537
Slovenia	--	15.678	17.083	17.079	16.926	17.42	16.114	15.989	100.6109
Spain	224.14	315.64	379.38	372.27	387.95	360.1	327.8	312.4	2139.909
Sweden	57.078	60.654	57.61	56.732	56.517	54.609	49.827	59.189	334.4839
Switzerland	43.481	45.439	45.749	45.543	43.878	45.344	44.073	42.016	266.6034
Tajikistan	--	5.9538	7.423	7.418	7.2273	6.8722	2.4379	2.6546	34.03294
Turkey	129.48	201.93	230.9	250.96	280.19	272.9	269.06	269.37	1573.375
Turkmenistan	--	23.944	47.987	48.772	52.014	55.98	50.727	52.091	307.5721
Ukraine	--	324.87	351.13	331.34	352	350.53	245.76	281.09	1911.833
United Kingdom	601.82	560.34	583.06	585.5	569.89	563.87	516.19	528.89	3347.414
United States	5040.4	5863.3	5999.2	5924.3	6026.3	5844.6	5435.3	5636.7	34866.42
Uzbekistan	--	107.73	117.11	121.15	122.89	127.12	107.15	106.16	701.5862
OSCE Total	8717.8	13102	13691	13734	13783	13596	12575	12982	
World	21523	24150	28262	29029	29733	30256	30236	31502	
EU-27	4177.7	4102.3	4284.6	4297.7	4257.7	4191.3	3866.6	3940.2	

Source: US EIA International Energy Statistics, 2013, Total Carbon Emissions from the Consumption of Energy

C: Total Primary Energy Consumption (Quadrillion Btu)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Canada	13.305	12.87	13.1	13.526	14.114	14.17	13.818	14.026	13.55	13.1	13
United States	98.815	96.17	97.65	97.978	100.16	100.3	99.629	101.3	99.27	94.56	98.04
Albania	0.0962	0.092	0.095	0.1145	0.1165	0.121	0.1185	0.1032	0.11	0.115	0.125
Austria	1.3859	1.44	1.451	1.4705	1.5096	1.551	1.5362	1.5442	1.534	1.475	1.527
Belgium	2.7338	2.703	2.679	2.7823	2.8079	2.779	2.7376	2.7363	2.915	2.654	2.748
Bosnia and Herzego	0.2236	0.221	0.232	0.2274	0.2534	0.273	0.2785	0.26	0.291	0.302	0.325
Bulgaria	0.8677	0.904	0.875	0.8865	0.8749	0.919	0.9406	0.8413	0.817	0.721	0.769
Croatia	0.3756	0.384	0.374	0.3931	0.4081	0.404	0.415	0.3948	0.407	0.389	0.396
Cyprus	0.1031	0.113	0.111	0.1116	0.1176	0.12	0.1263	0.1266	0.132	0.125	0.121
Czech Republic	1.4062	1.452	1.451	1.5176	1.5153	1.556	1.5883	1.6461	1.615	1.531	1.591
Denmark	0.8764	0.889	0.858	0.8993	0.8659	0.846	0.9018	0.8854	0.842	0.794	0.831
Finland	1.2166	1.228	1.243	1.3172	1.3526	1.265	1.3256	1.3508	1.295	1.207	1.303
France	10.958	11.09	11	11.121	11.403	11.36	11.381	11.295	11.29	10.73	11.03
Germany	14.41	14.76	14.45	14.703	14.819	14.42	14.682	14.226	14.4	13.52	13.94
Greece	1.338	1.355	1.36	1.4375	1.4272	1.443	1.4855	1.5094	1.471	1.403	1.342
Hungary	1.0224	1.057	1.061	1.0851	1.0854	1.158	1.148	1.1242	1.107	1.037	1.051
Iceland	0.1199	0.123	0.127	0.1283	0.1297	0.131	0.1433	0.167	0.209	0.204	0.205
Ireland	0.6003	0.628	0.624	0.6191	0.6443	0.664	0.7027	0.703	0.693	0.621	0.628
Italy	7.5818	7.623	7.653	7.9047	8.1667	8.079	8.0094	8.0393	7.839	7.351	7.626
Luxembourg	0.1538	0.161	0.17	0.1789	0.1975	0.206	0.2035	0.1993	0.196	0.186	0.199
Macedonia	0.1151	0.106	0.107	0.1156	0.1181	0.119	0.1171	0.1141	0.114	0.113	0.121
Malta	0.0392	0.033	0.039	0.0393	0.0397	0.041	0.039	0.0414	0.043	0.088	0.104
Montenegro	--	--	--	--	--	--	0.0402	0.036	0.043	0.04	0.048
Netherlands	3.7934	3.929	3.94	4.022	4.1327	4.234	4.1418	4.3546	4.14	4.077	4.266
Norway	1.9885	1.893	1.94	1.82	1.9252	2.003	1.8442	1.9771	1.942	1.899	1.868
Poland	3.6245	3.455	3.453	3.5719	3.7477	3.674	3.8518	3.9183	3.891	3.783	4.055
Portugal	1.0705	1.086	1.083	1.1173	1.1124	1.126	1.1019	1.1277	1.062	1.065	1.126
Romania	1.5861	1.715	1.684	1.6308	1.6896	1.666	1.6745	1.6621	1.642	1.411	1.425
Serbia	--	--	--	--	--	--	0.7782	0.7682	0.748	0.745	0.775
Slovakia	0.785	0.83	0.844	0.8202	0.8053	0.83	0.8195	0.7915	0.802	0.725	0.772
Slovenia	0.2928	0.299	0.302	0.301	0.3142	0.319	0.3176	0.3186	0.34	0.308	0.31
Spain	5.5415	5.789	5.831	6.1375	6.3435	6.446	6.4938	6.7609	6.528	6.101	6.239
Sweden	2.2708	2.405	2.277	2.1697	2.3092	2.333	2.214	2.2859	2.222	2.051	2.222
Switzerland	1.2968	1.351	1.285	1.303	1.3129	1.263	1.286	1.3027	1.32	1.287	1.265
Turkey	3.1628	2.894	3.146	3.3174	3.512	3.734	4.0708	4.4552	4.29	4.297	4.49
United Kingdom	9.7291	9.881	9.933	9.9783	10.028	9.845	9.7288	9.5611	9.287	8.785	8.914
Armenia	0.1625	0.165	0.164	0.1754	0.1806	0.202	0.2038	0.2211	0.216	0.201	0.212
Azerbaijan	0.52	0.521	0.592	0.6016	0.637	0.659	0.6988	0.5924	0.718	0.567	0.556
Belarus	1.0521	0.963	0.907	0.9846	0.9518	1.124	1.1543	1.1513	1.12	1.051	1.131
Estonia	0.1963	0.204	0.203	0.2237	0.2327	0.233	0.2266	0.2311	0.224	0.198	0.223
Georgia	0.1375	0.126	0.148	0.1329	0.1357	0.152	0.1394	0.1665	0.174	0.178	0.192
Kazakhstan	1.8335	1.935	1.993	1.8252	2.1833	2.234	2.377	2.3835	2.367	2.143	2.255
Kyrgyzstan	0.2414	0.228	0.193	0.2039	0.2119	0.21	0.2154	0.203	0.178	0.207	0.202
Latvia	0.1541	0.161	0.154	0.1607	0.1757	0.185	0.1845	0.1726	0.163	0.165	0.161
Lithuania	0.2973	0.317	0.341	0.3526	0.3532	0.353	0.3528	0.3859	0.375	0.324	0.262
Moldova	0.1101	0.107	0.119	0.1305	0.1227	0.129	0.1383	0.1285	0.134	0.119	0.119
Russia	26.139	25.71	26.66	27.413	28.146	27.92	27.687	28.69	29.63	27.69	29.32
Tajikistan	0.2391	0.247	0.252	0.2705	0.2742	0.284	0.2803	0.2724	0.257	0.187	0.191
Turkmenistan	0.4011	0.502	0.585	0.7592	0.8071	0.832	0.8414	0.8999	0.932	0.887	0.923
Ukraine	5.7508	5.641	5.822	6.2826	6.2544	6.326	5.8688	6.2999	6.225	4.458	5.094
Uzbekistan	1.9547	2.045	2.096	2.1279	2.2541	2.161	2.2268	2.2266	2.347	1.998	1.995
Mongolia	0.0631	0.065	0.07	0.0665	0.071	0.072	0.0821	0.0852	0.09	0.09	0.093

% change in total primary energy consumption, 2000-2010

	2000	2010	% change in primary energy consumption, 2000-2010
OSCE Average	4.6428	4.572	-1.50%
China	40.936	100.9	248%
World	400.07	510.6	27.60%
EU-27	74.035	74.78	1%
CIS Average	8.9196	9.666	8.40%
Central and Eastern E	0.844	0.896	6.10%

Source: EIA, International Energy Statistics, Consumption of Non-Renewable Energy Sources

D: Dry Natural Gas Consumption (Billion Cubic Feet)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Canada	2991.4	3121.4	3173.4	3372.9	3341	3403.8	3307	3115	3011	3063.1	2912.8	3163.518
United States	23333	22239	23007	22277	22403	22014	21699	23104	23277	22910	24087	24385
Albania	1.0595	1.0595	1.0595	1.0595	1.0595	1.0595	1.059	0.353	1.059	1.0595	0.3532	0.35315
Austria	271.78	287.82	291.07	314.73	310.98	335.88	306.3	313.1	330.8	322.89	353.4	334.6096
Belgium	553.85	546.78	563.52	600.36	611.8	601.41	619	623.7	619.4	625.5	699.73	596.1878
Bosnia and Herz	10.595	10.595	5.6504	5.6504	10.595	14.126	14.13	11.3	10.95	7.4162	8.1225	8.12245
Bulgaria	192.82	204.97	173.11	190.77	187.2	190.7	197.8	118.3	113.4	73.102	89.7	107.7108
Croatia	97.823	100.29	92.878	107.71	97.116	94.997	96.41	98.42	104.7	94.68	100.26	101.4247
Czech Republic	326.17	349.44	337.33	341.07	339.06	335.25	328.1	305.5	306.8	289.02	327.72	315.8574
Denmark	181.87	180.64	180.25	182.9	182.86	176.12	180.1	161	162.3	155.74	176.36	147.5814
Finland	148.29	160.72	159.94	176.96	170.92	156.62	168.2	161.5	167.3	150.76	165.98	145.2859
France	1402.8	1470.9	1528.1	1510.8	1603.7	1740.3	1763	1656	1736	1665.5	1694.8	1670.046
Germany	3098.1	3239.4	3204.4	3565.8	3532.6	3464.4	3524	3418	3465	3302.2	3180.8	2740.338
Greece	72.466	71.372	76.634	86.169	94.785	100.37	117	142.3	148.6	124.59	135.96	167.2872
Hungary	424.98	472.13	472.97	514.75	510.37	529.12	501.5	468.5	462.7	400.19	428.44	408.1355
Ireland	141.72	148.32	151.43	152.14	156.52	147.65	167	180.4	182.9	177.25	194.44	171.0659
Italy	2498.4	2505.2	2488.2	2743.3	2846.7	3046.4	2984	2998	2998	2755.4	2934.6	2751.639
Luxembourg	26.663	27.687	42.06	42.555	48.064	47.287	49.55	46.33	44.32	44.815	48.17	41.77765
Netherlands	1725.4	1768.8	1767.2	1774.9	1811.2	1741.2	1690	1643	1714	1729	1937	1691.129
Norway	140.2	162.8	189.99	222.13	282.17	187.17	119.4	156.1	122.9	230.61	194.44	145.851
Poland	472.62	481.52	474	516.94	547.24	573.2	574.5	570.7	575.2	564.69	605.83	606.3939
Portugal	80.518	89.806	109.94	106.55	132.78	151.89	147.4	153.4	166.7	167.57	181.63	182.6139
Romania	600.36	695.71	646.26	635.67	635.67	642.73	657.6	605.3	560.8	454.5	454.5	486.2876
Serbia	--	--	--	--	--	--	81.22	77.69	79.46	61.448	76.987	83.69655
Slovakia	252.01	269.56	256.03	246.82	237.32	255.22	232.2	219.5	222.8	190.6	215.39	198.5763
Slovenia	35.668	36.728	34.256	35.809	38.246	39.694	39.02	39.66	38.1	36.092	37.434	31.99539
Spain	588.45	634.12	725.02	821.74	953.93	1125.9	1208	1299	1424	1272.5	1265.1	1184.995
Sweden	28.429	31.077	31.36	32.702	31.466	29.276	29.31	32.53	27.79	39.694	54.032	46.96895
Switzerland	104.96	109.23	107.22	113.33	116.93	120.04	116.7	113.7	121.2	116.36	130.03	115.4801
Turkey	523.9	563.06	621.12	748.01	792.57	966.75	1101	1292	1294	1240.1	1346.5	1579.04
United Kingdom	3373.3	3338	3379.3	3358.5	3513.8	3375.8	3213	3244	3352	3109.8	3336.6	2848.508
Armenia	49.794	49.441	38.493	46.616	46.969	60.036	60.04	72.54	68.16	54.738	61.095	72.0426
Azerbaijan	199.88	237.32	319.95	324.9	351.03	366.57	399.1	327.5	424	367.17	350.36	443.5564
Belarus	692.21	635.67	598.24	634.26	579.17	716.89	740.6	733.1	750.5	626.84	770.57	750.0906
Estonia	39.553	44.85	47.322	49.794	50.854	53.679	51.95	34.82	33.41	23.061	24.756	21.61278
Georgia	42.731	40.965	51.913	36.374	43.437	52.09	49.79	59.68	61.09	60.389	58.27	52.61935
Kazakhstan	490.88	505	526.19	321.23	482.72	476.68	521.4	441.1	313.2	304.42	303.25	436.1403
Kyrgyzstan	67.558	71.195	42.378	26.027	32.454	26.133	27.4	27.14	26.49	23.145	16.333	14.126
Latvia	56.504	60.036	60.036	63.567	67.452	68.511	67.1	58.27	44.85	55.091	53.679	55.7977
Lithuania	91.819	97.469	102.06	107	103.12	107.36	102.8	121.5	124.7	96.41	109.83	120.071
Moldova	75.221	72.396	77.693	84.05	76.634	86.522	93.58	86.17	88.99	82.284	76.634	74.51465
Russia	13059	12906	13564	14204	14567	14330	15224	15227	15546	13505	14961	17975.34
Tajikistan	44.144	45.91	42.025	47.675	49.053	50.5	45.06	23.31	15.19	8.0165	7.9812	7.02769
Turkmenistan	261.33	339.02	406.12	554.45	585.17	628.61	639.2	687.9	741.6	708.07	720.43	709.8315
Ukraine	2779.3	2616.8	2779.3	3023	3051.2	3079.5	2483	2889	2853	1559.5	1984.7	2281.349
Uzbekistan	1511.5	1596.2	1642.1	1669.7	1772.8	1702.2	1769	1783	1858	1631.8	1614.3	1802.478

	2000	2011
OSCE Average	1403.6	1549.436
% change in (average) OSCE natural gas consumption (2000-2011)		**10.40%**

E: Total Petroleum Consumption (Thousand Barrels Per Day)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Canada	2013.9	2043	2065	2191	2281.96	2315	2228.8	2283	2225	2153	2258	2289.3	2291.1
United States	19701	19649	19761	20034	20731.2	20802	20687	20680	19498	18771	19180	18949	18555
Albania	21.037	22.68	24.28	27.4	28.8283	31.2	31.889	31.54	29.99	27.56	25.87	28	27.82
Austria	250.6	267	273.6	288.8	295.372	299.3	298.82	293	282.8	269.1	277.1	262.9	258.08
Belgium	606.32	609.1	617.3	654.6	656.541	659.8	638.23	640.4	716.6	630.2	644.9	644.44	633.72
Bosnia and Herzegovina	19.232	19.28	20.13	21.77	24.9407	26.05	25.784	26.05	27.25	27.75	28.58	28	29.043
Bulgaria	99.884	101.3	105.7	102.2	104.454	113.9	116.05	114.1	104.9	102	103.1	105	114.99
Croatia	85.539	85.54	89.49	91.34	95.4981	95.76	103.33	98.02	95.26	90.16	82.77	92	93.461
Cyprus	47.497	51.63	50.88	51.6	54.5412	55.51	58.104	58.1	60.28	57.85	55.98	58	60.043
Czech Republic	169.81	178.8	176	187.6	205.899	212.9	211.51	211.2	215	205.5	201.4	198.98	199.06
Denmark	210	213.4	197.2	188.3	185.333	183.5	190.45	190.6	181.1	166.5	167.5	163.96	158.5
Finland	212.82	211.5	217.2	220.4	219.232	218.4	223.36	227.3	218.8	206.6	214.2	204.79	193.27
France	1999.6	2054	1985	2001	2009.34	1991	1991.1	1979	1945	1868	1831	1791.5	1738.4
Greece	399.21	405.7	408.4	428.7	419.76	423.9	444.1	449.9	428.9	403.3	373	343.42	313.24
Hungary	143.25	138.2	140.4	136.4	136.197	154.8	163.15	160.9	158.9	158.2	149.3	141.15	128.75
Iceland	18.23	17.49	18.05	18.31	19.0311	19.36	20.078	20.73	23.06	21.98	20.96	20.768	20.571
Ireland	169.98	182.4	179.4	176.2	181.754	191.9	202.21	194	191.5	162.7	161.4	144.99	131.03
Italy	1853.8	1832	1870	1860	1828.92	1781	1776.6	1729	1667	1544	1544	1453.6	1310.1
Luxembourg	47.552	50.62	51.73	55.51	62.4186	64.71	61.439	60.79	60.95	57.15	59.71	61.385	59.164
Macedonia	22.071	18.48	20.17	19.8	19.6493	19.89	19.626	20.19	18.72	19.1	18.58	19	17.083
Malta	18.159	15.06	18.05	17.98	18.2081	18.91	17.91	19.06	36.58	39.79	46.88	45	39.279
Montenegro	--	--	--	--	--	--	2.891	3.149	3.666	3.773	2.931	4	4.7453
Netherlands	854.52	893.7	898.3	918.6	947.866	1021	999.48	1111	1069	1005	1020	1009.8	998.1
Norway	211.4	219.6	218.6	229.3	215.522	216.7	236.7	231.7	229.4	224.9	220.8	255.17	256.48
Poland	411.26	404.7	406.4	430.7	454.137	470.4	500.29	520.6	533.5	537.7	560	578.69	537.78
Portugal	332.7	333.9	343.2	326	327.959	336.9	295.82	308.4	288.3	274.7	274.4	259.67	232.57
Romania	224.24	228.9	232.3	219.6	225.089	221.9	217.63	224	230.9	201.3	193.5	217	216.33
Serbia	--	--	--	--	--	--	89.088	91.5	76.75	81.66	83.69	81	80.02
Slovakia	66.765	71.16	82.88	74.98	74.8416	78.51	78.339	83.3	85.98	80.62	83.69	83.909	74.481
Slovenia	50.161	52.09	50.55	51.26	52.4317	53.68	55.567	55.08	63.72	55.39	54.78	55.151	54.003
Spain	1433.2	1492	1505	1542	1571.44	1607	1588.2	1611	1547	1467	1441	1383.7	1289
Sweden	361.99	369	372.6	369	368.393	359.6	354.47	350.4	336.8	318.3	335.6	316.05	300.84
Turkey	662.78	613.6	651.5	637.2	651.8	647.5	662.96	671.7	655.3	678.2	649.8	655.9	670.3
United Kingdom	1765.4	1747	1739	1759	1785.4	1820	1805.7	1753	1727	1641	1630	1607.9	1518.8
Armenia	35.208	37.09	38.64	39.91	41.2359	44.4	45.201	46.68	47	45.78	46.52	48	47.184
Azerbaijan	136.89	119.9	110.4	110.8	112.601	115.4	114.37	109.4	84.41	79.87	78.09	85	85.323
Belarus	139.77	130.3	123.4	142.8	158.459	171.3	174.28	175.7	157.3	182.5	152.4	188	187.62
Estonia	21.322	24.16	25.03	24.09	25.0137	25.22	27.063	28.51	27.41	24.63	25.55	26.138	28.423
Georgia	15.842	12.67	12.29	12.44	12.9657	15.04	16.143	18.06	18.86	19.89	21.11	20	17.021
Kazakhstan	194.75	210.5	217.2	207	221.252	229	234.46	236	247.5	210	206.3	216	250.69
Kyrgyzstan	10.57	9.249	10.09	9.573	12.2327	13.7	13.551	14.31	25.65	34.09	32.61	34	33.414
Latvia	28.855	29.75	28.23	29.82	32.6348	35.43	37.853	35.14	35.73	32.43	31.81	35	32.414
Lithuania	56.532	54.64	53.04	51.56	55.0722	68.35	73.049	74.15	67.67	57.01	56.98	60	72.68
Moldova	9.5829	10.56	11.98	12.91	14.2956	14.62	14.532	15.56	15.56	14.43	16.97	17	19.66
Russia	2578.5	2590	2636	2682	2750.81	2785	2803.5	2697	2906	2950	2992	3115	3195.5
Tajikistan	23.332	24.96	25.45	27.49	29.4889	31.75	33.924	39.62	10.77	10.34	11.77	14	14.421
Turkmenistan	62.361	74.15	78.46	86.78	94.5529	95.59	94.984	99.82	88.45	83.65	102.5	110	121.85
Ukraine	260.14	304.5	308	322.5	325.344	352.4	367.14	361.7	337.6	293.8	289.2	300	318.76
Uzbekistan	146.09	148.3	151.4	150.5	152.111	145.3	137.21	141.6	85.74	94.03	96.45	98	106.02
Germany	2766.8	2807	2710	2662	2649.4	2621	2638.9	2416	2542	2453	2470	2400.1	2388.1
Switzerland	273.95	276.8	267.7	270.1	269.716	271.3	270.44	258.6	267.5	259.8	265.6	258.18	259.96

Change in consumption of petroleum; 2000-2012

	2000	2012	% change
EU-27	14602	13071	-10.40%
U.S.	19701	18555	-5.80%
Russia	2578	3195	24%
Germany	2767	2388	-14%
average change in OSCE	841.72	780.1	-7.30%

F: Total Non-Hydro Renewable Electricity Net Generation (Billion Kilowatt hours)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Canada	8.998	9.51	9.938	9.817	10.7	11.27	11.54	10.91	14.51	18.45
United States	82.675	92.64	93.53	97.3	100.15	109.5	117.5	137.9	156.2	180
Albania	0	0	0	0	0	0	0	0	0	0
Austria	1.998	1.891	2.329	3.288	4.233	5.552	6.66	6.806	6.879	7.188
Belgium	1.62	1.719	1.711	2.09	2.478	3.473	4.138	5.072	6.424	7.479
Bosnia and Herzegovina	0	0	0	0	0	0	0	0	0	0
Bulgaria	0	0.011	0.006	0.02	0.022	0.027	0.053	0.138	0.248	0.731
Croatia	0.001	0	0	0.006	0.024	0.03	0.043	0.061	0.079	0.172
Cyprus	0	0	0	0	0.001	0.001	0.003	0.014	0.01	0.121
Czech Republic	0.713	0.691	0.501	0.73	0.759	0.977	1.329	1.717	2.234	3.139
Denmark	6.41	7.38	8.725	10.15	10.605	10	11.07	10.93	10.8	13.13
Finland	8.453	9.168	9.639	10.75	9.849	11.09	10.3	10.82	9.221	11.47
France	4.996	5.389	5.808	6.15	6.523	7.665	10.13	12.03	14.61	17.87
Germany	23.013	28.56	33.9	42.1	45.1	54.27	71.86	74.23	80.8	89.37
Greece	0.938	0.885	1.267	1.385	1.489	1.839	2.028	2.457	2.83	3.191
Hungary	0.127	0.072	0.198	0.757	1.74	1.439	1.819	2.258	2.784	2.984
Iceland	1.451	1.433	1.406	1.485	1.662	2.633	3.581	4.039	4.553	4.465
Ireland	0.431	0.47	0.54	0.764	1.242	1.751	2.127	2.619	3.206	3.132
Italy	8.291	9.599	11.32	12.95	13.851	15.28	16.6	18.24	21.89	28
Luxembourg	0.084	0.086	0.09	0.125	0.146	0.17	0.188	0.191	0.202	0.205
Netherlands	4.391	5.097	5.255	6.535	8.784	9.363	8.986	10.89	12.25	12.66
Norway	0.369	0.401	0.655	0.711	0.891	1.105	1.365	1.397	1.279	1.405
Poland	0.78	0.952	0.865	1.323	1.884	2.485	3.309	4.662	6.541	8.214
Portugal	1.962	2.194	2.258	2.713	3.834	5.026	6.412	8.13	10.31	12.53
Romania	0	0	0.003	0.004	0.007	0.004	0.038	0.029	0.02	0.419
Slovakia	0.16	0.158	0.115	0.041	0.062	0.429	0.507	0.542	0.559	0.709
Slovenia	0.072	0.102	0.128	0.126	0.12	0.117	0.118	0.293	0.196	0.235
Spain	8.747	12.24	15.63	19.38	24.321	26.79	31.71	39.56	48.43	55.95
Sweden	4.505	5.049	5.517	8.851	9.295	10.34	12.09	13.23	14.7	16.91
Switzerland	1.847	1.902	1.922	2.01	2.136	2.372	2.346	2.443	2.447	2.546
Turkey	0.382	0.327	0.266	0.255	0.275	0.374	0.725	1.228	2.271	4.041
United Kingdom	8.013	9.205	10.24	11.47	14.57	15.9	16.43	18.19	21.71	23.58
Armenia	0	0	0	0	0.001	0.001	0.003	0.002	0.004	0.007
Belarus	0	0	0	0.001	0.03	0.094	0.089	0.082	0.144	0.211
Estonia	0.012	0.024	0.036	0.038	0.089	0.116	0.124	0.169	0.509	1.017
Latvia	0.006	0.021	0.072	0.087	0.088	0.088	0.095	0.103	0.099	0.115
Lithuania	0.002	0.004	0.007	0.007	0.009	0.038	0.16	0.201	0.26	0.371
Russia	2.962	2.963	2.141	2.218	3.055	3.208	2.489	3.014	3.111	3.283
Ukraine	0.016	0.022	0.031	0.033	0.038	0.035	0.045	0.045	0.043	0.051
Total Non-Hydro Renewable Electricity Generation - Collated Figures										
World	264.43	295	318.5	354.4	391.37	436.2	495.2	560.4	646.6	764.9
EU-27	85.724	101	116.2	141.8	161.1	184.2	218.3	243.5	277.7	320.7
OSCE Total	184.42	210.2	226	255.7	280.06	314.9	358	404.6	462.4	535.4

Percentage increases 2000-2010: World 289%; EU 372%; OSCE 290%

Source: EIA, International Energy Statistics, 2001-2010

G: CO2 Emissions/per energy Generation/TPES

tons CO2 / terajoule	1990	2000	2005	2009	2010
Region/Country/Economy					
Canada	49.6	50.7	49.1	50.1	50.9
United States	60.7	59.9	59.4	57.2	57.9
Austria	54.3	51.6	52.8	47.8	48.9
Belgium	53.4	48.4	45.8	42.1	41.8
Czech Republic	74.8	71.0	63.6	62.5	62.0
Denmark	69.4	64.9	61.0	60.8	58.3
Estonia	87.0	74.1	78.0	73.7	79.3
Finland	45.8	40.8	38.5	39.5	41.3
France	37.6	35.7	34.3	33.1	32.6
Germany	64.6	58.5	57.1	56.3	55.6
Greece	78.1	77.1	75.0	73.2	72.9
Hungary	55.1	51.8	48.8	46.3	45.5
Iceland	21.5	16.5	15.0	9.1	8.5
Ireland	71.3	71.1	72.0	64.7	64.1
Italy	64.8	59.3	59.9	56.4	55.9
Luxembourg	73.1	57.9	62.1	60.5	59.9
Netherlands	56.7	56.1	55.3	53.8	53.5
Norway	32.2	30.7	32.4	31.4	28.8
Poland	79.3	78.0	75.7	72.9	71.8
Portugal	56.0	57.5	56.7	52.6	48.9
Slovak Republic	63.5	50.3	48.3	47.4	46.9
Slovenia	52.3	52.5	51.1	51.1	50.8
Spain	54.4	55.6	57.1	52.9	50.2
Sweden	26.7	26.5	23.3	21.8	22.2
Switzerland	40.6	40.5	41.0	37.5	39.9
Turkey	57.5	62.7	61.2	62.7	60.4
United Kingdom	63.7	56.2	57.3	56.4	57.0
Albania	55.9	41.9	44.6	40.5	43.3
Armenia	63.5	40.6	39.3	39.1	39.5
Azerbaijan	59.4	62.2	56.7	50.5	49.8
Belarus	65.3	56.8	55.2	55.6	56.3
Bosnia and Herzegovina	80.5	74.2	74.0	76.6	74.2
Bulgaria	62.5	53.8	55.0	57.6	58.6
Croatia	57.4	54.4	55.8	54.4	53.2
Cyprus	67.4	70.1	75.3	70.3	70.6
Georgia	64.0	38.3	36.4	41.3	37.8
Kazakhstan	76.9	75.6	73.8	74.6	73.9
Kyrgyzstan	71.6	44.3	45.3	57.1	57.1
Latvia	56.7	43.9	40.9	40.5	43.7
Lithuania	49.2	37.6	36.6	34.5	46.1
FYR of Macedonia	82.1	75.2	72.3	71.5	67.9
Malta	78.6	74.5	73.4	72.3	70.6
Republic of Moldova	73.1	54.2	52.7	56.0	56.1
Montenegro	..	..	47.2	45.2	60.6
Romania	64.1	56.9	58.0	54.1	51.6
Russian Federation	59.2	58.1	55.6	56.1	53.8
Serbia	75.8	76.3	73.1	72.6	70.5
Tajikistan	49.0	24.1	23.9	28.8	28.3
Turkmenistan	62.2	59.4	59.2	59.5	59.1
Ukraine	65.3	52.1	51.1	52.8	48.8
Uzbekistan	61.7	55.3	54.8	55.1	54.7
Mongolia	88.5	87.8	86.3	86.1	86.6

OSCE Average	**61.4**	**55.4**	**54.4**	**53.4**	**53.4**
China	**61.5**	**66.3**	**71.3**	**71.1**	**70.2**
OECD Americas	**59.2**	**58.8**	**58.0**	**56.3**	**57.0**
OECD Europe	**58.2**	**54.1**	**53.1**	**51.5**	**50.8**
World	**57.1**	**56.1**	**56.7**	**56.8**	**56.7**

Source: IEA, CO2 Emissions from Fuel Combustion, 2012