PAPER SERIES

GLOBAL SHIFT

THE CHALLENGES OF ENERGY INTERDEPENDENCE AND CLIMATE CHANGE

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Global Shift

The Challenges of Energy Interdependence and Climate Change

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Executive Summary

The global energy system, the base for all social development, represents one of the critical infrastructures of the international system. It is marked by a high degree of interdependence, and global management of this interdependence will pose serious challenges during the next decades. At the same time, the fact that world energy demand presently is, and will continue to be, largely met by fossil fuels links this system closely to the world's ecosphere: the burning of coal, oil, and natural gas is the most important driver of global warming and climate change. Present trends of global emissions of greenhouse gases (GHG) are unsustainable if potentially catastrophic risks related to global warming are to be avoided. Yet national and international policies with regard to GHG and, specifically CO_2 emissions, so far clearly have been insufficient to deliver the deep changes needed.

The United States, the European Union, and China are particularly critical actors in this regard; their policies will shape developments in global energy and climate change governance. Their policies will have to change if present trends are to be modified. So must international policies to limit global warming, which as of today are largely based on the United Nations Framework Convention on Climate Change and rely on a global negotiation framework — an approach that is deeply problematic in several important respects.

This paper proposes a different way to address the intertwined challenges of energy and climate change, namely through negotiation and joint implementation of an energy price trajectory, initially between member states of the transatlantic community but with the perspective to include others, most importantly China.

1 The Global Energy System: Basic Facts

Energy interdependence intertwines national economies in two major ways. First, most economies, including some of the biggest, depend on cross-border flows of energy resources for important parts of their total energy requirements. For example, the share of oil imports in total energy consumption in the United States since 1980 has fluctuated around 20 percent.

Second, this global energy system is supported by and critically dependent on global flows of information, knowledge, and investment capital. Much of the resource base, as well as many of the other resources such as information and capital, is controlled by (often huge) transnational corporations with global reach, both private and public (such as national oil companies). Flows of capital and technology are often also managed by transnational energy corporations. Overall, energy-related activities make up an important part of the world economy, and international energy trade represents a similarly important segment of world trade.[1]

The international oil market is at the heart of this global energy system. International trade in oil not only represents by far the largest component of world trade in fuels, it is also the most globalized and the relatively most important part of the world energy system: world oil trade accounted for 19.3 percent of total world primary energy consumption in 1990 and 22.2 percent in 2009. Thus, on average more than one out of five units of energy consumed anywhere in the world come from internationally traded oil.[2] As a result, international energy prices also tend to reflect, more or less directly, the price of other sources of energy.[3] World trade in natural gas (about 900 million cubic meters (mcm) in 2009) accounts for an even higher share (28 percent) of global consumption (3161 mcm), though most of this trade is conducted by pipeline and thus regional, rather than inter-regional. For coal, world trade in 2009 was about 926 metric tons (Mt), which represented about one-seventh (13.4 percent) of total global consumption.[4]

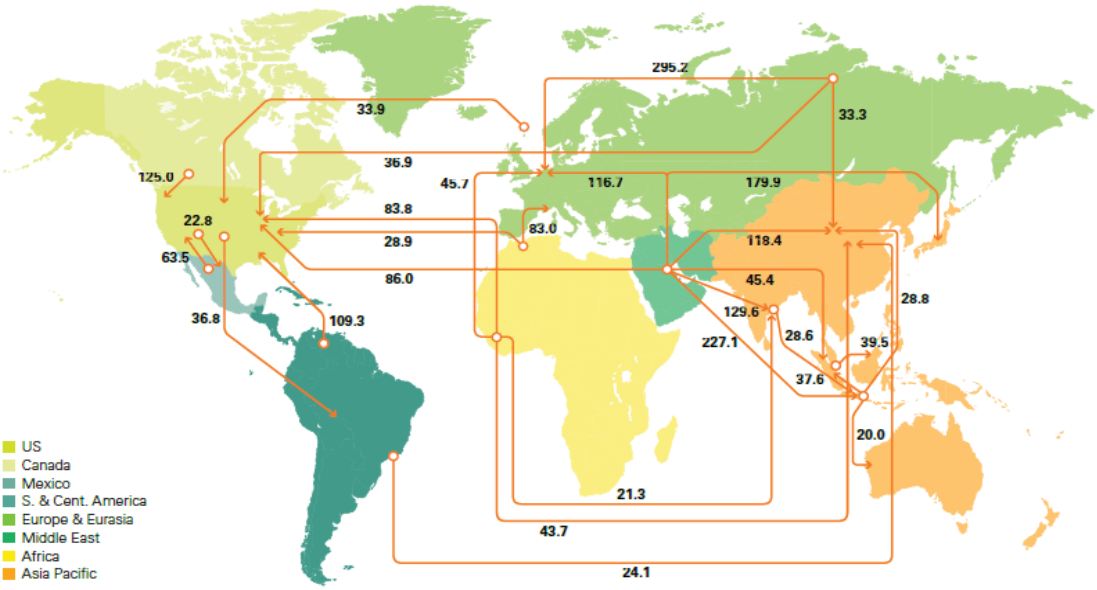
Interdependence may, but not necessarily will, imply vulnerability. As long as there are competitive markets with diversified sources of supply, imports of energy will often represent the most efficient way to procure energy resources. Strategic vulnerability exists only when sources of supply are heavily concentrated, when there are plausible scenarios for major and prolonged supply disruptions, when the possibilities to remove the causes of the disruption are limited, and when the impact of shortfalls of supplies on national and global economic activity would be serious. In practice, it therefore is the exception, rather than the rule. But where it exists, it will imply exposure to dramatic price increases and, possibly, even physical shortages — and thus potentially huge economic and social dislocations. Vulnerability in this sense has existed in the West with regard to oil since around 1970. In that year, U.S. domestic oil production, with about 11.3 million barrels per day, reached its highest level ever; since then, it has been declining, to about 6.7 million barrels per day in 2007, with a modest recovery in the last few years to about 7.5 mill barrels per day in 2010. As a result, since 1970 the United States has become dependent on oil imports to meet its growing energy demand, with about 60 percent of requirements supplied from abroad.

Similarly, by 1970 the then European Communities had already shifted away from coal toward imported oil as its primary source of its energy supply; oil's share in total energy consumption then fell back to 39 percent (1980) and 31.1 percent (in 2000) as a result of North Sea oil production. With the decline of output from North Sea fields, oil import dependence crept up again, to reach about 35 percent in 2010.

On average more than one out of five units of energy consumed anywhere in the world would come from internationally traded oil.

High levels of interdependence between nations and societies mean that energy objectives cannot be pursued in isolation: energy independence is a chimera. Rather, they need to be pursued cooperatively.

Figure 1: Major trade movements of oil in 2010 (million tons)



Source: BP Statistical Review of World Energy 2011

Since 1993, China has also become a major net oil importer; in 2010, China imported about 4.8 mill barrels per day, or 55 percent of total oil demand.

As figure 1 shows, energy interdependence and hence also potential vulnerability have been concentrated specifically on oil imports from the Persian Gulf. The share of the Middle East in world oil exports was 44 percent in 2000 and 35 percent in 2010.[5] European dependence on Russian natural gas imports constitutes another, though significantly less pronounced and regional, rather than global, strategic vulnerability.

It is important to recognize that strategic vulnerability cuts both ways: it is not only importers who may be affected by it, but also exporters of energy. Many petroleum exporting countries (which in 1960 established the Organisation of Petroleum Exporting Countries (OPEC) to protect their interests) are heavily, sometimes almost exclusively dependent on oil revenues to generate foreign exchange income and government revenues.[6] Under those circumstances, market access and oil price levels clearly become legitimate concerns from the perspective of national economic security.

High levels of interdependence between nations and societies mean that energy objectives cannot be pursued in isolation: energy independence is a chimera. Rather, they need to be pursued cooperatively, primarily through private market activities, but also through formal or informal arrangements of governance. International energy markets, as all markets, are embedded in a political context, in a structure of governance — and the international markets for oil and natural gas are heavily politicized. Thus, not only is there a place for governments to work out a framework for international energy transactions — they need to work together to provide a robust framework if

Table 1: Evolution of World Primary Energy Demand

Primary Energy demand (mtoe)	1990	2000	2005	2010	relation 2010: 1990
World	8095.6	9382.4	10800.9	12002.4	+ 48 %
United States	1963.3	2313.7	2351.2	2285.7	+ 16 %
European Union	1643.5	1720.4	1808.2	1732.9	+ 5 %
China	685.1	1038.2	1691.5	2432.2	+ 255 %

Source: BP Statistical Review of World Energy 2011 (Workbook)

markets are to function well and broader social aspirations are to be met.

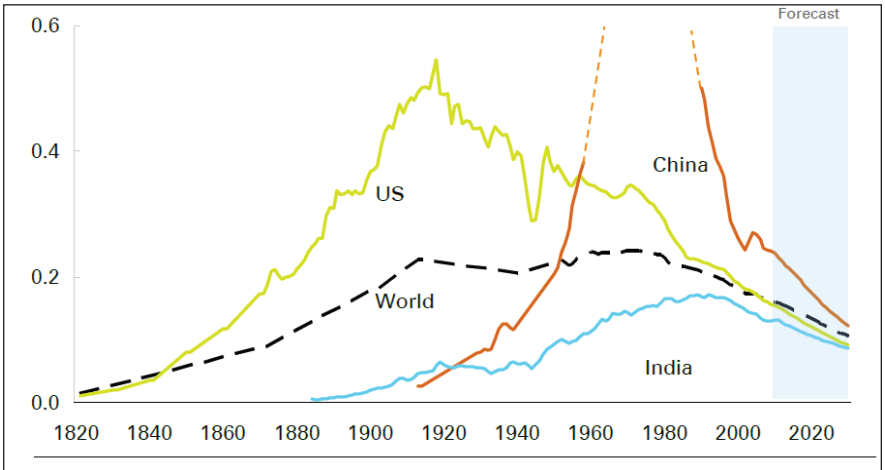
The Link between Energy and Social Development

The ability of societies to satisfy individual and collective demands for sustenance and well-being is closely tied to energy consumption.[7] Given the rapid advance of the world economy over the last decades, and in particular the rise of the developing world, it is therefore hardly surprising that world primary energy demand has been rising strongly over the last two decades, particularly outside the OECD world (see table 1).

Yet the relationship between energy input and economic growth is not linear; historically, energy input per unit of economic activity has been particularly high as societies have modernized and undergone industrialization. Thus, in economies with rapidly advancing industrial production (such as China or India), energy input per unit of gross national product tends to be significantly higher than in pre-modern, but also in post-industrial, service-centered economies (see figure 2).

The material well-being of rich societies, which is based on high levels of per capita energy consumption, can therefore to some extent be "decoupled" from this correlation: economic growth could thus be achieved with stagnant or even falling energy demand, as the energy needed to produce one unit of economic production declined due to technological advances. Nevertheless, world primary energy demand in the past decades has largely been determined by a) the growth of world population and b) levels of economic activity. A growing world population and huge disparities in social development between countries, including the persistence of absolute poverty and material deprivation on a large scale,

Figure 2: Energy use per unit of GDP, expressed in tons of oil equivalent per '000 $GDP (2009, purchasing power parity)



Source: BP Energy Outlook 2030

A growing world population and huge disparities in social development between countries...all point to further significant increases in world primary energy demand well into the future. But growth will increasingly be concentrated in non-OECD countries.

all point to further significant increases in world primary energy demand well into the future. But growth will increasingly be concentrated in non-OECD countries and shift toward new and abundant supplies of nonfossil fuel energy. In this context, levels of energy interdependence are likely to increase further.

Global emissions continue to grow rapidly: for CO_2 alone, the global increase between 1990 and 2009 totalled 7,671 million tons of CO_2, a rise of over 34 percent. China's CO_2 emission growth accounted for 20 percent of the global increase.

Energy and Climate Change

During the last century, humanity has begun to degrade the ecosphere in fundamental ways. This has affected many global commons, such as the world's oceans and forests, but perhaps the most dramatic and pervasive example of human-made environmental change has been global warming. The industrial revolution has led to an exponential growth in the emission of CO_2 and other greenhouse gases, which, while allowing solar radiation to reach the earth's surface, reduce long-wave radiation out into space and thus result in an overall increase of global surface temperatures.

Energy use is not the only, but a major source of CO_2 concentration in the atmosphere: fossil-fuel energy consumption accounts for about two-thirds of total CO_2 emissions. Concentrations of greenhouse gases and specifically of CO_2 in the atmosphere (expressed in parts per million of CO_2 equivalent) increased from a pre-industrial level of about 280 ppm to 393 ppm in mid-2010 — higher than they have ever been for the last 650,000 years.[8] As a result, average global temperatures have risen by about 0.8°C since 1970. And global emissions continue to grow rapidly: for CO_2 alone, the global increase between 1990 and 2009 totaled 7,671 million tons of CO_2, a rise of over 34 percent. China's CO_2 emission growth alone accounted for 20 percent of the global increase.[9]

2 International Governance of Energy and Climate Change Issues

The world energy system presently possesses two major arrangements of global energy governance — that for international trade in oil and the wide range of arrangements and efforts aimed at reducing CO_2 emissions. The principal purpose of those arrangements is to provide the world with secure and affordable, but also sustainable, supplies of energy in ways that will avoid potentially catastrophic risks to the global climate. Yet the two systems of governance are at best tenuously linked, which implies the potential for tensions between them. Moreover, each system of governance has its own problems and shortcomings. In the case of oil, the principal problems are its informality, its concentration in very few players, and its fragility; in the case of climate change, the problem is ineffectiveness.

Governance Structures in the International Energy System

The transition to strategic energy vulnerability during the early 1970s gave rise to a new system of managing world oil markets, a structure of global oil governance in which the previous vertical integration of the oil business from exploration to the pump was wrenched open by national oil companies, producer and consumer governments, and new market actors. International oil markets, but also those for natural gas and coal, are characterized by the presence of large, vertically integrated transnational corporations, both state-owned national companies and transnational corporations such as Exxon, Royal Dutch or BP, and Saudi Arabia's Aramco, the Iranian National Oil Corporation or China's Sinopec. Markets function within frameworks defined by politics; for international markets, those frameworks are provided by arrangements of regional and/or global governance. Prices in those markets are shaped not only by supply/demand balances and financial speculation, but also by oligopolistic pricing strategies based on control of market share and spare production capacity.

At the heart of those arrangements are governments that — formally or informally, unilaterally, bilaterally, or multilaterally — work with (but also against) each other. Institutionalized forms of multilateral cooperation in this structure of governance include importantly:

a) The International Energy Agency (IEA), the organization of the industrialized oil importing countries, which technically forms part of the OECD. The IEA serves as a source for information and analysis on energy issues and as a collective defense organization to help its member states cope with strategic vulnerability. Its most important tool in this context is the nationally held oil stockpiles, which provide the IEA members with the option to release significant amounts of oil into the markets.[10]

b) The Organisation of Petroleum Exporting Countries (OPEC), which comprises the principal developing oil exporting countries in the Middle East, in North and West Africa, and in Latin America. OPEC tries, through administering production quotas, to manage international oil prices within a price corridor.

The most important arrangement in this system of international oil governance, however, is informal and bilateral, rather than multilateral: the close but also conflict-ridden bilateral relationship between the United States and Saudi Arabia. In essence, this relationship is built around U.S. security guarantees for Saudi Arabia and its monarchy in exchange for a Saudi commitment to keep the oil flowing to importers at moderate prices, and to support the role of the U.S. dollar through oil sales, purchases (mostly of arms), and investments in dollars. This bipolar core arrangement is flanked by a second tier in this international oil governance structure, which consists of other oil exporting countries

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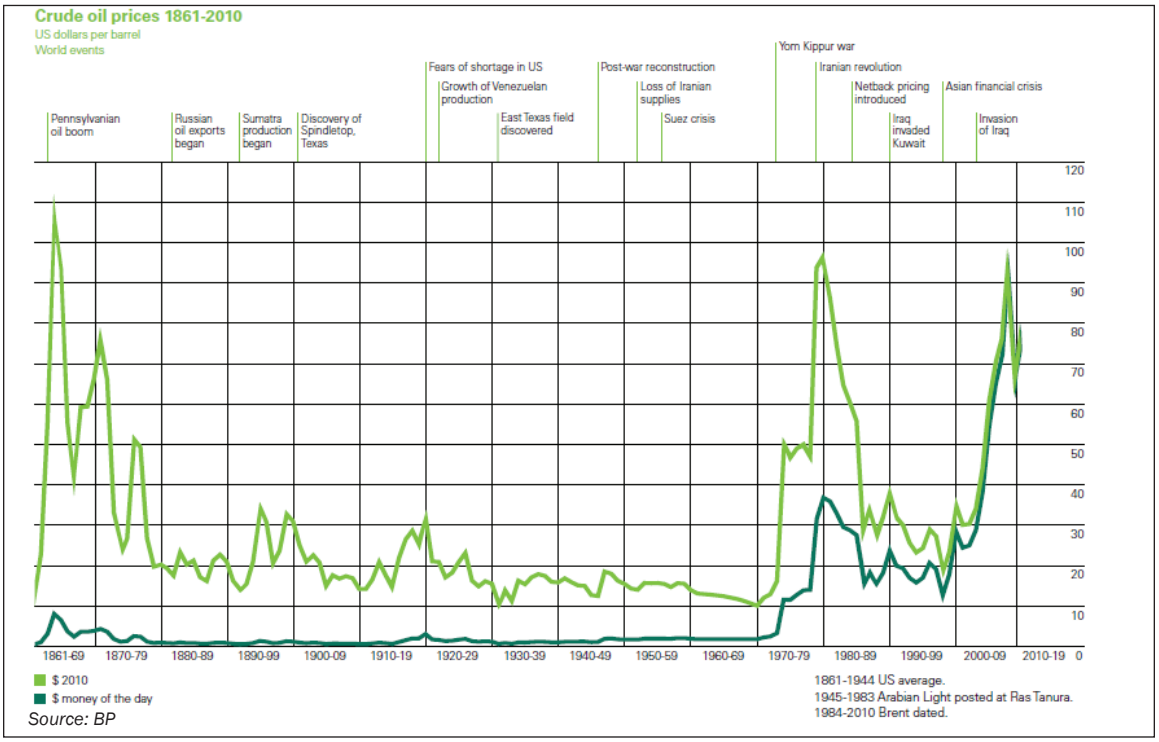
and the major OECD oil importers. While Saudi Arabia is usually followed in its policies by its close Gulf Cooperation Council (GCC) allies Kuwait and the United Arab Emirates, many other oil exporting countries would like to see Saudi Arabia's hold over OPEC rolled back and oil prices pushed higher. They are constrained, however, by Saudi Arabia's preference for lower prices, which is backed up by its huge spare production capacity, the most important single element of flexibility in the world oil market. This spare capacity, thought to be around 4-5 million barrels per day in 2011, represents the single most important source of flexibility the oil exporters have to cope with disruptions and keep oil prices from rising too rapidly. In the past, Saudi Arabia has also been willing to reduce its production to sustain prices in situations of sluggish demand and declining oil prices. Saudi Arabia's ability to impose its policy line on the rest of OPEC is backed by its enormous (and particularly cheap) oil resource base and its spare capacity, but it is tempered by its need for oil revenues and the complex geopolitical rivalry with Iran and, potentially, also Iraq. The other flank of the bilateral core arrangement consists of the major industrialized oil importers and consumers, the EU and Japan. They have mostly acquiesced to the U.S. lead in this system of governance, though relations have at times also been tense within this group.

The problem with this system of governance for world oil is that it leaves out an increasingly important set of players, the "rising powers" and major new oil importers, led by China and India. Moreover, the system has been showing signs of tension, disintegration, and politicization for several years already. Tensions are visible within the societies of the oil-rich petro-states. While huge oil revenues allow governments to satisfy basic societal needs and co-opt parts of their societies by providing them with opportunities to enrich themselves,[11] rising popular expectations and "youth bulges" (large shares of young people in societies, with the need to create large numbers of additional jobs) in many of those states appear increasingly to strain the foundations of social stability. There are also rising tensions between oil exporting countries in the Gulf, notably between Iran and most Arab monarchies in the Gulf.[12] Disintegration refers, on the one hand, to the decline of the role of vertically integrated Western oil companies, the so-called "Seven Sisters," and the rise of arms-length market transactions; more fundamentally, there is the widening gap between the United States and Saudi Arabia over issues of political change in the Arab world, the threat posed by Iran, and the Israeli-Arab conflict. Finally, politicization refers to the expanded role of producer governments (or their national oil companies) in the international oil market. Ultimately, decisions on prices and depletion rates (i.e., the speed with which reserves are brought to market or, alternatively, conserved for the future) reflect preferences of the governments and societies concerned; those preferences may change in light of political changes within them.

Overall, governance structures in the international energy system have so far been by and large adequate to secure supplies at affordable prices for oil, natural gas, and coal. There were some significant disruptions in supplies of both oil and natural gas during the last decades, however, and the first oil crisis in 1973/4 contributed to major and prolonged dislocations in the world economy. The impact of later disruptions remained limited due primarily to the flexibility provided by spare production capacities, mostly in Saudi Arabia, and by the emergency stockpiles in major industrialized consumer countries. In recent years, rising and volatile oil prices suggest that this system of governance may be about to become increasingly fragile: prices jumped by almost 40 percent in 2008, and then fell back again somewhat during the

Figure 3: World oil prices: the big picture



Source: BP

economic slump of 2009. Since then, oil prices have risen again, and once more broke through the $100/barrel ceiling in 2011 (see figure 3).

Governance Structures to Address Climate Change

At the core of international political efforts to limit global emissions lies the United Nations Framework Convention on Climate Change (UNFCCC), which was negotiated in 1992 and entered into force on March 21, 1994. It stipulates the objective of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (Art. 2, UNFCCC), which is to be achieved through international co-operation based on the principles of "common but differentiated responsibilities and respective capabilities." Accordingly, the "developed country Parties should take the lead in combating climate change" (Art. 3 (1)), while the "specific needs and special circumstances of developing country Parties" would be taken into consideration (Art. 3 (2)). The convention established specific responsibilities for the so-called Annex I countries (essentially, the advanced industrial countries).

As a follow-up to the UNFCC, the Kyoto Protocol, which came into force on February 16, 2005, set binding targets for 37 industrialized countries and the European Union for reducing greenhouse gas emissions (the so-called Annex I countries). Those commitments for the five-year period between 2008-2012 amounted to an average reduction of emission levels of five percent against 1990 levels. The major difference between the Protocol and

A look at global CO_2 emissions since 1990... suggests that present arrangements of global governance to address climate change are insufficient, if not completely dysfunctional.

Table 2: Evolution of greenhouse gas emissions (in million ton CO_2 equivalent), 1990 — 2009

CO_2 Emissions	1990	2000	2009	Reduction Target 2012	Difference (percent)[a]
United States	6111.8	7008.2	6530.8	5684.0	- 13 %
European Union	5752.3	5070.0	4666.1	5292.5	+ 13 %
Japan	1268.7	1344.3	1135.2	1192.5	+ 5 %
Russia	3321.7	2024.8	2097.0	3321.7	+ 58 %
Australia	418.4	496.2	549.4	451.8	- 18 %
Canada	591.8	717.1	701.4	556.3	- 21 %
China	2244.0	3077.6	7056.3	n.a.	n.a.
India	589.3	976.4	1537.0	n.a.	n.a.

[a] *Negative figure: 2009 emissions exceed target; positive figure: emissions below target*

Source: Ziesing (2010)

the Convention is that while the Convention encouraged industrialized countries to reduce GHG emissions, the Protocol commits them to do so. The Kyoto Protocol also established three market-based "mechanisms" to facilitate emission reductions, namely "emission trading," the "clean development mechanism (CDM)," and "joint implementation." All three mechanisms basically aimed at creating incentives for co-operation between developed and developing countries on emission abatement, not least through providing financial incentives for the latter to contribute to efforts to limit global warming. The Copenhagen Accord of 2009 resulted in a (vague and nonbinding) commitment to policies that would limit global warming to 2oC, while the UN environmental summit at Cancun in 2010 brought agreement that developing countries would contribute to emissions reductions, but in return receive financial and technological support from industrialized countries to do so. To this end, advanced industrialized countries committed themselves to supply $100 billion per annum from 2020 onward to a "Green Climate Fund."

Beyond the UNFCCC, and partly as alternatives to efforts to secure broad-based, binding agreements to reduce emissions of GHG through coordinated national action through the Kyoto Protocol (due to expire in 2013) and a follow-up agreement, there have been numerous other bi- and multilateral initiatives to tackle global warming through international or transnational co-operation.[13] In 2007, U.S. President George W. Bush in 2007 brought together a group of 16 developed and developing countries initially called the Major Emitters Forum (later relabeled the Major Economies Forum on Energy and Climate), which collectively represented about 80 percent of global emissions. The membership of this group closely resembles that of the G20, which has also taken up energy and climate issues, albeit not as a central part of its agenda.

A look at global CO2 $_e$missions since 1990 (the base year for the reduction commitments under the Kyoto protocol) and the performance of those countries that did pledge to reduce emissions (see table 2) suggests, however, that present

arrangements of global governance to address climate change are insufficient, if not completely dysfunctional.

With the exception of the EU, Japan, and non-EU Eastern European countries, most seem likely to miss their reduction targets by a wide margin, and where the targets are likely to be met or exceeded, this usually will be the result of circumstances (such as the breakup of the Soviet Union, which led to a vast reduction in CO_2 emissions on the territory of the former Soviet Union due to the collapse of Soviet industries), rather than of policy efforts.[14] According to David G. Victor, international policy efforts actually have made the already very tough problem of reducing global CO_2 emissions worse by pursuing deeply flawed strategies, such as trying to secure the broadest possible diplomatic agreements — universal membership — through agreements which are to be legally binding but lack enforcement mechanisms, and by applying the wrong tools (namely, timetables and reduction targets, rather than persistent policy efforts).[15] As a result, international climate change diplomacy has produced agreements that either were so vague as to be easy to fulfill but meaningless in practice, or so specific that even well-intentioned governments found it hard to achieve those targets.

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3 Trends and Critical Uncertainties

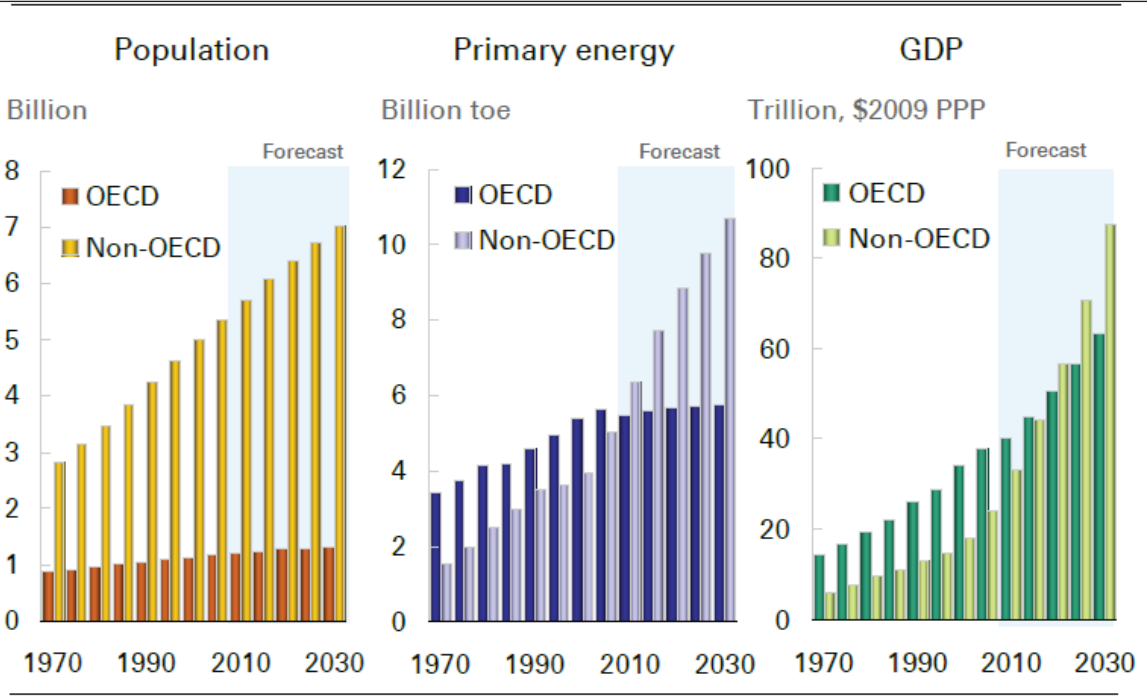
The global energy system...seems headed towards major upheavals.

As this chapter will show, present trends and projections suggest that the problems identified so far will grow massively in the coming decades. Energy demand will likely continue its recent strong growth, as economic activity in Asia, Africa, and Latin America continues to catch up. Too much of this demand will continue to be met with fossil fuels, putting additional pressure on an already fragile world oil market and further increasing the concentration of CO_2 in the atmosphere. This, in turn, will aggravate the impact of climate change. The global energy system therefore seems headed toward major upheavals. Yet policy responses to the accumulating problems, both with regard to strategic energy vulnerabilities and to climate change, so far have seriously lagged behind.

Energy Demand and Supply

Overall, world primary energy demand is generally assumed to grow significantly both in absolute figures (from about 12.3 in 2008 to about 16.7 billion toe in 2030) and — more moderately — in per capita terms (from about 1.8 to about 2 toe). This seems not only a fairly safe forecast, but it is also a morally compelling one. World primary energy demand will continue to be driven, first, by the growth of world population (set to rise, according to most recent UN estimates, from about 6.9 billion in July 2011 to between 8.0 (low variant) and 9.2 billion people (high variant) in 2035 — that is, by up to one third; that population growth will largely take place in non-OECD countries), and, second, by economic advances in developing countries, which offer the best opportunities for economic growth, but which will also need to grow

Figure 4: world population, primary energy demand, and GDP growth, 1970 - 2030



Source: BP Energy Outlook 2030

fast so as to raise levels of material development for the poorer parts of humanity.

This points to strongly rising levels of per capita income in the South, and hence to significantly higher world energy demand, as social development in the non-OECD world catches up further with that of the wealthier world (see figure 4). Future OECD energy demand is assumed to show only very modest increases overall and even a decline in per capita energy consumption from 2020 onward, as the efficiency of energy use is enhanced and economic activities shift further toward less energy-intensive forms, such as services.[16]

The essence of the energy/climate change conundrum is that the unsustainably energy- and resource-intensive modes of production and lifestyles of industrial societies have been spreading on a global scale. One particularly poignant example of this is the attraction of individual mobility provided by the passenger car. Sales of cars have been exploding in China and India in recent years, with China overtaking the U.S. market as the world's largest in 2010. Within three years, between 2007 and 2010, the size of the Chinese vehicle fleet more than doubled to an estimated 40 million total.[17]

Oil and Natural Gas Import Dependence

Given present trends and the long lead times required for shifting energy demand patterns, strategic oil import vulnerability seems likely not only to persist, but to become more pronounced — for the West, but also for other important countries such as China and India. According to the most recent projections by the International Energy Agency, by 2035 the United States will still meet 30 percent of its total energy demand from oil, most of it imported (in 2008, oil met 37 percent of total U.S. energy demand, with about two-thirds of that supplied from abroad). For the European Union, the vulnerability is likely to be even higher: in 2035, oil is expected to meet about 26 percent of total primary energy demand, but almost all of it will have to be imported (compared to 34.6 percent in 2008; about 85 percent of this was imported). The IEA, in its baseline scenario, projects OPEC oil exports to increase from 33.4 million barrels per day in 2009 (corresponding to 40 percent of total world oil production) to 49.9 million barrels per day (50.4 percent of total world oil production).[18]

The implications of the IEA baseline scenario also point to heightened pressure on proven oil resources and huge investment requirements in production and oil export capacity. Since proven and probable future oil reserves are now to a large degree controlled by national oil companies, decisions on investment and capacity expansion may be driven not only or not even primarily by oil price considerations: governments of oil exporting countries may chose to delay production to husband resources and benefit from higher oil price levels in the future, and they may be able to increase their oil revenues through higher prices, rather than through more export sales.

For the importers, the primary sources of supply will likely remain those countries with a) a huge hydrocarbon reserve and resource base and a favorable ratio of production to reserves, b) limited domestic oil requirements, hence large export potential, and c) limited oil income absorption capacities. From this perspective, the list of critical countries includes most countries bordering the Persian/Arabian Gulf (including Iraq), Libya, Venezuela, Nigeria, and Kazakhstan (as well as, possibly, Canada). Strategic vulnerability concerns therefore seem probable to be even more concentrated in the Middle East than they are already today, despite rising oil production and exports elsewhere.

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A more fragile and conflict-ridden system of international oil governance seems likely. This will probably result in stronger price fluctuations and a general upward pressure on oil prices.

Major uncertainties and risks inherent in the present global governance system for oil include the challenges that the Arab revolution and the Iranian theocratic regime, but also indigenous social and political fault lines, pose to the domestic stability and national security of the Saudi monarchy and its conservative allies on the Arabian Peninsula. Regionally, Teheran's nuclear weapons program, but also the Israeli-Arab conflict and the extensive U.S. military presence in the Gulf region (the two principal arguments that al Qaida uses in its propaganda against the Gulf monarchies) could engender tensions and even military conflict with long-term implications for global oil supplies. Finally, serious policy divergences might surface between the United States and the oil exporting countries even without regime changes or regional conflict. Those divergences could concern differences over policies toward the Israeli-Arab conflict, toward Iran and radical Islam, but also toward oil prices and the management of financial assets of producer countries. Such differences could also create tensions and frictions within the West, as they have repeatedly done in the past — for example, during the Israeli-Arab Yom Kippur war in 1973 and its aftermath.

A more fragile and conflict-ridden system of international oil governance therefore seems likely. This will probably result in stronger price fluctuations and a general upward pressure on oil prices, though with erratic ups and downs, which would have a negative impact on investment decisions. The IEA estimates that the world will have to find total investments of $33 trillion (or about 1.4 percent of gross world product) for the period 2010-2035 in the baseline scenario, half of which would be in electricity generation and transmission.[19] Investments in new oil production and distribution, in particular, but also other investments in the global energy system may suffer from uncertainties surrounding future price and production policy developments.

Unlike the United States and China, Europe is potentially vulnerable to energy import disruptions, not only with regard to oil, but also in its natural gas supplies, in this case from Russia. This, however, will best be addressed at the regional level, as the world natural gas trade, while becoming more global than before, will likely remain in essence regionalized. Completing the internal European natural gas grid and realizing a truly competitive pan-European internal market, establishing strategic storage facilities for natural gas, and ensuring that natural gas could flow from West to East (rather than from East to West, as it usually does) in an emergency so as to allow shortfalls in, say, Poland to be compensated from gas fields in Norway or from strategic storage in Germany would provide sufficient flexibility to contain strategic vulnerability.

Global Warming

The Copenhagen Accord sets a target of limiting the increase of global temperatures to 2o Celsius. There is broad agreement that this would require a stabilization of particle concentration in the atmosphere at (or below) 450 parts per million of CO_2 equivalent. Yet CO_2 emissions have in fact risen strongly in recent years.[20] Worldwide emission levels in 2008 were 37 percent higher than in 1990 and 25 percent higher than in 2000. While the EU (EU-27) was able to lower emission levels between 1990 and 2008 by 13 percent, those of the United States in that period rose by 8.3 percent.[21] Even under cautiously optimistic assumptions about policy changes, the IEA projections and scenarios do not foresee a stabilization of total greenhouse gas emissions in the course of this century, and then only at a level of more than 700 parts per million (ppm), rather than at the 450 ppm that scientists consider as the maximum tolerable

Table 3: World primary energy demand, by fuel, different scenarios (Mtoe)

			New Policies Scenario		Current Policies Sceneario	
	1980	2008	2020	2035	2020	2035
Coal	1,792	3,315	3,966	3,934	4,307	5,281
Oil	3,107	4,059	4,346	4,662	4,443	5,026
Gas	1,234	2,596	3,132	3,748	3,166	4,039
Nuclear	186	712	968	1,273	915	1,081
Hydro	148	276	376	476	364	439
Biomass and waste*	749	1,225	1,501	1,957	1,461	1,715
Other renewables	12	89	268	699	239	468
Total	**7,229**	**12,271**	**14,556**	**16,748**	**14,896**	**18,048**

**Includes traditional and modern uses.*

Source: IEA World Energy Outlook 2010

concentration to prevent unacceptably high risks and costs.[22] The principal reasons are that under the two scenarios based on established ("current policies") or recently amended and/or announced policies ("new policies"), world primary energy demand would continue to grow strongly, and all fossil fuels would significantly expand.[23]

Global warming has already been happening for some time, with major worldwide implications for desertification, water supplies, internal and international migration, and violent conflicts, particularly over access to water and land.[24] This is likely to escalate further: a growth in the concentration of CO_2 in the atmosphere in coming years is all but certain. But the implications of this for global and regional climate are full of uncertainties, though with a significant probability of downside risks materializing, which could significantly accelerate global warming, possibly dramatically if critical "tipping points" — thresholds beyond which there would be huge and rapid climate changes for the worse — would be passed.[25] There is a broad consensus in the U.S. National Intelligence Community that global warming represents one of the major national and global security concerns for the coming decades.[26]

Since the problem is global in nature, political redress will require globally coordinated and integrated national action, so as to shift the global economy onto a sustainable energy and emission trajectory. Yet there are a number of difficult political problems in this. First, how should the burden of adjustment be distributed, and on what basis? How could free-riding be avoided? On this, it is at least clear that the West has caused the problems directly (through its cumulative stock of emissions so far) and indirectly (by propagating emission-intense modes of production and consumption), and advanced industrial economies have indeed already accepted in principle their special responsibility for promoting sustainable global policies, not least through resource transfers to poorer countries. Intuitively, the notion that each human being, regardless of his or her nationality, wealth, or other distinctive criteria, should be entitled in principle to an equal amount of emissions seems the most persuasive basis for resolving this difficult issue.[27] If accepted, this norm could in principle be translated into specific reduction targets for all countries so as to achieve the convergence of per capita emission levels within a given timeframe (say, to 2050).

Global warming represents one of the major national and global security concerns for the coming decades.

A second problem consists in ensuring actual compliance with agreed commitments, which would encounter problems ranging from fraud to accurate data measurement. A third difficulty is that any effective reduction in emission levels would not halt, let alone reverse, the advance of global warming for a considerable time, since the lead times in reducing CO_2 concentration in the atmosphere are long (regardless as to whether the reduction would be achieved naturally through lowering emission levels, or technologically, e.g., through carbon capture and storage). The problems would thus likely get worse before they get better despite successful policy efforts. The challenges for "effective multilateralism" on global warming policies are thus huge.

Problems could... get worse before they get better despite successful policy efforts.

4 China in World Energy and Climate Change Politics

Challenges of Energy Transition

As figure 5 shows, China will play a particularly important role in the context of energy transition and global warming. The most recent estimates by the International Energy Agency (IEA) assume that China alone could account for about 90 percent of incremental global coal demand and net oil imports, close to 60 percent of the global increase in oil demand and CO_2 emissions, and about 35 percent of the net increase in world energy demand.

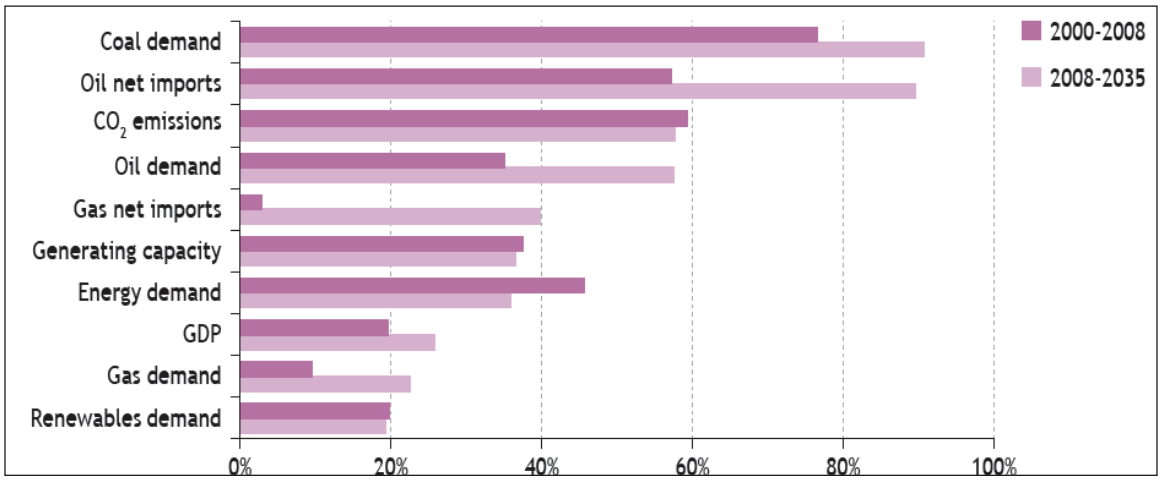
Over the past decades, the most important factor shaping China's rapidly growing energy demand has been the steep rise of economic growth per capita: between 1980 and 2005, per capita income, calculated in RMB, grew from 1,833 to 13,228 — that is, by about 721 percent, or on average 8.2 percent per year. Energy demand per capita, however, grew only at less than half the rate of economic growth between 1980 and 2000 — a rather unusual pattern, as industrial take-off generally goes hand in hand with energy growth higher than that of the overall.

The impressive advances of the Chinese economy have put enormous pressure on the national energy system: the country repeatedly experienced severe shortages of coal and electricity supplies between 2003 and 2006, and a real crisis in the winter of 2008.[28] Growing energy requirements also resulted in rapidly rising levels of energy interdependence, most obviously in the form of oil imports, which more than doubled from 128 million tons in 2003 to 294 million tons in 2010.

China's energy outlook will continue to be shaped importantly by its endowment with abundant coal resources. Coal has dominated in China's industrialization, and over the last three decades, its share in total energy supply has hovered between 70 and 75 percent. Coal consumption has been growing very rapidly since 2001: in the five years between 2002 and 2007 alone, the increase in China's demand for coal was equivalent to total U.S. coal consumption in 2007, and over the period 2000 — 2008, China accounted for three-quarters of the growth in global coal demand.[29] Demand for coal is expected to continue to rise strongly through 2035; by that time, China's share of global coal consumption could reach 50 percent (it was

China alone could account for about 90 percent of incremental global coal demand and net oil imports, close to 60 percent of the global increase in oil demand and CO_2 emissions, and about 35 percent of the net increase in world energy demand.

Figure 5: China's share of the projected net global increase for selected indicators



Source: International Energy Agency, World Energy Outlook 2010

China's energy situation clearly presents major challenges to the leadership.

43 percent in 2008). Electricity generation will absorb a large part of that coal demand: demand for electricity is projected to triple between 2008 and 2035, with most of the additional capacity consisting of coal-fired power stations. The IEA calls the dimensions of the projected capacity expansion "staggering": between 2009 and 2020, China would have to build additional generating capacity equivalent to total installed capacity of the EU, and by 2025, of the United States in 2008.[30]

China's indigenous conventional oil and gas resources are relatively small. While its oil production has been growing, domestic supply has been outpaced by demand rapidly, turning China into a net importer of quickly rising quantities since 1993, with a fast growing share of its oil demand being met by foreign sources. In 2010, China imported almost 70 percent of its total oil demand of 430 million tons, a rise of imports by 17.5 percent compared to 2009.[31] The IEA expects that by 2035 China will have to import 84 percent of a total oil demand of 750 mtoe; oil imports would grow under this scenario from 4.8 million barrels per day (2010) to 12.8 million barrels per day in 2035.[32] Natural gas imports, which were about 4.5 billion cubic meters (bcm) in 2008, are also likely to increase significantly, both through pipelines from Russia and Central Asia and via LNG shipments from Asia-Pacific and the Persian Gulf. The government has also been pushing massive expansions in renewable energy supplies and nuclear energy forward (although the enthusiasm for nuclear power reactors was dented somewhat by the Fukushima nuclear disaster in Japan). In 2010, China already was the global manufacturing leader in most renewable energy technologies, and in that year alone, its investments in clean energy totaled more than $154 billion.[33]

Overall, China's energy situation clearly presents major challenges to the leadership. Until 2005, Chinese planners had assumed that China's rather unusual pattern of rapid economic growth, coupled with persistent improvements would hold for the whole period 2000-2020, but energy demand in China took off dramatically since 2001, growing about 1.5 times as fast as the economy as a whole. By 2007, energy demand therefore was 60 percent higher than had been assumed by government planners.[34] This led to a dramatic policy effort during the 11th Five-Year Plan (2006-2010), which succeeded in bringing energy efficiency improvements back on track. For the 12th Five-Year Plan, China aims at a "structural transformation" of the energy sector through further improvements in energy efficiency and the advance of renewable energy and nuclear power as part of support for "strategic emerging industries."

The tasks for China's energy sector are nevertheless daunting for two major reasons. First, projected demand levels and their rapid growth are staggering, and lead times are considerable both for developing new sources of supply (e.g., coal mines, oil wells, or nuclear power stations) and for using energy more efficiently through new equipment (such as more fuel-efficient cars, industrial plants, and better insulated houses). The second reason is the energy policy mindset of the leadership and the weight of past energy policies. Until 2007, the focus of policy had been almost completely on supplying growing industrial energy demand. This approach, which of course has deep roots in the Communist Party's basic attitude toward modernization, has created powerful vested interests.

Nevertheless, the leadership has begun to rethink its traditional energy policy approach, which until then had focused almost exclusively on providing energy supplies for rapid growth, neglecting the demand side of the energy equation (i.e., enhanced energy efficiency). In its new policy thrust, as manifested in the 12th Five-Year Plan, the Chinese leadership has developed a highly intelligent policy approach that integrates its industrial policy vision

and its energy policy approach. Still, despite all new emphasis on enhancing energy efficiency, the need to increase energy supplies of all kinds, and from both domestic and international sources, will remain paramount.

Whichever choices the government makes, and whichever direction Chinese energy policies will take, China will remain highly interdependent with the world energy system — with rapidly rising oil imports as the most visible manifestation of this reality of interdependence. Even if China succeeds in shifting policies toward a sustainable energy trajectory, the country will become more dependent on oil imports, mostly from the Middle East, certainly for the coming two decades, and China will probably replace the United States as the world's largest oil importer during that period. It will thus experience a significant increase in its strategic energy insecurity; as with the West, this will be concentrated in vulnerability of its oil imports from the Middle East.

China has begun to react to this in a number of ways. They include new efforts to develop domestic and foreign alternatives to oil imports from the Middle East and steps to enhance oil security and assured access, not least through the cultivation of close relations with key Middle Eastern suppliers, notably Saudi Arabia, and other oil exporting countries in Africa and Latin America. The Chinese navy is clearly also preparing for a more expansive role in policing sea lanes of communications and possible "choke points" (Straits of Hormuz and of Malacca and the Taiwan Strait) from the Gulf to China.[35] The government has initiated a program to build up strategic petroleum stockpiles, and opened a dialogue with the International Energy Agency (IEA), *inter alia* discussing stockpiling policies.[36]

Given its growing dependence on oil imports and its strategic vulnerability, in the future China will inevitably take a closer interest in arrangements governing international oil markets, pursuing a mix of unilateral, bilateral, and multilateral approaches. This will also draw it more deeply into the domestic and regional politics of the Middle East, and its key issues: Iran's ambitions for a dominant role in the region, its challenge to the domestic political status quo on the Arabian Peninsula, and its nuclear program; the future development of domestic politics in the Arab world in general and in Iraq, potentially a huge source of oil exports, in particular; and the evolution of the Israeli-Palestinian and the Israeli-Iranian conflict.

Challenges of Environmental Sustainability

Already today, China is a major part of the global CO_2 emission problem, and that part is likely to grow dramatically in the future. At the same time, China faces the latecomer's dilemma: it is still catching up with the advanced industrialized countries in its overall standard of living, and its per capita energy consumption and emissions of CO_2 are still significantly lower than those in the West: in 2008, the average Chinese emitted about 5.5 tons CO_2 (energy-related emissions only), while the average American emitted more than three times as much (18.5 tons). In that year, China accounted for 22 percent of total global energy-related CO_2 emissions; the United States, with only 301 million people to China's 1.2 billion, accounted for almost as much, namely 19 percent. But data for the last decade show how quickly this picture is changing: Chinese emissions grew from 2,244 metric tons (mt) CO_2 in 2000 to 7,056 in 2009 — that is, by 4,812 mt, considerably more than total EU emissions (3,835 mt) in 2009, and almost as much as total U.S. CO_2 emissions in that same year (5,516 mt).[37] According to IEA projections, China's energy-related CO_2 emissions will increase from 2009 to 2035 by 54 percent (to 10,118 mt); this would then represent 58 percent of the total projected global increase. By 2035, China could thus account for over 28 percent of

Whichever choices the government makes, and whichever direction Chinese energy policies will take, China will remain highly interdependent with the world energy system.

global energy-related CO_2 emissions (United States: 12.5 percent; EU 7.8 percent).[38] Even the issue of historical justice would by that time look rather different from today: the total stock of Chinese CO_2 emissions since 1900 by that time would have probably already exceeded that of the EU.[39]

China has been doing, and will be doing, a great deal to help stem global warming out of its own, pragmatic assessment of its national interest.

Overall, although its predicament is far from unique (India in many ways confronts similar energy and environmental challenges), China faces particularly difficult policy choices with regard to securing an environmentally sustainable provision of energy. At the core of this conundrum are China's impressively rapid and sustained material achievements and its ambitious future growth objectives, its overwhelming reliance on the dirtiest source of energy, coal, and the rush of the Chinese middle class to buy cars. At the same time, China's ecology is particularly vulnerable. Climate change is likely to have a major impact on agriculture in the northern and north-eastern parts of China; it probably will accelerate the already serious advance of desertification and aggravate water shortages (which two-thirds of China's cities have already been facing for some time).[40] This poses risks to the Chinese Communist Party's leadership paramount political concern — social stability and, ultimately, the legitimacy of the CPP's rule. Over the last few years, there has been a major increase in violent local incidents; many of them were caused by, or at least related to, environmental degradation.

The Chinese leadership has reacted to those domestic challenges forcefully. Its new energy policy approach — if implemented successfully — would continue to reduce the specific energy intensity and emission rate of future economic growth, while at the same time massively expanding renewable energy and pushing for ways (such as smart grid electricity distribution and electric cars) to reduce future fossil fuel demand. The government has recognized the key role of energy pricing in all this, and it clearly aims at making fossil fuel consumption more expensive over time. In other words, China has been doing, and will be doing, a great deal to help stem global warming out of its own, pragmatic assessment of its national interest, and its policies may be on track to achieve a peak level of Chinese CO_2 emissions already before the middle of this century.[41]

Beyond its serious domestic challenges, China will also increasingly be confronted with international pressures to check its surging CO_2 emissions. The government has begun to react to those pressures already by significantly shifting its position in the context of international efforts to contain global warming.[42] China has improved its voluntary commitment on emission reductions by promising a reduction by 40 to 45 percent of specific CO_2 emissions per unit of GDP for 2020 over 1990 (this would still imply a huge overall increase in CO_2 emissions). Beijing has also hinted at a willingness to accept surveillance and international monitoring. Yet China still refuses to commit itself to specific long-term reduction goals, and it insists on maintaining the Kyoto Protocol differentiation between Annex-I countries (which have committed themselves to precise reduction targets) and developing countries, which should not enter such commitments.

5 Policy Recommendations

The analysis so far points to the following major conclusions:

- The world will need to find a lot of additional energy supplies and push down energy prices if it is to meet the material aspirations of a growing world population. This will exacerbate the already acute dilemma between the economic growth imperative and the need to avoid potentially catastrophic environmental risks due to global warming.
- The world will therefore have to shift its energy mix decisively away from fossil fuels. This would eventually also change patterns of energy interdependence and strategic vulnerabilities, but probably not the deep-seated interdependencies in the world energy and climate system.
- Present and future energy and climate interdependence will have to be managed through existing and/or new arrangements of governance, involving governments, corporations, other nonstate actors, and markets.
- Both the national policy responses and the arrangements for global governance presently in place are insufficient to respond adequately to the challenges the world is facing over the next two decades, let alone from a longer-term perspective. With regard to energy, present international governance arrangements exclude important rising powers and oil importers such as China or India, which are unlikely simply to accept this. And as far as global warming is concerned, governance arrangements have been plainly inadequate. There is thus an urgent need for new, more effective policies on energy and climate change, at national levels and multilaterally, to shift the world onto a sustainable energy trajectory.
- China is perhaps the single most important country in this context, given its huge impact on global emission levels of greenhouse gases and its rapidly rising dependence on international oil markets in general and oil imports from the Persian Gulf in particular. Yet the principal responsibility to initiate new policy approaches lies with the transatlantic community: the United States and Europe have been the main sources of the present stock of emissions in the atmosphere, and they are collectively best placed to initiate changes in international energy and climate change policies. Their key concern will have to be to help shift China's energy trajectory toward an environmentally (climate change) and geopolitically (dependency on the Persian Gulf) sustainable path.
- In principle, China, as the United States and the European Union and eventually all major emitters of greenhouse gases, can and should be expected to act on its own in ways conducive to a globally sustainable energy trajectory. But there is an inescapable need to coordinate national policy efforts, and China could not be expected to initiate this. The transatlantic community is best placed to do so, and it has accepted this logic already: both the United States and the European Union already play leading roles in international energy and climate policies.

There is an inescapable need to coordinate national policy efforts, and China could not be expected to initiate this. The transatlantic community is best placed to do so.

A Price Path for Carbon Dioxide

The first policy recommendation of this paper, as presented already in the Transatlantic Academy Report on Global Shift, is that

> the United States and the European Union should commit themselves as early as possible to the principle of progressively increasing

Markets are unable on their own to achieve the needed energy transition away from fossil fuels, as they are unable to price in the full costs of climate change.

the price of CO_2 emissions over the next decades through appropriate measures of taxation and/or emission trading. The community would thus ensure, in a verifiable way, that the cost of carbon emissions from domestic energy consumption in member economies rises by a commonly agreed rate every year. The rate could be determined on the basis of global economic growth and inflation rates. The community should also seek to persuade other countries, including China and India, to commit to such a policy.[43]

Figure 6 illustrates the policy idea.

The basic assumptions behind this proposal are as follows:

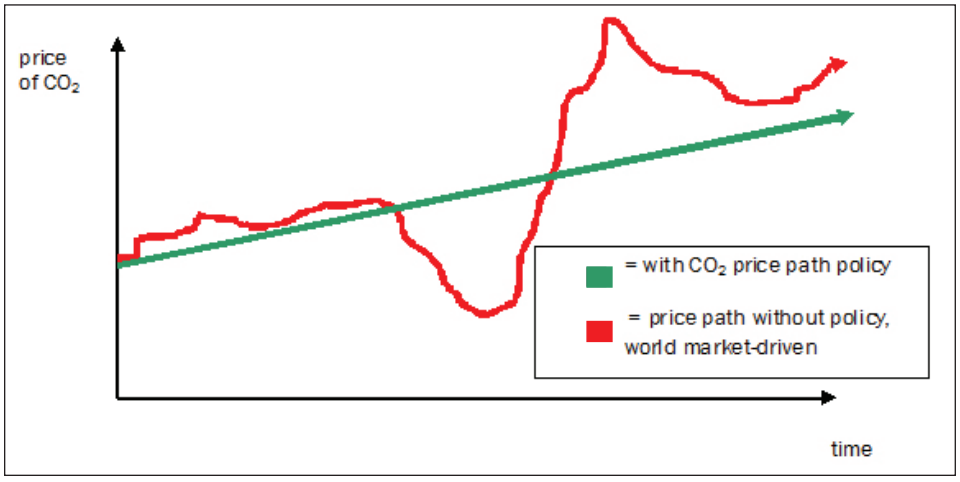
- The responsiveness of the world energy system to the challenges outlined above so far has been insufficient. One important reason for this is the combination of price fluctuations and major uncertainties about future price levels. Since energy investments both on the supply and demand side usually have long lead times and often are price-sensitive, this impedes crucial investment decisions and constrains technological innovation. Erratic investment patterns will accentuate price swings and thus enhance uncertainties further, and they are likely to contribute to higher prices for fossil fuels.

- Markets are unable on their own to achieve the needed energy transition away from fossil fuels, as they are unable to price in the full costs of climate change. Therefore, there will have to be a policy framework to prompt market responses in line with the objective to contain the risks and costs of climate change.

- A price path built around moderate but continuous annual increases over a number of years would offer the best prospects to achieve the needed far-reaching changes.[44] This would unleash technological innovation and decentralized market dynamics, promoting adjustments in terms of alternative energy sources to fossil fuels (which would all become more expensive over time, with some differential between the strongest — coal — and the lesser — natural gas and oil — sources of CO_2 emissions), as well as the more efficient use of energy across the board. Such a policy thus offers the best (and probably the only plausible) chance to turn around the rapidly deteriorating picture on CO_2 emissions and global warming.

- Such a price path of modest but continuous

Figure 6: Alternative illustrative price paths for fossil fuels for final consumers



annual increases would make adjustment to higher energy prices bearable in terms of its impact on overall levels of economic activity. In fact, the stimulus effect from investment and technological innovation to overall economic activity might well overwhelm the dampening effect of higher energy prices on levels of economic activity, thus stimulating economic growth and employment. This effect would partly, and possibly even fully, compensate the dampening effects of higher energy prices on economic activity.

- The most likely alternative to such a price path policy would be erratic adjustment driven by fossil fuel price fluctuations around a rising trend, in response to government interventions (e.g., OPEC production decisions, IEA stockpile releases), uncertain investment patterns, and political events. Sudden sharp price increases could lead to serious international economic disruptions, pushing demand for fossil fuels and CO_2 emissions down, as happened in 2009 (see figure 6). Overall demand for fossil fuels and emissions would most probably decline considerably less than with a price path, while economic activity likely also would be lower than in the price path scenario. The alternative thus would plausibly impose higher economic cost and greater social welfare losses in the short to medium term — without even including the long-term costs due to the impact of climate change over the rest of the century.[45]

- Energy markets are oligopolistic markets with considerable government involvement. Historical experience shows that prices can be managed and price fluctuations may be considerably reduced if governments and companies work together toward this end. Such a price path policy, while clearly politically challenging, does thus seem realistic.

- The proposal would generate significant financial resources both nationally (through fossil fuel or carbon taxes) and internationally (through emissions trading and the clean energy mechanism). Those revenues could and should be used primarily to finance energy adjustment and compensate lower income groups (both within countries and between them). Subsidies to promote specific energy sources should be avoided, however, as much as possible, as markets could be trusted to allocate efficiently in response to price signals, as long as they are allowed and induced to function competitively. The tax revenue generated within the member states of the transatlantic community could also be used profitably to reduce levels of public debt.[46]

- An alternative policy approach to such a price path policy would be technology policies to encourage adjustments toward a low-carbon energy system.[47] Yet this alternative would likely be less efficient, as technology policies are prone to be captured by vested interests. Moreover, policies to encourage the development of new energy technologies are unlikely to change investment patterns as effectively as price signals and a higher degree of confidence about future price levels.

Modalities

The agreement to gradually increase the price of all fossil fuels through progressively taxing their CO_2 content by a set amount for a pre-determined period of time would initially include only a limited number of countries. At a minimum, this should be the United States and the European Union as two of the most important actors on global warming. But the agreement could also include others, such as Japan, Norway, and Australia. In effect, member countries in this agreement would form an avant-garde club of promoters of climate

Member countries in this agreement would form an avant-garde club of promoters of climate protection, leading the rest of the world by example and by down payments of their own.

The negotiating strategy for an agreement on global warming would thus resemble that for the present world trade order.

protection, leading the rest of the world by example and by down payments of their own, as they would accept, in principle, a progressively deteriorating competitive position to the extent their energy prices and hence production costs came to exceed those of other countries.[48] But members would also benefit from international credibility with and support from other state and nonstate actors who shared their objective on global warming. Club members could thus put pressure on others through moral opprobrium, and they could also develop sticks, as well as carrots, to persuade other countries — most importantly, of course, China — to join the agreement. The negotiating strategy for an agreement on global warming would thus resemble that for the present world trade order: the General Agreement on Tariffs and Trade (GATT) was launched by 23 members, but its successor organization, the World Trade Organisation, by now has 153 members and thus close to universal membership.[49]

Members of the agreement would be free to choose the way in which they wanted to implement the price path decisions through national legislation (though they would have to comply in a verifiable and transparent manner). This would give governments considerable flexibility. Yet there would be a progressively rising price floor to fossil fuel prices.

Actual fossil fuel prices to domestic consumers could conceivably rise even faster, of course, if world market prices went up faster than the price path. In such a situation, market participants could still expect that energy prices would not fall below the floor set by the price path in the future even if world market prices fell again. Moreover, member governments of the agreement could also decide to take steps to buffer the price effects of rising world market prices on domestic consumers of fossil fuels (most obviously, by lowering or abolishing the tax temporarily) if world market prices exceeded levels implied by the price path policy.

The price path policy would represent a challenge to fossil fuel producers by consumer governments in the struggle about who gets what share of the surplus profits.[50] The often very substantial difference between costs and market prices is captured (through surplus profit margins) by the companies involved, but mostly by producer and consumer governments (through taxes). Governments and companies are thus involved in a three-sided struggle over the distribution of those surplus profits — and a price path policy would tend to shift the bargaining power in favor of consumer governments.

The strategy outlined here illustrates what the Transatlantic Academy *Report on Global Shift* defined as the need for "a new mindset" in transatlantic approaches to foreign policy and global governance. Thus, the transatlantic community would engage others not just by proposing agreements, but by going ahead and taking on commitments of its own. They would do so in recognition that such "leadership by example and by down-payments" is the best and most effective way to secure its own influence in a world of turbulence. The broad international support for such "leadership by example," which a recent World Bank study exploring public opinion showed, underlines the promise of such a strategy.[51]

The Politics of Implementation

How probable is it that such a policy could be agreed on and implemented persistently over a decade and more? At present, this seems far-fetched, most obviously in the United States, but also in Europe. There would undoubtedly be great political resistance to any climate change policy that could be presented by its detractors as a drag on economic growth and prosperity. This resistance

would be led by the broad range of interest groups with a stake in fossil fuel production, processing, distribution, and consumption.

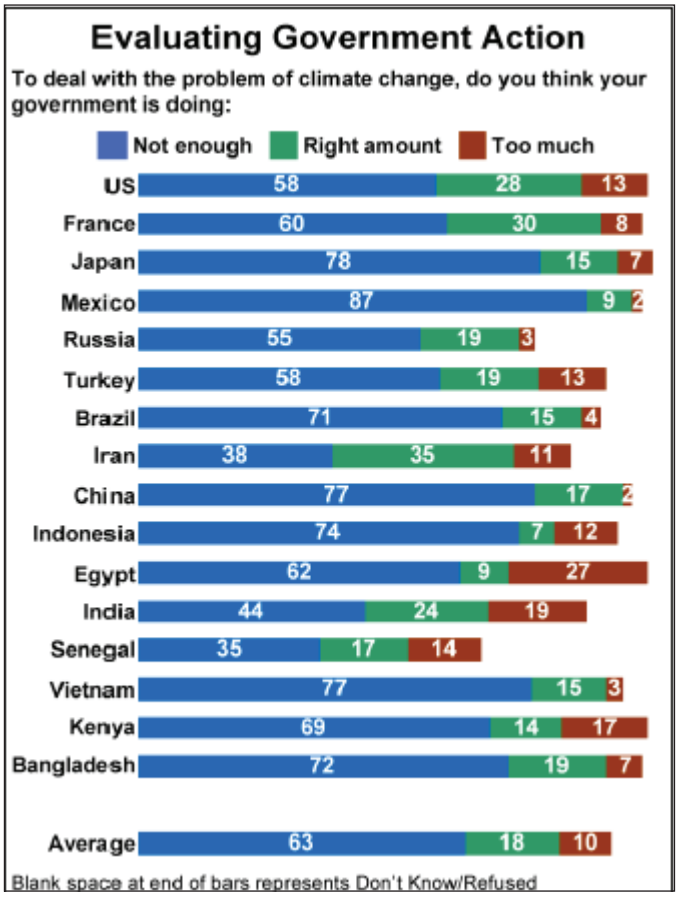
Yet political circumstances change, and there can be little doubt that higher prices will be needed to bring about effective action on global warming. A price path policy would establish a timeframe for adjustment (at a minimum, a decade) and thus moderate the pain and cost of change. And the effects of such a price path policy on innovation could be expected to make up for some, if not all, the effects of the higher cost of energy. Indeed, the example of China shows that a strategy of systematic energy transition can be pursued simultaneously with, and as an integral part of, a strategy of industrial and economic transformation. In any case, the costs of a price path policy would be limited; for lower income groups, they also could and should be compensated through tax rebates or other appropriate measures.

Once a sense of awareness and immediate crisis develops about the implications of climate change, the parameters of what is considered "politically feasible" will no doubt shift, perhaps quite dramatically. In fact, today there already exists a widespread recognition about the importance and urgency of addressing global warming. Since the mid-1990s, U.S. public opinion polls show consistently that about 70 percent of Americans believe that climate change is occurring and human-made. Polls also point to high levels of concern and a strong desire to take action, although this support for action is "strong but not intense."[52] The World Bank public opinion survey on climate change already mentioned found that in all 16 countries surveyed, majorities saw climate change as a serious concern, and in 10 of the 16 countries, the majority felt that climate change had already harmed their country.[53] On average, 87 percent of those polled felt that their country had a responsibility to act to prevent further global warming, and in most countries, large majorities felt that their government was not doing enough (see figure 7).

Public opinion data also suggest that already today, there is a significant awareness of the need for higher energy prices, and a willingness to pay

Public opinion data suggest that ...there is a significant awareness of the need for higher energy prices, and a willingness to pay for containing the risks of climate change.

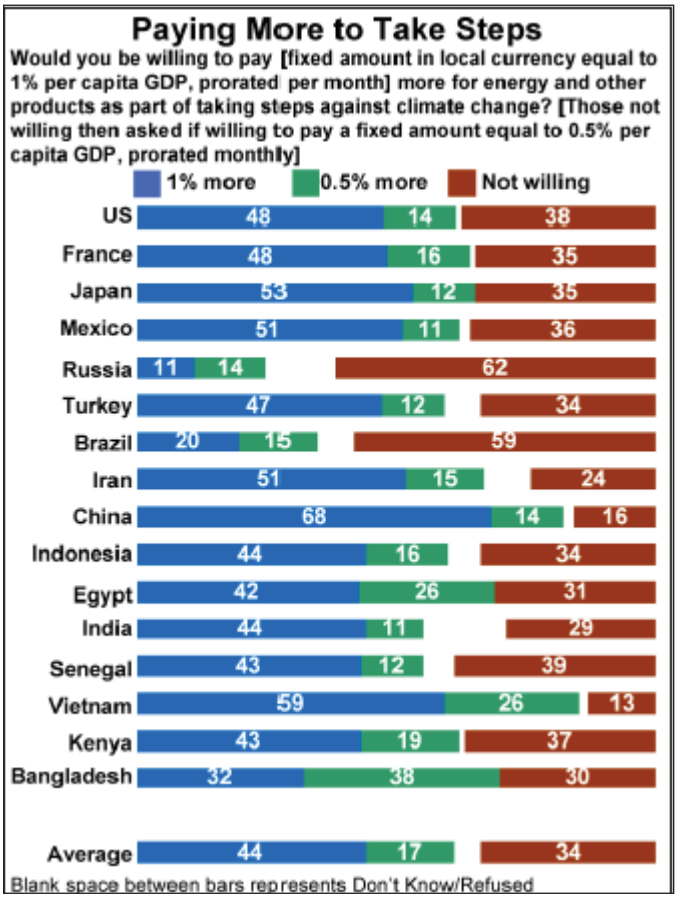
Figure 7: Global concern about climate change: governments are not doing enough



Source: World Development Report 2010

Strategic vulnerability for oil and natural gas importers would continue for some time...The management of this vulnerability need to be put on a broader basis to make it sustainable.

Figure 8: Willingness to accept higher energy prices to combat climate change



Source: World Development Report 2010

for containing the risks of climate change. Thus, the World Bank poll already quoted found that in 14 of the 16 countries, majorities were willing to pay between 0.5 and 1 percent in GDP in terms of higher energy prices (see figure 8).[54] In the United States, clear majorities support limits on GHG (86 percent) and want the United States to do as least as much as others do to combat climate change (94 percent). Eighty-three percent favor legislation requiring large companies to reduce emission levels by 2020 to 1990 levels, and very large majorities also favor tax incentives to promote clean energy supplies and efficient use. And a plurality (42 percent) of those polled thought that costs to address climate change and global warming would be "high but worth it" (while 27 percent felt no additional costs were needed, and 17 percent responded that the sacrifice would be too high).[55]

Ultimately, to criticize the lack of political realism of this policy recommendation misses its purpose. It is to suggest what would be needed politically, not what seems most likely to happen. The trajectory on global warming on which the world hurtles at present appears likely to produce huge, irreparable damage within the next decades. Corrective political action would have to be far-reaching and dramatic to contain those risks. I think that this proposal set forth the simplest, most flexible and least bureaucratic — and above all the most effective way — to achieve this.

Coping with Strategic Energy Vulnerability

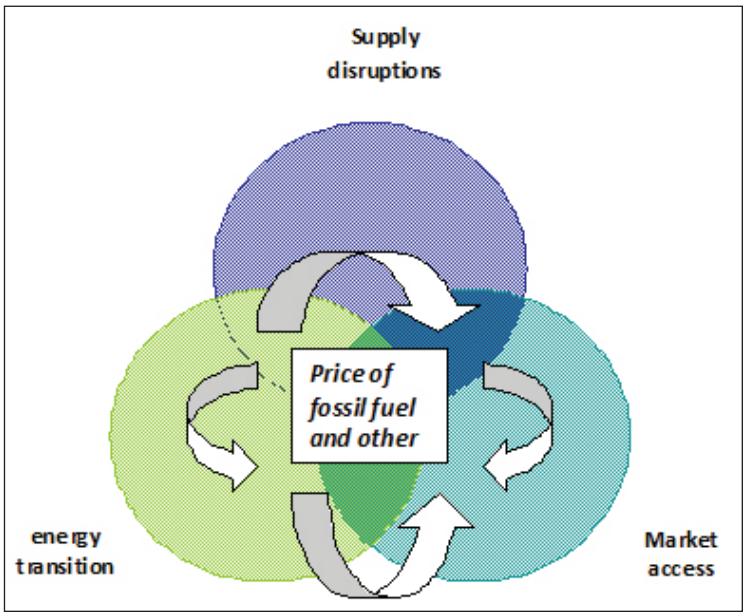
Even if the price path policy were implemented fully, rapidly and broadly, this would modify, but not dissolve, strategic energy vulnerabilities. As I have argued above, the concept of strategic vulnerability has three inter-related dimensions — vulnerability to supply disruptions, loss of market access, and vulnerability to the broader implications of energy transition. Figure 9 illustrates those three dimensions and their inter-relationship; government policies (such as the price path policy) and relative prices of energy crucially shape the specific relationship between the three dimensions.

Strategic vulnerability for oil and natural gas importers would continue for some time, even if

price path policies were vigorously and broadly pursued. The management of this vulnerability needs to be put on a broader basis to make it sustainable. In particular, it needs to include China and India, the two principal new major importers of Middle Eastern oil. Steps to bring China and India into existing international oil security arrangements managed by the IEA are important, but insufficient in themselves; a critical dimension of strategic vulnerability to supply disruptions concerns the political situation in the Gulf region. China, India, and others will therefore also have to be brought into regional security arrangements to sustain and enhance political stability in that region — in effect, a new, broad-based international security architecture for the wider Middle East. And the European Union will need to ensure that its (desirable) relationship of natural gas energy interdependence with Eastern Europe and Central Asia is managed in such a way that Europe will not be strategically vulnerable.[56]

Broad implementation of the price path policy would lead, within a few years, to a broad-based technological shift in both energy production and consumption, a change in demand and demand expectations for the future, and eventually also to falling energy prices. The price path policy would therefore tend to reduce the strategic vulnerability of oil and natural gas importers, but accentuate vulnerability of the exporters to loss of markets and generally vulnerability to the broader implications of energy transition and the future energy trajectory, such as difficulties to adjust national energy systems and the loss of competitive advantages related to specific patterns of energy

Figure 9: The three dimensions of strategic energy vulnerability



demand. Those vulnerabilities are most acute for the poor, within nations and between them.[57]

The fossil fuel exporters would probably try to resist and obstruct such price path policies. This would require a response, ideally in the form of initiatives for the co-operative management of global energy transition. This could include, for example, support for new energy opportunities — solar energy? — for oil exporters, market access guarantees, and cooperation on technological innovation. To cope with the conflicting priorities and interests of participants in the global energy system, and to constructively guide the energy transition away from fossil fuels, global governance of world energy, and in particular of world oil, needs to be deepened and broadened. An inclusive international framework for negotiations, bringing together the most important present and future oil and energy producer, consumer, and transit countries, therefore needs to be established and empowered, perhaps building on the extant frameworks of the International Energy Forum

An inclusive international framework for negotiations, bringing together the most important present and future oil and energy producer, consumer and transit countries, therefore needs to be established and empowered.

6 Abbreviations and Glossary

bcm: billion cubic meters (standard measurement for natural gas flows). One bcm equals approximately 0.90 mtoe in energy content.

CCS: Carbon capture storage/sequestration. This refers to the removal of CO2 at points of concentration (such as fossil fuel power stations) from the atmosphere and its long-term storage.

CDM: clean development mechanism. Negotiated in the UNFCCC context and set up in the Kyoto Protocol to this Convention as one of its specific instruments, it allows countries with emission-reduction or emission-limitation commitments (the so-called Annex B Parties) to implement an emission-reduction project in developing countries.

Emission trading. Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare — that is, emissions permitted them but not "used" — to sell this excess capacity to countries that are about to exceed their targets.

GCC: Gulf Cooperation Council. Its core function is to provide collectively for security against internal and external threats, but it also strives to foster cooperation on the Arabian Peninsula in other areas. Membership includes Saudi Arabia, Kuwait, Qatar, the United Arab Emirates, Bahrain, and Oman.

GDP: Gross Domestic Product.

GHG: Greenhouse Gases. The term refers collectively to all gases in the atmosphere, which affect the reflection of solar radiation and hence surface temperatures, such as water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone, as well as sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (CFs). The most important of those in terms of its impact on climate change is CO_2, which not only accounts for about two-thirds of all GHG released into the atmosphere as a result of human activity, but also persists much longer than most other GHG.

IEA: International Energy Agency. Founded in 1974, the IEA organizes cooperation among its member countries (all of which also belong to the OECD, though not all OECD members are necessarily members of IEA) ".. to ensure reliable, affordable, and clean energy for its 28 member countries and beyond." Its principal concerns are energy security, economic development, environmental awareness, as well as cooperation with nonmember countries.

Joint implementation. As defined in Article 6 of the Kyoto Protocol, joint implementation allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party.

Kyoto Protocol: see UNFCCC.

mcm: million cubic meters (standard measurement for natural gas flows).

million barrels per day (also: mbd): million barrels of oil per day. Standard measurement for (crude) oil flows; one barrel equals 157 liters.

Mt: million tons. For crude oil flows, 49.8 mt/year approximate one million barrels per day of oil.

Mtoe: million tons of oil equivalent (frequently used measurement for energy flows).

OPEC: Organization for Petroleum Exporting Countries. Founded in 1960 to defend developing oil exporting countries interests, particularly in terms of world oil prices. Founding members are Iraq, Iran, Kuwait, Saudi Arabia and Venezuela; Qatar (1961), Libya (1962), the United Arab

Emirates (1967), Algeria (1969), Nigeria (1971), and Angola (2007) joined later. Ecuador joined OPEC in 1973; it suspended membership from 1992 and to 2007; Gabon was a member from 1975 to 1992. Indonesia, which had joined in 1962, suspended its OPEC membership in 2009.

ppm: parts (of GHG) per million. Standard measurement of concentration of GHG in the atmosphere.

UNFCCC: United Nations Framework Convention on Climate Change. Basic legal framework for negotiating national CO_2 emission reduction commitments to contain climate change. Under its Kyoto Protocol, most developed countries pledged specific CO_2 emission (reduction) targets for 2012 (Annex B countries). The Protocol introduced emission trading, the CDM and joint development as new international instruments to combat global warming.

7 Endnotes

[1] Taken together, fuels accounted for about one-seventh (14.8 percent) of total world trade in 2009. As a result of growing demand and rising energy prices, the value of world trade in fuels has been rising strongly since 1995 — on average, by 12 percent per year. This average disguises hugely different annual changes, however. The value of world fuel trade in 2008 increased by 41 percent over 2007, but then fell in 2009 by 37 percent compared to 2008, which points to large swings in internationally traded fuel prices, mostly oil price fluctuations. In 2009, total world fuel trade was worth about $1.8 trillion (World Trade Organisation, *International Trade Statistics 2010*, Geneva: WTO 2010, p. 43).

[2] Own calculations, based on data taken from *BP Statistical Review of World Energy*, various years.

[3] This is most evident in the case of international trade in natural gas, which tends to be conducted through long-term contracts based on prices that are calculated on formulas reflecting the price of oil, in many applications (such as power generation or residential heating) the closest alternative to naturals gas.

[4] IEA, CoaI Information, Paris: IEA 2010 [http://www.iea.org/publications/free_new_Desc.asp?PUBS_ID=10, accessed June 17, 2011].

[5] *BP Statistical Review of World Energy 2011*, p. 18 [http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481, accessed July 1st, 2011]

[6] For example, Saudi Arabia depends on oil revenues for 90 percent of export earnings, 45 percent of GNP, and 80 percent of government revenues. *CIA World Factbook*, Saudi Arabia — Economy [https://www.cia.gov/library/publications/the-world-factbook/geos/sa.html, accessed Jun 18, 2011].

[7] In his fascinating universal history, Ian Morris constructs an indicator for social development which enables him to measure and chart social progress throughout the ages. Average energy transformation per person is one of the four ingredients he uses in this. See Morris, Ian: *Why the West Rules the World — for Now, The Patterns of History, and What They Reveal About the Future*, New York: Farrar, Straus & Giroux 2010, pp. 143ff.

[8] Morris 2011: 599. The rate of increase in GHG concentrations in the atmosphere in fact has been accelerating significantly. Thus, the IPCC Working Group One notes that since 1750, ".:..the absolute growth rate of CO_2 in the atmosphere increased substantially: the first 50 ppm increase above the pre-industrial value was reached in the 1970s after more than 200 years, whereas the second 50 ppm was achieved in about 30 years. In the 10 years from 1995 to 2005, atmospheric CO_2 increased by about 19 ppm; the highest average growth rate recorded for any decade since direct atmospheric CO_2 measurements began in the 1950s." See Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.): *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, 2007, Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA 2007, p. 135 (http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-2-1.html) [accessed April 15, 2011].

[9] Ziesing, Hans-Joachim: Wirtschaftskrise beschert Rückgang der weltweiten CO_2 Emissionen 2010, in *Zeitschrift für Energiewirtschaftliche Tagesfragen*, Vol. 60, Issue 9 (Sept. 2010), pp. 154-165.

[10] Emergency stocks have been released so far only three times: first in the Iranian oil crisis of 1979/80; second in the context of the Gulf crisis and the war to liberate Kuwait from the Iraq annexation in 1992; and most recently in June 2011, in response to a failure of OPEC to increase production to relieve pressures on oil supplies as a result of the Libyan insurrection. In all three instances, IEA actions were importantly informed by concern about rising oil prices. This "surge capacity" under the control of IEA member governments is quite substantial: the United States alone can release stockpiles at a rate of about 4.4 million barrels per day, slightly more than the production of Iran throughout 2010. See Pfeiffer, Sylvia: "West sends clear signal on oil," in *Financial Times*, June 23, 2011.

[11] For example, the Saudi monarchy reacted to the "Arab spring" — the popular revolts in Tunisia and Egypt that toppled the old regimes in the spring of 2011 — with additional social welfare programs totalling $133 billion See Sfakianakis, John: "Saudi king unveils raft of welfare measures," in *Financial Times*, February 23, 2011.

[12] One recent example of this tension was the OPEC meeting in Vienna in June 2011 where Saudi Arabia was outmaneuvered by Iran and thus utterly failed to get

OPEC collectively to increase production so as to contain rising oil prices. See Blair, David: "Oil leaps as OPEC descends into acrimony," in *Financial Times*, June 8, 2011.

[13] Keohane, Robert O./Victor, David G.: "The Regime Complex for Climate Change," in *APSA Perspectives on Politics*, Vol. 9 Issue 1 (March 2011), pp. 7-23

[14] Thus, Russia, Belarus, the Ukraine, and Croatia collectively reduced their emissions in 2009 by over 40 percent (their target was stabilization of emissions at the 1990 level). They represented more than three-quarters of all reductions achieved by Annex I countries and helped them in 2009 to actually meet the target. See Ziesing, op. cit., p. 155.

[15] Victor, David G.: *Global Warming Gridlock, Creating More Effective Strategies for Protecting the Planet*, Cambridge: Cambridge University Press 2011, pp. 203ff. See also Antholis, William/Talbott, Strobe: *Fast Forward, Ethics and Politics in the Age of Global Warming*, Washington, DC: Brookings 2011 (revised edition), pp. 68ff.

[16] See *BP Energy Outlook*, London: BP, January 2011, p. 17 [http://www.bp.com/sectiongenericarticle800.do?categoryId=9037134&contentId=7068677, accessed June 27, 2011]. The projections in the IEA's World Energy Outlook are comparable. See International Energy Agency, *World Energy Outlook (WEO) 2010*, Paris: OECD 2010, pp. 89f.

[17] IEA, *World Energy Outlook 2010*, op- cit., pp. 106f.

[18] IEA, *World Energy Outlook 2010*, Paris: IEA 2010, p. 119. This baseline scenario (called "new policies scenario" by the IEA) is already somewhat optimistic — it assumes significant departures from present trends and policies in place, in line with the "new policies" governments announced (but did not necessarily implement fully) during the course of 2009/2010.

[19] Ibid., p. 94.

[20] There was only one year recently in which emissions declined, namely 2009 (by 1.3 percent). This was very largely due to the world economic crisis.

[21] Ziesing, op.cit., p. 156.

[22] IEA, *World Energy Outlook 2010*, Paris: OECD 2010, p. 384.

[23] Two major recent developments which have the potential to substantially modify the global energy outlook are the uncertainties created by the Fukushima meltdown about the future of nuclear energy and the rapid expansion of shale gas production. Although the latter has its own — local — environmental problems, the overall impact of those changes seems likely to involve a larger role for natural gas. This does not suggest a great improvement from the point of view of climate change, however. While the use of natural gas is somewhat less polluting in terms of CO_2, it is not fundamentally different. Burning natural gas releases about half as much CO_2 into the atmosphere as burning coal, and about 30 percent of CO_2 emissions in the use of oil (generating power with nuclear energy does not produce any GHG emissions). But assumptions about "clean" natural gas in terms of climate change may be misleading; recent research suggests that if the full natural gas production and consumption cycle is analyzed, CO_2 emission may significantly exceed those of other fossil fuels, due mostly to the escape of up to 7.9 percent of methane in the production and transportation of natural gas before it is burned. Methane, the main component of natural gas, which in fact is many times as active as CO_2 in producing global warming, See Tom Zeller, Poking Holes in a Green Image, in *New York Times*, April 12, 2011, B1,6.

[24] This is an important aspect of violence in Sudan's Darfur province, for example; Jeffrey Mazo has called it the first modern climate-change conflict. See Mazo, Jeffrey, *Climate Conflict: How Global Warming Threatens Security and What to Do About It*, London: Taylor & Francis for IISS 2009, pp.73-86 (= IISS Adelphi Paper 409, September 2009).

[25] See Victor, op. cit., pp. 165ff; "The science of climate change," in World Bank, *World Development Report 2010: Development and Climate Change*, Washington, DC: World Bank 2009, pp. 70-84.

[26] See, for example, Department of Defense, *Quadrennial Defense Review 2010*, Washington, DC: Department of Defense, pp. IV, 86f. The CIA in September 2009 opened a Center on Climate Change and National Security.

[27] This position rests on the notion that all human beings fundamentally have equal rights and obligations; each

individual therefore should also be entitled in principle to the same emission levels. For the debate about this normative position see Posner, Eric A./Weisbach, David: *Climate Change Justice*, Princeton: Princeton University Press 2010, Ch. 6.

[28] Ibid., p. 283.

[29] IEA, *World Energy Outlook 2010*, pp. 201ff.

[30] Ibid., p. 232f.

[31] *BP Statistical Review of World Energy 2011*, op. cit.

[32] IEA, *World Energy Outlook 2010*, op. cit., p. 98.

[33] See World Resources Institute: "China's Energy and Climate Initiatives: Successes, Challenges, and Implications for U.S. Policies," April 11, 2011 [available at: http://www.chinafaqs.org/blog-posts/chinas-energy-and-climate-initiatives-successes-challenges-and-implications-us-policies, accessed July 21, 2011].

[34] Herberg, Mikkal: "Fuelling the Dragon: China's Energy Prospects and International Implications," in Wenger, Andreas/Orttung, Robert/Perovic, Jeronim (eds): *Energy and the Transformation of International Relations. Toward a New Producer-Consumer Framework*, Oxford: Oxford University Press 2009, pp. 269-297 (271).

[35] China's participation in escort and anti-piracy operations in the Gulf of Aden and Arabian Sea off the coast of Somalia therefore must also be seen as an exercise in gathering practical experience in such operations. See Weitz, Richard: "Priorities and Challenges in China's Naval Deployment in the Horn of Africa," in The Jamestown Foundation, *China Brief*, Vol. Issue 24 (December 2009).

[36] Hook, Leslie: "Asia moves to shore up is strategic oil reserves," in *Financial Times*, March 3, 2011; China National Energy Board and the International Energy Agency Joint Statement, Oct. 14, 2009, available at: http://www.enecho.meti.go.jp/topics/091021a/8.pdf [accessed July 21, 2011]. The first such meeting took place in 2006 (see http://www.iea.org/work/workshopdetail.asp?WS_ID=280).

[37] Source: Ziesing 2010, op. cit., Table 1, p. 155.

[38] IEA, *World Energy Outlook 2010*, op. Cit., p. 99.

[39] Herberg, op. cit., p. 293.

[40] Thus, every year the lives of 200 to 400 million Chinese people are already affected by extreme weather events; food production in China is estimated to decline by 5 to 10 percent in 2020 as a result of global warming in China. See Dittrich, Andreas: "Climate Policy in the People's Republic of China — Groundwork for Sustainable Growth?" *KAS International Reports* No. 4/2011, pp.77ff, available at: http://www.kas.de/wf/en/35.333/ [accessed July 21, 2011] and Podesta, John/Ogden, Peter: "The Security Implications of Climate Change," in *The Washington Quarterly*, Vol.31 Issue 1 (Winter 2007/8), pp. 115-138 (127).

[41] See the presentation by Levine, Mark: "Will China Overwhelm the World with its Greenhouse Gas Emissions?" at the World Resources Institute Briefing on China's Energy and Climate Initiatives: Successes, Challenges, and Implications for U.S. Policies, April 5, 2011, available at: http://www.chinafaqs.org/files/chinainfo/levine_eesi_4-5-11.pdf [accessed July 21,2011].

[42] See Wacker, Gudrun: "Caught in the Middle: China's Crucial but Ambivalent Role in the International Climate Negotiations," in Dröge, Susanne (ed): *International Climate Policy, Priorities of Key Negotiating Partners*, Berlin SWP 2010, (SWP Research Paper), pp.54-66 (available at http://www.swp-berlin.org/fileadmin/contents/products/research_papers/2010_RP02_dge_ks.pdf [accessed July 21, 2011]).

[43] See Deudney, Daniel/Goldgeier, James/Kern, Steffen/Kim, Soo Yeon/Maull, Hanns W./Rehman, Iskander: *Global Shift, How the West Should Respond to the Rise of China*, Washington, DC: Transatlantic Academy 2011, p.41.

[44] This assumption also was made in the context of the American Clean Energy and Security Act, which was passed by the U.S. House of Representatives in 2010, but failed to secure the necessary majority in the U.S. Senate. In this Act, the price of carbon was to increase over time, as permitted levels of emission were reduced. The effect would have been very similar to what is proposed here. According to the Congressional Budget Office, the cost of the program over a decade would have been approximately $175 per average household/year. See Antholis, William/Talbott, Strobe: *Fast Forward, Ethics*

and Politics in the Age of Global Warming, Washington, DC: Brookings 2011 (revised edition), pp. 47ff.

[45] In its discussion of the economics of climate change, the World Development Report 2010 points out that efforts to mitigate global warming are affordable (with total costs to 2100 estimated by various sources at between 0.3 and 0.7 percent of global GDP) and warranted not only from the perspective of cost-benefit analysis, but also as insurance against potentially catastrophic risks. See *World Development Report 2010*, op. cit., pp. 7ff.

[46] For example, a very modest carbon tax of $5/metric ton of carbon, which would add $0.044 to a gallon of gasoline, would raise some $30 billion annually in the United States, according to calculations by Galliana/ Green (cited in Pielke, Jr., Roger: *The Climate Fix, What Scientists and Politicians Won't Tell You About Global Warming*, New York: Basic Books 2010, p. 228).

[47] See Victor, op. cit., Ch. 5.

[48] The relevance of energy costs to the overall international competitiveness of export industries may actually be quite small, if not negligible. There are now already significant differences in energy costs, within the transatlantic community and beyond, but this does not seem to be significant factor in the overall export performance of countries. See OECD: "Addressing International Competitiveness in a World of Nonuniform Carbon Pricing: Lessons from a Decade of OECD Analysis," Paris: OECD 2010, available at: http://www.oecd.org/dataoecd/34/60/46533174.pdf [accessed July 22, 2011].

[49] See Victor, op. cit., Ch. 8 and Anthelis, William/ Talbott, Strobe: *Fast Forward, Ethics and Politics in the Age of Global Warming*, Washington, DC: Brookings 2011 (revised edition), pp. 91ff — both explicitly suggest GATT as model.

[50] This surplus profit (or "rent") represents the difference between total production and distribution costs including average profit levels, and the actual price realised by selling the fuel to the consumer.

[51] This survey on global warming was conducted in 2010 in 16 countries, among them several poor developing countries. In 15 out of 16 countries, strong majorities felt that if their government went ahead to take more forceful measures against climate change, others would follow that lead. See World Development Report 2010, "Public attitudes toward climate change: findings from a multi-country poll," Washington, DC: The World Bank 2010, p. 15 (available at: http://siteresources.worldbank.org/INTWDR2010/Resources/CC_Poll_Report_July_01_2010.pdf [accessed July 22, 2011].

[52] Pielke, op.cit., p. 42.

[53] *World Development Report 2010* (Public Attitudes), op. cit., pp. 8-10. Countries polled were the United States, France, and Japan (high income countries); Brazil, Mexico, Russia, Turkey (upper-middle income countries); China, India, Indonesia, Iran, Egypt (lower-middle income countries); and Bangladesh, Kenya, Senegal, and Vietnam (low-income countries).

[54] Ibid., pp. 18-20.

[55] Brown, Seyom: *Higher Realism, A New Foreign Policy for the United States*, Dallas: Paradigm Publishers 2009, p. 176f.

[56] This can be achieved relatively easily by appropriate measures such as enhanced emergency reserves and a flexible pipeline infrastructure. See Noël, Pierre: "Beyond Dependence: How to Deal with Russian Gas," London: European Council on Foreign Relations 2008, available at http://ecfr.eu/page/-/documents/Russia-gas-policy-brief.pdf [accessed July 22, 2011).

[57] See *World Development Report 2010* op. cit., pp. 4ff.

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