The Influence of Climate Change Considerations on Energy Policy: The Case of Russia

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Summary

To those working on climate change it is obvious that energy policy should be influenced by climate change considerations. The question that this paper seeks to answer is, to what extent do they influence policy and what contribution can a careful analysis of the costs and benefits of climate change options have on the formulation of that policy. We seek to understand this by looking in some detail at energy policy formulation in Russia. To do so it is necessary to look at the whole set of issues that determine energy policy. These include energy security, macroeconomic and uncertainty factors, local environmental issues and social issues.

The analysis has been carried out for a specific case – that of the RF, where energy policy is currently under formulation to 2010. Two options have been looked at: a "High Coal" option, where there would be a substantial change in fuel mix away from gas to coal; and a "High Gas" option where the current fuel mix is retained and the increase in demand is met from all sources in proportion to current use. The analysis shows that, at international prices for fuels, the "High Coal" option is attractive. However, when we include the potential decline of price for natural gas in the European market, the relative preference for this option drops dramatically but it still remains the preferred option. When, account is also taken of the carbon benefits of the High Gas option, using plausible values for carbon, the attraction of the High Coal option is further reduced but not altered. When finally account is taken of the health associated with the lower use of coal in the High Gas option, the preference can be reversed but it requires a critical value for the health benefits. This critical value – at around $3,000 for a life year lost -- is plausible for the RF, if anything the actual value is probably higher.

What the analysis shows is the need for a careful evaluation of the different factors determining energy policy. Among these is climate change. It is not the critical factor but it can be an important one. Perhaps more important are the environmental benefits that go with the lower carbon High Gas options.

Keywords: Climate policy, Russia, Ancillary benefits

JEL: H41, Q28, Q32, D62, J60

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1. Introduction

To those working on climate change it is obvious that energy policy should be influenced by climate change considerations. The question that this paper seeks to answer is, to what extent do they influence policy and what contribution can a careful analysis of the costs and benefits of climate change options have on the formulation of that policy? Governments who have ratified the Kyoto Protocol (or are in the process of doing so) recognize, in one form or another, their commitment to reduce greenhouse gas (GHG) emissions, and the use of fossil fuels for energy generation is the principal source of these emissions. Countries in Annex B of the Protocol (broadly speaking the industrialized countries of the world), have a quantified obligation to reduce emissions relative to 1990 levels by the first commitment period (2008-2012). A number of instruments are being developed to make the meeting of these targets as inexpensive as possible. These include emissions trading, carbon taxes and other economic or flexible instruments. For a discussion of these and the issues arising in their implementation see IPCC, 2001, Chapters 6-7.

Broadly speaking, national energy policy is formulated by making a prediction of energy demand and then looking at the least cost sources by which this demand can be met. Even without climate change, the analysis is complicated by a number of factors:

- Governments are concerned about energy security and may be willing to sacrifice some of the advantages in terms of cost not to be too dependent on unreliable, foreign sources;
- The costs of future delivery of different types of energy is uncertain, but commitments have to be made now in the form of investments in energy supply and conversion (e.g. oil and gas pipelines);
- Energy generation can have significant non-climate change related environmental effects and the pressure to take account of these is increasing.
- Governments are under pressure to use domestic resources even when they are not economic, because not using them would imply higher unemployment and social unrest.

On top of this the issue of climate change is now be overlaid. What impact is it having in practice? We seek to understand this by looking in some detail at energy policy formulation in Russia. Section 2 examines the National Energy Strategy and the options being considered. Section 3 looks at the information available on the different factors that should determine the choice – potential economic gains versus environmental, social and other costs. Section 4 brings together the different impacts to see what can be said about the choice of policy. Section 5 concludes with the lessons learnt from this case study for the formulation of energy policy.

2. Energy Options in the Russian Federation

In the Russian Federation (RF) there are a number of energy scenarios being considered. They start by estimating overall and sectoral growth in GDP and by estimating the expected change in energy intensity (i.e. amount of energy needed per unit of GDP by value). For the RF, two cases have been examined: a ‘low growth’ case, where annual GDP growth is only 3.7 percent to 2005 and 1.7 percent from 2005 to 2010; and a ‘high’ growth’ case where annual GDP increases are 6.2 percent to 2005 and 5.7 percent from 2005 to 2010. In the ‘low growth’ case economy is in stagnation; there is no technological change. In the ‘high growth’ we assume development of infrastructure, high investment level, sustainable use of natural resources, technological changes based on increased R&D. Corresponding to the low growth case, energy efficiency is assumed to increase by 13-15 percent over the decade to 2010 whereas in the high growth case the increase is assumed to be 40-45 percent

Following from the energy scenarios are sub-scenarios for electricity generation, which accounts for roughly 30 percent of total national energy consumption. To keep the analysis simple, these are presented below for only the high growth national energy scenario. Corresponding to that case, the choices can be reduced to two sub-scenarios. The first is one where the fuel mix remains more or less as it was in 2000, which implies a 25 percent increase in energy consumption overall, with corresponding increases in coal, oil and gas[2]. The second is based on a policy decision to increase gas exports and thereby meet more domestic demand for energy from coal. In both cases increases in overall energy demand are almost the same amount, but in the second the share of coal goes up from 31 percent to 46 percent and that of gas declines from 61 percent to 47 percent. In making a choice between these two, the government will be making a conscious policy decision – more gas exports and more coal at home, or more gas at home and fewer exports. The data are given in Table 1[3].

The choice between these two options depends, as noted above on a number of factors. Table 2 summarizes these. They include:

- Direct Generation Costs
- Macroeconomic Costs and social impacts
- Energy Security
- Price and Other Uncertainty
- Environmental Impacts

[2] Our estimates of capacity of electric power plants in 2010 are calculated using old capital depreciation rates taken from the report «Towards improved fuel management in electric power sector», which makes projections till the year 2015. This report was prepared by the expert group commissioned by RAO EES Russia (JSC Unified Energy Systems of Russia) in 2000. The underlying assumption in both sub-scenarios is that by the year 2010 Russian thermal power plants will reverse the declines in efficiency and achieve characteristics typical in the early 1990s – i.e. before Perestroika.

[3] Table 1 only gives data on fossil fuel use. In addition, electricity is also generated from hydro and nuclear sources, which account for around 30 percent of total electric energy in 2010. This share is unchanged when comparing the ‘coal’ versus ‘gas’ options. A ton of coal equivalent is also referred to as a ton of standard fuel.

- Climate Change Impacts

We consider each of these below.

Table 1: Actual and Projected Shares of Fossil Fuel Use in Russia

	Amounts (Mn. Tons Coal Equivalent)				Shares			
	COAL	OIL	GAS	TOTAL	COAL	OIL	GAS	TOTAL
Actual for 2000 Actual	80.1	19.9	163.6	263.6	30.4%	7.5%	62.1%	100.0%
Forecast for 2010 High Coal/Gas Export Option	154.0	22.4	156.8	333.2	46.2%	6.7%	47.1%	100.0%
Current Fuel Mix/High Gas Option	103.8	25.5	201.1	330.4	31.4%	7.7%	60.9%	100.0%

Source: *Economic Growth, Fuel Mix And Air Quality In Russia, Alexander Golub, Daniel Dudek, Bert Droste-Franke, Michael Ksenofontov, Elena Strukova, Rainer Friedrich, Anil Markandya, Environmental defense, 2002, p.7-8; Authors calculations*

Table 2: Factors Determining the Choice Between the 'Coal' and 'Gas' Options

Issue	**High Coal/Gas Export Option**	**Current Fuel Mix/ High Gas Option**	**Quantitative Analysis**
Direct Generation Costs[1]	Costs are lower as coal is cheaper in energy equivalent terms	Opportunity cost of domestic use is export price, which is higher	Full analysis possible but data limited
Macroeconomic Impacts	Greater earnings of foreign exchange from natural gas export, but risk of price decline at the European market	Less foreign exchange, but natural gas rice at the European market may go up as a result of Kyoto protocol implementation	Full analysis possible, but price shift is uncertain
Energy Security	In both options dependence on external sources, and therefore energy security, is not an issue		Not possible
Uncertainty of Future Prices	Uncertainty of price is present in both options.		Possible but complex
Environmental Impacts	High negative impacts have been associated with coal use	Lower impacts with higher gas use	Limited analysis possible
Climate Change Impacts	Higher emissions of CO_2	Lower emissions of CO_2	Full analysis possible but price of carbon is uncertain

3. Assessment of the Russian Energy Strategy By Different Criteria

3.1 Direct Generation Costs.

The Russian power system was designed with considerable for operation on coal, oil or gas, so neither option entails any significant investment in boilers. There will, however, be differences between the two in terms of complementary investments and these have not been estimated. To that extent the comparison presented in this paper is incomplete. However, most power plants use mostly natural gas at present. Although they have old equipment for coal combustion, it has to be renovated. Also, transportation costs are much more significant for coal. To this respect transfer to coal from natural gas is rather costly for the energy industry. It is difficult to present even rough estimations now.

As for the direct fuel costs, we can take the projected prices for coal and gas in 2010, from which we can compare the difference in direct costs. The comparisons are given in Table 3, which shows that it makes a big difference, which prices are taken – domestic or international. With the estimated international prices, the high gas option is more costly by about $2 billion in 2010. With domestic prices --, however, the two options have very similar costs – in fact the high gas option is about $140 million less expensive.

From an economic perspective, the comparison should be made at world prices but as far as domestic decisions on fuel mix are concerned, they will be driven by domestic prices, as that is what the generators will have to pay for the fuels. Hence governments will have to use taxes and other economic instruments to ensure that domestic prices determine the socially optimal selection. We return to this issue in Section 4.

Table 3: Direct Cost Comparisons Between Two Options[4]

	High Coal/Gas Export Option				Current Fuel Mix/High Gas Option				
	COAL	OIL	GAS	TOTAL	COAL	OIL	GAS	TOTAL	Difference
Fuel Costs at International Prices									
Prices in 2010. $/t.c.e.	46.4	115.4	93.0	-	46.4	115.4	93.0	-	
Total Fuel Costs $Mn.	7,146	2,585	14,580	24,310	4,816	2,942	18,699	26,457	2,148
Fuel Costs at Domestic Prices									
Prices in 2010. $/t.c.e.	46.4	59.4	45.2	-	46.4	59.4	45.2	-	
Total Fuel Costs $Mn.	7,146	1,331	7,084	15,561	4,816	1,516	9,085	15,417	-144
Quantities in 2010 Mn. t.c.e.	154.0	22.4	156.8	333.2	103.8	25.5	201.1	330.4	

Source: Price Forecasts are From Russian Energy Strategy (2000).

Having in mind renovation costs for coal combustion equipment and coal transportation costs one could conclude that High Coal scenario would induce higher direct generation costs.

3.2 Macroeconomic costs and social considerations

The macroeconomic dimension here is essentially the issue of foreign exchange earnings. With the gas export option more foreign exchange is earned, which is generally seen as a

[4] The following conversion factors have been used in reporting prices in tons of coal equivalent or ton of standard fuel equivalent (t.c.e) which is the same. One ton of oil is equal to 1.43 t.c.e. and one 1,000 cubic meters of gas are equal to 1.14 t.c.e. One t.c.e. is equal to 1.45 tons of Russian steam coal. These figures are averages for the country and clearly must be seen as approximate. As far as prices are concerned, there are regional variations. We have taken the average domestic prices of European Russia and Siberia.

desirable feature. From the data in Table 3 we can see that the RF would export about 44.3 million t.c.e a year more in the gas export option. At the international price of gas, this would earn about $4.1 billion a year, which represent 4.0 % of total export earnings in 2001[5]. For a country such as Russia, which is running a trade surplus and which faces, to some extent, the macroeconomic problems of an overvalued exchange rate associated with a natural resource based economy, this increase has to be seen as a mixed blessing (see, e.g. Auty, 2001 for a discussion of the 'resource curse'). Certainly there is no *a priori* reason to believe that increased foreign earnings are, at the margin, a desirable phenomenon for the country.

There is also the issue of what impact, if any, the high gas export option will have on gas prices themselves. An increase in exports of 44.3 t.c.e is equal to about 39 billion cubic meters of gas. At present gas consumption in the Western Europe (EU plus Norway and Switzerland) is in the region of 425 billion cubic meters per annum. Hence if the entire export increase went to that region it would represent an increase in gas supply of around 10 percent. This would lower the price of gas, by an amount depending on the demand elasticity but likely to be 3-4 percent. Russian export of natural gas to the European market is about 240 million t.c.e. So Russia may lose nearly $1 billion as result of the price decline following an increase of export to the European market. This is more than 40% of expected benefits from increase of export of natural gas. While not a major consideration it is a factor, which reduces the benefits of an export strategy.

The principal social impacts of the energy options are through prices and employment. In the RF case price effects are not likely to be large, especially if domestic prices of fuels prevail, as in that case the two options have very similar fuel costs. There is, however, a difference in the employment impacts. A high coal option would allow more jobs to be retained in the coal mines, which are often located in economically depressed areas of the country. Unfortunately no estimates have been made of the additional employment benefits, in number of jobs or in the value of a job. Moreover it is not clear that high demand for coal would stay over a long period of time. Then the temporarily increased employment in coal mining could end up by jobs cuts in the future following by all possible negative and political consequences. Finally, it is not so obvious that increase of the share of coal in Russian energy balance would necessarily lead to increase of demand for Russian domestic coal. Note that in the high coal scenario coal consumption would go up nearly 4 times in European part of Russia. Due to transportation costs Russian producers of coal would face the competition with European producers. Demand for coal in Europe would go down under the pressure of Kyoto treaty, and as a result of increase of share of natural gas in European energy balance. Some studies suggest that import of coal from Europe could be economically feasible (See Danilov-Danilian, 2003). Therefore Russia may face reduction of domestic coal production and corresponding losses of jobs in mining sector. Thus social impact of fuel mix change to higher coal could be negative. Hence, in the present time, this analysis has to be conducted without the benefit of required information.

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[5] See http://www.wto.org/english/res_e/statis_e/its2002_e/its02_byregion_e.htm, International trade statistics, 2002, trade by region.

3.3 Energy Security

Energy security is an important concern in most countries, but in the RF it is a minor issue. The country is more than self-sufficient in energy and does not need to worry about reliability of supply from abroad. There may be a concern about disruption of exports, for example if a terrorist act results in a gas pipeline being damaged. The higher the level of exports the greater the damages from such action, although the level of expenditure on protecting the supply system will not be much different in the two options. Thus, while there is a security dimension to energy policy, it does not significantly influence the choice of the energy options.

3.4 Uncertainty

The prices reported in Table 3 are, of course, only estimates, with large uncertainties around them. What happens if international prices are significantly lower, or higher? Since uncertainty about prices is probably greatest for oil, followed by gas, and is lowest for coal, the high coal option will have the lower variance in the cost of energy[6], making it the more attractive from this perspective.

3.5 Environmental Impacts

The burning of all fossil fuels results in emissions that have significant environmental impacts. Moreover, since coal is the most polluting of the three fossil fuels being considered here, the high coal option will have the greater environmental cost. This cost has been analyzed in some detail in a study undertaken by a joint German-Russian research project, using the ECOSENSE model, which is an integrated software tool designed to estimate human health and other impacts of air pollution. It was developed by experts involved in the ExternE project and Green Accounting project series (EC 1996, EC 1999a, EC 1999b, EC 2000). It has been used within numerous national and international studies. Ecosense simulates air dispersion of pollutants and calculates exposures and impacts for the whole model region on the basis of an emission database. The model region for EcoSense Russia is situated, expressed in geographical degrees, between 13° East/161.5° East and 28° North/82° North.

The impact pathway methodology followed when using the EcoSense model for the estimation of physical impacts includes the following steps:

- Emission of pollutants;
- Atmospheric transport over regions / Chemical transformations and dry and wet deposition processes.

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[6] There is also uncertainty about future development in renewable technology and the prices of renewables, but over a ten year time period this is not likely to play a major part. Timing of entering Kyoto Protocol into force and results of negotiations about the second commitment period (2013-2017) also add to uncertainly. Earlier entering of Kyoto Protocol into force and tougher emission targets for the second commitment period could increase demand for natural gas dramatically. At the same time, dumping on AAUs market could reduce this price.

- Assessment of physical impacts like human health effects using exposure response models, which link the pollution concentration to end point such as higher mortality.

In general terms, Ecosense translates emissions of NO_2, SO_2, NH_3 into ground level concentrations, using standard meteorological air dispersion models. Complex chemical reactions are taken into account. These reactions produce among other substances fine particles of sulfur and nitrogen compounds, PM_{10} and $PM_{2.5}$ (see the description of the air quality model below).

For the RF, the first task was to estimate the excess emissions associated with the high coal option versus the high gas option. This required construction of an emissions inventory for each option, which reported the annual emissions of the key pollutants (SO_2, NO_x, and particulate matter (PM))[7] by geographical location.[8] The second task was to model the dispersion of the pollutants across the RF, using the Windrose Trajectory Model (WTM) (see European Commission, 1999, p, 68-69). The third task was to establish an inventory of the population at risk. Since most of the damages from air pollution are found to be to human health, only a human population inventory was established, which extended outside the RF, as some of the pollution is dispersed outside the territory. Finally, the impacts of the increased concentrations on the human population were estimated based on exposure response functions that have been internationally established. The results of the analysis are presented in Table 4. It reports the impacts in 2010 of the higher use of coal in 2010: an extra 118,000 life years lost in the RF and 9,000 outside the RF from premature mortality; an extra 9,000 cases of adult bronchitis inside the country and 1,000 cases outside the country; and an extra 191,000 cases of child bronchitis inside the country and 24,000 outside the country. These are only some of the possible health impacts of the burning of fossil fuels. To keep the analysis simple, and to retain the highest credibility, we only used those exposure response functions for which there was the maximum agreement. Greater details are available in Golub et al, (2002).

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7 Two alternative techniques were used to calculate unit emission factors. One was based on the results of simulations using the model which was initially developed by the World Bank and later modified by Evsei Gurvich (See Gurvich et al, 1997) for the Institute of Economic Forecasts for using in Russia. There are two parts to the model: (i) model of economic development, including description of capital turnover, and (ii) air pollution estimates, including SO_2, NO_X, TSP, and CO_2. Another way to calculate unit emission factors was the technique adopted by Intergovernmental Panel for Climate Change (IPCC). Both methods produced fairly comparable results. For example, the difference in SO_2 emission factors was only 2%, and for NO_X this difference was 20%. We should also note that the emissions of fine particulate matter (PM_{10}) needed for EcoSense were derived from 1998's emissions of total suspended particles (TSP) of stationary and road transport sources on oblast level and the information about emission shares of economic source sectors for the whole of Russia. For the calculation of PM_{10} emissions it was assumed that they represent 60% of the TSP emissions. The Russian team provided the factor.

8 We assumed that there is no increase of abatement activity since conversion to coal is happening on old facilities. No installation of new equipment for coal combustion was assumed there.

Table 4: Additional mortality and morbidity due to fuel-mix change in Russia in 2010

	Morbidity of children	Morbidity of adults	Mortality
Regions	Cases chronic cough/year	Cases chronic bronchitis/year	Life Years Lost
Northern	2,967	128	1,811
North-Western	7,313	318	4,515
Central	85,133	3,697	52,604
Central-Chernozemny	9,815	424	5,998
Povolzhsky	15,880	683	9,668
Volgo-Vyatsky	13,155	891	8,541
Urals	22,400	969	13,727
Northern - Caucuses	16,814	727	10,301
Western-Siberian	9,601	415	5,882
Eastern-Siberian	7,419	320	4,565
Far-Eastern	496	21	305
Kaliningradskaya Oblast	84	4	51
Total	191,078	8,595	117,968
Outside Russia	23,662	1,014	9,084

These impacts are significant, and in the EU application of the model they were translated into money terms using unit values for a case of bronchitis, a loss of a life year etc. In the case of the RF we have not done that, as the supporting studies for the valuation of the end points are not available. Instead, in Section 4 we look at what critical value would have to be placed on the health effects, *per life year lost and per case of bronchitis*, for the decision of the choice of energy option to be changed from a high coal to a high gas option. Policy makers can then see if this value is reasonable or not, and in doing so they can compare it to values obtained in other countries.

3.6 Climate Change Impacts

There is a difference between the two scenarios of emissions of carbon dioxide. Estimates of this are relatively easy, as we know the carbon content of the different fuels. They reveal that, in 2010 the high coal option generates approximately an extra 60 million tons of CO_2. By that time, there will be a value to these emissions, either because they can be traded directly, or because there is an implicit cost to them through carbon taxes or other instruments that will place a value on the emissions. It is difficult to estimate what this 'price' will be, but the range that is being discussed is in the range of

$8-12 per ton of CO_2[9]. We take a mean value of $10 in the next section and look at the sensitivity of the results to that value.

To sum up, we have looked at six factors that impinge on the decision of which energy option to pursue. In some cases a money value can and has been placed on the factor. In others a money value is possible but has not been placed owing to a lack of data. And in some others no value can reasonably and credibly be placed. In the next section we look at how to bring these factors together for a policy maker.

4. Using Information on Different Criteria to Make an Energy Policy Decision.

The information provided so far is summarized in Table 5, which reports the data for the different criteria. We begin by considering the case where fuels are valued at international prices. In this case we can conclude the following:

(i) On a direct cost basis the High Coal option is preferred, with an annual cost advantage of $2.1 billion (Note, this figure was calculated assuming zero cost of fuel mix change; thus the benefits are overestimated and actual cost advantage will be lower than $2.1 billion);

(ii) As we pointed out above, a large increase in Russian exports may lead to decline of price for natural gas at the European market. As we calculated above Russia would lose about $ 1.2 billion due to this decline.

(iii) When climate change impacts are included with a value of a ton of CO_2 of $10/ton, the cost advantage in favor of the High Coal option is reduced to 1.5 billion. However if the price of carbon dioxide would rise up to $35.8/ton, it will be for the advantage to switch to the High Gas option. $35 is break-even price for selection between high coal and high gas scenario. According to the newest design of the EU GHG emission trading regime direct access of Russian and Ukrainian GHG allowances on EU market is prohibited. As a result Russia may not be able to enjoy the allowances prices at the EU market, which will be at least twice higher than break-even price. If Russia reaches the compromise with EU on accessibility of the EU carbon market finds a loophole to this bureaucratic barrier, then benefits from increase of coal consumption will be even more questionable.

(iv) The health impacts favor the High Gas option but we do not have a direct unit value for the physical impacts to make a comparison in money terms. To get round this, we estimate the value of each life year necessary to make reverse the preference – from High Coal to High Gas, **even without**

[9] Predictions are from International Energy Agency. Current market prices are volatile and depend on quality of certificates – $0.6 to $3 per ton CO_2 for verified emissions reduction; $4-12 per ton of CO_2 for permits approved by the buyer country. Rich Rosenweig, a carbon specialist with Natsource, stated in October 2002 that prices for carbon trading in the open market had been as high as $16 per ton in recent weeks. As soon as Russia ratify Kyoto Protokol and this treaty enter into force prices may go up.

any other impacts (decline in the price of gas, climate change, etc.). That value turns out to be $3,000. Any higher value of VLYL would lead to the conclusion that a higher share of the natural gas use in the RF is preferable. In detailed studies for the EU, a value of a life year has been taken as €96,000 in the case of a chronic mortality impact and €165,700 in the case of acute mortality impact. Thus at the very most this critical value is around 2 percent of the EU average value.[10] As a comparator, Russia's *per capita* GDP, at $1720 in 2000, was about 9 percent of that of the EU ($18,500). Since then the gap has narrowed slightly. If we apply the benefit transfer method using the European estimate of VLYL we get a value of about $12,000 for the RF, which is much more, than the break-even point. ($3,000 per LYL). Furthermore, we should increase VLYL values in line increases in real per capita GDP expected in the RF to 2010 (approximately 5 per annum). Doing this results in VLYL value in 2010 of nearly $20,000. The total damage in 2010 from mortality alone is then more than $ 2.3 billion, which clearly turns the tables in favor of the High Gas option.

(v) Benefits from the selection of high gas option would be even higher if we add avoided morbidity damage. According to (Bobylev at al, 2003) the cost of illnesses was $ 600 per case in the year 2000. For the year 2010 then it should be $1,000 per case, based on the above GDP growth . The total annual damage from morbidity risk will be $240 million.

The other factors are not quantified.

Thus a very low economic estimate of damage to human health, as little as $3000 for one life year lost, brings the economic benefits of high coal scenario down to zero. Higher estimates offered above of $20,000 for a VLYL would bring the damage from conversion to coal up to $2.2 billion[12].

Next we consider the case where fuels are valued at domestic prices. In that event the High Gas option is preferred purely on cost grounds and the climate change impact makes it even more favored and it does not need any health benefits for the government to choose the High Gas option. Indeed we can say that in this case the non-quantified criteria favoring the High Coal option would have to be valued at least $740 million a year for it to be the chosen one.

[10] In Table 4 we report health impacts in terms of life years lost, chronic cough in children and chronic bronchitis in adults. The relative values of these impacts in the EC studies gave chronic cough as 0.2 percent and chronic bronchitis as 175 percent of the cost of a chronic mortality life year lost. In deriving the critical value of a chronic life year in the RF we have retained these proportions. Note also that we have not valued health impacts outside the RF. This may be appropriate for the government of Russia but is not, of course globally optimal.

[12] Note, this estimate is still much lower than one presented in Bobylev at al, 2003.

5. Conclusions

This paper has looked at how climate change policy can influence energy policy. To do so it was necessary to examine the whole set of issues that determine energy policy. These include energy security, macroeconomic and uncertainty factors, local environmental issues and social issues.

The analysis has been carried out for a specific case – that of the Russian Federation (RF), where energy policy is currently under formulation to 2010. Two options have been examined: a "High Coal" option, where there would be a substantial change in fuel mix away from gas to coal, with the surplus gas being exported; and a "High Gas" option where the current fuel mix is retained and the increase in demand is met from all sources in proportion to current use. The analysis shows that, at international prices for fuels, the "High Coal" option is attractive. However, when we include the potential decline of price for natural gas in the European market, the relative preference for this option drops dramatically but it still remains the preferred option. When, account is also taken of the carbon benefits of the High Gas option, using plausible values for carbon, the attraction of the High Coal option is further reduced but not altered. When finally account is taken of the health benefits associated with the lower use of coal in the High Gas option, the preference can be reversed but it requires a critical value for the health benefits. This critical value – at around $3,000 for a life year lost -- is plausible for the RF, if anything the actual value is probably higher.

The final number of avoided losses and damages is calculated is $2.2 billion, if Russia stays with the low coal fuel mix option. However, we cannot guarantee that Russian decision makers would be capable to make the choice in favor of the High Gas Option. During the last few years the share of coal in Russian energy balance slightly increased. Why? The decision-making process still is very far from one which responds to price signals in the market economy. Decision-makers are looking for immediate direct benefits and are ignoring potential costs, which are external are would be paid in future.

What the analysis shows is the need for a careful evaluation of the different factors determining energy policy. Among these is climate change. It is not the critical factor but it can be an important one. Perhaps more important are the environmental benefits that go with the lower carbon High Gas options.

Table 5: Comparison Between High Coal and High Gas Options

	High Coal/ Gas Export	Current Fuel Mix/ High Gas	Difference: High Coal - High Gas
Criteria with Money Values: International Prices of Fuels			
Direct Cost: International Prices ($Mn.)	24,310	26,457	2,148
Carbon Value at $10/ton of CO2 ($Mn.)			-600
Losses from decline of gas prices			-1200
total			348
Critical Value of LYL for High Gas to be Preferred			
2,970			
Economic value of mortality risk			2300
Economic value of morbidity risk			240
Tonal economic value of health risk			2540
Grand total for high coal scenario			-2192
Criteria Without Money Values			
Energy Security			No Preference
Uncertainty of Future Prices			High Coal Preferred
Social Impacts			No preferences
Criteria with Money Values: Domestic Prices of Fuels			
Direct Cost: International Prices ($Mn.)	15,561	15,417	-144
Carbon Value at $10/ton of CO2 ($Mn.)			-600
Net Value			-744
Critical Value of LYL for High Gas to be Preferred			
0			
Criteria Without Money Values			
Macroeconomic Impact			No Preference
Energy Security			No Preference
Uncertainty of Future Prices			High Coal Preferred
Social Impacts			No preferences

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(liii) This paper was circulated at the International Conference on “Climate Policy – Do We Need a New Approach?”, jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001
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