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FORMERLY NORTHWEST ENVIRONMENT WATCH

Sightline Institute's comments on the ENERGY 2020 Assumptions Book for WCI's economic analysis project

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To:	WCI partners; ICF Consulting; interested parties
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WCI has rightly chosen to undertake an economic analysis of the policy options it faces in controlling carbon emissions within its region. There are many routes to reaching any given emissions goal, and all WCI stakeholders stand to benefit if the choices we make are those that minimize economic costs. As the centerpiece of its economic analysis project, however, WCI has enlisted a proprietary model, ENERGY 2020, that provides insufficient transparency in its core assumptions. We do not know the modeling strategies that will underlie its results, nor how they compare to the approaches taken by other models used for similar purposes.

In this brief report, Sightline Institute will highlight specific modeling issues likely to have a substantial impact on the results generated by ENERGY 2020. Our goal in doing this is to bring about greater transparency, so that stakeholders can properly interpret the output generated by the model.

While there are many questions that need to be explored in assessing an analytical tool like ENERGY 2020, we would especially like to call attention to these five:

1. Does the model assume, directly or indirectly, that the current pattern of supplier and end user choices is economically rational? If not, to what extent are current choices assumed to be suboptimal?

2. Does the model allow the existing capital stock, in energy supply and end use sectors, to be retired before its planned amortization date? If so, what condition triggers early retirement?

3. What potential for technological change is embodied in the model's assumptions regarding non-fossil fuel energy sources?

4. How are future price expectations incorporated into the model's end user demand functions?

5. How can the output of the model be compared with others currently being used to assess similar policy options?

Taking each point in turn:

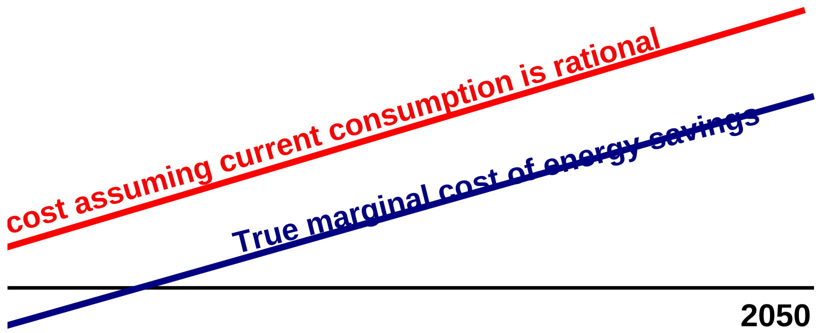
1. Does the model assume, directly or indirectly, that the current pattern of supplier and end user choices is economically rational? If not, to what extent are current choices assumed to be suboptimal?

Regarding end-user demand, the Assumptions Book (p. 27) states, "Rather than using price elasticities to determine how demand reacts to changes in price, the model explicitly identifies the multiple ways price changes influence the relative economics of alternative technologies and behaviors, which in turn determine consumers' demand." This appears to imply that Energy 2020 employs a rational choice model of energy demand—a model which assumes that changes in energy prices lead to changes in device efficiency, capital stock and consumption choices, and which then aggregates all price-induced choices to model the overall demand response.

The economic costs calculated by a rational choice model depend, in very large measure, on whether the model assumes that today's energy consumers are, in fact, rational. If consumers are making the optimal energy use choices today, greater efficiency can be achieved only through price-induced investment and consumption adjustments. Substantial empirical research, however, suggests that current choices are *not* efficient. Residential energy users fail to make investments in insulation and other energy-saving improvements even though they yield rates of return far in excess of interest rates on household credit instruments. Even industrial users fail to make energy-saving investments whose internal rates of return approach 100% (Anderson and Newell, 2004). The McKinsey study, "Curbing Global Energy Demand Growth: The Energy Productivity Opportunity" (2007), argues the US can trim its 2020 energy demand by about 20% simply by making investments utilizing existing technology that are already profitable at a 10% hurdle rate of return.

It is difficult to overstate how important this issue is for economic analysis. If the optimistic view of these and other studies is correct, much of the carbon emissions reduction foreseen by WCI is achievable at little or no cost. On the other hand, if economic modelers assume (falsely, we believe) that such profitable savings do not exist—that is, if they assume that existing choices are rational when in fact they aren't—future adjustment costs will be biased upwards, and this effect will persist even after self-financing energy savings are exhausted. Essentially the entire marginal cost-of-energy-savings curve will be shifted upwards, as in the figure below; profitable savings today are deemed unprofitable, and somewhat costly savings in the future, as we move along the curve, are deemed even more costly.

Figure 1: Overestimation of Energy Savings Costs if Current Use is Assumed Rational



Over time, as the cap is reduced, end users are moved upward along their marginal cost curve of energy savings. If this cost is overestimated today, it remains overestimated throughout the horizon of the analysis.

Every meaningful analysis of the costs of GHG emission reduction must begin with an assessment of whether there are zero- or negative-cost options for energy savings that are currently underutilized. It is not possible to determine, based on the documentation we have received, how ENERGY 2020 answers this question.

2. Does the model allow the existing capital stock, in energy supply and end use sectors, to be retired before its planned amortization date? If so, what condition triggers early retirement?

Since ENERGY 2020 forecasts costs based on each period's capital stock, including the end user capital like housing and manufacturing plants, and energy sector capital like electrical generating facilities, much depends on the technical characteristics of these assets. The model begins with the current size and composition of capital, incorporates existing plans (in the case of electrical generation), and estimates the pace and characteristics of new additions to the capital stock based on the rational choices of households and businesses in the WCI region. Little is said about the retirement of currently used stock, however. Is it assumed that each investment will remain in use until it is fully amortized? Is an allowance made for the early retirement of capital based on energy cost considerations? If so, what cost differential is assumed to trigger early retirement?

The issue of capital write-off has arisen in many contexts in recent history. The oil price spike of the 1970s, even though it was transitory, accelerated the retirement of much industrial plant around the world. An even more extreme case is that of Eastern Europe, much of whose capital stock was suddenly unprofitable when the walls came down in 1989; facilities were written off en masse, even though the result was extreme economic distress. It is altogether possible that in the high-cost energy era we are entering into, many of the plans embodied in end use and energy supply capital will have to be set aside. On the one hand, this could be a source of economic disruption, as we saw in the 1970s and 1990s; on the other hand, early retirement of cheap-energy-era investments will lower the microeconomic calculation of costs that ENERGY 2020 is most focused on. It is impossible to delve further into this question without a more explicit account of the manner in which ENERGY 2020 forecasts retirement of existing capital.

3. What potential for technological change is embodied in the model's assumptions regarding non-fossil fuel energy sources?

Another crucial area of debate in the economics of GHG mitigation is the potential for cost-reducing technological change, particularly in the area of non-fossil fuel energy sources. Another McKinsey study, "The Case for Investing in Energy Productivity" (2008) takes an optimistic view, arguing that relatively small investments in new technology can have dramatic impacts on cost-effective energy-saving options. Of course, because we are concerned with technologies that do not yet exist, there is uncertainty over cost and timing, and even over their eventual availability. In this regard, Appendix F of the Assumptions Book is, at best, inscrutable. It gives simple point estimates for the cost components of all non-carbon energy sources except hydro and geothermal, allowing only for a capacity factor range for solar (thermal) and wind. Point estimates do not incorporate scale economies, which may be important in these technologies. Given the centrality of the cost and availability of non-carbon energy sources to the larger debate over climate change policy, it is important that we be given more documentation regarding the treatment of these sectors in ENERGY 2020, and more opportunities to investigate the effects of introducing optimistic or pessimistic scenarios for new technology.

4. How are future price expectations incorporated into the model's end user demand functions?

The responsiveness of end users to changes in energy costs depends to a considerable extent on their expectations regarding whether these costs are likely to be transitory or permanent. Households and businesses are less likely to make costly, energy-saving capital investments when energy prices rise, for example, if they expect this increase to be short-lived. The same can be said for behavioral responses, which often have a "lumpy" character, such as changing residence to reduce the commute to work. Historical data provide the only empirical basis for estimating such responses, but, while past price changes are directly observable, changes in expectations are not. We do not know with much precision which energy users in previous years viewed price changes as more or less permanent, so we cannot incorporate this element very easily for the purpose of estimating the parameters of the model.

This issue is important because the historical experience of *past* energy prices increases may very well be a poor guide to *future* behavioral and investment responses. Earlier price run-ups did in fact prove to be transitory, and, to the extent their expectations were correct, economic agents were justified in basing their decisions on more stable long-run prices. If the WCI states and provinces (or larger jurisdictions) institute a cap-and-trade system over a multi-decade time horizon to significantly cut carbon emissions, rational agents ought to assume that the resulting price increases for energy products will be long-lived. This in turn should lead them to respond more strongly to price signals than in the past. Of course, while the broad outlines of this argument are difficult to dispute, there is much uncertainty over how large a response difference we ought to anticipate. The documentation we have received regarding the treatment of price expectations in ENERGY 2020 does not address this issue; it doesn't even mention the problem of expectations at all.

5. How can the output of the model be compared with others currently being used to assess similar policy options?

WCI is not the only initiative in climate policy, and ENERGY 2020 is not the only energy policy tool on the shelf. Over the next year or two there will be many ongoing studies that look at the costs of GHG mitigation, both within and outside of WCI member jurisdictions. In order to make sense of the data presented to us, we will want to know how it compares to the forecasts generated elsewhere. An intelligent comparison of output, of course, requires a detailed comparison of inputs. If the GHG mitigation costs estimated by the Energy 2020 model are higher than those estimated by some other model in another region, stakeholders will need to understand whether those differences result from the particular models that are employed, or from the particular characteristics of the WCI jurisdictions themselves.

Other modeling initiatives, such as MIT's "Assessment of U.S. Cap-and-Trade Proposals" (2007) are open-source, and can be viewed and reviewed by the general public. We can view the exact equations used to generate their conclusions and compare them with alternatives. Stakeholders can see in as much detail as they wish the assumptions and methods used to characterize each sector of the economy, so they can offer alternatives for sensitivity analysis. We do not have this option with ENERGY 2020, and we will therefore never be able to fully disentangle model-specific from data-specific forecasting outcomes.

But this is just the beginning of the problems with the lack of transparency in the WCI's chosen model. ENERGY 2020 is the energy subset of a complete CGE (computable general equilibrium) model of the US and Canadian state/provincial economies. To produce a finished forecast it must be merged with an additional model that incorporates the remaining sectors and addresses macroeconomic outcomes such as employment and economic growth. Although the ICF team has not committed to any such general model at this point, the Assumptions Book suggests that the preferred "partner" will be Regional Economic Models, Inc. (REMI). **This is yet another proprietary model.** Like ENERGY 2020, those on the receiving end of its forecasts can only speculate on the modeling choices that resulted in them. Thus, in the later stages of the WCI economic analysis project, we are likely to be even more in the dark than we are now.

These five concerns are fundamental. They represent longstanding issues in the economics of energy conservation, a field of intense research for over 30 years. After all, academic journals and government agency reports are rife with contradictory forecasts and empirical claims about energy economics; so without a thorough understanding of how any particular analysis was conducted, it may be impossible draw any inference beyond “Here is another set of numbers.” It is only by relating model outputs to modeling inputs, assumptions and methods that we can determine whether any new set of numbers is credible. We expect WCI to request this level of documentation for ENERGY 2020.

In addition to these major concerns, we hope for greater clarity on a number of more detailed issues concerning the Energy 2020 model.

1. *End user device efficiency*. An important driver of final energy demand will be the efficiency of the energy-using devices, such as appliances, that convert energy inputs into the services people value. The device options available to consumers, discussed on p. 13, appear to be static over the time horizon of the model. This is another context in which technological change may be important, however; it has certainly been important in the past. Also, the selection of these devices is said to be “based on past experience with consumer choice,” raising once again the questions of the presumed permanence of price expectations.

2. Emissions factors for biofuels. These are stipulated for three fuels differentiated by feedstock; the source is a California report from last year. Research in this area, however, is in a state of high flux, so modeling should explicitly incorporate a range of uncertainty for these factors, taking into account new research as it appears. (For further discussion of the great uncertainty in biofuels emissions factors, please see Sightline Institute’s March 17, 2008 comments to the scope subcommittee on the WCI’s Draft Program Scope Recommendations.)

3. *Co-generation*. This may prove to be an important source of efficiency improvement in much of the WCI region. The Assumptions Book suggests that co-generation will occur only in the context of industrial self-provision of electricity; that is, the heat will be derived only from the industrial sector, and it will be channeled only to this sector for purposes of electrical conversion. This rules out, by assumption, any use of waste heat from the electrical generating sector itself, as well as the direct use of heat in the residential sector. We do not think such restrictive assumptions are justified.

4. *Infrastructure*. Investments in energy-saving infrastructure may well prove to have the largest beneficial impacts on the cost of meeting WCI’s GHG targets. Within the electrical generating sector, upgrades to the grid—so-called “smart grid” options—are expected to generate savings in themselves and facilitate the incorporation of sporadic sources like solar and wind. Even more dramatically, investments in mass transit and related infrastructure to support greater residential density have the potential to greatly reduce the

use of transportation fuels. We see no mention of such investments in the documentation we have been given.

5. *Diffusion of energy-saving technology*. ENERGY 2020 correctly recognizes that information may be a barrier to the diffusion of energy-saving technologies, even as price signals become stronger. On p. 29 a graphical model is presented to frame our thinking about this issue. The documentation does not indicate, however, how the sigmoid curve is calibrated—how quickly price changes alter market share. If this is based on historical data it again raises the issue of how past price expectations, and therefore information-gathering effort, are believed to foreshadow future ones.

6. *The reference case for oil prices*. ENERGY 2020 uses the EIA forecast for future energy prices. At the risk of being obvious, we would like to point out that the current price of gasoline at the pump in the US exceeds the 2030 EIA forecast cited in the Assumptions Book by about 75%. As a practical matter, the anticipated pace of fossil fuel price increases in the reference case is likely to have a profound effect on the costs attributable to WCI's policy options.

7. *Valuation of expenditure switching*. As energy prices rise, consumers will adjust by altering their spending patterns. They will drive less, heat their homes to a lower temperature (even with improvements in insulation), and spend a greater proportion of their income on goods and services that have a lower level of direct and indirect energy intensity. The problem faced by economists is how, or even whether, to place a monetary value on these expenditure shifts. A common procedure is to assume a particular functional form of utility, such as CES (constant elasticity of substitution), and use historic price and quantity data to infer the cost in utility resulting from such shifts. The justification is that, if consumers require the relative price of A to rise in order to switch their consumption of B, they must prefer A to B, and this loss of satisfaction, due to switching, ought to be taken into account.

In practice, we should expect consumption patterns to shift significantly in response to price signals, so the procedure used to assign a utility cost to this process may have a noticeable effect on the results of the modeling exercise. This raises two types of concerns. First, we need to have a more explicit account of the assumptions employed in ENERGY 2020 to estimate these utility costs. Second, we question whether the entire procedure, common as it is, should be regarded as valid. In recent years a vast amount of research has called into question the utility maximization model as even an approximate description of actual decision-making and subjective well-being; the new fields of behavioral economics and "happiness studies" (or "hedonic psychology") are built on this work. The issue is not just abstract in this context. One of the largest prospective expenditure switches may be away from motor vehicle use and toward other purposes. To achieve this, many individuals will have to change their jobs or residences in order to reduce their commuting distance. The standard utility maximization model assumes that the "rational" consumer is better off in the initial state before reducing his or her commute. Yet very careful research by Stutzer and Frey (2004) found that, in Germany, where cars are even more highly valued than they are here, those with longer commutes are less happy, holding all other factors constant. If this research applies to our region as well, we ought to tally reductions in driving time as a net economic benefit, rather than a cost.

To sum up, economists have been analyzing the effects of energy prices and conservation strategies for several decades. There is an immense literature, with continuing disagreement even over the most basic questions, including the potential for technical change, the role of expectations, and the extent to which no-cost energy saving options are already available. Without knowing how ENERGY 2020 positions itself relative to other models—what specific choices it makes among the alternatives well known to energy analysts—there is no basis for comparing its results to those produced by other models. As a result, the WCI modeling exercise may not add appreciable value to our current understanding of energy economics.

We commend WCI for taking seriously the implications of emissions reductions policies, but we remain concerned at the choice of a proprietary model in which key structures and assumptions are withheld from public view. We urge WCI not to base significant public policy decisions solely on analyses that do not conform to the standards of transparency normally upheld in government and academic work.

References

Anderson, Soren T. and Richard G. Newell. 2004, "Information Programs for Technology Adoption: The Case of Energy-efficiency Audits," *Resource and Energy Economics.* 26(1): 27-50, *www.rff.org/Documents/RFF-DP-02-58.pdf*.

McKinsey Global Institute, "The Case for Investing in Energy Productivity," February 2008, *www.mckinsey.com/mgi/reports/pdfs/Investing_Energy_Productivity/Investing_Energy_Productivity.pdf*.

McKinsey Global Institute, "Curbing Global Energy Demand Growth: The Energy Productivity Opportunity," May 2007, *www.mckinsey.com/mgi/publications/Curbing_Global_Energy/index.asp*.

Paltsev, Sergey et al., "Assessment of U.S. Cap-and-Trade Proposals," MIT Joint Program on the Science and Policy of Global Change, Report No. 146, June 2007, *papers.ssrn.com/sol3/papers.cfm?abstract_id=994225*.

Stutzer, Alois and Bruno S. Frey, "Stress That Doesn't Pay Off: The Commuting Paradox," Institute for the Study of Labor, Discussion Paper No. 1278, September 2004, *papers.ssrn.com/sol3/papers.cfm?abstract_id=408220*.