American Gas Cooling Center
400 N. Capitol St., N.W.
Washington, DC 20001

Mark E. Krebs Education Committee Chairman

Tuesday, January 08, 2002

Yolanda Clegg
Commission for Environmental Cooperation
393, rue St-Jacques Ouest
Bureau 200
Montréal (Québec)
H2Y 1N9 Canada

Subject: Comments regarding: *Environmental Challenges and Opportunities of the Evolving North American Electricity Market*

The American Gas Cooling Center (AGCC) is a trade association for utilities and manufacturers whose common goal is to develop viable markets for highly energy efficient space conditioning alternatives that are not powered by electricity. Technologies we represent include recovering heat from distributed generation (DG) and utilizing it directly for space heating, domestic and process water heating and to power absorption refrigeration and desiccant dehumidification systems.

We commend the CEC for its insightful series of electric utility issue analyses. The following comments are intended to offer additional detail regarding what we consider to be highly important but often-misunderstood concepts that were mentioned in specific sentences within the subject document. In order of their occurrence, these are:

Sentence: "*Building a more supportive North American policy framework for energy efficiency and renewables represents a significant opportunity for achieving "win-win" outcomes*."

Discussion: We suggest that the sentence be restructured to read as follows:

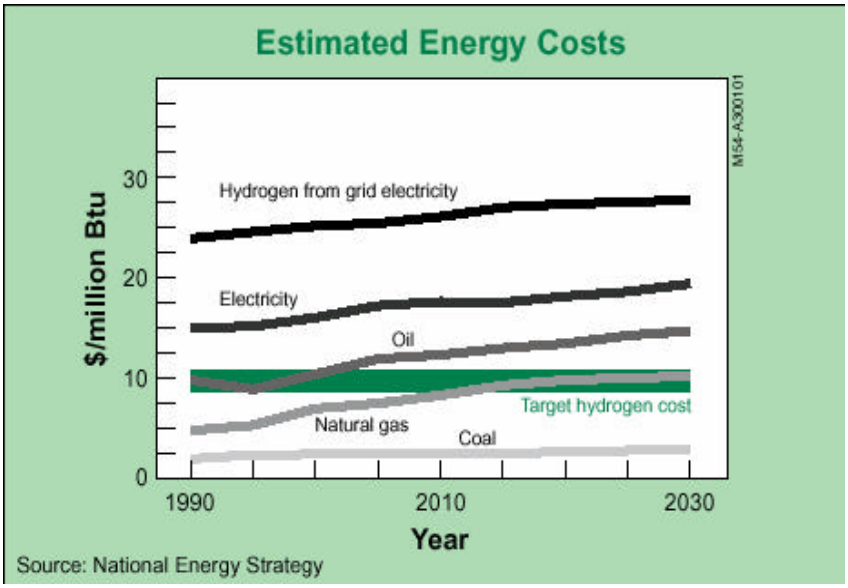
> "*Building a more supportive North American policy framework for energy efficiency and renewables can represent a significant opportunity for achieving "win-win" outcomes" if structured appropriately*.

The reason for these changes are due to the fact that ostensible "energy efficiency" policies, usually gauge efficiency on the overly simplistic basis of BTU per square foot rather than considering total fuel-cycles. Consequently, such policies do little more than promote increased electrical consumption in a manner that is tantamount to advocating that energy is somehow created within utility meters. Such policies erode consumer choice and the environment.

Sentence: *"Over time, whether and where "cleaner" electricity generation fuels can compete favorably with "dirtier" ones (considering their full lifecycle) will help answer many of the questions being asked today. A longer time frame would consider the still more uncertain pace of technological change and the advent of "breakthrough" technologies, such as hydrogen fuel cells."*

Discussion: Developing the proper analytical tools to transparently and robustly evaluate such tradeoffs over their complete fuel-cycles and life-cycles is something that is sorely needed as a basis of more rational policymaking and should therefore be fast tracked. Furthermore, alternatives to electricity (i.e., the direct use of natural gas, fuel cells, etc.) must be considered simultaneously. Otherwise, society will continue down the path towards an electric energy monoculture.

Often myopic approaches to solving problems create different (and sometimes far worse) problems. Classical cases-in-point of unintended consequences include the catalytic converter[1] and MTBE. Likewise, the ostensible environmental superiority of fuel cells may not pan out given that the cheapest source of hydrogen may be coal gasification. . The graph shown below is from a forecast that illustrates this conclusion:



In short, if fuel cells end up predominately coal-fueled, emissions at the point-of-use might be minimal, but total fuel-cycle emissions might be immense. Therefore, risk analyses should be another major feature of proper energy policy development tools.

Sentence: *"In addition to promoting energy security through a more distributed and diverse energy portfolio, greater attention to these areas could help cushion the region from the impacts of more conventional electricity sources."*

Discussion: Such a portfolio should also consider end-use alternatives to electricity, especially if such alternatives are less costly (on a societal basis) and less environmentally degrading.

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[1] Catalytic Converter Is Growing Cause of Global Warming http://www.junkscience.com/news2/catalyt.htm

Sentence: *"Finally, there are a number of opportunities to enhance public access to environmental information as well as to improve mechanisms for transboundary integrated resource planning and assessment. A more informed and active citizenry can help ensure that the integration of the North American electricity market benefits our shared economic and environment goals*."

Discussion: If integrated resource planning (IRP) only considers electricity production and consumption, it is, in reality, segregated resource planning; regardless of whether or not the complete electric fuel-cycle is analyzed. Such "segregated resource planning" will underachieve (at best) its societal objectives through counterproductive "rebate wars" (whose victor should be obvious) and similar aberrations of ostensibly well-intended policies.

We hope to shed further light upon IRP and fuel-cycle analysis issues to improve the CEC's knowledge of them. To begin, the following tables show that, for each Btu extracted from the ground, converted to electricity in a combined-cycle power plant and delivered to an electric water heater, only 0.36 Btu ends up as usable hot water. Conversely, for a gas water heater, 0.54 Btu is delivered as hot water because the direct use of natural gas avoids the losses of indirect use as a fuel to make centrally generated electricity, even at "state of the art" efficiency.

Electric hot water overall efficiency (energy derived from combined-cycle turbine)

gas wellhead to power plant	90%
power plant thermal efficiency	50%
power plant to end-use meter	90%
electric resistance water heater efficiency	90%
cumulative efficiency	36%

Gas water heater overall efficiency

gas wellhead to end-use meter	90%
gas water heater efficiency	60%
cumulative efficiency	54%

These calculations indicate that the direct use of natural gas for water heating is already far superior to supposed "best available control technology" (BACT) that many believe to be state-of-the-art combined-cycle turbines (CCT)-when fuel-cycle efficiency is properly considered. Distributed generation with heat recovery (a.k.a., CHP or BCHP) only improves such inherent advantages. Moreover, these calculations are lenient towards CCTs, given that ideal "ISO" efficiency ratings are used (59 deg. F and sea level) and given that numerous real-world variables that substantially detract from CCT fuel-cycle efficiency are being omitted in this example for simplicity. Such factors include but are not limited to the following:

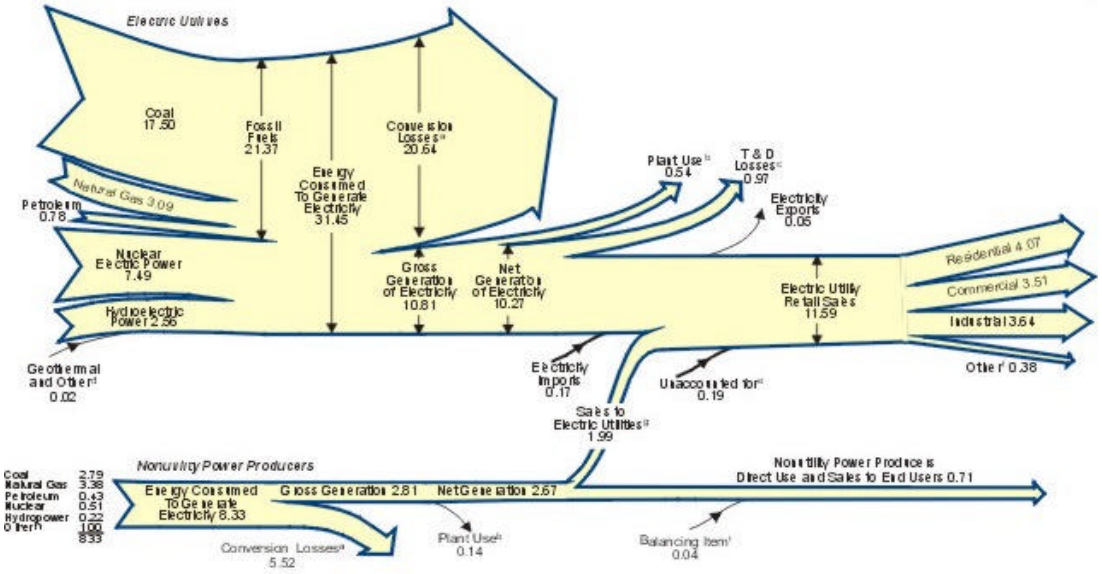
- Efficiency and emissions (other than SCR controlled NO_x) from CCTs vary significantly as a function of inlet air temperature.
- When temperatures are highest, turbine capacity and efficiency are lowest.
- When temperatures are highest, electric demand, hence T&D loss is highest.
- Turbine vanes (and thus efficiency) can deteriorate significantly over time.

While issues such as these may not have been what Alfred Einstein was most concerned with at the time, he nevertheless elegantly stated the rationale behind fuel-cycle analysis in the following quotes:

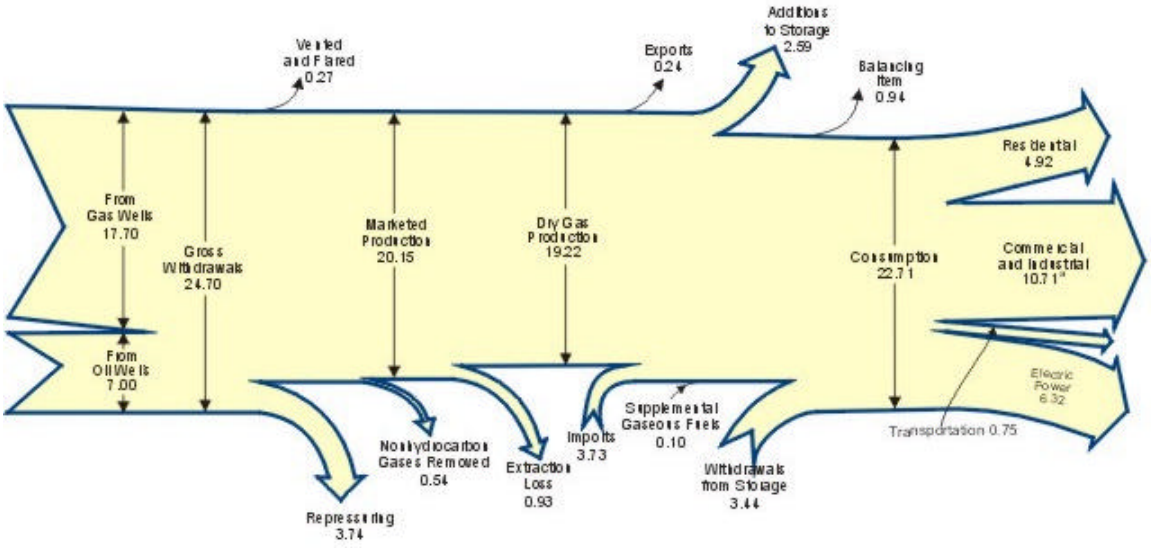
- "Problems can never be solved by thinking on the same level that created them."
- "Solutions to problems should be as simple as possible – **but no simpler**.

The basic theory and importance of fuel-cycle analyses is further reviewed by the next two graphics and the discussion thereof:

Source to Site Electricity Flow 2000 (Quadrillion Btu) [2]



Source to Site Natural Gas Flow 2000 (Trillion Cubic Feet) [3]



[2] http://www.eia.doe.gov/emeu/aer/diagrams/diagram5.html
[3] http://www.eia.doe.gov/emeu/aer/diagrams/diagram3.html

One Quadrillion Btu (1 Quad) and a trillion cubic feet (TCF) of natural gas contain essentially equivalent amounts of energy. Therefore, comparing the previous Energy Information Administration (EIA) graphs the following relationships can be determined:

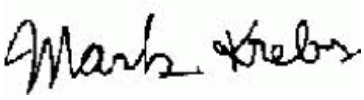
1. Natural gas delivers twice the amount of energy to consumers relative to electricity
2. Natural gas delivery is accomplished at least 2 ½ times the efficiency of electricity production and delivery (37% overall electricity vs. 91% natural gas efficiency).[4]

- Further comparing the natural gas and electric statistics contained within the EIA's Annual Energy Review[5], it is evident that natural gas performs these services with far less environmental degradation and at less than ¼ of consumer cost relative to electricity ($47 billion yearly revenue for the natural gas industry versus $218 billion for the electric industry). Despite these features, contemporary American energy policies over the past two Administrations have focused primarily upon the increased importance of natural gas as a fuel for producing electricity.

Conclusions: The success of a market economy is based upon educated consumers with viable choices. Unfortunately, most consumers (as well as most regulators and legislators) are either kept unaware of or are purposefully ignoring important physical differences between total resource efficiency and efficiency at the point of end-use, as well as the resulting overall emissions differences. We also contend that the ongoing "rush to gas" for fueling CCT's adversely impacts consumer choice and needlessly wastes finite energy resources of natural gas. As of September 11th, the national security implications of this rapidly emerging energy monoculture should also be thoroughly reconsidered.

As these comments have hopefully reinforced, a comprehensive utilization of IRP and fuel-cycle analysis techniques should be the cornerstones of energy and environmental planning. In the event that the CEC would like additional information concerning these matters, AGCC offers its support. I can be contacted at (314) 342-0714 or via the following e-mail address: mekrebs@i1.net

Sincerely,



[4] EIA's electricity flow graph does not include production and delivery losses for the primary fuels, so it is not truly "source to site". For example, the losses associated with natural gas transmission or coal transportation to the power plant are not included. Also, note that the nuclear input is not uranium, or even enriched uranium, but nuclear electric power (which has a resource efficiency of approximately 16% when enrichment and power plant losses are taken into account. Conversely, EIA's natural gas flow graph does start from the wellhead. Also note that Hydro and Nuclear enter the electricity graph at 100% efficiency. Nuclear is only ~20% efficient, as is hydro (delivered electricity/potential hydraulic energy. That makes the 37% closer to 27% and the ratio closer to 3.5:1. CCTs are only ~40% (0.9*0.5*0.9).

[5] http://www.eia.doe.gov/emeu/aer/contents.html