The Oil Drum: Net Energy

Discussions about Energy and Our Future

Some Thoughts on the Obama Energy Agenda from the Perspective of Net Energy

Posted by David Murphy on February 9, 2009 - 10:16am in The Oil Drum: Net Energy
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The Obama-Biden comprehensive a New Energy for America Plan is designed to:

1. Help create five million new jobs by strategically investing $150 billion over the next ten years to catalyze private efforts to build a clean energy future.
2. Within 10 years save more oil than we currently import from the Middle East and Venezuela combined.
3. Put 1 million Plug-In Hybrid cars -- cars that can get up to 150 miles per gallon -- on the road by 2015, cars that we will work to make sure are built here in America.
4. Ensure 10 percent of our electricity comes from renewable sources by 2012, and 25 percent by 2025.
5. Implement an economy-wide cap-and-trade program to reduce greenhouse gas emissions 80 percent by 2050

The Obama energy agenda focuses on - and these are not mutually exclusive - efficiency, electrification, and the promotion of alternative energy resources. Its five main goals are set up in a way so that success in any one of the five individual areas will reinforce the other 4, helping the overall agenda achieve success. For example, creating 25% of the U.S. electricity production from renewable resources (goal #4) will aid in decreasing the U.S. greenhouse gas emissions by 80% (goal #5).

The energy agenda is a welcomed change showing a future outlook that is based, at least to some *[small]* extent, on the physical realities of the natural resource world. However, from the perspective of net energy, some potential problems do exist. My goal here is to discuss some possible shortcomings of the new administrations energy agenda from the perspective of net energy.

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1) Help create five million new jobs by strategically investing $150 billion over the next

ten years to catalyze private efforts to build a clean energy future

With a recession in full swing and the recent announcement of thousands of job losses at major companies within the United States, creating jobs has become mission number 1 of the new Obama administration. In the meantime, the collapse of the stock market has made raising capital the number one problem for the alternative energy sector. The primary goal of the Obama plan is to bolster the alternative energy sector of the economy by injecting $150 billion dollars of capital into alternative energy companies/programs, and in doing so create 5 million *[permanent]* jobs.

The situation, as seen from the perspective of net energy, is as follows: any alternative technology with a reasonably high EROI is usually profitable, and if something is profitable it will not have trouble sustaining growth long after the 150 billion dollars is spent. For example, the growth of wind farms (EROI ≈ 18:1) in the U.S. has outpaced every other country in the world for the past 4 years, and in 2008 the U.S. passed Germany with the World's largest installed wind power capacity. With a little help to bolster new wind power companies in these tough economic times, I believe that the moderately high EROI of wind power could translate to sustained profits and this industry should grow into the distant future, and as a result create long-lasting jobs. The same probably could be said for solar, geothermal, and bioenergy (for burning – but not ethanol).

On the other hand, lets look at alternative energy technologies with very low EROI's. Corn-based ethanol is argued to have an EROI between 1.2 and 1.6 to 1. These low EROI values mean that the corn-ethanol industry is operating at the margin of positive energy returns, and because of that fact, the industry as a whole is vulnerable to shocks. For example, Verasun, one of the largest ethanol companies in the U.S., filed recently for bankruptcy, Aventine Renewable Energy and Pacific Ethanol have both lost about 80% of their value, BioFuel Energy lost 46 million dollars on poor hedges on commodity prices, and the list goes on... The financial collapse and the reduction in the price of oil had a large negative impact for these companies, which is exactly the point: negative disruptions in financial markets or in the price of oil will have magnified impacts in this industry due to the fact that the energy surplus contained within the ethanol product is marginal at best. Ironically, the large increase in energy prices that encouraged alternatives probably had something to do with the financial collapse that made them no longer feasible economically.

2) Within 10 years save more oil than we currently import from the Middle East and Venezuela combined

Decreasing the amount of oil we import from unstable regions is always a good idea from a political standpoint, but that may not hold true from a net energy perspective. It is a good idea from the net energy perspective if the decrease in imports from Venezuela and the Middle East is met by a similar decrease in consumption within the United States. It is a bad idea if the decrease is compensated by an increase in imports from "friendly" countries, that have generally, at least when compared to the Middle East, poorer quality resources that emit much more CO_2.

For example, Canada is the largest foreign supplier of oil to the United States, and much of their future oil production resides in the tar sands of northern Alberta. The EROI of developing oil from the tar sands is between 2 to 5:1. Compare that with oil from the Middle East, which has an EROI of roughly 20:1.

This large difference in EROI impacts the difference between "gross" and "net" oil deliverables. Using an equation from Mulder and Hagens (2008), I can estimate the gross energy extracted to deliver one unit of net energy for any EROI value. The equation is:

$$\text{Gross Extraction} = \text{EROI} / (\text{EROI} - 1)$$

Using this metric, to deliver one net unit of oil from the Middle East would require the gross extraction of 1.05 barrels of oil equivalent (boe), while in Canada the same net delivery would require the gross extraction of 1.25 boe. In the end, Canada would need to extract roughly 20% more boe than the Middle East to deliver the same amount of net oil to the U.S. Currently the U.S. imports 790 million barrels per year from the Middle East (defined here as the "Persian Gulf", including: Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates). The gross extraction cost of this fuel in the Middle East is 40 million boe, while in Canada it would be 198 million boe, a difference of 158 million boe. Low EROIs quickly add up to high extraction costs, and although the low EROIs do not currently impact price, they will certainly impact the net ultimate recoverable oil from any given basin. For example, the tar sands have roughly 170 billion barrels of proved reserves, and extracting that oil at an EROI of 5:1 will mean that 42.5 billion boe will be used just to extract and deliver the other 127.5.

> 3) Put 1 million Plug-In Hybrid cars -- cars that can get up to 150 miles per gallon -- on the road by 2015, cars that we will work to make sure are built here in America

Plug-in hybrid cars are an efficiency improvement for our transportation system as a whole, and matched with the production of electricity from renewable technologies, they represent a large step away from a fossil-fuel intensive transportation system.

Electricity has a higher quality than oil or gasoline in that it can be converted into mechanical work at higher efficiencies than can internal combustion engines, which are limited to Carnot efficiencies, and it can be transported long distances much easier than oil or gasoline. For these reasons the high-speed trains in Europe and Japan use electricity for power rather than fossil fuels directly. Hence electricity driven transport is an efficiency improvement over the internal combustion engine.

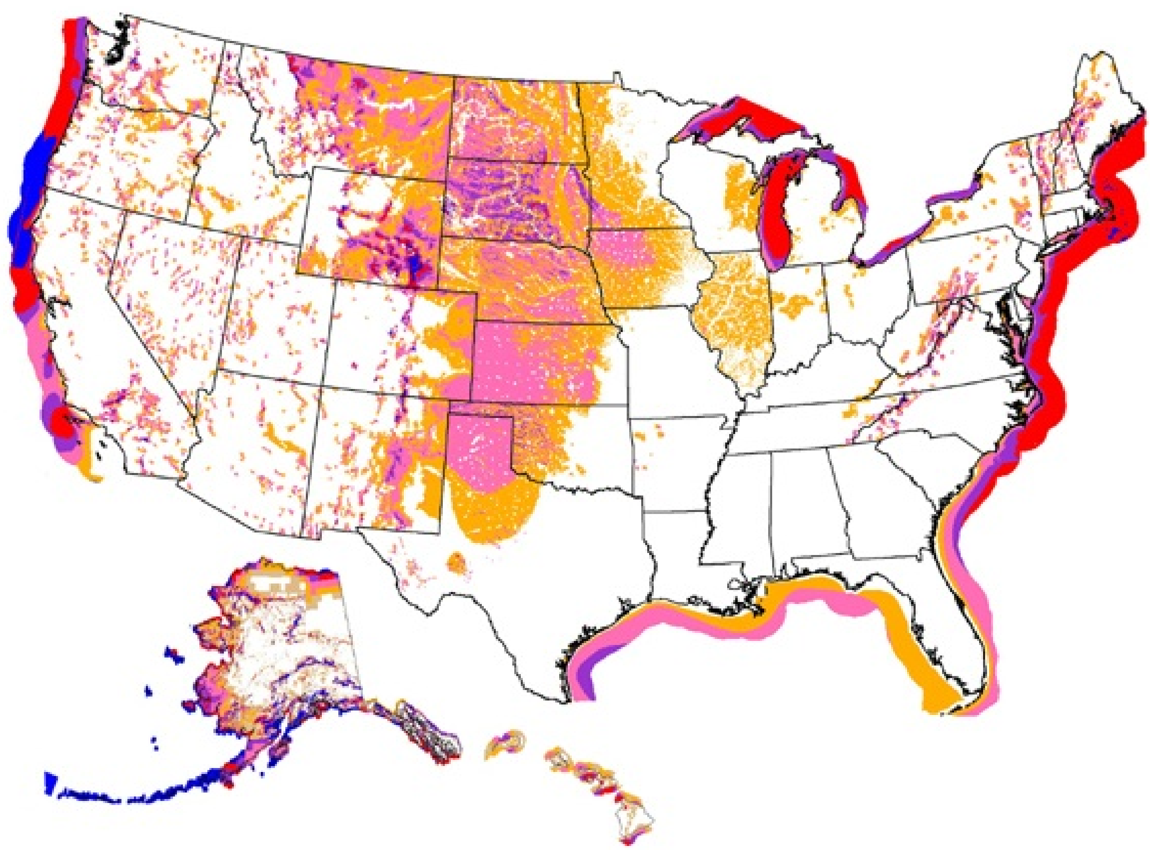
Most important, however, is that electricity can be produced from wind, solar, geothermal, and other renewable sources. Currently, however, much of the electricity in the U.S. is produced from fossil fuels, and without a switch to renewable sources of electricity, a move to electric vehicles will only shift the emission of greenhouse gases from the tailpipe to the smokestack.

From a net energy perspective, electric vehicles make sense as they increase efficiency, but the biggest variable in this equation is making the electricity grid technologically capable of effectively transmitting wind and solar power to car batteries without large transmission (entropic) losses. We need to undertake much more comprehensive EROI assessments if we are to understand these relations well.

> 4) Ensure 10 percent of our electricity comes from renewable sources by 2012, and 25 percent by 2025

The 2012 goal will not be difficult to meet, as 9% of the nameplate capacity of the electrical system in the U.S. is produced from renewable resources already (renewable defined as: hydroelectricity, wind, solar, and geothermal).

Continually increasing the amount of electricity that comes from renewable sources will indeed make meeting all the other goals much easier, and much like the conclusion from number 3, the important aspect from the net energy perspective is whether the U.S. can establish an electricity infrastructure that will allow for effective transmission of electricity from places of production to places of consumption, because places where the sun shines the most or the wind blows the hardest are usually places were people don’t live. Questions like the following become overwhelmingly important: what is the energy cost of upgrading transmission lines, and how will that affect the EROI of the renewable energy technologies that utilize those lines?

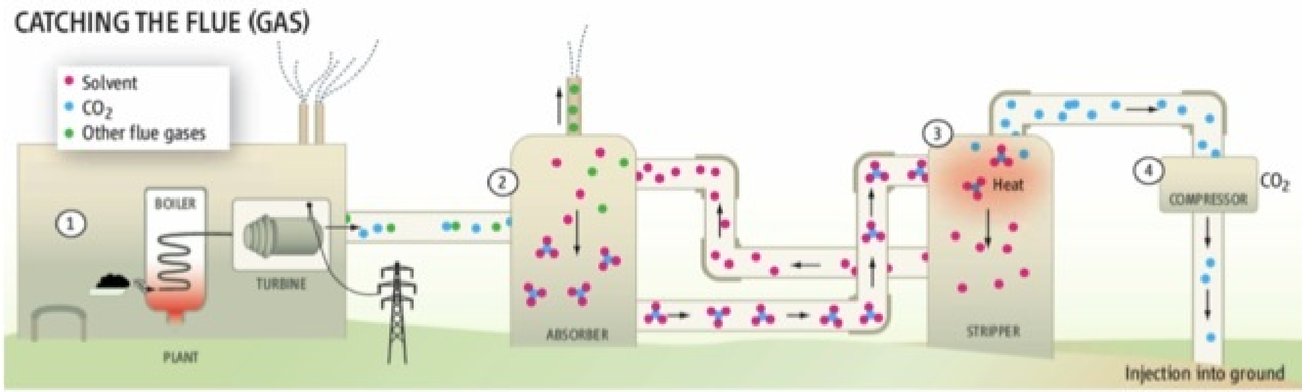


[Spatial Map of U.S. Potential Wind Power]

5) Implement an economy-wide cap-and-trade program to reduce greenhouse gas emissions 80 percent by 2050

A successful cap and trade program is needed to reduce greenhouse gas emissions. I am wary, however, that too much emphasis is being placed on the future of carbon capture "technology" while decreasing consumption is being overlooked.

Much attention has been given to carbon capture technologies, such as carbon capture and sequestration (CCS), without much regard for its impact on production efficiency or the extreme costs of building such facilities. CCS technology decreases the power output of a plant by about 30% (see Michael Webber). In other words, the U.S. would have to burn 30% more fuel just to maintain the same level of power output. I am also skeptical of storing pressurized carbon dioxide underground – see Law of Unintended Consequences. In the end, maybe trading carbon-dioxide emissions for lower efficiency is the best option, but it will come at a high net energy cost.



Carbon Capture and Sequestration (Science, 2007)