

## **Clean Energy Project Exchange**

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Most now agree that global warming requires quick and effective action from both the public and private sector. Setting clean energy priorities for reducing and eliminating carbon – especially in the production of electricity and the transport sector that together account for two-thirds of all U.S. carbon emissions – is one of the most important issues facing us. Because carbon remains in the atmosphere for such a long time, early action is necessary. Furthermore, since the cost of reducing carbon will cascade through the entire economy, it is imperative that carbon reducing projects be the most cost-effective.

Policy-makers, businesses, and individuals are currently faced with making smart choices to reduce their carbon footprint. Congress and many early-acting states are considering a variety of policies to mitigate climate change, including cap and trade, allocation vs. auction, input and output based allocations and a carbon tax. Once policies are in place, managers of utilities, businesses, and policy-makers will need to choose actual projects. A utility will be faced with whether to build a wind farm, a nuclear power plant, a clean coal plant, or further invest in demand-side management (DSM) programs. A corporate board of directors will have to determine whether to allocate its resources to green power programs, on-site renewable energy, or energy efficiency. Local governments and policy-makers will have to decide whether to provide incentives for more efficient transportation or change the building codes. While many would say the answer to mitigate climate change should be doing all of the above, realistically, one must decide what to do first and how best to allocate limited money.

The basic question we need to answer is: What energy projects will produce the greatest amount of greenhouse-gas reduction in the shortest period of time with the least amount of money? The difference between a good project and an optimal project will mean the difference of tens or even hundreds of billions of dollars spent effectively over the coming decades. Having the ability to quickly determine which project will be the most effective in reducing carbon, will also mean we can begin to stabilize carbon concentrations in the atmosphere sooner.

### **Setting Clean Energy Priorities is Complex**

There are 10 major means of producing electricity or reducing electric load – demand-side management, oil, gas, coal, nuclear, wind, solar, biomass, geothermal and ocean power. Setting clean energy priorities is not simply arranging these technologies and fuels in some priority order. We demonize some of these choices and glorify others depending on current perspective, business or philosophical position. As Milt Copulos, President of the National Defense Council Foundation puts it, we are arguing “energy theology.”

Clean energy choices in the real world are complex decisions. A utility manager, for instance, must consider cost, energy reliability, carbon footprint, supply availability, time constraints, public consensus and many other factors. As such, choosing the best energy projects to reduce carbon can vary significantly.

Consider this example: Suppose you must decide on how to best allocate compact fluorescent light bulbs (CFLs), incentives for conventional hybrid automobiles, and a demonstration program for new plug-in hybrid autos between two target markets – Seattle and Cleveland. Furthermore, suppose that you are interested in allocating these three measures in a way that would reduce the greatest amount of carbon – although there would

certainly be other considerations. Since it is generally assumed that these measures reduce energy use and therefore carbon, then a reasonable approach might be to divide the measures equally between Seattle and Cleveland.

However, Seattle is primarily a hydro-based electric system and Cleveland's electricity is produced primarily from coal. Both cities have petroleum based transportation systems. Considering their specific generation mix, allocating the above resources for the greatest amount of carbon reduction would require sending all the CFLs to Cleveland, all the plug-in hybrids to Seattle, and splitting the conventional hybrids between the two cities.

Changing out light bulbs in Seattle does many good things. It reduces consumer bills, avoids new power plants, and potentially saves water resources, but when electricity is generated from hydropower, it does little to reduce carbon. And even though plug-in hybrids are a good choice in any area – even with coal-based utilities – there is no doubt that more carbon is avoided when they are plugged into a carbon-free energy source such as hydropower. Finally, conventional hybrids should be split between the cities because both have petroleum-based transportation systems and the same amount of carbon would be avoided in both markets with this measure.

The above example shows how clean energy priorities may vary depending on the fuel mix of a region and prioritizing to reduce carbon is not always obvious. Priorities may also change based upon factors such as the renewable inventory of the region, supply availability, public consensus, water resources and much more.

### **Tools to Make Prioritizing Easier**

Before addressing the tools, consider some of the elements to be considered in setting priorities. If the central purpose is to reduce carbon, then a key calculation to be made is the Carbon Return On Investment (CROI). That is, how much carbon is removed from the atmosphere – or not placed in the atmosphere – for each dollar spent.

At Austin Energy, we use a simple calculation to determine the cost per ton of CO<sub>2</sub> per displaced dollar spent in our Demand Side Management (DSM) and renewable programs. Since we know our fuel usage according to time-of-day and the times that the different DSM measures operate, we can calculate the carbon displacement of each measure. As a result, we allocate most of our budget to DSM and then to wind, biomass and solar. A similar calculation appears in the book *The Carbon Buster's Home Energy Handbook: Slowing Climate Change and Saving Money* by Godo Stoyke. His calculation determines which personal strategy for reducing carbon and saving money will pay back your investment in energy and carbon savings the fastest.

A simple version of the CROI calculation is  $(x-y)/k$  where  $x$  is the current amount of carbon actually being produced or calculated to be produced from a certain fuel/technology,  $y$  is the carbon expected to be produced from the cleaner fuel/technology and  $k$  is the cost of the energy project. A more complete analysis would take into account the full carbon balance calculation for both options. Moreover, another version would distinguish between the marginal cost of the new technology and what it is replacing.

CROI is emerging as one of the most important criteria for choosing clean energy projects. However, other criteria could also be the deciding factor. Supply availability can be as crucial as cost. Supply constraints stretch across the entire energy sector – whether it is a lack of pure silicon for solar cells, the availability of wind turbines, building new transmission lines, a shortage of nuclear engineers, or congested rail lines delivering coal. Scarcity of

water is also becoming a critical factor, especially in the western states. Technologies and fuel sources that require little or no water are sometimes chosen on that basis alone. Many other criteria can go into a clean energy decision whether the decision-maker is a government official, corporate executive or utility manager. Tools to assist decision-makers in prioritizing their clean energy choices are essential and must take all of these factors in to account.

### **Customized Carbon Calculator**

To correctly calculate a carbon footprint, it is essential to use the appropriate electricity fuel mix that correlates directly to each footprint. There are currently several versions of carbon calculators available on the Internet that use national averaged figures and offer variations on the same theme – enter your electric consumption, vehicle miles traveled, and airline travel – and receive an estimate of carbon that you are responsible for and need to mitigate. This is problematic because again, a person living in Seattle and a person living in Cleveland would receive the same answer with the same input of data even though the fuel profile of each city is different. We need customized carbon calculators that incorporate the specific electricity mix to each footprint, instead of using a national averaged figure.

Currently, the EPA, U.S. Conference of Mayors, and Austin Energy are working to develop a customized carbon calculator. This can easily be done for other utility service areas and thus provide a more accurate starting point for carbon reduction calculations. Other refinements, specific to certain regions and behaviors, could also be added.

### **Carbon Return on Investment Matrix**

The second tool will work to prioritize multiple energy projects with the goal of reducing carbon. This tool is a matrix in a simple spreadsheet format with transparent and updateable data sources, ultimately capable of scenario analysis. Along one side of the matrix are all of the major fuel sources with accompanying technologies. For example – coal, gas, nuclear, wind, solar, etc. Click on any of them and reveal the specific technologies for the fuel conversion, such as Integrated Gasification Combined Cycle with Carbon Capture and Sequestration for coal, or Concentrated Solar Power under solar, and so forth. All major technology/fuel conversions are included.

At the top of the matrix are several columns with specific information about the fuel/technology that can be used as criteria for comparison. Cost factors used for comparison include \$/KW for capital cost, levelized cost of energy, and perhaps other cost parameters. Energy and carbon balance are listed, if known, and relevant regulations and incentives could be noted.

In addition to the cost factors along the top of the matrix, there is a Carbon Return on Investment Index (CROI) column. This column ranks the different technologies on the amount of carbon displaced by the technology in reference to a standard, such as carbon emissions from a standard pulverized coal combustion plant. The matrix would automatically sort by this index, listing the energy project options from highest CROI to the lowest.

Also included across the top would be a section on limiting constraints. A column would have notes on supply issues, showing average time of delivery for a technology. Water

consumption would occupy another column, and there could be other relevant factors shown such as emission information or environmental impact notes.

The sources of data for this spreadsheet are the major determinants of its usefulness. Rather than trying to establish an unbiased, objective source of data for each of these parameters, the data should be public and transparent. Each data source would be footnoted so the user can see the source and judge for themselves its accuracy. If there are multiple values given, the user could see each one and select the one to be used to prioritize. Over time, the data would become more refined and accurate as multiple sources converge.

In many cases, the user would have actual offers or bids to be ranked against other data. In that case, the tool would be interactive to the extent that the user could take a value from a column, like the \$/KW, or price of a unit and insert their own value based on a real offer.

Ultimately, this tool should be able to perform scenario analysis by taking limiting factors into account. In the real world a utility manager may have a limited time frame, water availability concerns and a specific financial threshold. With these limiting factors taken into account, the tool would be able to discard all options outside those set parameters and sort according to CROI or capital cost or in accordance with some other criteria for comparison.

Additionally, this tool could be customized to the entities using it, with different versions for utilities, governments and business. A business owner would be primarily concerned with prioritizing energy efficiency, curbing carbon emissions and on-site generation measures, not power plant options. Governments may be most interested in which measures to promote through incentives, or may be choosing projects for their own consumption.

If the data provided above was displayed and updated regularly with a competent scenario analysis algorithm, it would prove extremely useful to utilities and major power consumers in both selecting priorities and speeding decisions. The tool would need to have the characteristic of being updatable, interactive, transparent and rigorous.

Tools like these will assist decision-makers on numerous levels to set clean energy priorities and choose projects quickly and effectively to reduce carbon and meet energy demands.