In the August 2005 Discover Magazine, there is an article entitled Counting Carbons. The article contains information about how much carbon dioxide is produced annually as a result of normal use of household appliances. According to the article, one kilowatt-hour used in the household is equivalent to 1.64 pounds of Carbon Dioxide. Based upon national averages for a 2000 to 2500 square foot house, 74,600 cubic feet of natural gas plus 11,782 kilowatt-hours of electric energy add up to 28,643 pounds of Carbon Dioxide are produced by the use of energy in the home annually. OK, I said, I live in a 2,600 square foot house, and I am an energy freak, how do I stack up to the average? I got out my trusty NorthWestern Energy bill for August 2005, and added up the natural gas and electric energy on the bill and came up with my home's carbon dioxide production – 81.9 DKt/.9 DKt/MCF *1000 cu.ft/MCF * 0.121 lb co2/cu.ft (at 900 btu/cu.ft.) = 11,011 pounds of Carbon Dioxide from natural gas use. 4025 kwh*.413 pound per kwh – 1662 pounds from electric energy. Total CO2 for my house 12,673 pounds per year using Discover's numbers. So my house produces 44.2% of the carbon of the average American home. How do I do it? Efficient appliances and lighting, keeping things shut off when I am not using them, and throw in some solar water heating and solar electric generation, and you are there.

I don't think the Discover article took into account the carbon dioxide emissions caused by losses in the electric transmission and distribution system. My house is on the electric utility distribution system. Getting the electric power to my house involves shipping the power from the generator over the transmission system, then over the distribution system. There are transmission system and distribution system losses, basically caused by the electric current heating up the wires because of the wires' resistance. How much is lost? It varies from location to location, but for a good easy number and perhaps a charitable number, let's say 10% of the electric energy produced by central station power plant is lost through heating up of power lines.

How efficient are central station power plants? The coal fired power plants in Montana are at best about 35% efficient – in other words, it takes almost three times as much energy going into the power plant in coal as what comes out in electric energy. Where does the rest go? It goes into heat, which is rejected to the surrounding area of the plant.

So we take the transmission and distribution system losses into account, and we come up with about 31.5% efficiency of central station fossil fueled electric energy. Bear in mind that this is as good as central station coal gets. Combined cycle gas fired plants can be as efficient as 60% - this is as good as central station power gets period, 40% of the energy leaves as heat and is not useable.

How does this tie in to distributed generation? I choose to get personal, because distributed generation is personal. People can generate electricity at their homes, businesses, or in industrial sites. I choose to pick on Carbon Dioxide because the Discover article was close at hand, and I am fundamentally lazy. I could have picked sulfur dioxide, a cause of acid rain, or Mercury, a cause of autism and other mental disorder. Pollution is one reason we want our electric energy production and use to be as efficient as possible. Conservation of our natural resources is another. Other reasons? A

big power plant is an attractive target for terrorism, centralized plants are vulnerable to weather events like Katrina, and big central station power plants concentrate the relatively few jobs they create at the locale of the plant. Large central power plants tend to pollute the most nearby the plant, but also spread the pollution far and wide. I remember seeing warnings about mercury pollution in Montana lakes – another reason for catch and release.
You can see where I am heading in making the case for distributed generation. Distributed power is modular electric generation or storage located near the point of use. We can easily extend the concept of distributed generation to include energy efficiency, in which case we call it distributed energy resources, but I'll focus this talk on distributed generation, and I'll make the case that electric generation at the point of use can be more efficient and cleaner than central station power generation.

How efficient and clean is distributed generation? Well, the first thing that makes it more efficient is that there are comparatively little electric transmission and distribution line losses. If the generator on my house generates more power than my home uses, the power naturally goes to the nearest load, my next door neighbor. I argue that because of that, the power generated at the point of use is worth 110% of that at the output of the central station. Past the line loss issue, we have to talk about technology. What kind of generators are available, and what are their pros and cons? First, fuel consuming distributed generator technology includes reciprocating engines, gas turbines, and fuel cells. Their main benefit in distributed generation is their ability to put to use the 65% of the energy rejected in heat. We can use this heat in manufacturing processes, for space heat, and for water heat. These systems are called combined heat and power systems, and the overall plant efficiency can go up to as 65% or even higher. Even if the generator was fueled by coal, the pollutants emitted would be less than one half that of coal fired central station power. Distributed generators can take advantage of locally produced fuel such as methane from landfills, confined animal feeding operations, and waste water treatment plants. In this case, there may be no net carbon added to the atmosphere, and odor control can be an added benefit. In fact, methane production is a by product of odor control systems. Solar fueled generators are even cleaner, adding no pollution to the local area. These generators are of course solar electric systems and wind energy systems. In a sense, the efficiency of these systems is not an issue, because the fuel is delivered free, on site. They are as clean as we can get.

When people complain to me about their power bill, I sometimes suggest that they can disconnect from the utility and generate their own electricity. Why don't they? We all need to recognize that the electric utility is a great security blanket. Not only is the power there when we need it, it is comparatively dirt cheap if we ignore the environmental costs – which we typically do. The basis for economic comparison for any distributed energy resource is the electric utility. The only way that anyone will install distributed power is they have some reason other than economics – environmentalism, bad power quality because of their location, a desire to own a cool toy, an unreasonable hatred for the utility. I have heard all of these. What people don't realize is that we need the distribution utility, even if we are generating our own energy. If the distributed generator is not working, the utility is there. We need the distribution utility to get our generation to our neighbor if we are producing more than we need. Without the utility, storing the energy produced by an intermittent resource like wind or solar represents a large cost to the distributed generator. Utility reticence regarding distributed generation is caused by two things: Archaic rate design, and unfounded safety concerns. Rate design must be done for the future to better accommodate distributed generation, taking into account societal benefits of distributed generation. Utility resistance to distributed generation stems from ignorance of safety standards and codes which are in place to assure the safety of distributed generators. The fact is that thousands of distributed generation systems are installed and working in parallel with the utility grid, and I have not heard of one instance where a properly installed distributed generator has caused any injury.

There are policies in place that help distributed generation, but they fall short of doing what needs to be done to see wide spread adoption of distributed generation. The most helpful policy for distributed generation is net metering. Net metering allows the generator to bank energy with the utility for later use. The Public Utility Regulatory Policy Act of 1978 requires utilities to purchase power from qualifying facilities. The Montana Renewable Power Production and Rural Economic Development Act requires utilities to purchase renewable energy. A 30% federal income tax credit will be available staring in 2006, and a state income tax credit has been in place for some time now. Low interest loans for renewable generators are available through the state Department of environmental Quality. These are all positive steps toward implementation of distributed generation. However, they fall short. Limitations on the size of renewable generators that can be interconnected and interconnection requirements by utilities is a continuing barrier. Uncertainty about the rates paid to qualifying generators is a barrier, to be addressed by the Federal Energy Regulatory Commission, sometime in the next few months. The failure to take societal benefits and environmental externalities into account when determining appropriate rate treatment for renewable generators is a barrier. In fact, Northwestern Energy has implemented policy to keep any environmental benefits resulting from net metered systems, systems installed which cost them nothing, to help show they are meeting requirements of the Montana Renewable Portfolio Standard. This is getting something for nothing, and it is taking the potentially saleable environmental benefits away from the people who paid for them and giving them nothing in return.

So how do we get around these barriers? We need to get the utilities all on the same page as far as what technologies must be allowed net metering, to include biomass energy. We need to go back to the legislature and get the limit to net metering of 50 KW removed. Cooperative members need to let their Cooperative boards know that a 10 KW limit to distributed generators is not acceptable. We need to work with the Public Service Commission to set reasonable utility rates for distributed generation to sell energy. We need to work with the PSC to grant some credit for environmental benefits of distributed generation, including credit for line losses avoided by using DG. We need policy to make sure that the proper owners of DG can sell the environmental benefits if they wish.

What else can we do to encourage DG? Get credit for the time value of the power generated. Solar electric systems generate on utility peak in the summer time, wind systems generate on utility peak in the wintertime. Other DG technologies, pumped storage facilities and landfill or digester methane can generate when the utility needs the power, and store the gas generated on off peak times.

I hope I have conveyed to you that DG is more efficient and cleaner than central station coal fired power. I also hope I have conveyed to you that although there are policies in place to encourage distributed generation they fall short of their aim. My vision for the future is to have everyone, homes, businesses and industry to be generating their own electric energy, and using the waste heat for process, space, and water heating. If we were to do this, we could easily double our overall electric energy efficiency, save natural gas used for heating, and enjoy a cleaner environment.

As I continue to work on my home's efficiency and as I continue to add generation capacity to my own generator, my use of coal generated electric energy will go down, my goal is zero.

I task everyone with doing the energy limbo – how low can you go?