Insight
Energy Security (and saving the planet)

An edited version of this Insight first appeared in the ASHRAE Journal.

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Energy security is pretty easy to get a handle on—don't buy oil from the Middle East, Russia, Nigeria and Venezuela. We don't need it anyway. We have plenty of energy right here in good old North America. The problem is that it is not cheap energy and it is not clean energy. We can make it clean, and we will, but it will be even more expensive. And actually that is good because we won't waste it when it is expensive.

To be perfectly clear we don't have an energy crisis we have a cheap oil crisis. We are running out of light, sweet, Arabian crude (**Figure 1** and **Figure 2**). And guess who has the oil (**Figure 3**)? The sooner we run out of it the better. As soon as the price of oil gets high enough we will change over to another energy source.

Here's the way I see it. The first thing you have to understand is that energy security is first and foremost a car-truck-transportation problem that—as it gets solved—will change the rest of the economy—for the better I might add. In fact we have already solved the transportation problem although most folks don't appreciate it. The good news is that the Government didn't do it and couldn't do it. The bad news is that Government might yet still screw it up. I want the marketplace and innovation to sort it out. The only thing we need from government is a modicum of environmental protection so we don't pee in our collective planetary bed while this gets sorted out. I think we can count on that—the environmentalist's heads would otherwise explode.

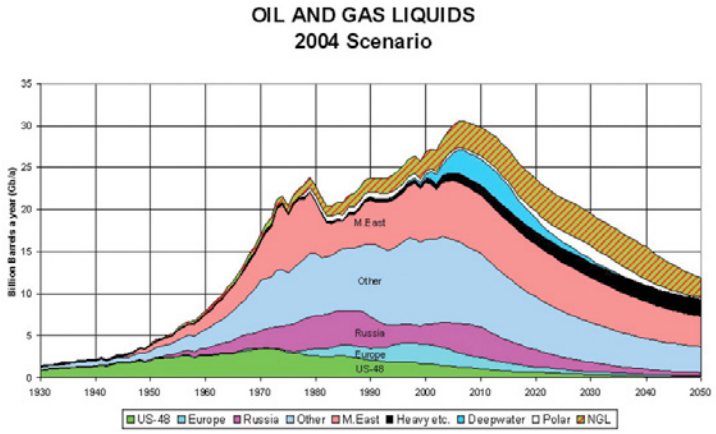

Figure 1: "King" Hubbert—When a modified Hubbert approach is applied to world oil production we see that either "peak oil" is here already or very close. M. King Hubbert was a geoscientist who worked for Shell Oil in Houston who predicted correctly that US oil production in the lower 48 states would peak in 1972. Dr. Hubbert predicted this in the 1950's. *Graph is from the Uppsala Hydrocarbon Depletion Study Group*.

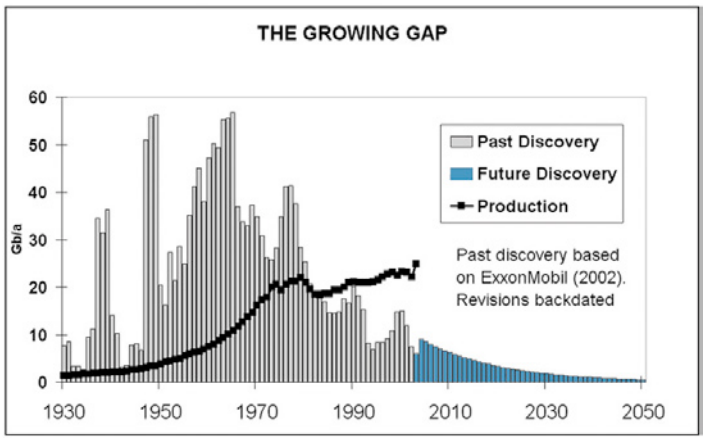

Figure 2: Where Have All the Dinosaurs Gone… Long Time Passing?—Oil comes from dead dinosaurs (according to the Fred Flintstone school of geology) and there aren't no more dinosaurs around to die….we aren't growing more dinosaurs. Let me translate. There is only a fixed amount of oil to find and that amount is a function of our Planets geologic history. When you are using twice as much as you are finding you will run out. I see a pattern developing here between current Government energy policy and current Government economic policy…Only a Government can spend twice as much as it collects. *Graph is courtesy of Chevron Oil*.

So what is this solution to energy security? The plug-in hybrid vehicle. That's it? Yes, that's it. Not fusion? No. Not solar? No. Not the flux capacitor? No.

A hybrid vehicle is nothing more than an electric vehicle with gasoline as the energy source for the electricity. When we add a big enough battery we can plug it in and

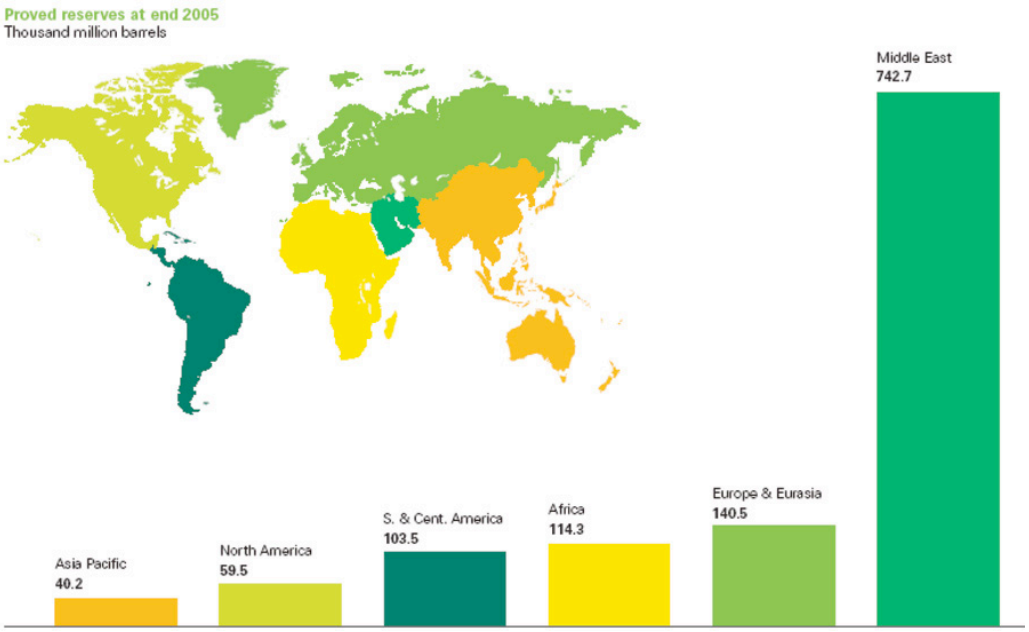

Figure 3: Who Has The Oil? Nice, stable governments. *Graph is courtesy of British Petroleum*.

run the vehicle using juice we get from the grid rather than juice we get from the gasoline. As we transition current hybrid vehicles from nickel hydride to lithium ion battery technology we are going to be able to plug-in the vehicle and get 50 to 75 miles between charges. This is a big deal because this is the distance of the average commute. And we don't have to worry about running out of battery power because we still have the gasoline there to take over when we run the battery down.

It gets even better when we dilute the gasoline with ethanol—and boy can we dilute it—up to 85 percent (E85 ethanol is 85 percent ethanol, 15 percent gasoline)—and presto—end of transportation energy problem, hello energy independence. The vehicles will have all electric drive[1] —gasoline/ethanol will be burned only to run a generator to charge the battery packs.

Will the vehicles get smaller? What are you on crack? This is America—the land of the 60 oz. Slurpee and the 40 oz. bladder. We are a nation of big assed Americans with big assed cars and trucks. We are going to go for high performance and size. How do you say 500 brake horsepower in kilowatts? Do you have any idea what torque you can get with series-shunt electric drive? We don't have the tire technology to take the stress. Electric dragsters will leave the nitro burners in the dust.

So what is this transition of the transportation sector from petroleum to electricity and ethanol going to do to the rest of the economy? Well, electricity is going to get expensive—very expensive. And so is natural gas, because we make electricity from natural gas. Oh, we make electricity from coal too, but coal is dirty, and we are going to have to make it clean and that will make it expensive. So we will have expensive electricity made from natural gas and from clean coal. What about Nuclear? It will be cheaper to make the electricity out of clean coal than with Nukes. The big problem with Nuke is what to do with the waste. We were going to stick it in Nevada, but too many people live there now and the Congressional representation is now strong enough to kill that idea. So where to put it? What's a big state with no people and weak Congressional representation? I pick Montana.

With the plug-in hybrid I bet the cost of electricity will go to 35 cents/kilowatt and the cost of natural gas will double. At 35 cents/kilowatt that translates to 75 cent/gallon gasoline. Peanuts, nothing, zip, zilch. Electric plug-in hybrid vehicles win. The American Dream lives on—we do love our cars. Now, with winners, there are often losers.

Who loses? Pay attention here, now comes the fun part. Buildings consume 40 percent of all energy in the US economy (**Figure 4**)—more energy than the transportation sector (which pushes 30 percent). We cool our buildings with electricity and heat our buildings with natural gas. Folks, we are going to triple the cost of air conditioning and we are going to double the cost of heating. The transportation sector is going to compete

[1] The General Motors "Volt" is an impressive piece of work. The internal combustion engine runs only a generator to keep the battery pack charged. It is all electric drive. I had my doubts about GM–I still do–but they could actually pull this off. I can hardly wait for 2010 when it rolls out. This vehicle could change everything. Detroit could get its Mojo back – and help the Republic as well.

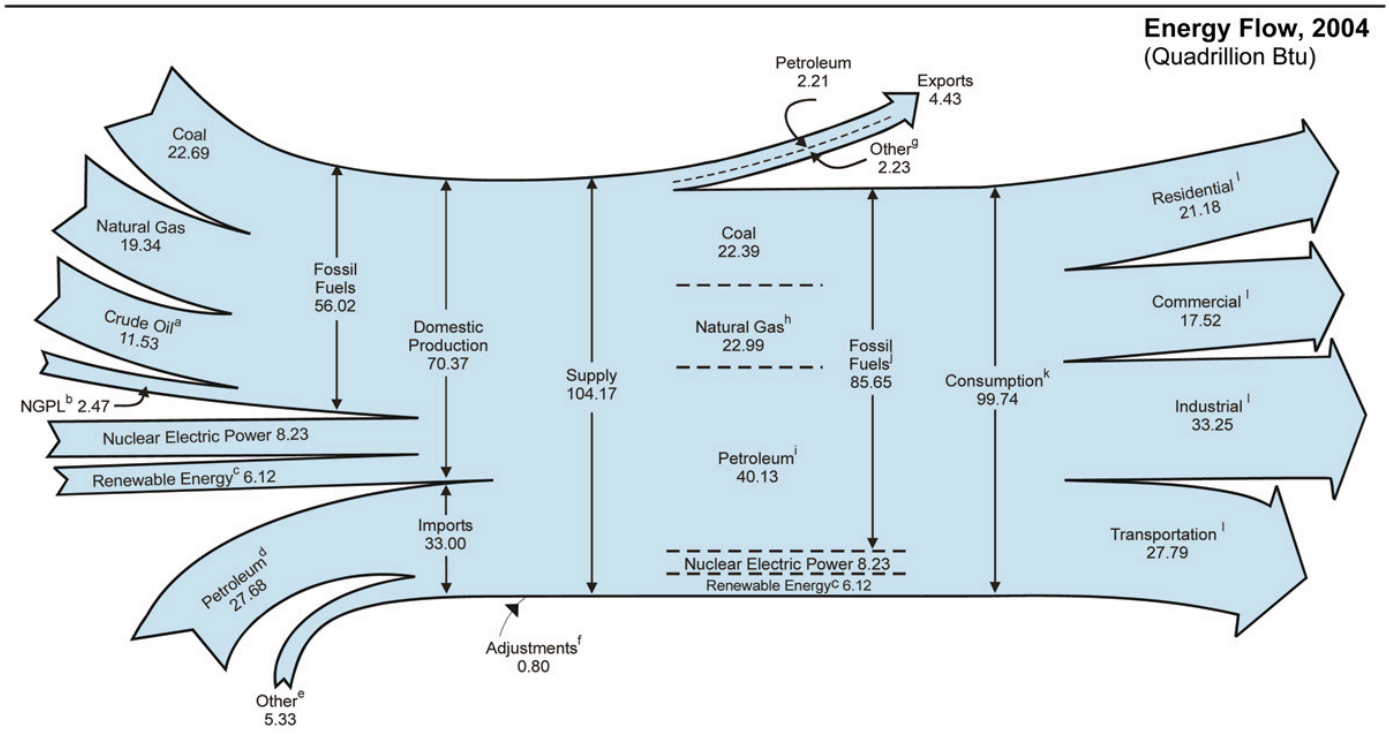

Figure 4: Energy Flow In the US Economy—Neat graph – energy "input" into the economy on one side and where it goes – the "output" – on the other side. Note that the building sector currently uses the most energy – more than transportation and more than industry. The transportation sector will compete with the building sector for the same energy. Guess who will win? *Graph is from the US Energy Information Agency.*

with the building sector for the same energy and the transportation sector is going to win.

A rational person would say, OK, just make the buildings smaller, with smaller windows, and smaller appliances. I remind you this is America. Twiggy is an European icon. Anna Nicole is an American icon. Next question. We are not going to get smaller buildings but we are going to get ultra efficient buildings. We are going to double and triple the amount of thermal resistance in the typical building enclosure. We are going to insulate, and we are going to insulate big time.

Now this is both good and bad. Good for energy security, bad for building durability. Insulation reduces energy flow and here is a good time to remind everyone that there is no such thing as a free thermodynamic lunch. As the energy exchange across building enclosures reduces, drying potentials reduce and this means we are in for a world of hurt in the coming years in terms of corrosion, decay, mold and other moisture induced deterioration as we change our building technology to take into account the new energy cost realities. It gets ever worse, or better, depending on who profits from the problems, when you consider that over 80 percent of the buildings that will be around in 2035 are already here and they will have to be insulated as well (**Photograph 1** and **Figure 5**). Who knows how to do that? I can tell you who does not: the info babes and male models on cable TV doing renovation shows.

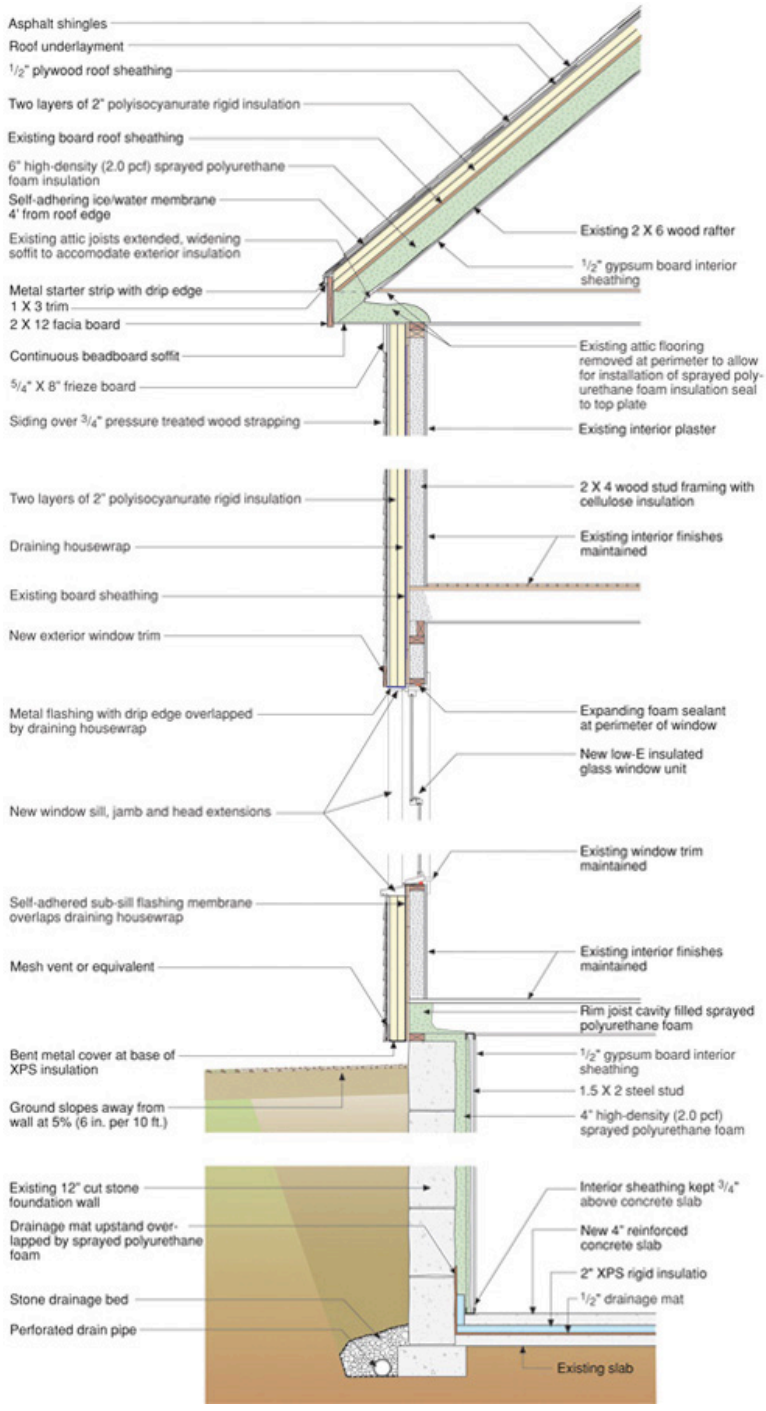

Figure 5: Super Insulated Retrofit—R-60 roof, R-40 walls, R-20 basement wall insulation, R-10 basement slab insulation. Reduces total energy consumption to 65 percent of that of a similar building constructed to the 2003 Model Energy Code.

Building science and building diagnostics and building technology and building rehabilitation are going to boom because things are going to bust. Can it get even better? Yes. They can't out source the jobs offshore to Bangalore, India. This has to be fixed by Americans right here in America. The future is not in plastics, my boy, the future is in construction. Actually, the future is in fixing construction.

Lets now go back a step and look at the ethanol part of this a little bit more closely. Where are we going to get the ethanol? Look around Grasshopper. The politicians are meddling. Corn is not the right play for the ethanol source, but that is where the subsidies are going. It is never smart to trade food for fuel. The price of corn is going way up. That means beef prices go up too—the Big Mac price index is in for a ride. Yes, food prices are going to go up because the politicians are meddling. Cellulosic ethanol is the answer, but we will get corn ethanol in the short term until this silliness gets sorted out.

Now, this is not the key point for us in the construction industry, entertaining as it may be. This ethanol thing is going to affect us in a big way once the marketplace figures out that cellulosic ethanol is the right play. One of the dominant building materials we use is cellulose fiber. It is likely to be a winner in the future as well. However, it does not make sense for us to get this cellulose fiber by cutting down 1,000-year-old trees in Washington State. We should be growing and harvesting our fibers in Iowa, and Nebraska and Mississippi and Alabama on plantations.

And we are beginning to do so. The days of 2x10's and dimensional lumber are over. The rise of engineered wood, OSB, hardboard, particleboard, fiberboard and laminated paper composites has arrived. All of these products are cellulose fiber based. All will be in competition for the same cellulose fibers that the transportation sector also covets. Cars will be competing with buildings for the same energy and raw materials. We know who will win. The car always wins. That means that the fibers the building sector will get will be second rate and expensive. And none of the engineered wood products are as

durable as the real thing—wood. We will be adding stuff to the fibers to make the stuff work. I predict the stuff won't stay in the stuff and we will have environmental issues right along with the durability issues. Damage Functions and the Arrhenius[2] Equation here we come.

The steel industry and the concrete industry and the glass industry are going to take their lumps in all of this. Steel and glass and concrete architecture may win design awards, but you can't build energy-efficient structures out of steel and glass and concrete—unless you reduce the amount of glass and insulate the rest on the outside.

We are going to have fun boys and girls. Think about what lies ahead? Less robust materials in highly insulated building enclosures with low drying potentials. Stuff is going to stink, rot, break and otherwise annoy. This process has already begun, with part load humidity problems and mold. There are going to be a lot of mistakes in the next decade as we get all of these things sorted out. But I wouldn't trade this for anything else in the world. Because our country needs us to clean up the mess from the energy security ethanol hangover we are going to have.

Photograph 1: 1912 Sears Craftsman House Retrofit—Super insulated retrofit done to an existing century old building in Concord, MA. Section shown in **Figure 5**. This is what the future for existing buildings looks like.

[2] Svante Arrhenius. Dead, European, Nobel Prize Winner, no longer fashionable to study. Dr. Arrhenius showed that every 10 degree Kelvin rise in temperature "doubles the badness" for materials. Same for relative humidity and ultra-violet radiation. The Arrhenius Equation addresses the effect of the temperature, relative humidity and UV damage functions on building materials. He also "invented" the "Greenhouse Effect." It wasn't Al Gore – Mr. Gore was too busy inventing the internet…