Sell The Beach House, Part II

Students sometimes ask me what they can do personally to "stop" global warming. That question makes me uncomfortable, because I pride myself on being truthful – yet, I don't want to be a Gloomy Gus and rain on the parade of an enthusiastic 19-year-old. So, I usually just smile and give them my Standard Answer: save energy. Drive a high-mileage car. Buy LED light bulbs. Don't leave the door to the fridge open.

However, that isn't quite the truth. Saving CO_2 emissions by using energy-efficient appliances can help *slow down* global warming, but it cannot stop it. Recycling and other eco-friendly ideas are fine and useful by themselves, but they also cannot do more than *slow down* the warming. Unfortunately, the only way to ***stop*** global warming is to halt all CO_2 emission by human civilization, and that means facing a terrible truth: there isn't thing one that my students or anyone else can do to stop global warming within our lifetimes. We will be lucky if we can stop it within the next 150 years.

Let me give you a few numbers. As I write this, in 2012, the United States has yet to install even a *single* off-shore windmill. (Off-shore windmills tend to be larger and more efficient than the land-based variety.) The largest land-based wind turbine currently built by General Electric can put out 2.75 megawatts. The United States uses about 108 quadrillion BTUs of energy per year, so if you do the arithmetic that means we would need to construct a flabbergasting 4,379,000 windmills to provide us with the energy we use now (assuming the windmills are active 30% of the time, which is typical). At an average price tag of $3 million each, the capital cost alone of switching from fossil fuels to 100% wind power would be $13 trillion. This price tag does not include the upgrades to the nation's electrical network that would be necessary to cope with over four million new generators. Nor does it take into account any growth in our energy needs.

And of course, it does no good to generate all that electricity if no one can use it. Converting America's 350 million vehicles to all electric power would cost about $25,000 per vehicle for a total price tag of $8.75 trillion, and converting 100 million homes which now use oil or natural gas to all-electric heat would cost another $500 billion. Frankly, I have no idea what it would cost to convert all of America's gas stations into fast-charge electrical stations, and I am also not quite sure how to build an all-electric jet airliner.

The bottom line is, converting the USA from a fossil-fuel economy to a windmill economy would easily cost north of $25 trillion. We use about a fifth of the world's energy, so that puts the global cost of such a change somewhere around $130 trillion.

Technologically, we still have enough time to stop global warming. Economically, the necessary funds could be generated over a span of maybe 25 years if we really put our minds to it. But politically? As our good friends from New York City would say: *Forget about it*. As long as the world-wide cost of shifting to alternative energy sources is $130 trillion, I boldly predict that we aren't going to shift. In answer to the objection that the mass-manufacture of windmills would bring their cost down, I say, not enough to make a difference. The primary cost of a giant windmill is not the parts in it, but rather the labor needed to construct a monster tower the height of a 20-story building. There is no reason to believe that the cost of wind power will diminish by more than perhaps half with expanded usage.

One could talk about solar and geothermal energy, of course, and I am not going to knock the air out of their sails the way I just did with wind power – but I could. Even now, after decades of hype about alternative energy, the United States ***still*** gets 89% of its energy by burning stuff (oil, coal, natural gas, wood), and the sheer tonnage of carbon fuel that we burn each year is relentlessly going ***up***, not down. It is true that some of the secondary economic derivatives, such as the rate at which we are increasing our use of fossil fuels, are

leveling off or going down, but the amount of fuel itself that we use is still going up. This is a fine time to own oil stocks, I regret to say.

Even worse, most of that 11% of non-carbon energy which we do use isn't derived from any glorious alternative energy with a bright future. Most of it is old-fashioned nuclear energy (7%) based on the fission of uranium-235, which has capital cost issues even worse than wind power. The rest is hydroelectric power (3%), which has virtually no future at all, because the industrialized world has already dammed almost every river that it makes any economic sense to dam. Wind, solar, and geothermal energy all combined account for just 0.5% of our energy supply. We (human civilization) now use 45,000,000,000,000,000,000 joules of energy per year, 90% of which is generated by burning carbon fuels, and folks, that represents a lot of burning. We have spent 250 years building an industrial civilization that is powered almost solely by fossil fuel, and this is one ship that cannot be turned on a dime.

In a world already drowning in debt, with the the U.S. already running a Federal deficit of $800 billion per year and with 48 states out of 50 also running deficits, with Europe's entire economy shaking as several nations teeter on the brink of complete insolvency, with even China's economy beginning to slow down, it is lunacy to believe that the human race will suddenly get its act together and start spending anything like what it needs to on windmills (or any other form of alternative energy). Social commitments and the military will continue to gobble up most of the world's money, just as they do now – and I haven't even begun to consider how much political muscle the oil and coal companies of the world might begin to flex if their profits were to ***really*** be threatened by large expenditures on alternative energy.

Don't get me wrong. I think it would be wonderful if love and peace suddenly blanketed the planet. It would be wonderful if our so-called leaders linked arms, started singing happy songs, and vowed to lay down their weapons and divert the military trillions we spend into upgrading our energy infrastructure.

I'm just not holding my breath, that's all.

I don't fault my students for believing that there is a solution to global warming. It is very American to assume that every problem has a solution, and that every problem can be solved if you just apply hard work and good old American know-how to it. Look at the propaganda (excuse me, I mean of course the thoughtful and nonpartisan solutions) generated by the two major political parties. The Right is afraid to admit that global warming is even a problem – because in American that would mean there is a solution to the problem, possibly involving taxes on their favorite oil companies. So, they have spent years lying through their oil-industry teeth and proclaiming that the warming is all a myth.

As for the Left, since there must be a solution to the over-use of fossil fuels, they have brilliantly decided that the best solution is to – stop using fossil fuels. The general idea here is that fossils fuels are a luxury, so a carbon tax to discourage their use and encourage the use of alternative energy is the politically perfect way to stop the ice caps from melting. I refer you to the above numbers on windmills, and note that the Left might as well propose blocking out the Sun by putting giant Venetian blinds into orbit around the Earth. That would certainly cool the Earth, and it would be exactly as realistic as thinking that we can do without fossil fuel anytime soon.

I would get grim satisfaction from being able to appear on a nationally-televised news show someday, just to watch the expression on the face of some Big Name anchor as I calmly informed him or her of the simple truth: no one has a good "solution" to global warming, because there isn't any solution to global warming. We have ***already*** gone too far, and now we are going to have to live with it.

Let me hammer this point home. One of the less appreciated aspects of CO_2-driven warming is the fact that the Earth would continue getting warmer for at least another 30 years – then stay at that new temperature indefinitely – even if we could stop burning all fossil fuel tomorrow. You see, putting greenhouse gasses into the atmosphere is something like putting on a coat: there is a time lag between when you put on the coat

and when the warmth of your body heats the interior of the coat to its maximum temperature. The Earth has not yet caught up, temperature-wise, to even the CO_2 that is already in the atmosphere, never mind the CO_2 that we have yet to emit. The world has approximately a 100-year supply of fossil fuel, based on known reserves, so I personally suspect that means we can expect at least another 100 years of happy combustion before we finally move to an energy economy completely free of fossil fuel. By that time the amount of CO_2 in the atmosphere will be probably 50% larger than what it is now, with a correspondingly greater greenhouse effect.

(Yes, I am aware of schemes to combat global warming by constructing "anti-CO_2" factories that would take the CO_2 out of the atmosphere and bury it in the ground. I am aware of schemes to salt the oceans with iron fertilizer to encourage the growth of plankton to help remove CO_2 from the atmosphere. These schemes aren't nearly as crazy as they sound, because they would work fine except for one thing – we can't afford them. I refer you back to my paragraph where I boldly predict the world will not spend $130 trillion to stop global warming.)

In the very long run, I am optimistic enough to believe that humanity will not melt the polar ice caps. But don't kid yourselves, folks. Global warming is going to get a lot worse before it gets better.

I have therefore become an advocate of what might be called "warming futurism". I do not spend much time worrying about what ***I*** can do to stop global warming, because I don't believe that I can. Instead I think about what I can do to help *future generations* deal with global warming, since they are the ones who will actually have to.

My thinking in this direction revolves mostly around energy research. Research takes time as well as money, and time is the one thing we have which future generations very well may not. (Indeed, it is precisely because we have so much time left before the world melts that our so-called leaders are not willing to spend the $130 trillion that it would take to shut the melting down.) The Americans of the future will, sooner or later, find themselves facing extremely strong incentives to start building non-carbon energy infrastructures, no matter what the cost. But, they may or may not have much time to decide what to do, and they may well have nearly no time at all to do any in-depth research.

To put it another way, our generation has (alas) very little political incentive to actually do much about global warming, but we do at least have the luxury of enough time to think about it. Future generations will have vast, dare I say imperative incentives to stop global warming – but they may be very short on time, if our so-called "leaders" dawdle and delay as much as I am sure they will. If we are going to leave our children a world choking in CO_2, then at the very least we owe them the research and the technology they will need to help fight it.

Thus I strongly support research into any and every non-carbon energy source you can imagine, across the board and certainly including nuclear energy, because our children are going to need that research. Whenever I am asked about the "best bet" for future energy sources and where we would be best advised to place our energy research dollars, I flatly say, there is no best bet. The global need for energy is almost unimaginably vast, and getting vaster every day. Renewable energy sources currently provide a pathetic percent or less of our total energy, whereas in the not-so-distant future they will have to provide it all. We cannot afford to be politically correct about this. We cannot afford to be picky. Off-shore wind, on-shore wind, biomass, passive solar, photovoltaic solar, advanced nuclear-reactor cycles, traditional geothermal, low-temperature geothermal, you name it. We will need them *all*.

As I write this, the primary opposition to building off-shore windmills arises from concerns that the windmills will spoil the lovely ocean views of the well-heeled who live along the shore. This sort of appalling self-absorption is a perfect example of what I mean when I say that political forces prevent our generation from doing anything serious about global warming. The selfishness of the present trumps our benevolence for the future. Our grandchildren, however, will not be able to afford such politics. The politics

of selfishness must inevitably give way like dust in a hurricane before the onslaught of ***real*** global warming and the utter, nearly desperate need of the future to find energy sources that do not emit CO_2. We may or may not owe our descendants any working off-shore windmills, but we certainly owe them the research, the knowledge, and the technical know-how to build their own. Research takes time as well as money, and time is something on *our* side, not on the side of the future.