2005 and Beyond: Reflections on the Past and Predictions for the Future

Chapter 12

Despite the significant effort expended to gather the words, images and remembrances presented in the previous chapters, I find this final chapter of the FSEC chronicle hardest to write. Assembling the past is easy compared with predicting the future, but yesterday always frames our view of today and tomorrow. Within the framework of the 21st century, we already see FSEC's institutional demeanor changing along with the picture of the nation's energy status.

Reflections on the Past

Looking back on the last 30 years, I am most disappointed in our still-insignificant use of solar energy and the slow growth of the solar industry. The successes in building energy efficiency have been truly outstanding over the years, but solar has not achieved anywhere near the same level of success. In particular, I am deeply disappointed by the minimal penetration of solar water heating in the housing market and the continuing high price of PV. PV costs were predicted to drop to $1.50 per watt many years ago, yet costs are still $3.50 to $4 per watt – about $7 per watt installed.

I am convinced major responsibility for this dilemma lies in Washington, which still avoids the needed national leadership and vision. Let me recall some comments made by FSEC staff during the '70s:

"A considerable amount of creative work will be required to realize the great promise of essentially endless energy which the sun provides. The sun is ultimately the source of all life on earth – we must reassert that fundamental fact and take advantage of the innovations which inevitably result when active groups of talented engineers and scientists work together toward exciting and challenging goals."

– Ross McCluney, Research Associate, 1977

"The impact of today's energy problems has no exceptions. Every person, institution, and industry has felt the effects of dwindling non-renewable fossil fuel sources and soaring consumption. Energy is and will be the most significant technological, social, political, and economic issue ever faced by the world."

– David Block, Director, 1977

"The solar age finally dawned upon America on "SunDay," May 3, 1978, as millions of citizens, young and old, from Maine to Hawaii, joined in a celebration of the sun. It was a great day for solar energy. These activities won national media coverage as President Carter announced the domestic policy review and a $100 million boost in the federal solar budget. Then in October, after 18 months of protracted action, Congress finally passed an energy bill providing tax credits of up to $2,200 on solar purchases, retroactive to April 20, 1977."

– Subrato Chandra, Senior Systems Analyst, 1978

"World gas and oil reserves continue to decline, and suitable alternate energy sources have not yet become available. I am pleased that Americans everywhere are really conserving energy, but that is not enough. Not only may we eventually exhaust these reserves, but recent experiences with foreign sources of oil certainly have shown that the United States must become energy-independent of other nations, not relying on friend or foe for this precious commodity."

– Omar G. Hancock, Research Engineer, 1979

"The solution to the energy problem will be reached only by all of us working together."

– David Block, Director, December 1979

These remarks resonate almost 30 years later because of the lack of national leadership and the seesaw nature of the political environment in Washington. We, as a nation, have transformed President John F. Kennedy's plea from "Ask what you can do for your country" to "What can I do for the good of my party and my re-election?" This shallow thinking weakens our commitment to energy security, so our energy policy waves back and forth with the political tides.

A review of the energy budgets presented in Chapter One supports this view. At the beginning of the energy crisis in 1974, President Nixon budgeted just $21 million for renewables. Six years later, President Carter raised that number to $833 million. The Reagan presidency dropped the number from $824 million in 1981 to $401 million in 1982. President George W. Bush's renewable energy budget for 2002, 20 years later, was $425 million – about half of Carter's budget number. As dismal as these numbers are, imagine how they look when adjusted for inflation – $425 million in 2002 compared with $1,790 million in 1980 – a fourfold difference going in the wrong direction.

When researching the renewable budget numbers, I also looked at the federal budget numbers for nuclear, fossil and conservation technologies. If you sum these total federal dollars

between 1974 and 2002, a 28-year period, here are the results: renewables received the lowest amount of total funds – just $9.5 billion, while nuclear received two-and-a-half times that amount – $24.1 billion. At $10.1 billion, even fossil technologies received greater support than renewables. Conservation and energy efficiency efforts received a total of $14.1 billion over the 28-year period.

Given these funding disparities, those of us in solar R&D can be very proud of what we have accomplished. Despite massive financial support for nuclear, not a single nuclear plant has been constructed in the last 28 years. Yet, with minimal support, solar technologies have significantly advanced. Something just doesn't make sense here.

Consider an even more glaring discrepancy. Congress and the administration have had no problem in spending hundreds of billions on two wars in the oil-rich Gulf. Think of the advances in renewable technologies the nation could have accomplished if only a small percentage of these billions could have been directed towards renewable energy research and development.

Beyond government, our educational institutions have failed in guiding the nation toward a sustainable energy path. Our educational programs train the nation's future leaders. Almost every university in the United States has a series of academic programs in information and computer technologies, and engineering – education's glamour fields. But, with very minor exceptions, no university has an academic program in energy or renewables. Why? Simply put, our lack of national leadership.

Need I say more on the nation's misplaced priorities?

Energy Concerns

We know some facts about our energy future. One is that only three forms of energy will be available to us – fossil, nuclear and renewables. There is no genie in a bottle and no technology advance will change this fact. So, we must build our energy future on these three resources.

Facing this fact, how will we answer the following questions?

- *Can the U.S. continue to increase its use of imported of oil?*
- *Can the nation achieve any type of national security with continued reliance on oil from the Middle East?*
- *Can we as a nation continue to deplete our native natural gas resources for utilities and transportation?*
- *Can we continue to ignore improved gas mileage requirements through higher CAFE standards?*
- *Can we continue to produce SUVs forever into the future?*
- *Can the world's oil supply keep up with demand?*
- *Can the U.S. continue to price its oil at one-half the world price?*

Troublesome realities shape the answers.

- *The U.S. now imports almost 60 percent of the oil it consumes; drilling in the Alaska National Wildlife Refuge will not appreciably reduce this percentage.*
- *Two Gulf wars in 10 years have reduced, rather than strengthened, our national security. Just picture the devastating effect on stability of oil supply and demand if a Saudi prince were to be assassinated.*
- *In 2003, the U.S. produced 17 million new cars; China produced 4.4 million new cars. The U.S. now has 220 million cars; China's foreign minister predicts that China will need 120 to 150 million cars by 2020. Where will the world get fuel to propel these vehicles?*
- *As China and other nations burn more and more coal to meet greater and greater demand for electricity, the globe will bear an even larger environmental burden.*
- *The revolution in communication technology will drive underdeveloped nations to grow and develop – their populace will require*

it. In the not-too-distant future, every person and location in India and China will be accessible by cell phone. Society in these countries will want to grow and will demand energy to fuel this growth. In the past, we used cheap energy resources – oil, natural gas, coal, iron ore, etc. – to fuel such growth. We will need to find more and more energy resources to support global development.

- *Fossil fuels will remain the lower cost option until they become scarce and demand greatly outstrips supply. Many of the world's foremost geologists believe the world will reach peak oil production around 2010 to 2020. [See Reference 150 for an excellent discussion on this topic.] Once the world starts on the downswing of the oil peak, demand will drive up costs.*
- *The U.S. economy is built on a base of low energy prices for both electricity and transportation. The country's ability to maintain these low prices will be severely challenged in the future. With most of our oil coming from outside our borders, we will not be able to control its price.*
- *Because of environmental and national security concerns, use of nuclear fuels has not grown or changed over the past 30 years. A major energy crunch in the future will almost certainly alter this trend. And war has a way of quickly altering public opinion. Also nuclear technology has the potential to become a supplier of hydrogen, which in turn, would have the effect of making nuclear more popular.*

Discussions on each of these topics make up entire books. But even this brief overview clearly makes one point clear: business as usual is not a possible future solution. The only real answer to these issues is massive conversion to renewable technologies. R&D to support this inevitable answer must be given the highest priority, and support for it must come from the top.

Predictions for the Future

Because of the finite supply of fossil resources, and the environmental and security dangers inherent in nuclear resources, I see renewables as our only viable energy means for the future. With minimal environmental effects, renewables have the versatility to be used directly for thermal energy, to produce electricity through a variety of technologies, and to provide transportation fuels as either ethanol or hydrogen. Environmental aspects will make renewables our future winner.

Only one energy carrier bridges fossil, nuclear and renewable energy – hydrogen. The importance of hydrogen in the nation's future makes it equally important to FSEC's future.

Look at Iceland – the little country that could.

With its abundant geothermal power, Iceland may well become the world's first hydrogen energy economy. It plans to convert all the country's 180,000 vehicles and 2,500 fishing trawlers to hydrogen. This transformation won't happen overnight; Iceland is giving itself 30-40 years to accomplish the change. The scheme is backed by DaimlerChrysler, which will build the country's first hydrogen-fueled buses, together with energy giant Royal Dutch Shell and Norwegian industrial group Norsk Hydro. All three firms have invested in a new company called Icelandic New Energy, which, with the

government, aims at showing the world that a hydrogen economy can exist and function quite favorably. This test-bed economy may well hold the key to mankind's future energy needs.

So why not Florida? What location in the U.S. has more potential for a hydrogen revolution than NASA Kennedy Space Center with its need for hydrogen to power the Shuttle? Imagine the start of a hydrogen economy in the U.S. born at KSC. We can use renewables to produce hydrogen to send the Shuttle to space and to fuel our vehicles on earth. This is our future!

We don't have to wait for hydrogen innovations to make a difference in Florida's energy future. Solar pool heating and water heating are proven to be reliable, cost-effective technologies that pay back their costs in energy savings. My own solar water heating system proves the cost-effectiveness of the technology. We need programs to support greater use of these systems.

Moreover, we need support for photovoltaics – the electric generation technology of the future. For electricity generation, PV fits the bill – simplicity, no moving parts and output that follows the utility peak demand. These systems are already cost-effective in many specialized applications. Costs have dropped a hundredfold from the product's early development days to today's price of about $7 per watt installed, which translates to a cost of about $0.20/kWh in Florida. Federal research programs are aggressively pursuing cost reductions to $3 per watt by 2010. The goal is to reach $1.50 per watt by the year 2020. New cell materials and manufacturing technologies show that, with production volume, industry can achieve these cost reductions. PV is in both Florida's and FSEC's future.

FSEC research shows that combining solar with energy efficiency will speed us toward our energy future. Our Lakeland project proved this with results that were a surprise even to us. In June 1998, on the hottest day ever recorded in that town, our research home saved 70 percent of cooling energy compared to the standard control home! Taking into account electrical energy produced by the photovoltaic system, the house offered 92 percent utility energy savings compared with the standard home. And this case is not an isolated case: we have seen similar results throughout Florida.

Nearly 100,000 homes are being built every year in Florida. Add them to the six million homes that already exist in the state, and you can see the enormous potential for savings from solar energy and efficiency. My testimony to Florida's 2020 Commission states that these savings equate to 10,000 megawatts of utility generation capacity. Solar energy will be in our nation's and Florida's future – you can bet on it!

Leadership at the University of Central Florida has shared this vision of energy for Florida and has supported FSEC from its inception. Most recently, M.J. Soileau, UCF's exceptionally capable Vice President for Research, has provided a strong support base and selected a new FSEC Director. Beginning January 3, 2005, James M. Fenton leads a new FSEC administration. Fenton comes to FSEC from the University of Connecticut and will bring research opportunities in fuel cells. His challenge will be to maintain FSEC's high level of creativity and program productivity. I hope this history provides insight to him and that his tenure at FSEC will be as bright as ours was in the past!

— David L. Block, Director Emeritus, February 8, 2005