Carbon-Free, Nuclear-Free Alliance

www.carbonfreenuclearfree.org
Email: cfnf@ieer.org
Phone: 301-270-5500

6935 Laurel Ave, #201
Takoma Park, MD 20912

Summary of *Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy* by Arjun Makhijani (RDR Press and IEER Books, 2007)

Downloadable free at www.carbonfreenuclearfree.org/files/images/CarbonFreeNuclearFree.pdf

A three-fold global energy crisis has emerged since the 1970s; it is now acute on all fronts

1. Severe climate change, caused mainly by emissions of carbon dioxide,
2. Insecurity of and violence and war associated with control of oil supplies,
3. Nuclear weapons proliferation as it is connected to the spread of nuclear energy.

There has been a great deal of activity at the state and local level as well as among some corporations and investors to address energy issues as they relate to climate. Solar photovoltaic arrays are being installed in megawatt chunks on commercial rooftops and parking lots; venture capital is pouring billions into everything from electric cars and associated battery technology to converting cellulosic biomass into liquid fuels to new solar photovoltaic and solar thermal electric generation technology. But only one work has integrated it all to show how these individual elements can be used to build an efficient energy economy based entirely on renewable energy sources. *Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy* (called the *Roadmap* for short below) lays out a plan for how all fossil fuels and nuclear power can be completely phased out by 2050 in a manner that is technically and economically viable. The *Roadmap* also includes approaches to meeting fuel requirements without recourse to using food crops as feedstocks for biofuels.

A U.S. economy that is nearly free of CO_2 emissions is not only desirable; it is, practically speaking, a treaty requirement under the United Nations Framework Convention on Climate Change (UNFCCC), which calls for global greenhouse gas emissions reductions in a manner that is cognizant of current and historical inequities. A norm of equal per person CO_2 allowances is a minimal interpretation of the UNFCCC. Specifically, a global reduction of CO_2 emissions by 80 percent by 2050 coupled with an equal per capita allowance system, a demand of China, India, and other developing countries, means that the U.S. will have to reduce its emissions by about 96 percent by that date.

The nuclear industry is proposing to fill a part of the gap with dozens of new nuclear power plant proposals – but there is a catch. New nuclear power plants are costly[1] and financially risky. Even the leaders of the nuclear industry have said that they will not build new plants without 100 percent federal loan guarantees, which could run into hundreds of billions of dollars.[2] At the high end this is a scale comparable to the sub-prime mortgage risk capital. Such government subsidies for private nuclear investments could well foreclose the needed large-scale investments in renewable energy sources.

The *Roadmap* is based on presently available technologies, many of which are commercial today, such as wind-generated electricity and energy efficient building. Other technologies, such as plug-in hybrids and

[1] In late 2007, Florida Power and Light estimated the capital cost at $5,000 to $8,000 per kilowatt in its filing with Florida regulators.
[2] On March 10, 2008, Gregory Jaczko, a member of the U.S. Nuclear Regulatory Commission, stated that the U.S. government would need to put up $500 billion in federal loan guarantees over the next decade if it really wanted a nuclear renaissance. Source: Selina Williams, "US Government Loan Guarantees for New Nuclear Too Small-NRC," *Dow Jones Newswires*, March 10, 2008.

all-electric vehicles, using aquatic plants such as microalgae as power generation fuel are not yet commercial but clearly visible on the technical horizon.

Efficiency must be the foundation of a renewable energy economy that makes economic sense. For instance, the average energy use per square foot of residential buildings is about 58,000 Btu per year. But Hanover House in New Hampshire, which was built with passive solar features, such as high thermal mass and one active solar component – a solar thermal water heater with a 1,000 gallon buried tank – uses only about 8,300 Btu per square foot per year (see Figure 1). The total building cost was modest: $111 per square foot.

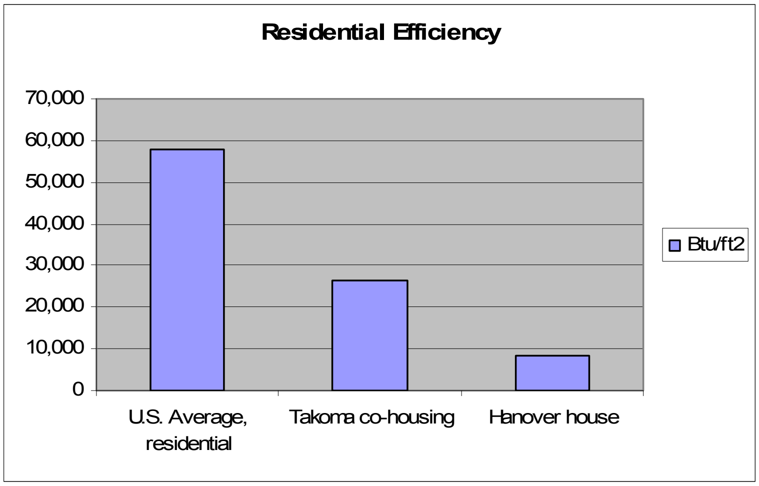

Figure 1: Average residential energy use compared with two efficient buildings: Takoma Co-housing in the Washington, D.C. area and Hanover House in New Hampshire

The United States has ample renewable energy resources to accomplish the transition. Wind energy potential, excluding cities, national parks, and other sensitive areas, amounts to about three times total U.S. electricity generation in 2005. Six states – North Dakota, Texas, Kansas, South Dakota, Montana, and Nebraska, *each* have greater wind energy potential than the total electricity generated by all 104 U.S. nuclear power plants. Solar energy is even more plentiful. In fact, the area of commercial rooftops and parking lots is large enough to supply most U.S. electricity generation. And no new transmission corridors will be needed, though distribution systems will eventually have to be strengthened.

Solar photovoltaic electricity costs, while on the high side today, are declining rapidly and can be expected to be lower than the delivered cost of nuclear electricity from new plants, especially if the solar cells are installed at intermediate scales (several hundred kilowatts to several magawatts) on commercial rooftops and parking lots. Solar thermal power plants are already approximately equivalent with new nuclear costs.

Intermittency of wind and solar energy does not become a significant issue until they assume a share of the electricity system much greater than the present one percent. Wind energy deployed with due attention to geographic diversity can supply 20 to 25 percent of electricity generation with only a few percent increase in reserve requirements. Due to the huge overbuilding of natural gas fired power plants in the last two decades, done in anticipation of continued cheap gas supplies, a significant surplus of natural gas capacity is available as standby capacity. Reserves can be complemented in many areas by using hydropower in a manner that is coordinated with wind energy availability. Finally, by taking advantage of the diversity in solar and wind energy and building a smart grid, a solid foundation for a distributed grid can be laid in the next 15 to 20 years.

Some baseload capacity and/or energy storage will be required to go to fully renewable grid, an example of which is shown in Figure 2. Compressed air storage, vehicle-to-grid technology, stationary storage devices, such as sodium-sulfur batteries, can complement biomass-fired IGCC (integrated gasification combined cycle) power plants, geothermal plants, and solar thermal plants with heat storage for 12 hours or more. Biomass would be obtained from aquatic plants such as microalgae, water hyacinths in tropical and subtropical regions and duckweed and cattails in temperate areas. Aquatic plants and biomass that does not use agricultural land would be the sources of biofuels. The development of direct production of hydrogen from solar energy and of electrolytic hydrogen production from wind-generated electricity could accelerate the transition and reduce land requirements for biofuels.

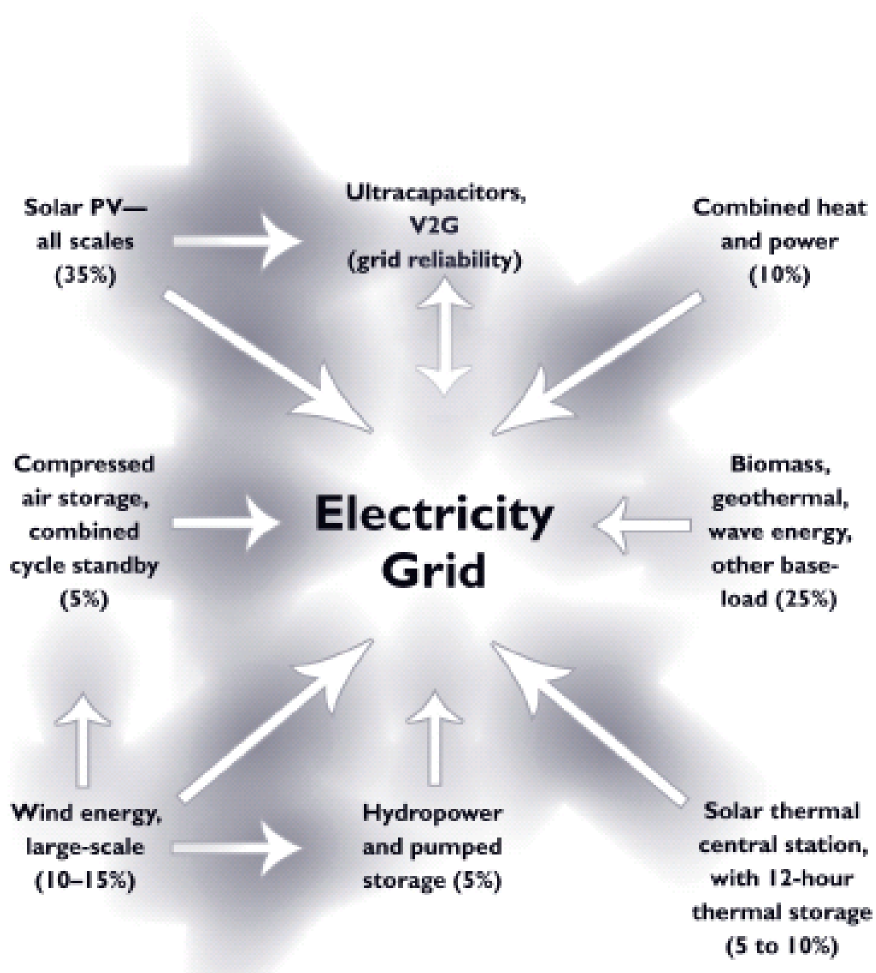

Figure 2: An example of a fully renewable energy electricity grid

Main Recommendations:

1. A single national cap on fossil fuel use should be created for all large users combined (defined as those using more than 100 billion Btu per year, which excludes small businesses and individual households). The allowances would be auctioned by the U.S.

Treasury in a single national market much like its financial securities. In such a system those who have been efficient are rewarded because they have to buy fewer allowances; those who use renewable energy sources would not need any. There would be no offsets, no generation of CO_2 credits for actual or supposed non-polluting activities, and no international trading of allowances. Holders of allowances would either use them or sell them. Verification and enforcement would be done by the EPA. This approach would cover about two-thirds of energy use (including essentially all electricity generating companies, large and medium industries, airline companies, large trucking companies, and a portion of the commercial sector). Accounting would be at the level of the (U.S.) parent corporation. It would be expected to generate $30 billion to $50 billion per year in revenues, which would provide the financial foundation for government action on energy, including revenues to be shared with state and local governments and to be used to assist worker and community transition..

2. Small energy users would be covered in so far as they use grid electricity since fossil fuel using electric companies would be covered by the national cap and by efficiency standards for appliances. Small users of fossil fuels would be covered by efficiency standards for buildings and vehicles. A Btu per square foot standard for new buildings and efficiency standards enforced at the time of sale of existing buildings would greatly increase the efficiency of the building stock over the next several decades.

3. All subsidies for fossil fuels, nuclear energy, and biofuels from food crops would be eliminated.

4. Performance-based federal purchases of buildings, energy sources, and vehicles would be oriented towards bringing the most advanced technologies that would work together for creating a renewable energy economy. For instance, governments at all levels could specify that they will only purchase carbon-neutral buildings by 2025 and that they will be make plug-in hybrids their standard vehicle purchase by 2015. The latter would be used as the basis for demonstrating large-scale vehicle-to-grid technology deployment.

5. Government contracting could give preference to companies with low carbon footprints.

6. Government research, development, and demonstration (R,D&D), including that done in public-private partnerships, as well as incentives for private R,D&D would be considerably increased.

The energy system that would result from these policies would create many more jobs in the United States. For one thing, the $250 billion spent in 2007 on imported oil would be spent on domestic energy sources and efficiency. Overall, the *Roadmap* estimates that the proportion of GDP spent on energy services would be about the same as in a business-as-usual scenario (which assumes no turbulence and no costs of climate change, and which is therefore unlikely to be realized). The unit costs of electricity and fuels would be somewhat higher, the total energy bill somewhat lower; the difference would be invested in energy efficiency.

It will take vision and political courage to enact the tough policies that will be needed to create an economy free of fossil fuels and nuclear power. But an announcement of such an economy as the U.S. goal along with those policies can put the United States in a positive global leadership role on possibly the most critical issue to face humanity. That would surely help reverse the precipitous recent decline in the regard in which it is held in the world. More than that, the United States can help lead the world to a fully renewable energy system that does not contribute to the threat of nuclear proliferation.