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My view: Our energy future

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By Anthony J. Marolda

Our current, primary sources of energy are fossil fuels, and will remain so for many years to come. However, the supply and production of fossil fuels, including oil, coal and natural gas, are going to eventually peak and then start to decline. Given the growing energy demands of the world, the cost of these fossil fuels will, therefore, increase dramatically with the decrease in supply. Some analysts call this event “peak oil.”

Depending on the evolving discovery and recovery technologies, it may be 50 or a 100 years or more to peak oil but it will come. Then what? History shows that entrepreneurial spirit, technology readiness and economics will converge on a new power-generating system that will meet the markets’ needs at the most competitive price. For example, it was Thomas Edison who, in 1882, brought together the technologies of electric power generation and the light bulb to create illumination for homes and businesses with superior results and at a cost that was competitive with gas. So it will be in our energy future.

Current alternative energy sources, such as solar panels mounted on the ground or rooftops, or wind farms composed of giant wind turbines, are limited by the environmental conditions they require to produce power. When it is dark or cloudy or the wind isn’t blowing, the solar panels and the wind turbines are lifeless. With these technologies, therefore, there will always be the necessity for having enough generating capacity from other, steadier sources of energy production in order to meet our total needs at any point in time. So these part-time technologies are not the long-term answer.

Nuclear power is steady and does not produce harmful emissions, but it has many negative aspects that make it an unlikely long-term solution. For example, although it is improbable with modern technology, disastrous accidents are possible such as occurred at Three Mile Island, Chernobyl and Fukushima. Furthermore, nuclear power plants produce radioactive wastes that need to be stored safely for very long periods of time.

What, then, might the new, alternative energy sources be and how and when will they be available? No one can say for sure, but there are several possibilities on the horizon that could eventually meet all of the conditions for steady, safe, efficient, economic energy generation. I will focus on just two of the more interesting ones, fusion power and solar power satellites (SPS).

Fusion power is generated by creating super-hot plasma, a highly excited state of a gas, where energy is released from the fusion of the nuclei of billions of deuterium atoms (found in water). This energy is converted into heat, which is used to create steam that runs an electric generator. The advantages of fusion are that it produces no atmospheric emissions, the fuel is cheap and abundant, there is no chance of a catastrophic accident and the amount of radioactive waste is at a minimum. So why don't we have it already?

The primary problem has been in containing the hot plasma long enough to produce more energy output than went into creating it. Scientists have been working on an approach for decades. While progress in solving the technological problems has been slow, it has been steady. Scientists in many countries are now involved in the work. But, it will probably take a few additional decades until an economic, commercial version of a fusion power reactor is available.

The latest and largest project designed to achieve the goal of significant net energy from a fusion system is the International Thermonuclear Experimental Reactor (ITER) being constructed in the south of France. The United States, along with the European Union and five other countries, is sponsoring the project. This year, 2015, the test device, called a Tokamak, will start to be assembled. It will be completed in 2019 and the first tests using super-heated plasma will be in 2020. The primary goal of the tests is to deliver as an output 10 times the amount of power the reactor consumes, and then to scale the technology up to produce a demonstration fusion power plant for commercial use. The construction of the commercial plant is planned to start in 2024. So, the last half of the 20th first century could see the availability of cheap, abundant and safe energy from this new source. (For more information see www.iter.org.)

A second possible energy source to replace fossil fuels is solar power satellites (SPS). With this alternative, large satellites are placed in geosynchronous orbit over the Earth, having up to six square miles of solar energy collecting panels. Each satellite of this size would produce the same amount of power as two land-based nuclear power plants. The collected solar energy is converted to another type of energy, either microwave or

infrared laser, and wirelessly beamed to collectors on the ground, where it is converted into electricity and distributed to users. The major benefits of this system would be that solar energy is free and abundant, its collection in space would be uninhibited by atmospheric conditions or the day-night cycle, and there would be minimal environmental issues. Another benefit would be that the energy could be beamed to places where it is needed, either to existing distribution infrastructure, to battlefield locations for the military or to remote locations like the Arctic and Antarctic regions.

The concept for SPS was conceived and patented by Dr. Peter Glaser of Arthur D. Little Inc. in the 1960s. The International Academy of Astronautics (IAA) recently published the results of a three-year study that assessed the role that SPS might play over the coming decades (www.iaaweb.org). A major conclusion was that such systems are indeed technically feasible. Some technologies still need further development, but no breakthroughs are required. The major question is the economic viability.

Significant cost reductions in several technologies would have to be achieved. For example, the cost of earth-to-orbit transportation is critical, including bringing large payloads to geosynchronous orbit, about 22,000 miles above the Earth. Several commercial firms are exploring such systems and the IAA believes that they are likely to evolve over the next few decades to become cost-efficient. Given the size of the solar cell arrays that will be required, a large decrease in the cost of solar cell production and/or a significant increase in their efficiency would also be important to making the systems economically viable.

The Japanese are currently the leaders in exploring this promising technology. For example, the Japan Aerospace Exploration Agency is planning a series of ground and orbital demonstrations of the various technologies needed to produce an SPS. They expect that, during the 2030s, they could have a commercial system in place that will produce about 1 gigawatt of power, about the size of a typical nuclear power plant.

In conclusion, as the economics of traditional energy production changes and other technologies evolve, commercial companies will bring new sources of power on line to meet the world's needs. Both fusion and SPS are good, long-term possibilities.

Anthony Marolda is a resident of Annisquam. He has a U.S. patent with an application in fusion power. He also worked on the economics and technology of solar power satellites with their inventor, Dr. Peter Glaser, when both were officers of Arthur D. Little Inc.