Nuclear Power, Solar and Wind Energy-Important Questions for the G&T Classroom

By Harry T. Roman

Nuclear power plants, like other engineered systems, are built within certain design conditions, what they are able to tolerate from the natural and man-made environment. The Japanese earthquake and tsunami probably exceeded or came close to design conditions for the power plant. As an energy technology matures, it gains more experience, and the future design for new nuclear plants will improve. Nuclear power was first used for electric power generation in 1957. It has been used in naval propulsion since 1954. In light of the radioactivity releases from the crippled Japanese plants, there are likely to be strong calls for a total re-evaluation of the nuclear option here in the U.S.

Experts might argue vigorously that even the worst U.S. nuclear accident in the late 70s at Three Mile Island resulted in no deaths to the public. No U.S. sailors have died as a result of a nuclear accident, and those sailors all live within about 25-200 feet of the reactors, all the time. Nuclear power is no different than a live fire…it is dangerous, and regulations, safety standards, and expert oversight allow both of these technologies to be a common part of our lives.

The risks we take with any energy system reflect what we are willing to tolerate. Look at airplanes. Crashes occur very infrequently, but when they do hundreds of passengers might be killed. In a way, this is similar to nuclear plant accidents…accidents don't occur very often, but could involve multiple deaths. We do not suspend airline traffic after a major accident. Why stop the use and building of power plants?

Opponents have argued, people choose to fly voluntarily, and that makes the risk different from having a utility company impose the risk of nuclear energy upon them. Well, try driving your car on a highway with a full tank of gas…the energy equivalent of 20 sticks of dynamite in your trunk…how much choice did you have to incur that risk? How much choice do you have in how others drive with their own dynamite equivalent load in their trunks? What might your realistic options have been? Is the answer electric vehicles? And what will charge those vehicles at night?…..most probably low cost nuclear generated base-load electricity. Nuclear powers a big part of our electrical load.

Keep in mind what motivated utility companies to build nuclear power plants in the first place:
-Move away from high-priced foreign oil for base-load electric power production
-Remove the pollution from use of oil for power generation
-Use a concentrated form of energy that is available within our borders
As a result, only a small amount of oil is used today for power generation.

If one thinks the current high prices for oil makes gasoline expensive for our cars, imagine if nuclear is not available for power generation and our electric rates skyrocket as well. This is exactly what happened in the early 70s when several Arab oil embargoes caused a huge double whammy on the American economy. The use of nuclear power helps everyone as it cleans our environment. The risks taken benefit all Americans. Our president recognizes nuclear power as a major source of carbon-free energy production.

I hear lots of talk about solar and wind energy and how we can become totally green. I think a more healthy approach might be to develop a balanced mix of energy technologies that create a robust energy strategy. What about the risks of using solar and wind? Consider these possibilities:

1) How would near-shore and offshore wind turbines have fared with a tsunami and its debris laden surge of water?
2) Is their design as rigorous as that of a nuclear plant or other energy generating system?
3) What do we know about the long-term downstream effects of large wind machines that extract energy from the wind?
4) What happens if wind significantly diminishes downstream? How does this impact those microclimates downstream?
5) Large amounts of wind turbines are located on/near mountains and in valleys. What would an earthquake do to those energy production facilities?
6) How does this impact customer reliability within the utility grid?

Certainly as green energy generation systems mature, their designs will reflect the experience to-date with them. In the very early days of large wind machines, a blade failure experienced at one site threw an 8-ton blade ¼ mile. How do you rationalize wind turbines as safe?

Implementing any energy system is complex, multi-dimensional, and benefits from citizen input. Forty years of working in the energy industry before retiring has taught me the importance of public input. Think of your G&T charges as future citizens, teaching them to ask good questions and objectively view the pros and cons of possible energy options. Energy engineers make use of matrix diagrams [spreadsheets] to see how multiple parameters affect the decisions to install energy systems. Here are some of the parameters that a decision to install a major energy production system might require. This is not a complete or exhaustive listing, nor are the parameters identified listed in rank or priority order:
-Environmental impact of construction
-Time to build and approve the plant
-Cost of the plant-both to build and operate
-Availability of workers and employees
-Economic impact of the plant on the local environment (jobs, economic stimulus…etc.)
-Long-term environmental impact on flora, animals, humans…..etc.
-Safety of the plant and risks from accidents
-Plausible accident scenarios and how to mitigate them
-Regulatory and legal concerns

These concerns must be quantified in rigorous mathematical terms, clearly delineating how much of an impact is likely to occur. It is not about good intentions or personal feelings concerning any one power generation option. Here enters the objectivity, the dispassionate assessments and evaluations. It is not a quick and dirty analysis. For instance, it can take several years to perform the planning analysis for a nuclear plant installation, and another decade to build it. Long-term thinking is important.

Immerse your gifted students in this evaluation and assessment of energy systems. Explore the issues involved and the timely concerns. How do they envision the energy future? What sorts of options would they favor? Ask them to quantify their decisions and back it up with facts from books, articles, the Internet, or maybe from energy engineers invited in to talk to your class. Dig deep. It is an important issue. This balanced method of inquiry goes far beyond this topic. It is a life-long skill.

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Harry is a retired engineer, inventor, teacher, and author. He holds 12 U.S. Patents; and has published over 500 articles and papers, as well as 50 teacher resource books and math games. Over 60,000 teachers nationwide read his educational articles every month. His Gifted Education Press books include:
1) ***Solar Power, Fuel Cells, Wind Power and Other Important Environmental Studies for Middle School Gifted Students and Their Teachers: A Technology, Problem-Solving and Invention Guide***;

2) ***Energizing Your Gifted Students' Creative Thinking and Imagination***;
3) ***Heroes of Giftedness: an Inspirational Guide for Gifted Students and Their Teachers***. (major contributor)

His latest book, "STEM----a Powerful Approach to Real-World Problem Solving for Gifted and Talented Students in Middle and High School Grades", will be released by GEP later this year.

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