



Harris Group Inc.

The Energy Puzzle - How the Utility Industry Can Put the Pieces Together

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I don't do crossword puzzles, and I'm not a fan of jigsaw puzzles. But I am paid to figure out the energy puzzle for my clients; and, given the wide array of choices and variables, as well as the complex regulations and politics; it isn't always easy these days.

That said, it's imperative that we find a way to fit the energy pieces together so that the public and private sectors can develop policies and strategies that will bolster our nation's economic, environmental and national security while improving the quality of life for future generations.

I'm an engineer, so the best way to start this process from my perspective is by putting all the pieces on the table and assessing their viability in the current climate.

Here are 11 technologies in today's energy puzzle:

1. Coal - The primary power generation in the U.S., with reliable technology and a relatively inexpensive fuel supply. Emissions are a key concern with this technology, however.
2. Nuclear - The most cost-effective source of long-term, base-load power generation. An aging fleet and the disposal of the spent fuel rods are two key concerns.
3. Natural Gas - Along with nuclear, this is the most reliable technology when it comes to producing power. Natural gas facilities are more capable of adjusting load, whether in combined cycle or simple cycle mode.
4. Wind - It's relatively low cost to install, and the "fuel" is free, but the generation reliability is relatively low when compared to nuclear, coal, and natural gas. Wind power is also usually most prominent at night, which requires a drop in base-load production.

5. Solar – It's very expensive to install and generally takes up a lot of space, but, like wind, the fuel is "free." The overall operation time for solar facilities is also limited, in most cases, to daylight hours.
6. Biomass – This energy source is comparable to coal, but it's generally limited by fuel supply; and most biomass plants usually max out around 50MW. Biomass does have a better carbon footprint than coal, yet it's unclear whether it truly reduces emissions.
7. Waste-to-Energy (WTE) – It's expensive and the reliability is not very high. WTE projects should mostly be looked at in terms of waste removal. Emissions on a WTE facility are also always a concern.
8. Hydro – This energy source is expensive, and it's generally seasonal and location-specific. There are also numerous environmental concerns that come with damming up rivers, or pulling water out of a river.
9. Landfill Gas (LFG) – This is a good renewable source, but the quantities are generally small. Emissions from burning LFG are a concern.
10. Integrated Gasification Combined Cycle (IGCC) – With only two operating utility-scale facilities in the US, the experience with this technology is limited and the installation cost is high.
11. Wave Generation – This energy source, as well as using the ocean currents, is unproven and has a number of technological issues to resolve.

Now that we've put all the pieces of the energy puzzle on the table, we have to look at how they might fit together. And that depends on a number of factors that dictate how today's overall energy system must be managed and controlled.

Seven guiding and gating factors are:

1. Emissions / Pollution – This factor has captured the most public attention and the bottom line is that people today are increasingly concerned about how environmentally friendly power generation is. All 11 of the technologies – or pieces – above have environmental issues, so part of the puzzle is to determine how these environmental issues can be mitigated while still supplying the necessary generation.
2. Cost of Installing New Generation – The cost of new generation has currently taken a "back seat" to environmental issues, but this is also before the general public is required to pay for the various Renewable Energy Standard programs or the

installation of a new nuclear plant. No matter the technology, there will be financial implications for installing new generation.

3. Location and Available Resources - Unfortunately, the power generation technologies are directly impacted by general surroundings and the availability of resources. The geographic location of a facility will end up driving the preferred technology.
4. Infrastructure - Many new facilities are directly impacted by the available infrastructure, in particular transmissions constraints. No matter the technology, if the facility can't move the power from the facility to a populated region, then even the most effective generation facility can prove pointless.
5. Cost to Operate - The operations and maintenance cost (including fuel costs) will drive the cost to the end user. The inter-relation between the efficiency of a technology, the fuel cost, and the size of the facility will generally drive the selection of one technology over another.
6. Operational Requirements - Generation facilities are limited on the level of operation. For example, it is difficult to get a natural gas facility to operate at 10 percent load while meeting emissions requirements, or it is impossible to guarantee that a wind facility will operate at a specified load for 24 hours per day. Therefore, the technology will depend on the requirements of the system.
7. Construction Cycles - When looking at a new facility, the generation needs must be evaluated based on when the generation must be on line. If the additional load demanded on the system must be supported in 18 months, then the system cannot wait the 36 to 48 months to install a coal facility.

Now that we have identified a small sample of the technologies and the guiding and gating factors, we have to work on a solution.

It's important to stress that the key to making the energy puzzle work is to balance the selected technologies with the guiding and gating factors. If done properly, this can make for a well-balanced generation system that provides power cleanly, cheaply, and efficiently.

Balancing the system is relatively easy to do if you start with a clean slate, but it's much more difficult when existing systems are in play. Unfortunately, there isn't a populated area in the US that would provide you the opportunity to start with a clean slate.

These are just some of the intricacies and obstacles that get in the way of utility, Co-op, municipal, and IPP executives as they seek to meet both consumer and regulatory demand for cleaner and cheaper energy.

There are so many competing interests and issues at play that putting all the pieces together and solving the 21st century energy puzzle seems more elusive than ever at times. But, for the good of the nation, we must keep trying by utilizing thorough development practices, good due diligence, and compromise.

About the Author

Mr. Markell is a registered professional engineer with over 19 years experience in the energy industry. His background includes direct involvement or evaluation of operations and maintenance, rotating equipment, power plant construction, performance testing, and major project agreements such as EPCs, PPAs, LTSAs, and O&M Agreements. He has managed the due diligence efforts on a wide range of power facilities and technologies ranging from green field power facilities to sludge handling systems. Mr. Markell has been involved in due diligence reviews for various coal technologies, combined cycle technologies, QF cogeneration facilities, gas-fired peaking facilities, landfill gas facilities, nuclear facilities, hydro facilities, geothermal facilities, and biomass facilities as the Project Manager or key contributor. Mr. Markell is Vice President of the Project Finance/Independent Engineering team at Harris Group Inc.

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About Harris Group's Project Finance and Independent Engineering Unit:

Harris Group's Financial Consulting team offers a full suite of technical due diligence and independent engineering services. Since 1989, Financial Consulting's veteran engineering staff, supported by an in-house, multi-discipline engineering firm, has provided our customers with the depth and expertise necessary for thorough and detailed reviews on a wide array of industry technologies.

About Harris Group Inc.:

Harris Group provides consulting, process expertise, and multidiscipline engineering and design. We help our customers select and implement capital and maintenance projects that improve their competitive positions. With twelve offices in the U.S. and a sister company, AO Harris Group International, in St. Petersburg, Russia, we serve customers worldwide.

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