Size Matters!

I have been to a bunch of trade shows and conferences this year. Taken individually, it looks like "business as usual," but taken collectively there are some disconnects in the scope and direction of Distributed Generation and its supporting technologies.

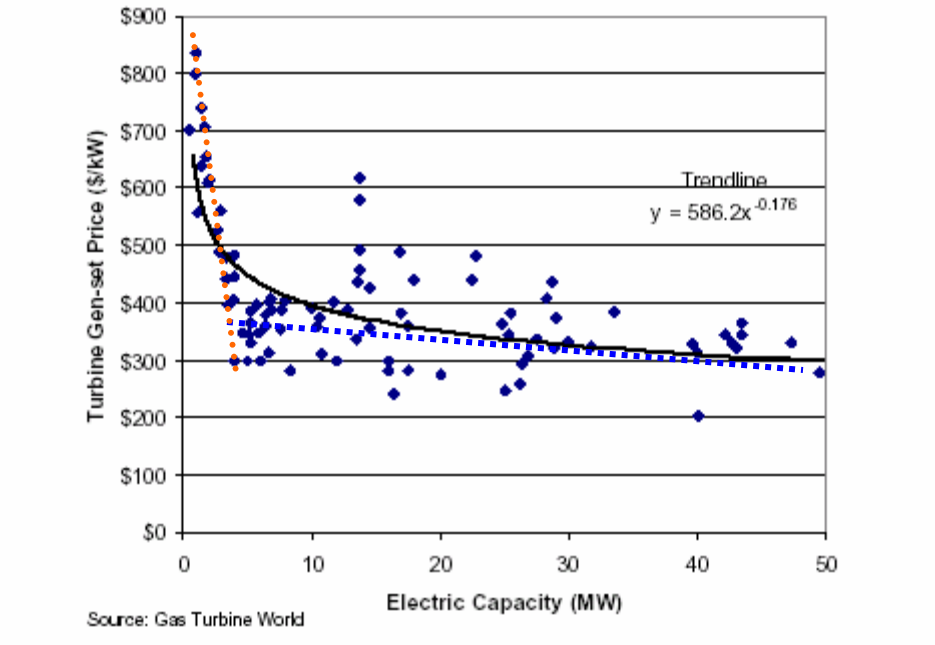
The **Hybrid Fuel Cell Conference**, Irvine, CA was a curious mixture of Federal Energy Management Program (FEMP) attendees, fuel cell hybrid developers and their respective supporters. The originally scheduled individual conferences were combined when DoE realized that they were to be held at the same time and in the same place. The hybrid session was sponsored by the National Energy Technology Lab and the recurring theme was to drive fuel cells hybrids to larger sizes, with claims of 75% electric efficiency. This initiative is clearly driven by the desire to use a coal derived fuel, and the needed project scale to achieve affordability.

In the mean time, the actual hybrid system developers focused on the general lack of off-the-shelf gas turbines to support their efforts toward systems sized anywhere from one to five MW, with peak efficiency claims of 70%. The most interesting presentation was by Rolls-Royce. Although somewhat counterintuitive, Rolls-Royce suggested that using a dedicated gas turbine design was a preferred choice, and that these systems actually wanted to be smaller, rather than larger. They presented a "canned" gas turbine concept as an approach to managing the relatively large and expensive, hot interconnects required by these hybrid systems.

Cut to the **DoE Small Gas Turbine Road Mapping Workshop** Washington, DC. I was confused by this one, thinking that I was attending a relabeled microturbine session. The workshop material classified small as 1-40MW, with only a token mention of 500kW. With minor exception, the content was entirely focused on incremental improvements in axial turbine components, driving designs toward higher pressures and temperatures.

The presentation material indicated a range of turbine availability, plotted on a cost per kW (vertical axis) vs. MW (horizontal axis), and efficiency projections were made based upon the proposed incremental improvements incorporated into the nominal sizes in question. (See the graph below, from the workshop based upon work by *Gas Turbine World*.) The built-in assumption is that there is a single design recipe for this class of machinery. In actuality "the curve" is really two curves: a relatively horizontal curve from 5 to 40MW; and a relatively vertical curve under 5MW. The horizontal portion reflects the result of continuous improvements made over time, and the vertical portion reflects the non-competitive nature of current offerings (readers please note, the lines are "eyeballed", not mathematically derived.)

The conclusions that efficiency could be incrementally improved, but that power would remain constant, also needs to be challenged. The efficiency of a 1MW would improve from 22% to 27%, and a 5MW unit would improve from 27 to 33%, but their ratings would not remain constant. And, manufacturers do not usually apply these concepts in new, smaller sizes centerlines because of the practical cost limitations to implement them. The machines will get larger as the efficiency improves and consequently, will not effectively address their non-competitive position below 5MW.



The **ASME Turbo Expo** in Atlanta offered insights into microturbine development status, as well as fuel cell hybrid systems in a variety of sizes. All of the microturbine developers are struggling to reach their, now modest, sales projections. Uncertainties over fuel costs and de/re-regulation, coupled with the continuing electric utility predatory practices have forced developers to 250-500kW in an effort to mitigate transaction costs and to become more relevant to utility interests. There were a number of large scale hybrids with fancy reheat & economizer concepts, but all of these seemed overly complex and driven by a built-in assumption that larger hybrid systems were the way to go.

NETL also presented some survey information claiming substantial market potential for distributed 40MW systems, but the data appeared to be driven by the question…"if we had a 40MW system, how many could we sell?" rather than an objective appraisal of optimum size.

I also learned that the 75% efficiency claim is for natural gas fired units…coal based systems have a goal of 60%.

Conclusions:

1. The use of clean coal derived power at 60% is a worthwhile goal and that's what NETL should concentrate on.
2. Rolls-Royce is on the right track and that natural gas fueled hybrid systems want to be smaller and will be more cost effective and efficient that larger scale units currently being pursued.
3. Gas turbines need a different design recipe to address under 5MW sizes if they expect to compete.

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