Report Back:

Community, Apartment, Small Commercial:

"Product Specs" in 3 years and beyond

June 2, 2011

Recall: Previously discussed metrics in 6-10 years

Category	ARPA-E's proposed	Modifications
System rating	200-500 kWe	**10 -1000 kW**
Electrical efficiency (@ ≥50% kW rating)	≥60%	**> 55% for 50-200 kW Range**
Part-load efficiency	≥75% of max efficiency	**>75%-90% at 50% load**
Emissions	EPA, CARB tier??	**EPA Tier 4 - CARB should be used**
Cost	First cost: $xxk installed, or $1000/kW or LCOE: $0.15/kWh over 7 years	**Aim for $0.10/kWh. Installed cost 600-1500$/kW**
Payback	2 – 3 yrs	**< 3 years**
Unit volume @ price point	5,000	**100-5000**
Fuel type	NG, propane, biogas, fuel-flexible	**Fuel flexible a bonus**
Maintenance frequency	Once per year, maintenance <8 hr, $xxx	**Twice a year**
Reliability	<1 unintentional outage per yr, <8 hrs 99.91%	**95%-99%**
Lifetime	>60,000 hrs before major overhaul or replacement	**Hard metric, prime mover needs > 44 000 hours. Some want longer.**
Electrical output type AC/DC, frequency	AC = 60Hz, 120v DC option??	**208, 480 V as well**
…and more…		**Noise, 60 dB at 10 m** **Temperature -40 F to 125 F** **Turndown Ratio > 3**

Key takeaways for the 3 year timeframe common to the 3 groups

1. A typical ARPA-E award is unlikely to be sufficient enough to build a 200 - 500 kW prototype

2. No technology agnostic 3 year metrics exist that will ensure reaching the 6-10 year metrics

Other Takeaways

- Specific sub challenges that could be solicited for seedling projects
  - New materials enabling higher temperatures.
  - Better coatings.
  - Higher strength alloys.
  - Different engine cycles.
  - Isothermal or isoenthropic compression for high efficiency ICEs
- Fast ramping is valuable for grid connected units.
- Cost assumptions should be provided to performers from ARPA-E to ensure an apples to apples comparison.
- There is an important distinction between modular and non-modular technologies – it is much easier to see how modular technologies (like fuel cells) will scale and thus easier to see how the costs will evolve.

Group 1 key points

Two pathways for measuring progress during a 3 year program:

1. Technology specific metrics (Fuel cells, ICEs, microturbines, Stirling)
    1. Each area has their own specific current state of the art metrics
    2. Shared 6-10 year LCOE target (with efficiency, capex, opex inputs)
    3. Develop area-specific 3 year targets to enable the 6-10 year LCOE target
    4. These would be teased out during the breakout sessions on workshop day 2.

2. Open model – performers provide:
    1. The 6-10 year metrics (capex, efficiency, etc) that combine to provide a $0.10/kWh product.
    2. A trajectory of what they will accomplish from year 0-6/10 to achieve the metrics at the end.
    3. What measurable results they will achieve within 3 years that will confirm their trajectory
        - ~10 kW prototype that achieves efficiency or cost improvement in a novel, promising way
        - Significant improvement/ modification to a baseline model.

Group 2 key points

- 50 kW prototype is the right size to enable reliable properties when scaling up to 500 kW
- 52% efficiency
- Need a cost target for 3 years, but what? Halfway to $1000 / kW?

Group 3 key points

- Demonstrate efficiencies from 50-55% at any scale
- Demonstrate proforma calculation with $0.15 / kWh or better and TRL 3 as key input data
- Typical prototyping costs $10-20k / kW
  - $1M prototype → $1M / ($20k / kW) = 50 kW, maybe 2x smaller because of far-outness