U.S. Department of Energy
Mid-Atlantic Clean Energy Application Center
Promoting CHP, District Energy, and Waste Heat Recovery

MADRI WORKING GROUP MEETING #29

Washington, DC

August 20, 2013

Combined Heat & Power Cost/Benefit Analysis

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DOE's Clean Energy Application Centers

- **DOE's Regional Clean Energy Application Centers (CEACs) promote and assist in transforming the market for CHP, waste heat to power, and district energy technologies and concepts throughout the United States.**

- **Key services of the Regional Clean Energy Application Centers include:**
  - **Market Assessments** – Supporting analyses of CHP market potential in diverse sectors, such as, health care, industrial sites, hotels, and new commercial and institutional buildings.
  - **Education and Outreach** – Providing information on the benefits and applications of CHP to state and local policy makers, regulators, energy end-users, trade associations, and others.
  - **Technical Assistance** – Providing technical information to energy end-users and others to help them consider if CHP, waste heat recovery or district energy makes sense for them.

Overview

Q: What needs to be done to make distributed generation (DG) more accessible to end-use customers while balancing the interests of all stakeholders?

Identify the Costs & Benefits for all stakeholders - Owner, Ratepayer, LDC, ISO & Society.

This is key to balancing interests and implementing sustainable policies

Cost/Benefit Analysis

- A cost-benefit analysis (CBA) is a systematic process for calculating and comparing benefits and costs of a decision or government policy. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.
- Benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time are expressed on a common basis in terms of their "net present value."

French economist Jules Dupuit, is credited with creation of the cost-benefit analysis in 1848.

Cost/Benefit Analysis

- **Total Resource Cost Test (TRC)** compares the energy benefits to society as a whole with the participant's cost of installing the measure plus the cost of program administration.
- **Societal Cost Test (SCT)** is similar to the TRC, except the SCT explicitly quantifies externality benefits such as avoided pollutant emissions not represented in market prices and other non-energy benefits (e.g., improved health, economic continuance).
- **Program Administrator Cost Test (PAC)**, sometimes referred to as the utility cost test, compares the utility's avoided cost benefits with energy efficiency program expenditures (incentives plus administrative costs).
- **Participant Cost Test (PCT)** compares participant benefits (incentives plus bill savings) with participant costs (capital cost, installation, O&M, etc.).
- **Rate Impact Measure Test (RIM)** compares the utility's avoided cost benefits with the cost of administering energy efficiency programs plus lost revenue from reductions in customer energy consumption.

Cost/Benefit Analysis

- **The basic elements in a CBA are:**
  - **Identification of the Benefactors and Beneficiaries**
  - **Valuation of Costs and Benefits**
  - **Determination of NPV of Costs and Benefits**
- **For CHP the Benefits are diverse:**
  - **Owner – Reduced energy costs, increased power quality, ability to grid island, etc.**
  - **Ratepayers – T&D cost offset, capacity cost reductions, increased grid reliability and power quality, reduced RPS compliance costs, etc.**
  - **Society – Healthcare cost reductions due to reduced emissions, job creation and retention through increased competitiveness, access to places of refuge, taxes on production during grid outage, reduced reliance on imported energy, water use reductions, etc.**

Cost/Benefit Analysis

- **Determination of NPV of Costs & Benefits**
  - **CHP Benefits typically extend over long periods**
  - **Discount Rate – heightened importance due to length of C&B's**
  - **Multiple Discount Rates – EPA[1]**
    - Healthcare cost offsets – Societal discount rate
    - T&D offsets – Utility weighted average cost of capital
    - Owner CapX – Commercial weighted average cost of capital
  - **Over 20 years, the NPV of an annual $1,000 offset is:**

Type	Societal	Utility	Owner
Typical Discount Rate	3%	7%	10%
NPV	**$14,877**	**$10,594**	**$8,514**

Note 1: National Action Plan for Energy Efficiency (2008). Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy Makers. www.epa.gov/eeactionplan

Capacity Offset

This utility's average resistive losses on their distribution system are only about 7% over the course of the year.
At their system extreme peak, the estimated total losses reached about 11%, one and one-half times the average losses for the year.
At that extreme peak, however, the marginal resistive losses – those that would be avoided if load had been a little bit lower if an efficiency measure were installed – were 20%.

..... Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements RAP 2011

Capacity Offset

- **Based on peak load line losses on peak demand days when the ISO capacity obligation is set, every MW of CHP would offset 1.25 MW of capacity with local generation. With cooling from the CHP thermal output, an additional 20% demand reduction is possible in peak load times, further reducing the regional generation and transmission capacity obligations.**
- **CHP offsets grid generation and transmission capacity obligations with reliable and cost effective power. CHP operation allows for aggregation of multiple units to provide reliability equal to the grid.**

Areas for Consideration

- **What are the discount rates used for calculating future years benefits and costs?**
- **Are hourly marginal metrics used for ascertaining benefits or annual averages?**
- **What are the boundaries for the costs and benefits – site, distribution area, utility service area, state?**
- **In restructured markets are the wholesale energy and capacity market effects of changes in the marginal units serving loads captured? DRIPE**

Areas for Consideration

- **Are federal incentives such as accelerated depreciation or Investment Tax Credits (ITC) subtracted from the installed cost basis?**
- **Are cost reductions due to changes in REC purchases included in the avoided cost calculation?**
- **Are marginal or average losses used in crediting avoided supply costs?**
- **What if any non-energy benefits are included in the analysis? (other resource savings, improved power reliability/quality, reduced reliance on imports, grid resiliency, etc.)**

Areas for Consideration

CHP can be a valuable tool in achieving multiple ratepayer and societal benefits including non-energy benefits such as lower healthcare costs, economic development, job growth and energy security.

While the TRC is based on energy benefits, the SCT recognizes the energy and non-energy benefits, providing a broader basis for CHP policy development.

"Reliance upon TRC for cost-effectiveness screening is very widespread. This is due more to the legacy of TRC and entrenched practice than it is to the merits of the methodology. The TRC test (as commonly applied) has serious shortcomings that are likely to impede the full acquisition of cost-effective energy efficiency as a utility resource. Some combination of a Utility Cost Test and Societal Cost Test would be a preferred approach"

Benefit-Cost Tests for Energy Efficiency, Martin Kushler, Ph.D. Senior Fellow ACE^3, Presentation to the NEEP Regional EM&V Forum, October 2011

"We recommend that the Societal Cost Test be used to screen energy efficiency programs. This test includes the broadest range of energy efficiency costs and benefits, and provides the best measure of public policy benefits that are of great importance to legislators and regulators, including environmental benefits. If a state chooses to use the Societal Cost Test, the test should account for all the public policy benefits to the greatest extent possible"

Energy Efficiency Cost-Effectiveness Screening - How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs, Synapse for RAP, Nov 2012.