New CHP Value Propositions

Ways to improve CHP deployment and increase value to California

Thomas R. Casten, Chair

Recycled Energy Development LLC

Presentation summary

- Review the good – CA actions that encouraged CHP and WER development
- Review several problem areas
- Explain added values that CHP/WER can provide to CA
- Suggestions for path forward to encourage more CHP/WER development in CA.

California Positives for CHP Developers

- The 6,500 MW CHP goal and the CHP Settlement set a clear policy and remove a lingering issue that has discouraged new development.
- The Self Generation Incentive Program should start a CA and indeed national trend of developing CHP and Waste Energy Recycling (WER) projects in the sub-5 Megawatt range
  - The high transaction costs of small WER and CHP have suppressed development, which in turn suppresses innovation and value improvement.
  - The SGIP should break this chicken and egg cycle and bring forth developers. RED's backpressure steam turbine division, Turbosteam, is making significant commitments to recycling waste steam pressure drop across CA.
  - The feed-in-tariff removes much uncertainty for hosts and CHP/WER developers, and should induce projects in the upper end of the eligible range

CHP / WER developer concerns in CA

- The utilities continue to oppose distributed generation, largely because it is not in their self-interest.
  - The standard interconnection process seems to be broken, with utilities making all DG hook up to transmission and wait, sometimes for years, for Cal ISO to approve.
  - Several grid benefits that CHP/WER could provide are ignored by utilities
- The CARB deliberations on CO2 have put a chill on manufacturing and commercial facilities; potential CHP hosts fear that by doing the right thing – performing two jobs with one fire – that they will face added costs for CO2 compliance.
- CARB continues to make new plants bear a disproportionate share of the pollution reduction burden and fails to grant emission credits for displaced central generation.

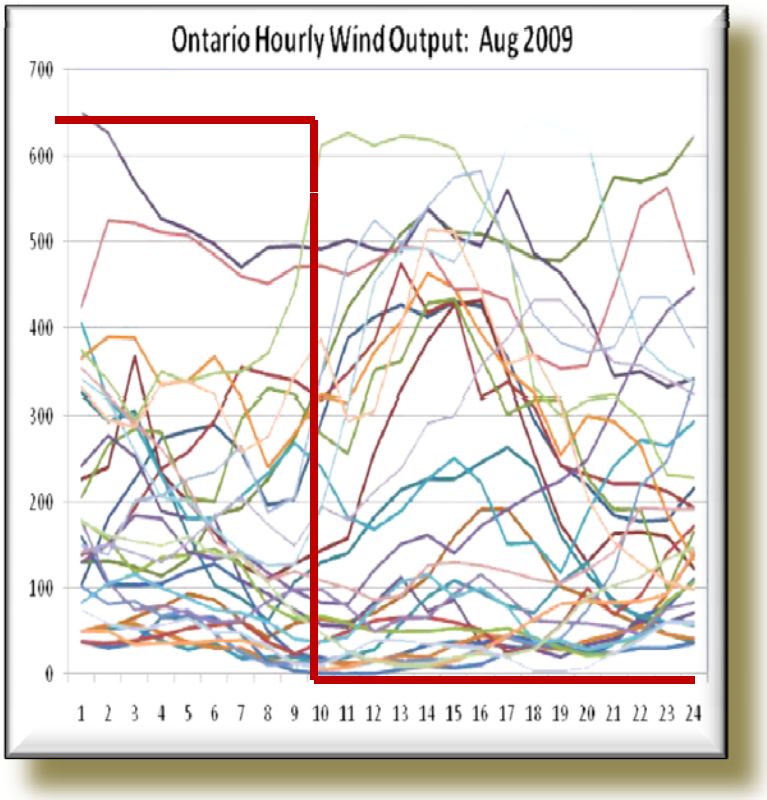
Suggestions for ways CA can speed societally profitable clean energy deployment

- First, find ways to reward utilities for supporting distributed generation and improving delivered electric efficiency. Developing 6500 MW of doubly efficient CHP and WER projects is too important to be slowed by utility self-interest.
- Deeply consider programs to connect sub-20MW DG to the distribution systems and a program of contracts for reactive power support. I will explain below
- Look at ways to use targeted CHP to also provide voltage support to transmission lines enabling significantly reduced line losses (60%) and effectively giving steroids to the existing wires
- Develop a program for long-term contracts to induce oversized CHP plants that provide spinning reserves for growing wind and solar generation without the conventional fuel penalty.

Use CHP to cut line losses, free up T&D to carry more renewable energy

- Carnegie Mellon studies show that local generation, connected to distribution system can dramatically reduce line losses:
- **DG connected to grid at distribution level:**
  - Eliminate 6.5% to 7.8% average line losses on power generated plus:
  - Lower line losses on remaining grid power by reducing load on wires,
  - Total line loss savings ~ 14%.
- **DG as above, but providing balancing reactive power:'**
  - On average, each MWh of DG offsets 1.25 to1.45 MWh of central generation.
  - On peak, each MWh of DG offsets 2 to 2.25 MWh of central generation, frees T&D
- **DG sited along transmission lines providing balancing reactive power:**
  - DG providing voltage support could reduce line losses by 60% and allow transmission lines to be thermally loaded
  - Transmission lines presently limited by voltage drop, not thermally loaded
- **Regulations to induce line loss savings:**
  - Reflect line losses in CHP payments and credits
  - Incentivize utilities to connect DG to distribution and contract for VAR support
  - CA ISO offer long term contracts for VAR support described above.

Induce fueled-CHP spinning reserve plants for growing renewable generation



Ontario Hourly Wind Output
by day August 2009

- Obviously wind and solar are much more variable than a base load coal plant or gas turbine.
- Thus each MW of renewables will require more MWs of reserve than other generation

Oversized CHP can balance wind variability with no fuel penalty

- **Wind and solar power is clean, but output varies dramatically, creating balancing problems for grid managers**
- **Conventional answer**: First use available hydro storage, then operate simple cycle gas turbines at ~40% load for 3,000 to 4,000 hours per year; ramp up as needed
  - 13,000 to 14,000 Btu/kWh, displacing 7,000 Btu/kWh CCGT
  - Adds 6 to 7,000 Btu cost and emission penalty
- **CHP Spinning Reserve answer**: Oversize a CHP GT plants to operate at 40% load at all times to provide thermal load; ramp up as needed
  - 4,500 net Btus/kWh displacing 7,000 Btu/kWh CCGT
  - Saves 3,500 Btus/kWh vs. conventional loss of 7,000 Btus/kWh
- **Regulatory changes to encourage CHP Spinning Reserves**
  - ISO offer long-term contracts for spinning reserves
  - Modify Feed In Tariff rules so 20 MW limit applies to the thermally matched portion of generation, but allows spinning reserve generation
  - Incentivize utilities to encourage CHP Spinning Reserves

CHP/spinning reserve savings versus conventional wind backup economics

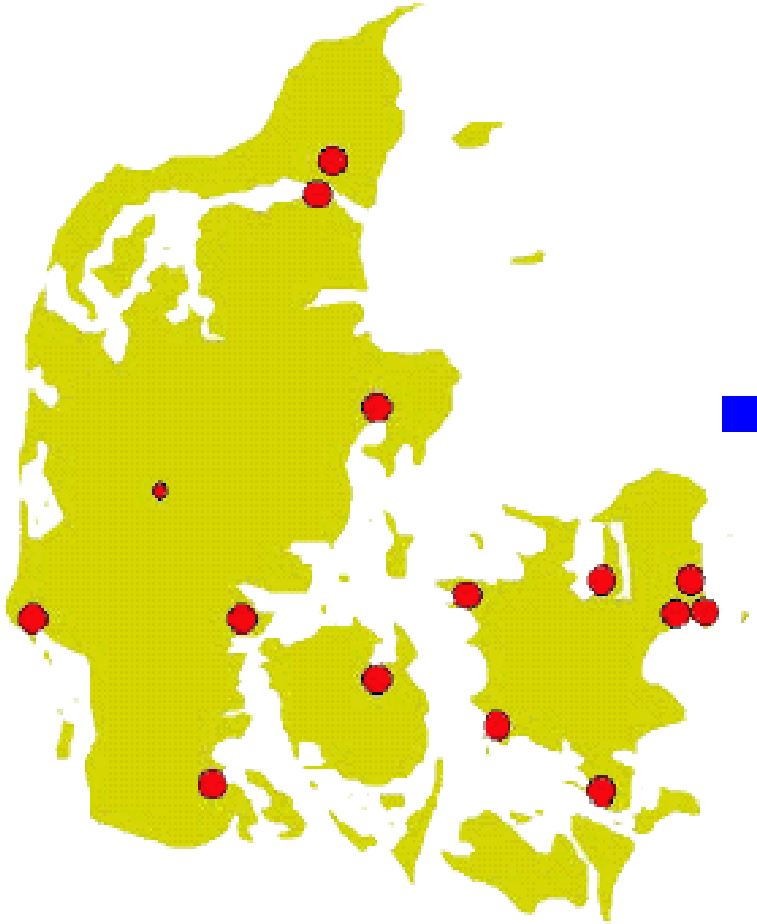
- To back up a 120 megawatt wind farm with spinning reserves:
  - A part-loaded electricity-only plant burns an incremental $4.3 million of natural gas per year
  - Using the same turbine in CHP mode, with the part load waste heat displacing host boiler fuel saves $7.7 million per year, a difference of $12 million per year
  - CHP/spinning reserve support of wind farm saves society up to $34 per MWh of wind generation
- Unless some of the benefit is used to incentivize developers and utilities to build CHP Spinning Reserves, the larger generation capacity will not be added to CHP plants, and the added costs of backing up wind and solar will delay renewable development.

Conclusions

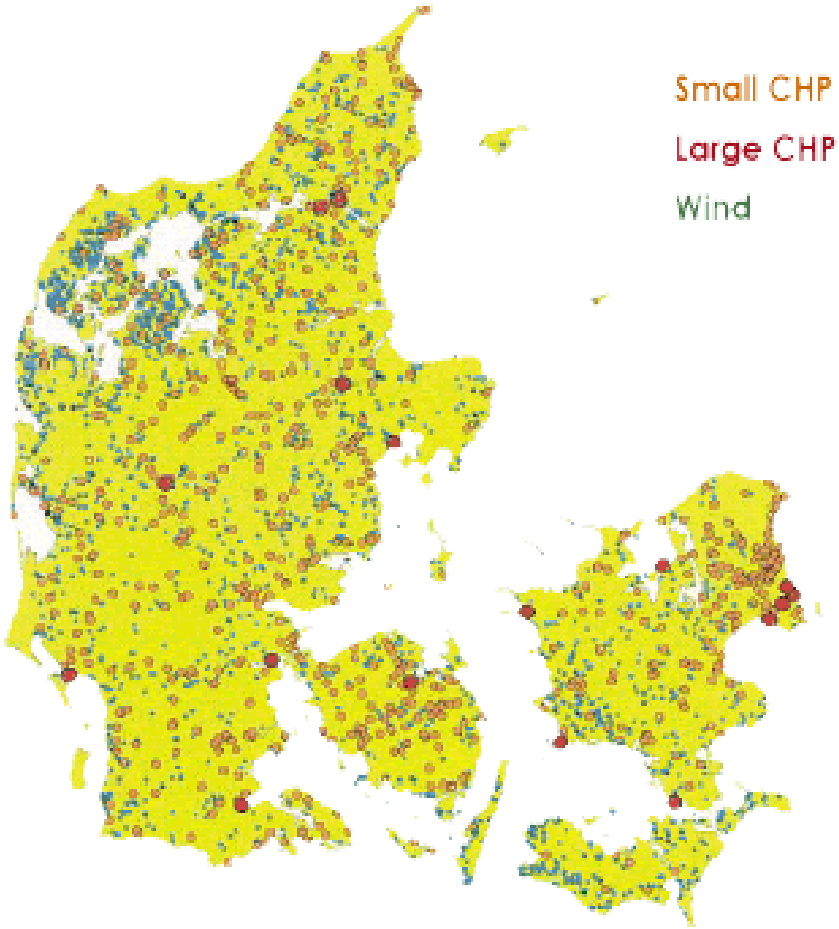
- California is already a CHP leader and has now moved strongly to further the transition to a 21st century efficient electric system
- I believe the new programs will attract CHP/WER developers and their financial backers to invest in CA.
- Without commenting on how Cal ISO, CPUC and CEC split responsibilities, I encourage CEC to champion several actions:
  - Start rewarding utilities for increased efficiency and CHP/WER deployment
  - Clear up CARB rules to reward CHP/WER for CO2 reductions
  - Encourage <20 MW interconnections to distribution systems with VAR support contracts
  - Encourage CHP Spinning Reserve plants by offering long term contracts
  - Encourage CHP with VAR support along transmission corridors to reduce line losses.
- Finally, consider Denmark experience, where thoughtful regulatory changes caused the country to set records for nationwide delivered efficiency.

Thoughtful regulations transformed Denmark in 20 years

Centralized System of the mid 1980's



More Decentralized System of Today



Thank You