
Cornell Energy Challenge

100% Renewable kWh



Prepared by
ECC Energy & Sustainability Task Force
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Background

- Subgroup of ECC Energy Task Force
 - » Reviewed “Options for Achieving a Carbon Neutral Campus” 2016
 - » Selected to focus on “100% kWh” goal
- Worked closely with Bert Bland, Associate V.P. for Cornell Energy & Sustainability
 - » Reviewed data available in “Energy Fast Facts”
 - » Prepared multiple drafts of a white paper --- refined as learned more

Background

- Key Findings:

- Cornell has a fully integrated energy system which serves all its kWh and space conditioning needs internally
- It looks from NYS grid perspective like a 30,000 person municipality with its own generation
- This is a major change from a decade or two ago – as you can see from the history paper
- But its energy system is heavily dependent on natural gas -- and that makes achieving carbon neutrality a real challenge

Cornell Energy Facts

I Supply side:

- Central Energy Plant (CEP)
 - 2 gas turbine generators (15 MW each) with heat recovery
 - 2 steam generators (7.5 MW total) plus steam for heat
 - 5 steam boilers
- Lake Source Cooling Plant (LSC)
- Hydroelectric Plant (1.5 MW)
- Solar PV Plants
 - 5 2 MW plants: Owned by Cornell
 - 18 MW: On campus land. Developer owned, RECs to Cornell
- Natural Gas purchases: 3.11 Trillion BTU, ~ \$2.25/MBTU

Cornell Energy Facts..

- | Demand side:
 - » Electric energy: 202,400 MWh
 - » Electric load:
 - ~24 MW average
 - 36 MW peak, more typically 30 MW
 - Fairly flat load curve

- | NYS Regional Energy Purchasing Consortium
 - » Recently formed
 - » Will develop additional renewable resources in state
 - » Cornell has a key role

The Cornell Energy Challenge

- It is likely that Cornell can reach nominal “100% Renewable kWh” by 2025 with RECs from new solar and wind projects
- But getting entirely to zero carbon is a much bigger challenge:
 - » The Earth Source Heat (ESH) Project, if successful could eliminate the need for the natural gas fired boilers and heat recovery from the steam and gas turbines
 - » But the turbine and steam generators will still be needed to provide electricity and will burn natural gas

The Cornell Energy Challenge...

- There are several possible options to pursue
 - » Carbon capture and storage: Capture is doable but storage or conversion to benign chemicals requires substantial capital and more research
 - » Replace natural gas with renewable fuels
 - Biofuels: Lots of technical and land availability issues
 - Renewable H₂: technology exists but, while cost is competitive with gasoline, it is *not* competitive with natural gas
 - Build 100-150 MW of PV with storage in good solar regions:
 - Cornell owned and operated
 - Wheel power to “our” substation
 - No electrons move, only \$/MWh

Possible Continuing ECC Task Force Activities

- Work with the new Sustainable Cornell Council and its Carbon Neutral Campus Committee
- Work with the Energy and Sustainability Group to carry out technical and economic analyses of options for replacing natural gas usage – will need to agree on a common cost of carbon (IMF recommends \$75/ton)

Possible Continuing ECC Task Force Activities..

- Pilot project for producing H₂ for use in campus vehicles
 - 20 KW solar powered PEM electrolyzer system producing ~5 Kg/day at 700 bar pressure
 - Site PV, electrolyzer, and dispenser at CEP
 - Acquire a commercially available FCEV (eg Hyundai SUV) for university fleet – this may be a challenge
 - Could also set up a bleed stream of H₂ to put into boiler NG line to demonstrate long term potential of conversion

Final Thoughts

- | Cornell has already made superb progress toward a low carbon energy system
- | We greatly appreciate the excellent advice and support offered by Bert Bland (Cornell Associate VP leading the ESG) and his willingness to guide us on a tour of the CEP, LSC. Solar and Hydro facilities