Greenhouse Gas Abatement with Distributed Generation in California’s Commercial Buildings

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poster presented at the 6th Annual California Climate Change Research Symposium Sacramento Convention Center, Sacramento, California, September 8 - 10, 2009

http://eetd.lbl.gov/EA/EMP/emp-pubs.html

The work described in this poster was funded by the California Energy Commission, Public Interest Energy Research Program, under Work for Others Contract No. 500-07-043, 500-99-013 and by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.
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**Motivation & Objective for this Research**

- to determine the role of distributed generation (DG) in greenhouse gas reductions by
  - applying the Distributed Energy Resources Customer Adoption Model (DER-CAM)
  - using the California Commercial End-Use Survey (CEUS) database for commercial buildings
  - selecting buildings with electric peak loads between 100 kW and 5 MW
  - considering fuel cells, micro-turbines, internal combustion engines, gas turbines with waste heat utilization, solar thermal, and PV
  - testing of different policy instruments, e.g. feed-in tariff or investment subsidies

**Schematic of the Energy Flow in a Building - Global Concept**

**California Commercial End-Use Survey (CEUS) database**

CEUS database contains 2700 premises from PG&E, SMUD, SCE, and SDG&E service territories:

- 12 building types, e.g. schools, colleges, hotels, warehouses, etc.
- 12 forecasting Climate Zones (FZ); using 10 year normalized weather sample; containing simulated hourly estimates of end-use electricity and natural gas consumption
- eQUEST simulations (frontend tool for DOE2)

35% of commercial electric demand considered

- buildings between 100 kW and 5 MW electric peak load are considered
- no miscellaneous building types
- SMUD and LADWP are not considered

**Result: Reference Case in Comparison to California Air Resources Board's (CARB) 2020 Goal**

- 4 GW
- 30 TWh/a
- 6.7 Mt/a

2020 cost savings of mid-sized bldgs: 0.19B$/a

vast majority of adopted technologies are internal combustion engines with heat exchangers

**Result: Influence of a CO2 Pricing Scheme**

**Result: Influence of Investment Incentives for Fuel Cells in 2020**

**Distributed Energy Resources Customer Adoption Model (DER-CAM)**

DER-CAM optimization techniques find both the combination of equipment and its operation over a typical year that minimizes the site's total energy bill, including amortized capital costs, or CO2 emissions by considering

- hourly load profiles for electric, heating, cooling, and natural gas loads
- any onsite technology that can be described by capital costs, O&M costs, efficiency, etc.
- building/microgrid energy balance
- operating constraints, e.g. solar radiation
- regulatory constraints, e.g. CO2 prices / taxes or zero-net energy buildings

**High Level Schematic of DER-CAM**

**Conclusion**

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