Energy Forecasting in California

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California Energy Commission
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California Energy Commission

• Created in 1974 by California legislature for energy planning
• Funded by utility bill surcharge (0.022 cents/kWh), various other sources
• 5 Divisions:
  ▫ Efficiency and Renewables
  ▫ Energy Facilities Siting
  ▫ Energy Research and Development
  ▫ Fuels and Transportation
  ▫ Electricity Supply Analysis
Analysis of Electricity Market

• Demand Analysis Office (DAO) and Electricity (supply) Analysis Office
• DAO forecasts electricity and natural gas demand consumption (except natural gas for generation)
• 9 full-time personnel year equivalents
Electricity and Natural Gas Forecast

- **Residential:** End Use model
  - 3 housing types, 24 appliance and space conditioning categories
- **Commercial:** End Use model
  - 12 building types, 10 equipment and space conditioning categories
- **Industrial (process, extraction, assembly):** mixed model
  - Econometric model of production by sector, end use models derive kWh given production (EPRI “Inform”)
- **Agricultural and Water Pumping:** econometric model
  - crops, dairy, livestock, urban water pumping
Important Inputs

- Economic data (Economy.com)
- Demographic data (Calif. Department of Finance)
- Residential Appliance Saturation Surveys
- Commercial End-Use Surveys
- Utility load data, historic electricity and natural gas consumption
- McGraw Hill (formerly Dodge) floor space
- Weather data
- Electricity and natural gas price forecasts
- Agricultural production data
Framework for Energy Demand Forecast Models

ECONOMIC AND DEMOGRAPHIC ACTIVITY

- RESIDENTIAL
  - Housing Model
  - Unit Energy Model
- COMMERCIAL
  - Floor space Model
  - Unit Energy Model
- AGRICULTURE / WATER PUMPING
  - Crop Production Model
  - Urban Water Pumping Model
  - Dairy and Livestock Model
- INDUSTRIAL
  - Thermal Processes Model
  - Motors, Lighting, HVAC Models

ENERGY DEMAND FORECAST SUMMARY MODEL

PEAK DEMAND AND HOURLY LOAD FORECAST MODEL

ANNUAL ENERGY AND PEAK ELECTRIC DEMANDS AND ANNUAL NATURAL GAS DEMANDS

Source: California Energy Commission staff, May 2005
10-Year Forecast Outputs

- Annual Peak and Energy Forecasts
- Climate Zone Level (16 climate zones)
- Impact of Efficiency and Conservation Programs
Forecast Usage

- Assembly Bill 2021 (efficiency targets)
- Long-Term Procurement
- Resource Adequacy
- Greenhouse Gas Reduction (Air Resources Board)
- Grid Studies/Transmission Planning
- Natural Gas Assessment
Related Efforts

• Year-ahead Peak Demand forecast for resource adequacy

• Summer Outlook
  ▫ Assessment of the overall capability of the physical electricity system to provide power to meet electricity demand in the following summer
  ▫ Probabilistic analysis
Related Efforts

- Scenarios Analysis Project
  - Designed to develop greater understanding of actions needed to achieve major reductions in greenhouse gases in electricity sector
  - Analysis of consequences and tradeoffs involved
  - 13 thematic scenarios testing for sensitivities to high and low fuel prices, high and low hydro-electric generation, different levels of efficiency measures and renewables
  - Methodology: “Market Analytics” by Global Energy Decisions
Improvements to Methodology:

Ongoing Demand Forecast Assessment Project
- Increased attention to forecasts uncertainties to complement current “point forecasts”
- Model revision to provide more detail on impacts of building and appliance standards and other conservation and efficiency measures
- More formalized short-term forecasting effort
Extra Slides
Residential Energy Demand Forecast Model

HOUSEHOLD COMPONENT
(Population, Persons per Household, Per Capita Income, Housing Vintage, Climate Zone)

APPLIANCE COMPONENT

Historical Stock Data
Projected Stock
Replacement / Installment Patterns

Projected Appliance Stock by End Use, Housing Vintage, Housing Type, and Fuel Type

UNITS OF ENERGY CONSUMPTION (UEC) COMPONENT

Appliance Usage
Appliance Efficiency

Unit Energy Use by End Use, Housing Vintage, Housing Type, and Fuel Type

Annual Residential Electric and Natural Gas Demands
Figure 3-1
Commercial Energy Demand Forecast Model

ENERGY DETERMINANTS
- Efficiency Program Inputs
- Energy Usage Inputs
- Economic Inputs
  - Energy Use per Sq. Ft. by End Uses and Building Type

FLOORSPACE DETERMINANTS
- Vacancy Model
- Floor Space Model
  - Historic and Projected Office Vacancies
  - Historic Non-Office Commercial Building Vacancies
    - Stock Floor Space from past Surveys and Models
    - Projected Additions from Economic Drivers
  - Floorspace Square Footage by Building Type

Annual Commercial Electric and Natural Gas Demands
Figure 4-1
Industrial End-use Forecasting Model Structure

Exogenous Variables Module
- Industry Model E, Q, CU, Q*
- Fuel Prices Module P

Stock Accounting Framework
- Lighting Model
- Motor Model

Reduced Form Framework
- Thermal Process Model
- Other Process Model
- HVAC Model
- Miscellaneous Uses Model
- Cogeneration Model

INFORM Forecast Structure
Agricultural and Water Pumping Energy Demand Forecast Models

Demographic and Economic Variables
- Rainfall
- Total Crop Production
- Energy Prices

Expected Energy Demand for Irrigation Water Pumping
- Diesel Price
- Crop Production Energy Demand

Domestic Water Pumping Energy Demand

Dairy/Livestock Production
- Energy Prices
- Dairy and Livestock Energy Demand

Annual Agricultural and Water Pumping Electric and Natural Gas Demands