CEC Hot Water in Title 24: Roadmapping Workshop
July 16th, 2013

The Importance of Hot Water in Commercial Buildings in California

FISHER NICKEL inc.

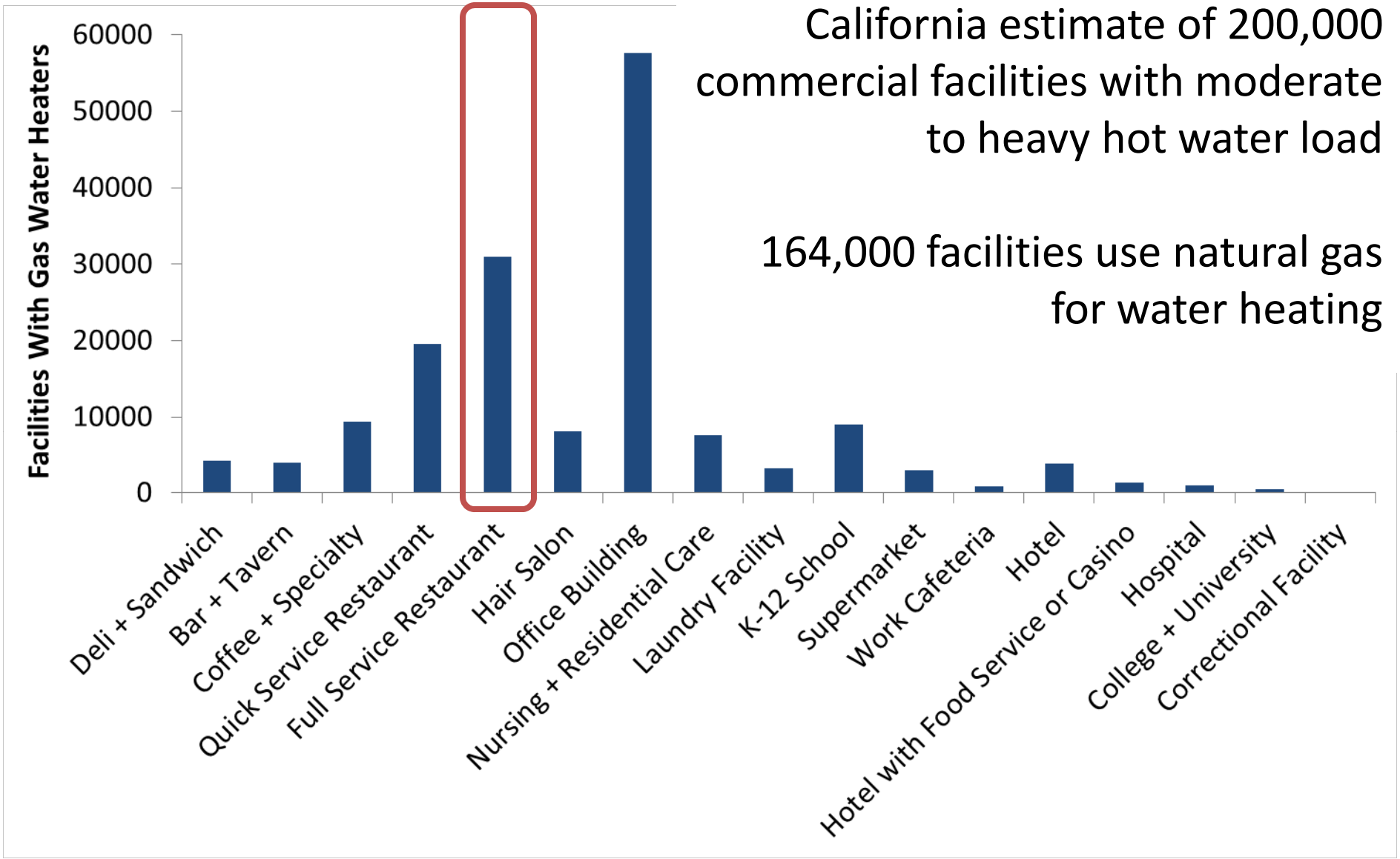
PG&E Food Service Technology Center

Amin Delagah
amin@fishnick.com
925-866-5265

Commercial Segments Examined With Moderate to High Hot Water Load

- Deli + Sandwich
- Laundry Facility
- Bar + Tavern
- K-12 School
- Coffee + Specialty
- Supermarket
- Quick Service Restaurant
- Work Cafeteria
- Full Service Restaurant
- Hotel
- Hotel with Food Service or Casino
- Personal Care Services
- Office Building
- Hospital
- College + University
- Nursing + Residential Care
- Correctional Facility

Facilities Using Natural Gas for WH



California estimate of 200,000 commercial facilities with moderate to heavy hot water load

164,000 facilities use natural gas for water heating

Solving For Segment Gas Load

Example: Full-Service Restaurants In California

1. Recount Data 2007 → ***34,400 Facilities***
2. Gas Heating in 95% of Facilities → ***32,680 Gas Heaters***
3. Average Hot Water Use → **2500 Gallons Per Day**
4. 363 Days Operation → ***907,500 Gallons Per Year***
5. 145°F Outlet - 65°F Inlet → ***80°F Average Temperature Rise***
6. Estimated: 90% of Facilities Operate at 65% Standard Efficiency and 10% of Facilities at 85% High Efficiency → *67% Average*
   → ***65% Nominal System Efficiency***

Gas Load Equation

Solving For Facility Gas Load

Daily Water Heating Gas Load = $q = \frac{Q c_p \rho \Delta t}{\eta_s}$

Where:

$$q = daily\ gas\ load, therms$$

$$Q = daily\ flow\ rate, gallons$$

$$c_p = specific\ heat\ of\ water = 1.00 \frac{Btu}{lb°F} \left(\frac{1\ therm}{100{,}000\ Btu} \right)$$

$$\rho = density\ of\ water = 8.33 \frac{lb}{gal}$$

$$\Delta t = temperature\ rise\ (outlet - inlet), °F$$

$$\eta_s = water\ heating\ system\ efficiency$$

Solving For Sector Gas Load

Example: Full Service Restaurants In California

7. Daily Gas Load Per Facility

$$= \frac{2500\ \frac{gallons}{day} * \frac{1}{100{,}000}\frac{therm}{lb°F} * 8.33\ \frac{lb}{gal} * 80°F}{65\%} = 25.6\ \frac{therms}{day}$$

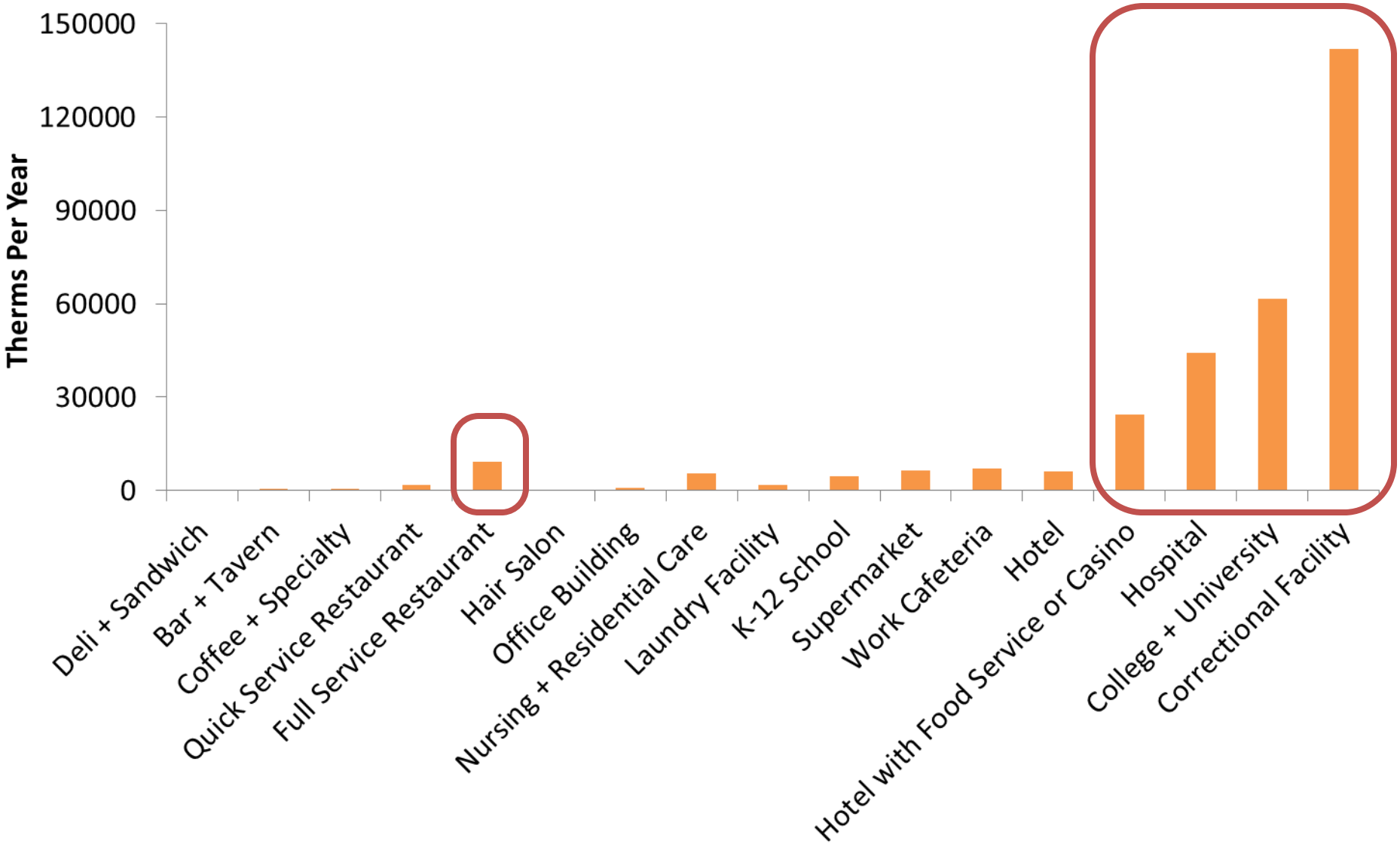
8. Annual Facility Gas Use

$$= \frac{25.6\ therms}{day} * \frac{363\ days}{year} = 9300\ \frac{therms}{year}$$

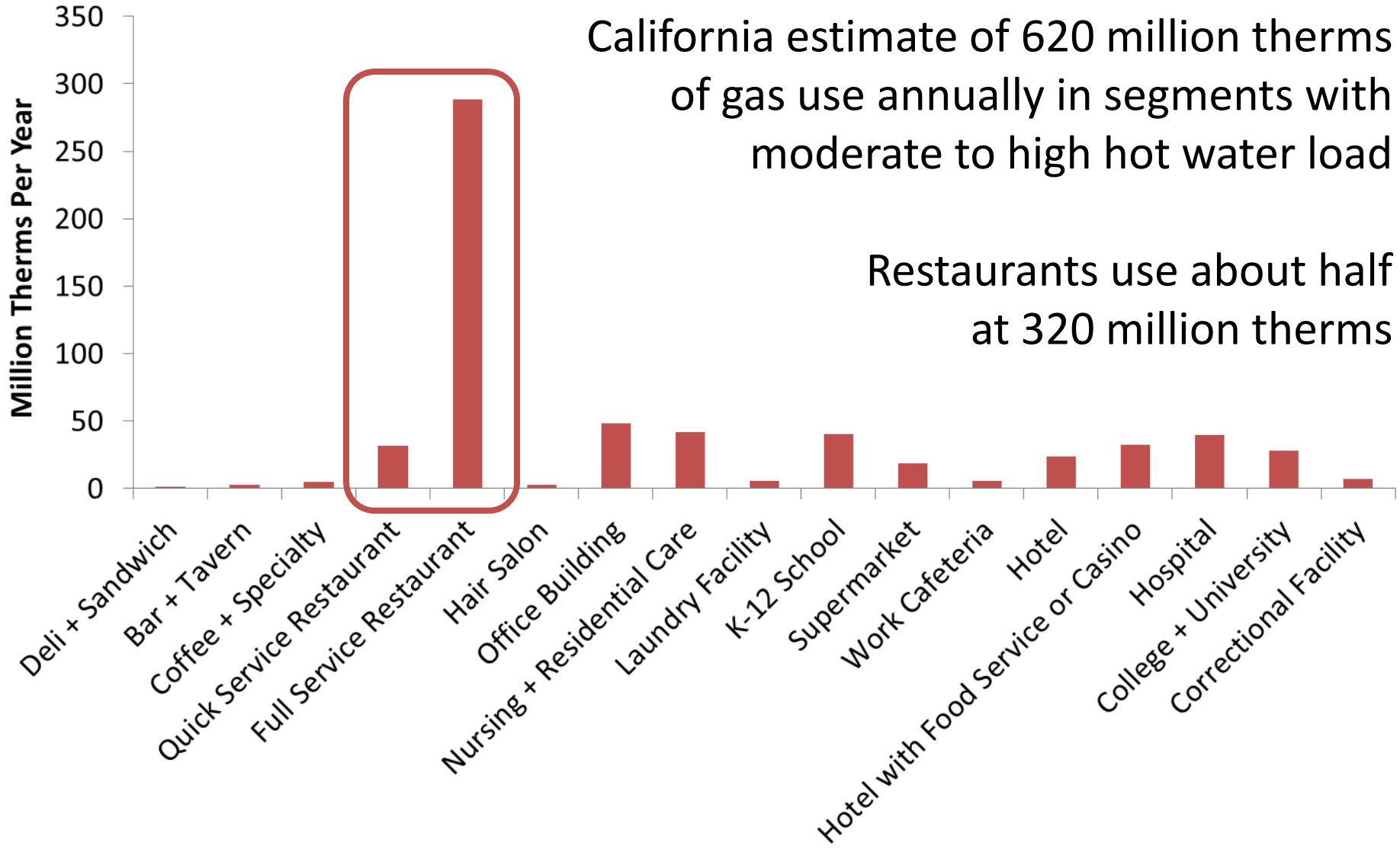
9. Annual Full Service Restaurant Sector Gas Load

$$= \frac{9300\ therms}{year} * 30{,}960\ Facilities = 288\ million\ therms$$

Annual Gas Use Per Facility



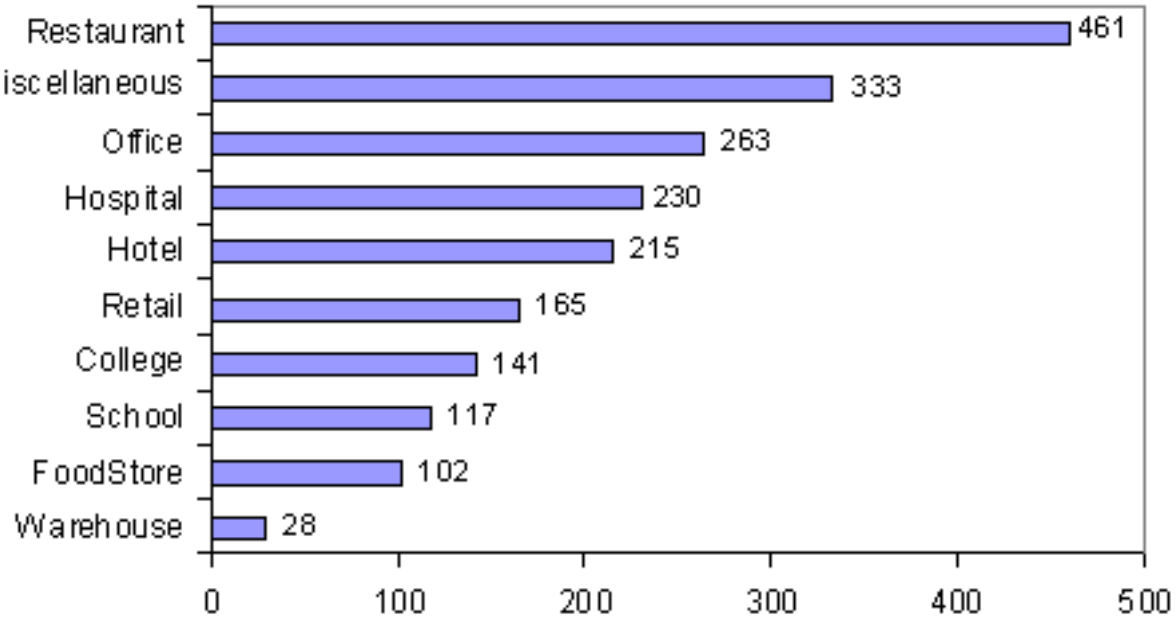
Annual Gas Load Per Segment



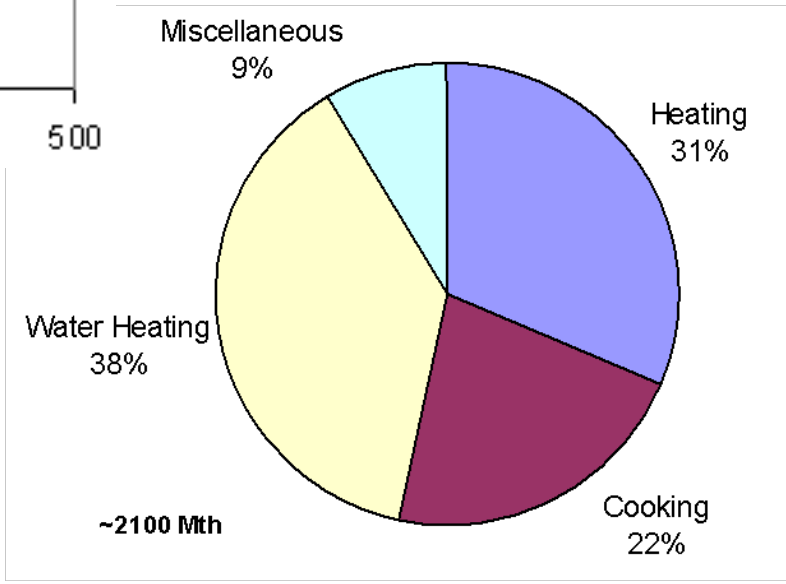
California estimate of 620 million therms of gas use annually in segments with moderate to high hot water load

Restaurants use about half at 320 million therms

2000 CPUC Study on Commercial Natural Gas Usage by Building Type



Three major investor-owned utilities reported that commercial facilities used 2,100 Mtherms of natural gas annually.



38% of gas use was for water heating!

Equates to 800 Mtherms annually in commercial facilities.

2006 CEUS Survey

A 2006 CEC report titled, California Commercial End-Use Survey by ITRON estimated annual gas use for water heating in restaurants at 72 Mtherms and in all commercial building types at 407 Mtherms.

Total commercial gas use was estimated at 1280 Mtherms.

Table E-4: Natural Gas Usage (Mtherms) by Building Type and End Use

Building Type	Heat	Cool	WH	Cook	Misc.	Proc.	Total
All Commercial	465.50	19.10	406.70	289.10	23.00	75.20	1278.60
Small Office	31.20	0.00	6.00	0.50	0.10	0.40	38.10
Large Office	113.70	3.60	17.20	1.50	0.70	8.10	144.80
Restaurant	11.50	0.00	72.40	228.20	0.00	0.50	312.60
Retail	21.20	0.00	5.50	3.60	1.90	0.30	32.50
Food Store	13.70	0.00	11.00	14.90	0.00	0.10	39.80

Findings from FSTC, CPUC and CUES studies

- FSTC and CPUC report estimates compare well together.
- Gas load for water heating in commercial facilities especially food service (72 Mtherms) appears to be underestimated in CEUS.
- Water heating gas load of 320 Mtherms in restaurants and 800 Mtherms in the commercial sector are significant as they demonstrate the energy intensity of water heating in this sector.
- 10% of water heaters in California used in commercial facilities are electric, annual use is estimated at 2,000 GWh, which equates to approximately 70 Mtherms.
- Total annual commercial load is estimated at 870 Mtherms.

Perspective for the Roadmap

- 20% of commercial facilities have condensing heaters in California compared to 60% in the Midwest even though payback is 1.5 years on average. One solution is to mandate condensing water heaters in certain segments.
- Optimization of distribution systems in existing systems: insulating **all** hot water pipes, recirculation pump timer.
- Encouraging the integration of demand circulation, point of use or decentralized hot water systems for new systems.
- Efficient hot water using end-use equipment is the low hanging fruit and the most cost effective since it provides energy and water savings.
- Free heating technologies like refrigerant and dishwasher waste heat recovery need to be supported.

Thanks for Listening!