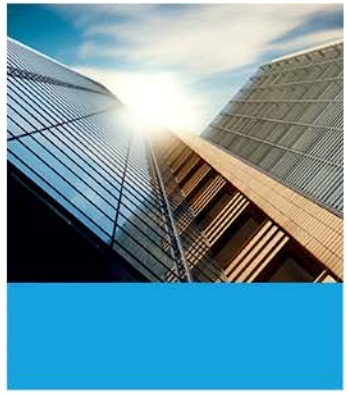



Looking Beyond the Hour

Hossein Haeri

ACEEE Energy Efficiency as a Resource Conference

November 1, 2017

Outline

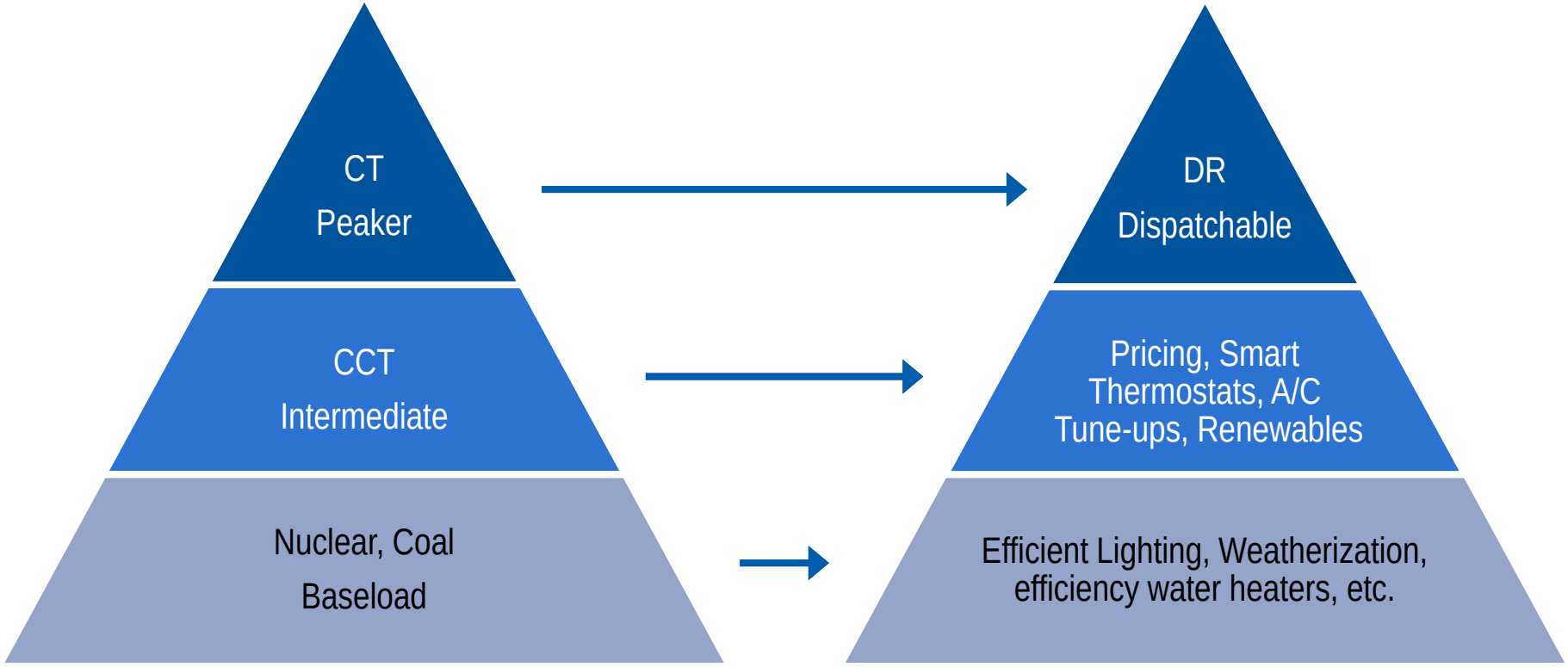
Role of EE in Power System Planning

System Benefits of EE

Measuring and valuing capacity contributions

Remembering Arthur Rosenberg

The DSM Virtual Power Plant



Conventional Generation

Demand-Side Management

Energy Efficiency – A Layered Cake

Avoided Externalities

Ancillary Services

T&D System

Capacity

Energy

Capturing Capacity Value of Energy Efficiency

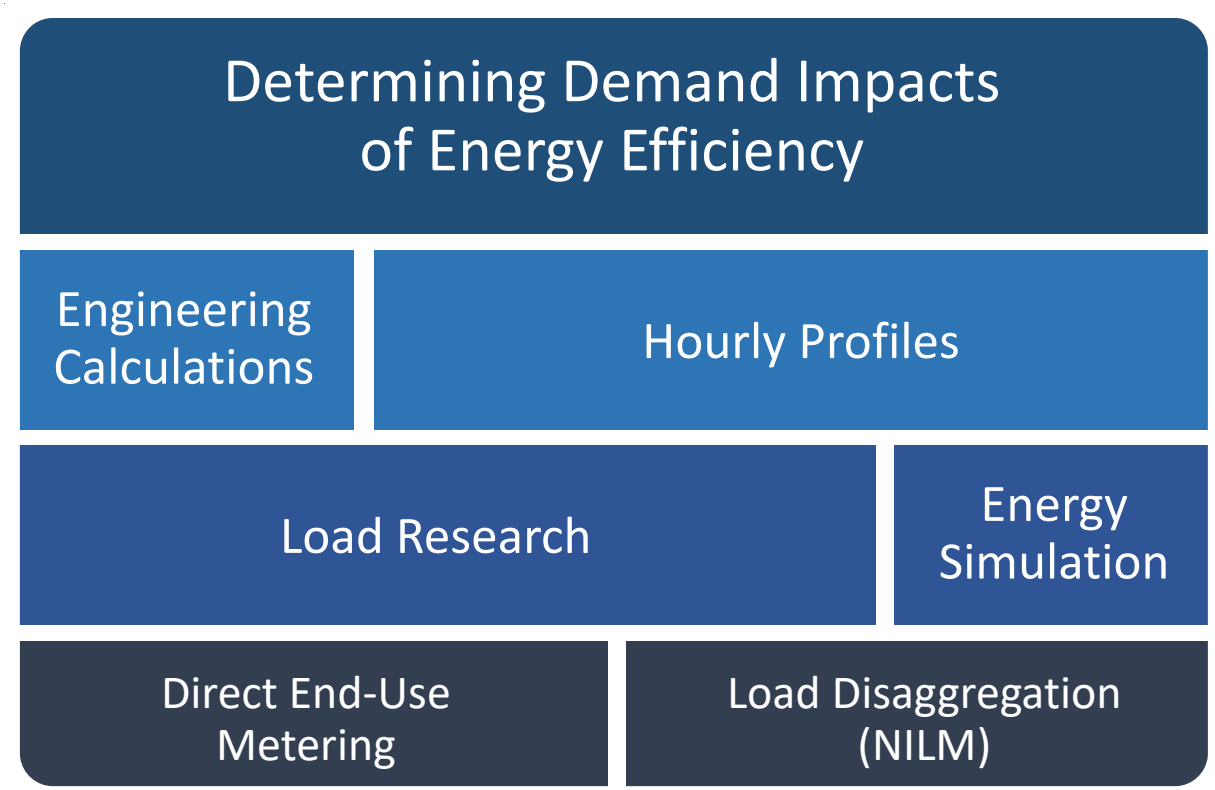
What is needed:

- Hourly system load profile
- Hourly energy efficiency measure "savings" profile
- Avoided hourly energy cost ($/MWh)
- Avoided capacity costs ($/kW-year)

What to do:

- Define peak hours (window)
- Determine coincidence factor
- Calculate conservation load factor (CLF)
- Calculate capacity benefits

Where Load Shapes Come From



Defining Peak

Highest peak (1) hour

Highest consecutive hours

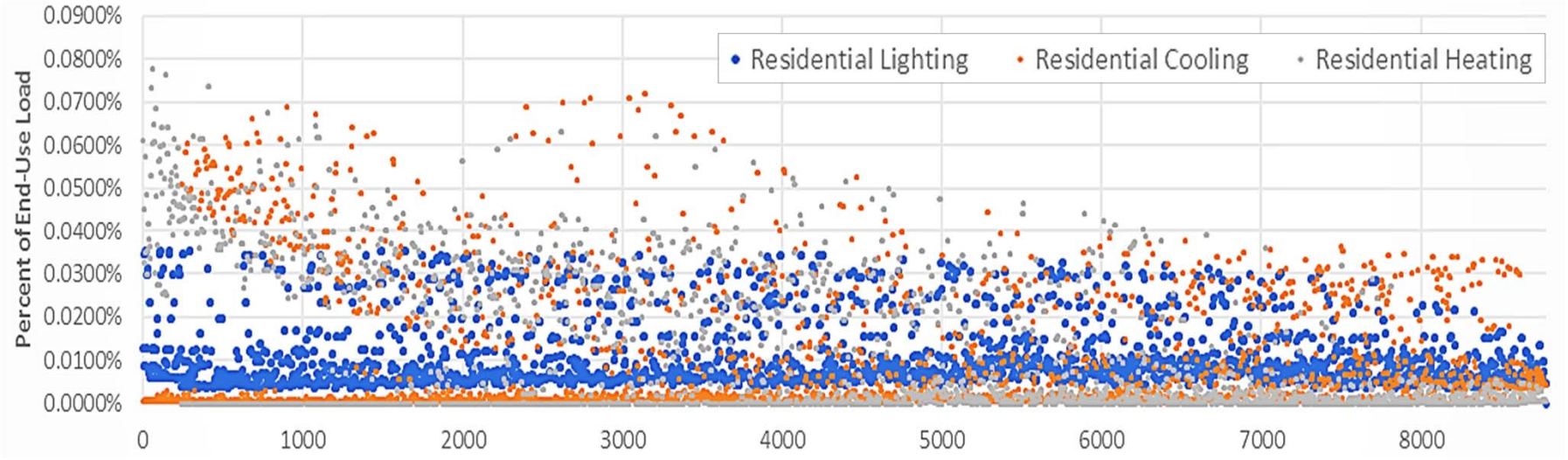
Top regions of load duration curve (top 5%)

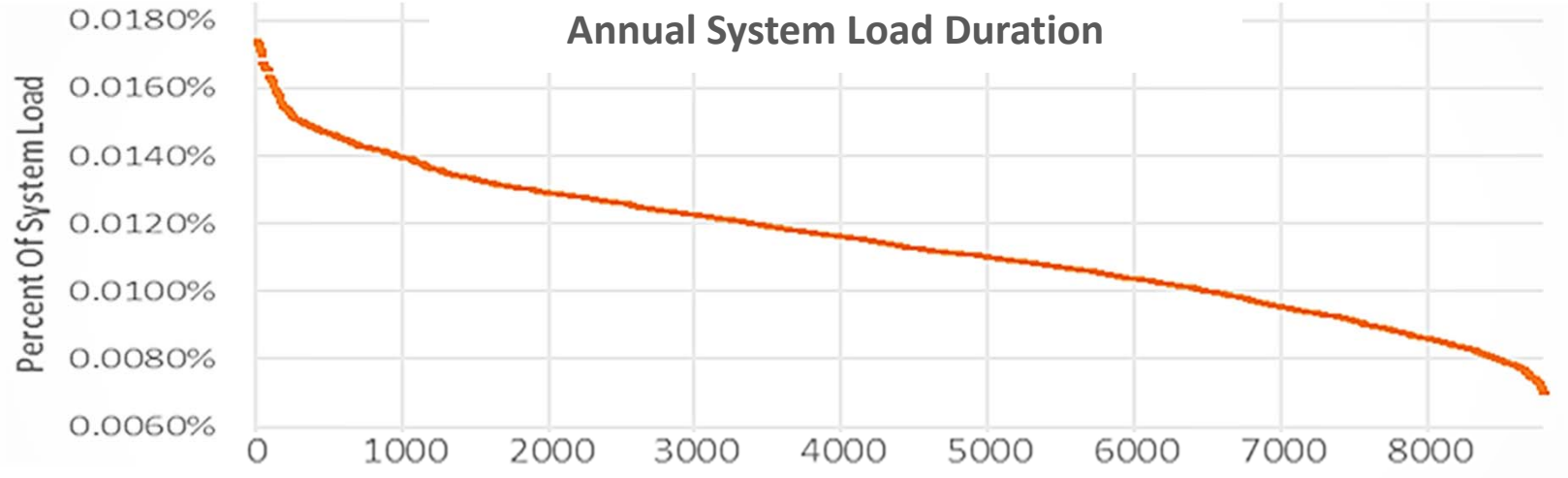
Daily peak hours (e.g. 3:00 – 8:00) weekdays in January and February

Loss of load probability (LOLP)

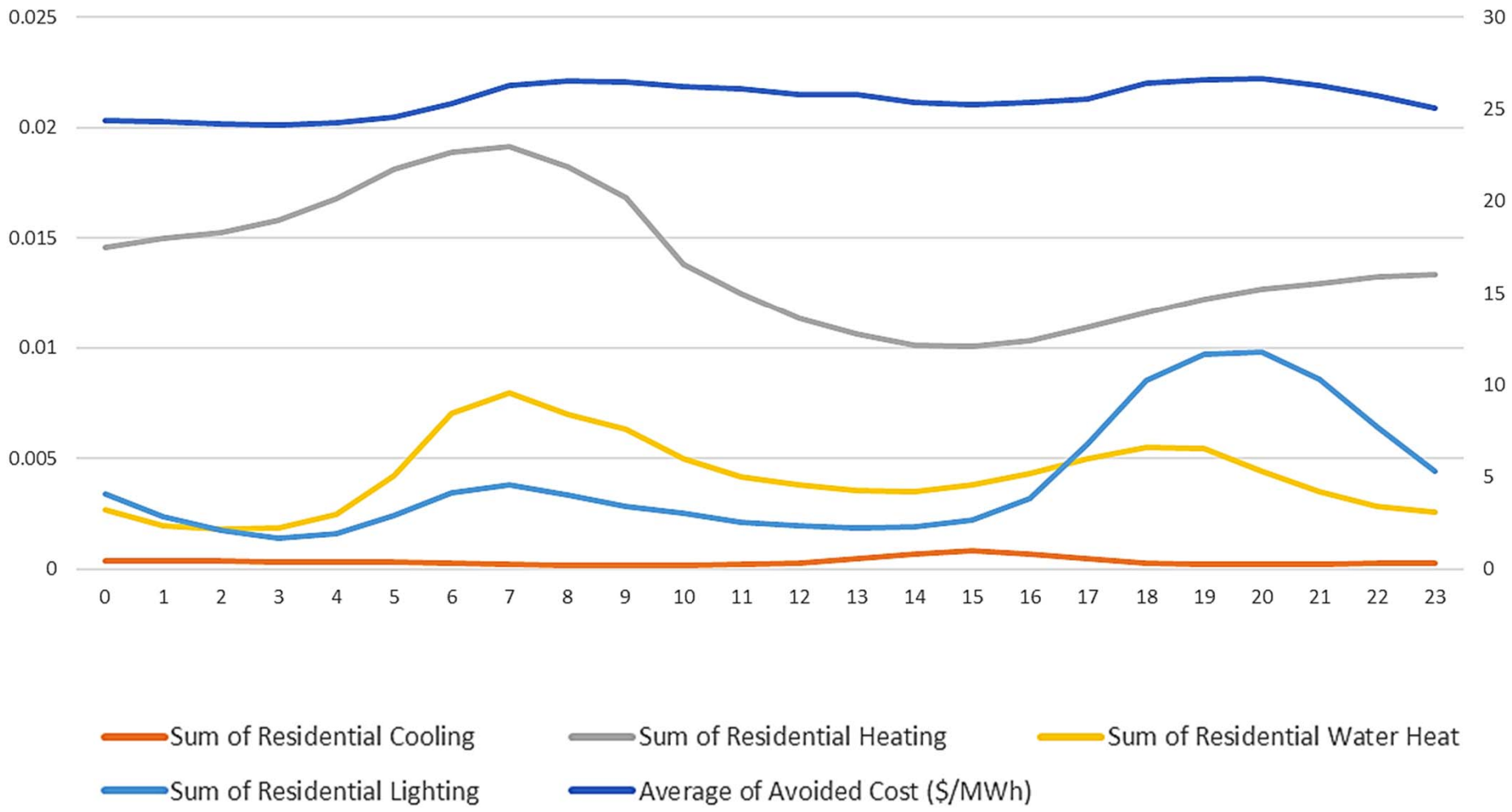
Hourly peak probability distribution

Example: Residential Sector





Example: Residential Sector



How We Define Peak Matters

	Peak Hour	TopTwenty Hours	Peak Period
No Capacity Value	4.8	4.8	4.0
	3.6	5.7	4.1
	0.2	0.0	0.3
	17.0	12.9	11.6
With Capacity ($100/kW-Yr.)	22.2	22.2	19.1
	16.5	25.8	19.3
	1.0	0.0	1.6
	78.1	59.0	55.3
Percent Change	17%	17%	15%
	13%	20%	15%
	1%	0%	1%
	61%	46%	44%

Conservation Load-Factor

Assume a residential lighting and A/C efficiency program with savings of 10% in lighting and 10% in A/C usage annually:

1. Calculate the peak coincidence factor for each program
2. Calculate the conservation load factor for each program

Conservation Load-Factor

Conservation load factor:

$$CLF = \frac{\text{Average Annual Hourly Energy Savings (kW)}}{\text{Peak Load Savings (kW)}}$$

Or:

$$CLF = \frac{\text{Annual Energy Savings (kWh)}}{\text{Peak Load Savings (kW) * 8760}}$$

Heating (HP):

- Annual savings (kWh) = 457
- Peak hour savings (kW) = 0.28
- CLF = 0.19

Lighting (LED):

- Annual savings (kWh) = 40
- Peak load savings (kW) = 0.01
- CLF = 0.41

Valuation of Capacity Savings

Recall that:

$$CLF = \frac{\text{Annual Energy Savings (kWh)}}{\text{Peak Load Savings (kW)} * 8760}$$

Or:

$$CLF * 8760 = \frac{kWh}{\text{Peak kW}}$$

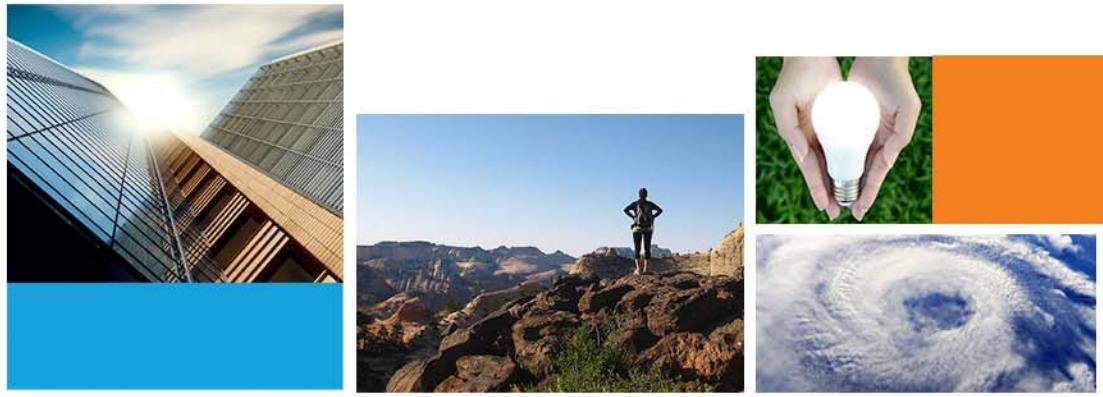
Assume capacity value of $100 per kW per year

- Value of 1 kW of savings from heating
  = $100 ÷ (0.19 * 8760) = 6.0 cents
- Value of 1 kW of savings from lighting
  = $100 ÷ (0.41 * 8760) = 3.0 cents

The lower the CLF, the higher the capacity value from a kWh saved.

ANY

QUESTIONS



Hossein Haeri

Senior Vice President, Energy Services

hossein.haeri@cadmusgroup.com

Office (503) 476-7140

Facebook.com/CadmusGroup

@CadmusGroup

Linkedin.com/company/the-cadmus-group