Electric Rate Design and Energy Efficiency

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American Council for an Energy-Efficient Economy

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Our research explores economic impacts, financing options, behavior changes, program design, and utility planning, as well as US national, state, & local policy.

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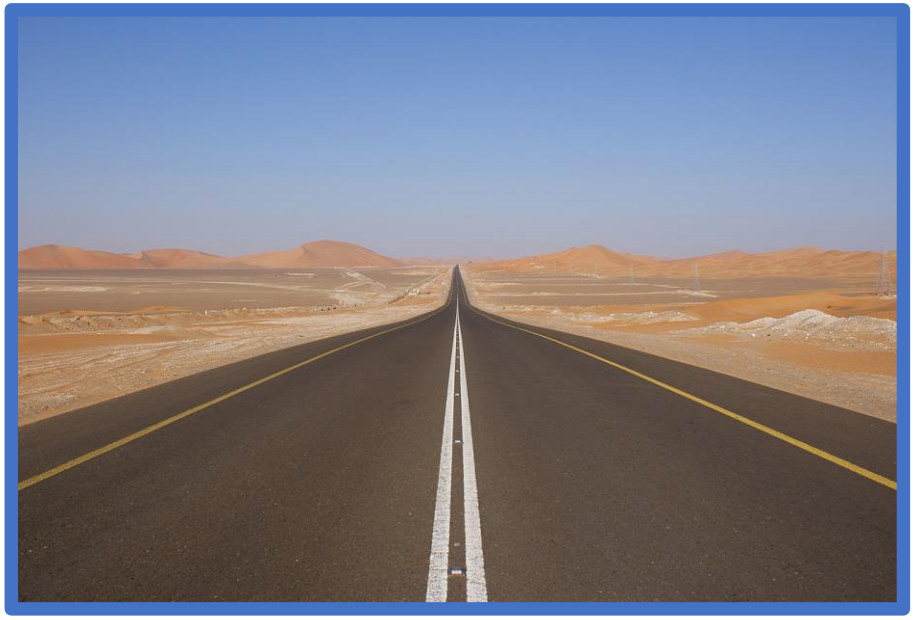
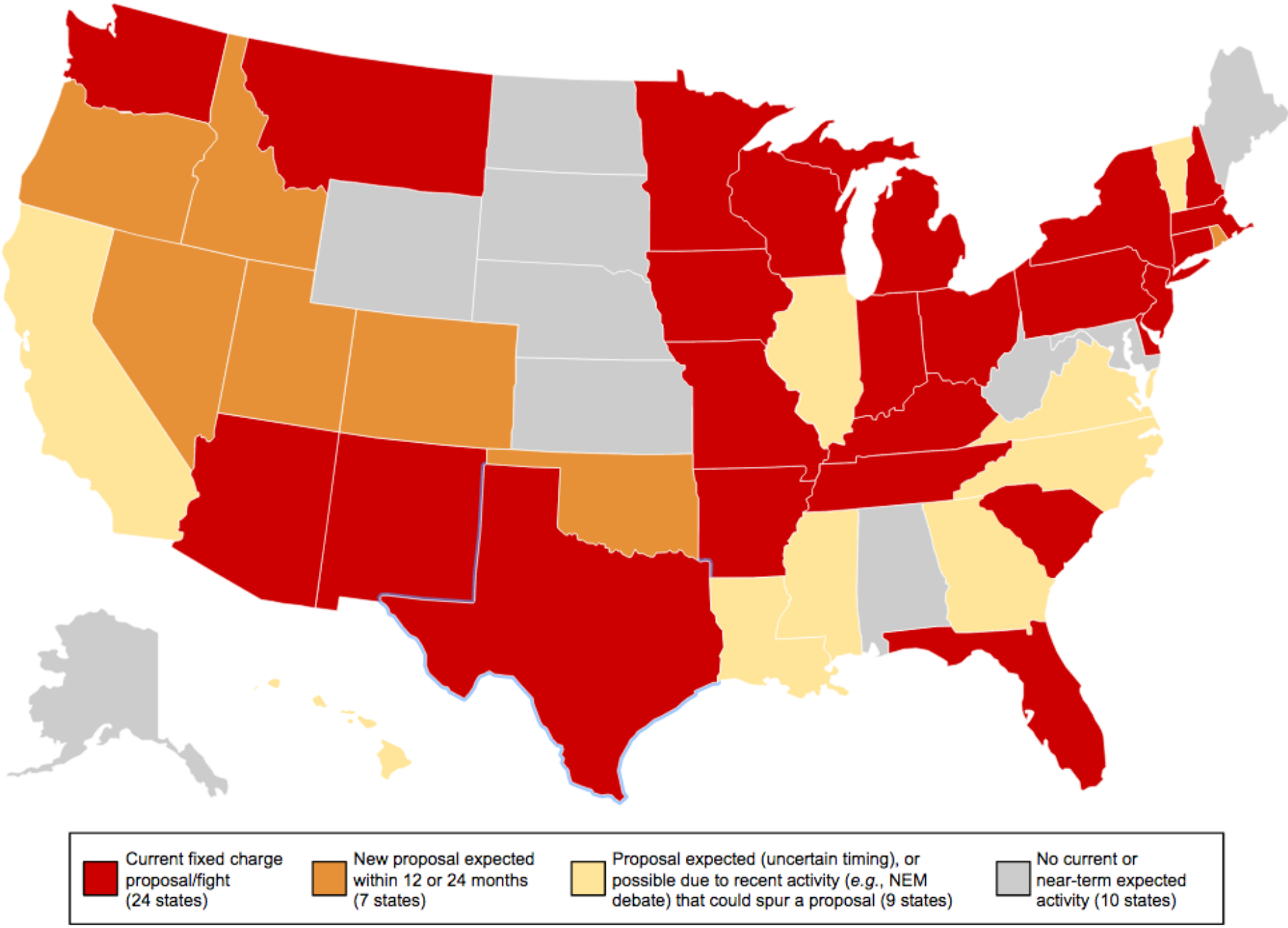
Drivers of change in rate design

- Increased penetration of AMI
- Rapid market growth in solar PV
- Flat or declining electric sales



Changes in Rate Design

- Higher fixed (customer) charges
- Residential demand charges
- Time varying rates
- Segmented customer classes
- Decoupling or formula rates


Current fixed charge proposal/fight (24 states)
New proposal expected within 12 or 24 months (7 states)
Proposal expected (uncertain timing), or possible due to recent activity (e.g., NEM debate) that could spur a proposal (9 states)
No current or near-term expected activity (10 states)

Higher Customer Charges Results

- 87 cases decided between 2013 and 2016
  - **3 with decrease**
  - **30 with no change**
  - **40 under a 40% increase**
  - **15 higher than 40% increase**
  - **Average increase is 15%**
- Proposals still continue
  - **Current national average for 51 largest is $8.65 per month**

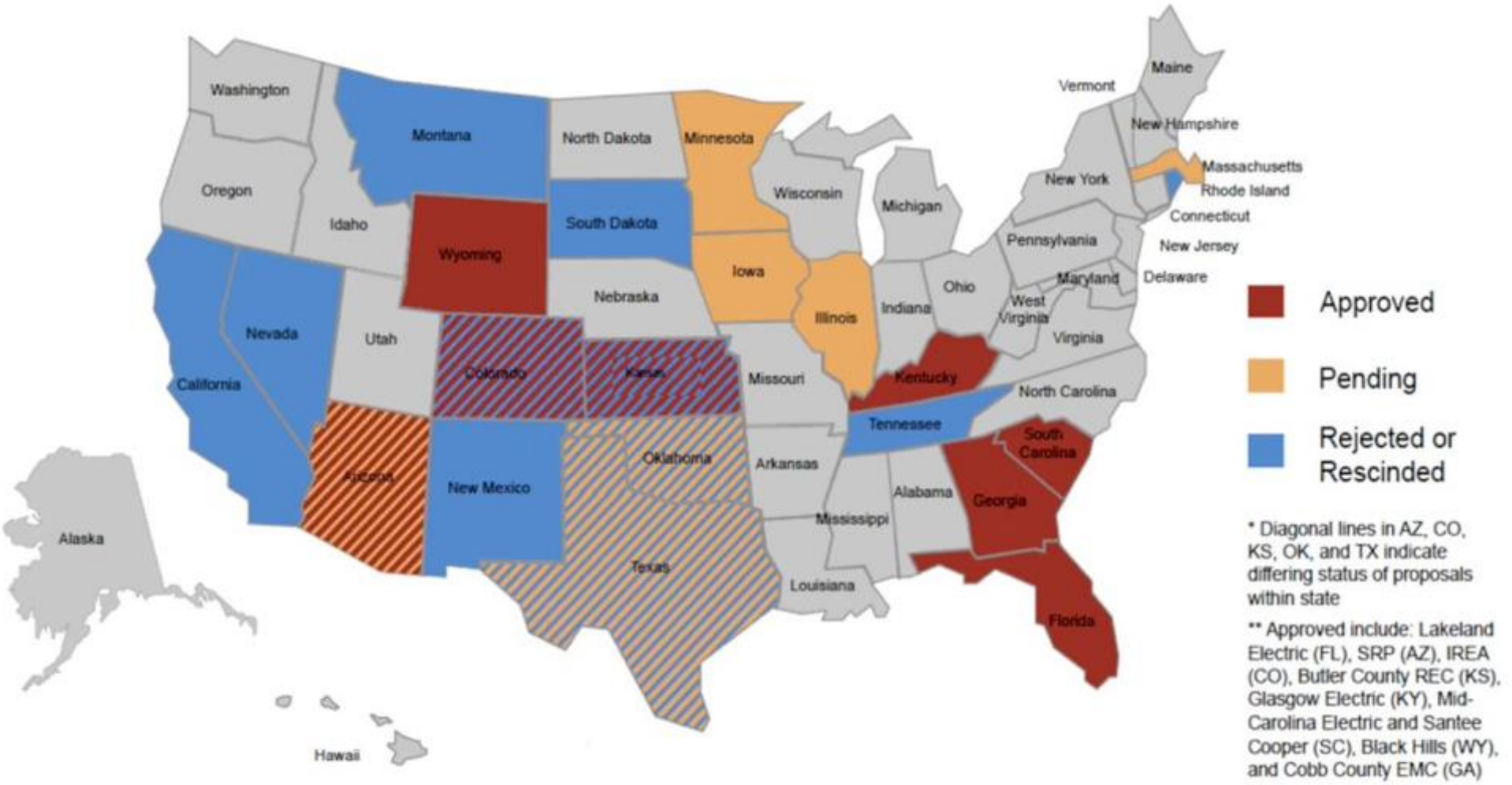
Residential Demand Charges

- AMI meters make demand charges feasible for smaller customers
- Uncommon until recently
- Today – over 30 utilities in U.S. (mostly coops), nearly all voluntary
- Very few studies on customer response

Selected Examples

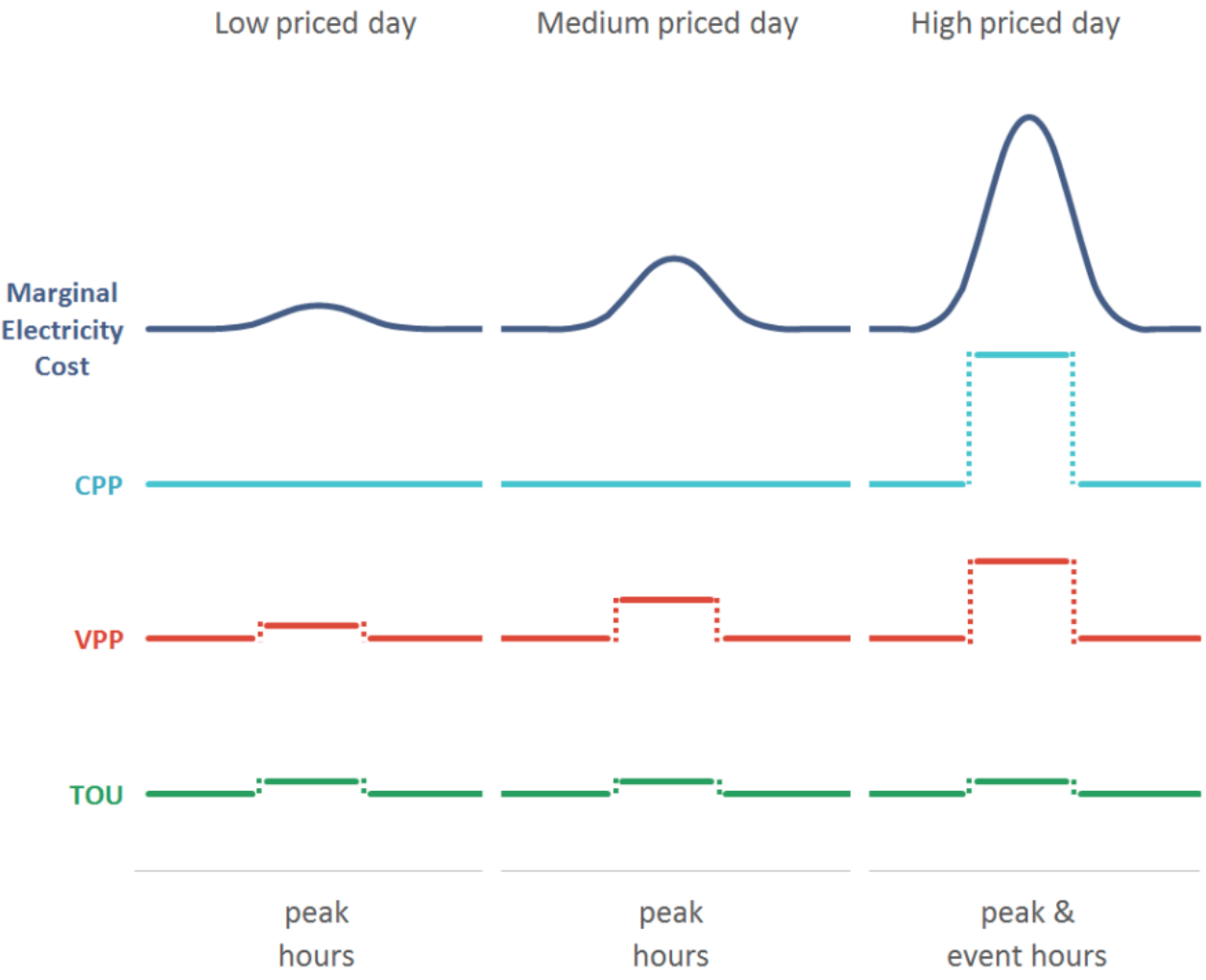
Utility	Customer charge ($/month)	Demand charge ($/kW)	Demand charge billing period	Volumetric rate
Alabama Power	$14.50	$1.50	all hours, all days	varies, TOU
Arizona Public Service	$16.68	$13.50 (summer) $9.30 (winter)	weekdays, 12 pm to 7 pm	varies, TOU
Black Hills Energy (SD)	$13.00	$8.10	all hours, all days	2.26¢/kWh
Black Hills Energy (WY)	$15.50	$8.25	all hours, all days	6.43¢/kWh
Xcel Energy (CO)	$12.25	$8.57 (summer) $6.59 (winter)	all hours, all days	1.74¢/kWh
Intermountain Rural Electric Association	$10.00	$14/kW	all hours, all days	6.59¢/kWh
Glasgow Electric Board	$29.16	$11.33 (summer) $10.37 (winter)	weekdays, 1 pm to 7 pm (summer), 6 am to 4 am and 10 am to 9 pm (winter)	varies, TOU

Residential Demand Charge Proposals



Source: AEE 2016

Time Varying Rates



Under CPP, event *hours* are set one day ahead (based on the wholesale price forecast), and the event *price* is static and pre-determined in advance

Under VPP, peak *hours* are defined in advance, and the peak *price* is variable and set one day ahead (based on the wholesale price forecast)

Under TOU, the peak *hours* and *price* are static and pre-determined in advance

Source: LBNL

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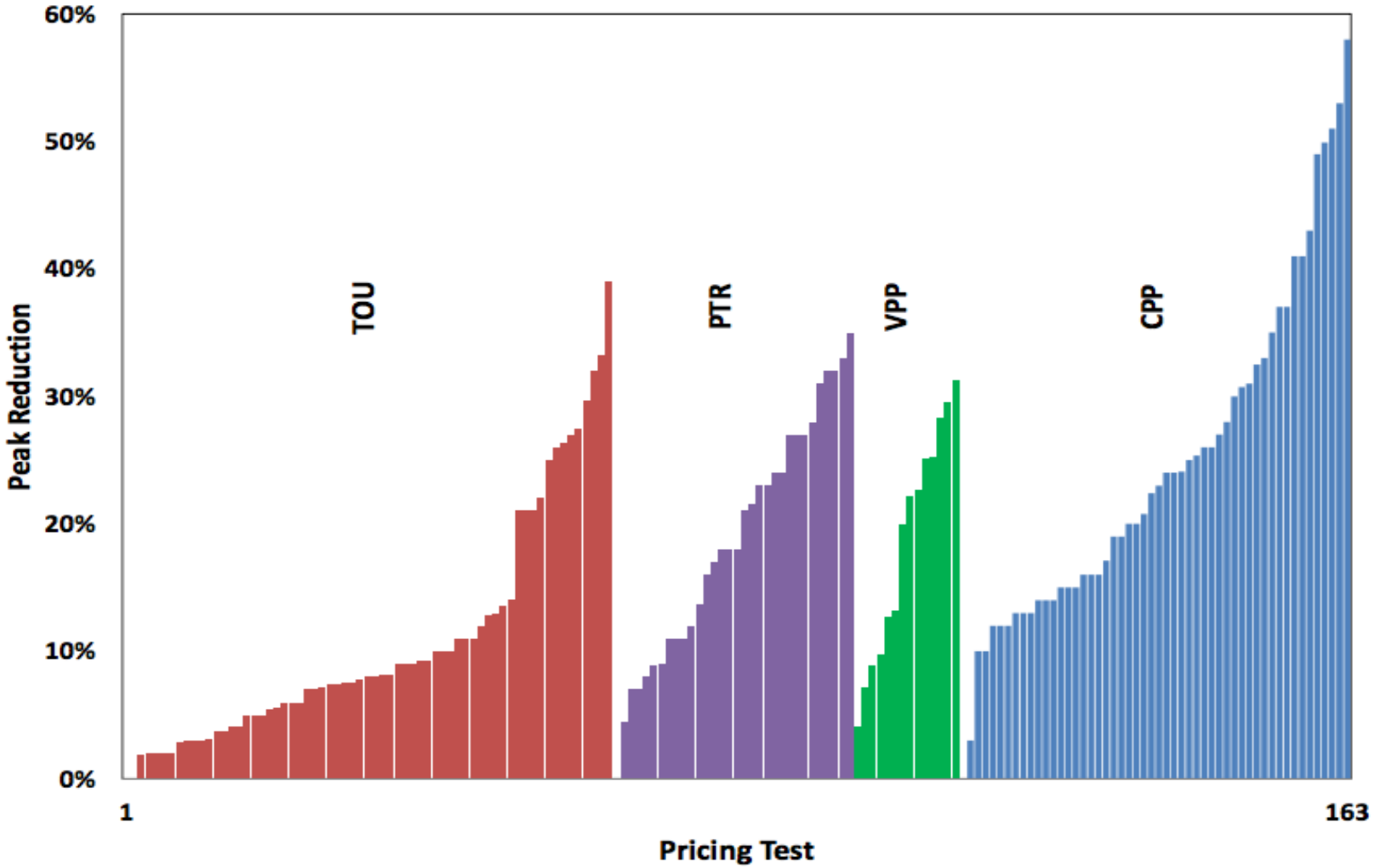
Time Varying Rates



Source: Faruqui

Time Varying Rates

- Changes in overall consumption
  - Reviewed 50 treatments from six pricing pilots
  - 46 of 50 observations showed a reduction in overall consumption.

Rate treatment	Number of observations	Average peak demand reduction	Average reduction in overall consumption
CPP	13	23%	2.8%
PTR	11	18%	2.3%
TOU	17	7%	1.2%
TOU+CPP	8	22%	2.1%
TOU PTR	1	18%	7.4%
All	50	16%	2.1%

Time Varying Rates

- Most utilities offer TOU rate but overall very undersubscribed
- Customer resistance due to potential bill swings
- Numerous pricing studies since early 1980's
  - Demonstrated price response and customer understanding
  - Roughly a 2% conservation effect
- Increasing prevalence following Consumer Behavior Studies

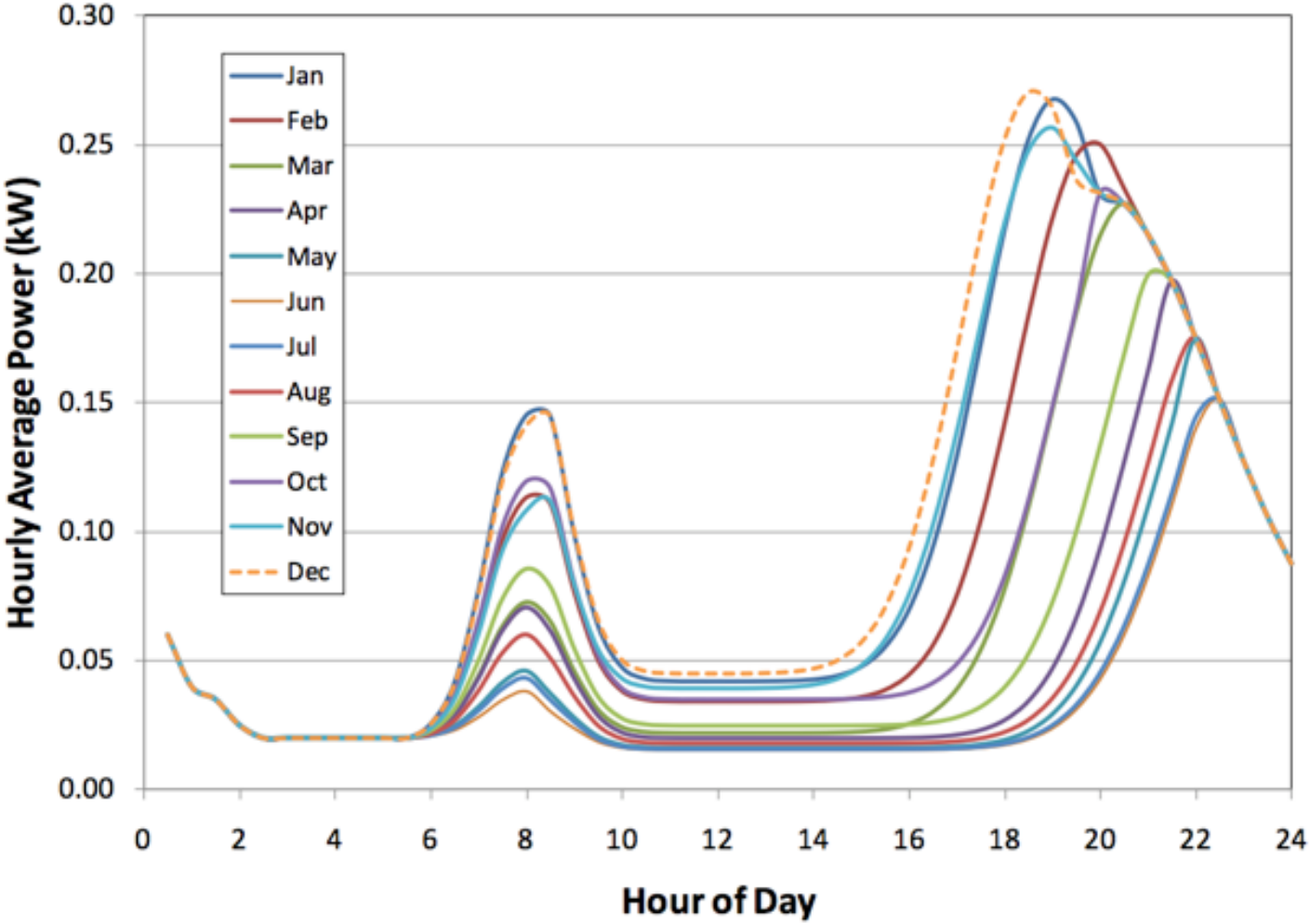
Rate Design and Payback – An Example

Rate Design and Energy Efficiency

- What factors drive customer decision to invest in energy efficiency?
  - **Overwhelmingly bill savings**
- How do changes in revenue neutral rate designs alter pay back periods for energy efficiency measures?
    - Arizona utility
      - **14 energy efficiency measures**
      - **20 iterations of revenue neutral rate design**

Measure or program	Annual energy savings (kWh)	Coincident peak demand savings (kW)	Incremental cost ($)
LED 40-watt replacement	27.17	0.00139	$4.04
LED 60-watt replacement	36.87	0.00189	$6.02
LED 75-watt replacement	42.69	0.00219	$9.91
Variable-speed pool pump	1,725	0.19600	$437
Duct test and repair	865	0.81282	$907
Prescriptive duct repair	421	0.39572	$300
Advanced diagnostic tune-up	492	0.27232	$157
Equipment replacement with quality installation	576	0.62160	$330
New construction ESTAR Homes v. 3.0	2,156	0.86000	$2,132
New construction ESTAR Homes v. 3.0—Tier 2	3,247	1.31000	$2,830
New construction total program	2,593	1.04000	$2,411
Attic insulation	787	0.28000	$922
Air sealing and attic insulation	1,235	0.36000	$1,610
Smart strip	96	0.02532	$22.49

Load shape data for end uses

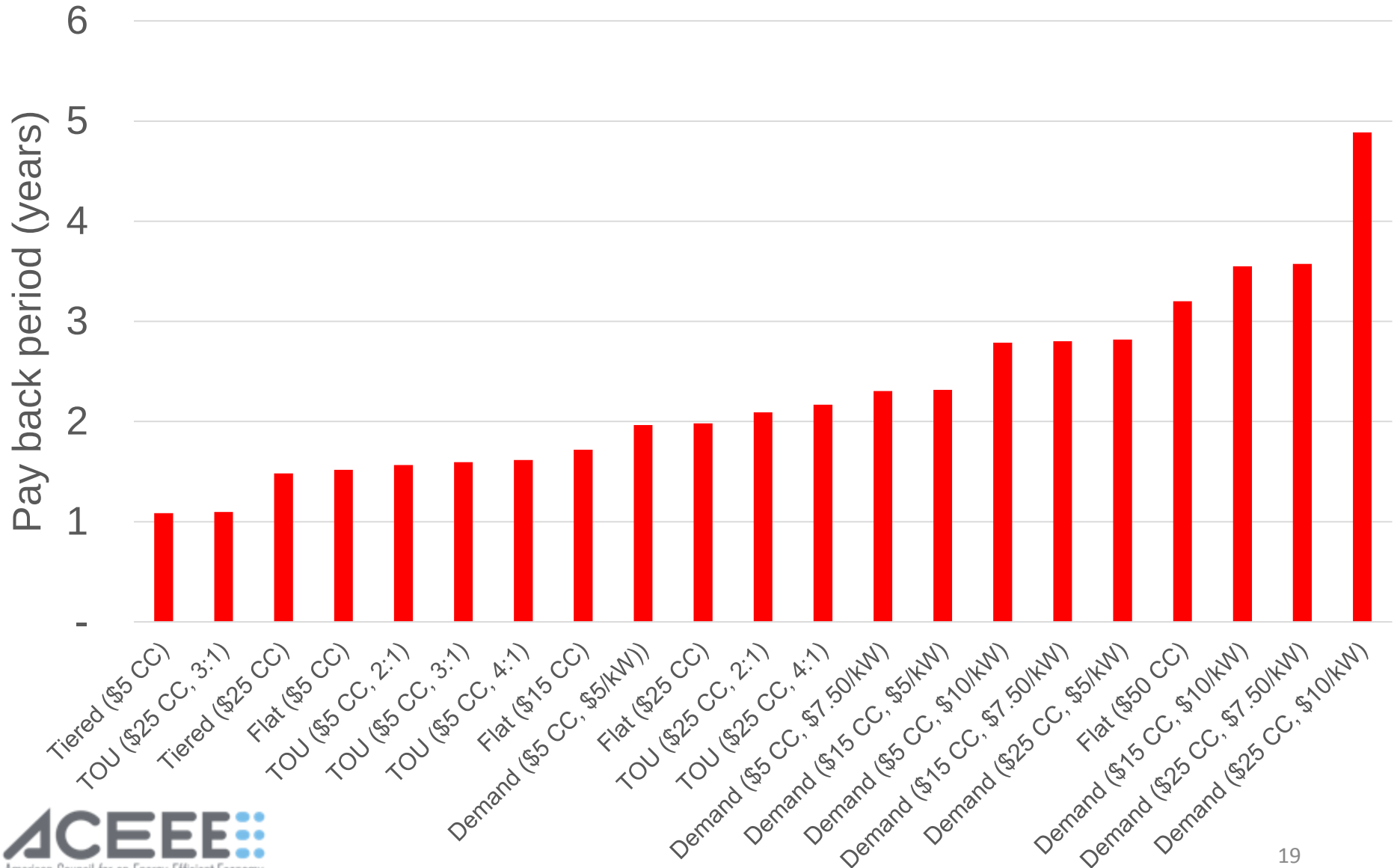


Source: Hendron, R. and C. Engebrecht. 2010. "Building America House Simulation Protocols." National Renewable Energy Laboratory. nrel.gov/docs/fy11osti/49246.pdf.

Rate Iterations

- Customer charge ($5 to $50)
- Tiered rates (3 tier inclining block rates)
- TOU rates (2:1, 3:1, 4:1 peak to off peak ratio)
- Demand charges ($5, $7.50, and $10 per kW)
- On peak window assumed from 3 pm to 8 pm

60 watt LED replacement bulb



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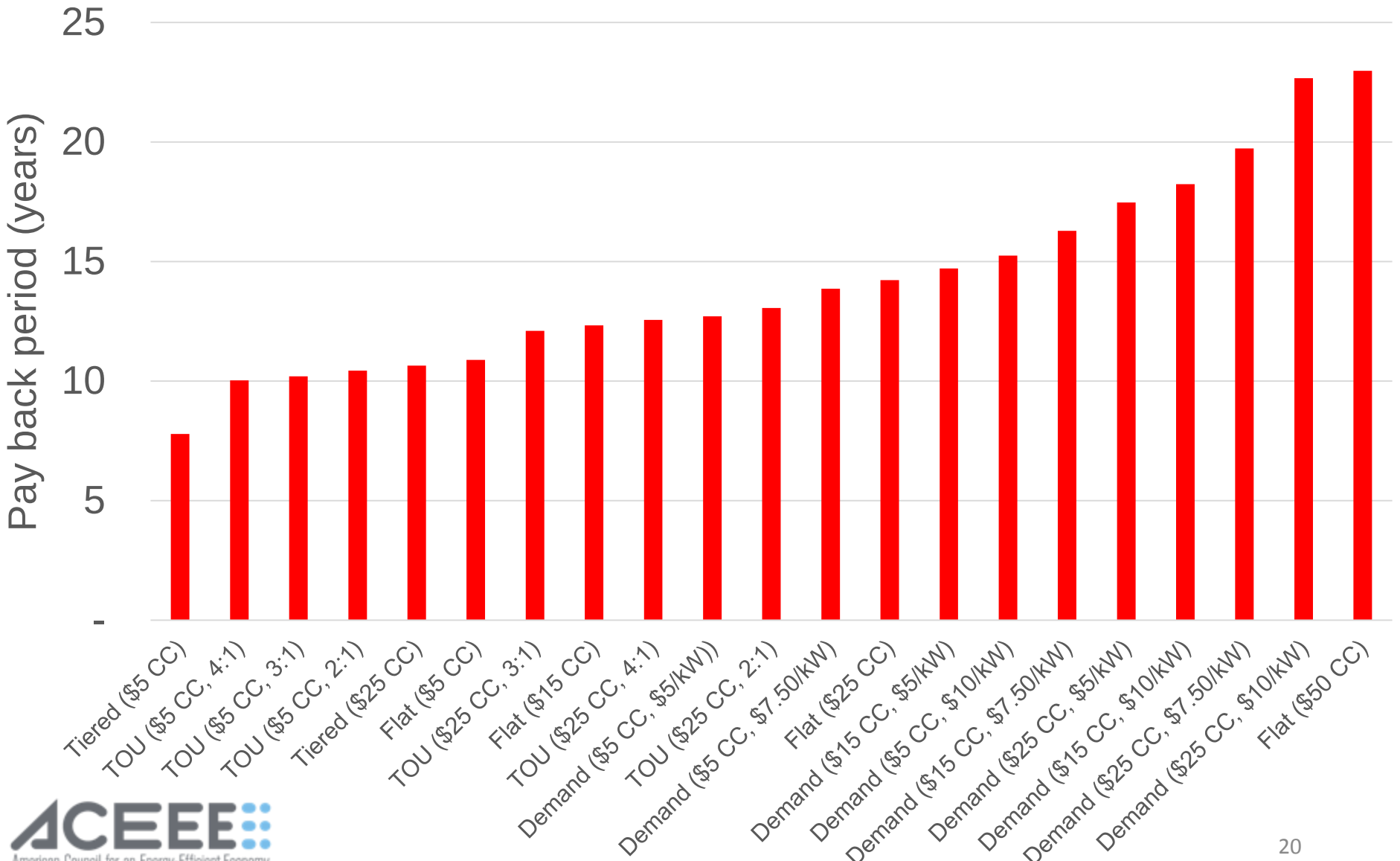
Attic Insulation



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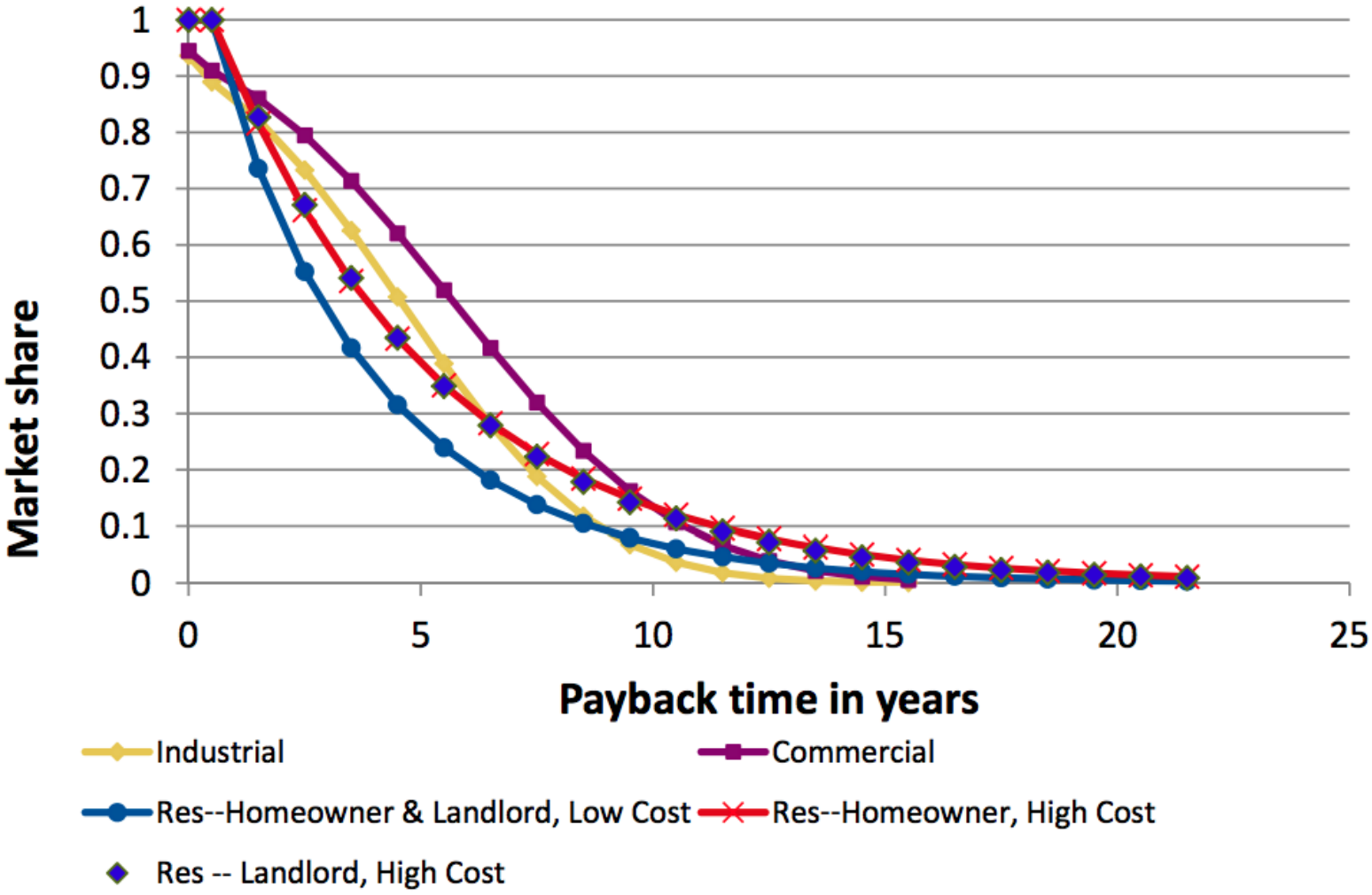
Payback Example Conclusions

- Customer charge
  - Flat & tiered rates – 31 to 62% increase
  - TOU rates – 24 to 34% increase
- Demand charges
  - Increased payback for all measures compared to flat, tiered, and TOU
  - 42% average increase moving from $5 to $10/kW demand charge
- TOU rates
  - Often among shortest pay back periods
  - Peak to off peak ratio impact differed by measure

Payback Curves



Source: 2013 Demand Side Resource Potential Study Report for Kansas City Power & Light

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Questions?