Retail Rate Design in the Face of Growing Distributed Energy Resources

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Residential DER Growth

Source: Wood Mackenzie (2020) – U.S. DER Outlook: 2016 – 2025E

Net Metering Challenges

- Net Metering: Behind-the-meter DER production (and consumption) is often paid the prevailing retail rate

- Issue: Existing retail tariffs are simplistic with time-invariant volumetric (¢ per-KWh) charges and limited fixed charges
  - Somewhat alleviated by TOU pricing, but still not perfect
  - Calls to raise fixed charges (raises equity concerns)

- Implications:
  - Poor mismatch with the underlying costs of energy services
  - Over or under compensation of distributed solar (and other DERs) ➔ Distortions on the *intensive* and *extensive* margin
  - Cost-Shifting concerns
  - Rate design problems magnified with distributed batteries and EVs

Value of DERs

Table 4. Potential Benefits of DERs.

Perspective	Category	Benefit
Electricity system stakeholders (i.e., utilities and their customers, including DER owners)	Bulk power system	Avoided energy costs
		Avoided generation capacity costs
		Avoided reserves and ancillary services costs
		Avoided transmission capital costs and line loss
		Avoided financial risk of primary energy source price volatility
		Avoided environmental compliance costs
	Distribution system	Avoided distribution capital costs and line losses
Society	Public health and safety	Improved resilience to disruptive hazards and stressors
		Public health benefits of avoided local pollution
	Environmental	Environmental benefits of avoided local pollution
		Avoided greenhouse gas emissions

Source: Gundlach and Unel (2019)

Time Value – Hourly and Seasonal:
Southern Cal. Edison Avoided Marginal Cost

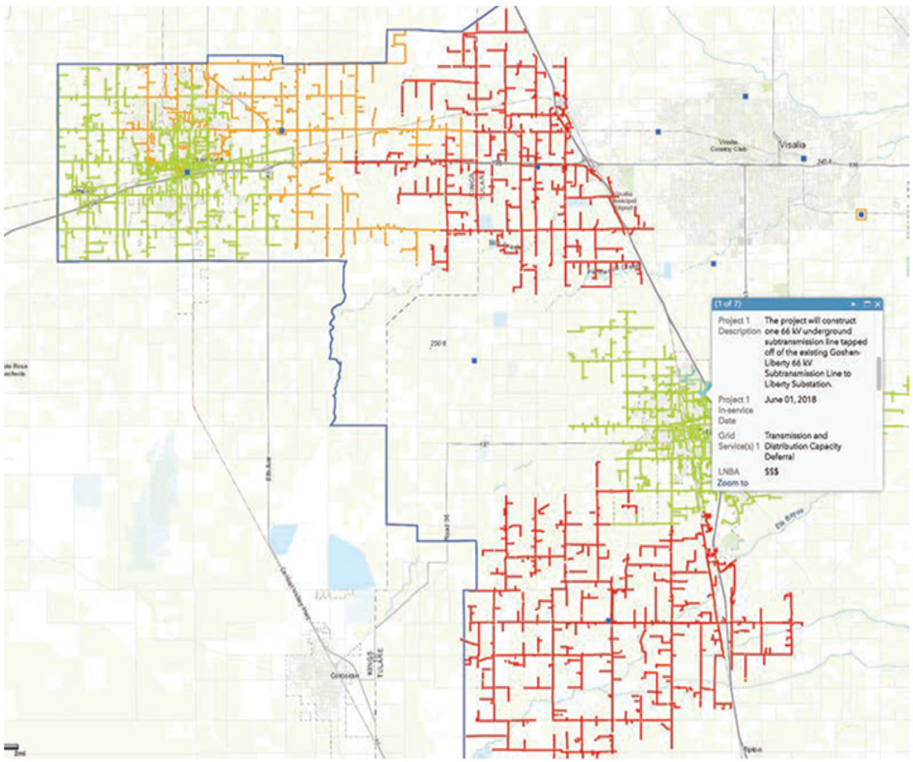
Month \ Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
January	0.069	0.068	0.067	0.067	0.069	0.081	0.091	0.094	0.088	0.082	0.083	0.084	0.083	0.076	0.082	0.085	0.097	0.124	0.128	0.11	0.104	0.092	0.082	0.077
Febuary	0.071	0.066	0.064	0.063	0.069	0.089	0.095	0.094	0.079	0.07	0.062	0.065	0.064	0.065	0.066	0.168	0.085	0.108	0.127	0.113	0.105	0.093	0.084	0.078
March	0.068	0.066	0.065	0.069	0.076	0.087	0.095	0.087	0.079	0.018	0.018	0.019	0.019	0.183	0.322	0.099	0.294	0.118	0.139	0.116	0.101	0.091	0.079	0.071
April	0.069	0.062	0.063	0.066	0.082	0.087	0.086	0.075	0.015	0.013	0.015	0.018	0.026	0.031	0.032	0.036	0.102	0.122	0.131	0.143	0.114	0.096	0.088	0.081
May	0.075	0.075	0.068	0.073	0.084	0.09	0.086	0.017	0.015	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.017	0.089	0.102	0.124	0.108	0.096	0.088	0.078
June	0.065	0.062	0.062	0.062	0.065	0.074	0.074	0.072	0.077	0.023	0.027	0.037	0.042	0.047	0.067	0.151	0.158	0.163	0.234	0.311	0.104	0.085	0.081	0.075
July	0.07	0.067	0.064	0.067	0.072	0.074	0.075	0.074	0.081	0.079	0.083	0.088	0.093	0.166	0.298	0.38	0.267	0.497	0.095	0.094	0.091	0.086	0.078	0.075
August	0.074	0.066	0.064	0.066	0.073	0.076	0.077	0.072	0.076	0.08	0.084	0.093	0.099	0.353	0.715	1.319	1.716	1.731	2.36	0.58	0.097	0.089	0.084	0.079
September	0.074	0.071	0.067	0.069	0.073	0.08	0.08	0.077	0.079	0.083	0.092	0.181	0.766	2.749	2.628	2.647	3.215	6.577	3.953	1.53	0.671	0.091	0.086	0.082
October	0.075	0.071	0.071	0.071	0.08	0.086	0.087	0.082	0.082	0.085	0.09	0.132	0.32	1.446	2.319	3.212	3.293	2.562	0.749	0.576	0.536	0.092	0.083	0.081
November	0.076	0.074	0.071	0.071	0.077	0.093	0.103	0.096	0.079	0.069	0.071	0.073	0.074	0.073	0.079	0.083	0.104	0.145	0.154	0.12	0.105	0.094	0.088	0.083
December	0.089	0.087	0.083	0.085	0.093	0.109	0.138	0.136	0.098	0.089	0.079	0.078	0.076	0.076	0.077	0.086	0.115	0.158	0.154	0.136	0.12	0.113	0.105	0.093

(a) Total Marginal Avoided Cost ($/KWh)

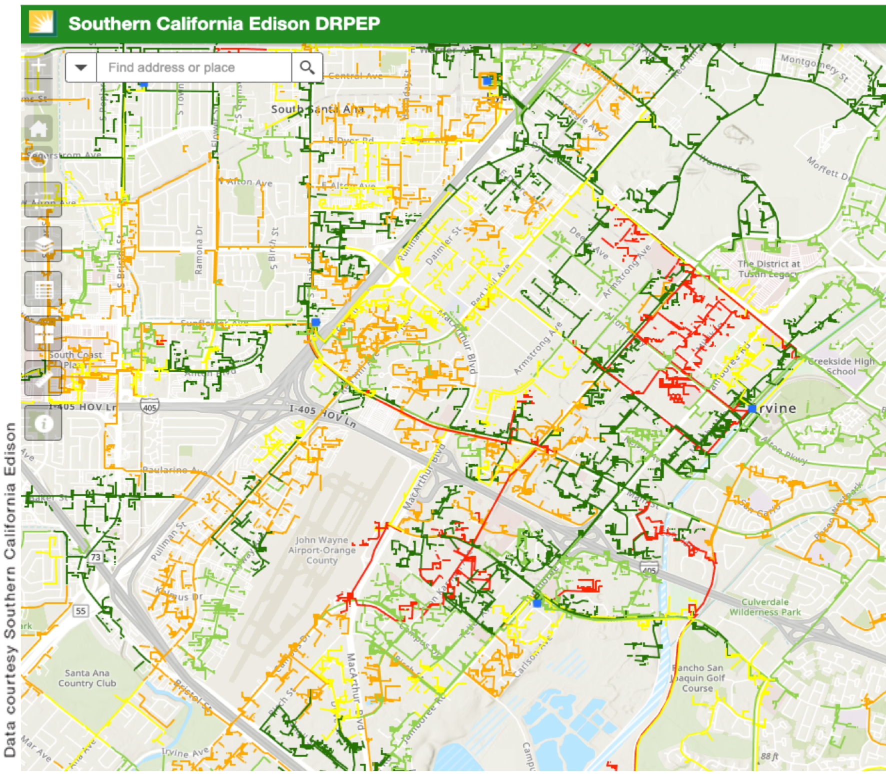
Source: Boampong and Brown (2020)

Dist. Spatial Value – Location, Location, Location

Locational Net Benefit Analysis



Integration/Host Capacity Analysis



Data courtesy Southern California Edison

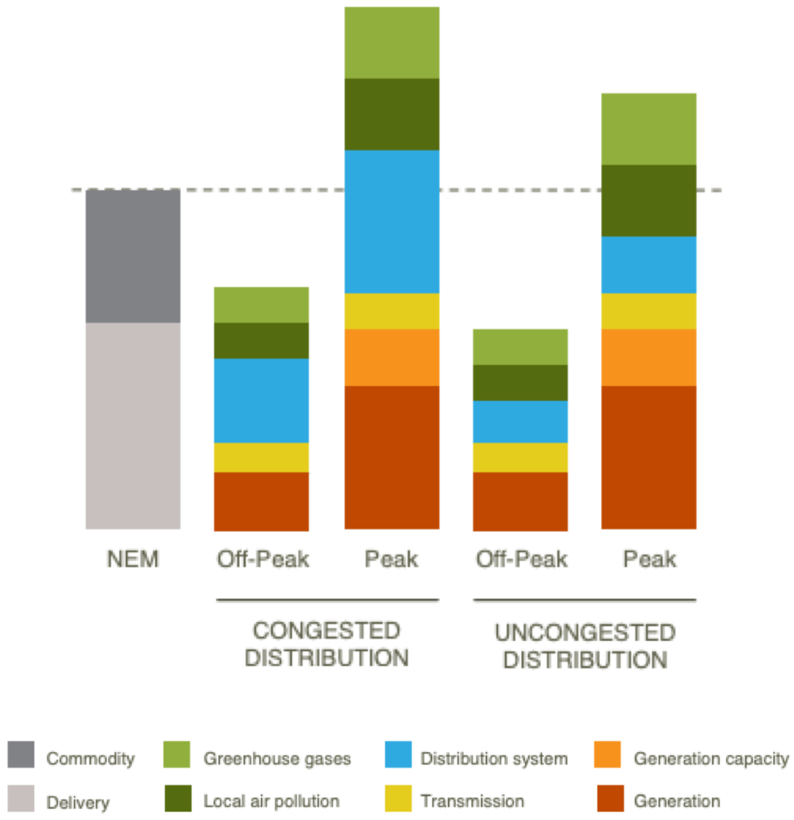
Source: SCE (2020)

Retail Rate Design Example - VDER

- "Value Stack" – (EX: New York)
  - Energy (LMP) [Hourly]
  - Generation Capacity (ICAP) [month - year]
  - Environmental (E) [Hourly – 25 years]
  - T&D Capacity [1 – 10 years]

- The Good:
  - Better approximates value and costs of DERs
  - Capacity measures can capture local constraints
  - Reduces cost-shifting + "death spiral"

- The Bad:
  - Complicated and controversial valuations
  - Smooths over too much (time + spatially)
  - Locks-in rates for 1 – 25 years



Source: Gundlach and Unel (2019)

Key Challenges Going Forward

1. Information
   – Need increased transparency on grid-value and costs of DERs
   – Where are DERs located on the grid?

2. Model Costs/Benefits → Rates
   – Challenges of mapping modeled benefits/costs → Rates

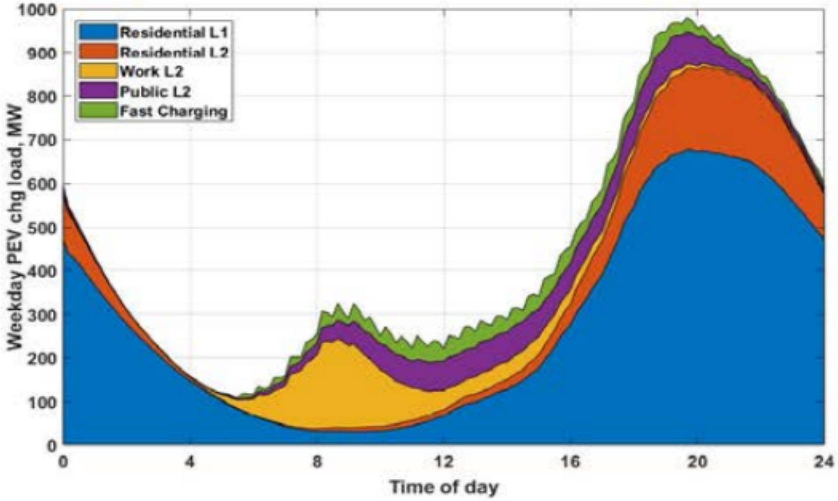
3. Balancing Economic Efficiency + Fairness/Gradualism
   – Movement to more efficient tariffs can result in big changes
   – Winners + Losers → value of pre-emptive policy action

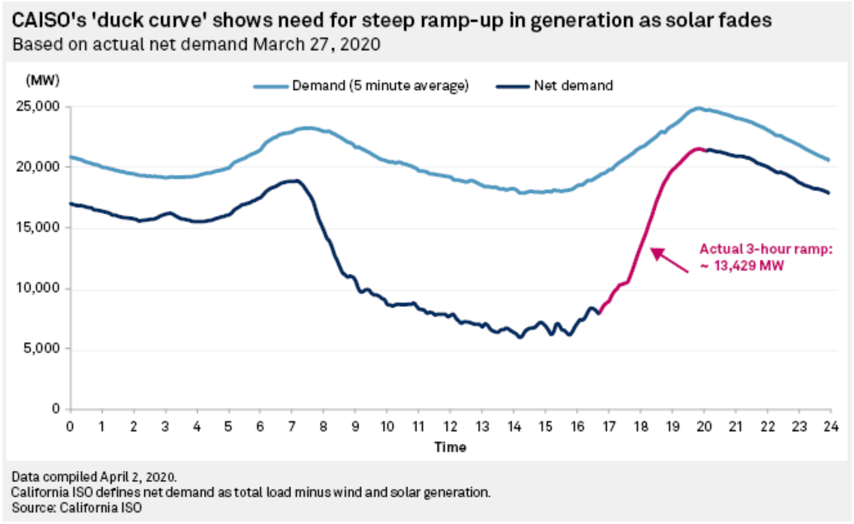
4. Stranded Cost Recovery
   – Emerging technologies → stranded assets
   – How do we allocate these costs?

Electric Vehicles + The Duck Curve

Simulated EV Loads

CAISO Duck Curve





Source: CEC (2018)

Thank You!

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