

Decarbonizing Thermal Systems with Renewable Steam

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ENERGY & ENVIRONMENT

ABOUT UMC



Space Needle



**Fred
Hutchinson**



**Columbia
Center**



**Seattle
Spheres**



What is the overarching goal of renewable energy development?



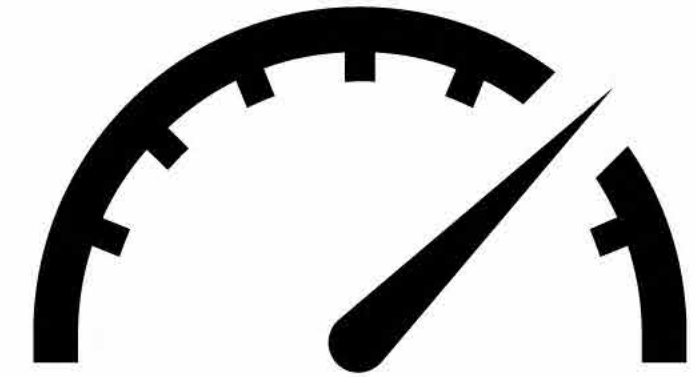
What is the overarching goal of grid energy storage?



Renewable Energy + Storage = Carbon Abatement

Renewable Energy + **Opportunistic Use** + Storage = More Carbon Abatement

An Attractive Opportunistic Use: Central Thermal Plants



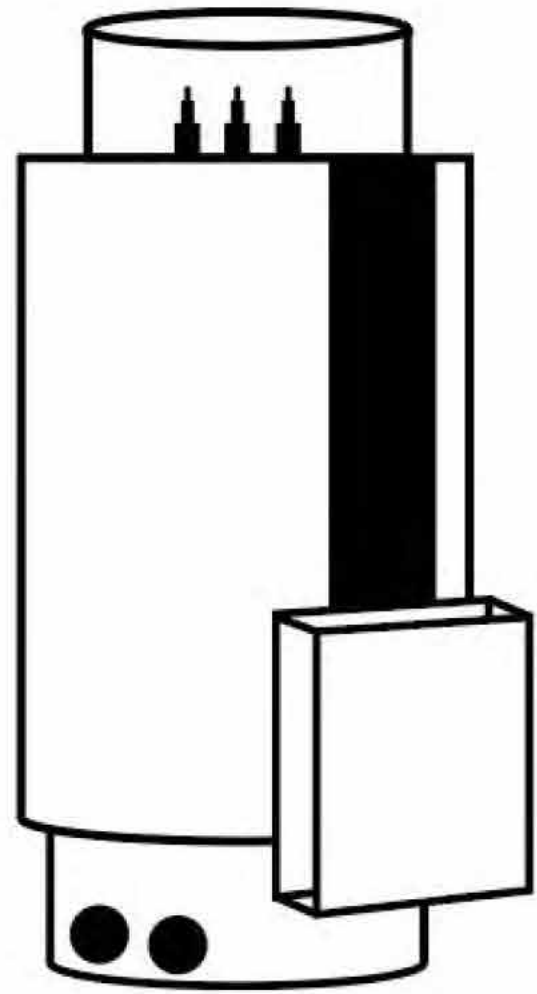
- 1-10 MW in thermal equivalent load
- Year-round opportunity
- Direct displacement of fossil fuel

TODAY'S PITCH

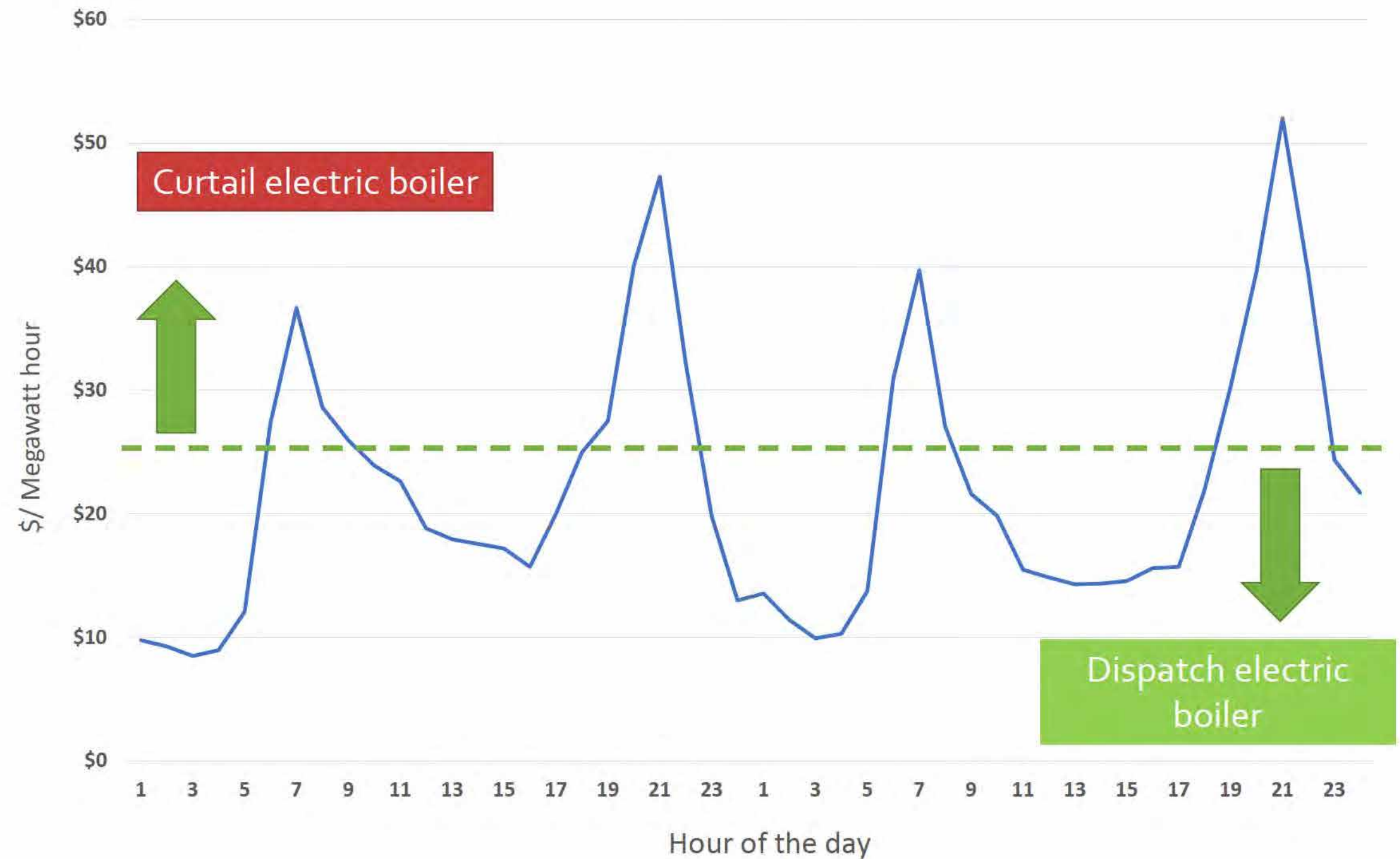


OPPORTUNISTICALLY
USING SURPLUS
ELECTRICITY IN
THERMAL PLANTS

DISPATCH ACCORDING TO MARKET

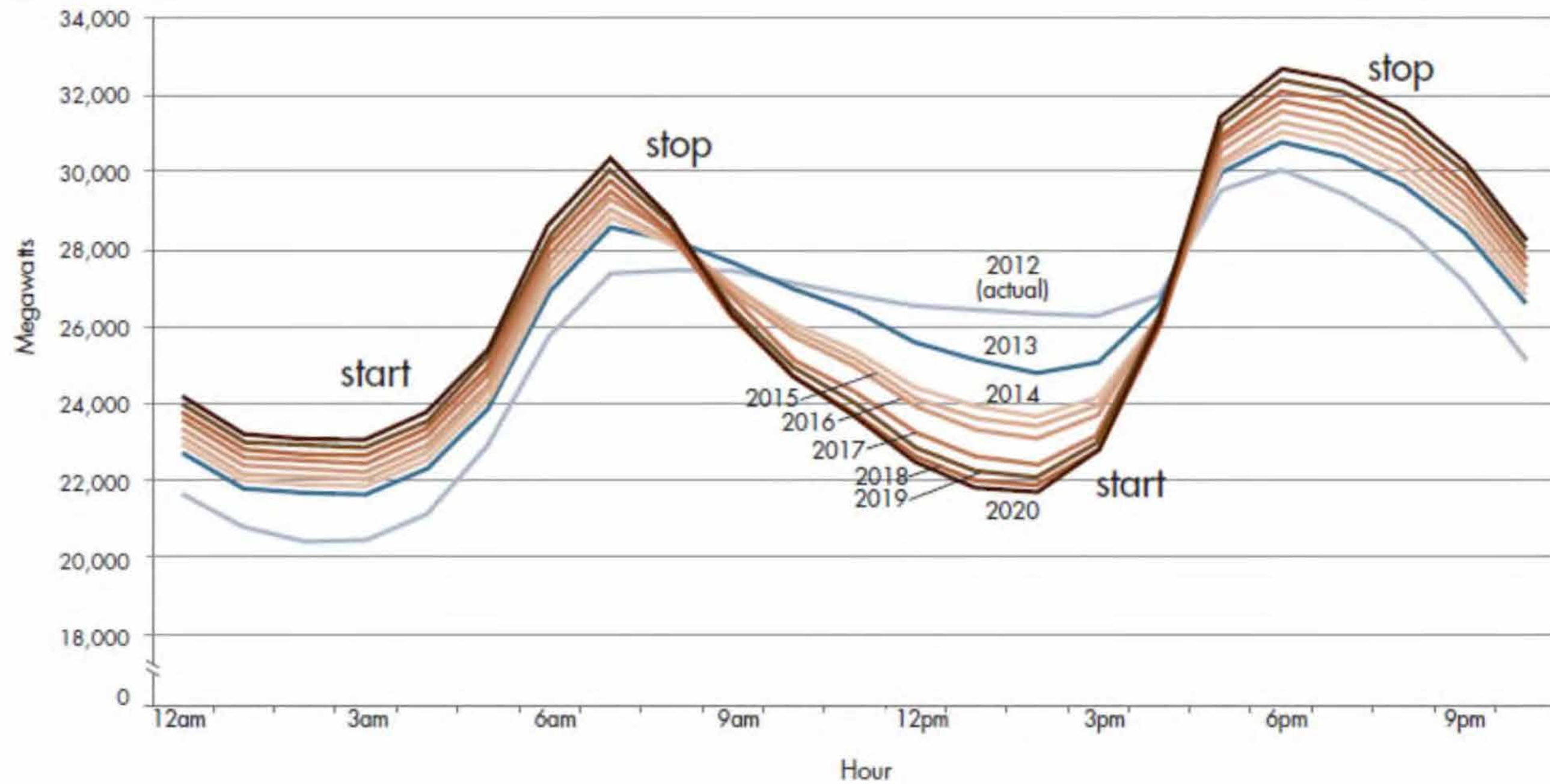


Hourly Power Pricing: Day Ahead
5/2/18-5/3/18



**ELECTRICITY
MARKETS
EVOLVE**

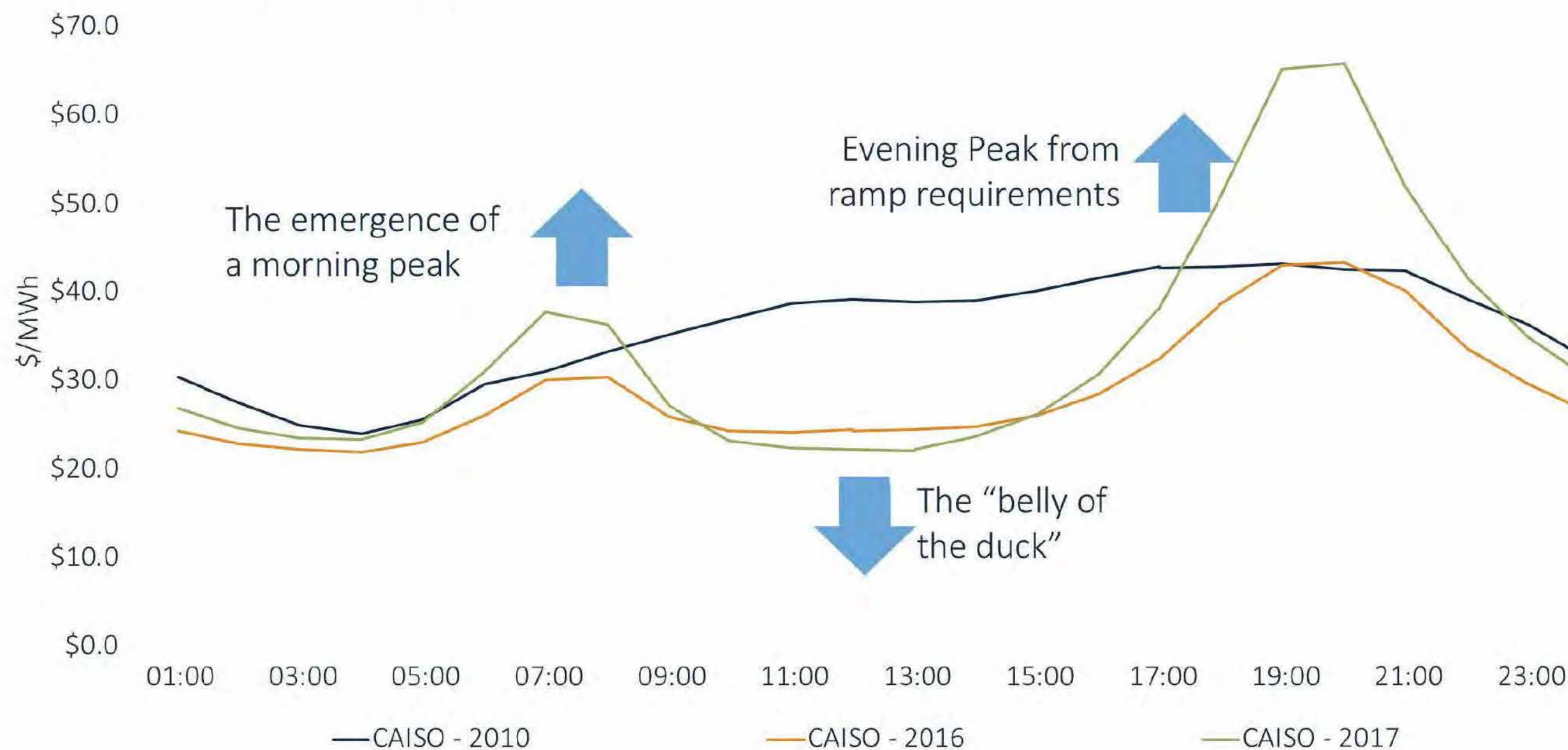




THE CAISO DUCK CURVE: REFLECTED IN PRICE TOO

Renewable penetration has wholesale price repercussions

Average Hourly Price for CAISO NP15 Zone, \$/MWh



Source: CAISO, GTM Research