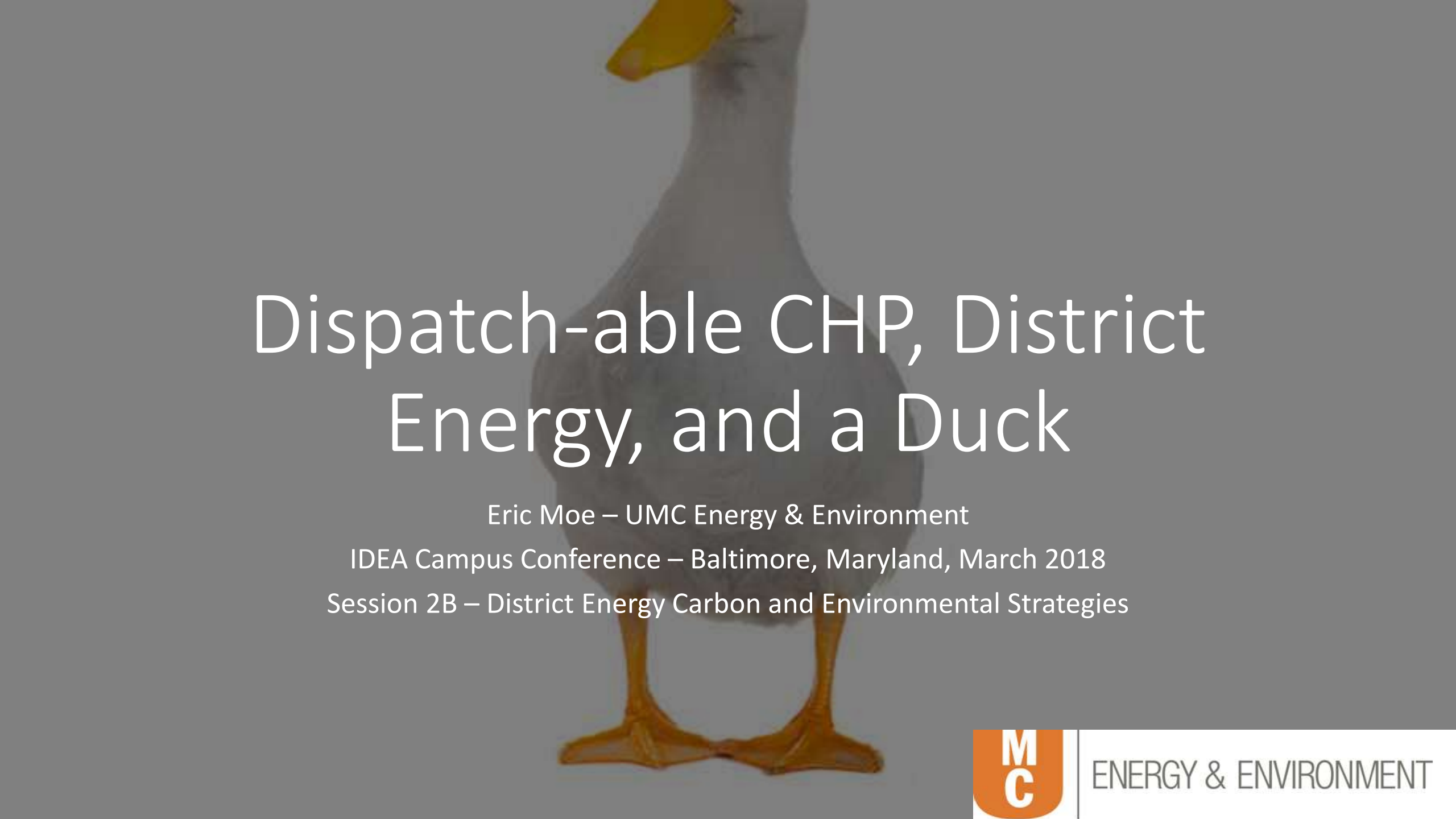


Dispatch-able CHP, District Energy, and a Duck

Eric Moe – UMC Energy & Environment

IDEA Campus Conference – Baltimore, Maryland, March 2018

Session 2B – District Energy Carbon and Environmental Strategies

ENERGY & ENVIRONMENT

Pacific Northwest energy landscape

Growing challenges for traditional electric utilities

Development of dispatchable generation and load

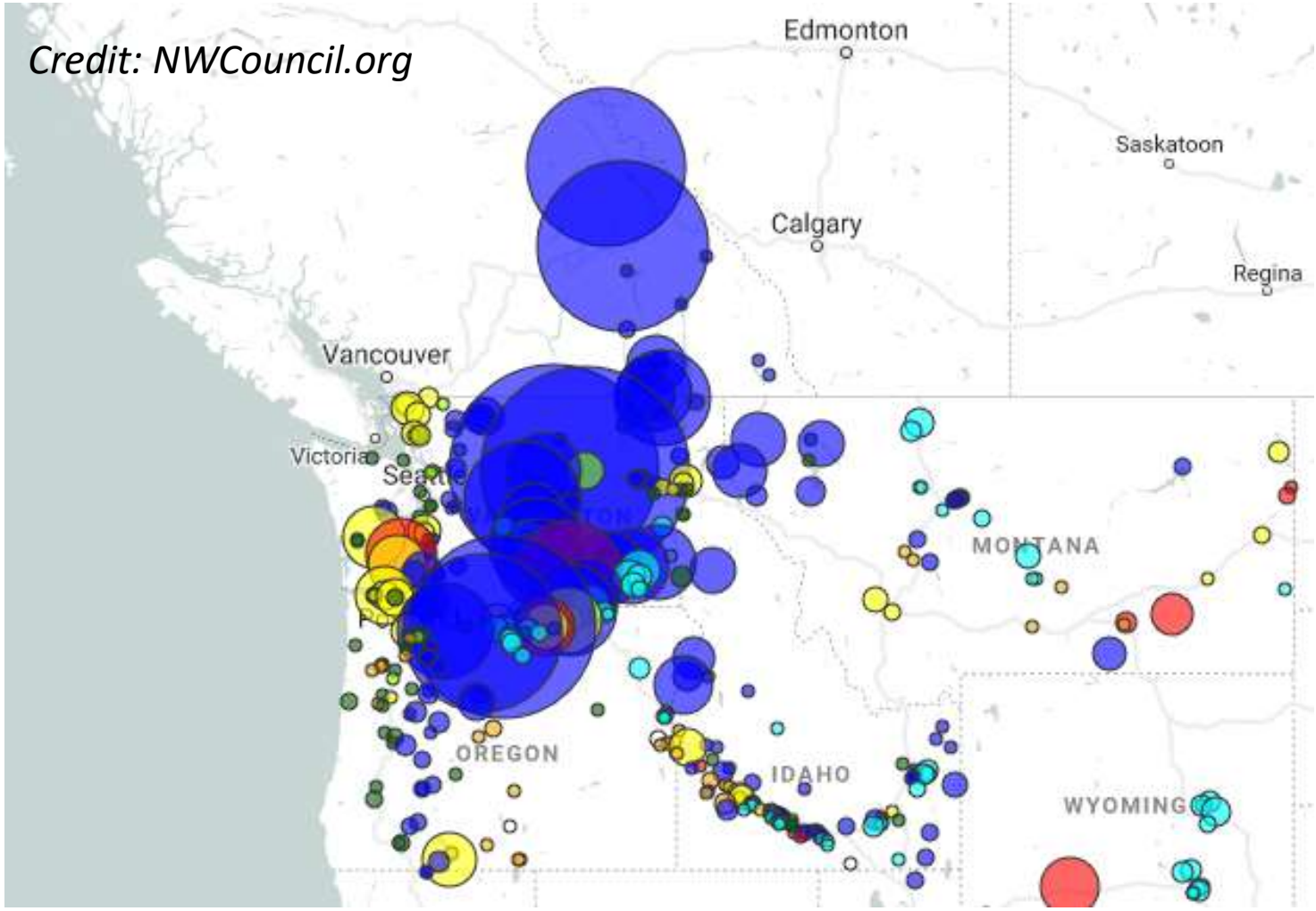
Case 1 – industrial district energy and cogeneration

Case 2 – next century campus

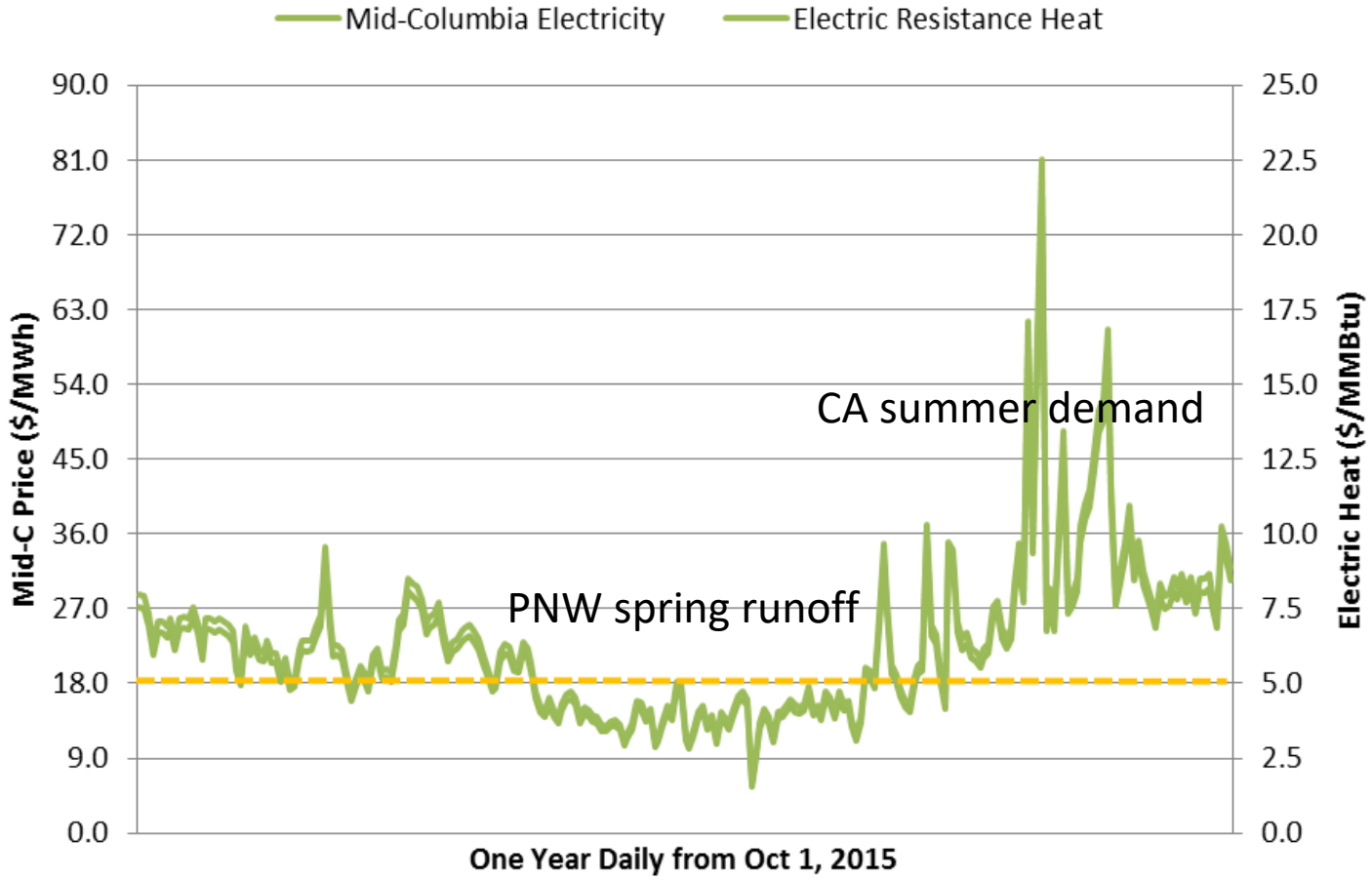
Optics

Presentation overview

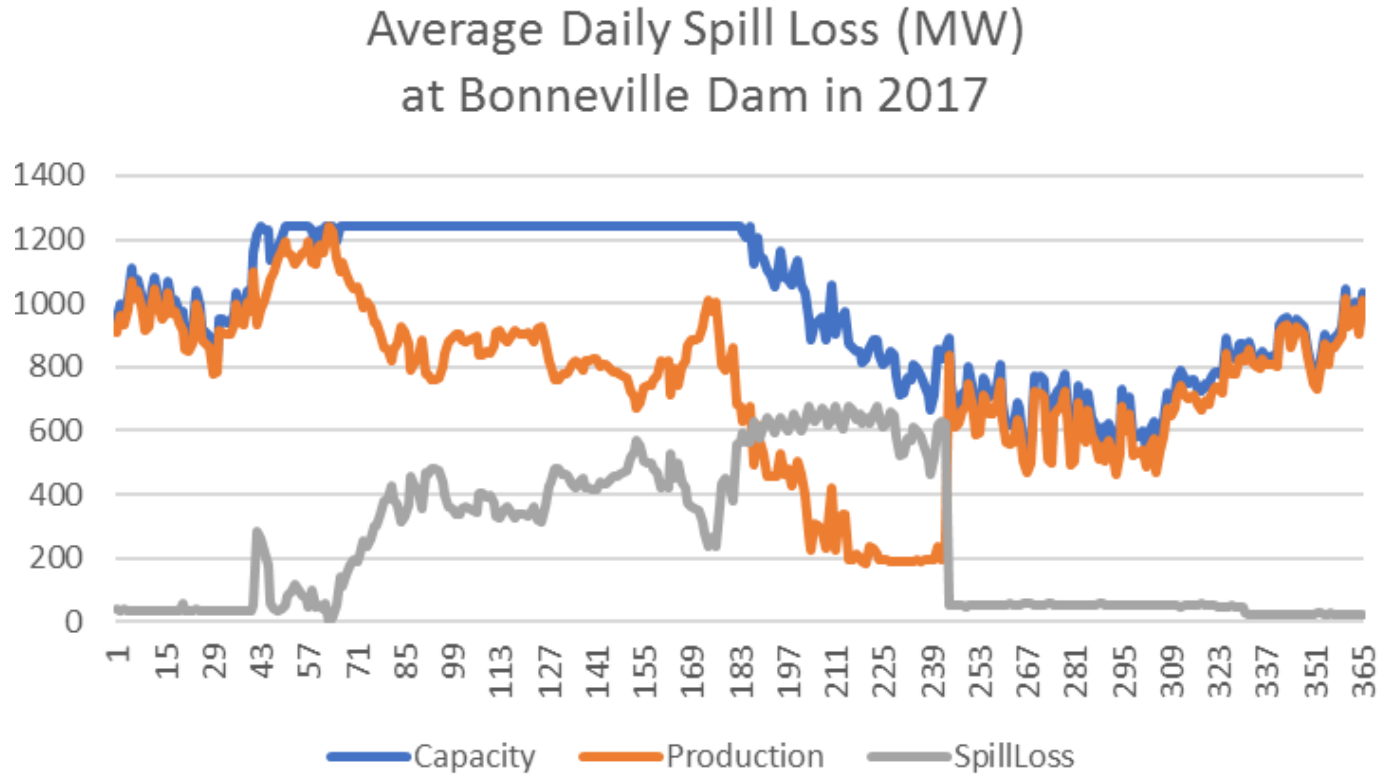
Pacific NW (PNW) energy landscape is dominated by hydropower



the market is flooded with power, especially during spring runoff, leading prices to tank



energy supply and balancing compete with fish and irrigation

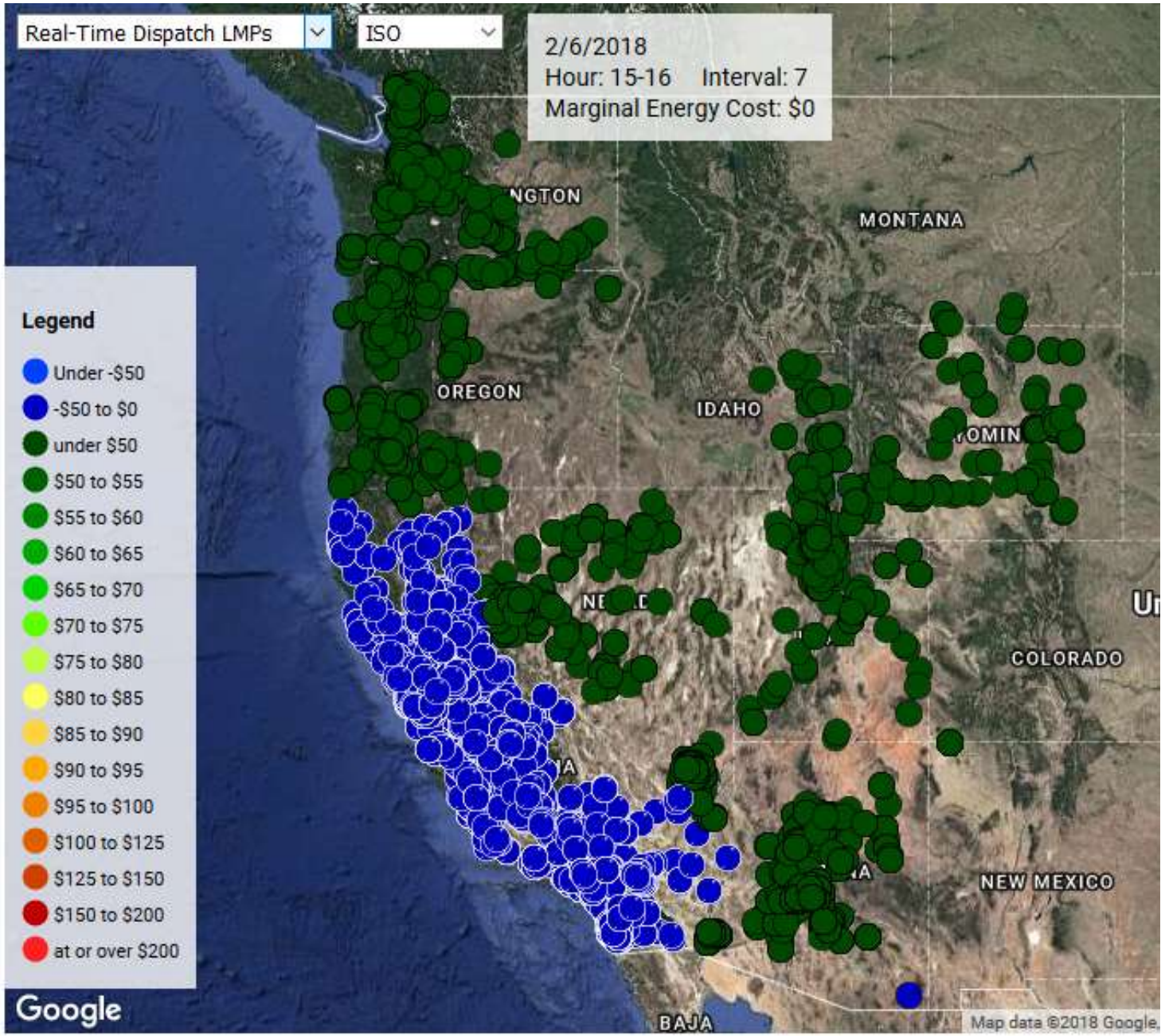


coal plants are retiring and pressure is growing to retire other large remote power plants (hydro dams and must run nuclear)

low and negative pricing leads to curtailment of intermittent renewables

almost all efforts to sink surplus power are electricity centric

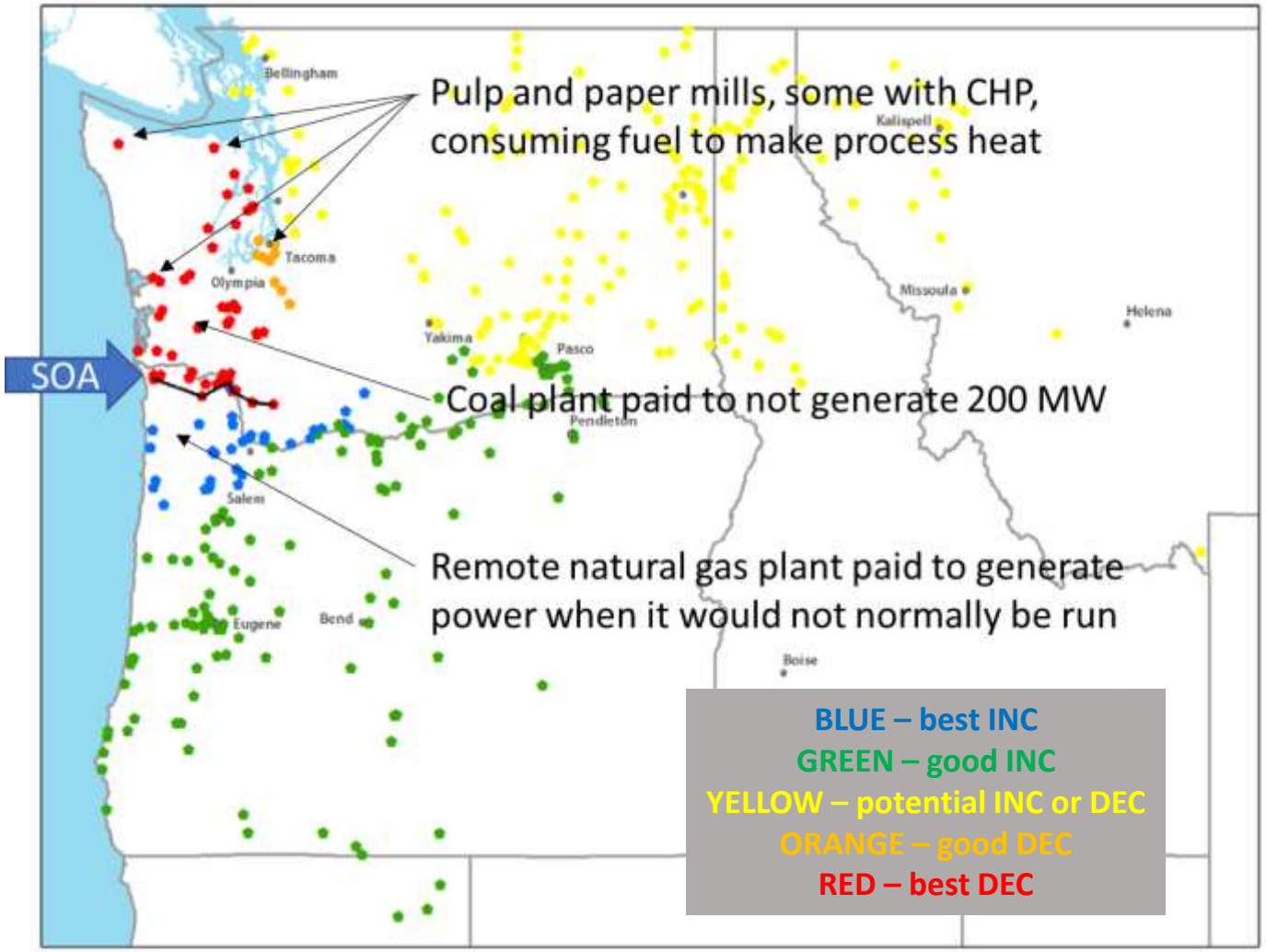
- batteries
- electric vehicles
- pumped hydropower
- new transmission



Credit: CAISO LMP Map

transmission constraints impede power flow from North to South across SOA gate in summer

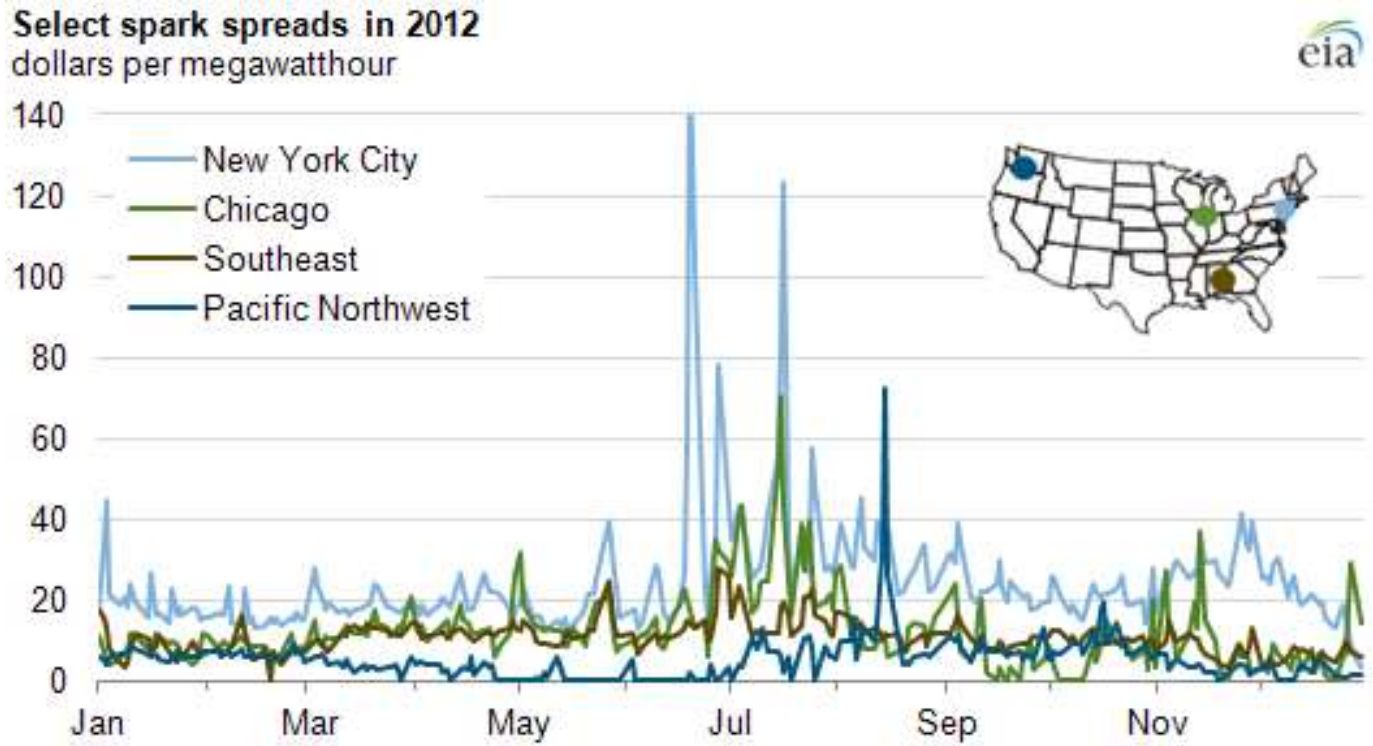
(Bonneville cancelled $1.5 billion transmission project, seeks non-wires alternatives)



Credit: Bonneville Power Administration

historically low spark spread has limited PNW cogeneration

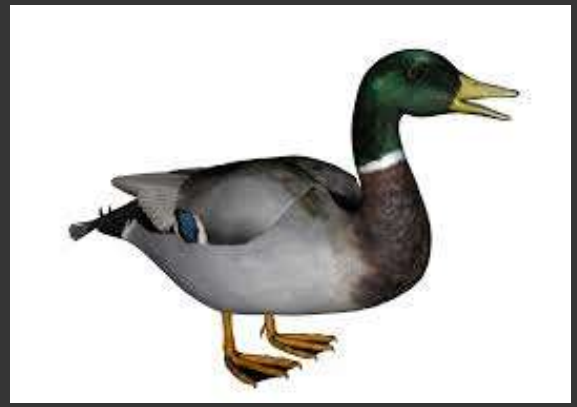
(except industrials)

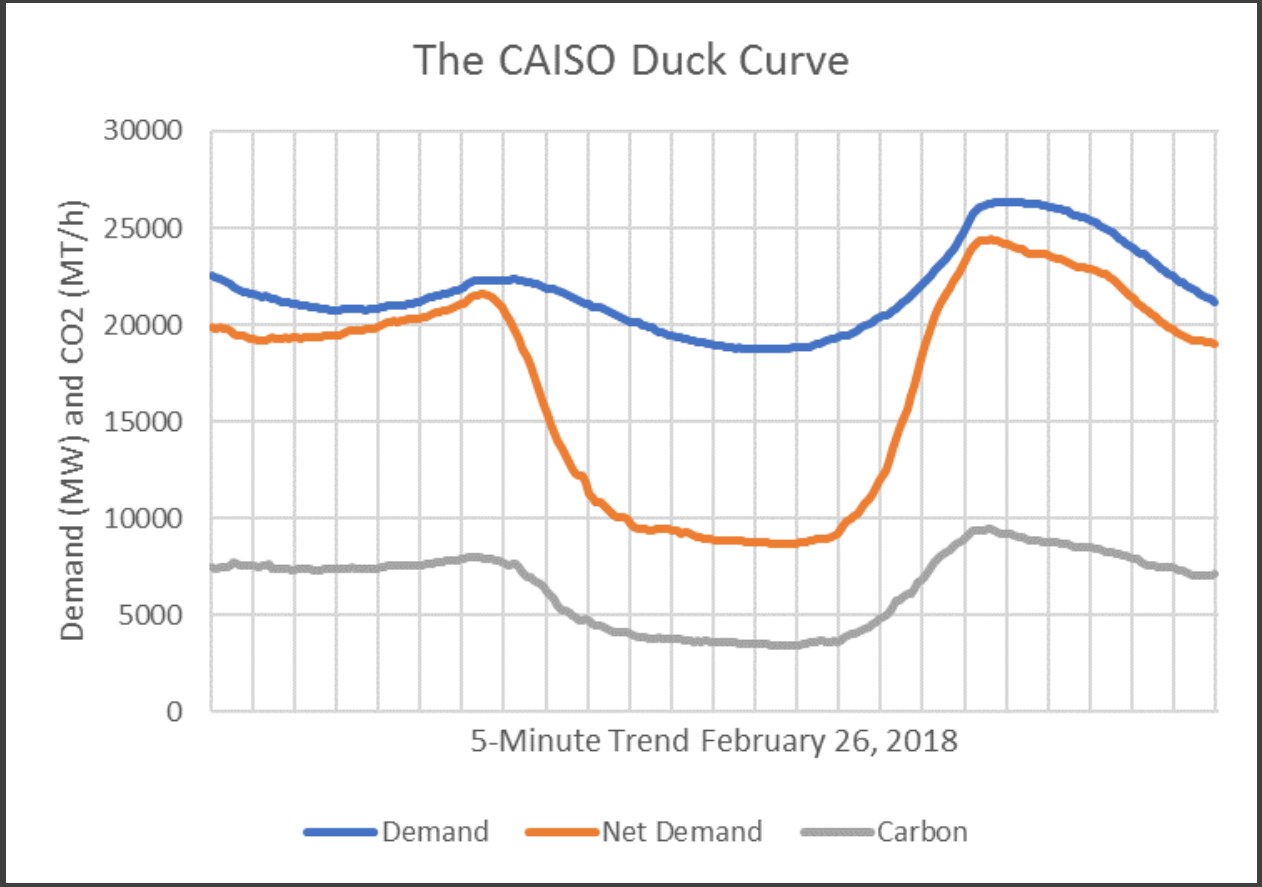


Credit: U.S. Energy Information Administration

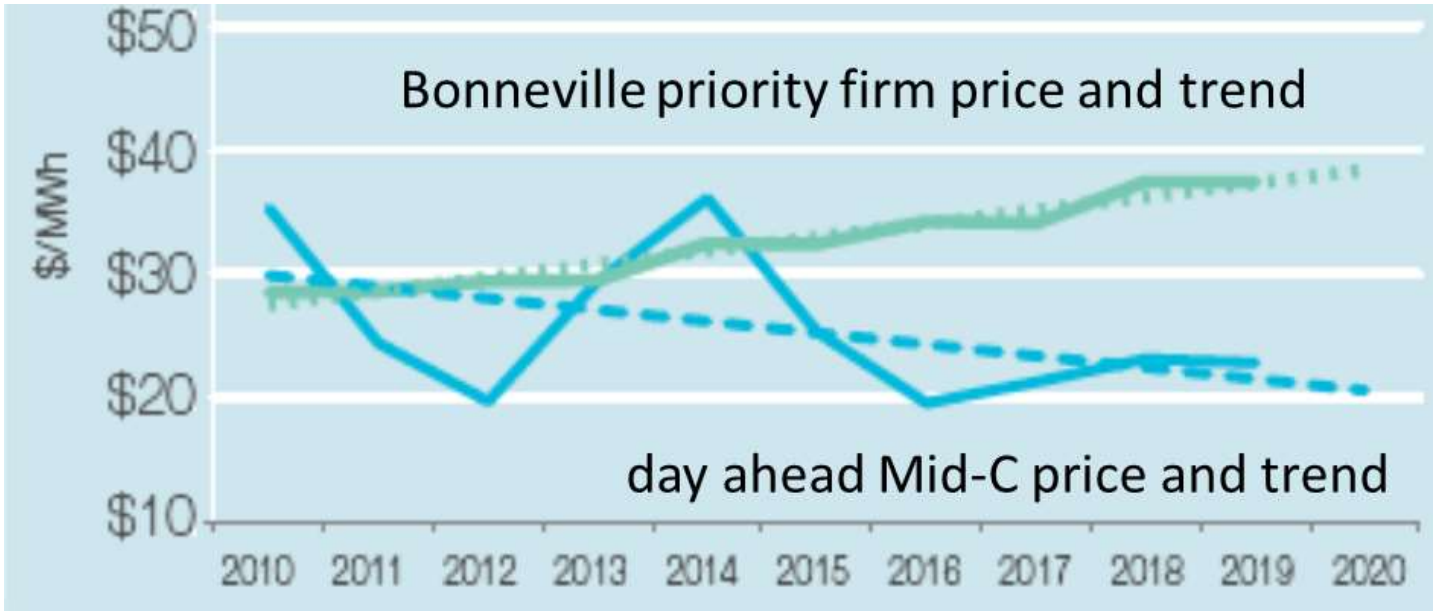
Market value is growing in dispatchable electric generation and load resources

(net demand = demand less solar and wind)





- 13,662 MW ramp in 3 hours
- High carbon when ramping
- Belly of the duck curtailment

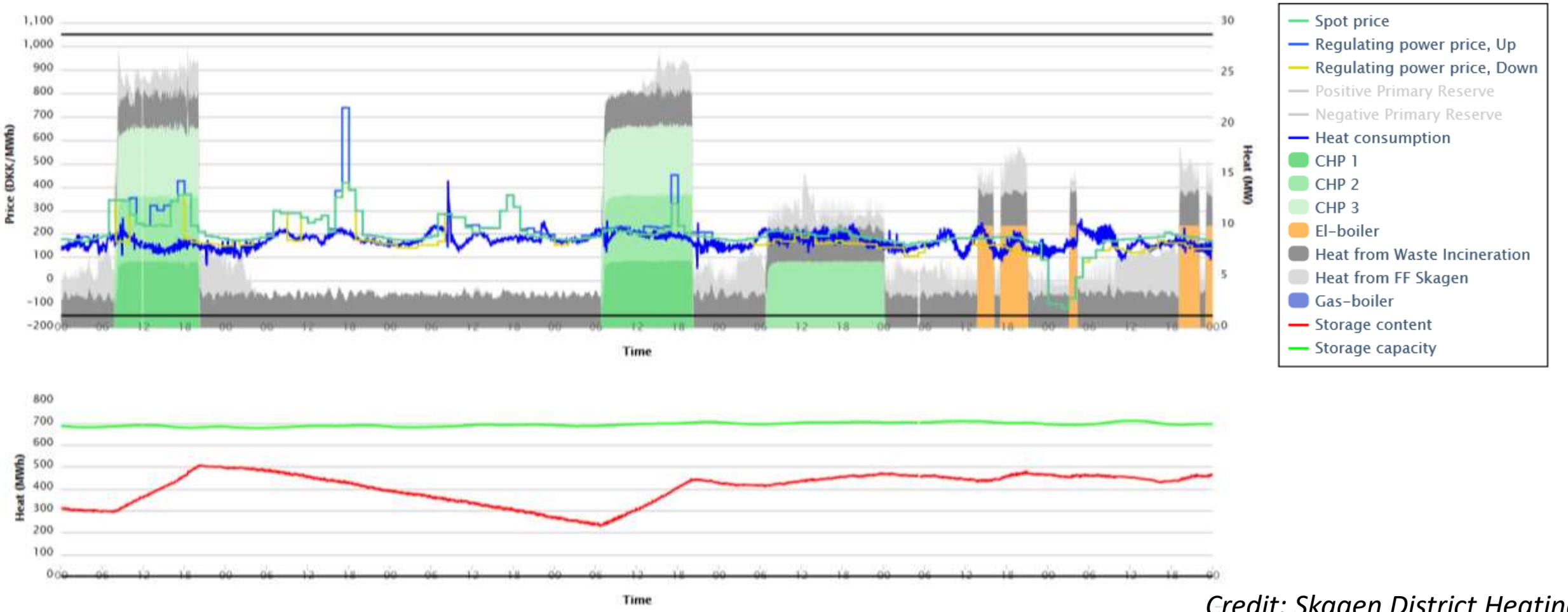


Credit: Bonneville Power Administration

- Falling wholesale prices
- Customer retention (cost, carbon)
- Integrating intermittent renewables
- Traditional investment opposition
- Coal and other plant retirement
- Behind the meter solar growth
- Loss of conservation revenue
- Decarbonization, regulation
- Investment pipeline

Growing challenges for wholesale and retail public and private electric utilities

Development of Dispatchable Generation and Load



Credit: Skagen District Heating

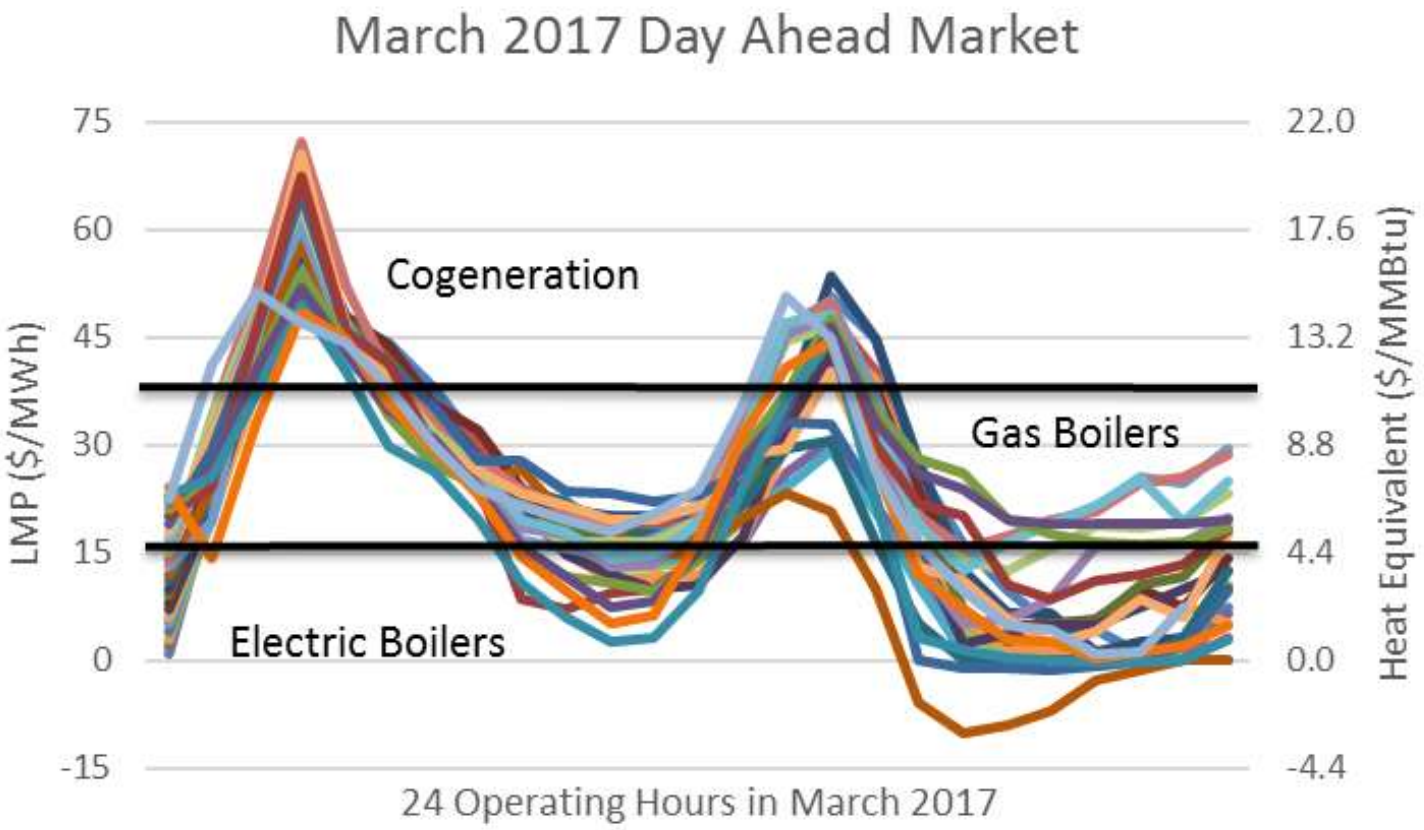
Example of Dispatchable Generation and Load

http://www.emd.dk/plants/skagen/

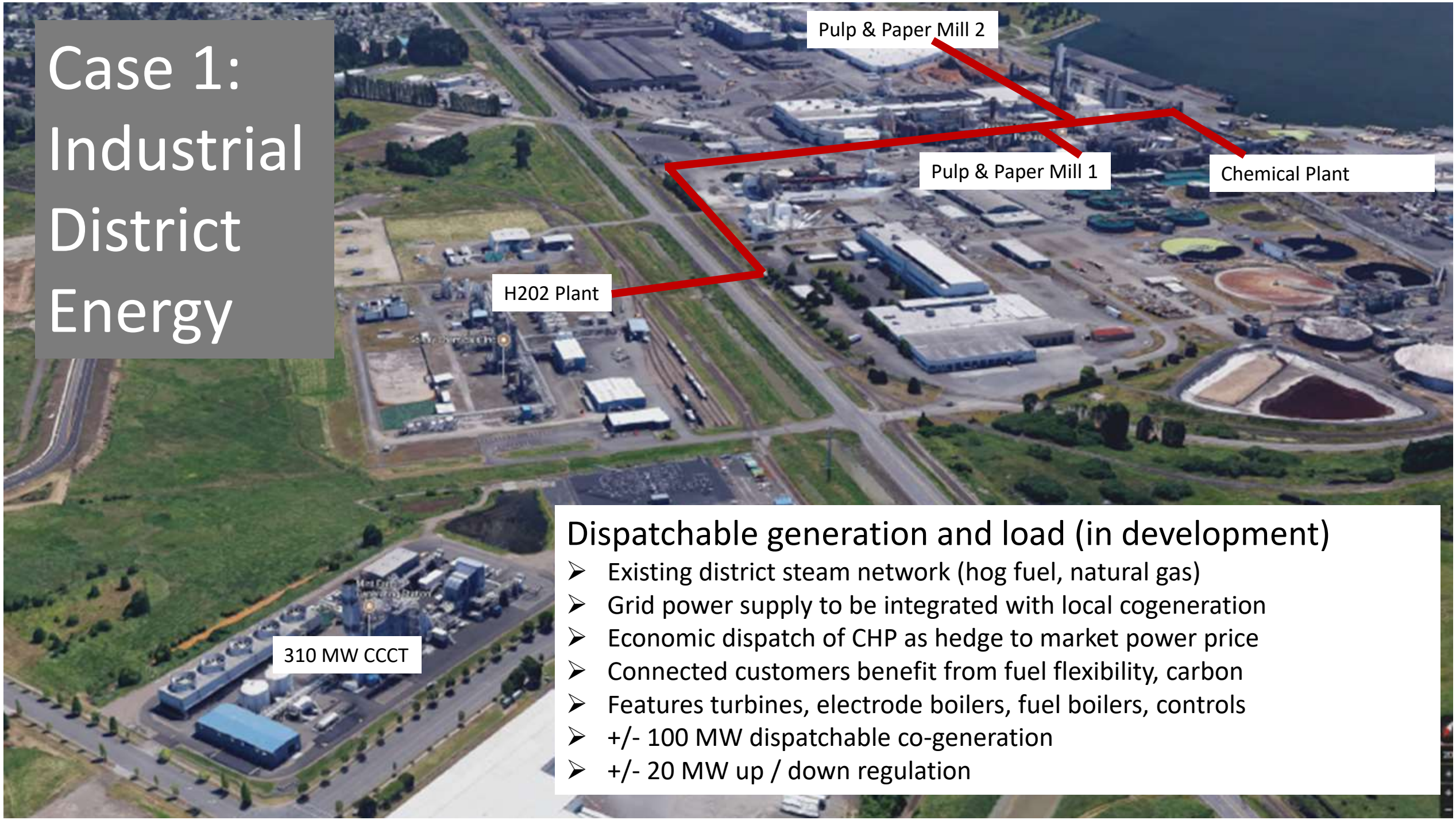
simple economics and carbon favor periodically making heat with wholesale electricity in lieu of natural gas

plus revenue opportunity in reserve and regulation markets

Credit: Parat



Case 1: Industrial District Energy



Dispatchable generation and load (in development)

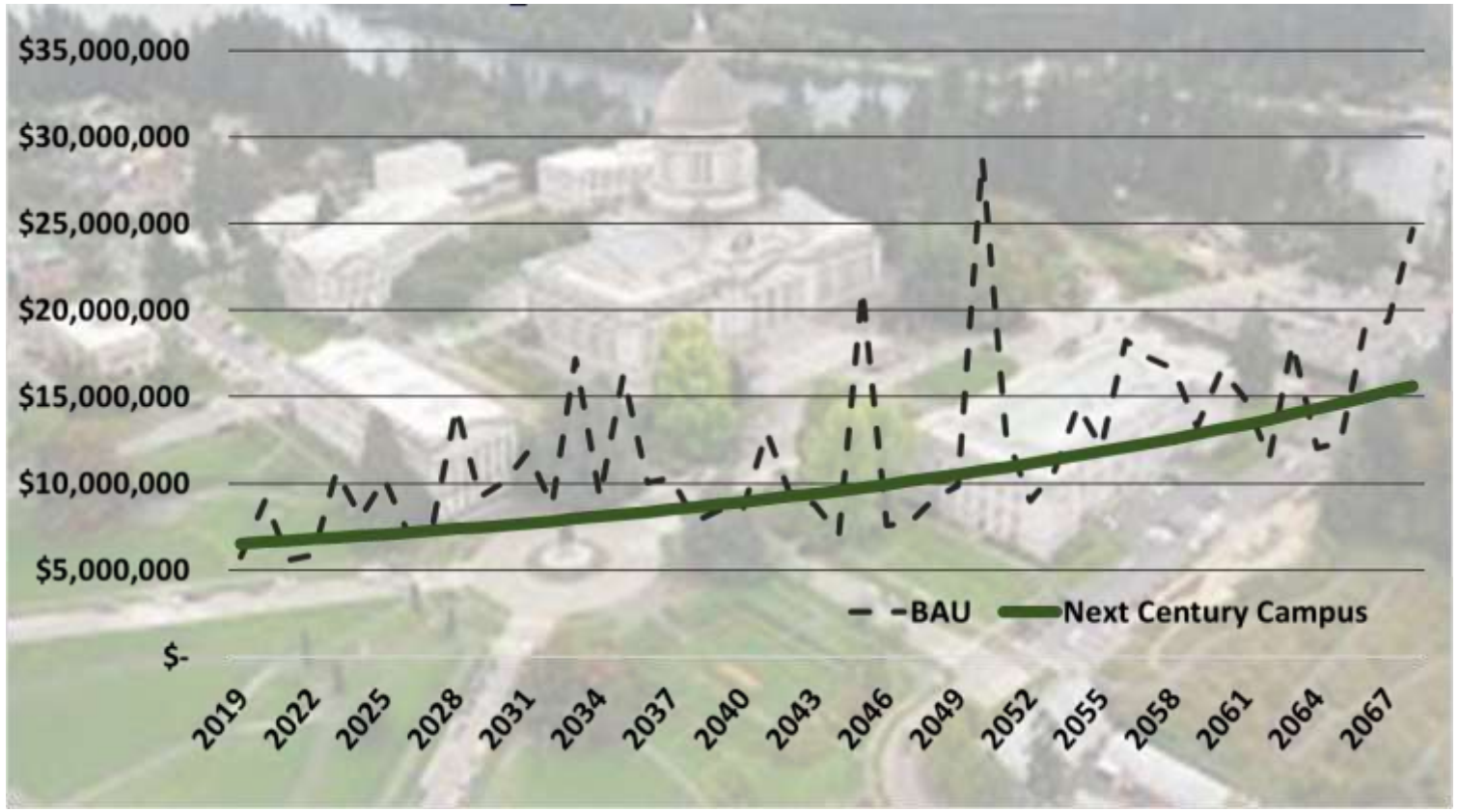
- Existing district steam network (hog fuel, natural gas)
- Grid power supply to be integrated with local cogeneration
- Economic dispatch of CHP as hedge to market power price
- Connected customers benefit from fuel flexibility, carbon
- Features turbines, electrode boilers, fuel boilers, controls
- +/- 100 MW dispatchable co-generation
- +/- 20 MW up / down regulation

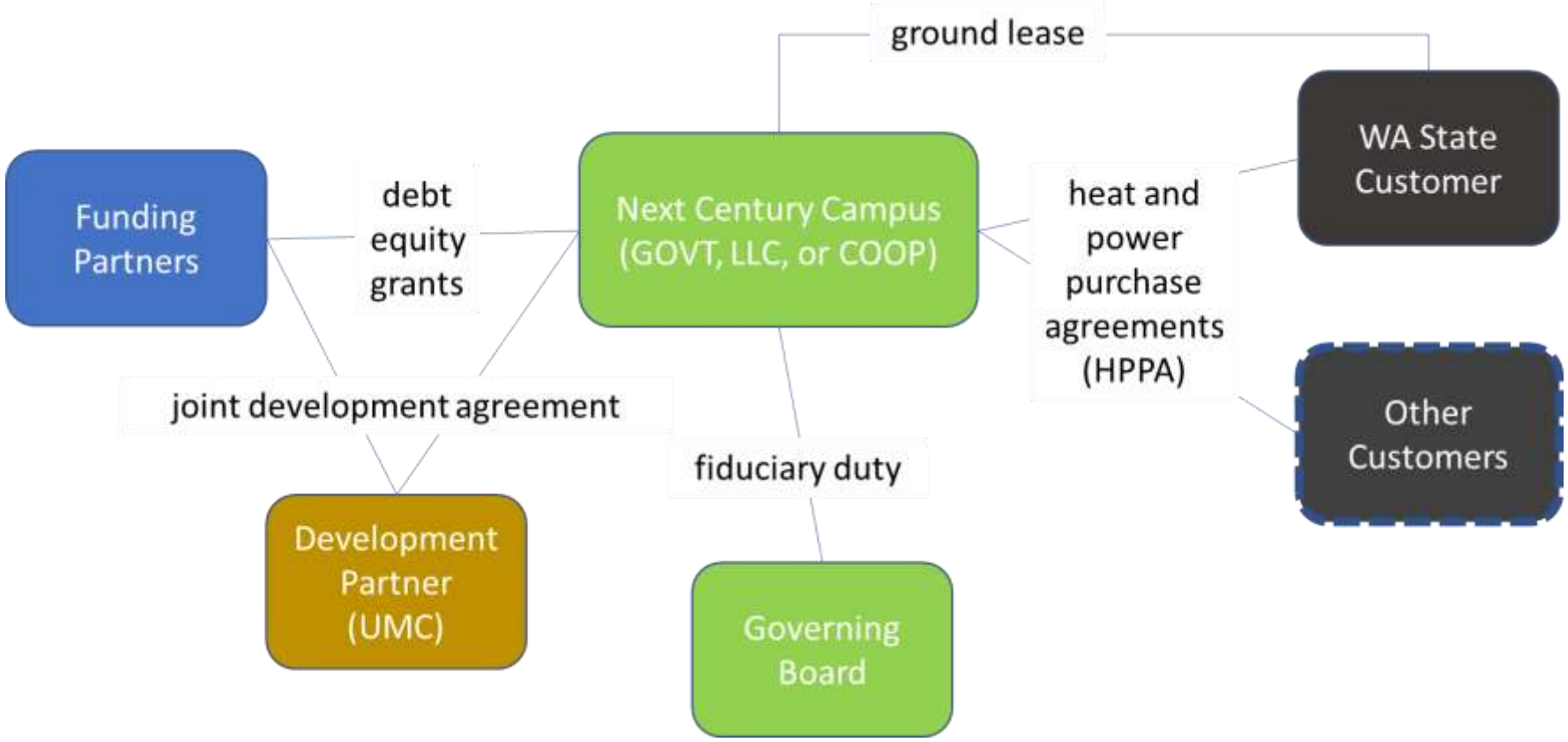
Case 2:
Next Century Campus

- WA State Capitol Campus
- Currently operated as a cost center (no revenue)
- Aging steam and condensate infrastructure
- Safety, efficiency, carbon, and comfort issues
- Not competitive in service to new buildings
- Limited chilled water distribution network
- Located at base of a known landslide zone

Old Plant circa 1920

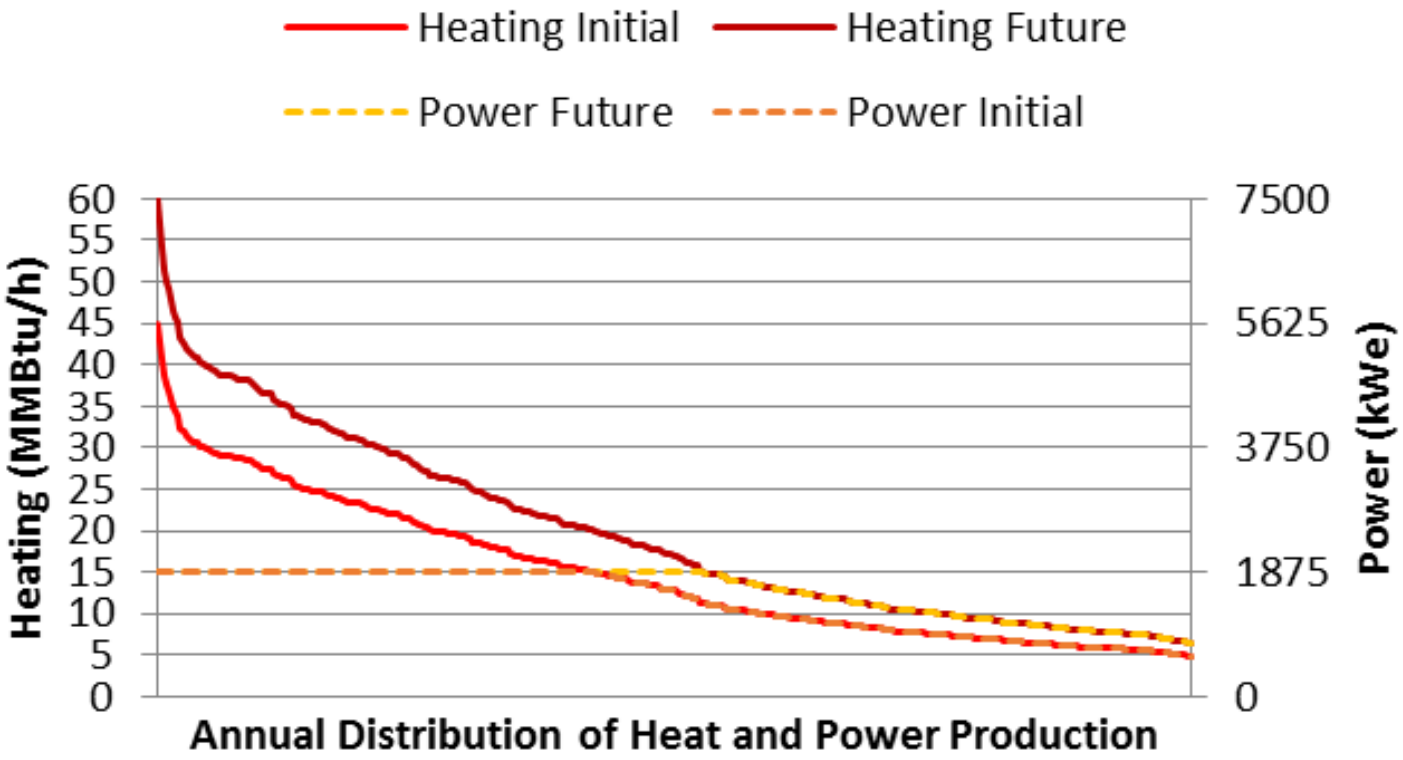
modernization, renewal, and growth requires a different funding strategy





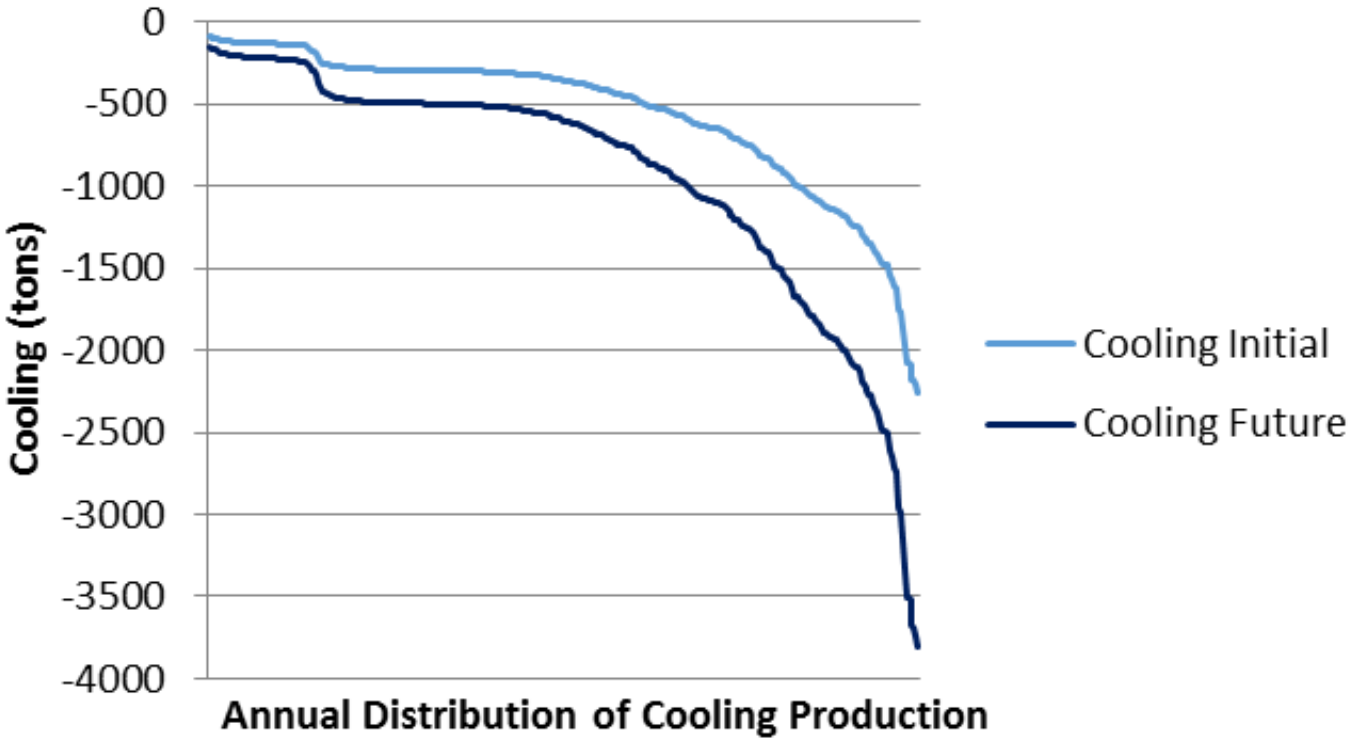
new district (thermal) energy enterprise structure to facilitate investment, renewal, operation, and growth

District heating infrastructure features steam to hot water conversion, thermal storage, and 2.5 MW dispatchable cogeneration

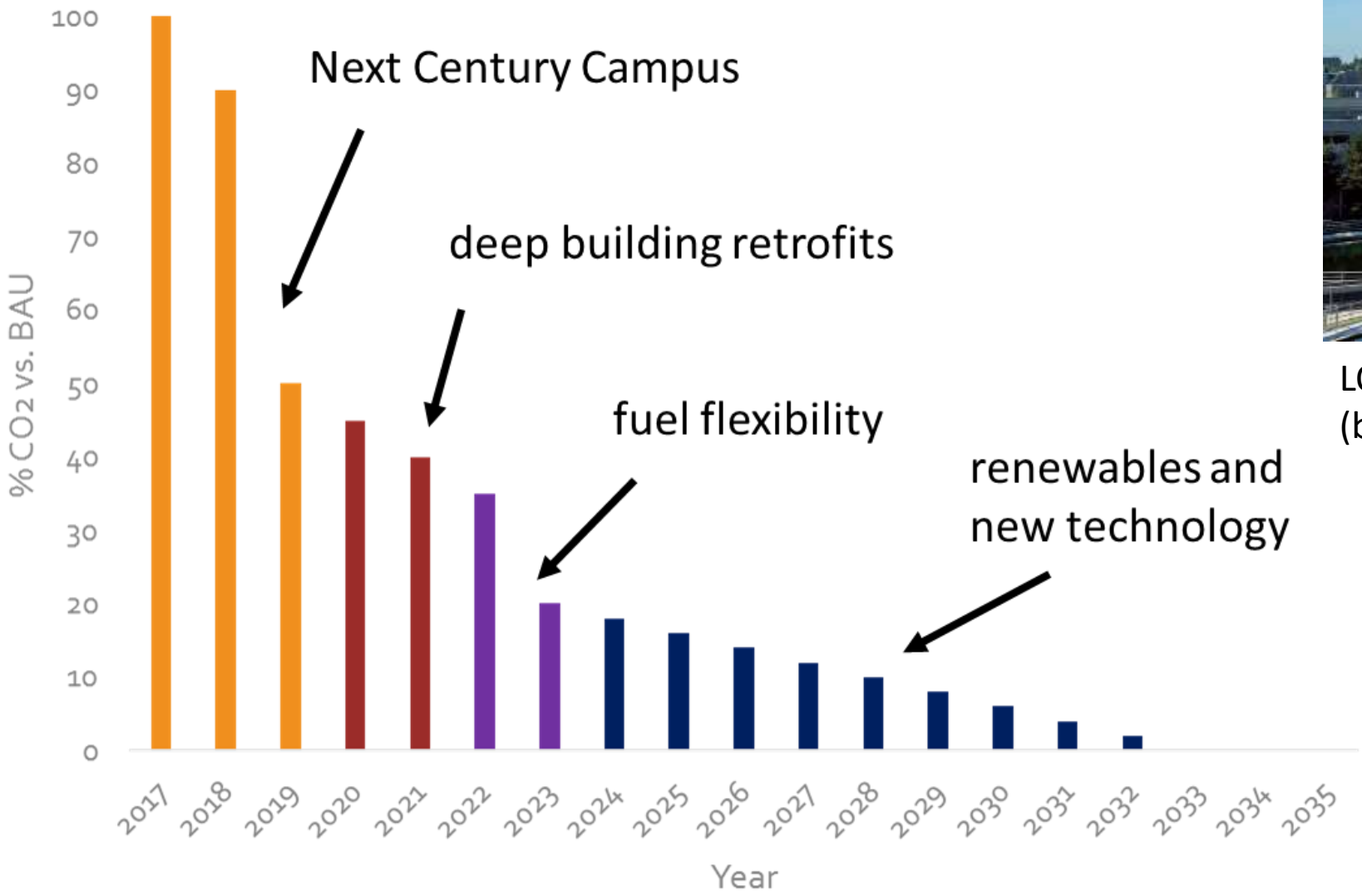


Initial	Future	Description
12	21	Buildings (#)
1,670,217	3,474,823	Connected space (sqft)
45	60	Diversified peak heating (MMBtu/h)
60	75	Installed capacity (N+1) excluding TES
26.9	17.3	Peak intensity (btu/h/sqft)

District cooling infrastructure features expansion to full campus, thermal storage, and provisions for chilled water heat recovery

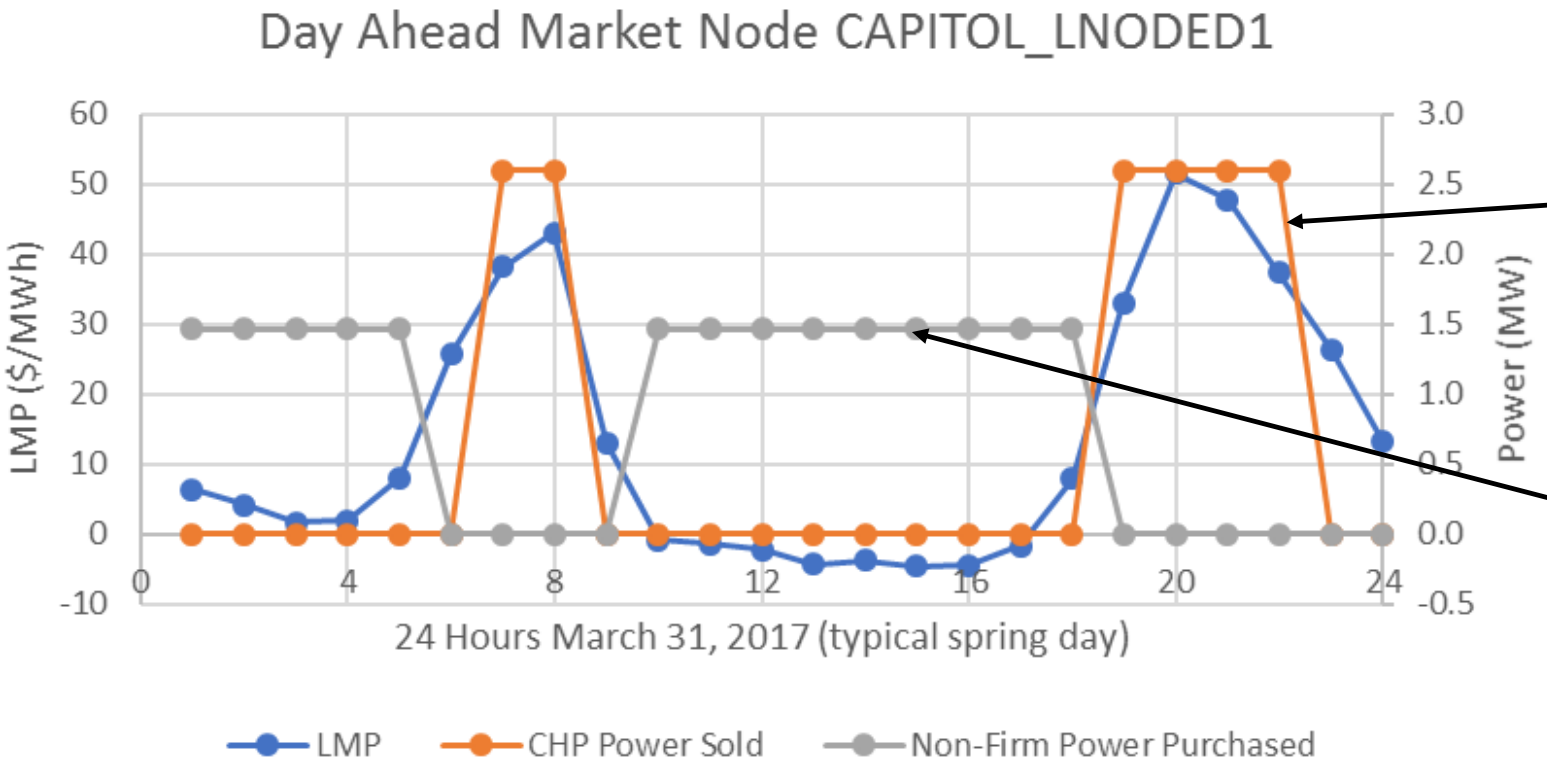


Initial	Future	Description
9	13	Buildings (#)
2,440,423	3,521,017	Connected space (sqft)
2,255	3,806	Diversified peak cooling (MMBtu/h)
3,200	5,000	Installed capacity (N+1) including TES
1,082	925	Peak intensity (btu/h/sqft)



LOTT Wastewater Treatment
(biogas, purple water supply)

Dispatchable generation and load to reduce operating cost and carbon



Cogeneration when justified by the power price

Periodic heat generation from surplus intermittent renewables in lieu of fuel

Questions?

Eric Moe, MSE MBA
Senior Developer – District Energy
emoe@umci.com
206-890-3266

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