Resource Adequacy Fundamentals

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OREGON DEPARTMENT OF ENERGY

2020 ENERGY REPORT

Goal of the Report

Pursuant to ORS 469.059, provide a comprehensive review of energy resources, policies, trends, and forecasts, and what they mean for Oregon.

Scoping the Report

Shaped by a data-driven process, equity considerations, and input from stakeholders and the public.

Designing the Report

Shorter briefs on a wider variety of energy topics, tear-away style. Themes cross sections for general 101 or technology reviews and deeper-dive policy briefs.


Policy Brief: Evaluating the Resource Adequacy of the Power System

Background

The electric power system is unique, relative to other industry sectors, in that it has little to no capability to store electricity as an end-use fuel. As a result, the electric generation and transmission system must be built to satisfy the largest hourly requirements for electricity—called peak demands—even though consumers use less (oftentimes significantly less) during most hours of the year. This results in an electric generation and delivery system that is, by design, underutilized much of the time, especially when compared to the liquid fuels and natural gas sectors.[1] To evaluate the adequacy of the power system, utilities and grid planners must forecast customer demand for electricity and compare that to the ability of existing resources to meet that demand in real-time. If the capabilities of existing resources might fall short, then new capacity resources will need to be deve years (or more) depending on the types of resources.

Suggested reading: For more background on Resource Adequacy and why it's important for maintaining the long-term reliability of the power system, see the Energy 101 on Resource Adequacy.

Resource Adequacy (or RA) is the term that grid plar evaluation of whether adequate generating capacity v over the next several years (typically from one to five

Resource Adequacy can be evaluated for individual loa areas within their system. It can also be evaluated for b regions. In any case, the following are several key techn of an adequacy evaluation:

Table 1: Resource Adequacy Evaluation: Key Technic

Demand: How much power will customers require in the future?	Energy effic efficiency sa; Population: decline? And; Economic g rate? Will it; Electrificatic adopt electri furnaces?

[1] Note that Resource Adequacy in this context focuses on long-te future power supplies, whereas the similarly-named Resource Suf the short-term management of existing resources and must be me time markets. (see Wholesale Electricity Markets Policy Brief for mo

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Energy 101: Resource Adequacy

We consume energy daily: when we charge our phones, flip a light switch, turn up the furnace to heat our homes, or fill up our car at the gas station. In terms of total end-use fuels consumed by Oregonians, 31 percent of the energy comes in the form of liquid transportation fuels (e.g., gasoline and diesel); 42 percent is electricity; and 26 percent is direct use of fuel oil or natural gas (e.g., for home heating or industrial processes).

Storing End-Use Fuels: Gasoline, Natural Gas, and Electricity

Electricity must be generated and delivered across a large transmission and distribution system, just in time to meet consumer demand. This differs significantly from other end-use fuels (and differs from virtually all other commodities and consumer products) that can be produced at an operationally or economically optimal time, and then stored for consumption at a later point in time.

This section refers to "end-use fuels" because of the important differences between primary energy sources and the end-use fuels that consumers actually consume to power their everyday lives. For example, crude oil is a natural resource extracted from the earth. This primary energy source must be refined into gasoline before it can be used in a vehicle. That gasoline, once refined from the original energy source, can be (and is) stored in large volumes as the end-use fuel that Oregonians consume. Similarly, natural gas, once captured and processed for injection into storage tanks or pipelines, is the end-use fuel that Oregonians consume in their homes and businesses.

Electricity is quite different. The primary energy sources used to generate electricity vary considerably – from the gravitational potential energy stored in volumes of water at altitude, to the nuclear potential energy contained within uranium isotopes, to the thermal kinetic energy of solar energy. A wall outlet cannot use that water, uranium, or solar energy until it has been converted into electricity—the end-use fuel.

Think about gasoline. What does it look like? Chances are you are imagining a physical volume of a brownish-colored liquid. You can literally fill a jar on the table in front of you with gasoline or diesel fuel, the two liquid fuels that predominantly power our transportation systems. Liquids are easily stored in large volumes. Think about natural gas or propane. What does it look like? This one is a bit more challenging, but you might imagine filling a balloon in front of you with some volume of natural gas, or a propane tank attached to your grill. Pipeline networks and large tanks can store vast quantities of these gaseous end-use fuels.

Now think about electricity. What does it look like exactly? Where might you store it? You might imagine a standard AA battery, which stores approximately 3 watt-hours (or 0.003 kWh) of energy.[1] The average residential customer in Oregon would need 9,000 AA batteries to power their house for a single day.[i] So while there are ways to store electricity, those storage systems have historically been limited in their ability to efficiently store energy over a long duration or in

[i] In 2018, the average residential customer of Oregon's investor-owned utilities consumed 10,151 kWh of electricity over the course of the entire year, or approximately 27.8 kWh per day. (OPUC Utility Statistics Book)

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https://energyinfo.oregon.gov/ber

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WHAT IS RESOURCE ADEQUACY?

Table 1: Power System Reliability Over Different Timescales

Short-term *(< 1 minute)*	**System Stability**	Short-term reliability (e.g., frequency response) focused on grid stability over very short time intervals
Medium-term *(Hourly or Daily)*	**System Balancing**	Medium-term reliability focused on managing imbalances on the system like those that occur between a day-ahead forecast and real-time conditions
Long-term *(1 to 5 years)*	**Resource Adequacy**	Long-term reliability focused on seasonal or year-to-year mismatches between supply-and-demand

How much **demand**?

How much **supply**?

How much **risk**?

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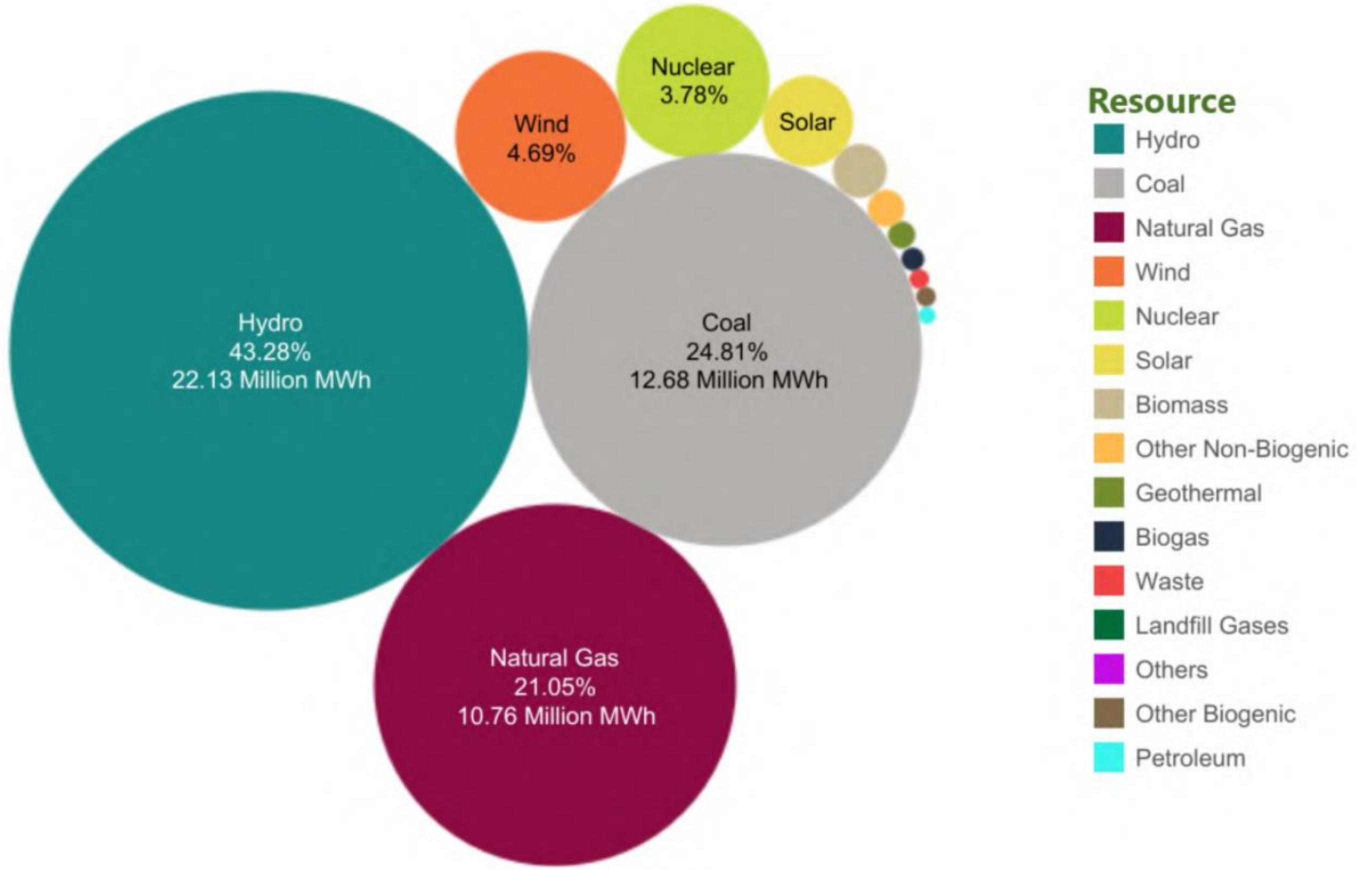
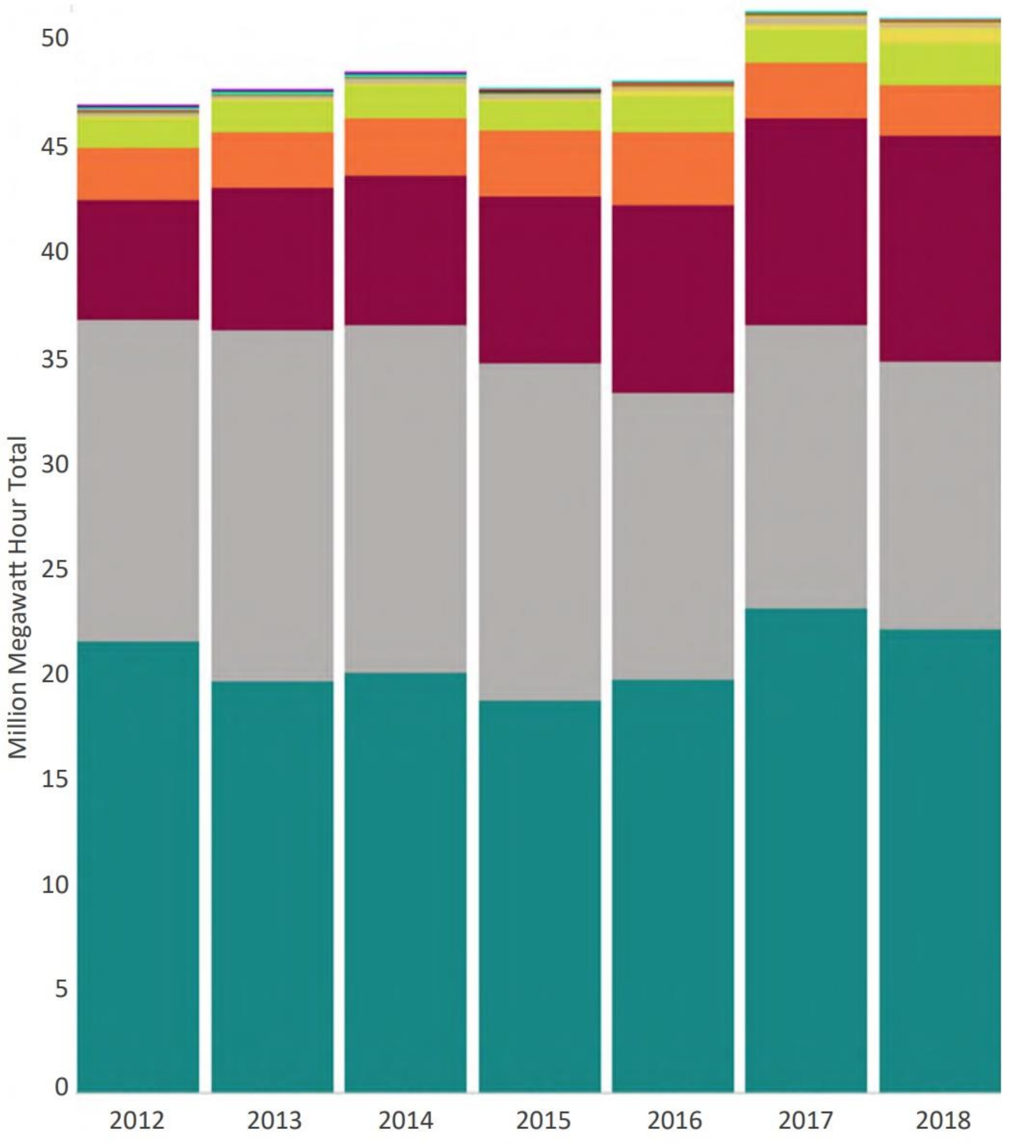
Source: Slide 6, WIRAB Webinar (April 2020)

Resources Used to Generate Oregon's Electricity

Based on 2018 data, this chart shows the energy resources used to generate the electricity that is sold to Oregon's utility customers.

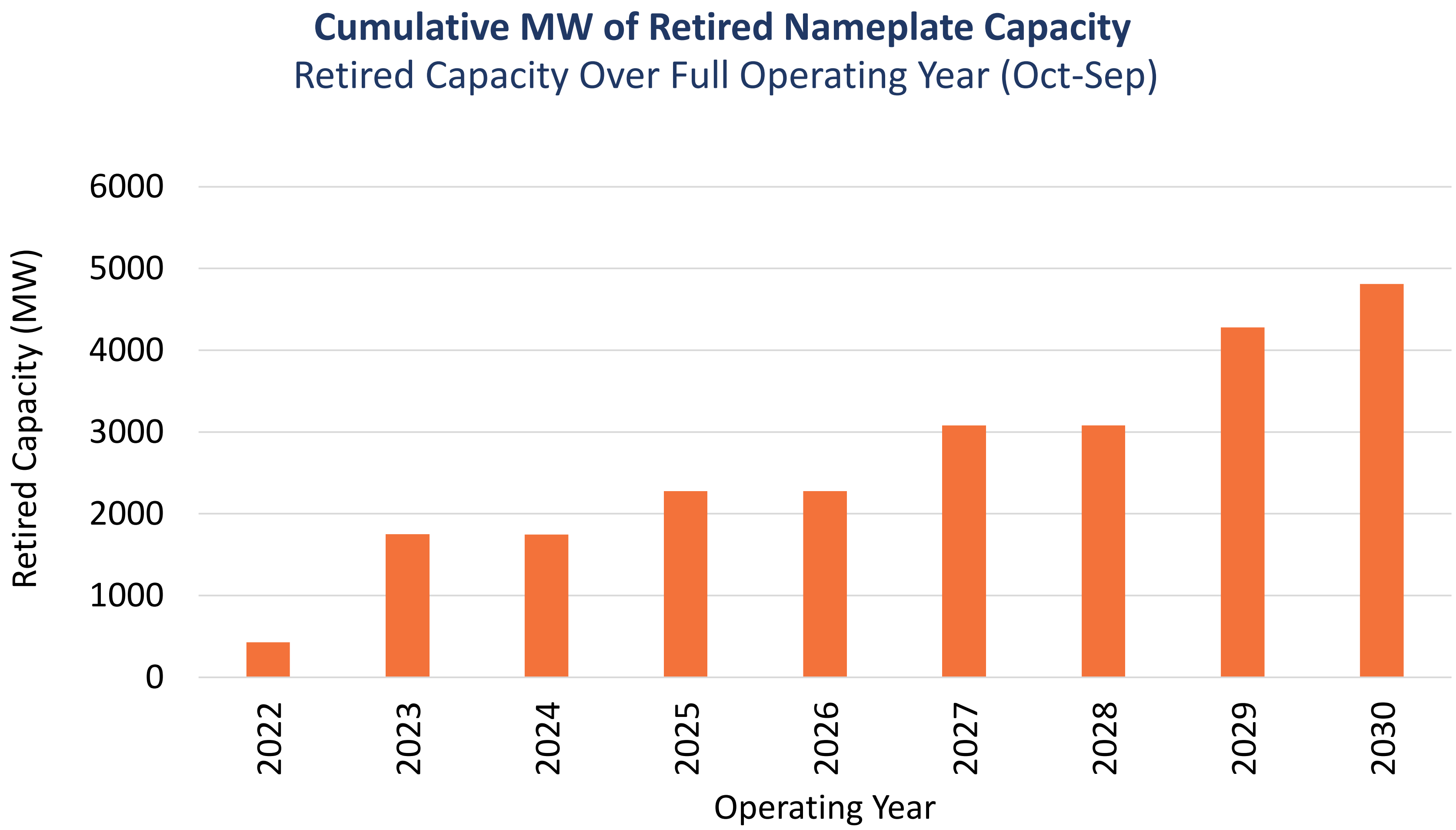


Oregon's Electricity Mix Over Time



Source: Energy by the Numbers, 2020 BER (November 2020)

ANNOUNCED COAL PLANT RETIREMENTS



Source: RA Technical Committee, NW Power Council (December 2020)

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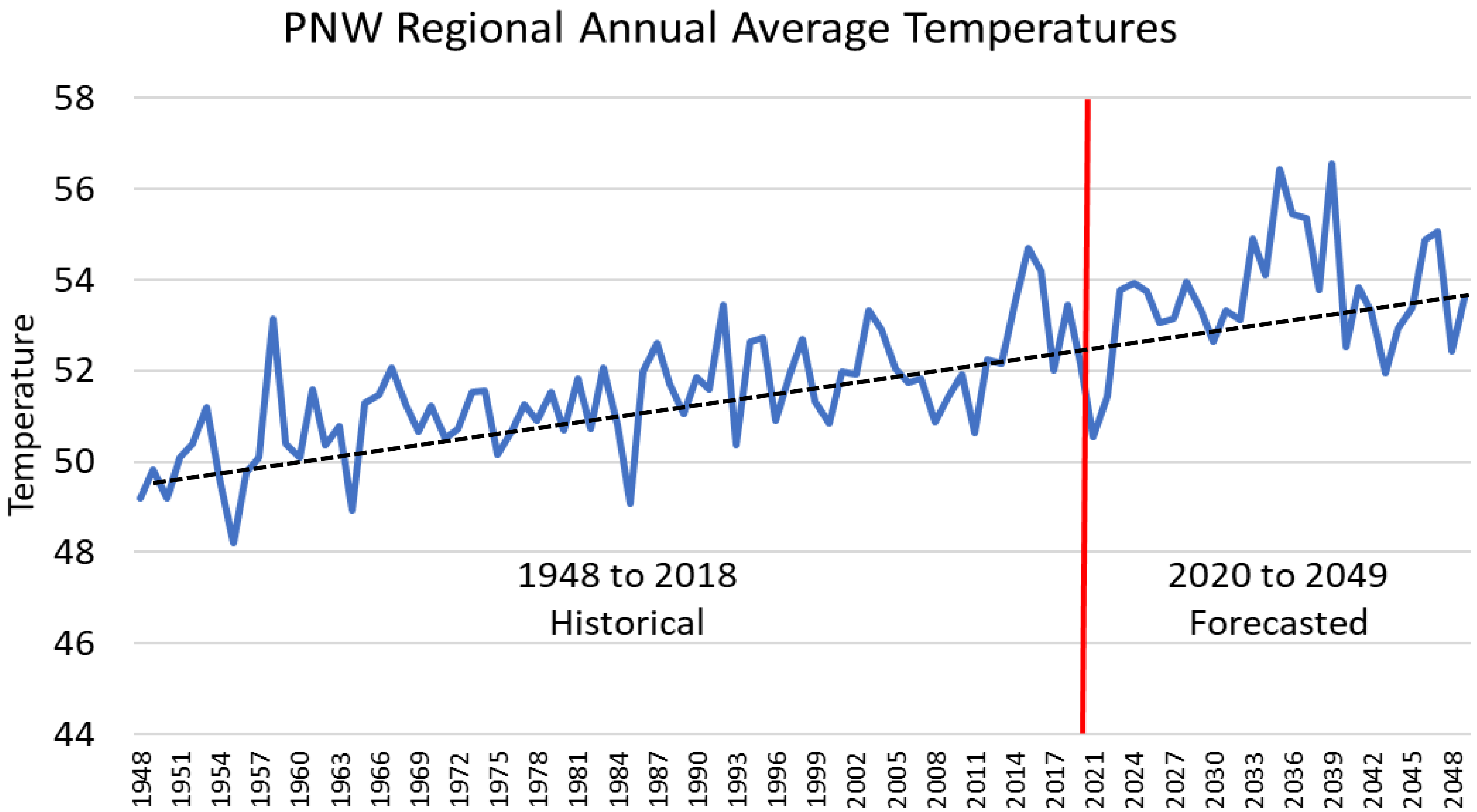
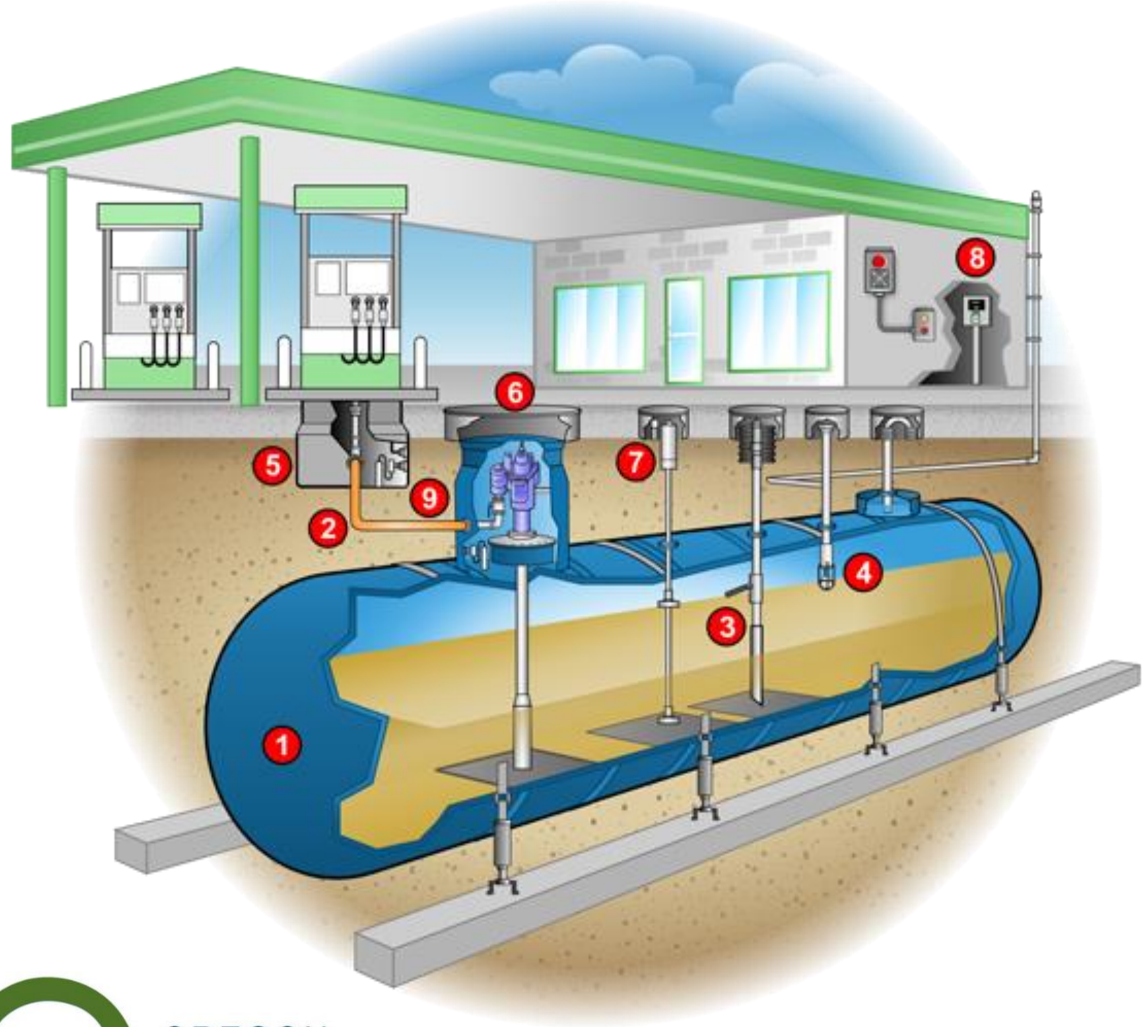
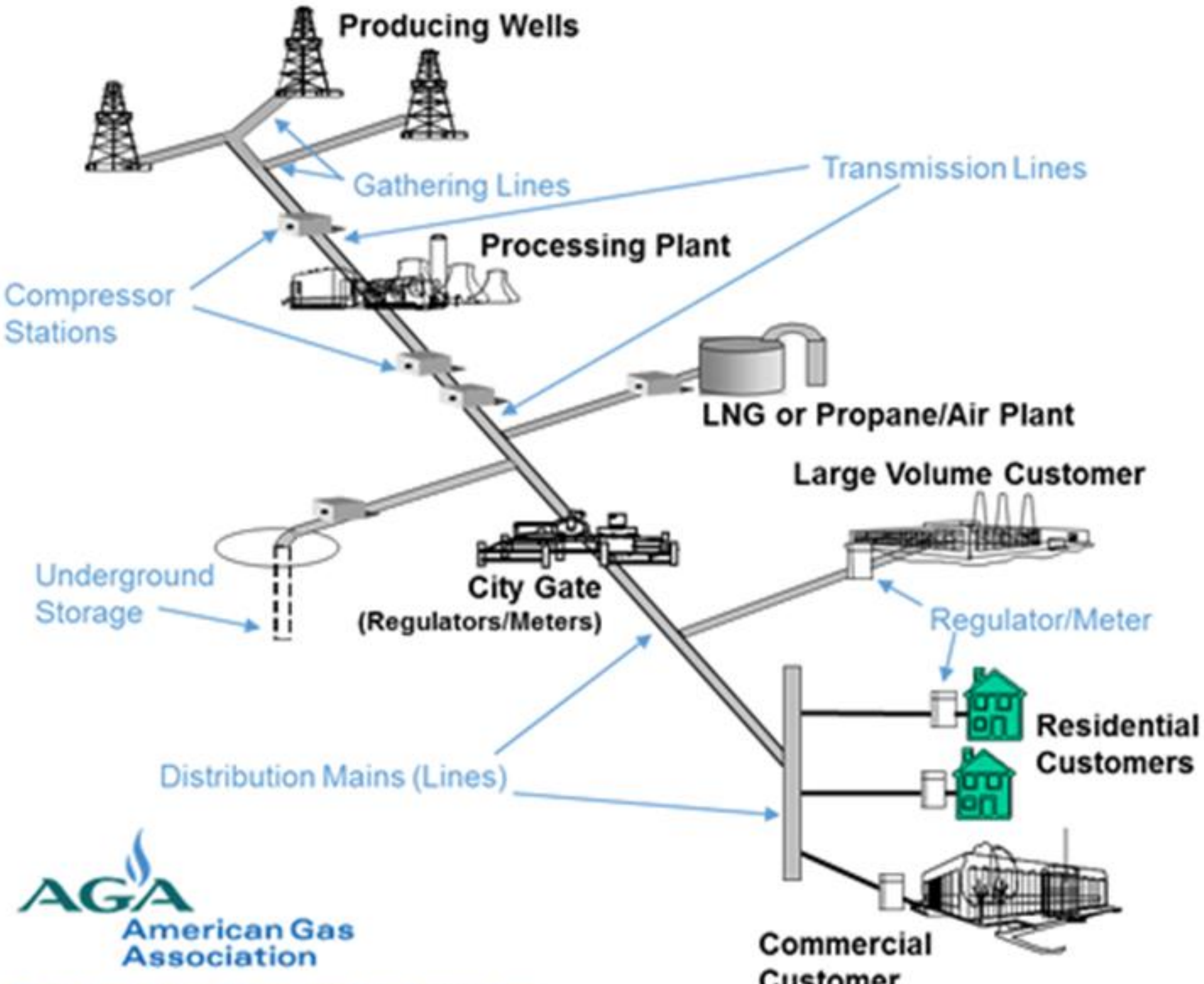
LONG-TERM TRENDS IN TEMPERATURE 1949-2049



Source: RA Technical Committee, NW Power Council (December 2020)

GASOLINE AND NATURAL GAS: ROLE OF **STORAGE**





Picture courtesy of American Gas Association

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ELECTRICITY: GENERATED FOR YOU IN **REAL-TIME**

Average Residential Electricity Usage:

10,000 kWh / year

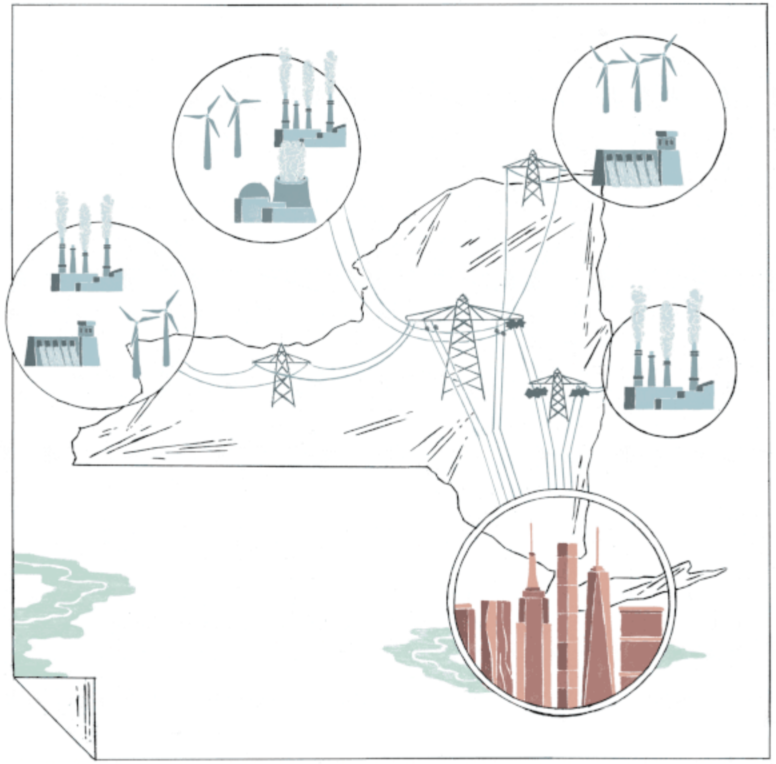
or

28 kWh / day

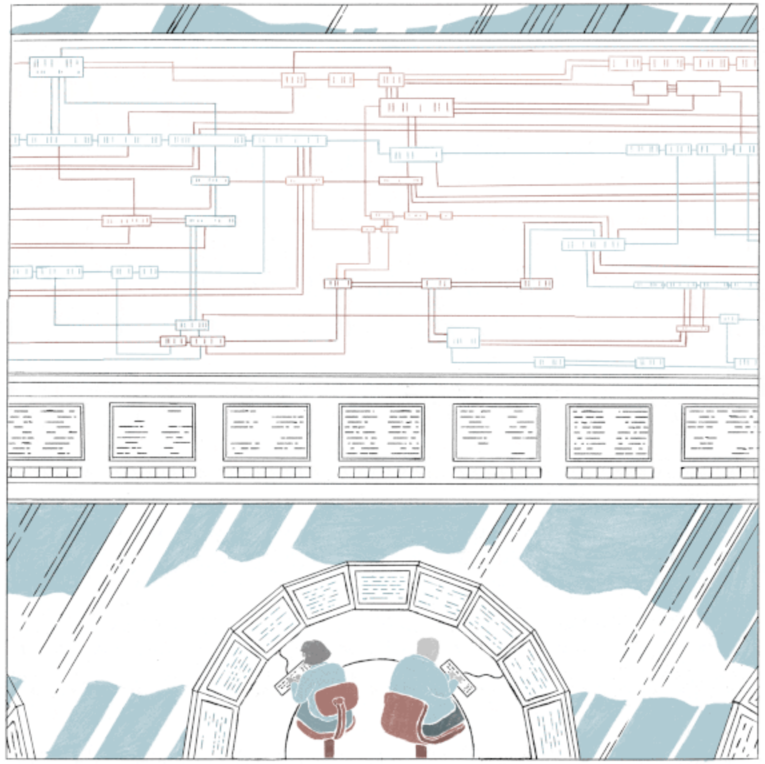
Source: OPUC, 2018 Utility Statistics Book, p. 1

ELECTRICITY: GENERATED FOR YOU IN **REAL-TIME**

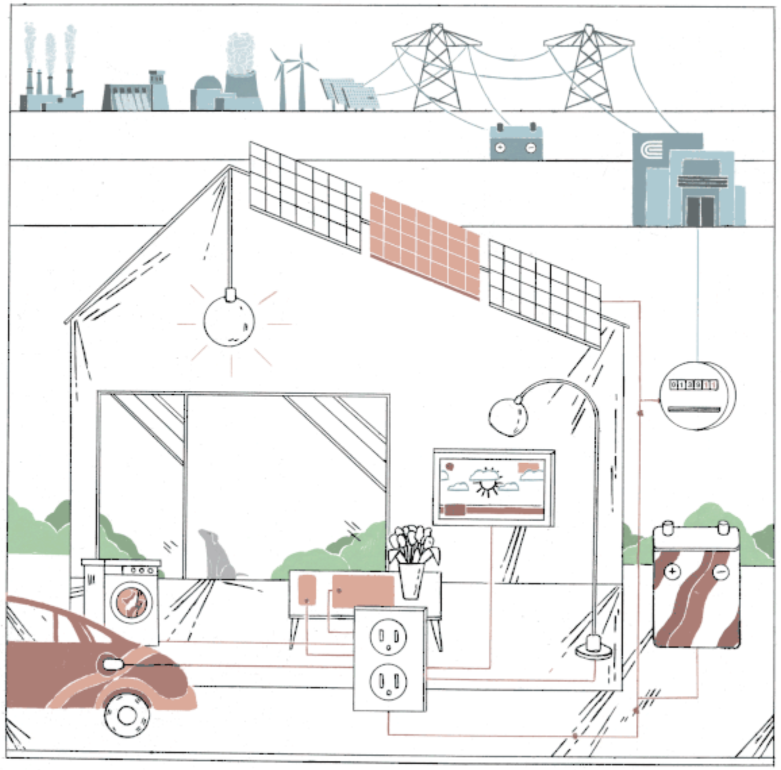
Generated by power plants



Balanced in real-time



And delivered into your home



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Source: *How NYC Gets Its Electricity*, NY Times (February 2017)

ELECTRICITY: POWER UP FROM STORAGE?

Storage in one AA battery:
3 watt-hours (or 0.003 kWh)

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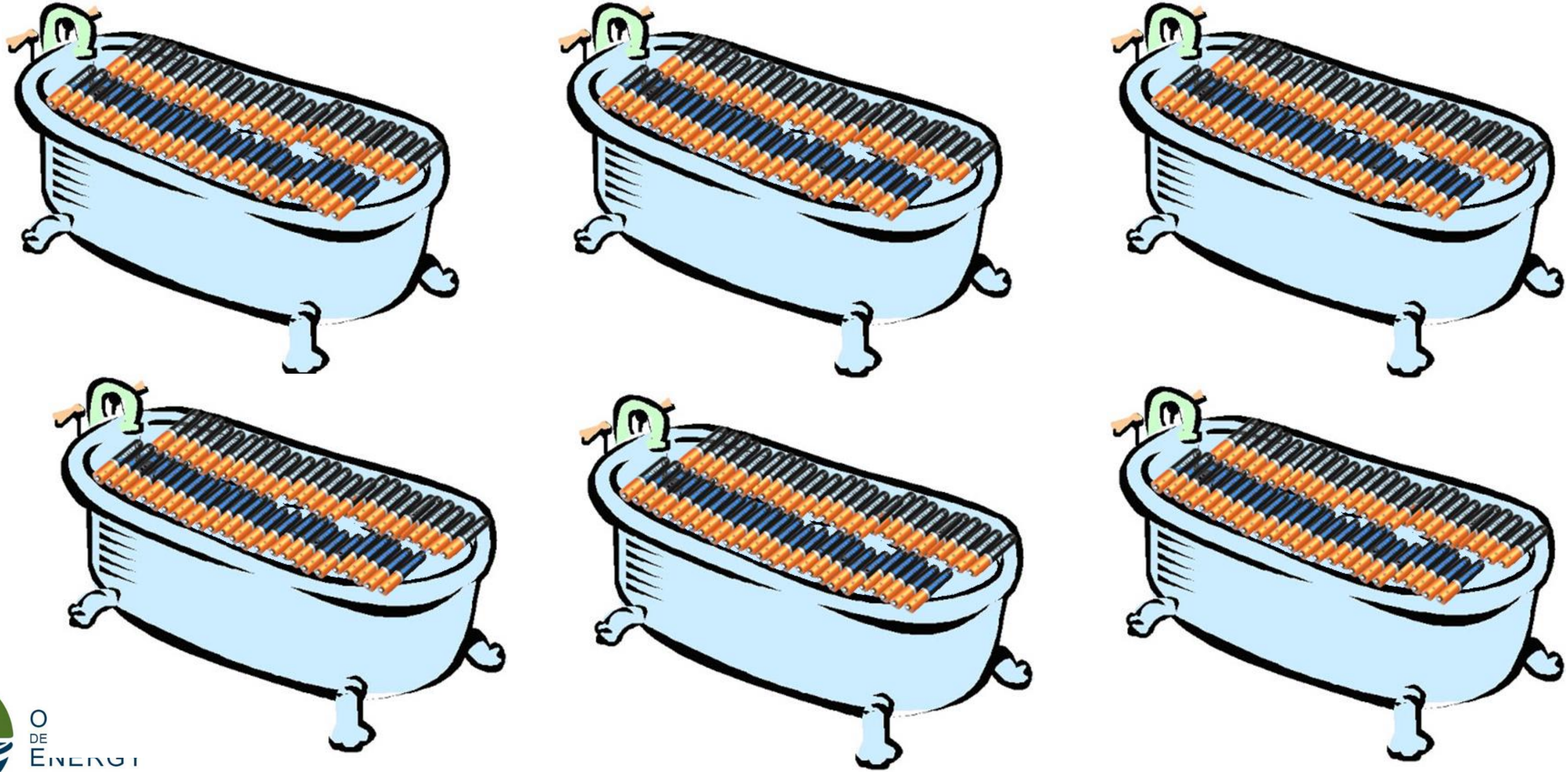
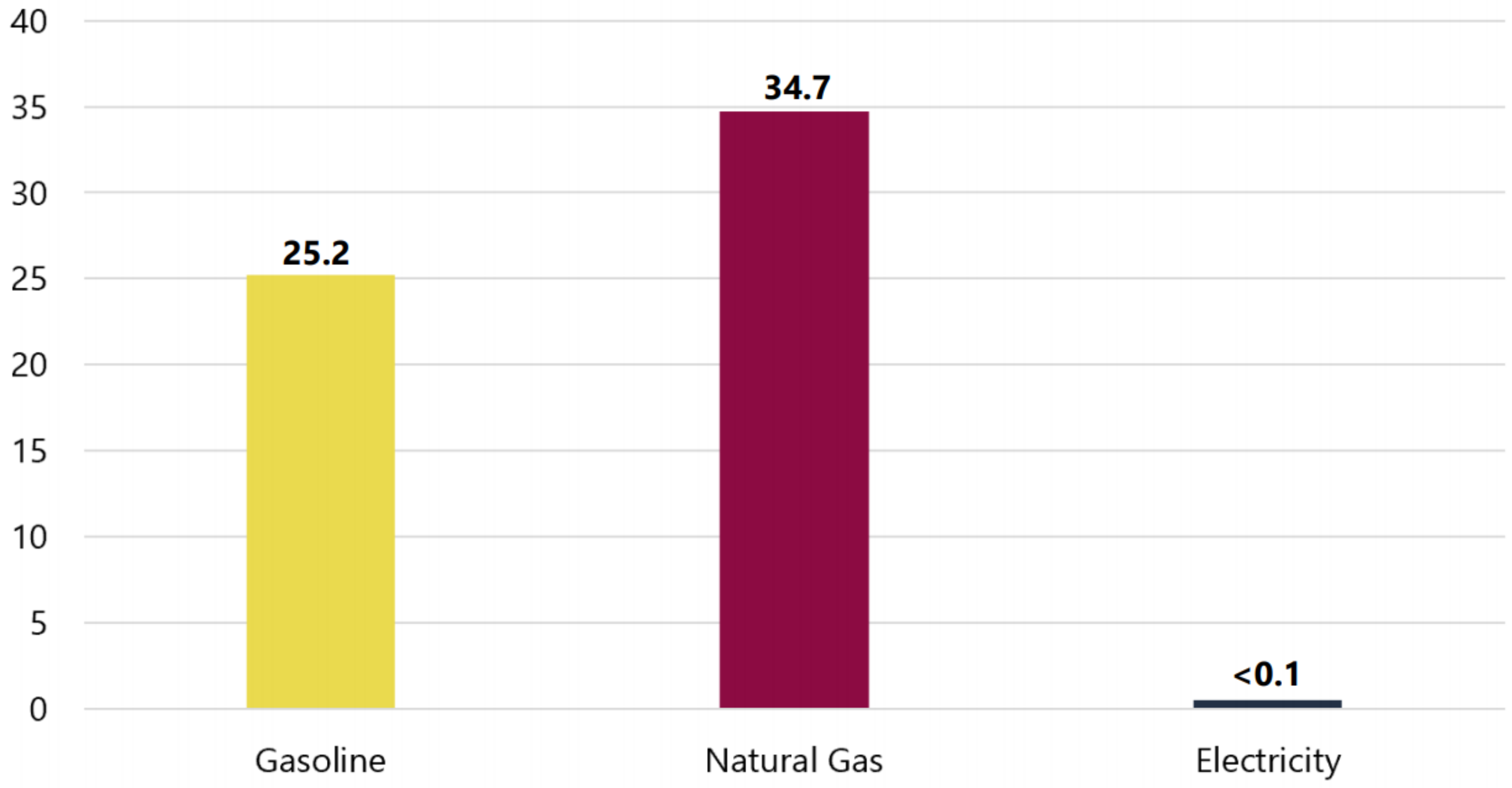
Source: *The Best Rechargeable AA Batteries*, NY Times (November 2019)

ELECTRICITY: POWER UP FROM STORAGE?



WHY DOES STORAGE MATTER?

Figure 1: Days of End-Use Fuel Storage in the U.S. Based on Average Daily U.S. Consumption by Fuel Type[2]



Derived from U.S. EIA data comparing average volumes of stored energy to average daily consumption for total gasoline (barrels consumed vs. weekly stocks); natural gas (mcf consumed vs. working natural gas in storage); and electricity (MWh of daily consumption vs. MWh of stored electricity).

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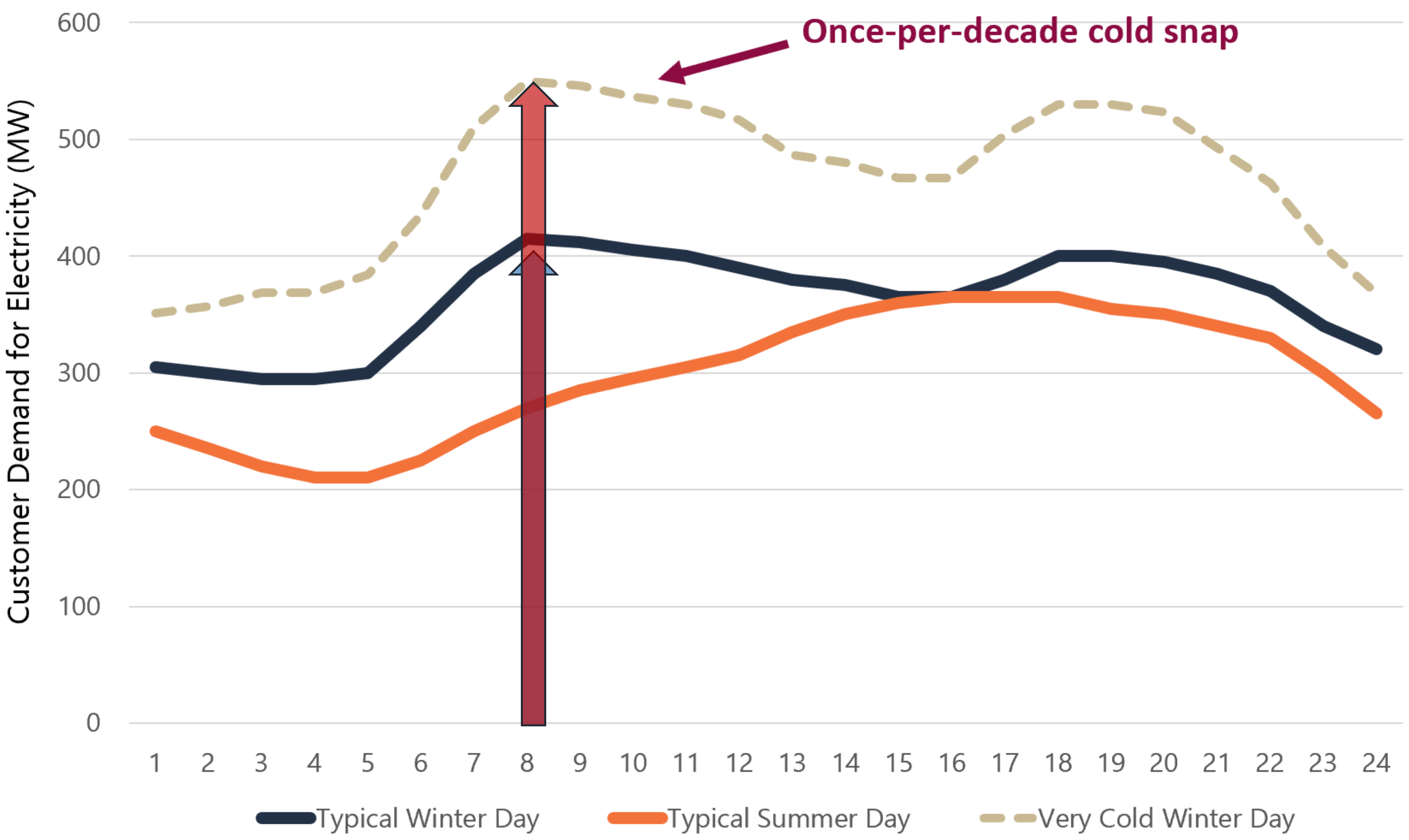
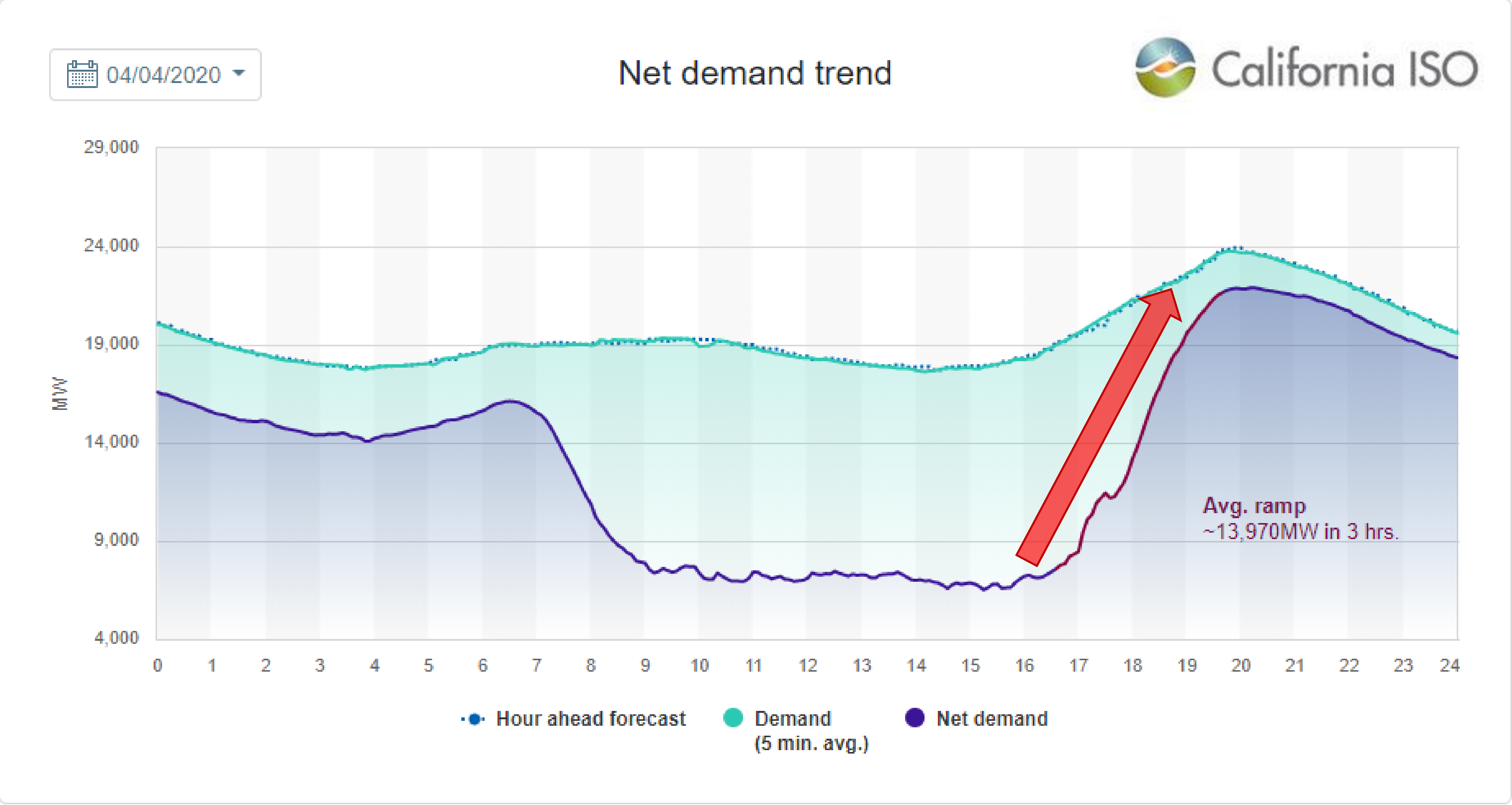
HYPOTHETICAL UTILITY DEMAND PROFILE



An Emerging Concern: Net Demand



PARTING THOUGHTS

- **Resource Adequacy:** Keeping the lights on by ensuring that adequate resources are available at all hours in the years ahead
- **New Challenges:** Changing resource mix (renewables coming, coal retiring) + climate change impacting historic patterns of usage
- **Evolving Process:** Individual utilities (with their regulators) in Oregon have long been responsible for evaluating and ensuring an adequate power system, but increasing interest in more coordinated state/regional efforts

Northwest Power and Conservation Council

NORTHWEST PowerPool

Oregon Public Utility Commission

Questions/Comments?

Biennial Energy Report online:
energyinfo.oregon.gov/ber

ODOE's website: www.oregon.gov/energy

Contact us: Adam.Schultz@oregon.gov

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