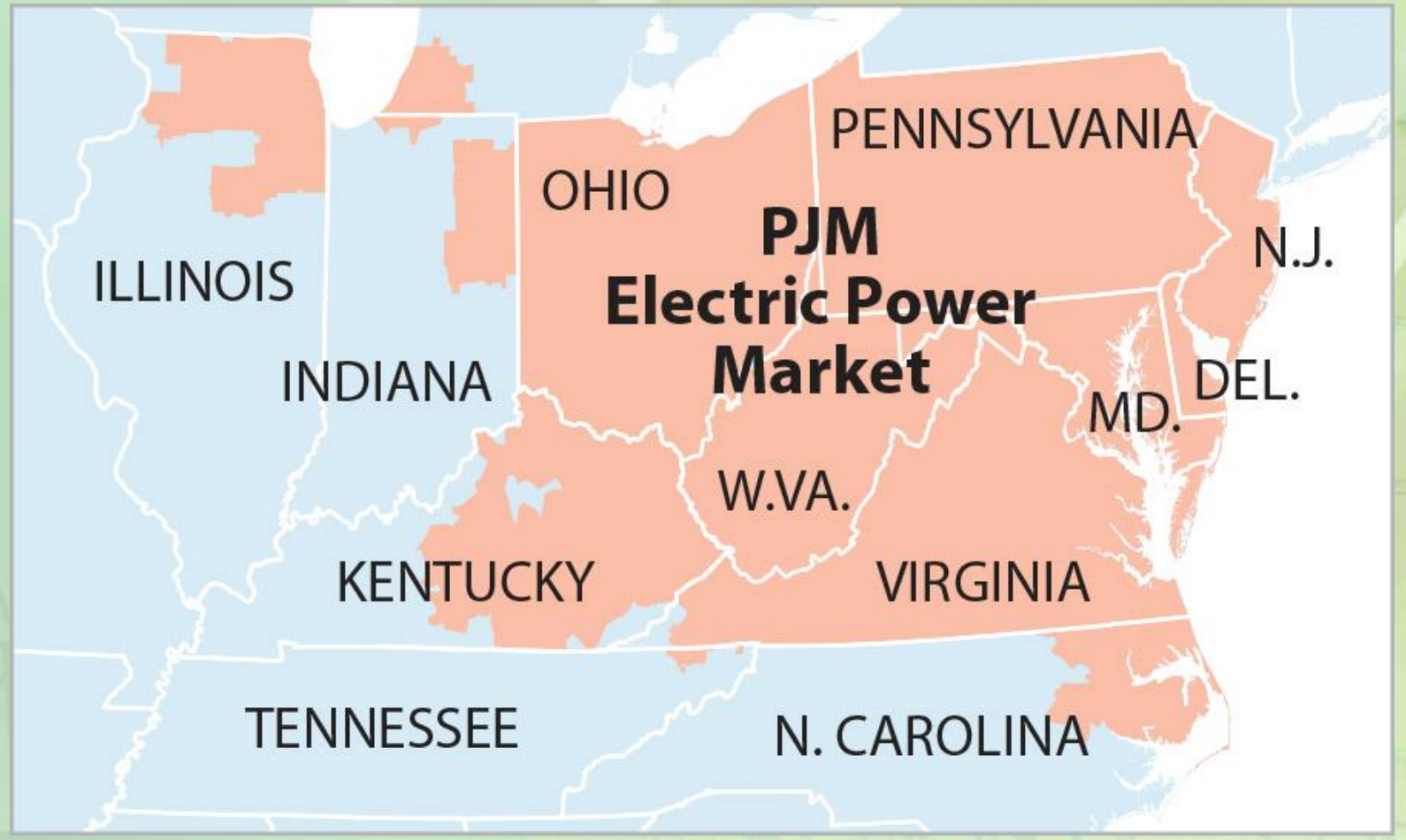
FEATURES OF DATA CENTER LOAD GROWTH IN PJM

THE PJM REGION



HISTORICAL LOAD GROWTH

- On a national basis, post-WW2 experienced a substantial amount of electric usage growth, but the *growth rate* has been generally slowing ever since.

PJM RECENT HISTORY

- Since 2011, peak PJM electric usage (load), has also been shrinking. Pre-2011, PJM had less service territory.
- Since 2023, growth is convincingly returning, both due to data centers and general electrification. (EVs and heat pump heating).

Table 3-6 Actual PJM peak load plus export: 2009 through 2023[31] [32]

	Date	Hour Ending (EPT)	PJM Load Plus Export (MWh)	Annual Change (MWh)	Annual Change (%)
2009	Mon, August 10	16	135,923	NA	NA
2010	Wed, July 07	17	149,376	13,453	9.9%
2011	Thu, July 21	17	169,290	19,915	13.3%
2012	Tue, July 17	18	166,081	(3,210)	(1.9%)
2013	Thu, July 18	17	157,277	(8,804)	(5.3%)
2014	Tue, June 17	18	142,428	(14,850)	(9.4%)
2015	Fri, February 20	8	144,850	2,422	1.7%
2016	Thu, August 11	17	154,743	9,893	6.8%
2017	Thu, July 20	16	148,343	(6,400)	(4.1%)
2018	Tue, August 28	17	152,509	4,166	2.8%
2019	Fri, July 19	18	153,589	1,080	0.7%
2020	Mon, July 20	18	148,996	(4,593)	(3.0%)
2021	Tue, August 24	18	151,680	2,684	1.8%
2022	Wed, July 20	18	149,531	(2,150)	(1.4%)
2023	Thu, July 27	18	152,797	3,267	2.2%

DATA CENTERS

WHAT IS A DATA CENTER?

- A data center is a term for facilities that house computing hardware.
  - Server farms are data centers that house computing that serves needs elsewhere. These uses may include computers that route internet traffic, that store data and provide services like websites. Server farms have been around for the history of the internet.
  - Current data center trends provide newer services, like Artificial Intelligence or sometimes cryptocurrency mining.
  - Data centers also house facilities to keep the computers cool, and also provide other services.

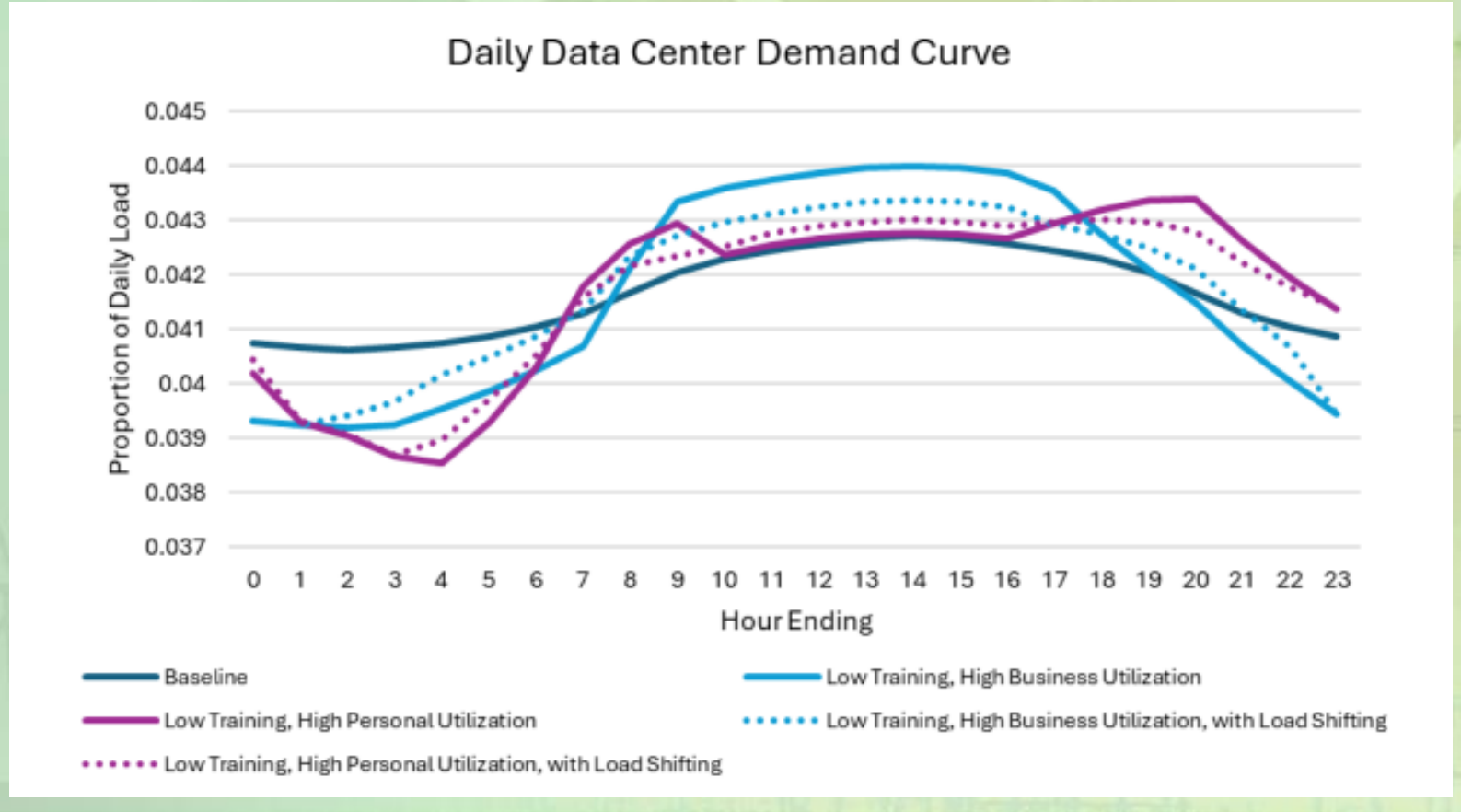
DATA CENTER ELECTRICITY USAGE

- Current data centers are high utilization facilities.
  - While a residence might only use electricity at certain times of day, newer data centers are rarely idle.
  - Older data centers, i.e. server farms, ran less often
  - Before 2011, the Northwest Power and Conservation Council indicated that 63% of servers had utilization below 10%.

DATA CENTER ELECTRICITY USAGE

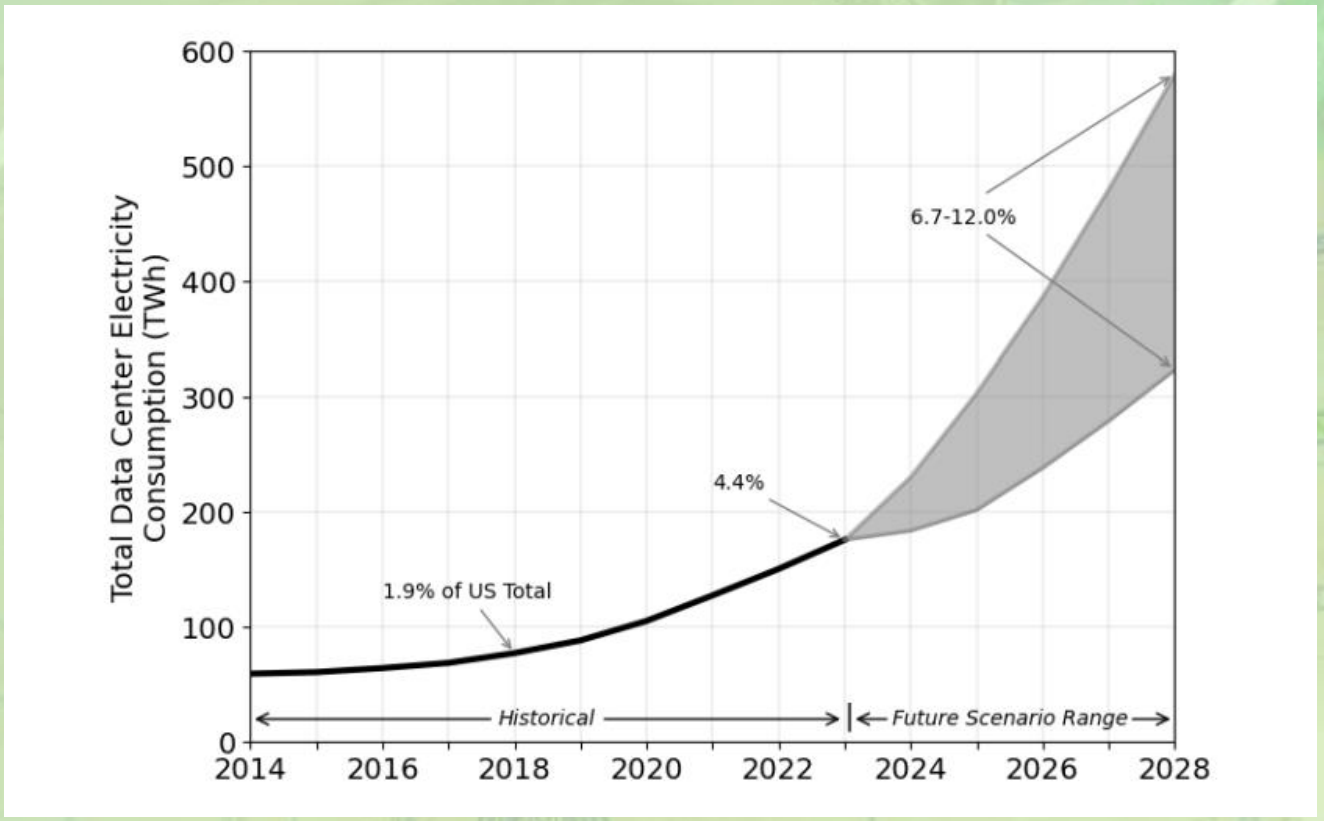
- Current data centers are high utilization facilities.
  - An estimate from the energy consulting firm E3 now uses a utilitization rate of 86%.
  - Computing makes up the largest chunk of data center energy usage.
    - Computing (40-50%)
    - Cooling (30-40%)
    - Other uses (lighting, etc.)
  - **Baseline usage is fairly flat throughout the day. (See next slide)**

DATA CENTER ELECTRICITY USAGE



DATA CENTER ELECTRICITY USAGE

- Lawrence Berkeley National Lab indicates that in 2028, data centers may use between 6.7% to 12.0% of total use electricity (Energy not peak load)
- Data centers used about 4.4% of total US consumption at the beginning of 2023.



DATA CENTER WATER USAGE

- Data centers also use a substantial amount of water, used for cooling.
- This water may be able to be recycled.

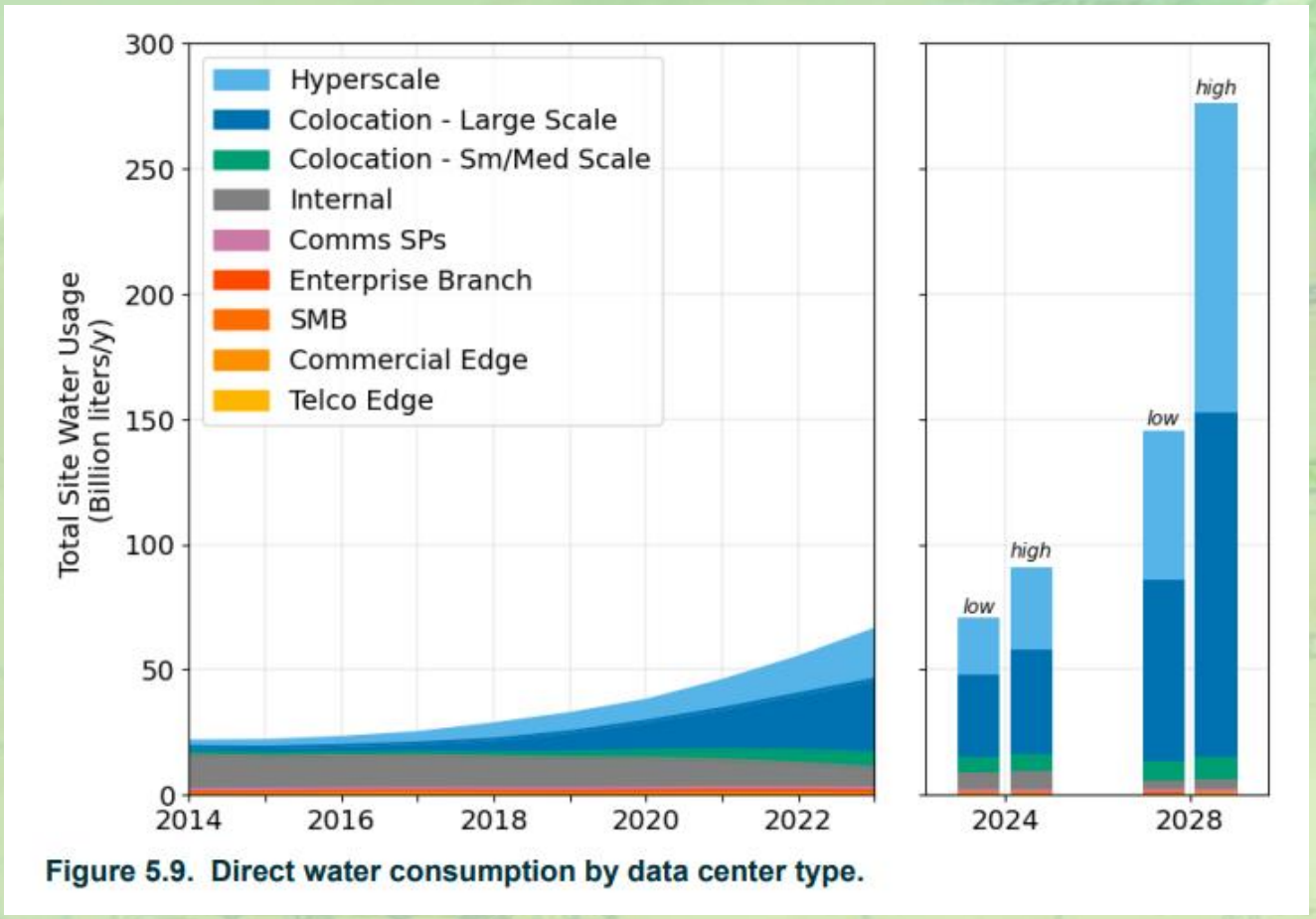


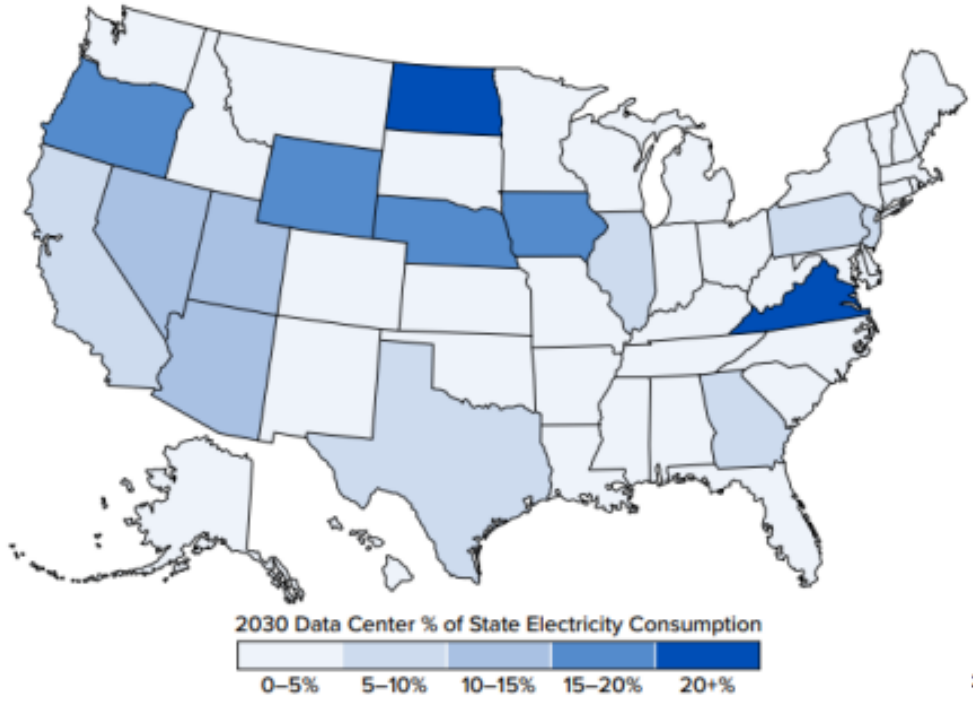
Figure 5.9. Direct water consumption by data center type.

WHERE ARE DATA CENTERS BEING BUILT

- This map depicts share of load, so low load states will look higher on this map. (Hence North Dakota)

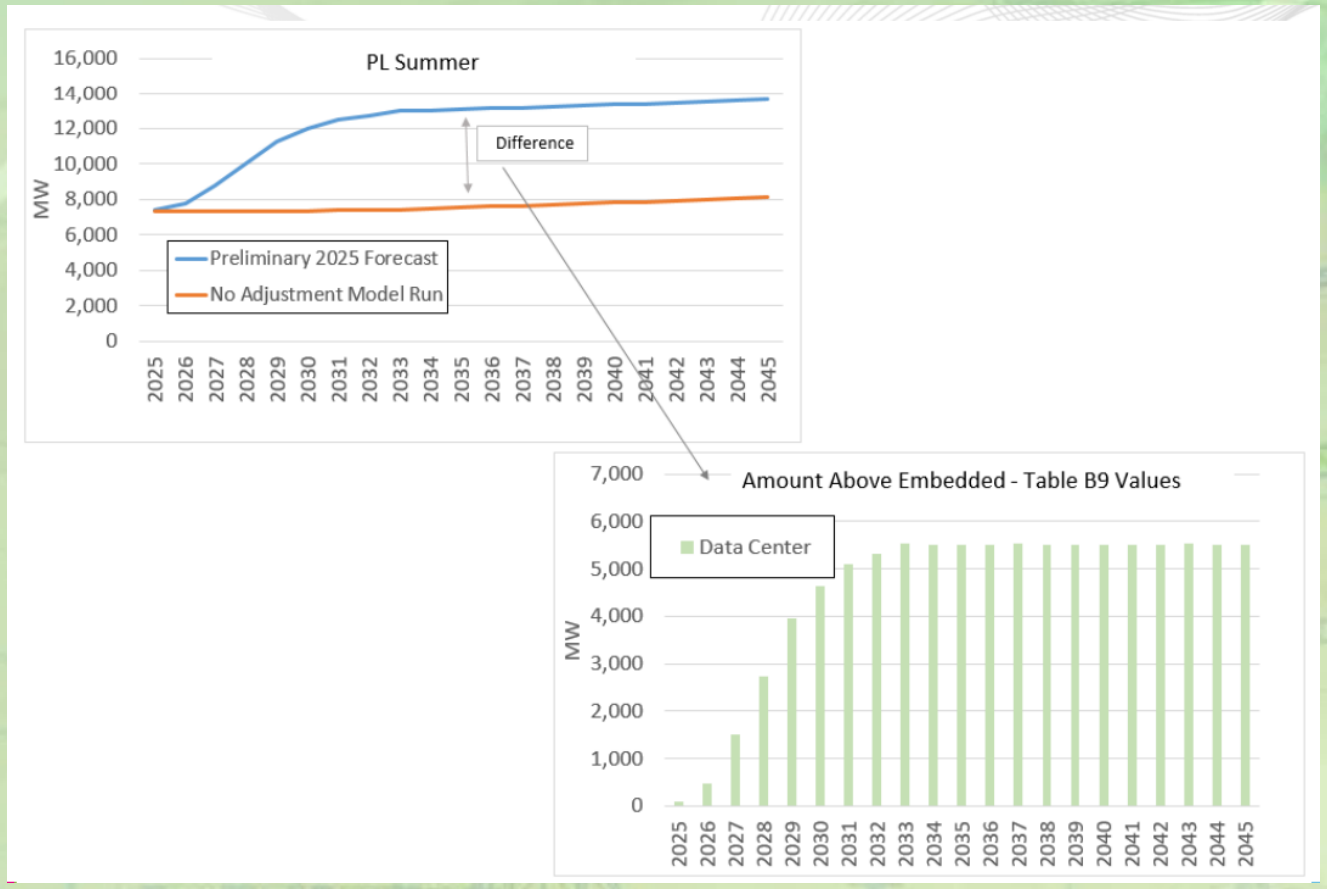
PAPUC

Figure 6: EPRI's Projected Data Center Share of Electricity Consumption in 2030



PJM DATA CENTER GROWTH

- Growth in PJM is mostly in Virginia, where data centers have existed for a while.
- But data center growth is also occurring in Indiana, Ohio, and Pennsylvania (specifically PPL).
- On the right, see PJM forecast changes between the 2024 forecast and the 2025 forecast due to data center increases.



PJM DATA CENTER GROWTH

- For context, on the right you can see around 5 Gigawatts of increased data center usage in PPL by 2030.
- The entire state of New Hampshire uses a little over one GW on average of electricity.
- Current Pennsylvania peak load is just under 30 GW.

DATA CENTER INTERCONNECTION

- Related to having very high loads, data centers connect at much higher transmission voltages, meaning they need much heavier duty wires than typical electric users.
- Distribution facilities (those facilities that serve end-use load), are usually in the range of 34.5 kilovolts (kV), or lower.
- Some data center interconnection proposals connect to the grid through six independent 138 kV wires and require other upgrades to the grid.

DATA CENTER INTERCONNECTION

- There are two types of interconnection methods data centers have been using:
- Type 1: Direct Connection to the Grid
  - Like most other electric users, a data center can connect directly to the existing grid.
- Type 2: Co-located Load
  - Instead of connecting directly to the grid, a data center can connect directly to a power plant. The power plant will be connected to the grid, and the data center will be receiving some of the generators electricity.

DATA CENTER INTERCONNECTION

- You may have heard about a Microsoft data center in relation to restarting the Three Mile Island Plant (now renamed the Crane Clean Energy Center). Although Microsoft is buying electricity from Constellation, the plant's owner, this is a direct grid interconnection; they are not co-located.
- An example of a Co-located interconnection, is the existing small data center behind the Susquehanna nuclear plant, which Amazon has been seeking to expend.
- Both Co-located and Direct interconnections have approximately the same impact on demand.

DATA CENTER PRICING EFFECTS

- Like all new load growth, data centers represent an increased stress on all parts of the electric grid: Generation, Transmission, and Distribution.
- Data centers are a particularly large new stressor, demanding growth of the grid at rates not seen in decades.
- Transformational load growth may cause short term price increases, but may benefit consumers over time.
- Because grid costs are mostly fixed (the cost of physical power plants and wires) and not the variable fuel costs, large new loads may help spread fixed costs over a larger base, lowering unit prices.

QUESTIONS?