Data centers could make electricity bills surge in Illinois

Prepared for Sierra Club and the Illinois Clean Jobs Coalition

April 30, 2025

Angela Zeng, Pat Knight

Summary of results

- Assumed additional data center load of 29 TWh to the ComEd region by 2040
  - Represents an increase in load of about 30 percent, relative to today's levels of load
  - Increase occurs alongside ambitious building and transportation electrification trajectories in non-data center sectors
  - A more recent statement from ComEd describes 14 GW (estimated to be about 105 TWh) of data centers to be in ComEd's queue
- Synapse analyzed the impact of this data center load on residential customer costs and highlighted detail specific to Illinois*
- In this Illinois-specific analysis, over the modeled period of 2025-2040, we find:
  - Net present value of ComEd electric system costs increase by $18 billion, a 30% increase relative to the Base case
  - Average ComEd residential bills increase by 8.3% with data centers
  - Cumulative CO_2 emissions increase by 84 million short tons with data centers

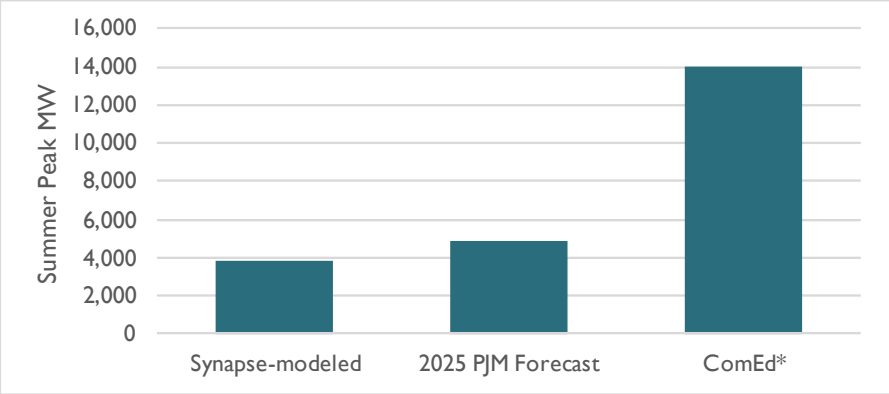
* *For the full analysis, over the entire PJM region, see https://www.sierraclub.org/sites/default/files/2025-03/pjmdatacentermodelingresults_dec2024.pdf.*

Data centers substantially increase costs to serve load

Figure 1. NPV of ComEd system costs

Notes: NPV calculations assume a 7% discount rate. The ComEd region (or system) is defined by PJM and consists of the ComEd utility and other smaller utilities.

Figure 2. Data center load in the ComEd region by 2040



** In a senate hearing on April 18, 2025, Commonwealth Edison described having 14 GW of data center projects in its queue.*

- The total NPV of ComEd's system costs are $18 billion higher in the Data Center case compared to the Base case.
- The Data Center case has higher energy and capacity costs throughout the study period. High loads and build constraints result in a higher reliance on inefficient, costly generation.
- The sum of the following value streams represents the total system costs needed to serve load under each scenario.
  - **Energy market costs:** driven by variable resource costs, including O&M and fuel costs.
  - **Capacity market costs:** represent "missing money" needed to pay for fixed costs not recovered in the energy market, clearing price is driven by the relative size of changes in peak loads compared to firm capacity.
  - **Transmission build costs:** cost of building new transmission lines.
  - **REC costs:** costs of complying with state RPS requirements.
- This may be an underestimation of costs. We modeled 29 TWh of data center load in ComEd's region based on the information available in Fall 2024. PJM's 2025 load forecast estimates there will be 34 TWh of data center load in ComEd by 2040. Furthermore, ComEd most recently described having 14 GW (estimated to be about 105 TWh) of data center projects in its queue.

Data centers are expected to drive up average *ComEd* residential bills

Base Case average monthly bill trends

$91
historical 2021-2023

$122
modeled 2025-2040

- Average residential bills likely to grow due to longer-term increases in gas prices and greater average monthly electricity usage associated with rising levels of EV and heat pump adoption
- PJM interconnection queue delays also prevent construction of cheap resources (e.g., wind and solar), leading to higher energy and capacity prices in the near term

Notes: Dollar amounts are in 2022$. On average, residential customers in the ComEd region used 630 kWh of electricity per month in 2021-2023.

Data Center Case average monthly bill impacts

$132
modeled 2025-2040

+$10
impact from data centers

+8.3%
change in bills

- Data centers to cause an estimated +8.3% increase in residential bills due to higher energy and capacity market prices
- Increased energy demand from data centers drives up near-term reliance on inefficient, costly power plants— this shifts the energy and capacity clearing prices higher
- Longer term, resolving PJM interconnection queue delays enables construction of cheap resources (wind and solar), which lowers energy and capacity prices in both cases— this reduces bill impacts of data centers
- Compared to the rest of PJM, the ComEd region is heavily urbanized and contains residential customers with smaller living spaces, leading to smaller historical bills and subsequently, smaller bill impacts; residential customers in the ComEd region will also have a smaller bill impact from data centers than those in the rest of PJM because of ComEd's ability to import lower cost energy from the MISO region
- The ComEd region is defined by PJM and consists of the ComEd utility and other smaller utilities; municipal and cooperative utilities that purchase any amount of energy and capacity from the wholesale market would also be exposed to proportional cost impacts

A similar percentage increase would lead to a $12 bill impact for *Ameren's* residential customers

Base Case average monthly bill trends

$109
historical 2021-2023

$146
modeled 2025-2040

Data Center Case average monthly bill impacts

$158
modeled 2025-2040

+$12
impact from data centers

+8.3%
change in bills

<u>Caveats to Ameren residential bill impacts:</u>

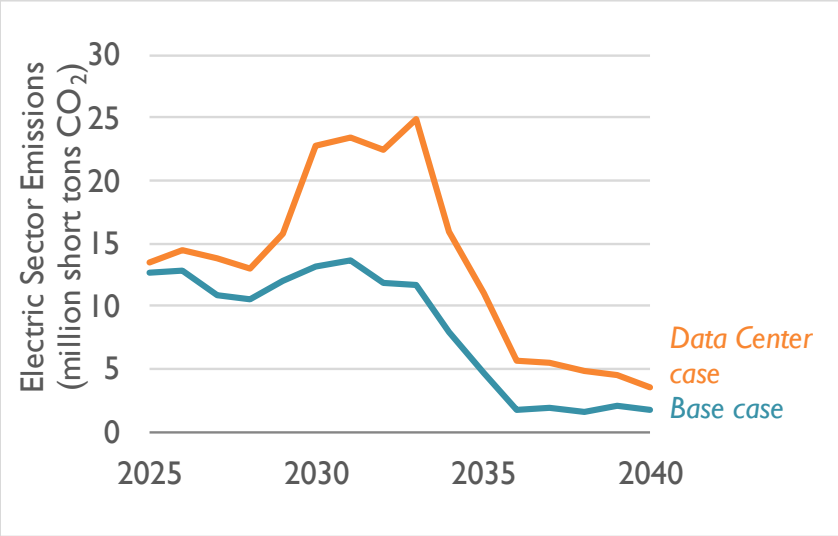
- The Ameren residential bill impacts (shown here) are estimates based on the assumptions that:
  - Data center load growth in Ameren territory is proportionally the same as assumed in the ComEd region.
  - Ameren experiences the same interconnection queue constraints that the ComEd region does.
  - Energy and capacity cost trends in Ameren are the same as those in the ComEd region.
- MISO's projection of data center load growth in Illinois, compared to historical load, is greater than PJM's projection. This could cause our analysis to under-estimate bill impacts.
- MISO is not experiencing the same magnitude of interconnection queue challenges as PJM. This could cause our analysis to over-estimate bill impacts.

Notes: We assume residential Ameren customers see the same % change in bills due to data center loads as residential customers in the ComEd region; On average, Ameren residential customers used 900 kWh of electricity per month in 2021-2023.

Data center loads increase CO_2 emissions

Over the study period, data center loads cause an increase of 84 million short tons (64%) of CO_2 emissions in the ComEd region of Illinois. 12 percent of this increase in CO_2 emissions is from new gas.

Figure 1. Modeled CO_2 emitted in the ComEd region



Notes: Emissions only include those produced from the electric power sector, from power plants located in the ComEd region of Illinois.

From 2025-2030:

- In the near term, data centers drive up existing gas generation, and subsequently, carbon dioxide emissions by 21 million short tons (a 29 percent increase).

From 2030-2040:

- Data center loads drive an increase in gas generation, resulting in increased CO_2 emissions.
- As the model constraints on building new gas start to loosen from 2031-2035 and eventually go away in 2036, the model adds 4.3 GW of new gas capacity in the Data Center case.

Climate and Equitable Jobs Act (CEJA):

- Among other elements, CEJA requires that (1) all gas-fired units retire by 2045, (2) gas plants cannot increase emissions above their 2018-2020 average and (3) all privately owned coal units retire by 2030.
- Our modeling does not explicitly include CEJA. However, due to other assumptions:
  - There is no privately owned coal remaining in the ComEd region in either case by 2034.
  - Gas plants in ComEd continue operating through 2040 (albeit at greatly reduced levels). Since our modeling period ends in 2040, we do not report on retirements that occur after 2040.
- If our modeling included CEJA, we expect that:
  - In the near term, existing gas outside of Illinois would likely ramp up generation to meet the ComEd load increases instead of gas within Illinois ramping up generation.
  - In the long term, less or no new gas would be built in Illinois. Instead, the model would build some combination of other resources to meet the ComEd load increases. Since the model is optimizing to reduce overall PJM system costs, these resources may be built in or outside of Illinois. They would likely include some combination of wind, solar, and batteries built in or out of Illinois, and gas built outside of Illinois.
- While including CEJA in this analysis may reduce the emissions impact in the ComEd region, the potential leakage of gas generation could shift emissions to other PJM states.

Range of potential rate and bill impacts

How much would data centers need to pay to offset their projected impacts on the residential sectors?

- We calculated the rate adders that data centers would need to pay to offset the increases in ComEd systemwide costs they are driving, in order keep other customers' rates at the same level as projected in the Base case.
- Average data centers rates would need to increase by 58% to avoid increasing costs for other customer classes in the ComEd region.
- Alternatively, data centers can meet their energy needs by building new and clean resources like solar or wind, including strategies that maximize on-site and behind-the-meter clean energy. These resources could mitigate the impact data centers have on electric system costs and resulting bill impacts to non-data center customers.

Table 1. Projected data center rates and cost adders required to mitigate bill increases for other customer classes in the ComEd region

	Unit	2025-2040
Projected data center rates	2022$/kWh	$0.07
Cost adder	2022$/kWh	$0.05
Adjusted data center rates	2022$/kWh	$0.12
Percent increase in rates	%	58%

Appendix

Illinois Tax Incentives & Other Considerations

- In 2023, Illinois provided $465 to 654 million in “tax benefits” to data centers, in tax exemptions or credits.[i]
  - In 2022, Illinois provided $94 to 467 million in tax benefits to data centers.[ii]
  - The Northlake Microsoft data center has a peak demand of 60 MW.[iii] This is up to $650,000 per MW in tax benefits.
- On a dollar per MWh basis, new solar and wind are about 40 percent the cost of new gas. The average cost of new solar and wind is about $30/MWh, while the average cost of new gas is $73/MWh.
- The ComEd system would need 7.4 GW of wind and solar to replace the incremental load that is otherwise met by gas in the Data Center case.[iv]

[i] The Illinois Department of Commerce estimates tax benefits to data centers to be about 10 percent of their investment commitment. By the end of 2023, data centers reported an average tax exemption value of 4 percent of their total investment. There were no claims for tax credits. See https://www.ilga.gov/reports/ReportsSubmitted/5069RSGAEmail10796RSGAAttach2023%20Data%20Centers%20Annual%20Report.pdf

[ii] By the end of 2022, data centers reported an average tax exemption value of 1.75 percent of their total investment. See https://dceo.illinois.gov/content/dam/soi/en/web/dceo/aboutdceo/reportsrequiredbystatute/dceo-data-center-investment-program-2022-annual-report-final.pdf

[iii] Data centers do not usually report their peak demands. It may be difficult to accurately determine the peak capacity of other data centers. See https://hillgrp.com/markets-we-serve/data-centers/northlake-data-center/ for the critical power capacity of the Northlake Microsoft data center.

[iv] This is a high-level calculation and does not include consider capacity or reliability requirements.

Project motivation, aims, and approach

Project motivation

- Across the country, data centers are driving a significant acceleration in load growth projections.
- Absent proactive planning and thoughtful policy intervention, this level of projected load growth has the potential to greatly increase emissions and raise energy costs for other ratepayers.

Aims

- To demonstrate the scale of the potential impacts, we analyzed the impacts of projected data center load growth in PJM through 2040.
- We examined the impacts of data center load growth on PJM system costs, CO_2 emissions, resource builds and dispatch, and average residential bills.

Approach

- We used capacity expansion modeling to conduct scenario analysis.
- We examined prospective future scenarios with and without data center load growth, absent any emissions mitigation strategies.
- This new analysis focuses on the detail behind the ComEd region in Illinois.

Modeled scenarios

Scenario Name	Goal	Description	Non-data center loads	Data center load	Clean energy costs	Environmental regulations
Base case	Provide a benchmark against which to assess the impacts of data center load growth	Examines a future without any new data center load growth	Ambitious electrification assumptions for EVs and buildings held constant across both scenarios	No new data center load beyond what exists in 2024	Based on NREL 2024 ATB Moderate case; a +25% cost adder is applied throughout the model period to reflect supply chain constraints	Environmental control costs associated with finalized EPA air pollution regulations included in both scenarios
Data Centers case	Understand impact of data center load growth, absent emissions mitigation interventions	Examines a future that includes projected data center load growth		Projections for new data center load are based on data from PJM and EPRI Includes 29 TWh of additional data center load in the ComEd region by 2040		

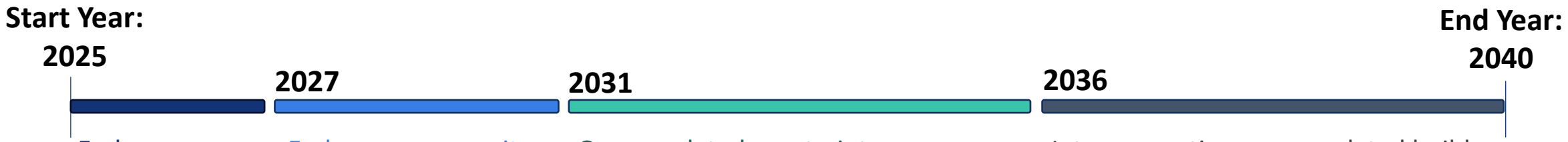
Methods: EnCompass model & topology

About EnCompass:

- EnCompass is an optimization-based power systems model for utility-scale generation planning and operations analysis.
- EnCompass covers all facets of power system planning including short- and long-term unit commitment, economic dispatch decisions, environmental compliance, and market price forecasting for energy, capacity, and environmental programs.
- EnCompass provides unit-specific, detailed forecasts of the composition, operations, and costs of the regional generation fleet given the assumptions described in this document.
- Synapse populated the model using the *EnCompass National Database*, created by Horizons Energy.
- More information on EnCompass and the Horizons dataset can be found at *https://www.yesenergy.com/encompass-power-system-planning-software*.

Modeled regions	• PJM split into 10 subzones • Regions within PJM can dynamically exchange energy with each other
Imported energy	• Energy imports allowed from MISO, TVA, the Carolinas, Canadian ISOs, and NYISO
Existing transmission	• Transmission constraints modeled using latest data published by PJM
New transmission	• New transmission can dynamically be built starting in 2027 • Costs based on data from **NREL's ReEDS model**

PJM interconnection queue assumptions



Endogenous capacity builds not allowed

Resources with commercial operation dates modeled exogenously

Endogenous capacity builds allowed based on data from PJM's interconnection queue; selectable resources include solar, onshore wind, lithium-ion batteries, and gas.

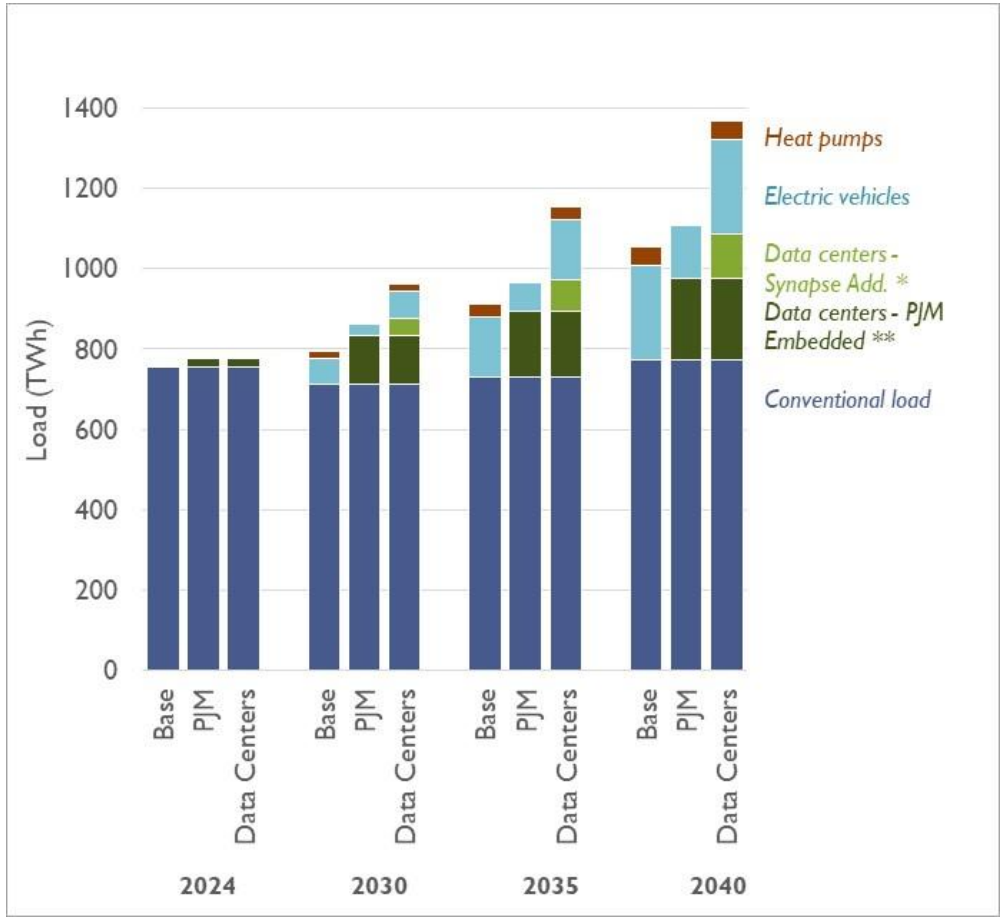
Queue-related constraints are increasingly loosened (representing gradual improvements to the PJM queue and local permitting processes)

Interconnection queue-related build constraints are removed, and endogenous capacity builds are driven by economics and resource potentials

Model can now select endogenous offshore wind and long-duration storage resources

Load components

Figure 1. Load Components in Synapse Base case, PJM 2024 Load Forecast, and Synapse Data Centers cases

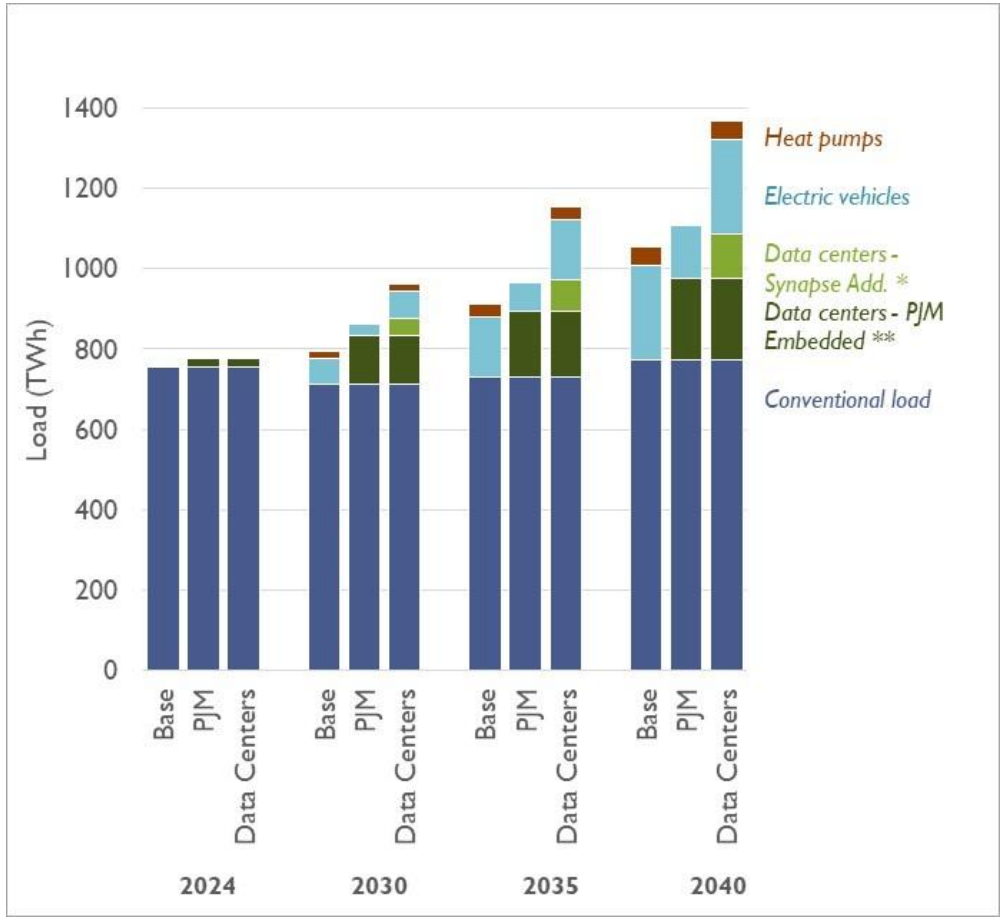


** Refers to Synapse's additional projected data center load above PJM's 2024 forecast.*
*** Refers to the data center load adjustments included in PJM's 2024 forecast.*

- **PJM's load forecast** incudes conventional load, electric vehicle projections, and data centers load adjustments from utilities.
  - All PJM data is from *PJM's January 2024 Load Forecast*
- **Synapse's Base case load** uses PJM's conventional load forecast and Synapse's projections for electric vehicles and heat pumps adoption (further details on Synapse's electrification assumptions are on the next slide). The Base case load also includes energy consumption by existing data centers, embedded within the PJM conventional load component.
- **Synapse's Data Centers load** uses the same projections for load components that are shared with the Base case load and described above. In addition, it includes Synapse's projections for new data center load in PJM, based on 2024 data from EPRI and PJM utilities.
  - This analysis was performed approximately 10 months after the release of *PJM's January 2024 Load Forecast*. Since then, updated information has become available regarding projected data center load growth.
  - Compared to PJM's 2024 forecast, Synapse's Data Center scenario load forecast includes an additional:
    - +44 TWh of data center load in 2030
    - +77 TWh of data centers load in 2035
    - +109 TWh of data centers load in 2040
  - By 2040, total annual energy consumption in Synapse's Data Center load scenario reaches 1,435 TWh, compared to PJM's forecast of 1,176 TWh.

Load components

Figure 1. Load Components in Synapse Base case, PJM 2024 Load Forecast, and Synapse Data Centers cases



** Refers to Synapse's additional projected data center load above PJM's 2024 forecast.*
*** Refers to the data center load adjustments included in PJM's 2024 forecast.*

PJM's load forecast

- Incudes conventional load, electric vehicle projections, and data centers load adjustments from utilities.
- All PJM data is from *PJM's January 2024 Load Forecast*

Synapse's Base case load

- Uses PJM's conventional load forecast and Synapse's projections for electric vehicles and heat pumps adoption (further details on Synapse's electrification assumptions are on the next slide). Base case load also includes energy consumption by existing data centers, embedded within the PJM conventional load component.

Synapse's Data Centers load

- Uses the same projections for load components that are shared with the Base case load and described above. Includes Synapse's projections for new data center load in PJM, based on 2024 data from EPRI and PJM utilities.
- Analysis performed approximately 10 months after the release of *PJM's January 2024 Load Forecast*. Since then, updated information has become available regarding projected data center load growth.
- Compared to PJM's 2024 forecast, Synapse's Data Center scenario load forecast includes an additional:
  - +44 TWh of data center load in 2030
  - +77 TWh of data centers load in 2035
  - +109 TWh of data centers load in 2040
- By 2040, total annual energy consumption in Synapse's Data Center load scenario reaches 1,435 TWh, compared to PJM's forecast of 1,176 TWh.

Key load input assumptions

Category	Details	Annual energy data source	Load shape data source
Conventional Load	PJM's forecast includes projections for conventional load growth and adjustments for weather and efficiency. PJM does not include heat pump load and only small EV load increases. Existing data center load is included within PJM's conventional load forecast.	PJM January 2024 Load Forecast	Horizon's National Database
Building electrification	We assume that all states reach a heat pumps sales market share of 99.9% by 2030 for residential and commercial sectors for both space and water heating.	Building Decarbonization Calculator (BDC)	NREL's ReStock and ComStock
Electric vehicles	We assume that MD, NJ, and other northeast states reach 99% light-duty EV sales by 2030; All other PJM states reach 85.5% light-duty EV sales by 2030; All states reach 60% medium- and heavy-duty vehicle sales by 2030.	Electric Vehicle Regional Emissions and Demand Impacts (EV-REDI)	DOE's EVI-Pro Lite tool
Distributed solar	Distributed solar resources are modeled on the supply side.	PJM January 2024 Load Forecast	Horizon's National Database
Energy efficiency	Not modeled in PJM since energy efficiency efforts have been relatively weak.	N/A	N/A
New data centers	New data center load is only included in the Data Centers case. Synapse's data center load forecast is based on current data center usage in PJM states (from EPRI, 2024), escalated using an annual growth rate trajectory that is consistent with Dominion's most recent projections of data center load growth. We assume a high utilization factor for data center load, with a relatively flat and inflexible shape.	EPRI's 2024 data center load forecast for PJM states & Dominion's annual data center load growth rate	ComStock hourly annual load for VA Large Office with Data Center building type & load type Electrical Total

All load components except for new data centers are held constant across scenarios.

Other key input assumptions

Fuel prices

- Henry Hub prices based on NYMEX data (up-to-date through July 2024) for near-term prices. Long-term prices were based on EIA's 2023 Annual Energy Outlook (AEO).
- Oil and coal prices based on EIA's 2023 AEO.

New resources

- The moderate cost trajectory from NREL Annual Technology Baseline 2024 is used for utility-scale solar, battery storage, onshore and offshore wind resources. A cost adder of +25% was also included to represent costs associated with supply chain constraints. All new clean energy resources are eligible for either the IRA Production or Investment Tax Credits.
- New gas plants must comply with EPA's finalized greenhouse gas emissions regulations under Section 111 of the Clean Air Act. Starting in 2032, new gas CCs can either take the 40% capacity factor cap or install CCS systems with 90 percent CO_2 removal rate. CCS capital expenditures, along with fixed and variable operations costs are sourced from Sargent & Lundy's January 2024 report prepared for EIA.
- Geothermal and SMRs were not included as selectable resource options.

Existing resources

- All fossil plants are allowed to economically retire beginning in 2027.
- Coal plants are assumed to follow the 111(d) compliance pathways that are consistent with their currently announced retirement dates. Coal plants with announced retirement dates after January 1, 2039, must install CCS controls on January 1, 2032. Coal plants with retirement dates after 2032 but before 2039 must co-fire with gas by 2030.
- Environmental compliance costs associated with finalized EPA regulations for criteria air pollutants are also included.

Policies

- Modeled RGGI for 10 participating states. Assume Virginia re-enters in RGGI and Pennsylvania is not a participating state.
- We incorporated the Virginia Clean Energy Act's (VCEA) renewable portfolio standard targets.
- All other existing state RPS policies are also modeled.
- All RECs consumed in PJM are produced in PJM.

Data centers are projected to cause annual energy consumption and peak load in the ComEd region to increase

Figure 1. ComEd region annual load (TWh)

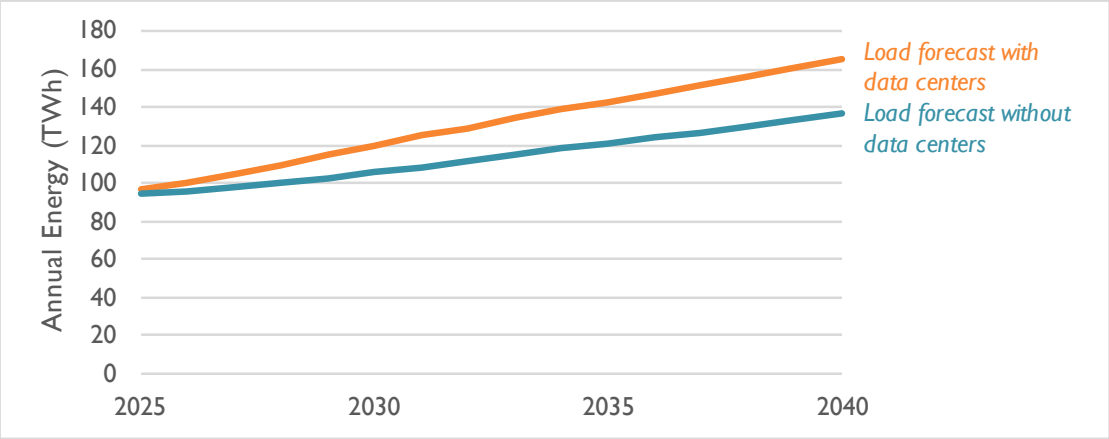
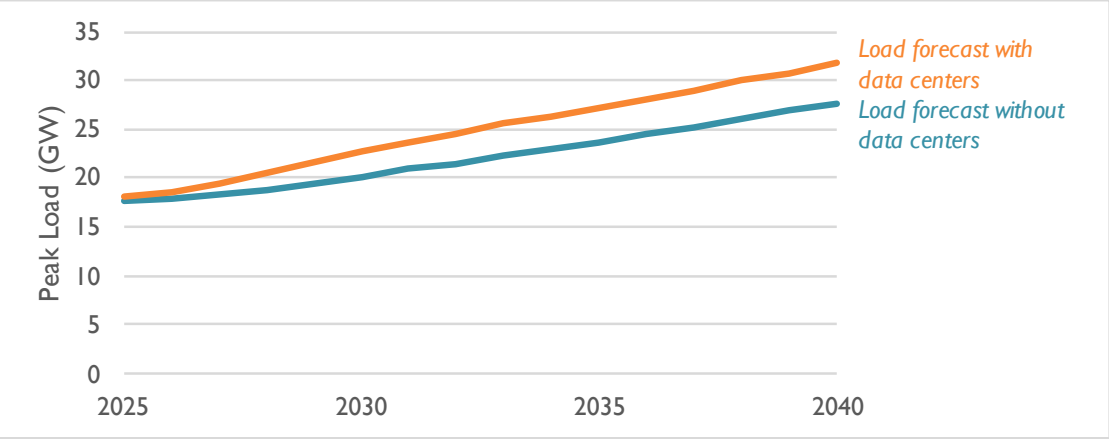


Figure 2. ComEd region peak load (GW)



- Relative to the Base case, by 2040, data centers in the ComEd region are projected to cause:
  - Peak load to increase by 4 GW (+15%)
  - Annual energy to increase by 29 TWh (+21%)
- **Conventional loads + electrification:**
  - Both scenarios utilize conventional loads from PJM, and include ambitious heat pump and EV trajectories created by Synapse
- **Data centers:**
  - The data center load forecast is based on the best available data at the time of modeling: data center usage in the ComEd region (from EPRI, 2024), escalated using an annual growth rate trajectory that is consistent with Dominion's most recent projections of data center load growth.
  - PJM's 2025 load forecast estimates that there will be 34 TWh of data center load in ComEd by 2040. Furthermore, ComEd most recently described having 14 GW (estimated to be about 105 TWh) of data center projects in their queue.