Economic Impacts of Relicensing the Quad Cities Clean Energy Center

PRESENTED BY

Dean Murphy

Wonjun Chang

PREPARED FOR

Constellation Energy Generation, LLC.

MAY 2026

Brattle

Overview

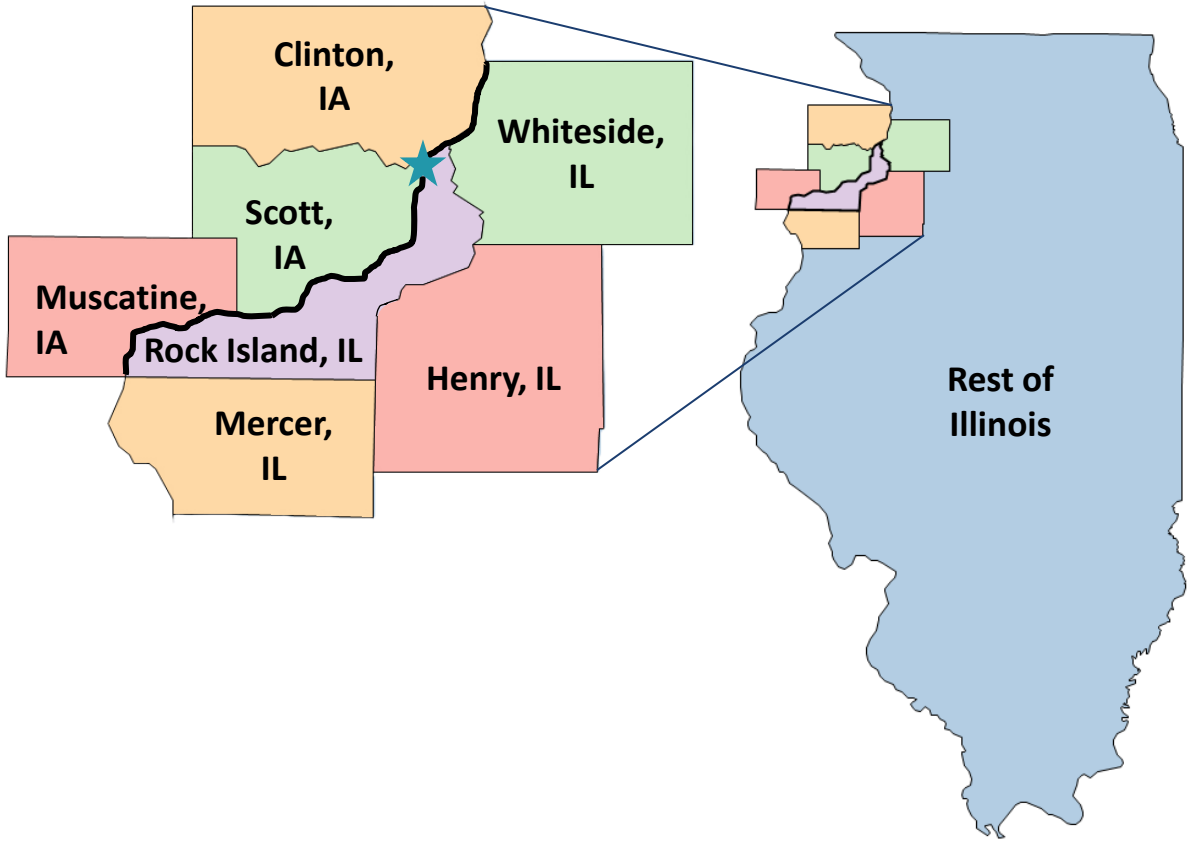
Project Overview

We examine the macroeconomic and power sector impacts of relicensing the **Quad Cities Clean Energy Center (QCCEC)** in Illinois. The analysis focuses on Rock Island county (where the plant is located) as well as neighboring Illinois and Iowa counties, and the rest of Illinois.

Our analysis answers the following questions:

- What are the impacts of relicensing QCCEC on the power sector, including electricity prices and emissions?
- What are the regional economic impacts, including GDP, employment and industrial production, across Rock Island county and surrounding Illinois/Iowa counties, as well as the rest of Illinois?

Map of Study Region



Relicensing QCCEC: Economy-Wide Benefits in Study Region[1]

Relicensing QCCEC in 2032 would result in:

$21 Billion Cumulative Contribution to GDP[2]

Heavily concentrated in the seven counties surrounding QCCEC.
Net GDP impact is positive in all years.

1,439 Jobs Supported in the Study Region

792 direct jobs at the plant.
Plus 647 additional jobs (avg, 2033-2050) in IL & adjacent IA counties.

$4.6 Billion Preserved in Estimated Tax Revenue

$1.1 billion in state tax revenue in Illinois and adjacent IA counties.
$3.5 billion in federal tax revenue.

Notes: Dollar values are undiscounted nominal dollars.
[1] The study region modeled includes all of Illinois, plus the three adjacent counties in Iowa: Muscatine, Scott, and Clinton Counties.
[2] $14.4 billion of the GDP impact occurs within Illinois and the remaining $6.3 billion occurs within the three adjacent Iowa counties.

Relicensing QCCEC: Economy-Wide Benefits in Illinois

Relicensing QCCEC in 2032 would result in:

$14 Billion Cumulative Contribution to Illinois GDP

Heavily concentrated in the four IL counties surrounding QCCEC.

979 Jobs Supported in Illinois

792 direct jobs at the plant.

Plus 187 additional jobs (average, 2033-2050) in IL.

$3.2 Billion Preserved in Estimated Tax Revenue

$0.8 billion in state tax revenue in Illinois.

$2.4 billion in federal tax revenue.

Notes: Dollar values are undiscounted nominal dollars.

Relicensing QCCEC: Economy-Wide Benefits in Adjacent IA Counties

Relicensing QCCEC in 2032 would result in:

$6 Billion Cumulative GDP Contribution

Net GDP impact in these counties is positive in all years.

459 Jobs Supported in Adjacent Iowa Counties

On average from 2033-2050 in Muscatine, Scott, and Clinton Counties.
This does not include QCCEC jobs held by IA residents.

$1.4 Billion Preserved in Estimated Tax Revenue

$0.3 billion in state tax revenue in Iowa.
$1.1 billion in federal tax revenue.

Notes: Dollar values are undiscounted nominal dollars.
Scope of economic impacts reported here includes only Muscatine, Scott, and Clinton Counties in Iowa.
QCCEC jobs held by IA residents are included as Illinois jobs, and do not contribute to measured employment impacts in adjacent Iowa counties.
Reported state and federal tax revenue impacts are in the surrounding Iowa counties included in the study region only, excluding the rest of Iowa.

Power Sector Benefits of Relicensing QCCEC in 2032

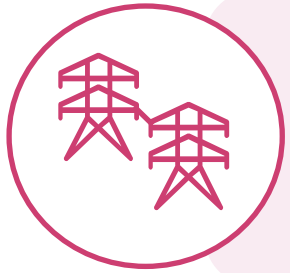
Extending QCCEC's license would also:

Prevent Over 88 Million Metric Tons (MMT) of Emissions in PJM & MISO through 2050

QCCEC reduces annual emissions by 4.8 MMT on average, offsetting around 93% of Chicago's annual on-road vehicle emissions (or ~1 million light duty vehicles).[1]

Increase Flexibility and Accelerate Progress Towards Meeting Clean Energy and Emissions Goals

QCCEC accounts for 12% of Illinois' annual electricity demand.
Its annual generation is equivalent to ~55% of in-state wind & solar generation.[2]



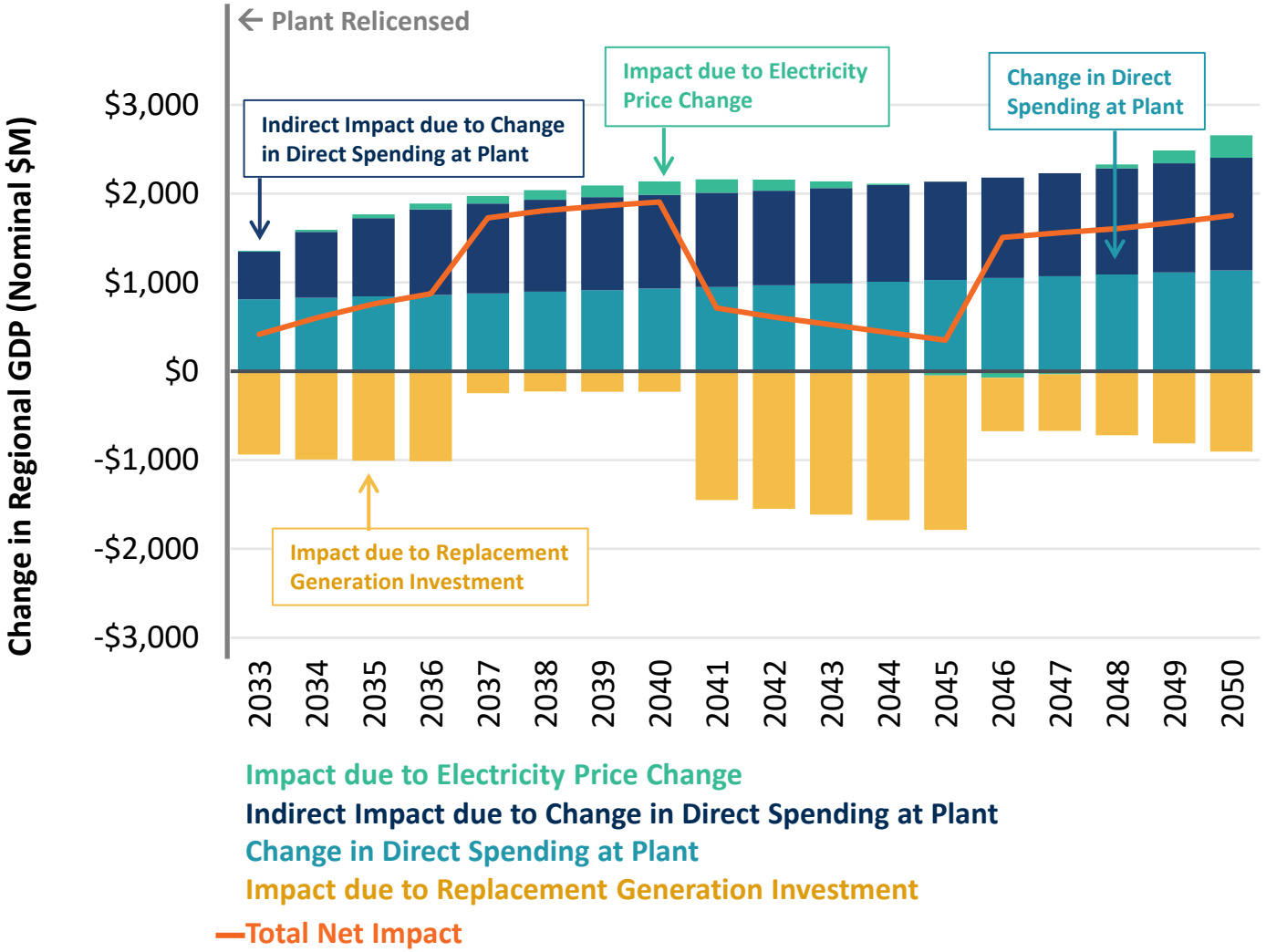
Provide Reliable, Baseload Supply, Reducing the Challenge of Meeting Growing Electricity Demand

QCCEC license renewal will provide enough energy to offset around 50% of the output of the existing coal plants that are expected to retire under state policy.[3]

Notes:
[1] 4.8 MMT is the average emissions reduction between 2033-2050. On-road vehicles produced 5.11 MMT of GHG emissions in Chicago in 2022 (Regional GHG Emissions Inventory); emissions offset is equivalent to ~1 million light-duty vehicles (LDVs) (EPA GHG Emissions).
[2] QCCEC produces about 15.6 TWh/year; 2024 retail electricity sales were 133 TWh; 2024 in-state wind and solar generation was 28 TWh (EIA State Electricity Profile).
[3] Scheduled plant closures will result in 31 TWh of annual coal generation losses (IL Department of Labor).

QCCEC Relicensing Impact on GDP in Study Region

GDP Impact



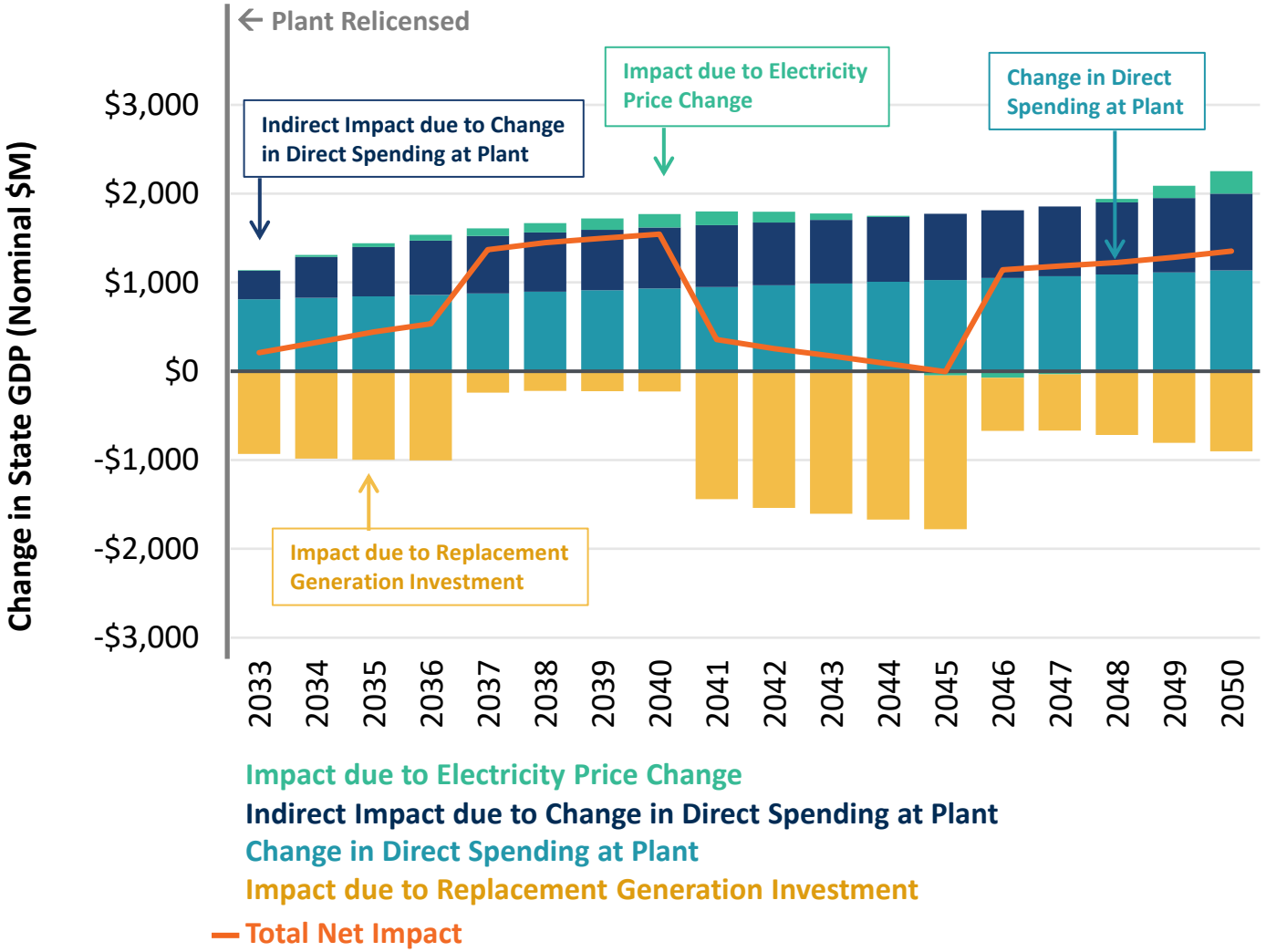
Key Observations

- Positive GDP impacts are driven primarily by plant expenditures and employment that occur with relicensing the Quad Cities plant.
- Relicensing Quad Cities would also result in lower electricity prices on average, saving ratepayers $6.8 billion by 2050 and further creating positive GDP impacts through increased consumption.
- These positive GDP impacts are partially offset by foregone investment in additional generation resources that would be needed if Quad Cities were to retire.
- GDP impacts are also strongly positive in the three Iowa counties neighboring QCCEC.

Notes: The study region includes all of Illinois as well as Muscatine, Scott, and Clinton Counties in Iowa.

QCCEC Relicensing Impact on Illinois GDP

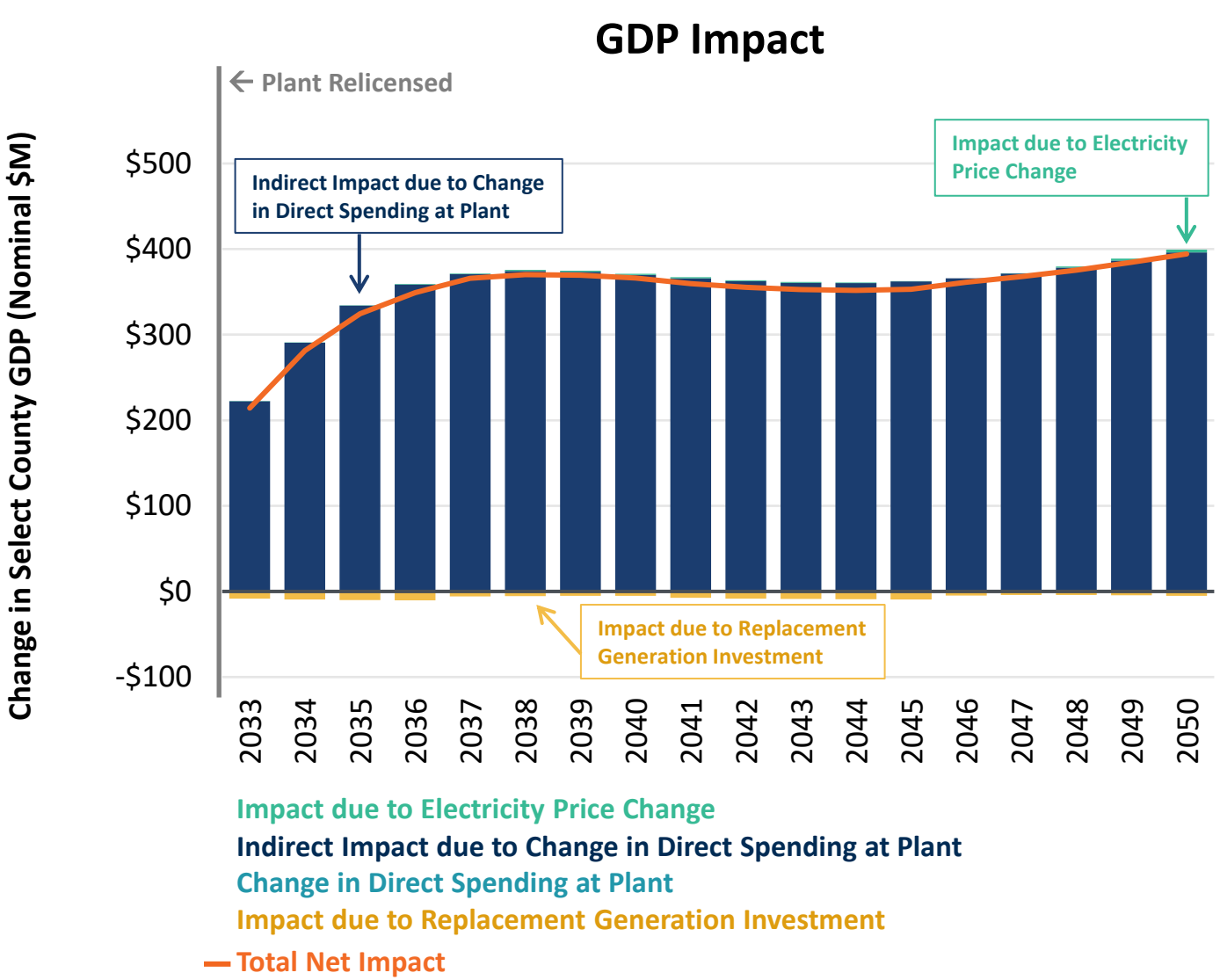
GDP Impact



Key Observations

- Positive GDP impacts are driven primarily by plant expenditures and employment that occur with relicensing the Quad Cities plant.
- Relicensing Quad Cities would also result in lower electricity prices on average, saving ratepayers $6.7 billion by 2050 and further creating positive GDP impacts through increased consumption.
- These positive GDP impacts are partially offset by foregone investment in additional generation resources that would be needed if QCCEC were to retire.

QCCEC Relicensing Impact on GDP in Adjacent IA Counties

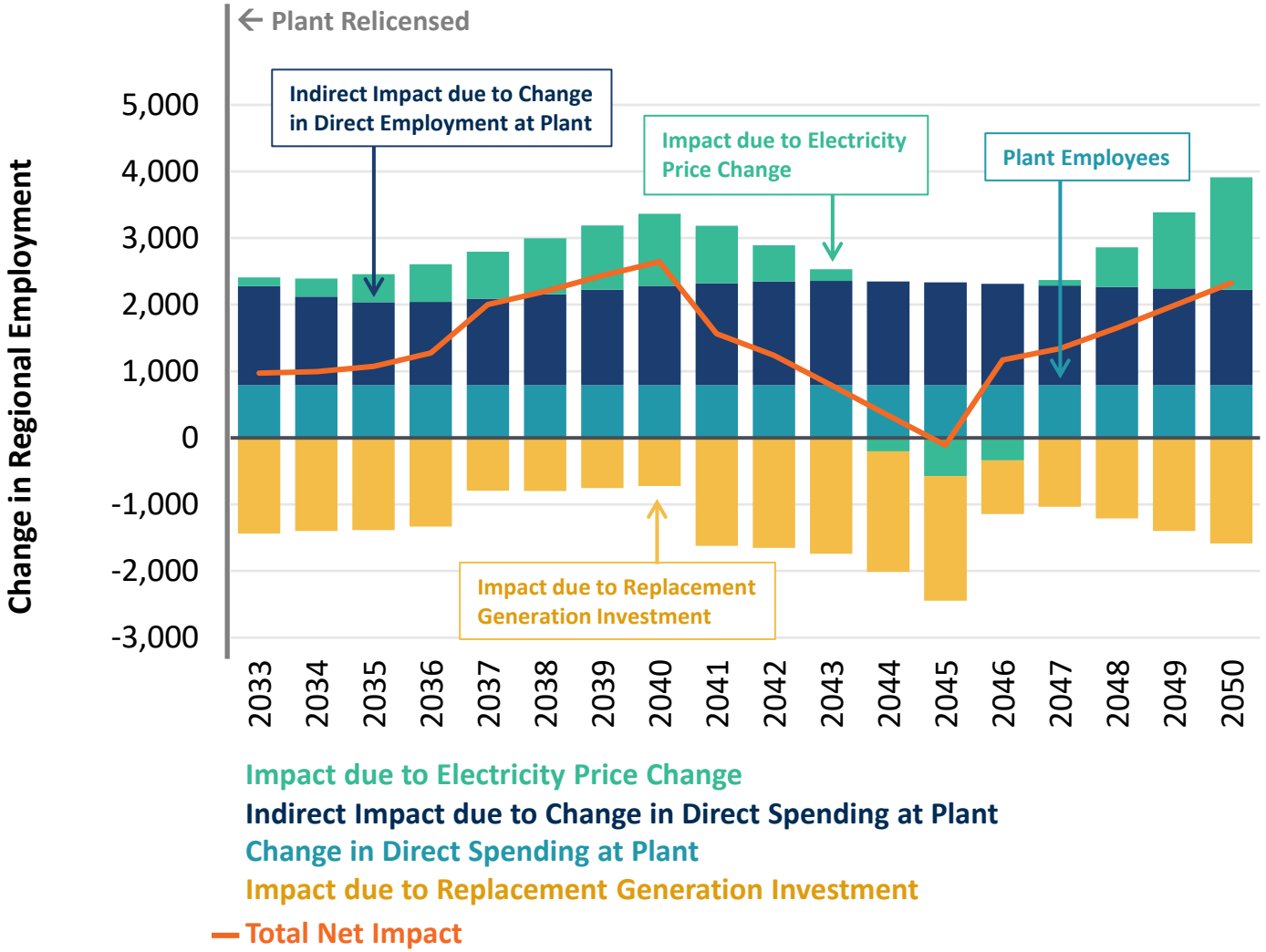


Key Observations

- Positive GDP impacts are driven primarily by the indirect impacts of plant expenditures and employment that occur with relicensing the Quad Cities plant.
- Relicensing Quad Cities would also result in lower electricity prices on average, saving ratepayers in the adjacent counties $100 million by 2050 and further creating positive GDP impacts through increased consumption.
- The offsetting impact of foregone investment in additional generation resources is minimal in Muscatine, Scott, and Clinton Counties.

QCCEC Relicensing Impact on Employment in Study Region

Employment Impact



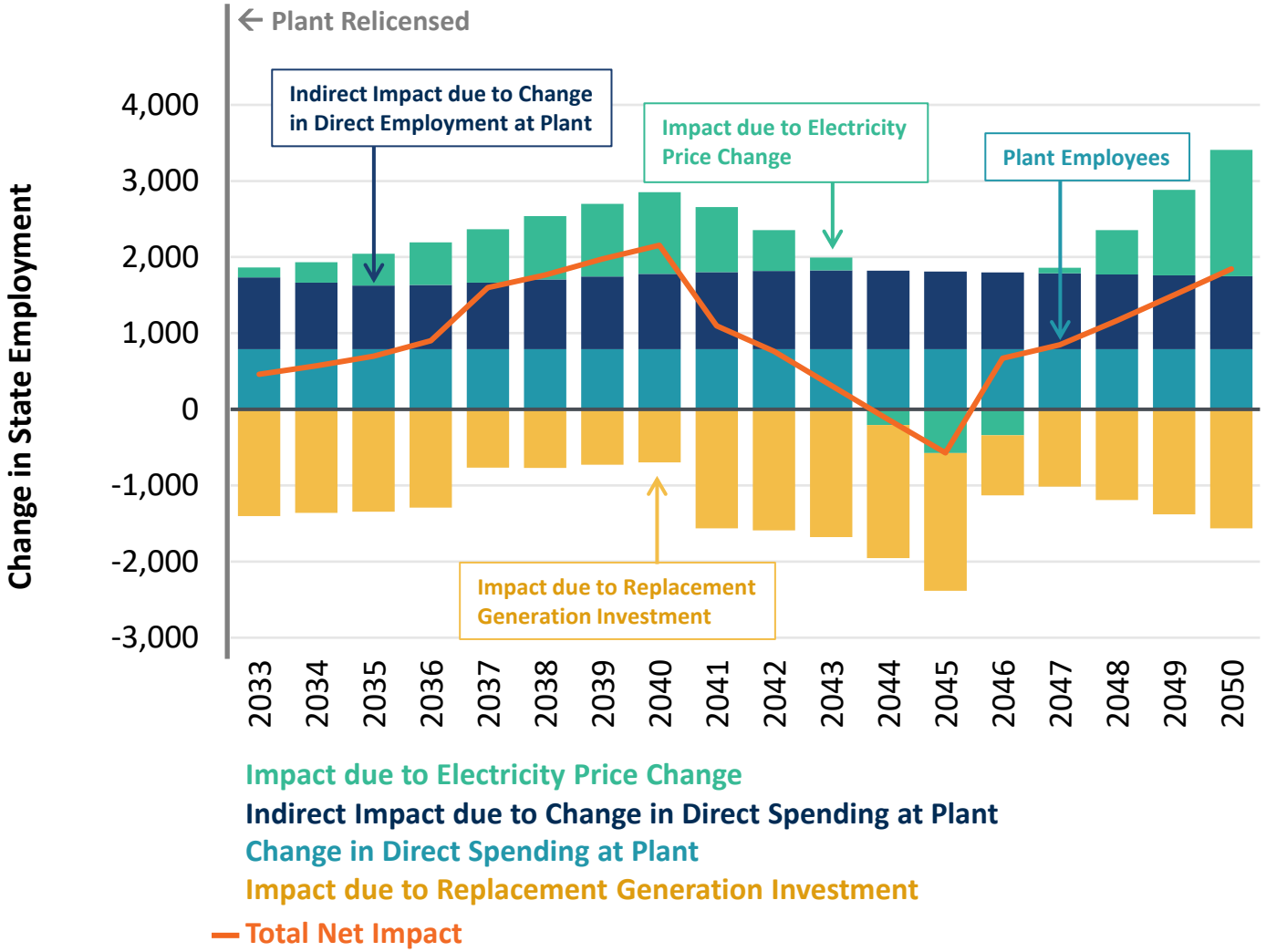
Key Observations

- Positive employment impacts are driven primarily by the direct employment at Quad Cities, plus indirect employment supported by plant spending.
- Employment impacts are more sensitive to electricity price changes than GDP, as lower prices lead to increased spending on wages.
- Positive employment impacts of relicensing are partially offset by foregone investment in replacement generation resources.
- Net of this offset, relicensing Quad Cities creates an additional 1,439 jobs on average.
- Employment impacts are also strongly positive in the three Iowa counties neighboring Quad Cities.

Notes: The study region includes all of Illinois as well as Muscatine, Scott, and Clinton Counties in Iowa.

QCCEC Relicensing Impact on Illinois Employment

Employment Impact

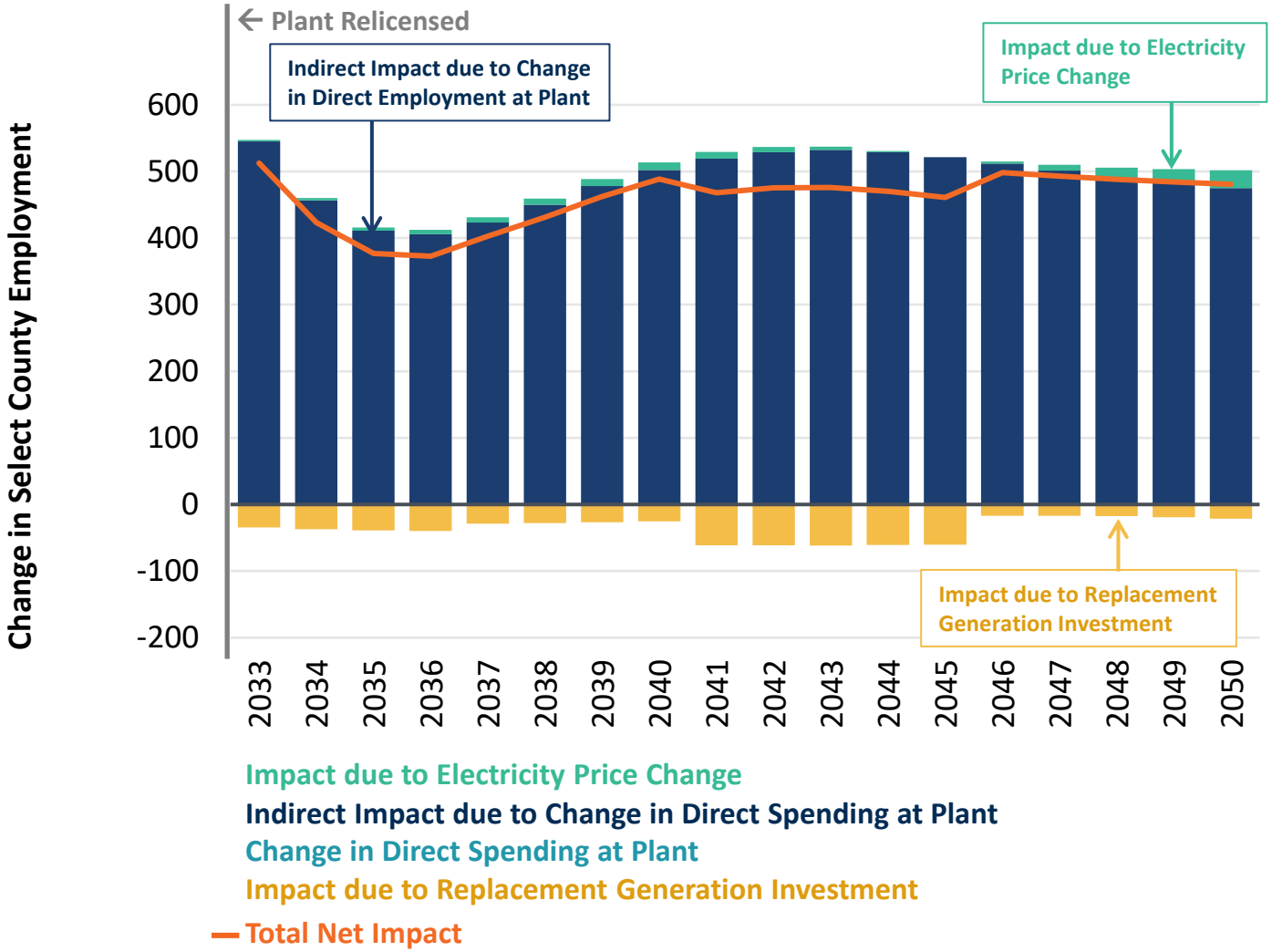


Key Observations

- Positive employment impacts are driven primarily by the direct employment at Quad Cities, plus indirect employment supported by plant spending.
- Employment impacts are more sensitive to electricity price changes than GDP, as lower prices lead to increased spending on wages.
- Positive employment impacts of relicensing are partially offset by foregone investment in replacement generation resources.
- Net of this offset, relicensing Quad Cities creates an additional 979 jobs on average.

QCCEC Relicensing Employment Impact in Adjacent IA Counties

Employment Impact

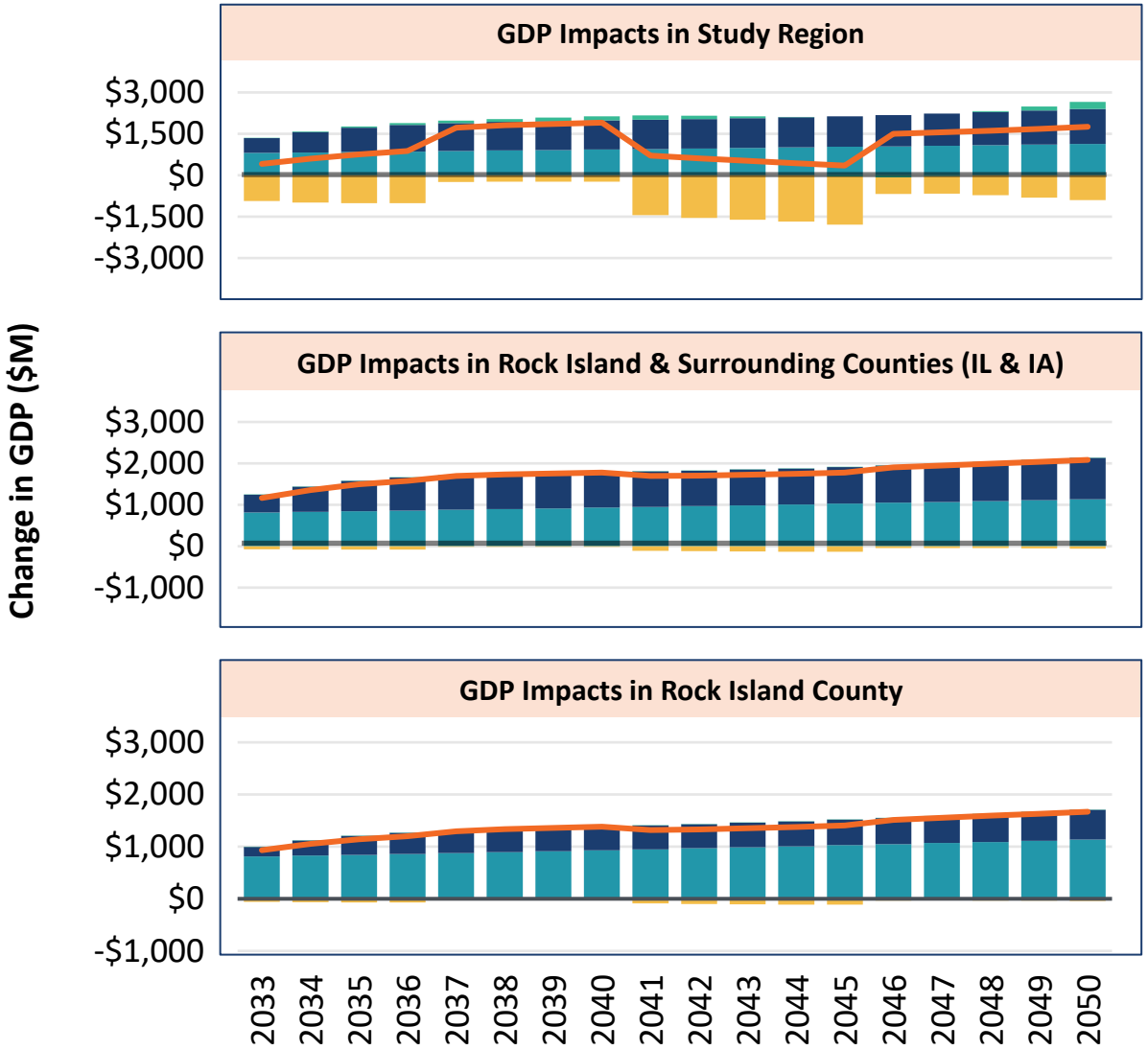


Key Observations

- Positive employment impacts are driven primarily by indirect employment supported by plant spending.[1]
- Employment impacts are more sensitive to electricity price changes than GDP, as lower prices lead to increased spending on wages.
- Positive employment impacts of relicensing are partially offset by foregone investment in replacement generation resources.
- Net of this offset, relicensing Quad Cities creates an additional 459 jobs on average.

[1] The positive employment impact does not include jobs at the plant held by Iowa residents; those are accounted for as Illinois jobs.

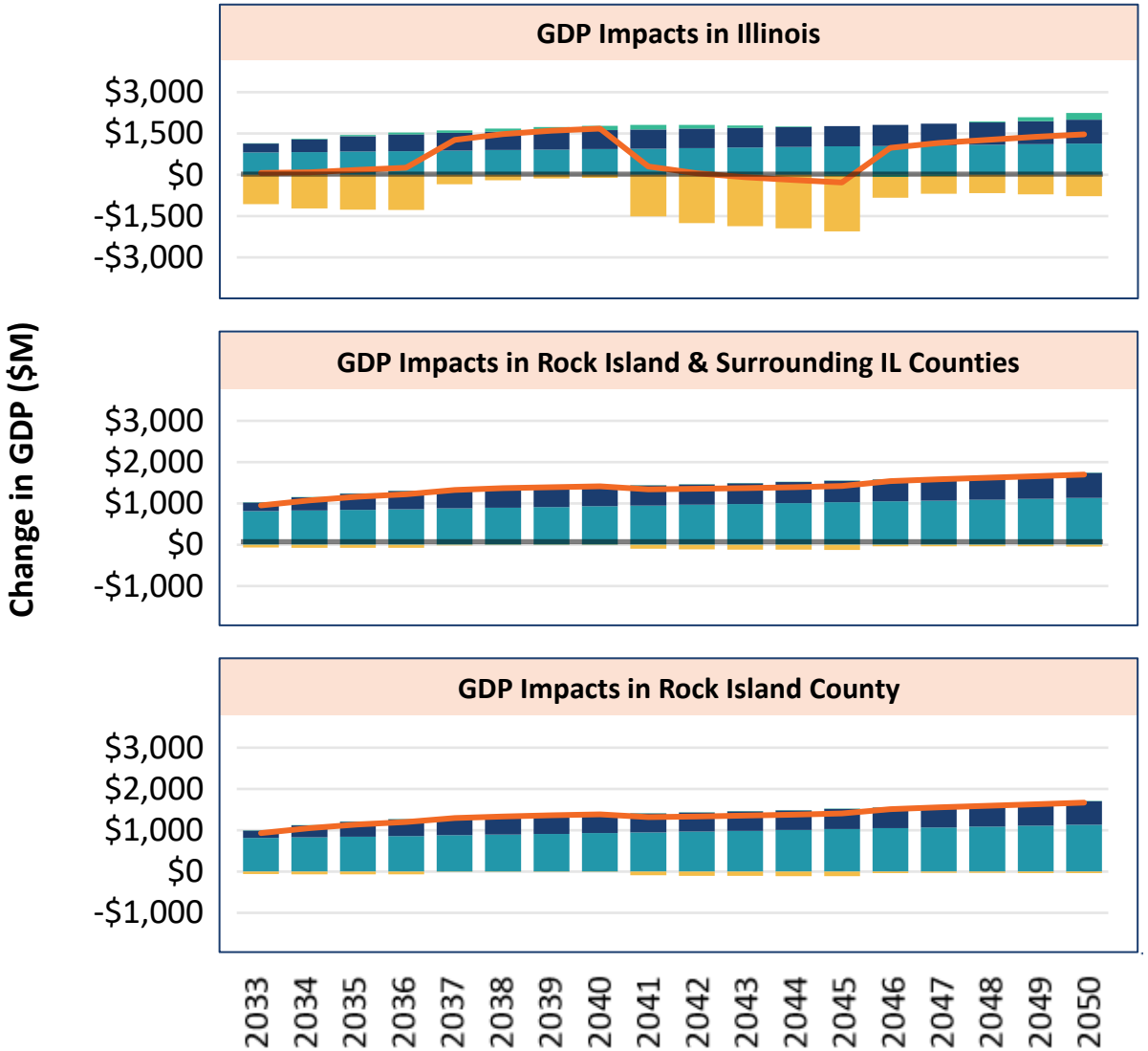
GDP Impacts are Highly Localized – Full Study Region



- The positive GDP impacts of QCCEC relicensing (orange line) greatly benefit Rock Island and surrounding counties, as increased economic activity due to plant spending (teal and navy) is concentrated in the counties surrounding the plant.
- Foregone investments in generation resources that would replace QCCEC (yellow) do not fully offset the positive impacts. This is especially true in Rock Island and surrounding counties.
  - Benefits are localized, but offsetting activity is not.

Impact due to Electricity Price Change
Indirect Impact due to Change in Direct Spending at Plant
Change in Direct Spending at Plant
Impact due to Replacement Generation Investment
Total Net Impact

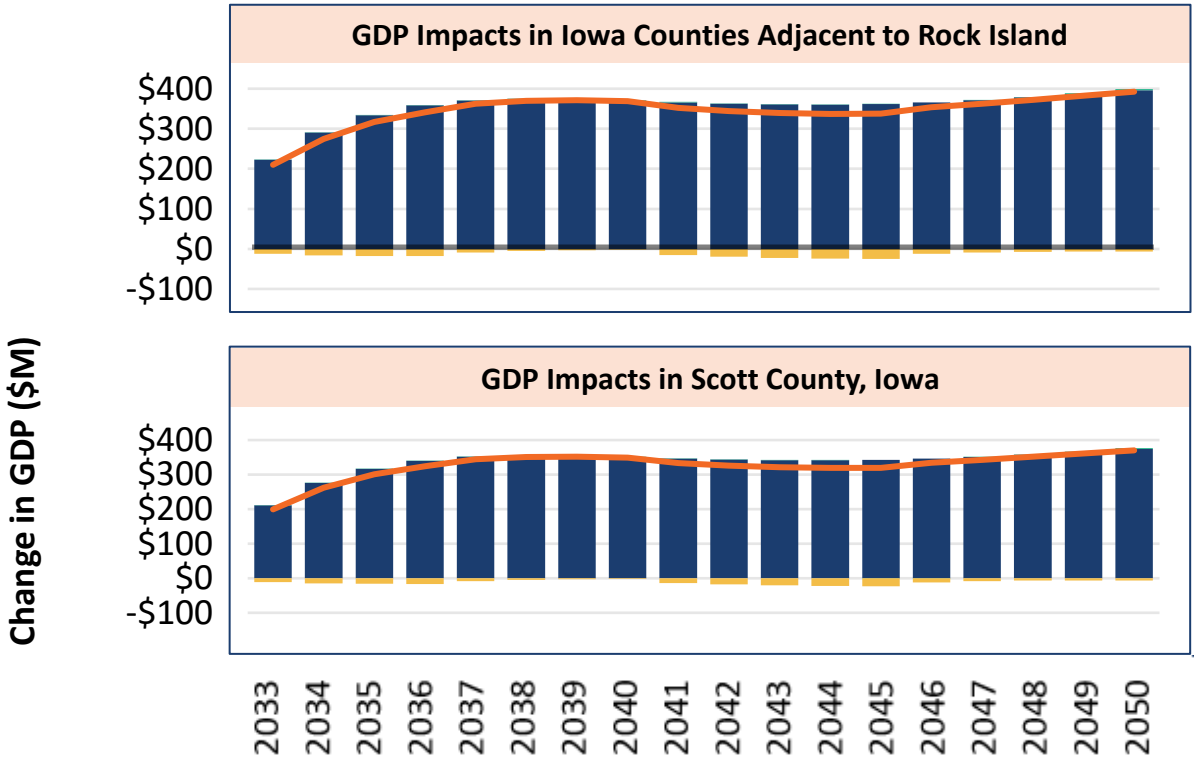
GDP Impacts are Highly Localized – Illinois Only



- The positive GDP impacts of QCCEC relicensing (orange line) greatly benefit Rock Island and surrounding IL counties, as increased economic activity due to plant spending (teal and navy) is concentrated in the counties surrounding the plant.
- Foregone investments in generation resources that would replace QCCEC (yellow) do not fully offset the positive impacts. This is especially true in Rock Island and surrounding IL counties.
  - Benefits are localized, but offsetting activity is not.

Impact due to Electricity Price Change
Indirect Impact due to Change in Direct Spending at Plant
Change in Direct Spending at Plant
Impact due to Replacement Generation Investment
Total Net Impact

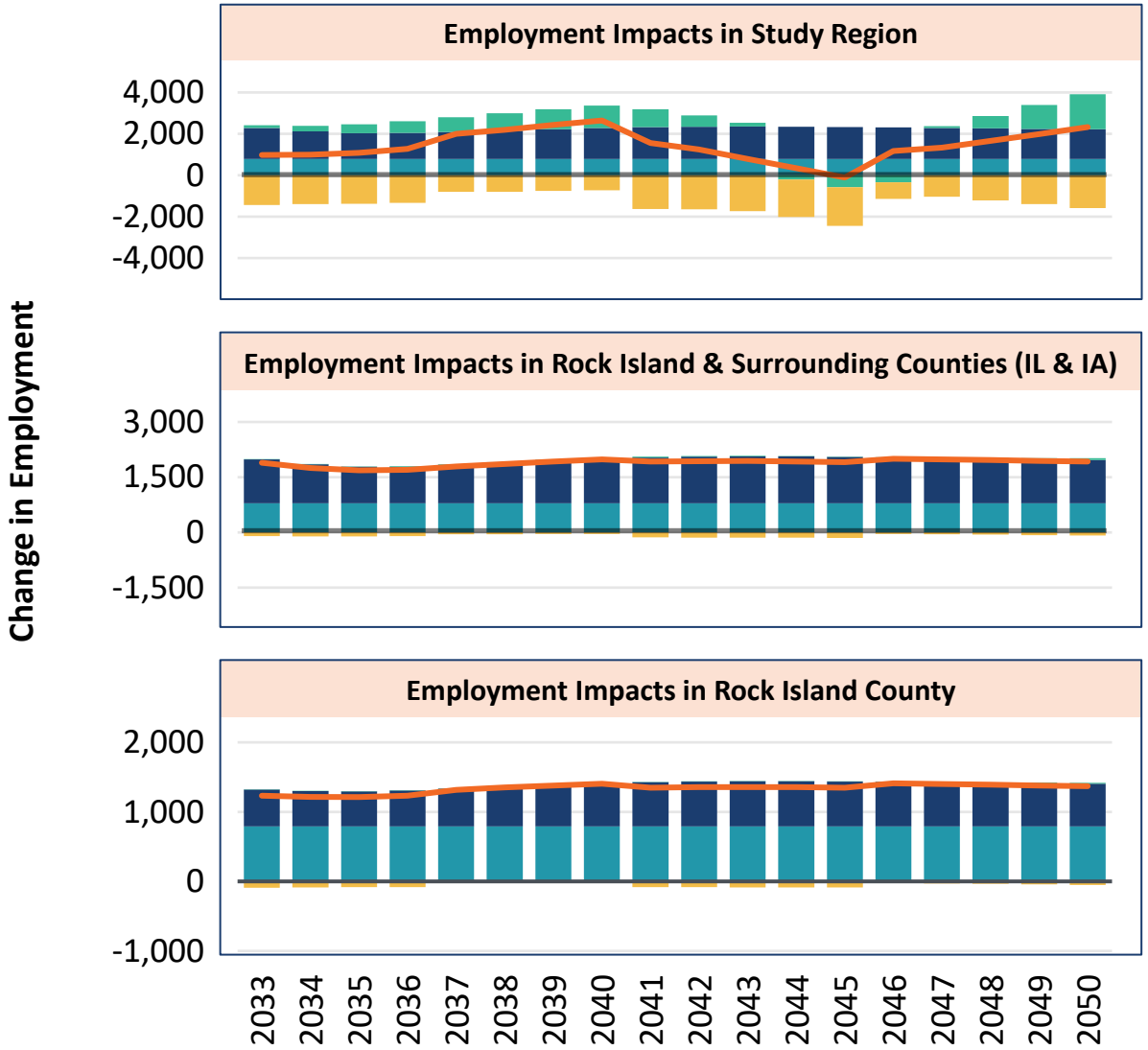
GDP Impacts are Highly Localized – Iowa Counties Only



- Direct spending at QCCEC leads to indirect economic benefits in the three modeled Iowa counties, with impacts concentrated in Scott County, which neighbors Rock Island, IL.
- Foregone investments in additional generation resources needed to replace QCCEC would be widely distributed, largely in Illinois, and thus offer little offset to the added economic activity from plant relicensing.

Impact due to Electricity Price Change
Indirect Impact due to Change in Direct Spending at Plant
Change in Direct Spending at Plant
Impact due to Replacement Generation Investment
— Total Net Impact

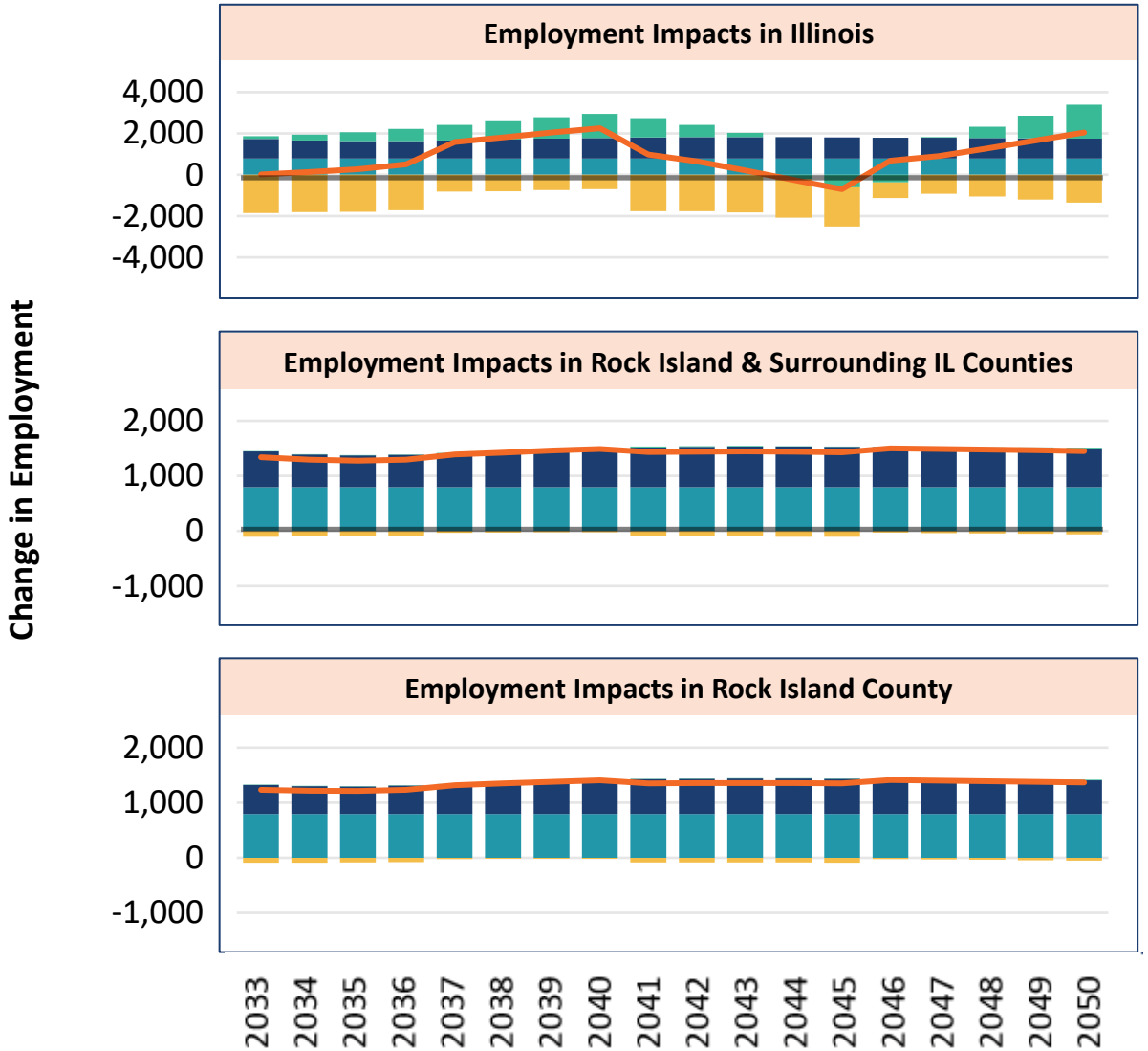
Employment Impacts also Highly Localized – Full Study Region



- The positive employment impacts of QCCEC relicensing are concentrated in the six surrounding counties.
  - Virtually all the direct employment is local; so is much of the indirect employment supported by spending at the plant.
- Foregone investments in generation resources that would replace Quad Cities are spread widely and thus do little to offset the local concentration of other impacts.

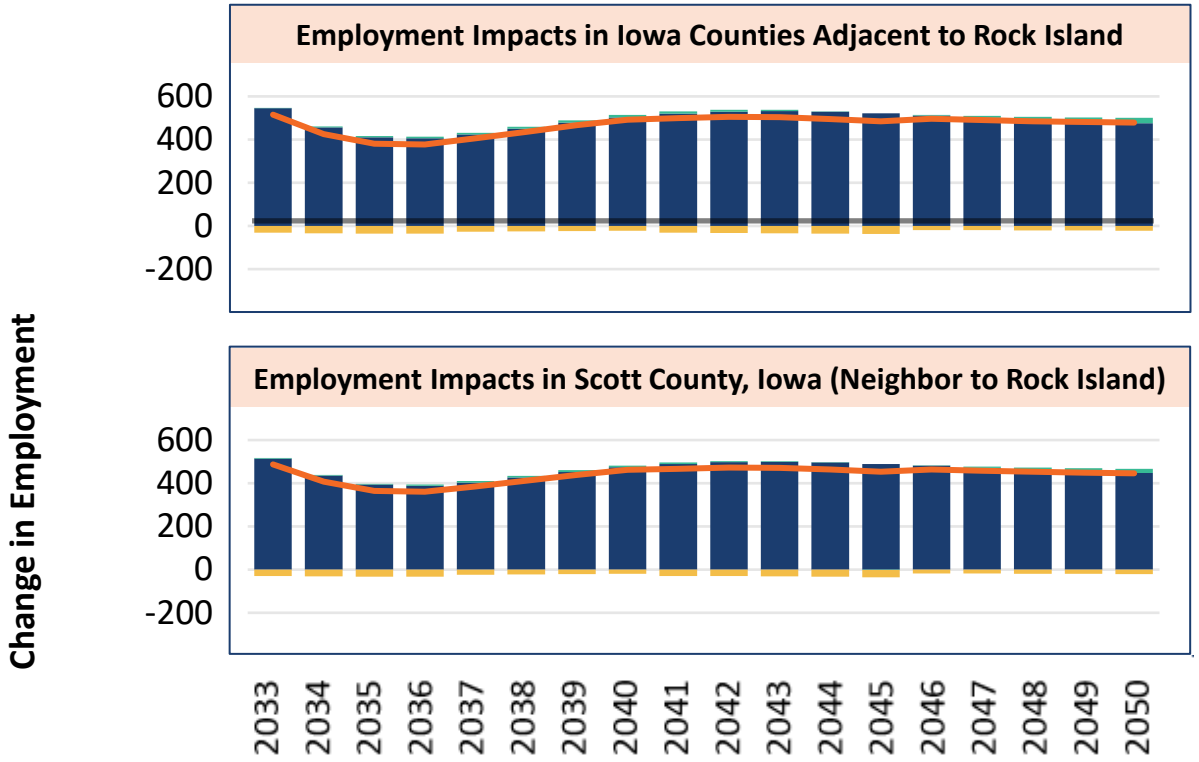
Impact due to Electricity Price Change
Indirect Impact due to Change in Direct Spending at Plant
Change in Direct Spending at Plant
Impact due to Replacement Generation Investment
Total Net Impact

Employment Impacts are Highly Localized – Illinois Only



- The positive employment impacts of QCCEC relicensing are concentrated in the six surrounding counties.
  - Virtually all the direct employment is local; so is much of the indirect employment supported by spending at the plant.
- Foregone investments in generation resources that would replace Quad Cities are spread widely and thus do little to offset the local concentration of other impacts.

Employment Impacts are Highly Localized – Iowa Counties Only



- Direct spending at QCCEC leads to indirect employment benefits in the three modeled Iowa counties, with impacts concentrated in Scott County, which neighbors Rock Island, IL.
- Foregone investments in generation resources that would replace QCCEC are distributed widely, largely in Illinois, and thus do little to offset the local employment benefits of plant relicensing in Iowa.

Impact due to Electricity Price Change
Indirect Impact due to Change in Direct Spending at Plant
Change in Direct Spending at Plant
Impact due to Replacement Generation Investment
Total Net Impact

QCCEC Relicensing Impact on Tax Revenue in Study Region

Relicensing QCCEC contributes to an estimated $0.8 billion in cumulative State tax revenue and $2.4 billion in cumulative Federal tax revenue from 2033-2050 in Illinois. It also contributes an estimated $0.3 billion in cumulative State tax revenue and $1.1 billion in cumulative Federal tax revenue from 2033-2050 in Iowa. QCCEC's contribution to State and Federal tax revenue is expected to increase significantly over time given increases in inflation.

Increase in Provided Tax Revenue at State and Federal Level by Region ($ Million) [1]

Region	State Tax Impact[2]	Federal Tax Impact[3]	Total Tax Impact
All of Illinois	$752	$2,444	$3,196
Rock Island & Surrounding IL Counties (Whiteside, Herny, and Mercer)	$1,297	$4,217	$5,515
Rock Island County, IL	$1,272	$4,133	$5,405
Iowa Counties Adjacent to Rock Island[4] (Muscatine, Scott, and Clinton)	$340	$1,067	$1,407
Scott County, IA	$322	$1,011	$1,333

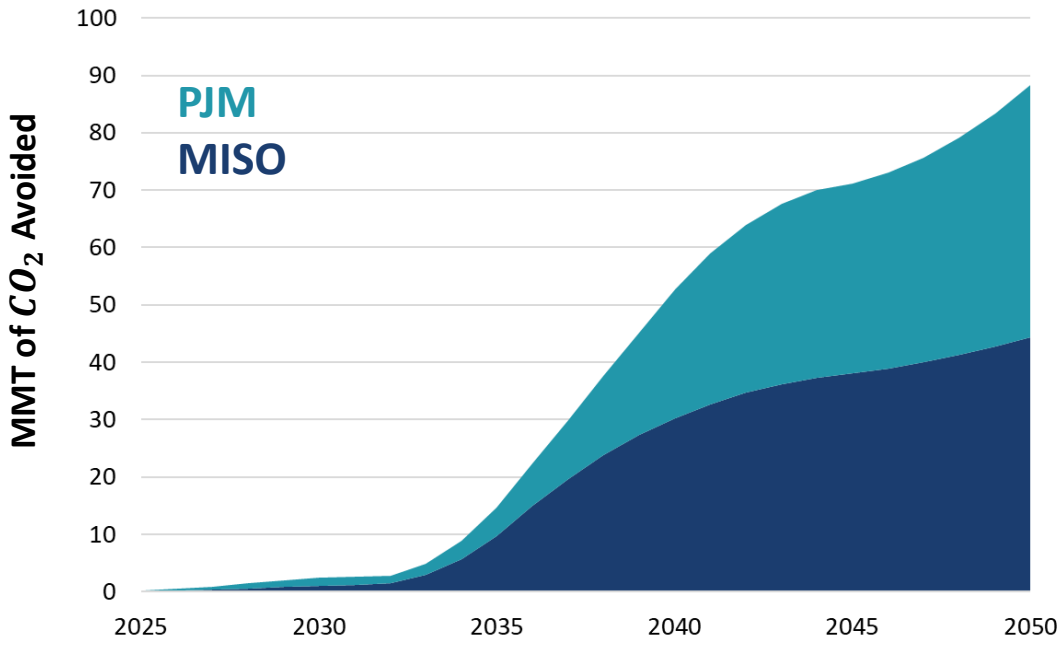
Sources and Notes:
1. Tax revenue is approximated as a fixed portion of GDP based on their historical relationship. It includes both direct spending at the plant and indirect spending.
2. State tax revenue estimated using average over 2014-2023 of IL tax revenue as percent of IL GDP (5%).
3. Federal tax revenue estimated using average over 2014-2023 of federal tax revenue as percent of federal GDP (17%).
4. Iowa state and federal tax revenue is from the three modeled counties only.

QCCEC Relicensing Impact on Emissions

Quad Cities' clean energy generation will reduce total CO_2 emissions by over 88 million metric tons (MMT) during its relicensed operation, to 2050. As of 2024, Quad Cities' energy production is more than half of the current in-state renewable resource generation, and accounts for about 12% of annual Illinois electricity demand.[1]

Carbon Emission Reductions:

Cumulative MMT of CO_2 Avoided



- Relicensing Quad Cities avoids substantial CO_2 in both the near- and long-term.
- Emissions avoidance declines briefly in 2045 as CCS generation is heavily utilized (to take advantage of temporary tax credits) and remaining Illinois fossil is retired under CEJA.
- Emissions avoidance ramps back up after 2045 as the PJM & MISO regions (outside Illinois) rely on fossil to meet continuing load growth.

[1] QCCEC produces about 15.6 TWh/year; 2024 retail electricity sales were 133 TWh; 2024 in-state renewable generation was 28 TWh (EIA State Electricity Profile).
Note: Emissions intensity of imports and exports from neighboring regions are counted towards zonal emissions limits in regions with emissions reduction goals.

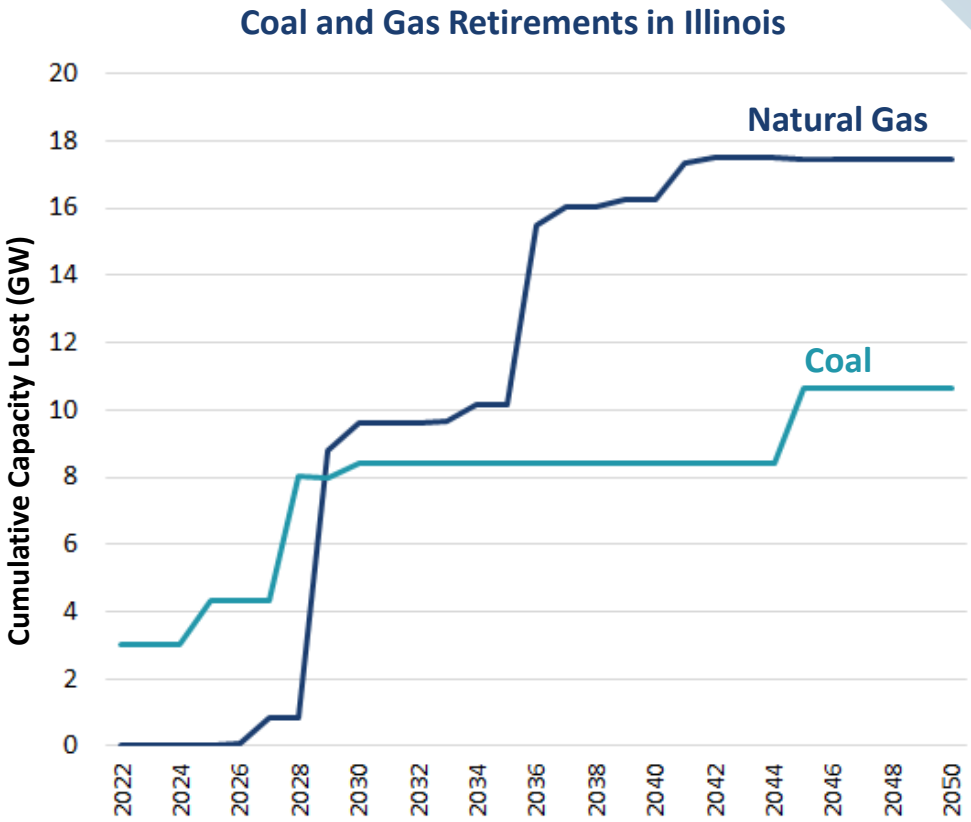
Overview of Modeled Policies

- **Renewable, Clean Energy, and Emissions Goals:**
  - Renewable Portfolio Standards (RPS) and Clean Energy Standards (CES) are modeled at the state level across PJM and MISO.
  - Carbon emissions limits are modeled based on state decarbonization goals.
- **Federal Tax Credits**
  - Investment Tax Credits (ITC) equal to 30% of installation cost are available for solar, offshore wind, battery storage.
  - Production Tax Credits (PTC) of $0.03/kWh are available for land-based wind.
  - Solar and wind credits are available to resources placed in service before 2028, while nuclear and battery storage credits are phased out between 2034-2036, in line with recent legislation.[1]
- **Section 45Q Credit for CO_2 Sequestration**
  - 45Q tax credit of $85/ton-$CO_2$ available to new and retrofitted CCS units online by 2036 (must begin construction by 2033).
- **Climate and Equitable Jobs Act (CEJA):**
  - We model a 2045 zero-emissions deadline for Illinois' electric sector as well as phased zero-emissions deadlines for GHG-emitting resources based on emissions rate.

[1] Solar and wind projects must begin construction before July 5, 2026, or be placed in service before January 1, 2028, to be eligible to receive tax credits. There is a four-year safe harbor if construction begins before July 5, 2026, and the project is completed by the end of 2030, but additional ownership and FEOC provisions apply. Given these limitations, tax credits for wind and solar in gridSIM are only modeled for resources online by 2028.

Climate and Equitable Jobs Act

- **Statewide Emissions:**
  - We model a *2045 decarbonization goal* for the Illinois electric sector, sloping linearly from present-day levels down to zero carbon emissions in 2045.
- **Unit Level Emissions:**
  - CEJA mandates zero emissions deadlines for GHG-emitting units according to their NO_x and SO_2 emissions and the unit's proximity to an environmental justice (EJ) community or equity investment eligible community (EIEC).
    - Plants that don't comply with emissions targets by the deadline (e.g., through CCS or hydrogen conversion) will be forced to retire.
  - We model a *phased retirement* of fossil plants based on analysis by the IL Dept. of Labor, which identifies retirement dates for each coal and gas plant in the state.



All fossil is retired by 2045 due to Illinois' zero-carbon goal.
Source: Climate and Equitable Jobs Act Economic and Workforce Effects Preliminary Analysis, Illinois Department of Labor.

Economic Impacts of Relicensing the Quad Cities Clean Energy Center (QCCEC)

Project Overview

We examine the macroeconomic and power sector impacts of relicensing the **Quad Cities Clean Energy Center (QCCEC)** in Illinois. To capture the interdependencies between the electricity sector and regional economic growth, our analysis integrates two modeling tools, characterizing first the electricity system, and also the broader economy:

- **gridSIM**, Brattle's power sector capacity expansion model, is used to simulate the power sector impacts of relicensing the QCCEC. Energy demand, resource adequacy, market regulations and clean energy policies in MISO and PJM were accounted for in the analysis. To model the impact of relicensing on the interchange between MISO and PJM, the two electricity markets that supply electricity in Illinois, gridSIM jointly optimizes capacity expansion and operation in both markets.
- **REMI Policy Insight Model**, a dynamic economic impact assessment tool, is used to simulate regional economic impacts. The model evaluates key macroeconomic indicators in Illinois (and neighboring Iowa counties) including GDP, employment and industrial production. Economic impacts consider two channels: gains in employment and spending in Rock Island county due to relicensing QCCEC; and power sector impacts, including changes in both customer electricity cost and resource investment activity.

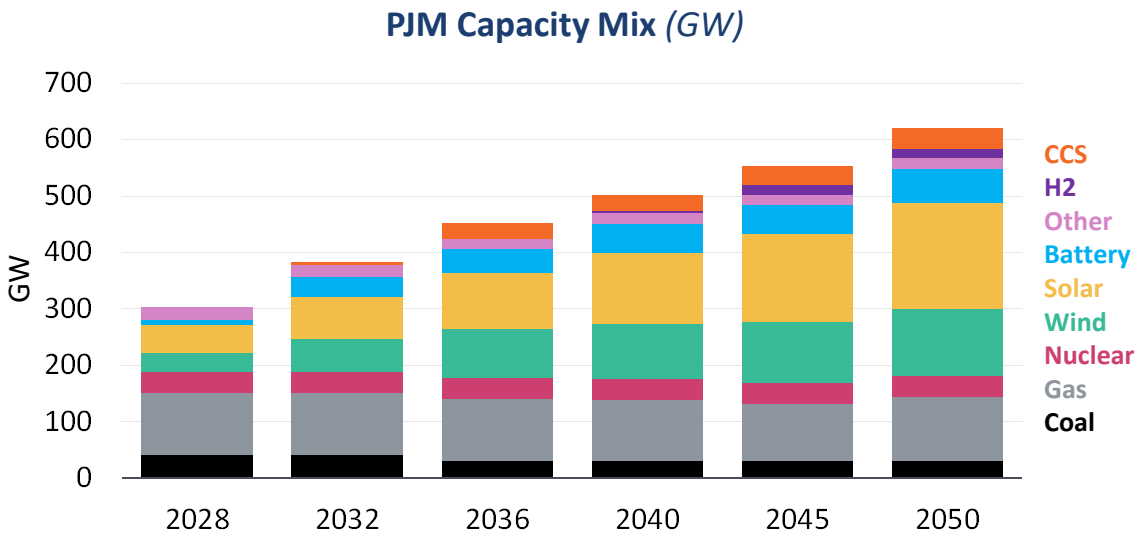
We assess the value of extending the plant's license by comparing two scenarios:

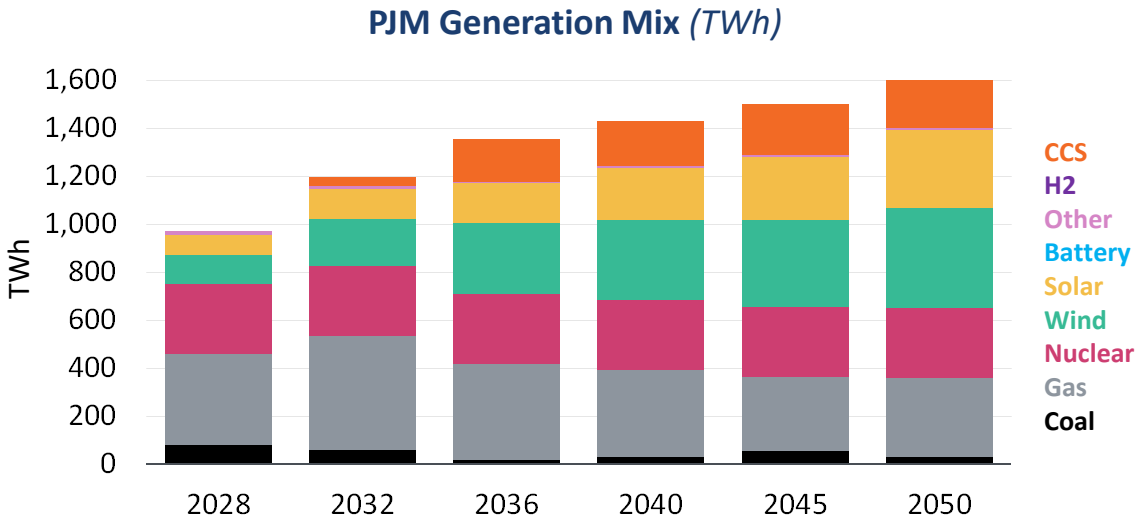
- Reference scenario: QCCEC is relicensed and operates until end of 2052.
- Alternate scenario: QCCEC retires at end of current license, end of 2032.

Power Sector Modeling

REFERENCE SCENARIO RESULTS

Capacity and Generation Mix in PJM

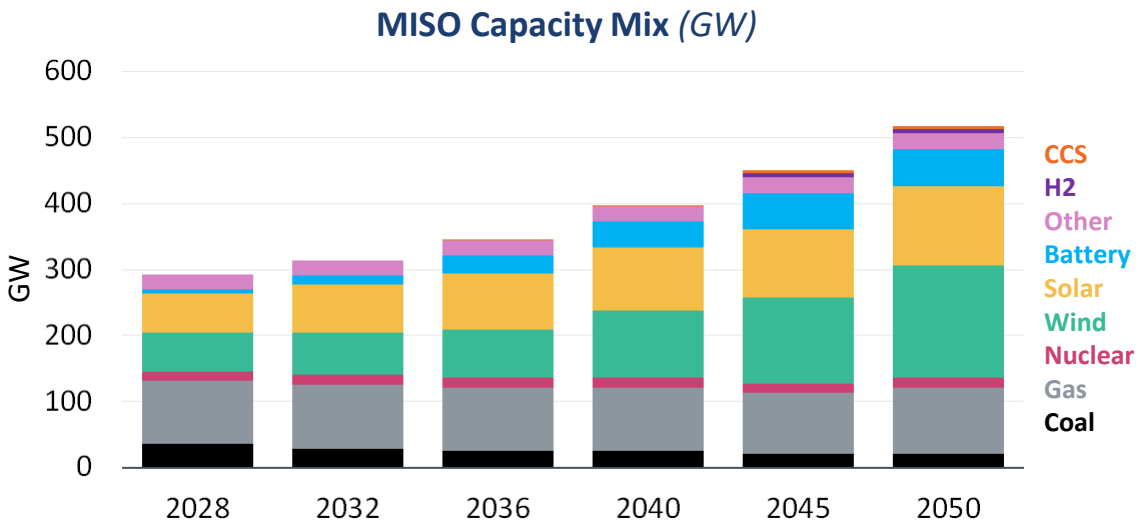


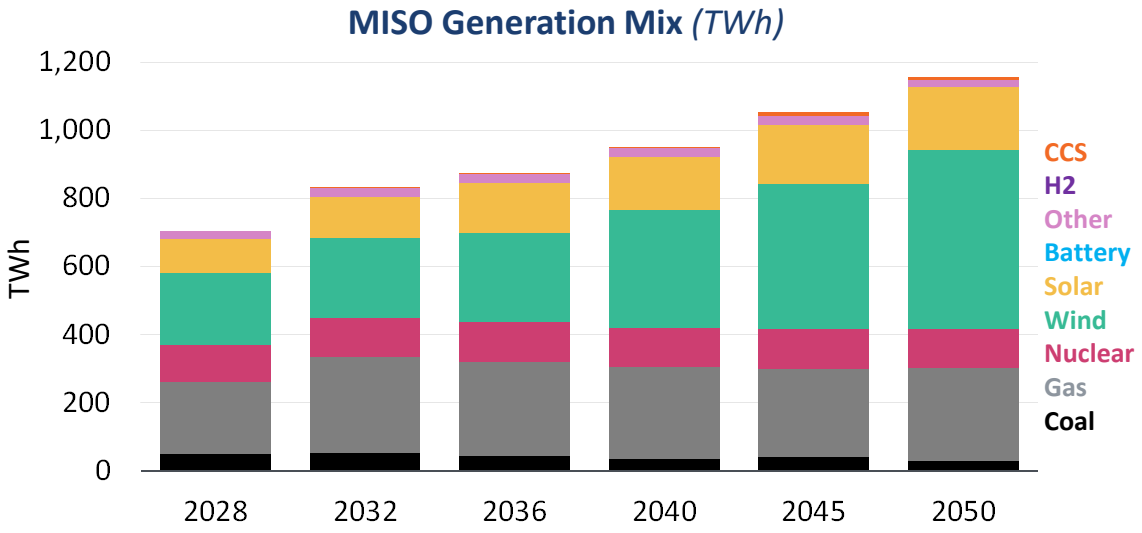


- Wind and solar capacity grow significantly, accounting for 48% of PJM's capacity mix by 2045, with the model choosing to build more solar than wind capacity.[1]
- Around 130 GW of fossil capacity remains on the system by 2045 (in states without strict emissions goals), due to high load growth and low projected gas prices.
- PJM builds ~50 GW of battery storage by 2045.
- Buildout of dispatchable, low-carbon technologies includes 17 GW of H2 CTs and 37 GW of gas w/ CCS by 2050 (9% of total system capacity).
  - Driven by favorable gas prices, high load growth, and limits on annual renewable build rates.[2]

[1] Wind and solar capacity additions are consistent with estimated resource potential and reflect siting limitations based on protected land status, zoning requirements, and setback requirements.
[2] Even in states with net-zero goals, we assume up to 10% of the overall emissions reduction target can be met by offsets.

Capacity and Generation Mix in MISO





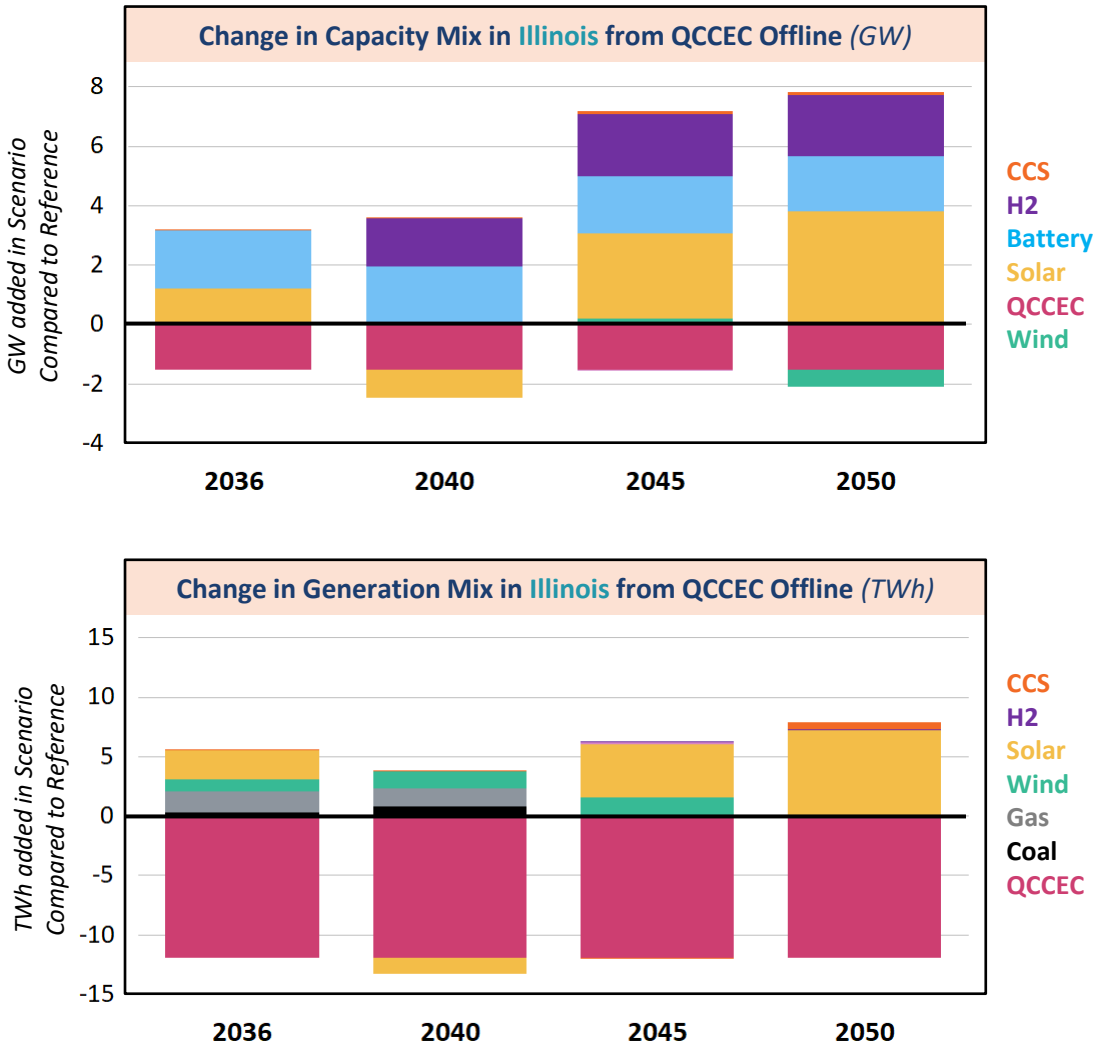
- Wind and solar capacity grow significantly, accounting for 52% of MISO capacity mix by 2045, vs 50%-61% across the MISO Series 2 Futures.[1] [2]
  - Renewables, especially wind, make up more of the generation mix.
- Fossil capacity of 113 GW in 2045 is consistent with Future 2 (MISO's moderate load growth scenario).
- MISO adds ~50 GW of battery storage by 2045.
- Buildout of dispatchable, low-carbon technologies includes 7 GW of H2 CTs and 5 GW of gas w/ CCS by 2050 (2% of total capacity).
  - Driven by favorable gas prices, high load growth, limits on annual renewable build rates, and stringent emissions goals in some states.[3]

[1] MISO Futures Series 2, Preliminary Results from September 24, 2025. "Other" includes conventional hydro, biomass, geothermal, oil, DER and DSM, to align with MISO Futures categories.
[2] Wind and solar capacity additions are consistent with estimated resource potential and reflect siting limitations based on protected land status, zoning requirements, and setback requirements.
[3] Even in states with net-zero goals, we assume up to 10% of the overall emissions reduction target can be met by offsets.

QCCEC Retired After 2032

POWER SECTOR IMPACTS RELATIVE TO RELICENSING

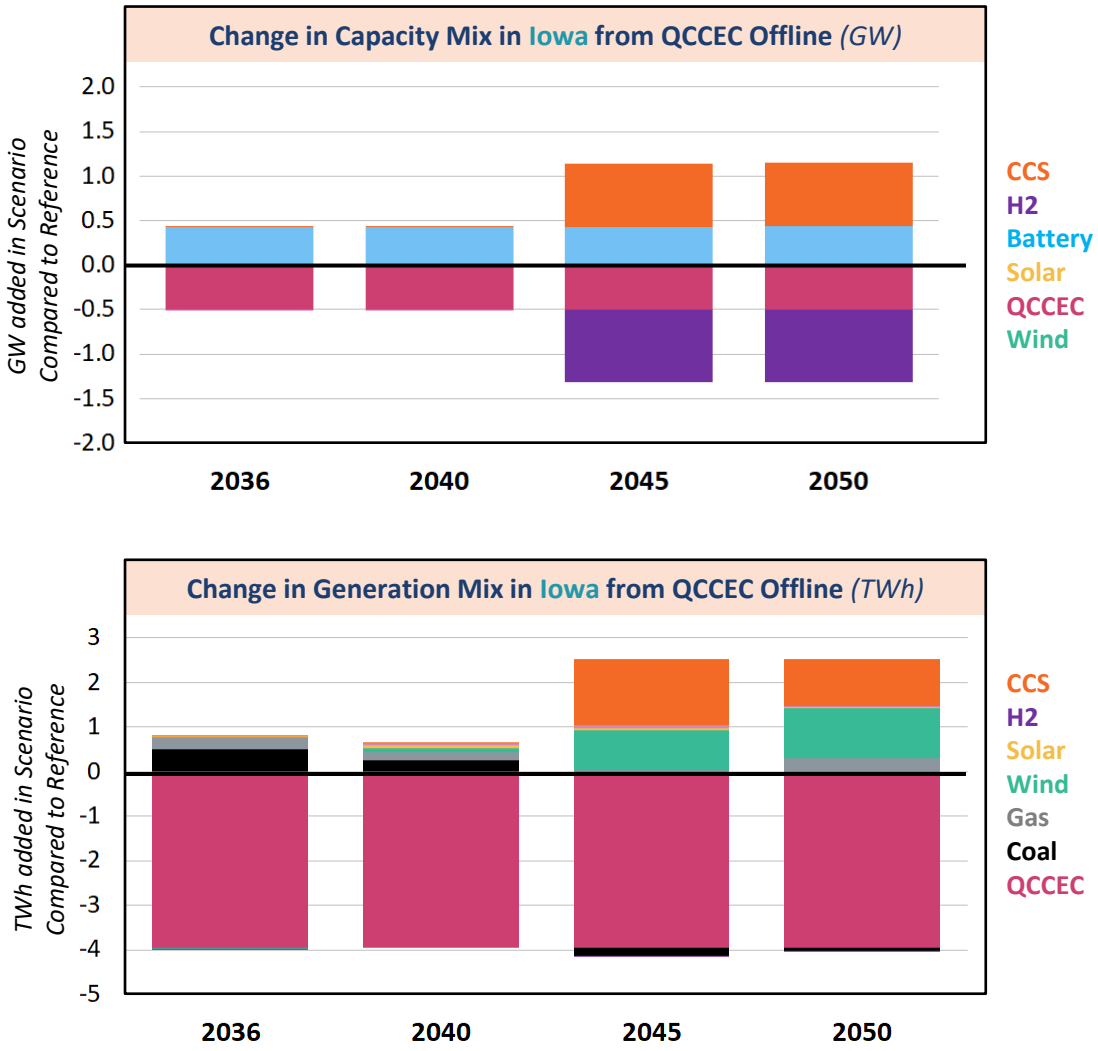
Capacity and Generation Impacts in Illinois



Retiring Quad Cities leads to:

- More storage, solar, hydrogen CT, plus limited gas w/ CCS capacity.
  - Solar and storage builds are driven by CEJA.
  - Gas w/ CCS, while limited, helps meet system need for clean, firm baseload generation.
  - Hydrogen CTs provide resource adequacy and operate as peakers during hours that cannot be served economically by solar plus storage.
- Increased fossil generation through 2040; more solar generation starting in 2045.
  - Illinois reduces net exports to neighboring regions. A portion of the generation required to replace Quad Cities is replaced internally.
  - Earlier years see slight reduction in wind curtailment.

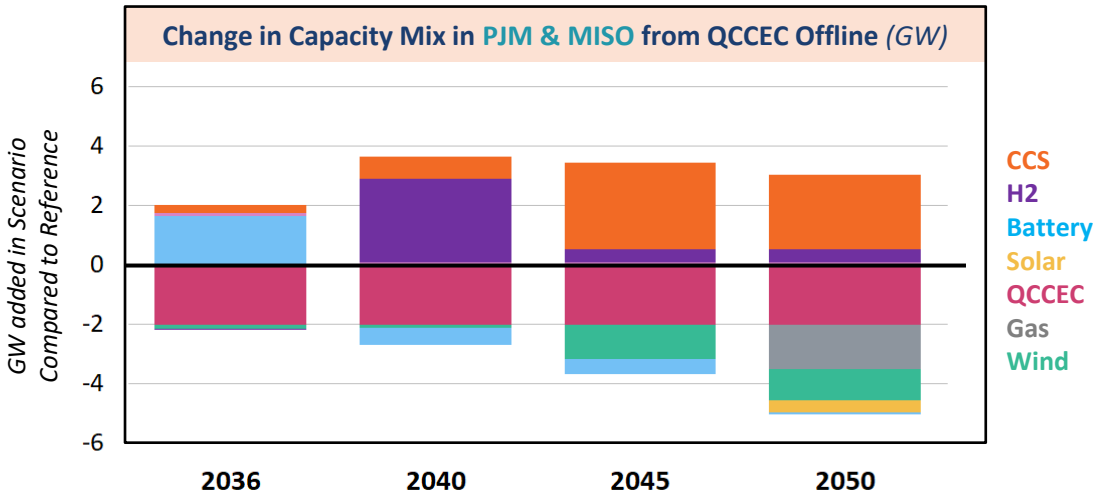
Capacity and Generation Impacts in Iowa

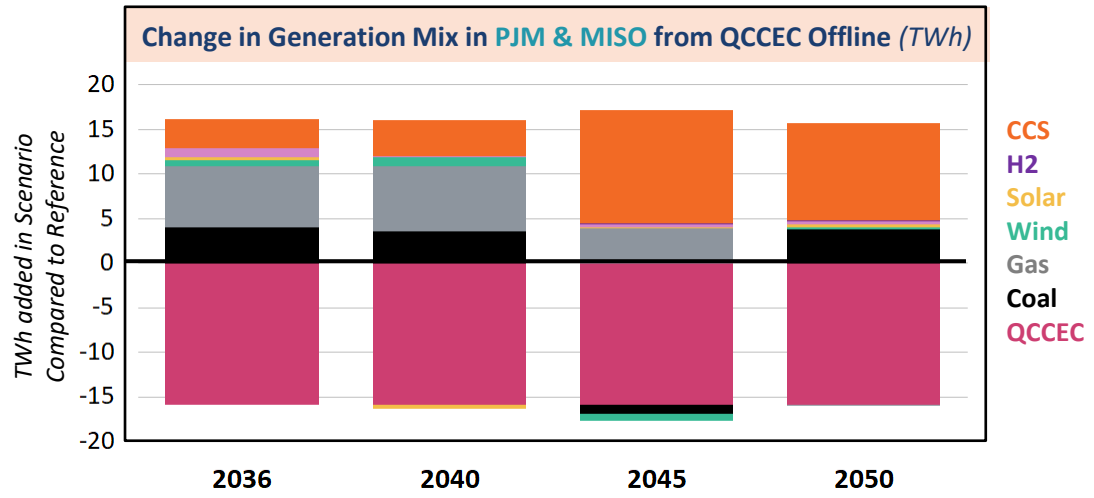


Retiring Quad Cities leads to:

- More storage and CCS capacity, and some loss of hydrogen CT capacity.
  - Gas w/ CCS is used as clean, firm baseload generation.
  - Storage increases ability to meet demand internally, reducing need for hydrogen CTs.
- Slightly increased fossil generation through 2040; more wind, gas w/ CCS and some gas generation starting in 2045.
  - Iowa reduces net exports to neighboring regions. A portion of the generation required to replace Quad Cities is replaced internally.
  - 2045 and 2050 see slight reduction in wind curtailments.

Capacity and Generation Impacts across PJM & MISO

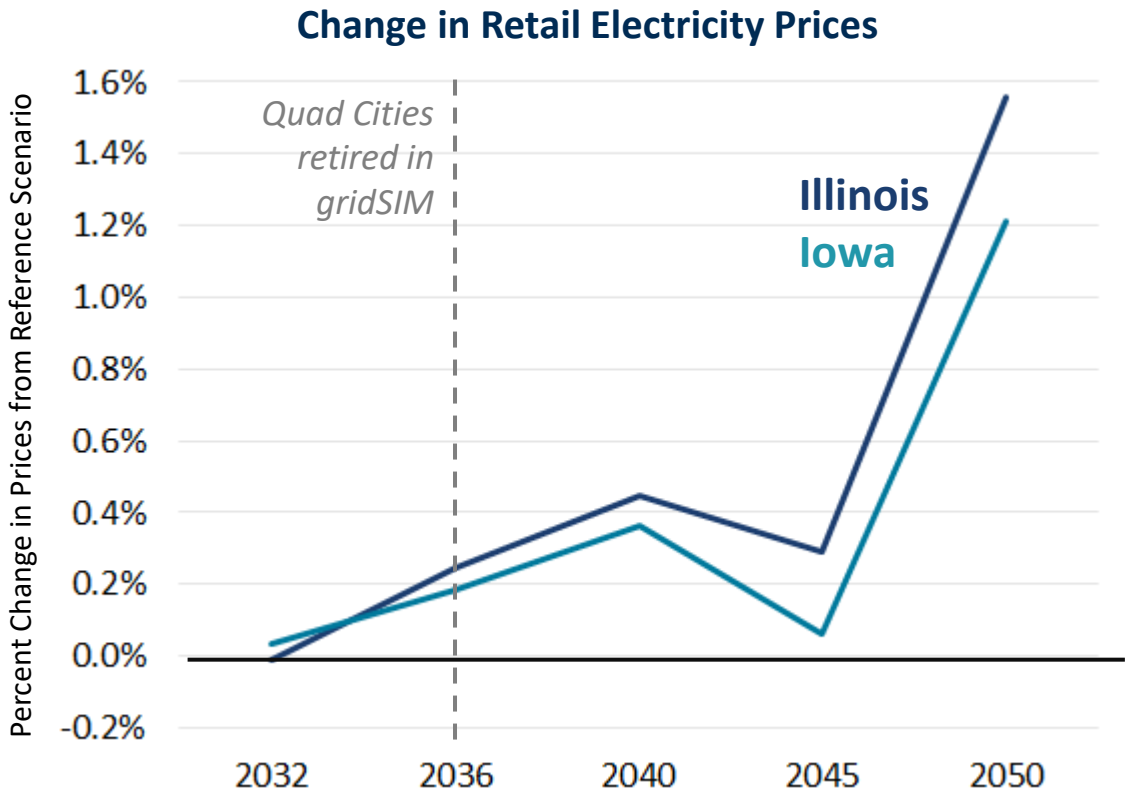




Retiring Quad Cities leads to:

- More hydrogen CT and gas w/ CCS capacity.
  - Storage builds are shifted earlier to replace lost nuclear capacity.
  - Hydrogen CT builds are also shifted earlier to supplement need for flexible generation.
  - Gas w/ CCS fills system's need for clean, firm baseload resource in the long run.
- Increased gas and coal generation across all years, with larger contributions from gas w/ CCS starting in 2045.
  - Although fossil capacity is not added, gas and coal resources operate at higher capacity factors absent QCCEC, resulting in increased emissions.
  - Most of the increase in fossil generation occurs outside of Illinois and Iowa.

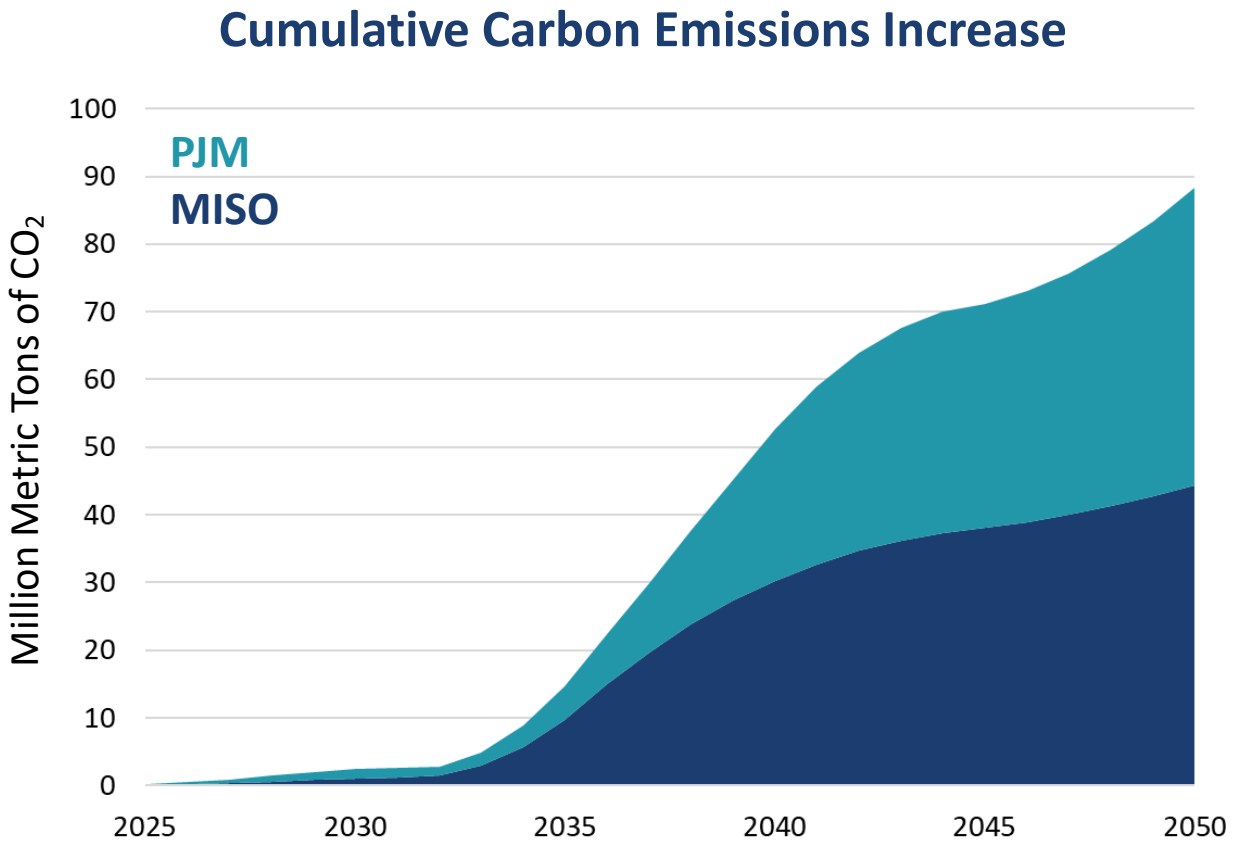
Retail Electricity Price Impact



- **Retiring Quad Cities leads to:**
  - A cumulative increase in ratepayer electricity costs of $6.8 billion between 2033-2050.
  - Modestly higher wholesale energy prices due to greater reliance on fossil generation (gas and coal) through 2040, shifting to more costly gas w/ CCS and hydrogen generation in later years.
    - Price percentage difference initially moderated in 2045 as capacity tightness in IL and surrounding regions keeps energy prices high with or without QCCEC online.
    - Higher price impact in 2050 due to high energy prices, driven by increased penetration of hydrogen generation and gas w/ CCS after 45Q tax credit expires.
  - Higher energy prices partially offset by lower wholesale capacity prices.
    - Greater utilization of existing gas resources and higher energy prices leads to more energy market revenue, and thus lower going-forward costs that resources must recover in the capacity market.

Wholesale price ($/MWh) is the sum of energy and capacity prices. The retail electricity price impact shown above is calculated as one-third of the wholesale price impact, reflecting the fact that delivered price also includes transmission and distribution costs, which are assumed to remain constant.
IL prices are calculated as the load-weighted average of MISO-LRZ4 and PJM-ComEd regions.
IA prices are calculated based on MISO-LRZ3. Further details are in gridSIM Model Assumptions appendix.

QCCEC Retirement Impact on Emissions



- **Retiring Quad Cities leads to:**
  - Large emissions increase as fossil resources see higher utilization across both PJM and MISO.
  - More than 88 million metric tons of additional CO_2 emissions by 2050.
  - Emissions increases decline briefly in 2045 as CCS generation is heavily utilized (to take advantage of temporary tax credits) and remaining Illinois fossil is retired under CEJA.
  - Emissions ramp back up after 2045 as the PJM & MISO regions (outside Illinois) rely on fossil to meet continuing load growth.

Note: Emissions intensity of imports and exports from neighboring regions are counted towards zonal emissions limits in regions with emission reduction goals.

Technical Appendix

Detailed REMI Results

Results by County in Quad Cities Region

GDP Impacts by Region, 2033-2050, Nominal $mm

Region	Cumulative	Average
Rock Island County, IL	$ 24.38	$ 1.35
Whiteside County, IL	$ 0.13	$ 0.01
Henry County, IL	$ 0.30	$ 0.02
Mercer County, IL	$ 0.07	$ 0.00
Muscatine County, IA	$ 0.10	$ 0.01
Scott County, IA	$ 5.97	$ 0.33
Clinton County, IA	$ 0.23	$ 0.01
Total	**$ 31.18**	**$ 1.73**

Employment Impacts by Region, 2033-2050

Region	Cumulative	Average
Rock Island County, IL	24,310	1,351
Whiteside County, IL	328	18
Henry County, IL	900	50
Mercer County, IL	240	13
Muscatine County, IA	36	2
Scott County, IA	7,835	435
Clinton County, IA	395	22
Total	**34,043**	**1,891**

REMI Modeling Assumptions

Modeling Economy-Wide Impacts in REMI

The **REMI Policy Insight Model** is a dynamic forecasting and policy analysis tool. REMI integrates input-output, computable general equilibrium and econometric methodologies to simulate policy impacts. The model evaluates key macroeconomic indicators including GDP, employment, and industrial production.

We modeled the following aspects of relicensing the Quad Cities Clean Energy Center (QCCEC):

- **Direct Employment and Spending at QCCEC:** All direct investment to operate Quad Cities were exogenously specified and assumed to occur in Rock Island County. Resulting GDP and employment impacts in IL driven by the operation of QCCEC are assessed using REMI.
- **Economic Activity Driven by Net Electricity Sector Impacts:** Changes in the power sector are estimated using Brattle's proprietary capacity expansion model, gridSIM. These projected impacts, including changes to the generation resource mix and electricity rates, are modeled in REMI to assess the impact to IL's GDP and employment. Changes in system costs due to QCCEC relicensing are distributed across counties based on county population.

Two scenarios were analyzed:

- A reference scenario in which QCCEC's license is extended.
- An alternate scenario in which QCCEC stop operations at currently scheduled retirement year.

Modeling Electricity Price Impacts in REMI

- The retirement of QCCEC results in changes to electricity prices in IL. Change in electricity prices impacts consumption of both electricity and non-electricity goods and services for firms and households in the regional economy. Increase in prices often results in lower overall consumption for households and lower output for producers.
- REMI models the percent change in electricity prices at the commercial, industrial, and consumer level, using price changes specific to PJM or MISO (determined by gridSIM).
  - For Rock Island county (the county in which QCCEC is located) and its five neighboring counties, price changes are assigned based on the electricity market in which each county is predominantly located.
  - For the rest of Illinois, price changes are weighted proportionally to the population in the PJM and MISO regions.

gridSIM Modeling Assumptions

Modeling Electricity Sector Impacts in gridSIM

gridSIM, Brattle's power sector capacity expansion model, was used to simulate the power sector impacts of relicensing the Quad Cities Clean Energy Center (QCCEC). Energy demand, resource adequacy, market regulations and clean energy policies in Quad Cities' regional electricity market as well as those in neighboring markets were accounted for in the analysis.

While QCCEC is located within the PJM electricity market, other parts of Illinois fall within the MISO electricity market. MISO and PJM are connected, and power constantly flows between them depending on the conditions in each grid—retiring QCCEC would therefore have material impacts on both markets. As such, MISO and PJM were modeled as a joint power system, allowing us to better capture these impacts. Power flows to other neighboring markets were also accounted for using historical data.

Two modeling scenarios were analyzed:

- A reference scenario in which QCCEC's license is extended.
- An alternate scenario in which QCCEC retires at the end of current license, end of 2032.

Overview of Modeling Strategy

INPUTS

Supply
- Existing resources
- Fuel prices
- Investment/fixed costs
- Variable costs

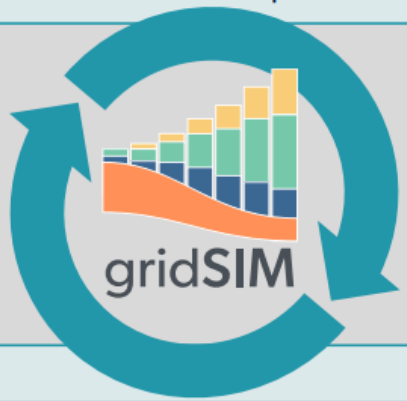
Demand
- Representative periods (hourly chronology)
- Capacity needs

Transmission
- Zonal limits and expansion costs
- Intertie limits

Regulations, Policies, Market Design
- Resource adequacy modeling
- Clean energy policies and investment support

gridSIM OPTIMIZATION ENGINE

Objective Function
- Minimize NPV of investment & operational costs



Constraints
- Market design and co-optimized operations
  - Capacity
  - Energy
- Regulatory & policy constraints
- Resource operational constraints
- Transmission constraints

OUTPUTS

Annual investments and retirements

Hourly operations

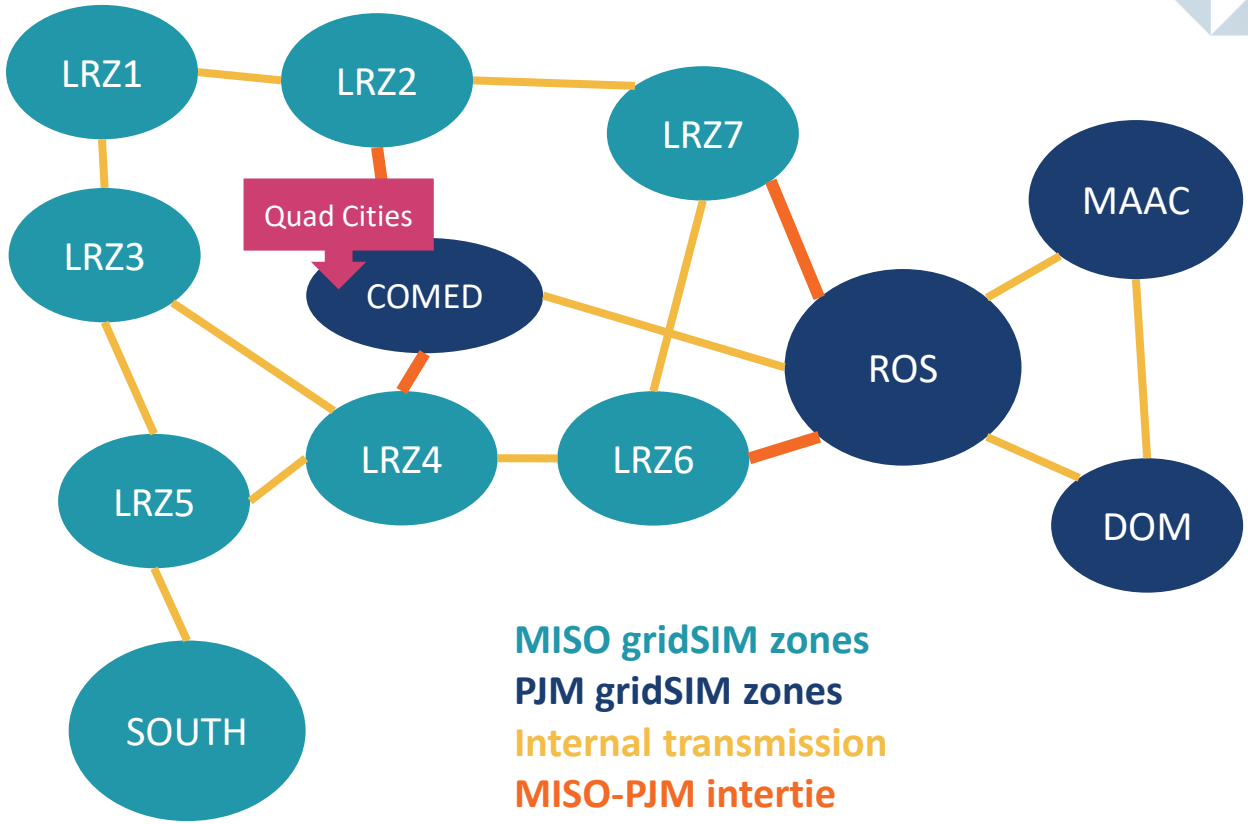
Annual transmission interface expansion

Clean energy additions

Resource adequacy risk assessment metrics

gridSIM Model Topology

- gridSIM optimizes capacity expansion and generation across both MISO and PJM. Model topology is based on a pipe and bubble framework representing 12 MISO and PJM zones.
- Energy transfer limits between two connected zones are calibrated based on the physical transmission limits specified in NREL's Regional Energy Deployment System (ReEDS) model.[1]
- Capacity transfer limits are based on MISO CIL/CEL limits, PJM CETL limits.[2]
- Zonal energy and capacity limits have summer and winter ratings to reflect seasonal variation.

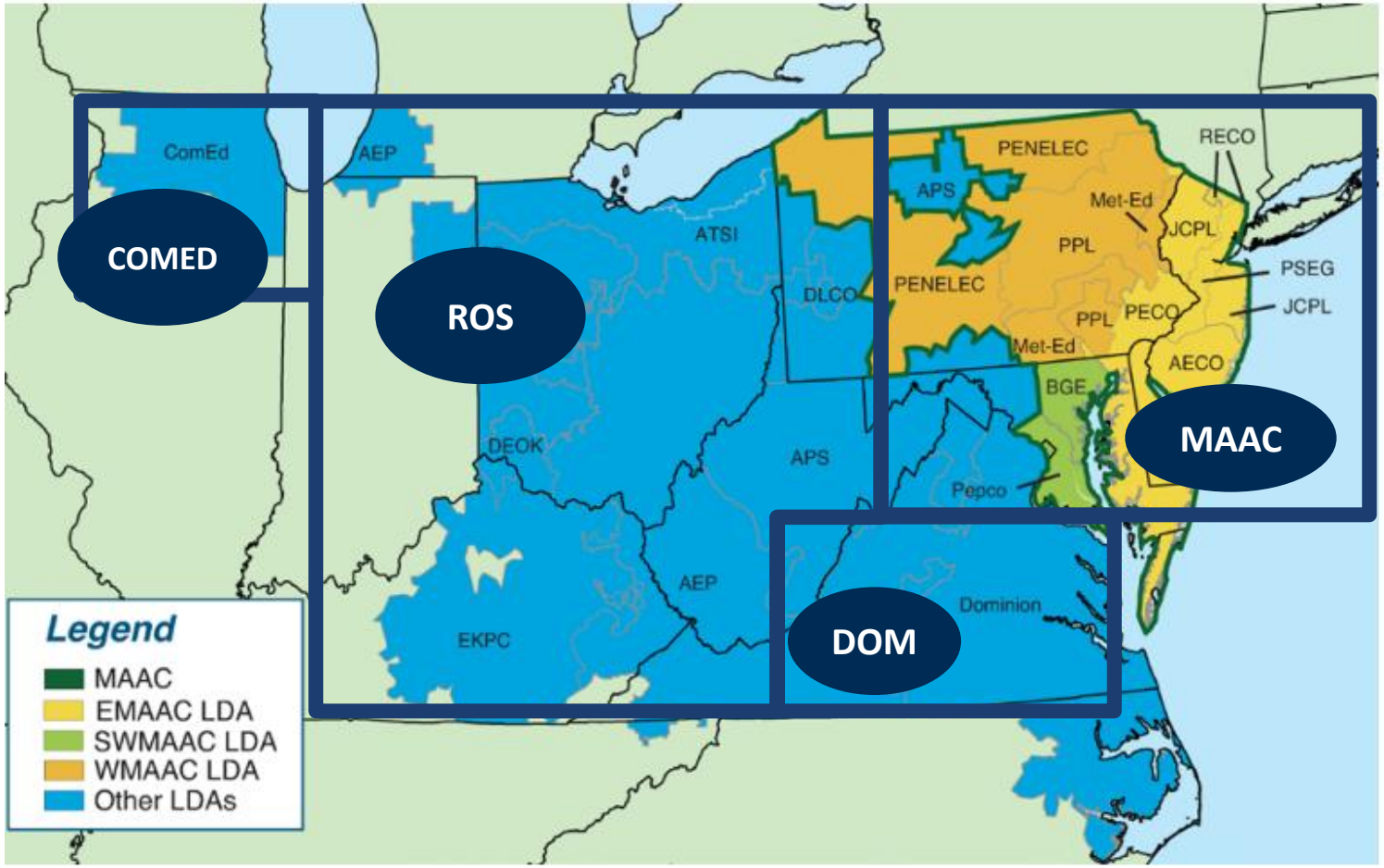


[1] Regional Energy Deployment System (ReEDS)
[2] MISO 2025-2026 PY Seasonal CIL/CEL, PJM 2026/2027 RPM Base Residual Auction Planning Period Parameters

Modeled PJM Zones

- The PJM system is comprised of 21 transmission zones.
- The system is modeled as four aggregated zones in gridSIM,

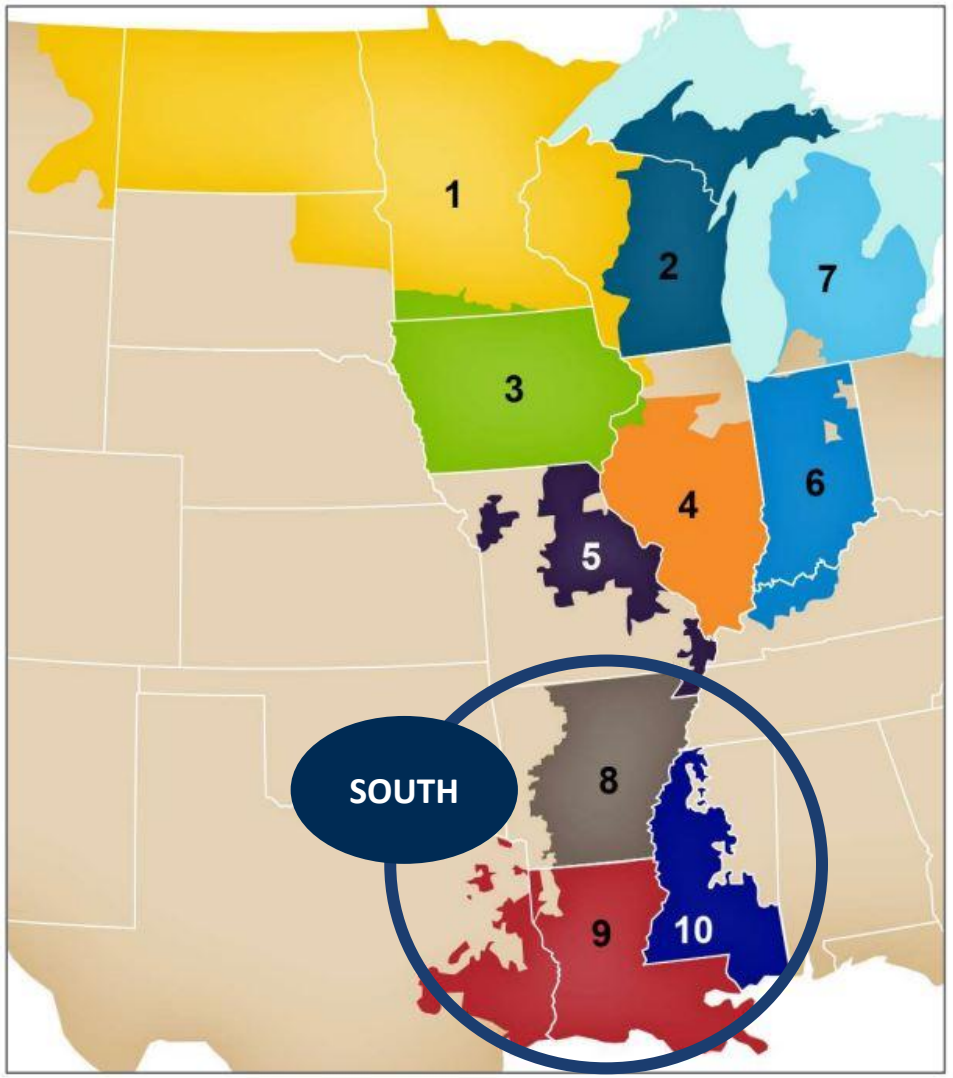
PJM Zones



Modeled MISO Zones

- The MISO system is comprised of ten local resource zones (LRZs).
- These zones are modelled independently except for LRZs 8, 9, and 10, which are aggregated into MISO South.

MISO Zones



Quad Cities Market Participation

- Quad Cities is physically located in PJM ComEd but participates in **both** MISO and PJM.
- 25% of Quad Cities' capacity is modeled within MISO LRZ 3 and the remaining 75% within PJM ComEd.

Quad Cities Market Participation

Owner	Capacity market	Energy market
Constellation (75%)	Participates as PJM ComEd resource	Participates as PJM ComEd resource
MidAmerican (25%)	Bid into MISO capacity market as LRZ 3 external resource	Scheduled into MISO as an import; receives PJM interface price

Quad Cities Parameters

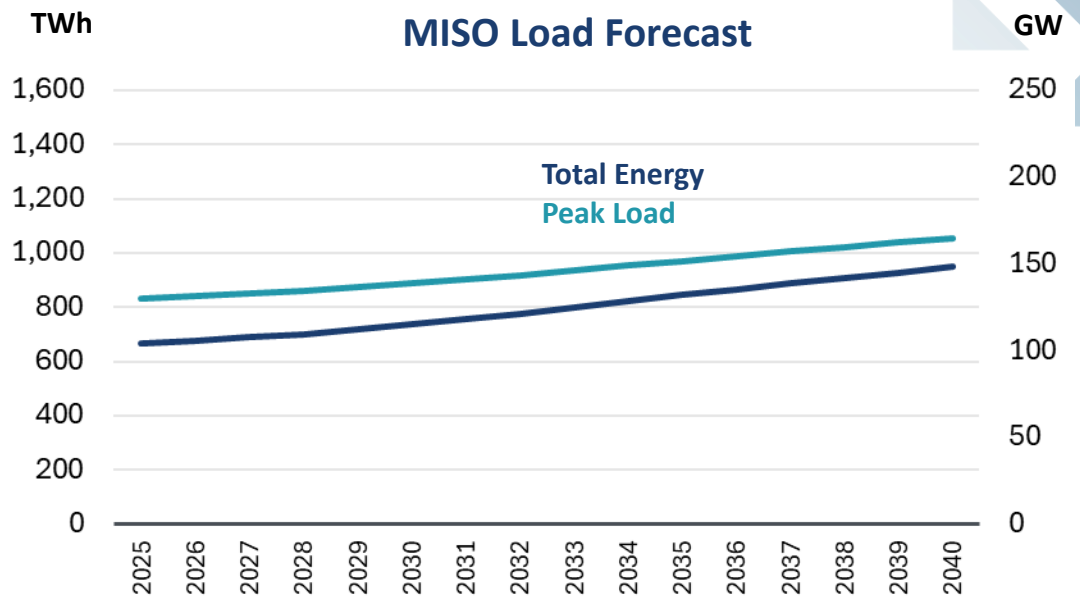
Assumption	Value
Net Summer Capacity (MW)	1,819
Capacity factor	94.7%
Currently scheduled retirement year	2032
Extended retirement year	2052

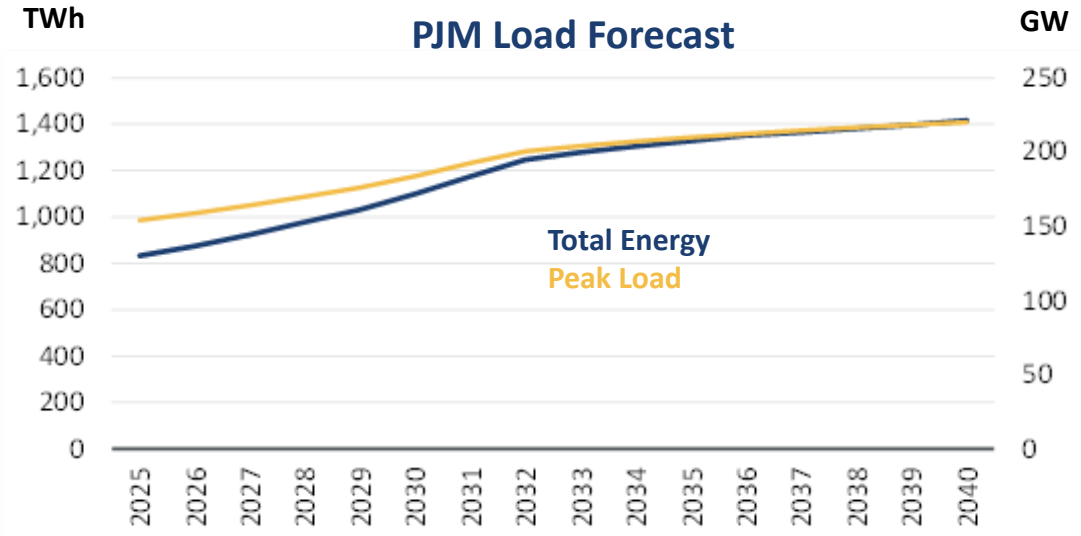
Existing and Planned Capacity

- Existing 2024 generation capacity by zone is based on data from Hitachi Energy Velocity Suite for both MISO and PJM.
  - Individual units are clustered (based on unit type and heat rate) into representative units for computational efficiency.
  - Installed capacities are subject to seasonal multipliers (summer and winter) to account for variation in resource availability.
- Planned additions and retirements for MISO are based on the 2024 MISO Regional Resource Assessment, which is a MISO-complied source including members' and states' publicly announced resource plans. Planned additions and retirements for PJM are based on Hitachi Energy Velocity Suite.
- Additional natural gas and coal phase outs are required in Illinois as part of CEJA.

Load Forecasts

- Forecasted total annual and peak load for MISO is consistent with the 2024 MISO Long Term Load Forecast's Current Trajectory.[1]
  - Purdue's 2023 MISO Demand Forecast is used to allocate historical MISO demand to each LRZ.[2]
  - Historical hourly load profiles are adjusted to account for electrification based on NREL Cambium.
- Forecasted total annual and peak load for PJM is from PJM's 2025 Load Forecast Report through 2040.[3]
  - Load growth is extrapolated for 2045 and 2050.
  - Hourly load shapes are also sourced from the underlying data in PJM's 2025 Load Forecast Report for all zones.





[1] MISO Long-Term Load Forecast (December 2024)
[2] 2023 MISO Independent Energy and Peak Demand (Purdue)
[3] PJM Long-Term Load Forecast Report

Resource and Fuel Costs

- **Resource Costs:**
  - Capital costs are based on the NREL Annual Technology Baseline, with regional multipliers based on EIA data.
  - Costs are adjusted to reflect more realistic commodity prices (based on Brattle report for PJM) and interconnection costs (based on Lawrence Berkeley National Lab study).
  - Unique modifiers are calculated for natural gas combined cycle units, natural gas combustion turbines, battery storage, solar, and wind.
- **Fuel Prices:**
  - Natural gas: Price forecasts are based on S&P Global Market Intelligence Forwards through 2037, with extrapolation to 2050 based on EIA Annual Energy Outlook. Each zone is mapped to the nearest trading hub, and prices are reported on a monthly basis.
  - Oil and coal: Annual price forecasts are taken from EIA 2024 Annual Energy Outlook.
  - Biomass: Annual price forecasts are based on the EIA Monthly Densified Biomass Fuel Report.
  - Nuclear: Annual price forecasts are based on NREL Annual Technology Baseline.

Overview of Modeled Policies

- **Renewable, Clean Energy, and Emissions Goals:**
  - Renewable Portfolio Standards (RPS) and Clean Energy Standards (CES) are modeled at the state level across PJM and MISO.
  - Carbon emissions limits are modeled based on state decarbonization goals.
- **Federal Tax Credits**
  - Investment Tax Credits (ITC) equal to 30% of installation cost are available for solar, offshore wind, battery storage.
  - Production Tax Credits (PTC) of $0.03/kWh are available for land-based wind.
  - Solar and wind credits are available to resources placed in service before 2028, while nuclear and battery storage credits are phased out between 2034-2036, in line with recent legislation.[1]
- **Section 45Q Credit for CO_2 Sequestration**
  - 45Q tax credit of $85/ton-$CO_2$ available to new and retrofitted CCS units online by 2036 (must begin construction by 2033).
- **Climate and Equitable Jobs Act (CEJA):**
  - We model a 2045 zero-emissions deadline for Illinois' electric sector as well as phased zero-emissions deadlines for GHG-emitting resources based on emissions rate.

[1] Solar and wind projects must begin construction before July 5, 2026, or be placed in service before January 1, 2028, to be eligible to receive tax credits. There is a four-year safe harbor if construction begins before July 5, 2026, and the project is completed by the end of 2030, but additional ownership and FEOC provisions apply. Given these limitations, tax credits for wind and solar in gridSIM are only modeled for resources online by 2028.

State Level Policy for MISO

State	Renewable and Clean Energy Goals	Emissions Reduction Goals (2005 Baseline)
Illinois[1]	RPS: 40% by 2030, 50% by 2040 (55% solar and 45% wind) CES: 100% by 2050	Zero Emissions by 2045 (ilga.gov)
Indiana	RPS: 10% by 2025	n/a
Iowa	RPS: 105 MW (completed 2007)	n/a
Louisiana	RPS: 80% by 2050	Zero Emissions by 2050 (louisiana.gov)
Minnesota	RPS: 25% by 2025, 55% by 2035 (10% solar by 2030) CES: 80% by 2030, 90% by 2035, 100% by 2040	Zero Emissions by 2040 (mn.gov)
Michigan	RPS: 50% by 2030, 60% by 2035 CES: 100% by 2040	Zero Emissions by 2050 (michigan.gov)
Missouri	RPS: 15% by 2021 (2% from solar) (achieved)	n/a
Wisconsin	RPS: 10% by 2015 (achieved) CES: 100% by 2050	Zero Emissions by 2050 (epa.gov)

[1] RPS and CES obligations are split proportionally based on the amount of IL load located in MISO vs PJM.

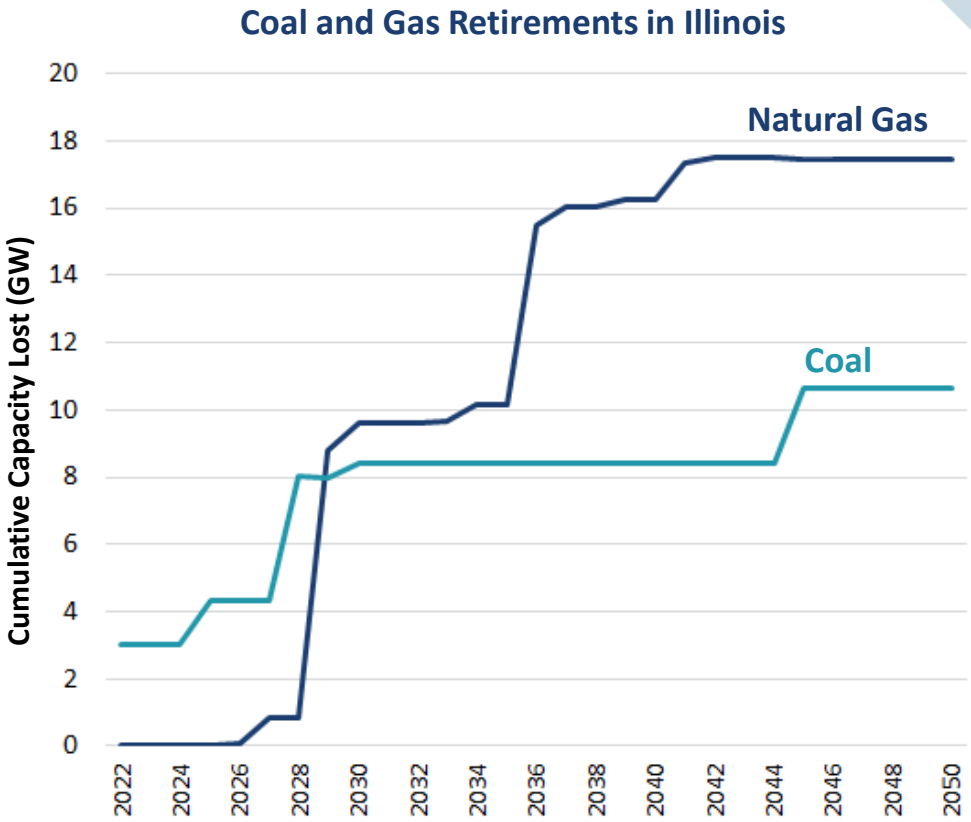
State Level Policy for PJM

State	Renewable and Clean Energy Goals	Emissions Reduction Goals (2005 Baseline)
Delaware	RPS: 40% by 2035 (10% from solar)	50% reduction by 2030, zero emissions by 2050 (de.gov)
DC	RPS: 100% by 2032 (5.5% Solar)	Zero emissions by 2032 (dccouncil.gov)
Illinois[1]	RPS: 40% by 2030, 50% by 2040 (55% solar and 45% wind) CES: 100% by 2045	Zero emissions by 2045 (ilga.gov)
Maryland	RPS: 52.5% by 2030 (50% Tier I, 2.5% Tier II)	60% reduction by 2031, zero emissions by 2045 (md.gov)
New Jersey	RPS: 52.5% by 2029 (50% Class I, 2.5% Class II) CES: 100% by 2050	80% reduction by 2050 (nj.gov)
North Carolina	RPS: 12.5% (completed)	n/a
Ohio	RPS: 8.5% by 2026	n/a
Pennsylvania	RPS: 18% (completed)	80% reduction by 2050 (pa.gov)
Virginia	RPS: 100% by 2050 (APCo), 100% by 2045 (DOM) CES: 100% by 2050 (APCo), 100% by 2045 (DOM)	Zero emissions by 2045 (va.gov)

[1] RPS and CES obligations are split proportionally based on the amount of IL load located in MISO vs PJM.

Climate and Equitable Jobs Act

- **Statewide Emissions:**
  - We model a *2045 decarbonization goal* for the Illinois electric sector, sloping linearly from present-day levels down to zero carbon emissions in 2045.
- **Unit Level Emissions:**
  - CEJA mandates zero emissions deadlines for GHG-emitting units according to their NO_x and SO_2 emissions and the unit's proximity to an environmental justice (EJ) community or equity investment eligible community (EIEC).
    - Plants that don't comply with emissions targets by the deadline (e.g., through CCS or hydrogen conversion) will be forced to retire.
  - We model a *phased retirement* of fossil plants based on analysis by the IL Dept. of Labor, which identifies retirement dates for each coal and gas plant in the state.



All fossil is retired by 2045 due to Illinois' zero-carbon goal.
Source: Climate and Equitable Jobs Act Economic and Workforce Effects Preliminary Analysis, Illinois Department of Labor.

Technology Options

- gridSIM can build endogenously on top of planned capacity additions beginning in model year 2028.
- The primary clean dispatchable resource options in gridSIM are hydrogen CTs (new and retrofit), gas CCs with CCS (new and retrofit), and nuclear SMR.

gridSIM Resource Types

Resource Type	First Model Build Year
Biogen	2028
Coal	2028
NG CC	2032
NG CT	2028
NG ST	2028
Nuclear	2032
Nuclear SMR	2032
Solar	2028
Storage (2, 4, 8 Hr)	2028
Onshore Wind	2028
Hydrogen CT	2036
NG CCS	2032

Nuclear Assumptions

- **Generation:** Nuclear generation is modeled using a monthly average capacity factor for each ISO. This average capacity factor is based on 10 years of historical data (2015-2024).
- **Retirements:** All licenses for nuclear units in PJM and MISO are assumed to be extended for an additional 20 years past the license expiration (consistent with the MISO Futures)
  - In the Reference scenario, Quad Cities is assumed to operate to its extended retirement year of 2052. In the Retirement scenario, Quad Cities is assumed to retire at the end of 2032 (so it is retired in the model at the beginning of model year 2036).

Demand Response (DR) and Behind the Meter (BTM) Solar

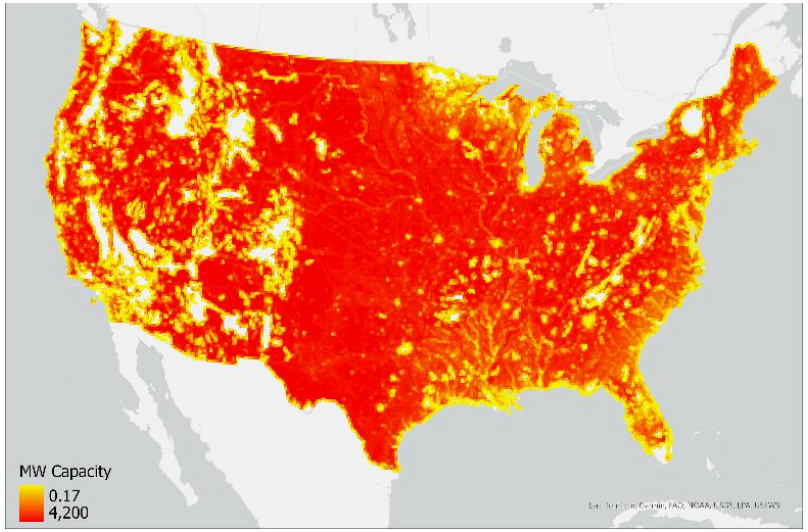
- **MISO:** Existing DR and BTM solar capacity is based on the 2024 Organization of MISO States (OMS) DER Survey Results[1] and anticipated capacity is based on the 2023 MISO Futures Report.[2]
  - 5.8 GW of DR and 5.7 GW of BTM solar in 2024, 14 GW of DR and 23 GW of BTM solar by 2042.
  - $1,000/MWh cost associated with utilizing emergency DR.
- **PJM:** Demand response resources are modeled by zone based on the amount of cleared demand response capacity in the 2026-2027 Base Residual Auction.[3]
  - $1,000/MWh cost associated with utilizing emergency DR.

[1] 2024 Organization of MISO States (OMS) DER Survey Results
[2] 2023 MISO Futures Report
[3] PJM 2026/2027 Base Residual Auction Report

Build Limits for Wind & Solar – Land Use Analysis

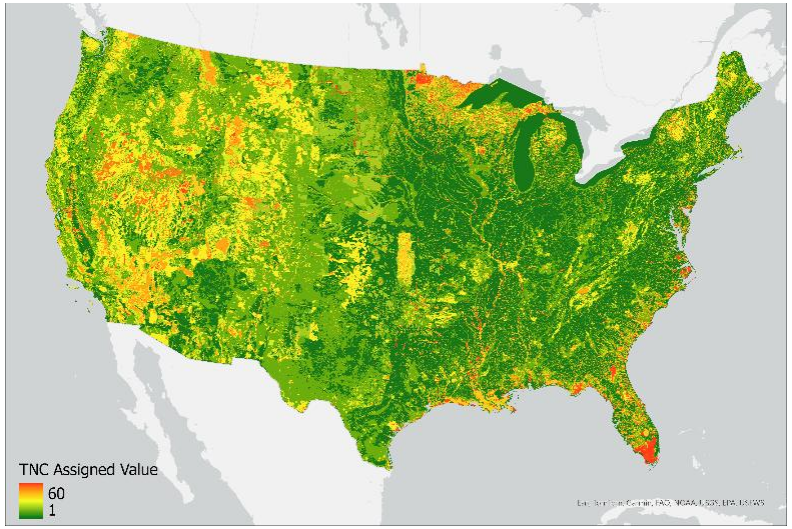
- NREL estimates generation potential across the continental U.S. after removal of protected lands, zoning requirements, and setback requirements.
- Nature Conservancy Power of Place Data estimates environmental and social impact of solar and wind development; this provides context to land importance beyond NREL's generation potential.
- NREL provides the generation potential which we overlay on buildable land from The Nature Conservancy to estimate limits, coupled with our own GIS data analysis.

NREL Solar Generation Capacity (Open Access)



Source: NREL Solar Supply Curves

Nature Conservancy Environmental Impact Estimate



Source: The Nature Conservancy, Power of Place

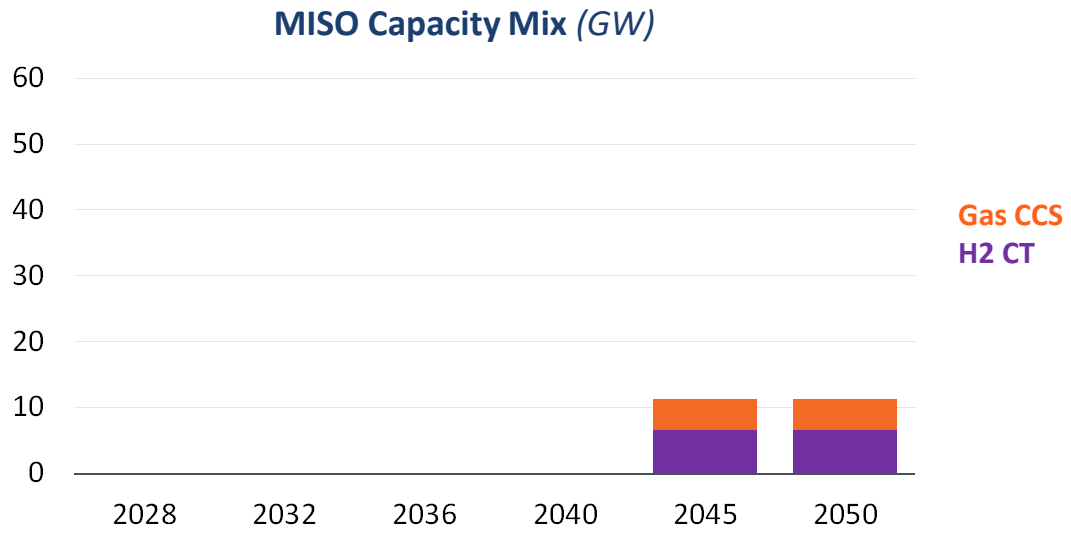
Build Limits

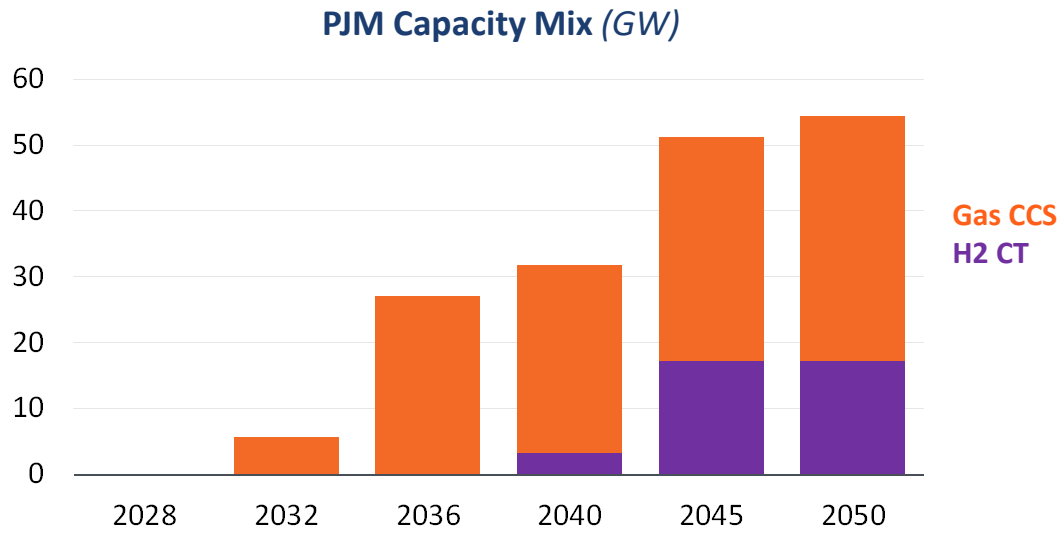
- Based on our land use analysis, we implemented cumulative wind and solar capacity limits.
  - PJM: 820 GW for solar and 120 GW for onshore wind
  - MISO: 1,530 GW for solar and 270 GW for onshore wind
- For PJM, solar and onshore wind annual build limits are 6.1 GW and 4.5 GW, respectively, based on PJM Capacity Expansion results implied build rates.
- For MISO, renewable build rates in gridSIM were determined to be consistent with MISO Futures Series 2 assumptions.

Dispatchable Emerging Technology Capacity

Model Results:

- gridSIM allows gas with Carbon Capture and Storage (gas w/ CCS) resources to be used at scale starting in 2032 and Hydrogen CTs to be used for generation starting in 2036.
- Dispatchable emerging technology resources make up 2% of the 2050 MISO capacity mix and 9% of the 2050 PJM capacity mix.
- CCS buildout is incentivized by favorable gas prices, tax credits for carbon sequestration, high load growth, and system need for low-carbon dispatchable generation.
- H2 buildout is concentrated in regions with more aggressive clean energy goals. Units are operated as peakers, mainly providing resource adequacy.





Carbon Capture and Sequestration (CCS) Costs and Operations

- Model can choose to retrofit existing gas CC units or build new gas CCs w/ CCS beginning in 2032.
- CCS retrofits and new builds have higher costs and reduced efficiency due to parasitic load in comparison to standard CC units.
- 45Q Credit of $85/ton applied based on credit for geologically sequestered CO_2, meeting certain wage requirements.
  - Only CCS resources constructed prior to 2033 are eligible (implemented as online by 2036).
  - Tax credits can be received through 12-year claim period.

Parameters for Gas with Carbon Capture

Parameter	Assumption	Source
First Allowed Build Year	2032	NREL, DOE
Carbon Capture Rate	90%	EPA
Capital Cost (2032$/kW)	New Gas CC w/ CCS: $3,186 Gas CC Retrofit: $1,581	NREL ATB 2024
FOM (2032$/kW-yr)	New Gas CC w/ CCS: $70.73 Gas CC Retrofit: $81.93	NREL ATB 2024
Fuel Cost	Same as Gas CC	
Transport and Sequestration Cost	$9/ton-$CO_2$ for storage (all regions) $20/ton-$CO_2$ for transport (MISO) $38/ton-$CO_2$ for transport (PJM)	Cost estimates from Congressional Budget Office; Difference in transport costs informed by distance to EOR and DSS storage sites from CATF
Tax Credits	$85/ton-$CO_2$ from 45Q Credit	45Q Tax Credit
Parasitic Losses	30% losses from parasitic load	Advanced Post-Combustion CO2 Capture (mit.edu); Global CCS Institute

Hydrogen Costs and Operations

- Model can build new hydrogen turbines or retrofit existing NG CTs beginning in 2036.
- No PTC for hydrogen production is assumed.

Parameters for Hydrogen Gas Turbine

Parameter	Assumption	Source
First Allowed Build Year	2036	MISO Futures report adds "Flex" resources in 2027; IL production cost modeling introduces zero emissions fuels in 2045
Operating Parameters	Operations are the same as NG CT	
Capital Cost	New build: 125% of NG CT capital cost Retrofit: 25% of NG CT capital cost	ETN Global
FOM	50% greater than NG CT	ETN Global
VOM	Same as NG CT	NREL ATB 2024
Fuel Cost (2024$)	Production and delivery cost: $64/MMBtu in 2036 and trending down to $58/MMBtu in 2050	Production cost of hydrogen produced through polymer electrolyte membrane (PEM) electrolysis from DOE H2A Production Analysis, Baseline scenario. Delivery costs from DOE Liftoff Report.

Retail Electricity Price Impact

- **Energy prices ($/MWh):**
  - Energy prices are calculated as the marginal cost of energy in each hour. The annual energy price is the load-weighted average price.
- **Capacity prices ($/MW-yr):**
  - Capacity costs are calculated based on Net Cost of New Entry (CONE). Net CONE is the sum of fixed O&M and capital costs minus revenues obtained through the energy, ancillary services, and ZEC markets.
  - Net CONE is divided by each resource's accredited capacity to obtain a $/MW-yr cost. The capacity price is set by the most expensive resource in each zone.
- **Wholesale electricity prices ($/MWh):**
  - Energy and capacity prices are converted to $/MWh and summed to calculate an all-in wholesale electricity price.
- **All-in retail electricity price impact (%):**
  - The retail price impact is calculated as one-third of the wholesale electricity price impact, based on the assumption that T&D costs remain fixed.

Notice and Disclaimer

The preparation of this analysis and presentation was supported by Constellation Energy Generation, LLC.

All results and any errors are the responsibility of the authors and do not represent the opinions of The Brattle Group or its clients.

We would like to thank Sophie Edelman, Jesse Griffin-Carney, Tina Zhang, Shannon Paulson, Emine Taha, and Carly McAdam for their invaluable assistance in preparing this analysis and presentation.