Illinois Nuclear Plants are Vital to the State But are at Imminent Risk of Closure

Summary

Four Illinois nuclear plants (Byron, Dresden, Braidwood, and LaSalle) are financially challenged because the current market does not compensate these facilities for their carbon-free energy attributes. The Climate Jobs Illinois Coalition (CJI) hired two energy consultants from Jacobs and Associates, Inc. to evaluate the future viability of these four plants.[1] Based on a thorough analysis of Exelon's confidential data, these analysts concluded that, absent a material financial change, it will be uneconomic to continue to operate these plants. Therefore, without legislation authorizing sufficient financial support, all four plants will likely close.

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The preservation of the Illinois nuclear fleet is in the best interest of utility customers, and all residents of Illinois because:

- Loss of the nuclear plants would impact thousands of power plant jobs in mostly rural communities as well as many more thousands of jobs in the communities surrounding the plants.
- Closing the plants would almost immediately increase electricity rates to Illinois customers.
- It is vital to have a reliable power supply. Recent persistent rolling blackouts in Texas and California demonstrated that vividly. The Illinois plants provide reliable service all hours of the day in all weather conditions. Loss of the nuclear plants would place this reliability at risk.
- The ability to meet state clean energy goals will be set back years with the loss of any of the nuclear plants. The Byron, Dresden, Braidwood, and LaSalle plants provide more than 60% of the state's annual carbon-free energy.

The Climate Union Jobs Act (The Act) provides Illinois an insurance policy, a "bridge" to preserve the clean energy nuclear fleet while Federal and regional plans to manage the

[1] Jacobs and Associates, Inc. has broad experience advising clients on financial, strategic, and operational issues across the electric value chain including conducting competitive assessments of power plant economics and assessing alternative strategies in response to new federal and state legislation and other initiatives. Past clients include regulators and utilities, including the ICC.

transition to clean energy are developed, encouraging the growth of new renewable energy solutions while maintaining reliable energy services to Illinois customers. In particular:

- The Act requires the Illinois Power Authority to sign 10-year contracts with existing sources of zero-carbon energy, similar to the 2010 procurements for long-term renewable energy.
- A contract would be available for qualifying clean energy generation to sell “carbon mitigation credits” to compensate for the provision of carbon-free electricity.
- The contract price would adjust as the market price for electricity varies to maintain the agreed upon cap for the all in price for electricity including market price plus carbon mitigation credits and to ensure retail customers do not overpay for the carbon-free attributes from the qualifying generator.
- 74 million carbon mitigation credits are provided for in the Act, enough to cover the four nuclear plants not currently receiving zero emission credits.
- The Act allows for the provision of additional carbon mitigation credits for the Clinton and Quad Cities plants when the current zero emission credits expire in 2027.
- Customers are protected because the Act requires repayment to customers if electricity prices rise above the contract price for any reason during the contract term, including a market price adder on carbon emissions.
- The bill gives Illinois and the Federal government time to implement other long-term policy options, such as a carbon price adder, capacity market changes or a Federal clean energy standard.
- It provides time to allow for improvements in storage technologies like batteries which ensure the availability of electricity to customer all hours of the day regardless of weather conditions.

What Nuclear Plants are Affected and at Risk of Closure?

Two dual-unit nuclear stations – Byron and Dresden – are slated to close in the Fall of 2021 without a financial support mechanism. Two others, LaSalle and Braidwood have also been experiencing significant financial pressure. The affected capacity is summarized in the table below. One terawatt-hour (TWH) equals 1 million megawatt-hours (MWH).

Nuclear Plant	County	Megawatts	Annual Generation in TWH at 95% Capacity Factor
Braidwood	Will	2,386	19.9
Byron	Ogle	2,347	19.5
Dresden	Grundy	1,845	15.3
LaSalle	LaSalle	2,320	19.3
		8,898	**74.0**

Combined, the four stations can meet about 50% of Illinois' annual electric energy requirement. Premature closure of any or all of these plants would make it extremely challenging and costly to completely decarbonize the State's electric sector.

The CJI hired two energy economists from Jacobs and Associates, Inc. to evaluate the future viability of these four plants. Jacobs and Associates analyzed the confidential data Exelon provided to the Governor's consultant and concluded:

- All four plants will likely retire absent legislation providing financial support.
- The revenue shortfall of these plants is at least several hundred million dollars per year even under revenue/cost sensitivity cases that are more optimistic than Exelon's internal projections.

Why Do These Plants Need Financial Support?

Carbon-free renewable energy facilities have been receiving substantial Federal and state financial support for years. Yet existing carbon-free generating facilities, such as hydroelectric and nuclear capacity, have not generally received any such financial support for the provision of carbon-free energy. As electric energy prices have fallen, the financial viability of all of Illinois' non-ZEC nuclear plants are threatened. The Byron and Dresden plants, for example, have already experienced several years with negative cash flow over the last decade, and that trend is expanding to all of the plants. Because Exelon must compete for capital to maintain the integrity of these plants, low returns make it difficult to raise these funds or justify new investment in the plants. Therefore,

without a “bridge” solution, such as proposed in the Climate Union Jobs Act, Exelon will shut down these plants. Similar bridge solutions have been implemented in other states to preserve nuclear plants including New Jersey, New York, Connecticut and in Illinois for the Clinton and Quad Cities plants.

How did you evaluate the profitability of the plants?

The evaluation of the future profitability of a power plant requires that both revenue and costs be forecasted reasonably.

Future electric power price forecasts are developed by using futures data in the initial years, and a market fundamentals model in the latter years. Trading platforms such as the Intercontinental Exchange (ICE) offer hedge products that are used universally in the energy industry. These futures are standardized instruments and enable two parties to either supply or purchase a set amount of power at a firm price at some defined point in the future. Accordingly, these transactions provide price discovery and indicate the level of future prices. Their limitation, however, is that futures transactions become increasingly scarce after several years necessitating the use of a fundamental supply and demand model for the latter years of a price forecast.

Effective fundamental models are generally very sophisticated and rely on important assumptions regarding future power plant fuel costs, demand projections, environmental legislation, transmission system topology, regional power imports and exports, planned plant retirements, and the expected build-out of new capacity. Accordingly, effective modeling of power prices has elements of both art and science. Highly skilled modeling practitioners generally develop different scenarios and run sensitivities so that a wider range of potential outcomes can be considered in ensuring that a power system is 1) reliable under almost all circumstances, 2) as economic as possible, and 3) getting much cleaner, given the first two considerations.

Energy prices – and therefore revenues – can exhibit considerable volatility over an extended period. Accordingly, most consumers, regulators, and legislators favor planning and actions that lead to very reliable power supply portfolios that do not fluctuate significantly in price year over year. The Climate Union Jobs Act was developed to ensure that Illinois consumers continue to benefit from the zero-carbon attributes of the State’s most reliable source of power at reasonable prices for at least the next 10 years.

To assess plant profitability, future costs and capital spending must also be forecast. To do this effectively, historical costs are the best place to start. In the case of the Exelon nuclear facilities, historical cash costs are significantly above the projected price of electricity, but well below the price of any viable alternatives. As such, sustaining the units with financial support is in the best interest of customers.

An owner of an existing power plant will need to cover all of its costs going forward including compensation for operating and market risks. Events in California in August 2020 and Texas in February 2021 show the peril of operating power plants when capacity shortfalls ensue. As such, a rational owner will need to cover these risks, or shut down the facility to avoid them altogether.

It is not uncommon at times for producers to accept prices that are slightly above short-run marginal costs and continuing to produce. Why won't Exelon accept revenue levels that cover short-run marginal costs and just keep operating for years?

Producers will indeed continue to produce at prices that are barely above the cash cost of production, but only for a limited time. It simply is not sustainable for long.

First, risks are inherent in any production process. Without reasonable margin, no rationale agent will continue to accept potential risks without adequate compensation. To behave otherwise would expose the producer to the risk of significant losses. In any market where prices are forecast to be lower than the cash cost of production, producers move swiftly to idle or close capacity permanently. This is the situation facing Exelon.

Second, most merchant generators engage in mechanistic hedging to protect margins. However, even with a hedged position, a producer still faces production risks. This is what resulted in billions of dollars in losses in Texas in February 2021 during protracted and bitter weather conditions. Producers sold energy forward at fixed prices, but then were unable to produce the power and had to buy replacement power at much higher prices to settle obligations. The reality of this situation is that producers face operational and market risk that must be compensated through adequate margins over the long run.

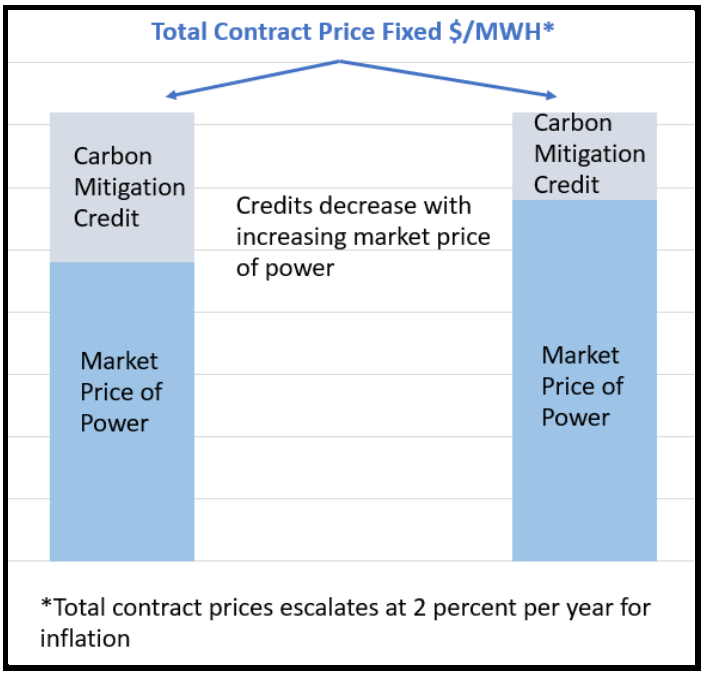
Producers must be compensated for the operating risks they assume, or they will exit a market. Arguing that producers will continue to operate for years on razor thin margins is not borne out by actual producer behavior over the long run.

Is There Another Way Economists Can Assess Financial Viability Under Uncertainty?

Yes, while sophisticated modeling tools can be very helpful in accounting for uncertainty, it is highly dependent upon the cost factors and other assumptions included within the model. Detailed models often underestimate future uncertainty and related risks. It is always useful to conduct "logic checks" on the output of sophisticated models. Another way analysts test economic studies for uncertainty is through a simpler approach – sensitivity analysis. Key economic and cost parameters can be adjusted by percentages or fixed values to test the results. For evaluating the financial viability of the non-ZEC nuclear plants, the CJI energy economists looked at several more optimistic scenarios than the costs and revenues projected by Exelon. In particular, they increased the projected revenues by 10 percent. In another scenario, projected costs including risks were reduced by 10 percent. Finally, a conservative assumption that both revenues would increase by 10 percent and costs would be reduced by 10 percent was examined. Among all of scenarios examined, the non-ZEC nuclear plants still demonstrated a shortfall in cash flow of hundreds of millions of dollars, again affirming the need for the bridge contract as an insurance policy.

Why Is the Bridge Contract Like an Insurance Policy?

So far, the Federal and most state governments have not enacted long-term policies to either tax carbon-emitting electricity generation or provide support to sustain existing carbon-free energy facilities. As is the case with any insurance policy, the bridge contract provides protection to Illinois energy customers and all residents of Illinois, while awaiting more comprehensive and economic solutions. In particular, the contracts compensate nuclear facilities for the zero-carbon attributes of their energy production and protect Illinois consumers by capping the total amount paid for those attributes plus the energy production. In the early years, utility customers compensate the clean energy generators for the shortfalls (just as customers have paid to support new renewable energy solutions). If market prices for electric energy increase in the future as many people predict (especially with the implementation of a nationwide "carbon price adder") customers are protected because the contracts require the clean energy generators to pay customers for revenues collected above an established price during the term of the contract as depicted below.



Customers are further protected because if market prices for power become higher than the bridge contract price for any reason, the increased revenues are returned to utility customers as credits until they are fully paid back for the initial years. Finally, by preserving the nuclear plants, system reliability is maintained as the nuclear plants have a history of high availability all hours of the day in all weather conditions.

Do renewable energy options provide the same level of reliability as the nuclear units?

No, unless they are developed with costly, long-duration storage capacity. The Climate Union Jobs Act provides preferences for clean energy solutions that match customer energy time of day usage. Wind and solar solutions are dependent upon weather conditions and are usually unable to meet customer requirements on peak days or weeks in the middle of summer and winter. Energy storage solutions can provide eventual relief, but the technology is not yet mature enough for long duration storage to meet peak day requirements with favorable economics. Just adding more and more renewable energy facilities does not meet peak load needs if the facilities are not available at all hours of the day in all weather conditions. In fact, with current technologies, the cost to replace and match the reliability of the nuclear plants with a combination of solar, wind, storage and new transmission line resources would cost much more than the expected bridge contract price envisioned in the Act and would be paid by all customers. As indicated previously, the bridge contract provides an

insurance policy protecting customers until further advances are made in storage technologies.

How much should the nuclear plants be permitted to charge for carbon mitigation credits?

To be eligible for the carbon mitigation credits and the 10-year bridge contract, an existing clean energy generator needs to show financial hardship. Like the ZEC law, showing need would require generators to submit cost forecasts including operation and maintenance expenses, fully allocated overhead costs using the industry standard allocation methods defined by the Institute of Nuclear Power Operations, fuel costs, non-fuel capital expenditures, spent fuel expenditures, a return on working capital, consideration of operational and market risks and any other costs necessary for continued operations.

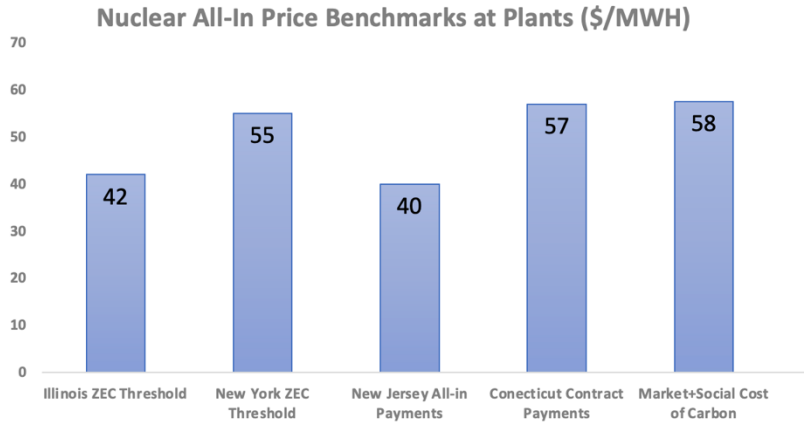
Determining a reasonable price for the bridge contract should consider the following factors, and as depicted graphically below:

- **Value Test** – the value to society of preserving clean power is estimated by the Federal government at $51 per metric ton, referred to as the Social Cost of Carbon. The estimate is expected to increase over time. When added to the market price of power in northern Illinois, the cost to customers would be $55 to $60 per megawatt-hour (MWH), far above current prices and the likely price anticipated in the bridge contracts.
- **Replacement Cost Test** – as indicated earlier, the cost to replace the carbon-free nuclear plants while maintaining reliability all hours of the day in all weather conditions with solar, wind, storage and transmission resources is apt to be even higher than the market price plus the Social Cost of Carbon discussed in the Value Test above. According to the National Renewable Energy Lab (NREL) estimates for the capital cost of storage is about $250,000 per MWH of storage [2]. To provide multi-day storage capabilities would cost tens of billions of dollars not even including the cost of solar and wind renewables.
- **Other State Program Test** – Similar zero emission credits have been applied in other states such as New Jersey, New York, and Connecticut with total contract prices between $40 and $56 per MWH. In Illinois, the total contract price including zero emission credits (ZECs) for Clinton and Quad Cities plants is $42 per MWH. Contract prices for the non-ZEC nuclear plants in Illinois would be

[2] https://www.nrel.gov/docs/fy19osti/73222.pdf

expected to be lower, because these plants are larger and therefore more efficient than Clinton and Quad Cities.

- **Cost Test** – Historical costs to operate the Illinois nuclear units offer a guide to future costs. Contract value should not be below historical spending, adjusted for inflation, for locational cost differences between plant sites and the Northern Illinois trading hub, and for the inclusion of a return on capital. While the CJI consultants have reviewed the detailed cost data, it cannot be publicly disclosed. However, with market prices currently at about $24 to $26 per MWH, revenues are well below the cost to operate the nuclear plants and substantial financial support would be required to continue operating them.



Why are risks an important consideration in determining a reasonable bridge contract price?

Aside from the inherent operational and market risks for a merchant generator discussed above, risks are important even when considering a fixed price contract arrangement. First, any insurance policy involves the consideration of risks. An insurance policy mitigates risks of the policyholder and is naturally accounted for by the provider of the insurance. Stated another way, any long-term contract involves trade-offs. The recipient of services or products receives certainty on price and is not subject to the variability of market conditions. The provider of services or products also receives certainty of revenues but gives up the opportunity for surplus earnings. When a long-term contract price is offered by a provider, it is natural to account for extreme down-side risks (that is unexpected costs) in the long-term price, again because there is no opportunity to recover the additional costs if market prices increase. No supplier would offer a long-term contract price at bare minimum cost, without some additional

margin to cover down-side risks. Again, the recipient of services also benefits from the contract by not being subject to the risks of higher market prices that might occur without a longer-term commitment.

Should a contract with a shorter term than ten years be considered?

No, a ten-year contract offers significant advantages. While a shorter-term contract might provide an opportunity for Federal or regional solutions to be further developed, this is not necessarily a better option for utility customers. First, with a longer contract, customers have greater certainty as to their electricity costs. Further, if electricity costs increase such as with the implementation of carbon pricing programs, customers would experience these increases in prices once the contract expires. With the bridge contract, customers are protected from further such price increases during the term of the contract. If market prices increase to a point above the contract price, bill credits are provided to the customers from Exelon. If the contract is shortened, there is less time available to provide potential customer bill credits. Finally, if the contract is shortened Exelon would be less inclined to support the plants with necessary interim capital investments – resulting in more difficulty should the State wish to later extend the contract.

Some might claim Exelon is understating the financial viability of the nuclear plants because they are under-estimating future revenue increases. Is this valid?

No, it is not. As described earlier, reasonable sensitivity analyses on revenues and costs indicated considerable shortfalls in cash flow even after more optimistic scenarios were considered. Further, the bridge contract proposal takes this concern off the table. If future revenues increase, the payment to Exelon under the contract would decrease dollar for dollar. In fact, if future revenues increase by more than the contract price, the payment to Exelon becomes a payment from Exelon to consumers.

If the nuclear plants were shut down, please explain why there would be an almost immediate increase in customer electric rates.

A study was conducted by The Brattle Group, well-regarded energy industry researchers. The study was conducted for the Illinois IBEW State Council and the Illinois AFL-CIO. The Brattle Group concluded there would be immediate impacts on customer rates without the nuclear plants, largely because of the loss of large base load

capacity that would not only increase electricity prices but would be replaced in the short term with generating plants fired with natural gas and coal. Further, carbon emissions would increase considerably. Brattle's conclusions are summarized below[3]:

Table 1: Summary of Electricity Price, Economic and Environmental Impacts Annual Average, 2020-2029

	Without Byron & Dresden	Without Byron, Dresden, Braidwood & LaSalle
Increased Electricity Costs in IL *(2020$/MWh)*	$2.11	$3.27
Increased Electricity Costs in IL *(Annual 2020$ Millions)*	$313	$483
IL State GDP Loss *(2020$ Millions)*	n/a	$3,464
IL In-State Job Loss *(jobs)*	n/a	28,030
IL State Tax Revenue Loss *(2020$ Millions)*	n/a	$149
Total CO_2 Emissions Increase *(Million Tons)*	20,094,860	45,208,804

Are there other options to the bridge contract to maintaining the financial viability of the nuclear plants in Illinois?

Yes. There is a proposal to initiate a local electric capacity market in Illinois rather than through the capacity bid process operated by the PJM Regional Transmission Organization (PJM). Under this plan a Fixed Resource Requirement (FRR) alternative would be implemented. With this arrangement, the nuclear operators would be paid for capacity through procurements conducted by the IPA and would not have to clear in the PJM regional capacity auctions. However, for the FRR arrangement to successfully forestall the closure of the nuclear plants, the plan would have to be implemented by April 2021, which is no longer possible. To protect customers, however, if the bridge contract is implemented now, and the FRR plan is initiated later, the customer would still pay the contract price and any carbon mitigation credits included in the price would be

[3] The Impacts of Nuclear Power Plants on the Economy and the Environment by the Brattle Group, reissued December 2020

offset by any FRR payments.

Conclusions

Preservation of the nuclear plants is in the interests of all Illinois utility customers to maintain reasonable rates and reliable electricity, all hours of the day and in all weather conditions. Preservation of the nuclear plants benefits residents and businesses because it is critical to meeting the clean energy goals by the 2030s. Finally, preservation of the nuclear plants will save jobs for thousands of utility employees and for many thousands more in the communities that surround the power plants. The Climate Union Jobs Act applies an orderly transition to supporting the growth of new clean energy renewable resources while at the same time preserving reliable and economical carbon free nuclear generation.