ILLINOIS ENERGY ROADMAP

JUNE 2017

Illinois
Department of Commerce
& Economic Opportunity
OFFICE OF ENERGY & RECYCLING

TABLE OF CONTENTS

EXECUTIVE SUMMARY

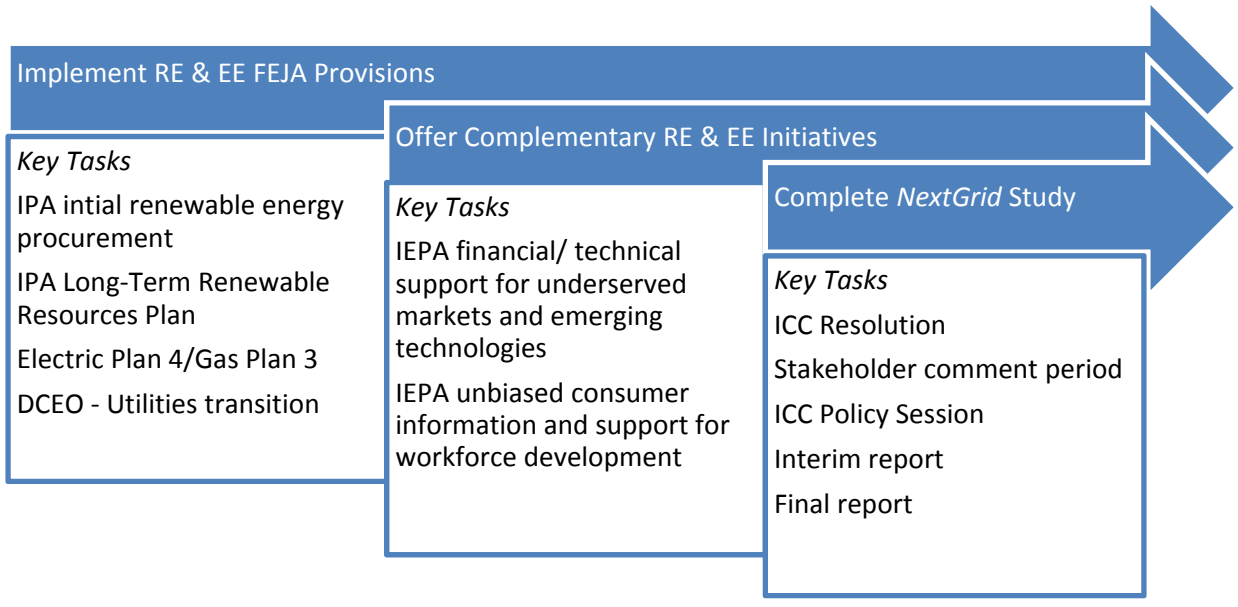
The Illinois Energy Roadmap Project has been a two-year, interagency effort to consider the State's energy future, focusing on the role of energy efficiency and renewable energy. This Project culminates with the publication of this Illinois Energy Roadmap, which lays out key energy actions the State will take to advance these resources over the next several years.

The Roadmap is the third and final deliverable of this Project. It was preceded and informed by the baseline study, or Goals Status Report, published in February 2016, as well as the Policy Review Report, published in March 2017, which summarized feedback received from stakeholders, as well as the major relevant provisions of the new Future Energy Jobs Act (FEJA) passed in December 2016.

The specific energy actions and timeline for their implementation included in this final Roadmap were developed through an iterative, interagency deliberation process, among our Advisory Group partners – the Governor's Office, Illinois Environmental Protection Agency (IEPA), Illinois Pollution Control Board (IPCB), and Illinois Power Agency (IPA). Taking into consideration the stakeholder feedback received at earlier stages of the Project, as well as baseline and updated energy modeling, the Advisory Group identified core renewable energy and energy efficiency actions and tasks the State Agencies intend to take over the next several years (see below).

The Advisory Group had to give careful consideration to what could be reasonable achieved within resource constraints, both budgetary and personnel. The Group discussed a universe of potential actions and tasks, prioritized them, identified responsible parties, and articulated realistic timelines for completion. Detailed discussion of each action, including objectives, tasks, milestones, and roles and responsibilities are included in this Roadmap.

It's important to note that the Roadmap is intended to be a living document, based on current State priorities, but may be adapted over time as gaps are filled or new challenges



EXECUTIVE SUMMARY

arise. Moving forward, the Advisory Group will continue to meet regularly to track progress toward the milestones laid out in this Roadmap, as well as discuss emerging energy issues and revise the Roadmap as necessary. The State will provide an annual update to stakeholders to highlight the status of meeting specific tasks and any changes to the Roadmap.

The goal of this Project has and continues to be to grow Illinois' economy through robust deployment of energy efficiency and renewable energy resources, while maintaining a reliable transmission grid, and keeping electricity prices relatively low. The development of these resources will also help Illinois meet current and potential future environmental regulations. The State feels that the actions laid out in this Roadmap go a long way to getting us there, however, it also recognizes that energy efficiency and renewable energy are just two pieces of Illinois' broader energy puzzle. To that end, the State also looks forward to building on the momentum of this effort and others to continue a robust interagency and stakeholder dialogue regarding Illinois' broader energy future and its ties to a strong economy.

PROJECT BACKGROUND

This Illinois Energy Roadmap is the third and final deliverable under a grant from the U.S. Department of Energy (DOE) to the Illinois Department of Commerce and Economic Opportunity (Department of Commerce) and its technical partners, the Galvin Center for Electricity Innovation at the Illinois Institute of Technology (IIT), the Energy Resources Center located at the University of Illinois at Chicago (ERC), and the Regional Economics Applications Laboratory (REAL) at the University of Illinois at Urbana-Champaign (U of I). The grant was awarded under the DOE State Energy Program 2014 Competitive Awards, Funding Opportunity Announcement Number DE-FOA-0001073.

The goal of this Illinois Energy Roadmap Project (Project) has been to evaluate how the development of renewable generation and increased utilization of energy efficiency can be combined to support economic growth, meet current and future environmental requirements, and maintain regional grid stability and identify what steps the State should take accordingly. The Project also takes into consideration other existing and potential future sources of electricity. It does not include evaluation or assessment of energy use in transportation.

The DOE grant specifically supports the efforts of the Department of Commerce and its partners to undertake technical evaluations, conduct stakeholder engagement, and coordinate interagency planning activities to craft a cohesive and effective roadmap for Illinois.

The Project has been an interagency collaboration, with representatives from the Governor's Office, Illinois Environmental Protection Agency (IEPA), Illinois Pollution Control Board (IPCB), and Illinois Power Agency (IPA) making up the Advisory Group.

PROJECT DESIGN

The Illinois Energy Roadmap Project was initiated during a period when the State's policies for energy efficiency and renewable energy appeared stalled, and the potential for new federally-driven energy policy changes appeared to be high (e.g., the Clean Power Plan). Against this background, the Project was to provide a means by which state agencies could coordinate planning to improve performance against existing and potential policy goals.

As the proposals that led to the Future Energy Jobs Act (FEJA, P.A. 99-0906) began to emerge after the Project kickoff, the Advisory Group recognized that it might need to adapt the Roadmap and its planning process depending on legislative outcomes. Luckily, the initial design of the Project has made this quite feasible. Much of the analysis conducted to date through the Project has been oriented towards evaluating potential outcomes of general increases in energy efficiency and renewable energy under different market conditions. The results of these analyses were to inform thinking about what recommendations and functional actions participating agencies could undertake to improve on existing energy policies. This is still relevant with the passage of the FEJA (a summary of the provisions of the FEJA can be found below and in Appendix A).

The enactment of this law reinforces the value of the Project. It demonstrates a deep

PROJECT BACKGROUND

KEY RENEWABLE ENERGY & ENERGY EFFICIENCY FEJA PROVISIONS

- **Renewables**
  - *Renewable Portfolio Standard (RPS):* Updates Illinois' existing RPS, requiring IPA to take responsibility for planning RPS for all Illinois retail customers and develop and revise long-term procurement plans every two years; maintains 25% by 2025 goal but sets new targets for wind and solar; distributed generation and community solar developers will know renewable energy credit (REC) values upfront, under an Adjustable Block Program, and RECs will be continually available rather than episodic.
  - *Solar for All:* New provision requires IPA to use proceeds from the existing Renewable Energy Resources Fund for low income solar projects and support.
  - *Net metering & Rebates:* New provision requires utilities to offer a rebate for renewable distributed generation projects; net metering maintained for residential customers until solar demand is 5% of utility peak.
- **Energy Efficiency Portfolio Standard:** Converts electric efficiency goals from incremental annual savings to cumulative persisting annual savings, increases cost caps, and allows utilities to earn a return on efficiency investments; exempts 10MW+ electric customers and eliminates IPA electric efficiency procurement process; shifts administration of all low income and public sector programs to utilities; converts planning processes to 4-year cycles.

recommitment among policymakers and stakeholders to expand the use of energy efficiency and in-state renewable energy in Illinois, as well as retaining zero-carbon baseload generation. It sets out several tasks agencies will have to complete in the near-term to medium-term to advance these goals, but also leaves room for potential complementary actions. In other words, by providing a new set of energy policies and functional processes for the State, the FEJA provides the Project with a better focus.

While some adjustments to the Project's design have been required along the way, it has continued to be organized around the following four stages:

Stage 1 - Baseline Modeling. The Project team worked with an Advisory Group (staff from key energy agencies in the State) to identify current and proposed energy regulations that apply to Illinois, and collect key data concerning the current operation of the regional electricity market to support market simulations. Then, with guidance from the Advisory Group and stakeholders, market simulations were run using IIT's Market Price Simulator (MarSi). MarSi is an energy market simulation software package developed at IIT that models the hourly operation of integrated regional electricity and natural gas pipeline systems based on user-defined operating conditions. Detailed information on MarSi can be found in the Roadmap Process Development section and Appendix B. Acknowledging that energy market conditions can vary dramatically over time, the baseline modeling was arranged in a

PROJECT BACKGROUND

manner to define a range of market outcomes based on different combinations of key variables (fuel prices, generation availability, transmission, and demand). The resulting sixteen (16) scenario outputs provide a full spectrum of market condition that could arise over the 2016-2030 period. The results of this first level analysis were presented in the Goals Status Report, in February 2016.

Stage 2 - Stakeholder Outreach & Advanced Modeling. Stakeholders were invited to provide comments on the findings presented in the Goals Status Report, and to recommend solutions to address any potential shortfalls in meeting Illinois' energy policy goals through a formal stakeholder comment process. The stakeholder process also included public workshops where guided conversations around the Goals Status Report were facilitated.

Parties that participated in the stakeholder outreach included: utilities, generators, environmental interests, and consumer interests and other groups.

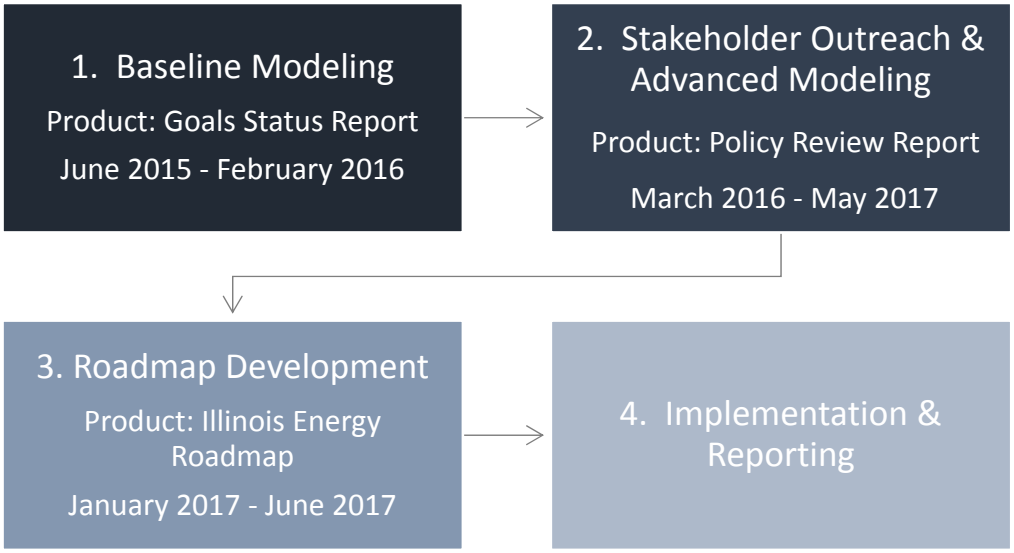
Stakeholder recommendations were reviewed and used by the Advisory Group to define three (3) new Baseline Scenarios to reflect potential 'business as usual' future market conditions for Illinois and the Eastern Interconnection. Additionally, based on stakeholder input, the Advisory Group identified four (4) Solution Scenarios to test against each of the Baseline Scenarios and identify local changes in energy prices, economic development, grid reliability, emissions, and energy exports/imports. A summary of the stakeholder feedback received and the outputs of this modeling activity were to be contained in this Policy Review Report.

By early Fall 2016, the Group was deep into Stage 2 of the project. Stakeholder outreach had been completed, recommendations reviewed, and most of the advanced modeling and a draft of the Policy Review Report was complete. However, at the same time, negotiations for what would eventually become the FEJA intensified, and by December its passage meant that both the Policy Review Report and the Roadmap itself needed to be somewhat retooled. Consensus was reached with the Advisory Group that the focus would no longer be on the advanced modeling, since much of it is now moot in the face of legislation that significantly impacts multiple aspects of the State's energy market. Rather, the Policy Review Report, published in March 2017, still summarizes the feedback received during the stakeholder process, but then reviews the major components of the new law, and outlines the subsequently revised approach to the development of the Illinois Energy Roadmap.

Stage 3 - Roadmap Development. Originally it was envisioned that during this phase the Group would determine the extent to which the Solution Scenarios in the Policy Review Report presented outcomes that were desirable, and identify actions to achieve those outcomes that could be implemented through: 1) individual agencies in the near term; 2) joint action between the agencies over the medium term; or 3) longer term options requiring new statutory authority.

In light of the passage of the FEJA, the Advisory Group has still identified near-, medium--term actions that the agencies

PROJECT BACKGROUND



would take to advance the State's broad energy goals of robust energy efficiency and renewable energy resources that support economic growth. However, the new law allows the Advisory Group to narrow the focus on actions that will represent the State Agency milestones for implementation of the FEJA and complementary measures that the Agencies wish to support. These actions, along with a timeline and responsible parties, are outlined in this Illinois Energy Roadmap.

Stage 4 - Implementation and Reporting. After the publication of the Roadmap the Advisory Group will conduct quarterly meetings to discuss initiatives, receive stakeholder input, and review new statutory requirements related to energy issues on an ongoing basis.

The Advisory Group's objectives will be to issue and implement an Annual Planning Report that presents: 1) status of meeting specific tasks, and; 2) proposed actions and recommended policy/statutory changes to be pursued over the subsequent 3-year period.

ROADMAP DEVELOPMENT PROCESS

Identifying the energy actions and timeline to be included in this Illinois Energy Roadmap has been an iterative process, taking into account multiple rounds of stakeholder feedback, energy and economic modeling, and Advisory Group agency priorities and deliberation.

STAKEHOLDER FEEDBACK

Stakeholder feedback has been a vital part of this process, and while it has been received throughout the duration of the Project, it was welcomed formally at three key intervals – to inform the baseline modeling phase, after publication of the Goals Status Report, and finally with regard to draft actions and timeline to be outlined in this Roadmap. Stakeholders have included key energy market participants, such as generators and utilities, policy organizations including environmental and consumer advocates, as well as industry and trade groups.

The first round of input was provided after the Advisory Group had settled on preliminary guidelines for the baseline energy modeling. In October 2015, parties were welcomed in Chicago and Springfield to a half-day meeting to review and discuss: the MarSi model, the datasets and assumptions the Advisory Group had initially determined it would make, and the scenarios the Advisory Group were looking to run through the model. Feedback regarding the baseline modeling was received both at the meeting and in written form for several weeks after the meeting.

The next and most significant round of stakeholder input came after the publication of the Goals Status Report, in February 2016, when parties were invited to provide feedback on primary policy questions. This feedback was instrumental in informing the Advisory Group's deliberations and actions identified in the Roadmap.

Stakeholders could provide input in two ways – by submitting written comments and/or participating in regional meetings. Written comments were accepted online for more than a month, and were posted on a public website, so that they could be reviewed by all parties. Two public forums were held in Chicago and Springfield, and stakeholders were given the opportunity to present their ideas, as well as pose questions to the Department, Advisory Group members, and one another.

Specifically, feedback was sought in three key areas:

Additional Data. What additional data can be used to augment the MarSi modeling activities that support the Project, e.g., data concerning generation and transmission assets, fuel prices, load patterns and projections?

Interpretations of Findings. What are stakeholder interpretations of the Project findings to date? Specifically, do stakeholders interpret modeling differently than what was presented in Goals Status Report and why?

Solution Scenarios. What approaches, if any, are needed to improve Illinois' performance with regards to its primary energy policies?

- What are the greatest strengths, weaknesses, opportunities, and threats regarding the Illinois energy sector?

ROADMAP DEVELOPMENT PROCESS

- What changes to EE & RE policy would you suggest?

Robust comments and formal presentations at the two public meetings were received from a wide range of the State's energy stakeholders, including those highlighted in the box on the right.

All presentations and comments can be found online. Advisory Group members were invited to review the complete set of comments but were also provided a digest, which summarized key points of each stakeholder, including:

Additional Data & Findings.

- Many commenters felt business as usual energy efficiency was underestimated and/or business as usual load growth was overestimated.
- Many suggested reviewing/incorporating different data sources for cost figures.
- Some changes to air data/assumptions about regulations were suggested, including those related to the U.S. Environmental Protection Agency's then-stayed Clean Power Plan.
- Several suggestions were made to perform complementary/supplemental modeling.
- Dynegy shared that they expect to retire 2500 MW of coal generation by 2018.
- Clean Line pointed out their proposed projects could represent 7000 MW of new supply.
- Exelon suggested baseline RE was underestimated in the modeling.

Solution Scenarios. Stakeholders proposed a variety of approaches to advancing energy efficiency and renewable energy in Illinois, including policy remedies and new areas of focus:

- Offering the utilities performance incentives for energy efficiency.

KEY ROADMAP STAKEHOLDERS

- 360 Energy Group
- Business Council for Sustainable Energy
- City Water, Light & Power
- Clean Energy Trust
- Clean Line Energy Partners
- Coalition to Request Equitable Allocation of Costs Together
- Dynegy
- Elevate Energy
- EnerNOC
- Environmental Law & Policy Center
- Exelon
- Farnsworth Group
- Illinois Competitive Energy Association
- Illinois Environmental Regulatory Group
- Illinois Industrial Energy Consumers
- Illinois People's Action
- International Brotherhood of Electrical Workers
- Invenergy
- ITC
- Midwest Energy Efficiency Alliance
- National Resources Defense Council
- Offshore Wind Illinois
- Patrick Engineering
- Sierra Club
- Strong Legal & Regulatory Solutions
- Union of Concerned Scientists
- Wind on Wires

ROADMAP DEVELOPMENT PROCESS

- Revising or removing the rate cap for the existing Energy Efficiency Portfolio Standard (EEPS).
- Instituting a Self-Direct Program on the electric side of the EEPS for large customers.
- Fixing a malfunctioning Renewable Portfolio Standard.
- Instituting a preference for in-state renewable resources.
- Building more transmission for renewable energy.
- Focusing on greater utilization of demand response.
- Growing energy storage capabilities.
- Considering a market design fix in Southern/Central Illinois.
- Pursuing cost-effective CHP projects through utility incentives to achieve a portion of future energy efficiency, future electrical supply, and emission reductions.

Finally, a preliminary draft version of this Roadmap was also circulated for written stakeholder comments, prior to publication.

Each round of comments has been critical to the subsequent discussions, modeling efforts, and energy actions identified by the Advisory Group. Several were addressed by the renewable energy and energy efficiency portions of the FEJA. Others have been incorporated into the complementary actions identified in the Roadmap. Although not all feedback could be resolved through this Project – particularly those issues that fell outside of the renewable energy and energy efficiency-focused scope – the State continues to consider this valuable input and looks forward to continuing to work on these topics beyond the Roadmap effort.

MODELING

The Advisory Group's development of the Roadmap has also been informed by two rounds of energy modeling, performed by technical partners at IIT. As noted earlier, the first round of baseline modeling was completed at the outset of the Project, and identified expected energy outcomes in Illinois, through 2030, under "business as usual" conditions. The results from this modeling are discussed in detail in the Goals Status Report.

Following the stakeholder feedback received in response to the Goals Status Report, the Advisory Group and its technical partners commenced the second advanced round of modeling, which was near completion in Fall 2016. However, as noted earlier, upon the passage of the FEJA, the Advisory Group determined that the modeling should be updated to ensure its relevance.

MarSi. The updated analysis continued to employ the MarSi model, also used in the baseline modeling. MarSi is an energy market simulation software package developed at IIT that models the hourly operation of integrated regional electricity and natural gas pipeline systems based on user-defined operating conditions. MarSi utilizes data from multiple sources to: i) identify the operational capacities and limitations of all utility-scale generation and transmission assets within the Eastern Interconnection; and, ii) identify historical consumption at all market nodes throughout the Eastern Interconnection. MarSi simulates the operations of the electricity markets in accordance with prevailing market rules

ROADMAP DEVELOPMENT PROCESS

(inclusive of issues such as spinning reserves, operating reserves, unit commitments, and natural gas fuel constrictions). For the purposes of this Project, MarSi was used to establish the market prices, grid reliability and CO_2 emissions. More details on MarSi can be found in Appendix B.

Scenarios & Assumptions. In the updated analysis the MarSi model was run to look at four scenarios out through 2030: updated baseline from the Goals Status Report, outcomes with FEJA provisions, outcomes without ZECs but higher economically-viable levels of energy efficiency and renewable energy (to compare to updated baseline), and outcomes with FEJA provisions and higher economically-viable levels of energy efficiency and renewable energy (to compare to FEJA). More detailed descriptions of these scenarios can be found below in Figure 1.

All scenarios maintained consistent assumptions for the following variables: fuel cost[1], load growth, and the development of new standard thermal generating plants (only power generation projects that are currently under construction were assumed to commence operation during the modeling horizon). The scenarios factored different assumptions concerning the following: the ongoing operation of the Clinton and Quad

Figure 1: Description of Modeling Scenarios

Scenario	Fuel Cost	Load Growth	Energy Efficiency	Thermal Generation		Renewable Energy Generation Development (in state)
				Retirements	New Build	
1	AEO-2016 (Reference Case)	AEO-2016 (Low Case)	EEPS + 111.5B levels	Announced + Clinton/Quad	All currently under construction	None - compliance met via RECs
2	AEO-2016 (Reference Case)	AEO-2016 (Low Case)	FEJA levels	Announced	All currently under construction	FEJA goals for wind/solar (assuming both high & low purchase cost ranges)
3	AEO-2016 (Reference Case)	AEO-2016 (Low Case)	Maximum economically-achieveable	Announced + Clinton/Quad	All currently under construction	FEJA goals for wind/solar (assuming high/low purchase cost ranges), with increase in cost caps to allow for a 50% increase in RECs purchased
4	AEO-2016 (Reference Case)	AEO-2016 (Low Case)	Maximum economically-achieveable	Announced	All currently under construction	FEJA goals for wind/solar (assuming both high/low purchase cost ranges), with increase in cost caps to allow for a 50% increase in RECs purchased

[1] Fuel costs and load growth data from U.S. Energy Information Administration's 2016 Annual Energy Outlook.

ROADMAP DEVELOPMENT PROCESS

Cities nuclear power stations, the level of energy efficiency delivered through utility programs, and the level of renewable energy asset development in Illinois. Please also note, for analysis purposes, Scenarios 2, 3, and 4 were further customized to reflect a high and low cost of acquisition for renewable energy resources.

Results. Scenario assumptions impact the balance of supply and demand and the cost competitiveness of different supply options in Illinois and the Eastern Interconnection. Each scenario yields differences in the following primary metrics: amount of energy efficiency and renewable energy delivered in Illinois, consumer cost for electricity, reliability of the regional transmission grid, level of CO_2 emissions from generators, and level of electricity imports versus exports. Detailed results from the second round of modeling are laid out in Appendix B.

Summary Observations. The objective of this round of analysis was to present a range of possible energy market opportunities that the State of Illinois may be able to influence (e.g., new energy efficiency volumes, new renewable energy assets). While it must be noted that due to the need to update the second round of modeling, much of the interagency Roadmap development discussion had to occur prior to these results being available, there are several key conclusions that support the framework laid out in this Roadmap:

- Scenarios 2, 3, and 4 all allow Illinois to remain a significant net energy exporter through 2030, while the baseline sees Illinois largely lose this status by 2030. Scenarios 3 and 4 see an even greater dominance of exports than 2. Scenarios 2-4 also see relatively lower wholesale energy prices, than the baseline, again with 3 and 4 being still lower than 2. Therefore, successfully implementing the FEJA is critical to maintaining one of the State's core economic drivers, and enhancing efficiency and renewable growth with complementary measures may also prove valuable.
- Meeting more aggressive energy efficiency targets appears to have more positive impact than retaining nuclear stations or increasing renewable energy asset development with regards to market prices, exports, and CO_2 emissions from generators. Therefore, Agencies may consider undertaking planning activities oriented towards ensuring that efficiency goals are met and exceeded over the near-, medium-, and long-term.
- Cost caps may cause modest reductions in renewable energy development in the state, if costs for renewable energy credits trend to the high side of projections. Therefore, Agencies may consider undertaking activities oriented towards securing the lowest possible costs for renewable energy resources in Illinois (e.g., providing additional financial support, broadening and deepening bidder pools).

Additionally, as this Roadmap is intended to be a living document and periodically reviewed and revised, the Advisory Group anticipates this modeling will continue to be reviewed and considered in the years to come.

ROADMAP DEVELOPMENT PROCESS

INTERAGENCY DELIBERATION

With this stakeholder feedback and the modeling in mind, the Advisory Group completed a series of planning meetings over the course of early 2017, to identify core energy actions and the implementation plans to be included in this Illinois Energy Roadmap. The Department hosted Advisory Group planning calls, met one-on-one with Agencies, and received written comments.

The Agencies had to give careful consideration to what could be reasonably achieved within resource constraints, both budgetary and personnel. The Group discussed a universe of potential actions and tasks, prioritized them, identified responsible parties, and articulated realistic timelines for completion.

The Advisory Group had to consider what core substantive areas it would focus on. A wide range of topics were discussed, including those summarized as potential action in the Policy Review Report:

Near-term (0-12 months). These actions will represent the State Agency milestones for implementation of the FEJA. The Group may also want to consider developing a contingency plan to provide an alternative approach to retaining existing nuclear generation within the state if FERC rules against the Zero Emission Standard approach.

Medium-term (13-36 months). These actions will be complementary measures that Agencies could support. For example: increasing efforts to lead by example in State facilities, providing input to utility energy efficiency and renewable energy programs, offering programs to fill the gaps of existing energy efficiency and/or renewable energy offerings (e.g., finance, CHP, low-income, electric cooperatives and municipal utilities), supporting complementary technologies like energy storage and microgrid, conducting consumer outreach and protection, facilitating the development of a standardized zoning and permitting standards to foster distributed renewable energy projects, incentivizing greater private development of RE resources, more robust transmission system planning, and/or workforce development focused specifically on the energy sector.

Long-term (37+ months). These will be actions Agencies could take to support the development of new baseload generating assets by 2026 or their retention beyond that date. For example: reducing permitting timelines, supporting siting evaluations, and/or developing a regional approach.

The Agencies also needed to determine the right balance of the types of activities under each action at its disposal. For example:

Fulfilling Statutory Mandates. A priority for all state agencies is fulfilling their statutory mandates and completing those activities which they are directed to perform by law. Implementing the provisions of the FEJA is a prime example of this type of activity.

Process Facilitation. Illinois state agencies have data and information that can be shared with other state agencies as well as energy developers. Improving access to data and information can improve the perception of Illinois being a challenging and specialized energy market.

ROADMAP DEVELOPMENT PROCESS

Advocacy and Intervention. Energy policy does not begin and end at the state borders. State Agencies can deliver guidance regarding Illinois' energy priorities to regional energy market operators as well as federal officials.

Technical Expertise. Illinois state agencies employ some of the most knowledgeable regional energy experts. Sharing these experts and their expertise among agencies and with stakeholders can serve to create and improve opportunities for generation, energy efficiency, and renewable energy.

Financial Incentives and Grants. Direct financial support in the form of grants and other incentives (e.g. loans, discounts, security, etc.) are popular, though limited in the current fiscal environment. State agencies with grant making capacity may be able to consider adjustments to existing or dormant programs to leverage limited resources to support the highest value initiatives.

Research and Partnerships. Illinois agencies can access the expertise of leading universities, research labs, and private sector groups to identify, evaluate and address the barriers that prevent energy development in Illinois. Agencies can also review existing rules and procedures to evaluate whether and to what extent they may be having either positive or negative impacts on energy development in Illinois.

The Advisory Group used the following core criteria for evaluating potential substantive areas and associated activities, including:

- Fulfilling statutory mandates
- Alignment with the scope of the Project
- Potential for impact towards meeting the Roadmap's stated goal
- Availability of necessary resources
- A balanced approach, including a mix of different types of actions, responsible parties, and near-, medium-, and long-term actions

ROADMAP ACTIONS & TIMELINE

As a result of this process, the Advisory Group has identified five core renewable energy and energy efficiency actions the State Agencies intend to take over the next several years:

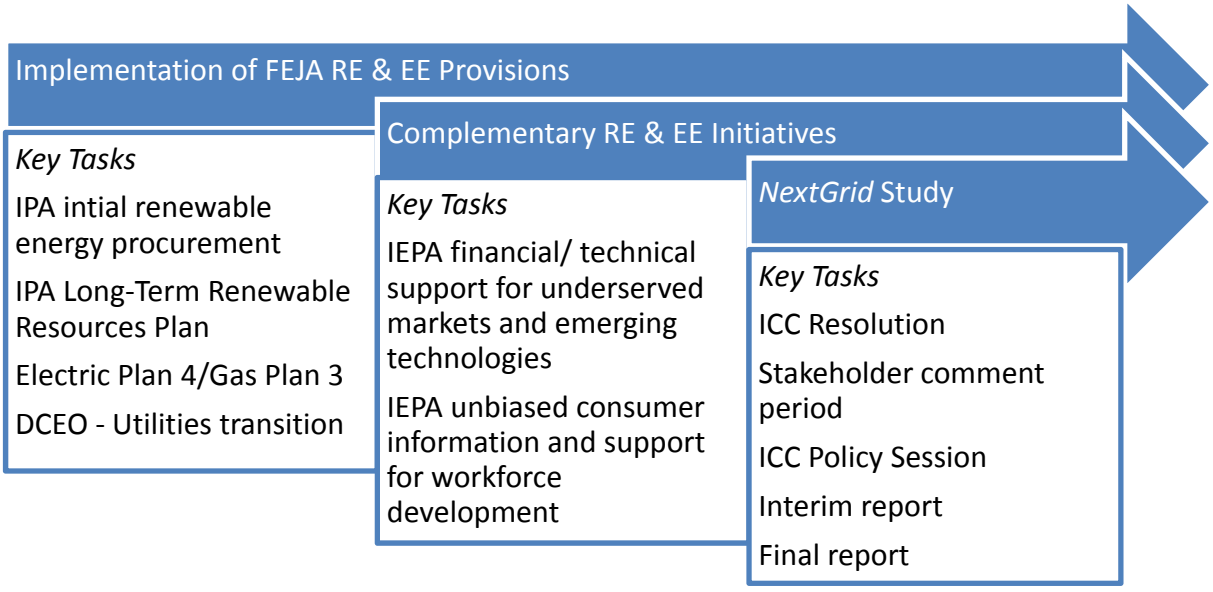
- *Implement the renewable energy provisions of the FEJA* (near-term)
- *Implement the energy efficiency provisions of the FEJA* (near-term)
- *Offer complementary State renewable energy initiatives* (medium-term)
- *Offer complementary State energy efficiency initiatives* (medium-term)
- *Complete a NextGrid study* (long-term)

Together, the goal of these actions is to grow Illinois' economy through robust deployment of renewable and energy efficiency resources, while maintaining a reliable transmission grid, and keeping electricity prices relatively low. The development of renewable and energy efficiency resources will also help the State address possible future environmental regulations.

Detailed discussion on each action, including objectives, tasks, milestones, and roles and responsibilities can be found in this section.

This Roadmap is intended to be a living document, based on current State priorities, but may be adapted over time as gaps are filled or new challenges arise. For example, the Advisory Group has included those actions and tasks for which budgetary and personnel resources are expected to be available, however this is subject to change, and actions, tasks, and/or timelines may need to be updated accordingly.

Please also note, although this Project has certainly taken into consideration the broader Illinois energy landscape – including sources like nuclear, natural gas, and coal – the focus from the outset of this effort has been energy efficiency and renewable energy, and thus the actions outlined in this document focus on these sources. The State recognizes that there are opportunities to also take additional energy actions over the near- and long-term, greatly appreciates the feedback that has been provided thus far, and looks forward to



continuing to work with energy stakeholders beyond the Roadmap Project.

IMPLEMENTATION OF FEJA RENEWABLE ENERGY PROVISIONS

Background. The FEJA sets new funding and goals for renewable energy resource development in Illinois. Per revisions to the State's existing Renewable Portfolio Standard (RPS), the IPA is to undertake planning and procurement activities to secure long-term Renewable Energy Credits (RECs) purchase agreements between investor-owned utilities and renewable asset developers from utility-scale wind and solar, distributed generation, community solar, and solar for low-income households.

Additionally, per the FEJA, the IPA will continue to develop and refine its Long-Term Renewable Resources Plan, and established for the first time a Solar for All Program, focused specifically on low-income solar projects and support.

Objectives. The primary objectives of this action include:

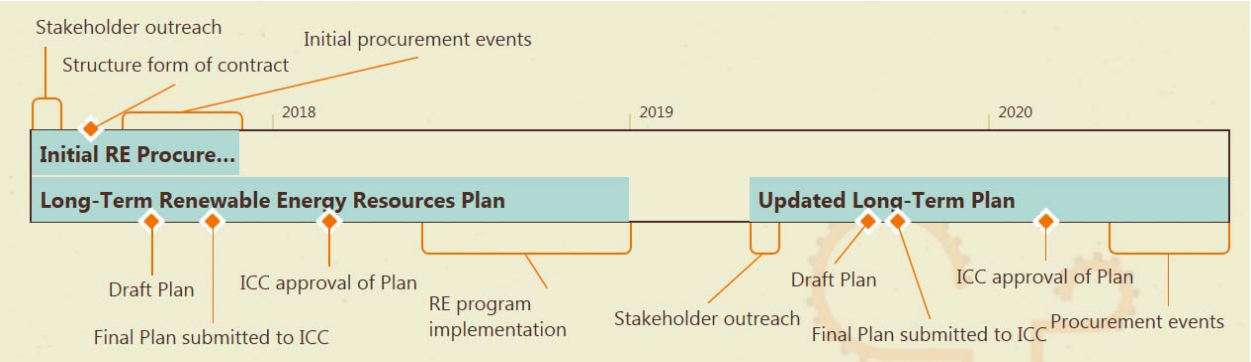
- Comply with statutory requirements of the FEJA
- Achieve statutory goals for renewable energy resource development
- Support the development of renewable energy in Illinois
- Achieve competitive pricing
- Structure a sustainable renewable energy market in Illinois

Tasks. The two main tasks related to the RE provisions of FEJA is (1) an initial forward competitive procurement for 1 million annual RECs each from new utility scale wind and utility scale solar and brownfield solar, and (2) the development of a Long-Term Renewable Resources Plan. The long-term plan will include an analysis of utility load forecast, budgets and annual RPS goals, propose an approach for the Adjustable Block and Illinois Solar for All Programs, propose a schedule and approach for other procurements to meet RPS goals, and plans for evaluation and ongoing adjustments (more details on the FEJA can be found in Appendix A). The primary tasks and milestones related to this action include:

1) IPA initial renewable energy procurement (utility-scale solar/wind)
   a) Stakeholder outreach (May 2017)
   b) Structure form of Contract (June 2017)
   c) Initial procurement events (August 2017 – November 2017; additional solar at a later date)
2) IPA Long-Term Renewable Energy Resources Plan (including Solar for All)
   a) Stakeholder outreach (May 2017)
   b) Draft Plan (August 2017)
   c) Final Plan submitted to ICC (October 2017)
   d) ICC approval of Plan (February 2018)
   e) Procurement events (June – December 2018, beyond)
3) Updated IPA Long-Term Renewable Energy Resources Plan
   a) Stakeholder outreach (May 2019)
   b) Draft Plan (August 2019)
   c) Final Plan submitted to ICC (September 2019)
   d) ICC approval of Plan (Spring 2019)
   e) Procurement events (Spring/Summer 2020, beyond)

ROADMAP ACTIONS & TIMELINE

Figure 2: Implementation of FEJA RE Provisions Tasks Timeline



Roles & Responsibilities. This action, its tasks, and milestones will be led by the IPA, with support from the ICC. IEPA, in coordination with the Illinois Commission on Environmental Justice, will provide feedback to the IPA regarding Solar for All within the bounds of statutorily-required processes. PCB will assist and/or observe as it sees fit.

IMPLEMENTATION OF FEJA ENERGY EFFICIENCY PROVISIONS

Background. The FEJA sets new funding and goals for energy efficiency programs in Illinois. Per revisions to the State's existing Energy Efficiency Portfolio Standard (EEPS), the investor-owned utilities must submit energy efficiency plans to the Illinois Commerce Commission (ICC) for approval. The ICC must approve the tariffs that allow the investor-owned utilities to collect reimbursements and returns on their energy efficiency program expenditures and continue to oversee the utilities achievement of EE targets and approve tariffs. Finally, DCEO which previously administered programs for the low-income and public sector markets will be transitioning this work to the utilities.

Goals. The primary goals of this action include:

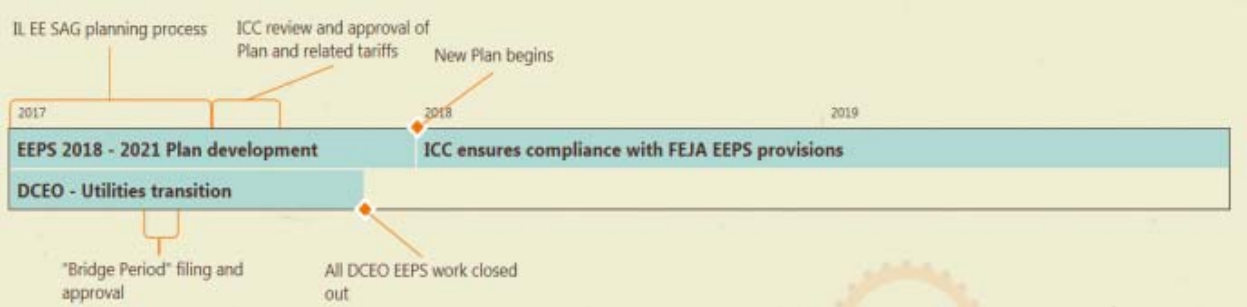
- Compliance with statutory requirements of the FEJA, including smooth transition of DCEO portfolio to utilities
- Achieve statutory goals for energy efficiency
- Assist Illinois consumers in accessing new efficiency programs
- Increase Illinois energy efficiency jobs

Tasks. The primary tasks and milestones related to this action include:

1) EEPS 2018 – 2021 Plan development
   a) Illinois Energy Efficiency Stakeholder Advisory Group (SAG) Planning Process (January – June 2017)
   b) ICC review and approve 2018 – 2021 Plan and related tariffs (August 2017)
2) DCEO – Utilities transition
   a) "Bridge Period" filing and approval (May 2017)
   b) DCEO EEPS work closed out (December 2017)
3) ICC ensures compliance with FEJA EE provisions (through December 2021)

ROADMAP ACTIONS & TIMELINE

Figure 3: Implementation of FEJA EE Provisions Tasks Timeline



Roles & Responsibilities. This action, its tasks, and milestones will be led by the ICC and DCEO. IPA, IEPA, and PCB will assist and/or observe as it sees fit.

COMPLIMENTARY RENEWABLE ENERGY INTIATIVES

Background. The FEJA sets robust funding and goals for renewable energy resources in Illinois. To support the achievement of these goals and fill potential gaps, the State can implement complementary renewable energy initiatives.

These initiatives will be primarily driven by the Illinois State Energy Office, which effective July 1, 2017, will be transferring from the Department to IEPA. The tasks laid out below are based on the gaps currently identified but may be adapted over time as gaps are filled or new challenges arise. It should also be noted that while these efforts are currently budgeted for, this is subject to change based on future budgetary constraints.

Goals. The primary goals of this action include:

- Support compliance with renewable energy goals of the FEJA
- Fill in gaps in the Illinois renewable energy market, in particular with regard to financial and technical support, and education and workforce development
- Continue to build a sustainable renewable energy market in Illinois

Tasks. The primary tasks and milestones related to this action include:

1) Providing financial and/or technical support for emerging technologies and/or underserved markets
   a) Energy storage – This IEPA initiative will build on DCEO grant-funded demonstration projects completed over the last four years, including one additional demonstration project at a critical infrastructure facility and case studies that will help other entities learn from the trailblazers. (State Fiscal Year 2018 – 2019)
   b) Renewables finance pilot – Following DCEO's 2016 design phase which included stakeholder engagement, IEPA will implement a residential renewable energy interest rate buy-down (IRB) pilot program. The goal is to use limited State funding to buy down the interest rate to eliminate the upfront cost of installing solar, one of the biggest barriers of going solar for homeowners. (FY18)
   c) WAP + Solar – IEPA will work with DCEO's Illinois Weatherization

Assistance Program (IWAP) and the Cook County community action agency to develop and pilot a program to provide technical and financial assistance for the development of solar projects at multi-family affordable housing facilities in Illinois. WAP performs energy efficiency upgrades to low-income Illinois homes, but for many years have been interested in integrating solar into the program as well. This will be a complement to broader Solar for All efforts. (FY18 – 19)

d) Coop and municipally-owned utility support – Illinois' electric cooperatives and municipal utilities already have a wealth of experience and success advancing renewable energy and energy efficiency in their communities. However, in light of the expanded opportunities afforded through the FEJA, IEPA will offer technical assistance to interested coops and munis to implement/expand clean energy programs. (FY18 – 19)

2) Providing unbiased consumer information and supporting workforce development
   a) Develop an Illinois consumer information and education website for renewables and energy efficiency – Due to the ever-changing nature of this industry, this website can keep consumers up-to-date on current clean energy programs and policies. For example, many programs, such as REC procurements, are difficult for homeowners and business to understand, and this website could be a central place to stay apprised of upcoming application deadlines. It's also important to provide information to consumers on the steps to implementing clean energy projects including permitting and utility interconnection and how to find qualified contractors. (FY18 – 19)
3) Additional efforts – Should additional budgetary/personnel resources be available, there are several supplementary activities that could also be valuable complements to those outlined above and required by the FEJA, including but not limited to: renewable energy workforce training, supporting solarize campaigns, and developing permitting resources.

Roles & Responsibilities. This action, its tasks, and milestones will be led by the IEPA. DCEO will assist on the WAP + Solar initiative. IPA, PCB, and ICC will assist and/or observe as it sees fit.

COMPLEMENTARY ENERGY EFFICIENCY INITIATIVES

Background. The FEJA sets robust funding and goals for energy efficiency in Illinois. To support the achievement of these goals and fill potential gaps, the State can implement complementary energy efficiency initiatives.

These initiatives will be primarily driven by the Illinois State Energy Office, which effective July 1, 2017, will be transferring from the Department to IEPA. The tasks laid out below are based on the gaps currently identified but may be adapted over time as gaps are filled or new challenges arise. It should also be noted that while these efforts

ROADMAP ACTIONS & TIMELINE

are currently budgeted for, this is subject to change based on future budgetary constraints.

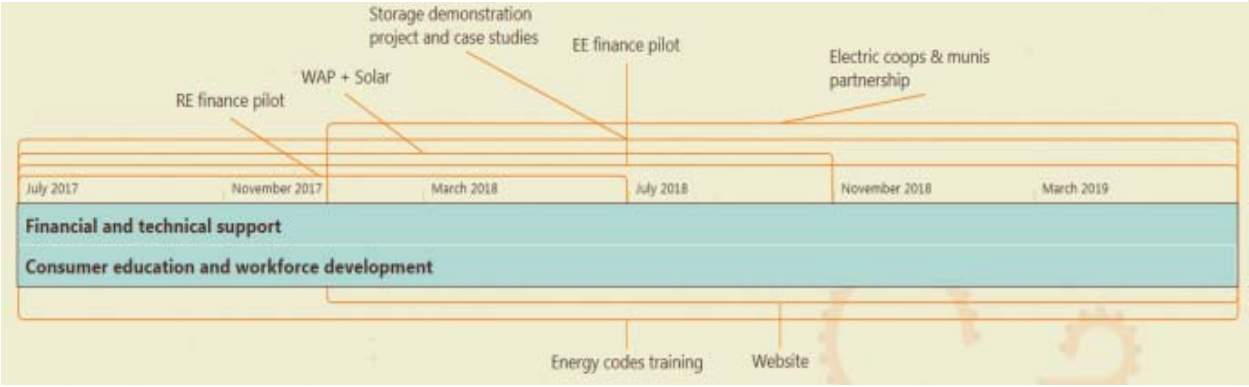
Goals. The primary goals of this action include:

- Support compliance with energy efficiency goals of the FEJA
- Fill in gaps the Illinois energy efficiency market where they exist, particularly with regard to financial and technical support, as well as education and workforce development
- Support long-term transformation of the Illinois energy efficiency market

Tasks. The primary tasks and milestones related to this action include:

1) Providing financial and/or technical support for emerging technologies and/or underserved markets
   a) Energy efficiency finance pilot – Illinois is a leader for energy efficiency in the Midwest, but unfortunately, due to a severe State budget crisis, its own facilities have not capitalized on this opportunity. With competitively-awarded DOE funding, IEPA will work with Illinois' Central Management Services to develop and pilot a sustainable finance program that will leverage private sector investment to help cover the upfront costs of energy efficiency projects. (FY18 – 19)
   b) See working with electric cooperatives and municipally-owned utilities above under Complementary Renewable Energy Efforts. (FY18 – 19)
2) Providing unbiased consumer information and supporting workforce development
   a) See development of a consumer information and education website above. (FY18 – 19)
   b) Energy code training – IEPA will continue to offer an annual training series on the Illinois Energy Conservation Code (IECC) directed at the Illinois construction industry. Homebuilders, general contractors, architects, engineers, code officials, HVAC specialists, realtors, and home performance professionals will be able to learn about the newest energy conservation codes for new construction, additions and renovation projects in Illinois. This program fulfills a State mandate. (FY18 – 19)

Figure 4: Complementary RE & EE Initiatives Tasks Timeline



ROADMAP ACTIONS & TIMELINE

3) Additional efforts – Should additional budgetary/personnel resources be available, there are several supplementary activities that could also be valuable complements to those outlined above and required by the FEJA, including but not limited to: technical assistance to public sector entities for developing energy savings performance contracts, building energy benchmarking programs, and/or combined heat and power projects.

Roles & Responsibilities. This action, its tasks, and milestones will be led by the IEPA. ICC, DCEO, PCB, and IPA will assist and/or observe as it sees fit.

NEXTGRID

Background. In March 2017, the ICC launched its consideration of the utility of the future, announcing *NextGrid* – a statewide collaborative to transform Illinois' energy landscape and economy. Although this specific action will be completed in the medium-term, its focus will be to identify energy actions the State may take over the long-term.

Convened by the ICC and led by an outside, expert facilitator, *NextGrid* is a consumer-focused and collaborative study.

Goals. The primary goals of this action include:

- Identifying and exploring future technological advancements and utility and regulatory models
- Informing policymakers on the issues and challenges associated with a quickly evolving energy landscape
- Providing recommendations to the ICC and Illinois General Assembly on a range of tangible actions and policies available to best benefit customers and communities throughout Illinois

Tasks. The primary tasks and milestones related to this action include:

1) ICC issues Resolution announcing *NextGrid* (March 2017)
2) Stakeholders file comments in response to the Resolution, regarding the selection of a facilitator, processes, and topics to be considered (April 2017)
3) Formal policy session (Summer 2017)
4) Interim report issued (Early 2018)
5) Final report issued (Late 2018)

Roles & Responsibilities. This action, its tasks, and milestones will be led by the ICC.

Figure 5: *NextGrid* Tasks Timeline

CONCLUSION

The Illinois Energy Roadmap Project provided a forum for Illinois' leading energy agencies to come together and begin to consider the State's energy future and potential economic impacts. Through this effort, the Advisory Group has developed and adopted a cohesive and informed plan of action for the State's renewable energy and energy efficiency resources.

Moving forward, the Advisory Group will continue to meet regularly to track progress toward the milestones laid out in this Roadmap, as well as discuss emerging energy issues and revisions to the Roadmap as necessary. The State will provide an annual update to stakeholders to highlight the status of meeting specific tasks and any changes to the Roadmap.

The goal of this Roadmap is to grow Illinois' economy through robust deployment of energy efficiency and renewable energy resources, while maintaining a reliable transmission grid, and keeping electricity prices relatively low. The development of these resources will also help Illinois meet current and potential future environmental regulations. The State feels that the actions laid out in this Roadmap go a long way to getting us there, however, it also recognizes that energy efficiency and renewable energy are just two pieces of Illinois' broader energy puzzle. To that end, the State also looks forward to building on the momentum of this effort and others to continue a robust interagency and stakeholder dialogue regarding Illinois' broader energy future and its ties to a strong economy.

APPENDIX A: FUTURE ENERGY JOBS ACT SUMMARY

The Future Energy Jobs Act was introduced in the Illinois legislature in Fall 2016 Veto Session and passed both chambers on December 1, 2016. Governor Bruce Rauner signed the legislation on December 7, 2016, setting the new statute (FEJA, P.A. 99-0906) with an effective date of June 1, 2017.

The FEJA makes significant changes to the electricity generation (both thermal and renewable) as well as energy efficiency sectors of the Illinois energy landscape.

Zero Emissions Standard. The statute requires utilities with at least 100,000 retail customers in the state and utilities with fewer than 100,000 retail customers for which the IPA procures power and energy to meet a new Zero Emissions Standard (ZES). Compliance with the ZES is met through the purchase and retirement of Zero Emissions Credits (ZEC) from Zero Emission Facilities which are defined as nuclear facilities that are interconnected with either the PJM or MISO regional transmission systems. The purpose of the ZES is to maintain the State's support for zero emission energy through procurement of zero emission credits to achieve the State's environmental objectives and reduce the adverse impact of emitted air pollutants on the health and welfare of the State's citizens.

The ZES requires the utilities to purchase an amount of ZECs equal to approximately 16% of the electricity delivered by utilities to retail customers during 2014. Each ZEC represents 1MWh of electricity generation from a qualified facility.

The Illinois Power Agency will be responsible for conducting a procurement process that will result in ten-year contracts between the utilities and the ZEC supplier(s), subject to approval by the Illinois Commerce Commission. ZEC providers must commit to operate the facilities from which the ZECs are sourced for the duration of the contract.

Energy Efficiency Portfolio Standard. The statute converts electric utility efficiency goals from the current incremental annual savings to a cumulative persisting annual savings basis. Cumulative persisting annual savings include savings from measures installed in each compliance year plus all measures from prior years that are deemed to still be in operation. 10% of the efficiency savings goals for the electric utilities can be met with savings from fuels other than electricity.

The electric utilities will also take over direct responsibility for low-income and public sector efficiency programs, which are currently administered by the Department of Commerce. Under the statute, electric utilities must spend 10% and 7% (for ComEd and Ameren respectively) of their annual budgets on public sector programs, and at least $25 million and $8.35 million (for ComEd and Ameren respectively) per year on efficiency programs for low-income populations (defined as household with incomes less than 80% of the regional median). No new efficiency programs will be funded through the Illinois Power Agency annual electricity procurements process (as authorize previously under 220 ILCS 5/16-111.5B).

The statute increases the cost caps for the electric utility efficiency program. The new

APPENDIX A: FUTURE ENERGY JOBS ACT SUMMARY

cost caps are based on percent increases over the average amount paid per kWh by eligible retail electricity customers in calendar year 2015:

- 3.5% for calendar years 2018 through 2021;
- 3.75% for calendar years 2022 through 2025; and,
- 4% for calendar years 2026 through 2030.

Except where cost caps are binding, utilities may not reduce their goals so long as there remains cost effective efficiency savings opportunities.

Large electricity consumers with more than 10 MW in peak demand will no longer pay into the efficiency programs, and will no longer be eligible to participate in utility efficiency programs after June 1, 2017.

Electric utility efficiency program plans require the approval of the Illinois Commerce Commission, and must specify how the utility will meet their annual cumulative efficiency goals in a cost-effective manner. Utility efficiency plans may also include funding for research, development, and pilot projects, but the cost of such activities is limited to 6% of efficiency program budgets.

The statute alters the electric utility efficiency programs by converting the planning process to two (2) four-year cycles followed by a five (5) year cycle.

The statute alters the natural gas utility efficiency programs by converting the planning process to indefinite four-year cycles. The statute also transfers natural gas efficiency program responsibility for public sector and low-income and public sector efficiency programs from the Department of Commerce to the utilities. Subsequent natural gas utility efficiency program portfolios must carve out at least 10% for public sector programs, and 5% of program funding may be directed to units of local government for market transformation initiatives. Natural gas utilities must present a portfolio of measures for low-income households (e.g., households with income at or below 80% of area median income) with funding levels equal to the proportion of revenues collected by the natural gas utilities from households at or below 150% of poverty income level.

Renewable Energy Provisions. The FEJA makes substantial changes to the Illinois renewable energy policy frame work, through three primary channels: redirecting the existing Renewable Portfolio Standard's (RPS) Renewable Energy Resources Fund (RERF) to support a new low-income solar program (Illinois Solar for All), altering the planning and contracting mechanisms for the RPS to support new statewide goals, and the development of a new distributed generation incentive.

- **Renewable Energy Resources Fund.** Originally, the RERF fund collected annual alternative compliance payments from Alternative Retail Electricity Suppliers to support the purchase and retirement of Renewable Energy Credits (RECs) by the Illinois Power Agency. The FEJA specifies that the funds contained in the RERF are to be used to support an Illinois Solar for All Program. Per the statute, the IPA is now to use RERF funds to purchase RECs generated from solar projects in the low-income sector under 15-year agreements.

APPENDIX A: FUTURE ENERGY JOBS ACT SUMMARY

Payments for all 15 years' worth of RECs under these contracts are to be paid for on an up-front basis once the solar asset is energized. The IPA is to then retire the RECs.

The Illinois Solar for All program includes the following program carve outs: Low-income Distributed Generation Incentive (22.5% of funding); Low-Income Community Solar Project Initiative (37.5% of funding); Incentives for Non-Profits and Public Facilities (15% of funding); and Low-Income Community Solar Pilot Projects (capped at lesser of $50 million or 25% of funding). At least 25% of the above-noted programs (except for the Community Solar Pilot Projects) funds are to be used in "environmental justice communities." The IPA can change the allocation of funding, with stakeholder input, if programs are undersubscribed.

For the purposes of the program, 'low-income' is defined as persons or families whose income does not exceed 80% of area median income. All projects supported through the program must include outreach, education, recruitment, and job training. Additionally, all projects must produce energy and economic benefits for participating low-income customers. Devices installed through the program need not be installed by a "qualified person" as is currently generally required for distributed generation installations.

The IPA is to define the terms, conditions, and requirements of these programs within a long-term renewable resources procurement plan that is to be approved by the ICC. The program is to be evaluated with regards to: number of projects supported, installed capacity, average cost of installed capacity, number of jobs or job training opportunities created, other social and environmental benefits created by the program, and total administrative costs for the program.

- **Renewable Portfolio Standard Planning.** The FEJA unifies RPS planning and statewide compliance under the IPA. Under the statute, the IPA is to review and revise a long-term renewable energy procurement plan at least every two years in conjunction with the ongoing annual standard procurement planning cycles. By June 1, 2019, the IPA will take responsibility for planning RPS compliance for all eligible retail customers (the current IPA portfolio) as well as for all non-eligible retail customers (currently the responsibility of Alternative Retail Electricity Suppliers).

  The statewide RPS goal will remain at the current scheduled escalation to 25% renewable energy resource inclusion by 2025. At least 75% of each year's goals are to be sourced from wind and solar. Additionally, the IPA is directed to meet the following volume purchase goals through long term (at least 15-year) REC purchase agreements:

  - By end of the 2020 delivery year: 2 million RECs each year from new wind installations, and 2 million RECs each year from new solar PV installations (50% from a new adjustable block REC program, 40% from utility scale solar PV, and 2% from Brownfield site projects).

APPENDIX A: FUTURE ENERGY JOBS ACT SUMMARY

- By end of the 2025 delivery year: 3 million RECs from new wind installations, 3 million RECs from new solar PV installations (50% PV from the new adjustable block program, 40% from utility scale solar PV, and 2% from Brownfield site projects).
- By end of the 2030 delivery year: 4 million RECs from new wind installations, 4 million RECs from new solar PV installations (50% PV from the new adjustable block program, 40% from utility scale solar PV, and 2% from Brownfield site projects).

"New Wind" projects are projects energized after 6/1/17 for the first procurement year and within 3 years after the procurement date for subsequent procurement years. "New Solar PV" projects are projects energized after 6/1/17. Low-income projects under the Illinois Solar for All plan do not count as "New" PV projects. Contract volumes for new wind are not to exceed contract volumes for new PV by more than 200,000 RECs in a single year. If an imbalance of more than 200,000 RECs does develop, then the IPA must adjust future planned purchases to remove the imbalance (contract curtailment of existing contracts is not required).

The prices paid for these REC purchase agreements must be cost effective, which means they must not exceed benchmarks equal to similar REC purchases within the region, and must not result in bill increases greater than 2.015% of the rates paid during the 2006/2007 delivery year or the amounts paid for these resources in 2011. Deliveries under the agreements are to begin between 6/1/19 and 6/1/21. Payments are made upon delivery of RECs.

The procurements of RECs may be reduced if any Alternative Retail Electricity Supplier elects to supply its customers with RECs from one or more non-wind or non-PV facilities that it owns. In the aggregate, the volume of such arrangements may not exceed 9% of statewide targets. Customers of any Alternative Retail Electricity Supplier utilizing this alternative option will see a commensurate reduction in the RPS cost included on their monthly utility bill.

The FEJA stipulates that RECs from Illinois may be used for RPS compliance. RECs from adjacent states may be used if they meet the state's public interest criteria (e.g., the health, safety, and welfare of its residents; minimize pollution; increase fuel diversity; and enhance reliability and resilience of local electric distribution systems). To allow RECs from adjacent states to be used for compliance purposes, the IPA must explain how the out-of-state RECs help meet the stated public interest criteria.

The IPA is to secure the distributed generation carve out RECs through a declining or Adjustable Block Program. The block program shall include: a schedule of standard block purchase prices to be offered; step adjustments between the blocks to reflect different nameplate capacity and purchase prices; and a schedule to manage automatic movement between steps. Only projects energized

after 6/1/17 will qualify to bid into the Program.

Initial requirements for the block program are: 25% from projects of less than 10 kW nameplate capacity; 25% from projects of greater than 10 kW but no more than 2 MW of capacity; 25% from community solar projects; and 25% as specified in the long term renewable plan. The Program should be designed so that at least 15% of RECs procured will benefit low-income households or organizations/agencies that serve them.

Contracts under the Program shall be for at least 15 years. RECs from these projects are to be paid under an accelerated schedule (projects of less than 10 kW nameplate capacity shall be paid in full when interconnected and energized; 20% of other projects shall be paid when interconnected and energized and the rest ratably over 4 years). Contracts must ensure delivery of the paid-for REC volumes over the 15-year term.

- **Distributed Generation Rebates.** The FEJA also requires utilities to file a new distributed generation rebate tariff for consumers. Initial rebates for non-residential net metering customers are to be equal to $250 per kW of nameplate capacity, and must be available to consumers with projects that meet specific conditions:
  - Installed capacity of less than 2 MW;
  - Generation is for site consumption, not commercial or wholesale use;
  - Located within an affected utility's service area; and
  - Connected under interconnection rules.

  The utility's tariff should also provide specific requirements for the use of smart inverters, and provide additional compensation for consumers in the event the utility utilizes the asset for voltage support, regulation or other ancillary services.

  The rebates will be available until the peak demand of the electricity provider's net metering customers equals 5% of the electricity provider's supplied peak demand from the previous year. After the 5% goal, the value of the rebate, which will be available to both residential and non-residential customers, will be established through an ICC proceeding. Each utility's rebates shall be treated as a regulatory asset, amortized over 15 years and earn a return.

APPENDIX B: ROADMAP MODELING

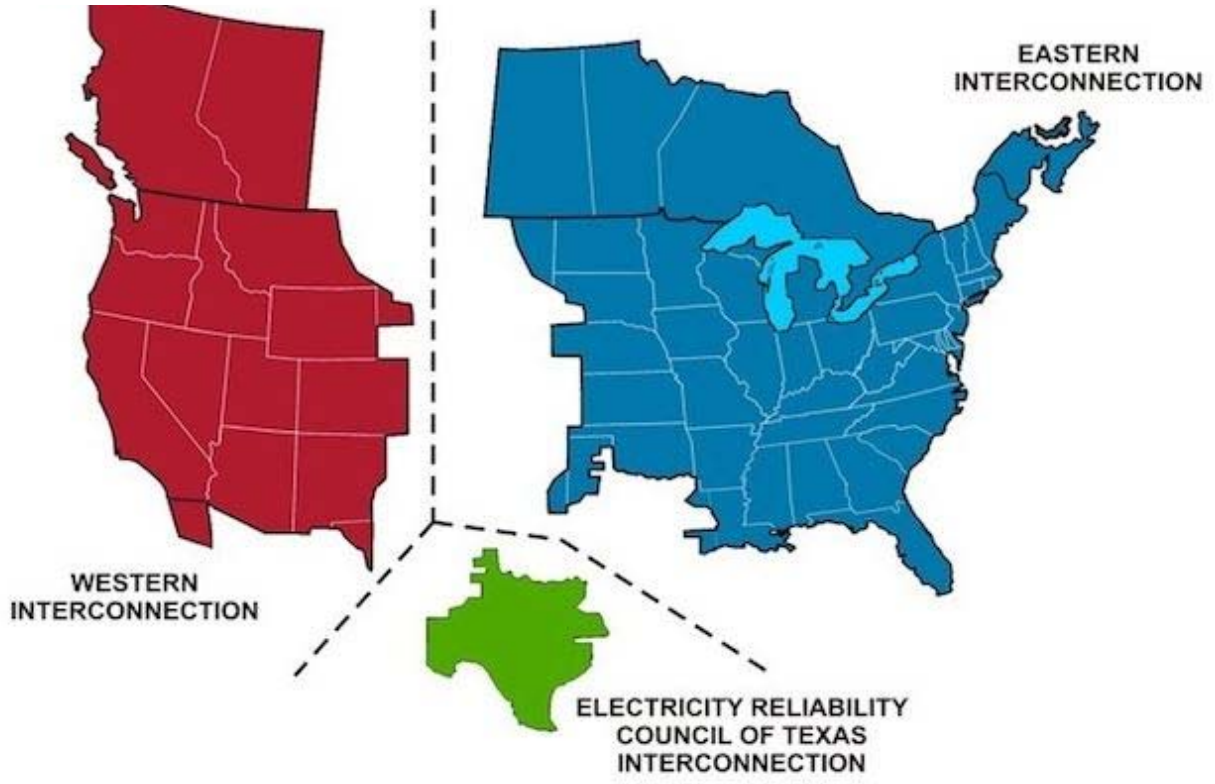
Illinois is part of a larger energy grid in which other entities maintain authority that effectively limits the extent to which some policy options may be applied.

For instance, Illinois may consider a policy that seeks to reduce air emissions from power plants by reducing the number of hours in a year that coal-fueled power plants may operate. Such a policy would be challenging given the fact that power plants operators have entered agreements with RTOs to gain access to the regional transmission system. Failure on the part of a generator to perform under these RTO agreements could result in financial losses for the generator or a loss of access to the regional transmission system.

The Project applied statistical modeling as a tool to assess Illinois energy policies in light of existing energy market operations. Statistical modeling for the Project is supported in large part by the Market Price Simulator (MarSi) electricity market model developed at the Illinois Institute of Technology. The MarSi platform has been used to develop a series of forward-looking scenarios for Illinois by modeling the energy markets in the Eastern Interconnection (see Figure 6 for map of Eastern Interconnection).

These scenarios assume different levels of power plant fuel costs, power plant availability, and consumer demand to provide a range of possible local generation, wholesale pricing, and emissions that could occur in Illinois and the Eastern Interconnection under current policies. The scenarios are designed to capture a full

Figure 6: Eastern Interconnection Geography Modeled by MarSi



range of potential market conditions over the 2017-2030 horizon.

Market Price Simulator (MarSi). MarSi is a simulation software package that models the hourly operation of integrated regional electricity and natural gas pipeline systems under a wide range of user-defined operating conditions. MarSi simulates market functions based on the variables and data provided, but does not force solutions into the scenario outputs.

MarSi utilizes data from multiple sources to: i) identify the operational capacities and limitations of all utility-scale generation and transmission assets within the Eastern Interconnection; ii) identify historical consumption at all market nodes throughout the Eastern Interconnection. This data serves as the basis of scenarios that simulate the operations of the electricity markets according to prevailing market rules (inclusive of issues such as spinning reserves, operating reserves, unit commitments, and natural gas fuel constrictions). This simulation can be applied against a variety of user-defined assumptions concerning fuel costs and the availability (or absence) of generation and transmission assets.

MarSi provides visibility into deregulated and vertically integrated utility regions by replicating the power plant dispatch queue, routing around transmission system bottlenecks (both physical electricity constraints as well as those caused by the interdependency of electricity and gas infrastructures). By simulating the market, MarSi provides the user with the ability to evaluate how a single power plant, state, or region is affected by changes in fuel prices, power plant and transmission availability, and changes in demand. MarSi also provides options for assessing the implications of removing or adding generation assets (either traditional or variable output) in the regional grid.

Over the last ten years, MarSi has been applied to study the optimal operation of a utility system with as much as 50% nuclear generation resources, the integration of hundreds of MW of wind energy into a utility system, the integration of thousands of MW of wind energy into a regional transmission organization, the integration of hundreds of GW of wind and solar energy into the three North American Interconnections including the Eastern Interconnection, the Western Interconnection, and the ERCOT.

MarSi has unique capabilities for the short-term modeling of electricity generating units and transmission networks as listed below:

- **Generation Resource Modeling.** MarSi has the capability of modeling various types of generation units with very detailed operating constraints. MarSi accepts both hourly generation bids (stepwise or piecewise linear, for market-based operation) and generation cost curve (quadratic or piecewise linear, for integrated utilities). Generation Unit Data utilized by MarSi is sourced from FERC and includes:
  - Thermal units (including nuclear units): generation limits, incremental heat rate

curves, minimum up/down times, ramp up/down rates, start-up cost characteristics, multiple emission constraints, multiple fuel constraints, must on/off, and other operating constraints.
- Wind and Pumped-storage hydro units: Wind unit characteristics, water conversion coefficients, volume limits, initial and terminal volumes, discharge limits, cycle efficiency.
- Combined-cycle units: generation limits, incremental heat rate curves, minimum up/down times, ramp up/down rates, start-up cost characteristics for each CT/ST configuration, multiple-emission constraints, multiple-fuel constraints, must on/off, and other operating constraints.
- Fuel switching units: heat rate curve for each possible fuel, generating capacity, minimum up/down time, ramp up/down rates, start-up cost characteristics for each fuel type, fuel and emission constraints, must on/off conditions.
- Cascaded hydro units: topology, water-conversion coefficients, volume limits, initial and terminal volumes, discharge limits, natural inflows, spillage, delay times
- Other Generation Characteristics: Generation outage schedule, hourly load forecast, spinning reserve requirements, operating reserve requirements, interruptible loads (cost and schedule), fuel constraints (for all fuel types and individual units), regional emission limits.

- **Transmission System Modeling.** MarSi has the capability of modeling full AC/DC electricity network constraints, including:
  - Line flow and bus voltage limits
  - Tap-changing and phase-shifting transformers
  - Detailed model of HVDC lines
  - Multiple contingency constraints
  - Preventive and corrective actions for transmission system security
  - Transmission outage schedule
- **Output Modeling Capabilities.** MarSi optimizes the hourly operating modes of generating units and determines fuel allocations depending on generating unit and electricity network. Typical MarSi outputs include:
  - Hourly commitment and MW generation dispatch of generating units
  - Hourly operating mode (combination of CTs and ST) for combined-cycle units
  - Hourly fuel allocation (gas or oil) for each unit with fuel-switching capabilities
  - List of binding constraints for transmission lines
  - fuel and emission allowance allocation
  - Locational marginal price (LMP)
  - LMP-based market scenario analyses.

Modeling Approach. Because energy market conditions can vary dramatically over time, the modeling approach sought to define a range of market outcomes based on different combinations of the following key variables:

- **Fuel.** The price paid (in constant 2015 dollars) per standard unit of the fuel used

APPENDIX B: ROADMAP MODELING

in power plants (coal, natural gas) drives the cost to generate and is a primary determinant with regards to whether a power plant can compete successfully in regional power auctions.

- **Generation.** The availability of net generation is a function of the number and type of existing generating assets, minus retirements, plus new assets, and adjusted for repowerings (e.g., conversion from coal to natural gas fuel). The availability and type of generation is a primary determinant in establishing clearing prices in regional power auctions.
- **Transmission.** The ability to transmit electricity beyond the local area allows power plant owners to sell to a broader market. Expansions to the transmission system is a primary determinant in the ability for more efficient (and lower cost) generation to reach consumers.
- **Demand.** The level of hourly consumer demand serves as the basis of the regional power auctions and is a primary determinant with regard to the clearing price of wholesale power as well as which power plants are supplying electricity to the grid.

Data sources for the assumption categories were sought from authoritative and published sources. Figure 7 below conveys the sources accessed to populate the MarSi platform for the Project's needs.

Results. Scenario assumptions impact the balance of supply and demand and the cost competitiveness of different supply options in Illinois and the Eastern Interconnection. Each scenario yields differences in following primary metrics:

- **Energy Efficiency.** The assumed level of energy efficiency varies significantly between the scenarios over the study horizon. As noted above in the load profile description, energy efficiency assumptions for Scenario 1 reflect the most recent efficiency program projections from Commonwealth Edison (ComEd) and Ameren. Efficiency projections for Scenarios 2A and 2B reflect the effects of the proposed energy efficiency programming under the Future Energy Jobs Act. Efficiency projections for Scenarios 3 and 4 reflect the maximum economically achievable levels of energy efficiency according to past filings by the utilities to the ICC, in order to examine what impacts additional efficiency would

Figure 7: Primary Data Sources for Modeling Activities

Element	Data Sources
Fuel Prices	Energy Information Administration (EIA-Annual Energy Outlook), NYMEX
Generation	DOE (EIA Forms & AEO), EPA, FERC (MISO, ISO-NE, NYISO, PJM, Southeast, SPP, ERCOT), NERC (FRCC, MRO, NPCC, RFC, SERC, SPP, TRE), NRC, NREL
Transmission	FERC (MISO, ISO-NE, NYISO, PJM, Southeast, SPP, ERCOT), NERC (FRCC, MRO, NPCC, RFC, SERC, SPP, TRE)
Load	EIA (Annual Energy Outlook), FERC (MISO, ISO-NE, NYISO, PJM, Southeast, SPP, ERCOT), NERC (FRCC, MRO, NPCC, RFC, SERC, SPP, TRE), NOAA

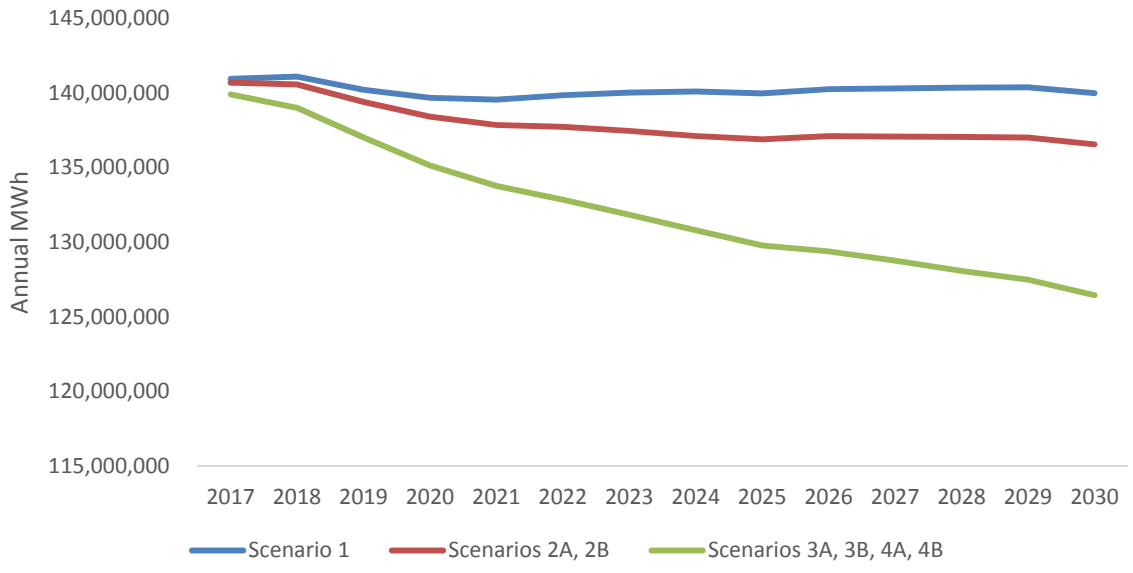
APPENDIX B: ROADMAP MODELING

have on the market. Figure 8 conveys the net effect of efficiency programs in each of the scenarios.

Energy efficiency assumptions in Scenario 1 yield a relatively flat forward cure for total load in Illinois. Energy efficiency assumptions for Scenarios 2A and 2B yield a slight improvement over Scenario 1 in the near term (through 2025), but generally flatten over the longer term. Energy efficiency assumptions for Scenarios 3A, 3B, 4A, and 4B yield a significant improvement over Scenarios 1 and 2 throughout the study horizon by delivering a full 10% reduction in annual consumption within the state by 2030.

- **Renewable Energy.** The level of renewable energy assumed to be developed in Illinois varied between the scenarios. Scenario 1 reflects no new substantial renewable energy development in Illinois, and assumes compliance with the Illinois Renewable Portfolio Standard (RPS) via the purchase of short-term renewable energy credits (RECs). All other scenarios assumed that the development of in-state renewable energy assets would occur on the strength of long-term purchase REC purchase agreements. Scenarios 2A, 3A, and 4A assumed lower range costs for these long-term purchase agreements, while Scenarios 2B, 3B, and 4B assumed higher range costs for the long-term purchase agreements. These cost assumptions are important as they can limit activity in pursuit of the RPS goals. Scenario 2 assumes that the cost cap from the FEJA is in place, while Scenario 3 and 4 raise the cost cap to allow for a 50% increase in RECs purchased, in order to examine what impacts additional renewables would have on the market. Figure 9 compares the annual projection of renewable energy generation in Illinois for each scenario, and Figure 10 presents the estimated additional renewable energy capacity projected to be developed in

Figure 8: Scenario Results – Projected Electricity Consumption in Illinois Net of Energy Efficiency



APPENDIX B: ROADMAP MODELING

Illinois across the various scenarios. Renewable energy generation in Illinois under Scenarios 2A – 4A is slightly lower than the projected outcomes under Scenarios 2B – 4B, due to the higher cost assumptions. These higher cost assumptions start to cause a lag in the rate of growth of renewables in 2020 and continue through 2030. In the end, higher cost assumptions reduce the potential growth of renewable energy generation in Illinois by approximately 1.8 million MWh/year, or 19%.

Figure 9: Scenario Results – Annual Generation of Electricity from Renewable Resources in Illinois

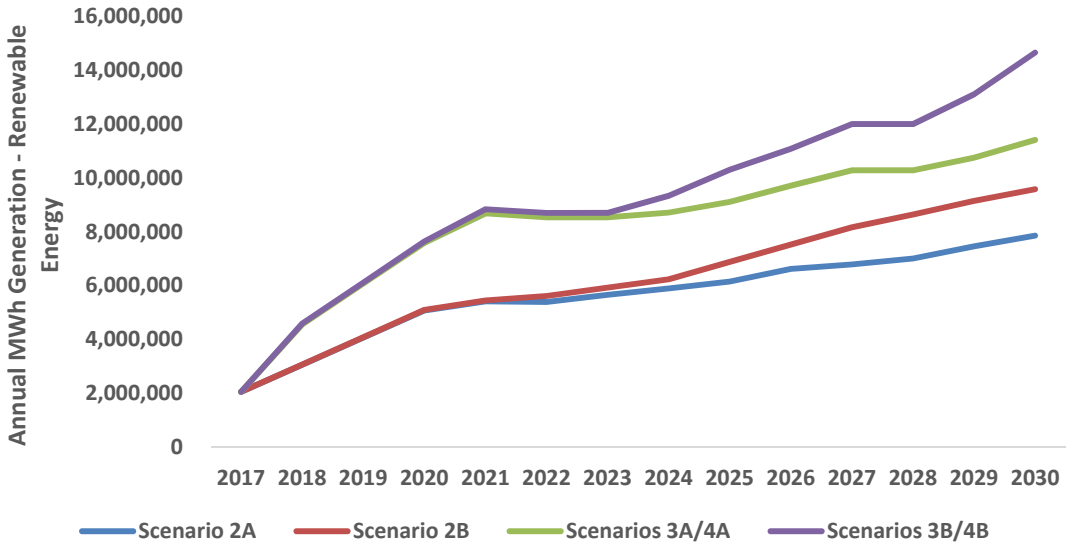
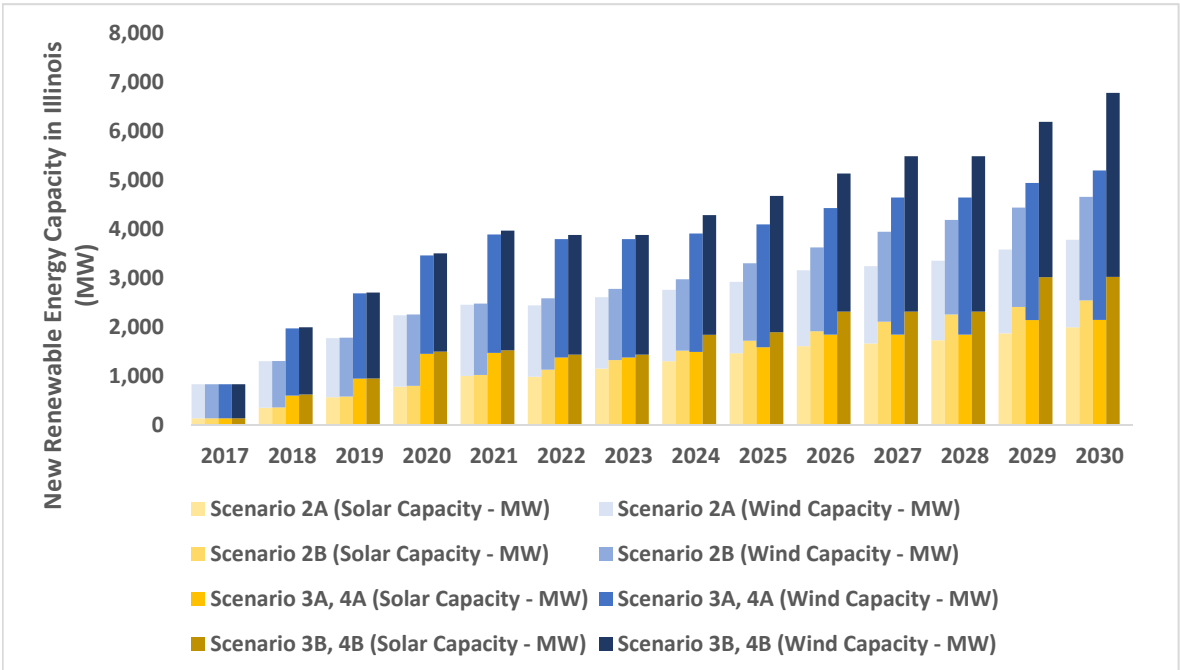
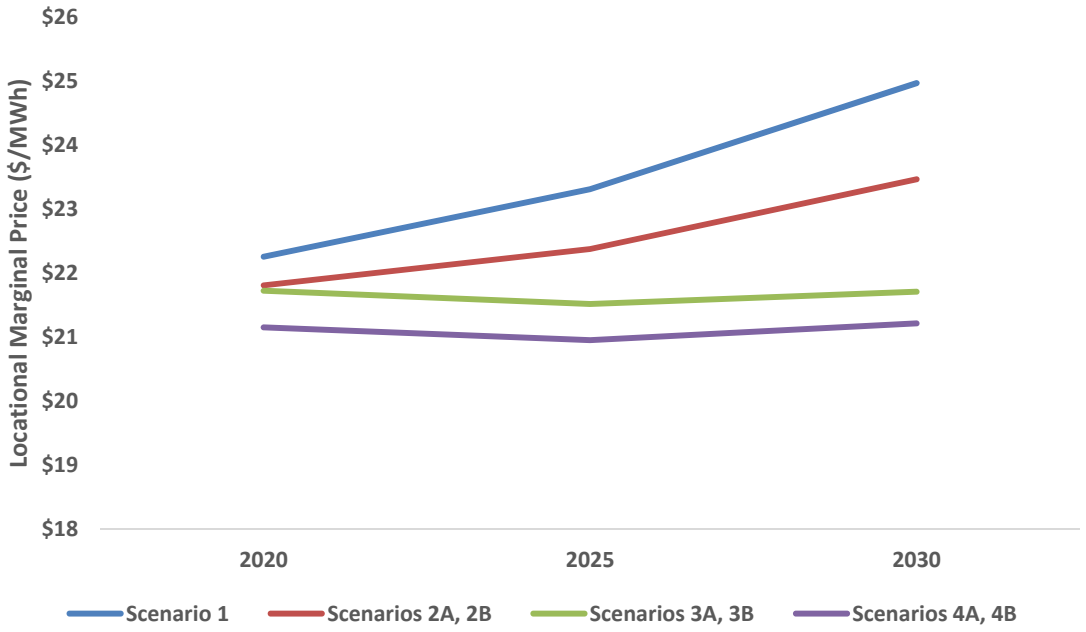


Figure 10: Scenario Results – MW of New Renewable Energy Capacity Resources in Illinois



APPENDIX B: ROADMAP MODELING

Figure 11: Scenario Results – Average Wholesale LMP for Electricity



- **Wholesale Electricity Cost.** The availability of generating capacity and the cost of fuel set the marginal price for power (e.g. the "Locational Marginal Price" or "LMP") within the regional wholesale power markets. We note that LMP is an indicator of the supply prices that consumers will encounter in future periods, and does not reflect the costs that consumers will pay for electricity distribution and taxes. Instead, the LMP projections presented in the Roadmap should be viewed as signaling the general direction energy supply prices will take over the longer term based on the balance of supply and demand within the region. Figure 11 conveys the projected average LMP prices for Illinois consumers for the years 2020, 2025, and 2030.

  The general pattern observed in Scenario 1 is for relatively modest cost escalation between 2020 and 2025, followed by more aggressive cost acceleration between 2025 and 2030. The late period escalation in Scenario 1 is a function of cumulative growth in load and fuel prices over time without the introduction of significant levels of new in-state generation.

  The general pattern observed in Scenario 2[2] is lower, though there is still relevant cost escalation in the near term (between 2020 and 2025), followed by a more aggressive cost escalation between 2025 and 2030. The LMP cost projections for Scenario 2 is generally lower than those found in Scenario 1 are due largely to the

[2] The LMP cost projections for sub-Scenarios 2A and 2B, 3A and 3B, 4A and 4B, are presented as a single set of data in the graph insofar as the LMP pricing difference between the sub-Scenarios (e.g., sub-Scenario 2A assumes slightly higher renewable energy generation in Illinois and sub-Scenario 2B assumes slightly lower renewable energy generation in Illinois) is relatively minor.

APPENDIX B: ROADMAP MODELING

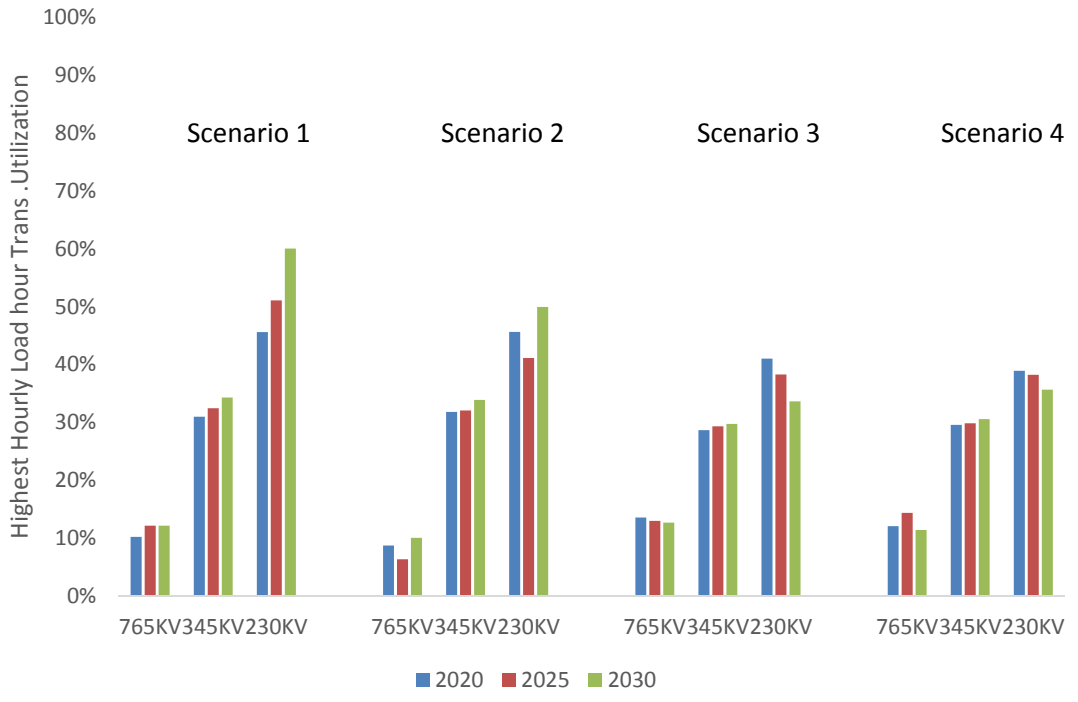
continued operation of the Clinton and Quad Cities nuclear stations where the increased level of local generation has a modest price suppression effect on market prices.

The general pattern observed in Scenario 3 is a lower than Scenarios 1 and 2 in all periods. The LMP cost projections for Scenario 3 are lower than those found in Scenarios 1 and 2 due largely to the increased level of progressive energy efficiency delivery in all periods which dampens demand (particularly in peak periods) and causes a more robust price suppression effect on market prices.

The general pattern observed in Scenario 4 is lower than all other Scenarios in all periods. The LMP cost projections for Scenario 4 are lower than those found in all other scenarios due largely to the combined effects of increased levels of progressive energy efficiency delivery in all periods which dampens demand (particularly in peak periods) and the continued operation of the Clinton and Quad Cities nuclear stations where the increased level of local generation has a modest price suppression effect on market prices.

- **Reliability.** The regional grid enables electricity to flow throughout the region, and has allowed Illinois to position itself as a primary electricity exporter. The reliability of the transmission network is managed by regional transmission system operators (PJM and MISO). Figure 12 conveys the projected highest hourly usage of the regional transmission system (as broken out by 230, 345, and 765 kV systems) in each of the Scenarios for the

Figure 12: Scenario Results - Highest Annual Transmission System Utilization



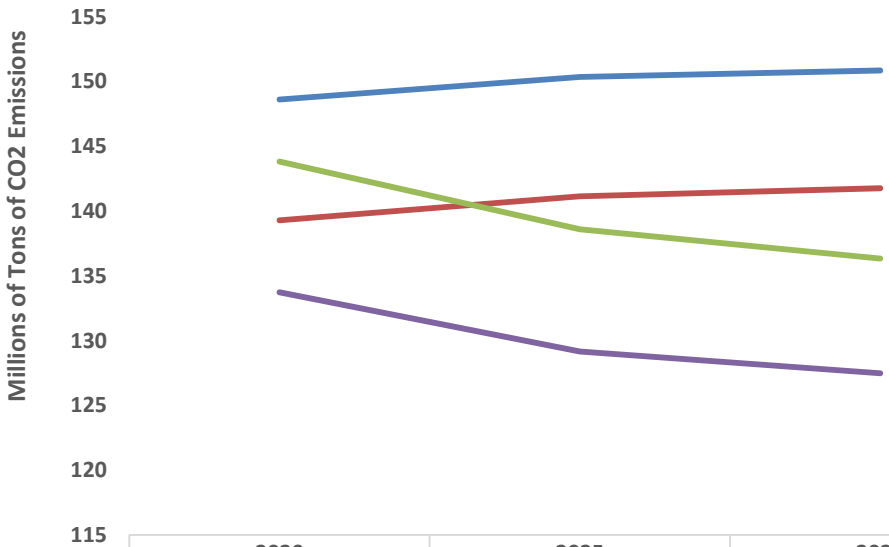
APPENDIX B: ROADMAP MODELING

years 2020, 2025, and 2030.

The general pattern observed in the Scenarios is for relatively modest changes in peak transmission system utilization over time. This indicates that the regional transmission system would maintain a high level of reliability over time in each scenario. The pattern of differences between the scenarios conveys a general reduction in peak usage of the 230 KV between Scenario 1 and all other scenarios. The 345KV systems show more muted reductions between Scenario 1 and all other scenarios. The 765KV systems show some slight increases from Scenario 1 and all other scenarios.

- **Emissions.** The combustion of natural gas and coal emits carbon dioxide (CO_2) into the atmosphere. Altering the fuel mix of power generating assets in Illinois can have a direct impact on the amount of CO_2 emissions attributable to power generation in Illinois. Figure 13 conveys the projected levels of CO_2 emissions from Illinois power generators in each Scenario for all years in the study. The general pattern observed in the scenarios is for reductions in CO_2 emissions from the baseline in all periods, although reductions vary across Scenarios 2-4, by use rates of coal and natural gas-fueled generating assets. For Scenario 2, the continued operation of the Clinton and Quad Cities nuclear stations will prevent the dispatch of marginal production from coal and natural gas assets, while marginal increases in in-state renewable energy will further reduce dispatching opportunities for coal and natural gas

Figure 13: Scenario Results – Statewide CO_2 Emissions from Electricity Generation



	2020	2025	2030
Scenario 1	148.62	150.37	150.85
Scenarios 2A, 2B	139.29	141.14	141.76
Scenarios 3A, 3B	143.82	138.60	136.33
Scenarios 4A, 4B	133.73	129.16	127.49

APPENDIX B: ROADMAP MODELING

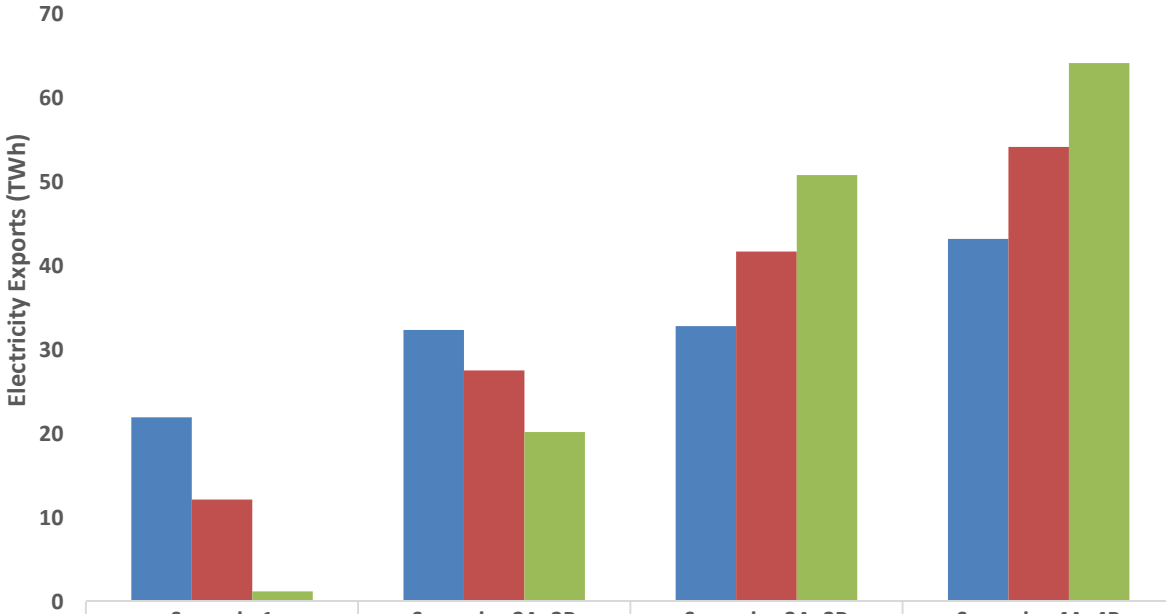
assets. For Scenarios 3 and 4, the larger increases in energy efficiency and modest increases in local renewable energy generation appear to even further reduce coal and natural gas generation within the state. However, Scenario 4 shows larger reductions due to the assumed continued operation of the Clinton and Quad Cities nuclear stations.

- **Import/Export.** Illinois has been the leading electricity exporter in the Midwest for over thirty years. Excess generating capacity coupled with operational efficiency, fuel diversity, and the fact that the physical plants are almost all fully depreciated provide Illinois with some of the lowest rates in the region. Retirement of existing power plants in Illinois will have direct impact on the ability of Illinois to remain an exporter – especially when we consider that building new central power plants to replace those retirements cannot be supported by traditional rate-base funding methods.

Figure 14 conveys the projected levels of electricity exports from Illinois in each Scenario for the years 2020, 2025, and 2030.

The pattern of differences in imports and exports between scenarios reflects balance of assumed generation retirements and new builds (including thermal and renewable) within and outside of Illinois as well as assumptions concerning the level of demand for electricity within Illinois (assuming

Figure 14: Scenario Results – Terawatt Hours of Electricity Exports and Imports



	Scenario 1	Scenarios 2A, 2B	Scenarios 3A, 3B	Scenarios 4A, 4B
2020	21.94	32.34	32.80	43.19
2025	12.14	27.51	41.67	54.13
2030	1.21	20.18	50.78	64.12

different levels of energy efficiency).

Scenario 1 assumes the retirement of the Clinton and Quad Cities nuclear stations, low but steady growth of local demand, and limited new generation development within Illinois during the study horizon. As such, Scenario 1 indicates that Illinois largely loses its exporter status by 2030.

Scenario 2 assumes the continued operation of the Clinton and Quad Cities nuclear stations, modest gains in efficiency, and some gains in local renewable energy generation. In this scenario, Illinois maintains its exporter status, but sees approximately 37% erosion in total annual exports by 2030.

Scenario 3 assumes the retirement of the Clinton and Quad Cities nuclear stations, significant and sustained gains in energy efficiency, as well as modest gains in local renewable energy generation. In this scenario, Illinois realizes approximately 56% growth in electricity exports between 2020 and 2030.

Scenario 4 assumes the continued operation of the Clinton and Quad Cities nuclear stations, significant and sustained gains in efficiency, as well as modest gains in local renewable energy generation. In this scenario, Illinois realizes its highest level of exports at 64 terawatt hours of electricity by 2030.