Best Practices in Integrated Resource Planning

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April 16, 2026

MO PSC IRP Workshop

Synapse
Energy Economics, Inc.

Energy Markets & Policy
BERKELEY LAB

Best Practices Report

Today's webinar will discuss selected content of a report published by Synapse Energy Economics and Berkeley Lab, available here.

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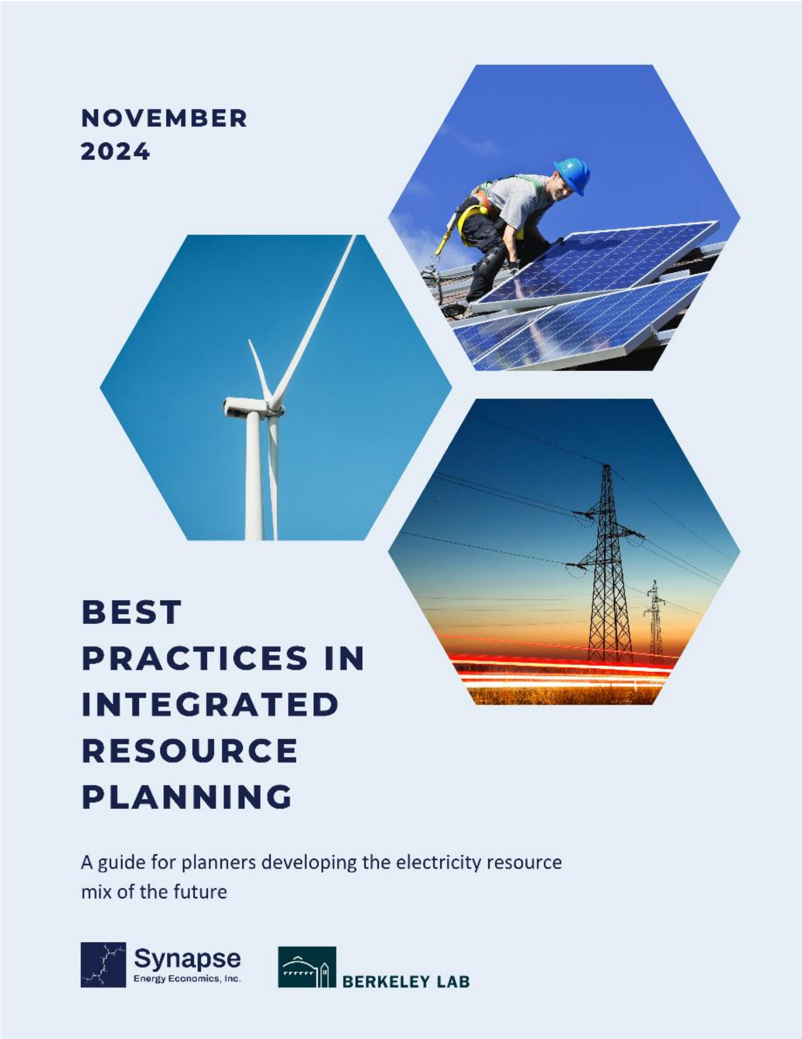
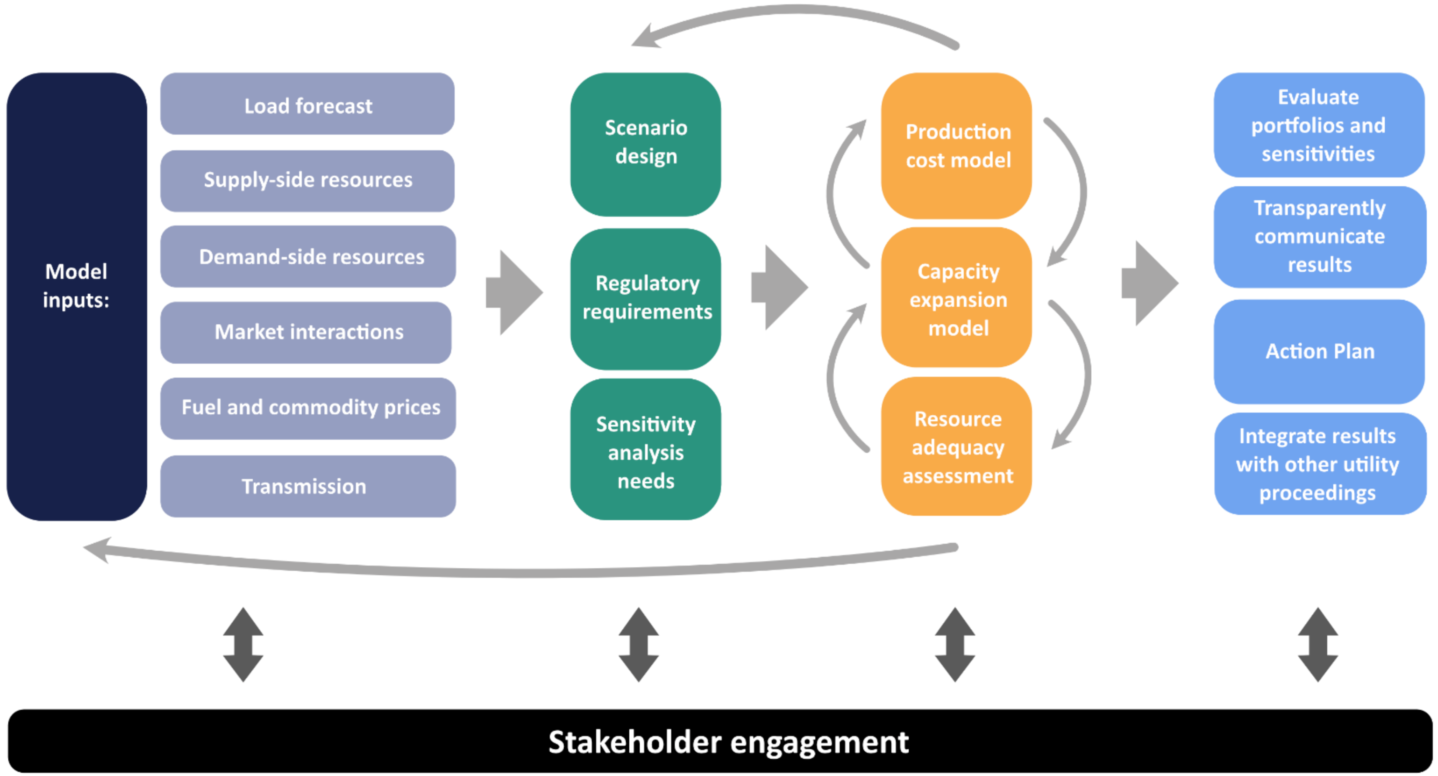
The U.S. Department of Energy (DOE), Office of Electricity, provided funding for Lawrence Berkeley National Laboratory's work described in this study under Contract No. DE-AC02-05CH11231. Contributions by Synapse Energy Economics were funded by DOE and The Energy Foundation.



Agenda

- What is IRP and where are IRPs used?
- Review of best practices
  - Stakeholder engagement
  - Model inputs
  - Scenario design
  - Modeling tools
  - Evaluating portfolios and presenting results
  - Action plan and other proceedings



Introduction to IRP

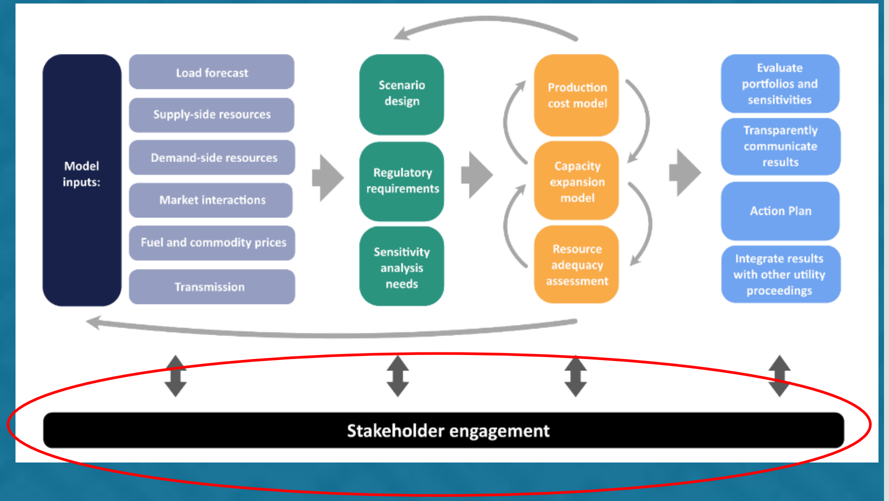
What is IRP?

- Integrated Resource Plan – The process, the plan, the document
- **An IRP is a plan that seeks to find an <u>optimal</u> combination of resources, from among supply and demand-side options, to satisfy future energy service demands in an economic and reliable manner**
- Used primarily in vertically integrated states, where utilities are responsible for meeting their customers' energy and capacity needs
- IRPs provide an opportunity to **<u>engage stakeholders</u>** and regulators in long-term planning decisions
- A properly executed IRP results in a **<u>transparent report</u>** and a **<u>clear short-term action plan</u>**

IRPs generally seek to find the least-cost resource plan subject to:

- **Reliability requirements**
- **Regulatory requirements**
- **Operational constraints**
- **Market factors**

Stakeholder engagement

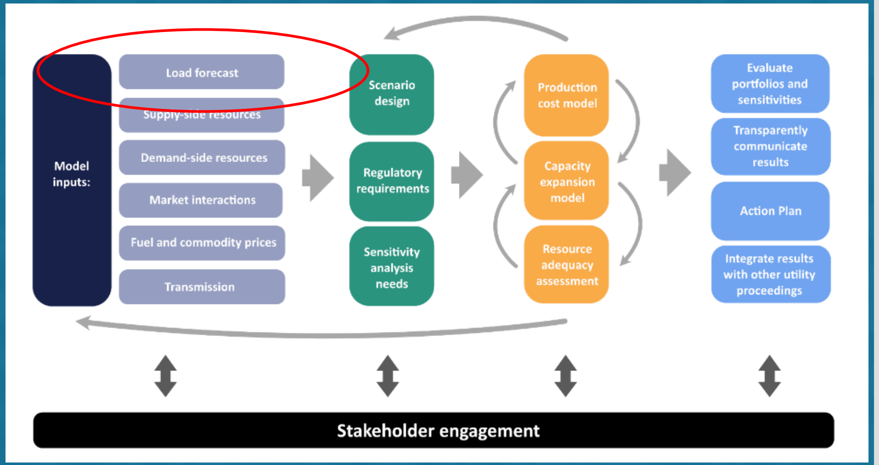


Engaging stakeholders

Best Practice 1. Use an inclusive stakeholder process
Best Practice 2. Engage technical stakeholders in IRP modeling

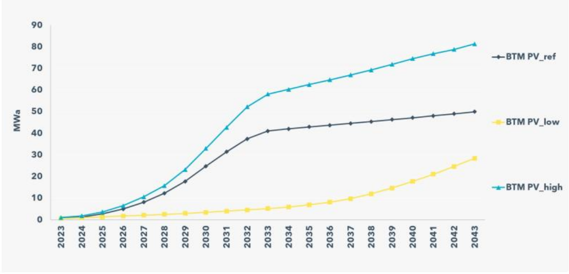
- Design an inclusive process that balances access and transparency with reasonable time commitments
  - Intentionally establish process norms to collect and respond to feedback
  - Remove barriers to participation
  - Prioritize transparency
- Provide modeling files and other information to allow technical stakeholders to replicate modeling outcomes and develop alternative portfolios
  - Input data
  - Explanations of how the utility used input data and values
  - Spreadsheets used for pre-processing and post-processing of inputs and results
  - Software licenses paid for by the utility

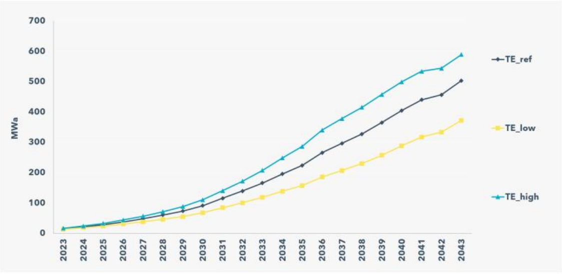
Model Inputs -
Load and DER forecasting



Load and DER forecasting

- Best practices in this section of the report cover four key topics
  - Develop a load forecast for the expected future
  - Incorporate load flexibility into electrification forecasts
  - Plan ahead for large load growth
  - Transparently represent distributed generation and storage





PV (left) and EV (right) forecasts from PGE's 2023 IRP

I. Stakeholder engagement

- **Best Practice 1:** Use an inclusive stakeholder process
- **Best Practice 2:** Engage technical stakeholders in IRP modeling

II. Resource adequacy

- **Best Practice 3:** Link resource adequacy assessments with resource planning
- **Best Practice 4:** Apply consistent accreditation frameworks to all resource types
- **Best Practice 5:** Use a regional perspective to plan for resource adequacy

III. Developing model inputs

- **Best Practice 6:** Use up-to-date inputs and assumptions
- **Best Practice 7:** Recognize historical data limitations

Load Inputs

- **Best Practice 8:** Develop a load forecast for the expected future
- **Best Practice 9:** Incorporate load flexibility into electrification forecasts
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- **Best Practice 11:** Transparently represent distributed generation and storage

Supply-side resource inputs

- **Best Practice 12:** Use accurate assumptions for the costs of new resources
- **Best Practice 13:** Represent the full cost and risk of advanced technologies
- **Best Practice 14:** Include realistic assumptions about resource availability timing, without unnecessary constraints
- **Best Practice 15:** Limit renewable integration cost adders
- **Best Practice 16:** Model all avoidable forward-going resource costs
- **Best Practice 17:** Model battery energy storage options

- **Best Practice 18:** Be consistent in treatment of emerging technologies

Demand-side resource inputs

- **Best Practice 19:** Ensure thoughtful and consistent assumptions for demand-side resources
- **Best Practice 20:** Model and bundle demand-side resources carefully
- **Best Practice 21:** Ensure consistency with IRP scenarios
- **Best Practice 22:** Incorporate all relevant benefits for demand-side resources

Market inputs

- **Best Practice 23:** Use reasonable market interaction assumptions

Fuel and commodity inputs

- **Best Practice 24:** Model fuel supply limitations
- **Best Practice 25:** Evaluate the impacts of gas price volatility and coal supply constraints

Transmission inputs

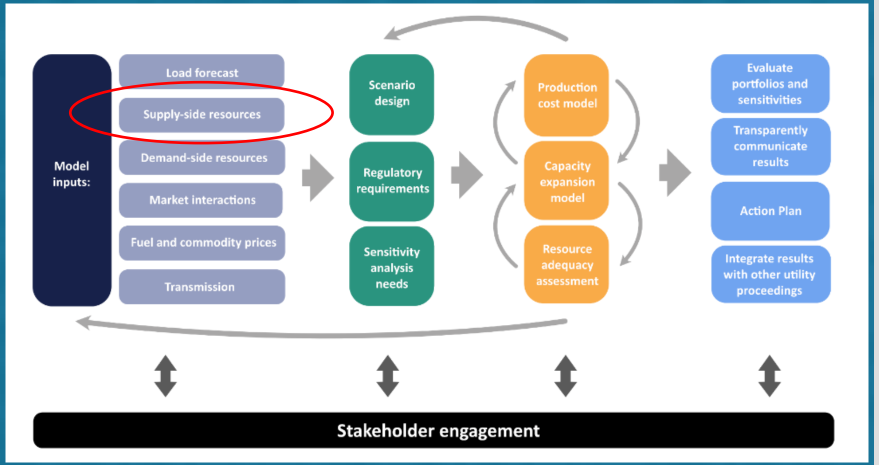
- **Best Practice 26:** Consider transmission alternatives and infrastructure expansion
- **Best Practice 27:** Properly justify bulk power system interconnection costs and constraints

Flexibility and DER forecast

Best Practice 9. Incorporate load flexibility into electrification forecasts
Best Practice 11. Transparently represent distributed generation and storage

- Integration of demand-side resources into forecasts with transparent characterization and modeling of flexibility, distributed generation, and storage
- Best practices
  - Traditional **demand response remains in the market potential study**; EV and heat pump flexibility modeling based on realistic assumptions for control and behavior
  - Separately forecast **adoption of DER over time and space**, as well as modeling DER **operation.** Adoption and operation follow **economic logic**, but are strongly **influenced by policy, regulatory, and retail rate incentives**
  - **Adoption**: Propensity of adoption method; **operation** does not have a best practice → scenarios
  - **Do not "hide" the DER forecast** with the load forecast
  - If a distribution system plan is available, **ensure the IRP uses the same assumptions** and outcomes

Model Inputs - Supply-side resources, markets, fuel and transmission



Supply side resources

Resource cost and timing

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Market, fuel, transmission inputs

Market assumptions

Best Practice 23. Use reasonable market interaction assumptions, assessing and balancing risk of market exposure and efficiency gains of market participation

Fuel supply and price volatility

Best Practice 24. Model fuel supply limitations
Best Practice 25. Evaluate the impacts of gas price volatility and coal supply constraints

Transmission considerations

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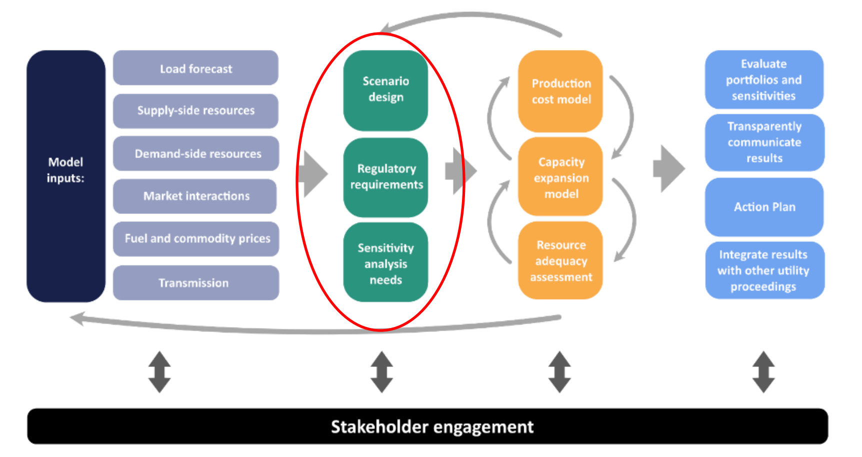
Designing Scenarios and Sensitivities



Scenario and sensitivity design

- Best practices in this section of the report cover:
  - Setting up a good base case
  - Designing scenarios to evaluate uncertainty, risk, and regulatory factors

Definitions

- A **scenario** represents a change to major assumptions and tends to portray a world or future that looks markedly different from base assumptions.
- A **sensitivity** changes a single key input to understand how that input affects or drives results, often across multiple scenarios. The goal of a sensitivity is to understand how sensitive the results are to a single variable.

IV. Designing scenarios and sensitivities

- **Best Practice 28:** Model a base case that allows for easy comparison
- **Best Practice 29:** Design scenarios to evaluate uncertainty and risk
- **Best Practice 30:** Plan for and incorporate important regulatory factors

V. Running the models (and iterating)

- **Best Practice 31:** Thoughtfully select capacity expansion and production cost models
- **Best Practice 32:** Thoughtfully select a geographic model scale
- **Best Practice 33:** Thoughtfully define the appropriate study period
- **Best Practice 34:** Thoughtfully select the appropriate time granularity for production cost modeling
- **Best Practice 35:** Calibrate the production cost and capacity expansion models
- **Best Practice 36:** Let optimization models optimize
- **Best Practice 37:** Base power plant retirement decisions on forward-looking costs
- **Best Practice 38:** Use modeling parameters that capture the value of battery energy storage
- **Best Practice 39:** Use stochastic approaches for robust portfolio creation
- **Best Practice 40:** Use the models iteratively

VI. Evaluating portfolio results and communicating transparently to regulators and stakeholders

- **Best Practice 41:** Use appropriate metrics to evaluate IRP results
- **Best Practice 42:** Report results clearly
- **Best Practice 43:** Benchmark inputs and results to other utilities
- **Best Practice 44:** Select a preferred portfolio
- **Best Practice 45:** Model state goals and priorities in preferred portfolio

VII. Integrating the IRP process with other utility proceedings

- **Best Practice 46:** Use IRP results to inform an Action Plan and utility procurement processes
- **Best Practice 47:** Use IRP results to inform other types of planning
- **Best Practice 48:** Evaluate bill impacts
- **Best Practice 49:** Consider energy justice comprehensively
- **Best Practice 50:** Consider the evolving natural gas distribution industry

Considerations when designing scenarios and sensitivities

Planners often face challenges during the scenario design process, including:

- Modeling a full, comprehensive range of uncertainties vs. producing clear, informative results
- Balancing stakeholder requests with utility priorities and commission requirements
- Minimizing shareholder risks vs. minimizing ratepayer costs

Best practices for designing scenarios and sensitivities

Best Practice 28. Model a base case that allows for easy comparison

- Thoughtfully develop a base scenario and ensure that all subsequent scenarios and sensitivities are internally consistent so that results can be readily compared across them.
- This does not preclude resource planners from intentionally designing scenarios that deviate from the base scenario in a clear manner to evaluate the impact of different load forecasts or cost assumptions.

Best Practice 29. Design scenarios to evaluate uncertainty and risk

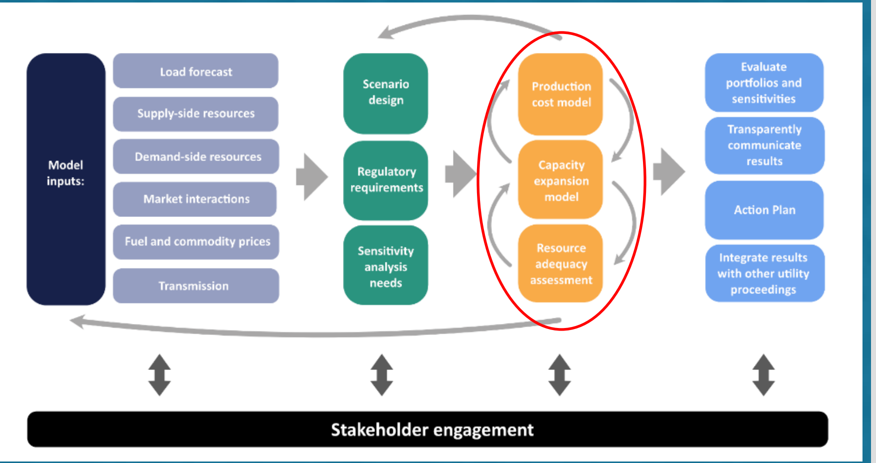
- Focus on developing a range of scenarios that evaluate real and likely futures.
- Scenarios that evaluate extreme themes or views may be interesting, but are ultimately not likely to provide useful information for IRP purposes.

Regulatory compliance

Best Practice 30. Plan for and incorporate important regulatory factors

- IRP is about selecting a least-cost, least-risk plan ***subject to compliance with reliability and regulatory constraints***.
- Best practice is to model all final, proposed, and likely regulations to allow time for proactive planning and identification of no-regrets actions.
- Modeling compliance as a single alternative scenario and not in the base case limits the utility's ability to plan for a future with the regulations in place.
- While there may be uncertainty, planners can analyze alternative futures with varying levels of regulations in other scenarios or sensitivities.
- Assuming that proposed environmental regulations will not exist in the future can lead to costly decisions and delays.

Models



Model inputs:
Load forecast
Supply-side resources
Demand-side resources
Market interactions
Fuel and commodity prices
Transmission
Scenario design
Regulatory requirements
Sensitivity analysis needs
Production cost model
Capacity expansion model
Resource adequacy assessment
Evaluate portfolios and sensitivities
Transparently communicate results
Action Plan
Integrate results with other utility proceedings
Stakeholder engagement

Running the models

Best Practices 31–40

- Best practices in this section of the report cover:
  - Choosing and calibrating capacity expansion and production cost models and using them iteratively
  - Selecting geographic and temporal scales for both models
  - Letting models optimize, including retirement decisions
  - Capturing the value of energy storage
  - Using stochastic approaches for robust portfolio creation

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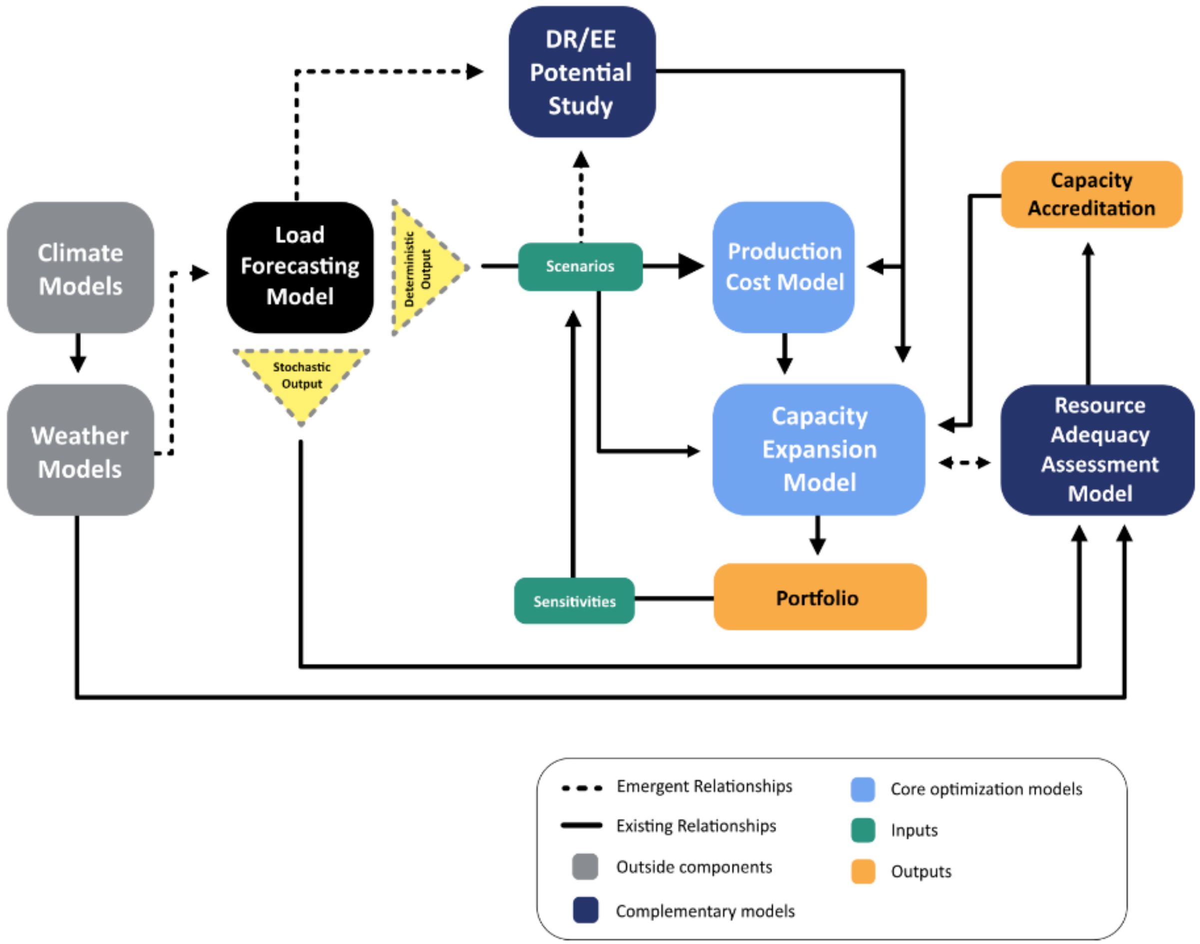
Best practices for modeling

- **Ensure** capacity expansion and production cost models are **state-of-the-art**
- Select **spatial and temporal scales thoughtfully** including (i) temporal granularity and (ii) planning horizon
- **Calibrate** both models!
- Let optimization **models optimize**
  - Don't force **build decisions** unless resources are under construction
  - Don't force **resource retirement decisions** unless testing specific scenarios
- Use **stochastic approaches** for robust portfolio creation
- Use **models iteratively**

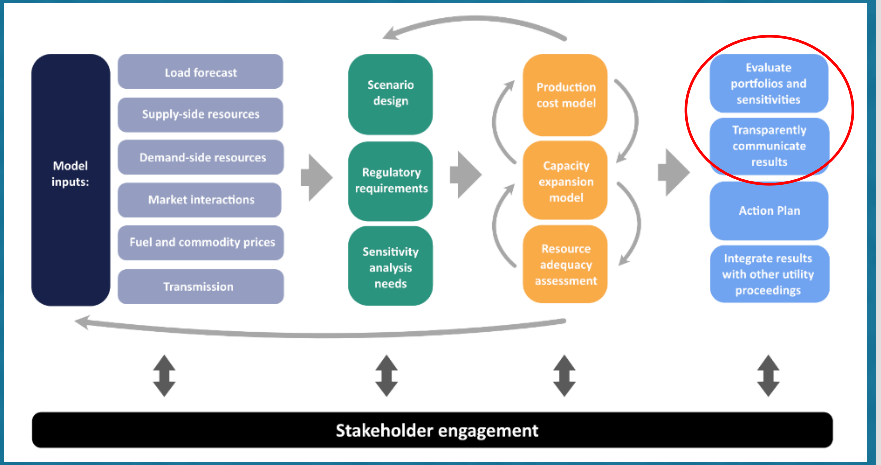


Resource adequacy

Best Practice 3: Link resource adequacy assessments with resource planning
Best Practice 4: Include realistic assumptions about resource availability timing
Best Practice 5: Model all avoidable forward-going resource costs

- Robust recent body of work with technical practices for RA assessments
- Iteratively run capacity expansion and reliability models to refine planning reserve margin and test it
  - Use this link to develop synchronized capacity accreditation frameworks to be used in crediting portfolios
  - Consider seasonal PRM and capacity accreditation (e.g. MISO)
- Apply consistent capacity accreditation methods, using ELCC or other modeled/hybrid methods for all resources away from equivalent forced outage rate demand (EFORd) or capacity factor methods for fossil fuel resources.
- Regional perspective for RA that captures actual neighboring dependence (e.g. PNM and Puget Sound Energy) to prevent excessive conservatism and cost → assess leaning on the system

Results Evaluation



Valuing and comparing plans

Best Practice 41. Use appropriate metrics to evaluate IRP results

- At the outset of the IRP process, define core metrics that are aligned with region-specific needs and goals to avoid skewing results towards a predetermined outcome
- Collaborate with stakeholders and regulators when defining metrics

Example:

- AES Indiana developed the evaluation categories for its IRP scorecard based on a set of pillars for electric utility service defined by a task force created by the Indiana General Assembly

	Affordability	Environmental Sustainability						Reliability, Stability & Resiliency
	20-yr PVRR	*CO_2 Emissions*	*SO_2 Emissions*	*NO_X Emissions*	*Water Use*	*Coal Combustion Products (CCP)*	*Clean Energy Progress*	*Reliability Score*
	Present Value of Revenue Requirements ($000,000)	Total portfolio CO2 Emissions (mmtons)	Total portfolio SO2 Emissions (tons)	Total portfolio NOx Emissions (tons)	Water Use (mmgal)	CCP (tons)	% Renewable Energy in 2032	Composite score from Reliability Analysis
1	$ 9,572	101.9	64,991	45,605	36.7	6,611	45%	7.95
2	$ 9,330	72.5	13,513	22,146	7.9	1,417	55%	7.95
3	$ 9,773	88.1	45,544	42,042	26.7	4,813	52%	7.86
4	$ 9,618	79.5	25,649	24,932	15.0	2,700	48%	7.90
5	$ 9,711	69.8	25,383	24,881	14.8	2,676	64%	7.57
6	$ 9,262	76.1	18,622	25,645	10.9	1,970	54%	7.95

	Risk & Opportunity								Economic Impact	
	Environmental Policy Opportunity	*Environmental Policy Risk*	*General Cost Opportunity **Stochastic Analysis***	*General Cost Risk **Stochastic Analysis***	*Market Exposure*	*Renewable Capital Cost Opportunity (Low Cost)*	*Renewable Capital Cost Risk (High Cost)*	*Generation Employees (+/-)*	*Property Taxes*
	Lowest PVRR across policy scenarios ($000,000)	Highest PVRR across policy scenarios ($000,000)	P5 [Mean - P5]	P95 [P95 – Mean]	20-year avg sales + purchases (GWh)	Portfolio PVRR w/ low renewable cost ($000,000)	Portfolio PVRR w/ high renewable cost ($000,000)	Total change in FTEs associated with generation 2023 - 2042	Total amount of property tax paid from AES IN assets ($000,000)
1	$ 8,860	$ 11,259	$ 9,271	$ 9,840	5,291	$ 9,080	$ 10,157	222	$ 154
2	$ 8,564	$ 11,329	$ 9,030	$ 9,746	5,222	$ 8,763	$ 9,999	99	$ 193
3	$ 9,288	$ 11,462	$ 9,608	$ 10,237	5,737	$ 9,244	$ 10,406	195	$ 204
4	$ 9,135	$ 11,392	$ 9,295	$ 9,903	5,512	$ 9,104	$ 10,249	74	$ 242
5	$ 9,590	$ 11,275	$ 9,447	$ 10,039	6,088	$ 9,017	$ 10,442	55	$ 256
6	$ 8,517	$ 11,226	$ 8,952	$ 9,629	5,136	$ 8,730	$ 9,909	88	$ 185

Benchmark results

Best Practice 43. Benchmark inputs and results to other utilities

When developing input assumptions and analyzing results, utilities can see how inputs and results of neighboring or similar utilities compare to each other. If there are major differences, these can be justified or explained to stakeholders.

Examples:

- As part of its 2025 IRP process, Tennessee Valley Authority hired a consultant to review its 2019 IRP and benchmark it against peer IRPs to identify key themes and trends to consider in the current IRP.

Tools:

- LBNL maintains a Resource Planning Portal that allows users to benchmark planning assumptions across jurisdictions.

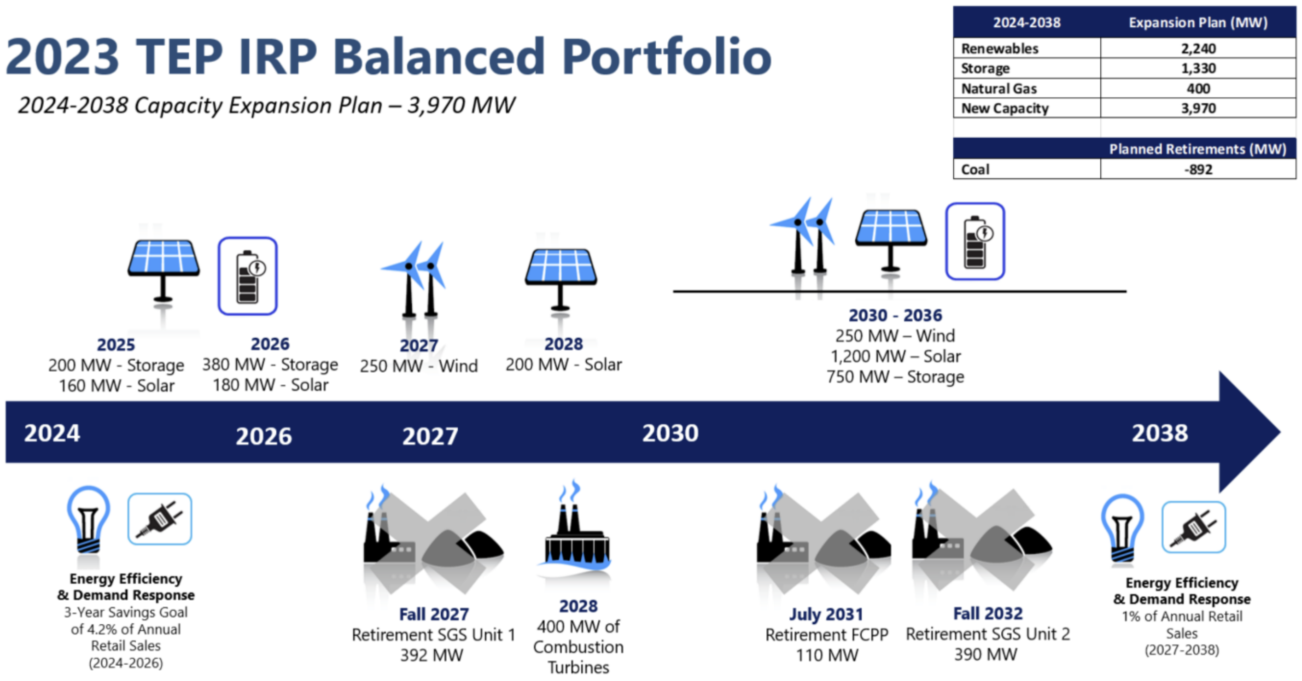
Preferred portfolio selection

It is important to select a preferred portfolio to guide near-term actions such as procurement.

Without a preferred portfolio, it is challenging for stakeholders and regulators to focus their feedback and oversight

The utility's selection of a preferred portfolio does not necessarily tie the utility to that portfolio, especially if conditions change

Figure 63. Balanced Portfolio Project Timeline



Note: *TEP retires 1,183 MW of fossil generation, 172 MW of solar, 80 MW of wind, and 20 MW of energy storage by 2038.*

Source: Tucson Electric Power 2023 IRP

The Action Plan

Best Practice 46. Use IRP results to inform an Action Plan and utility procurement practices

- The Action Plan serves as the basis for utility implementation of the preferred portfolio
- The Action Plan requires utilities to clearly explain proposed procurement decisions, business development, and analysis needs for the near-term, anywhere between 1–4 years
- Best practices - A well-developed Action Plan includes:
  - Individual identification of assets to be procured or requests for proposals (RFPs) to be designed, including capacity needs, location, and timing
  - Identification of outstanding analytical aspects of the IRP that will continue to be studied in the near-term, either because new information may be available soon or because it will inform a procurement decision
  - List strategies to comply with near-term regulatory mandates and targets

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Image source: https://medium.com/@TheBold/the-power-of-an-action-plan-6490791131a

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