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# NEI Integration Approaches – Supplemental Information

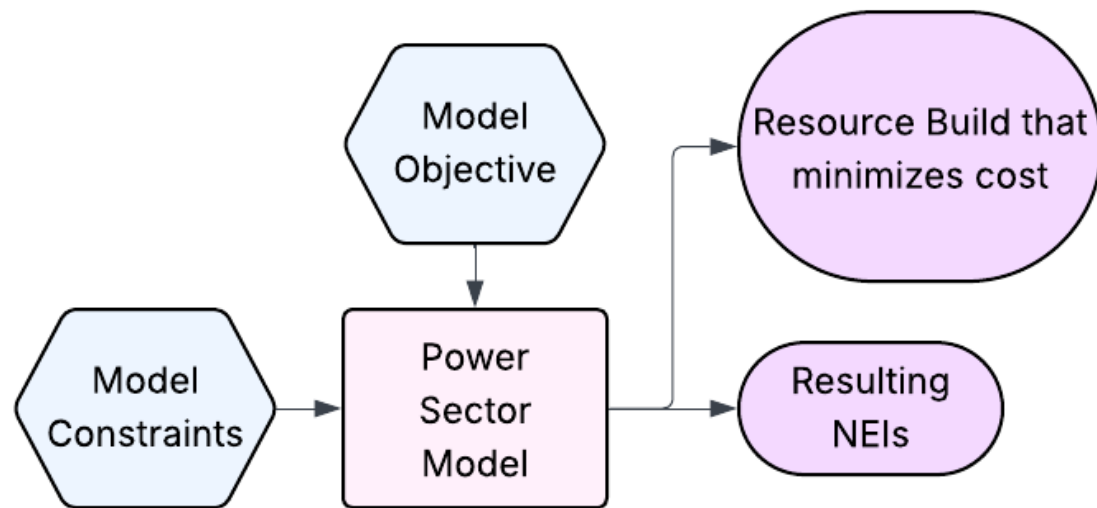




# Approaches for Model Integration: Post-hoc

Approach	Description	Advantages and Disadvantages
<b>Post-hoc analysis of NEI impacts</b>	After modeling is completed, this approach uses model outputs of changes in resource capacity and generation and separately evaluates potential NEI impacts to compare scenarios.	<p><b>Advantage(s):</b> Can be calculated independently based on scenario results and is the most straightforward to analyze. Allows for integration of more NEIs that do not yet have a modeling integration strategy.</p> <p><b>Disadvantage(s):</b> With the modeling step already completed, the analysis is limited to the resource choices contained in the predetermined scenarios, thereby excluding other potential portfolios that might offer improved NEI performance.</p>

Post-hoc Approach

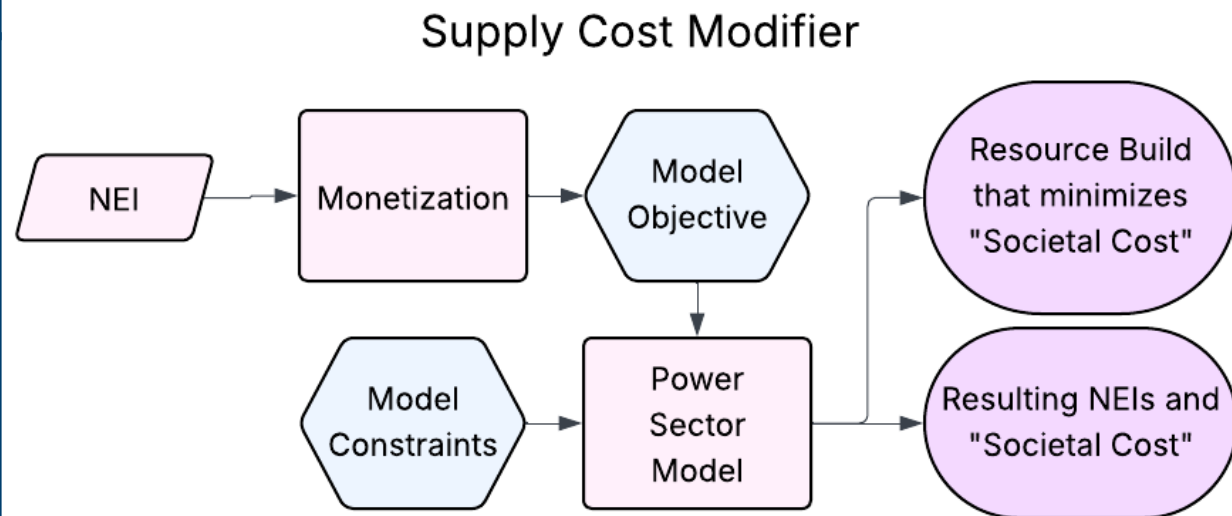


Each model run should have all its NEIs calculated regardless of how scenarios are built.



# Approaches for Model Integration: Supply Cost Modifier

Approach	Description	Advantages and Disadvantages
<b>Supply cost modifier</b>	Within the model, societal costs (positive or negative) associated with each NEI are added to the traditional financial costs for each technology.	<p><b>Advantage(s):</b> Integrates the NEI into the existing cost-minimization model.</p> <p><b>Disadvantage(s):</b> Relies on NEI monetization which is rarely straightforward and often controversial and uncertain.</p>

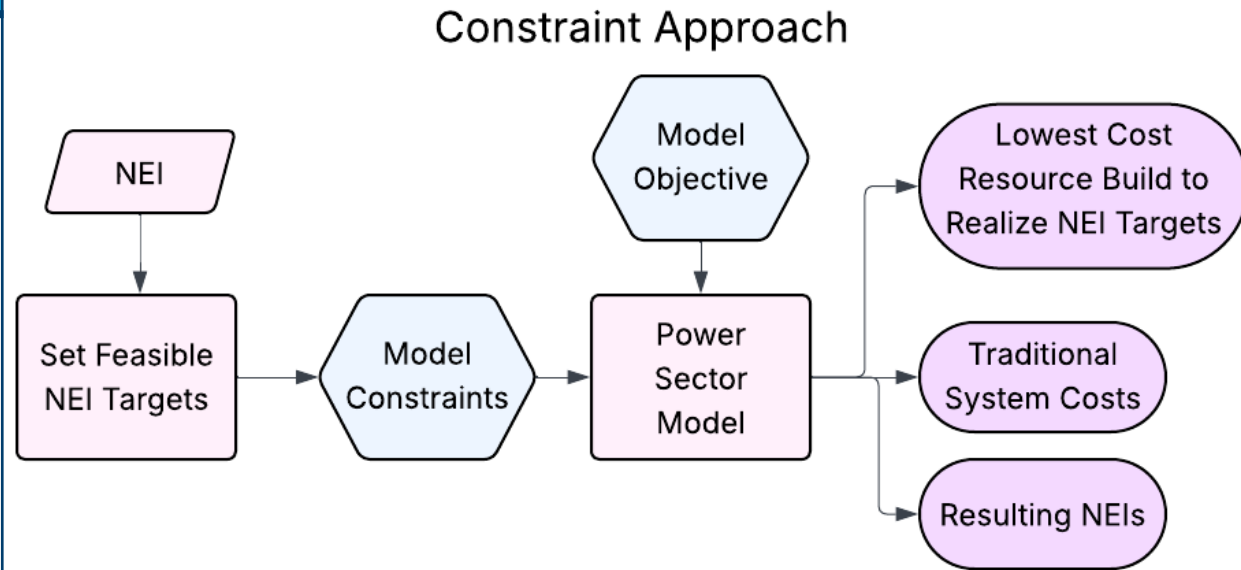


Model results will explore the pros and cons of this approach. This is the most common approach but can be misleading.



# Approaches for Model Integration: NEI Constraints

Approach	Description	Advantages and Disadvantages
<b>Constraints to meet NEI targets</b>	One or more constraints within the model can force modeled capacity and generation to meet NEI targets, similar to how GHGs targets are incorporated.	<p><b>Advantage(s):</b> Works for all metrics. Does not require monetization. Realizes scenario portfolios and resulting cost impacts regardless of cost effectiveness</p> <p><b>Disadvantage(s):</b> Requires identification of reasonable NEI targets which may be difficult or subjective</p>



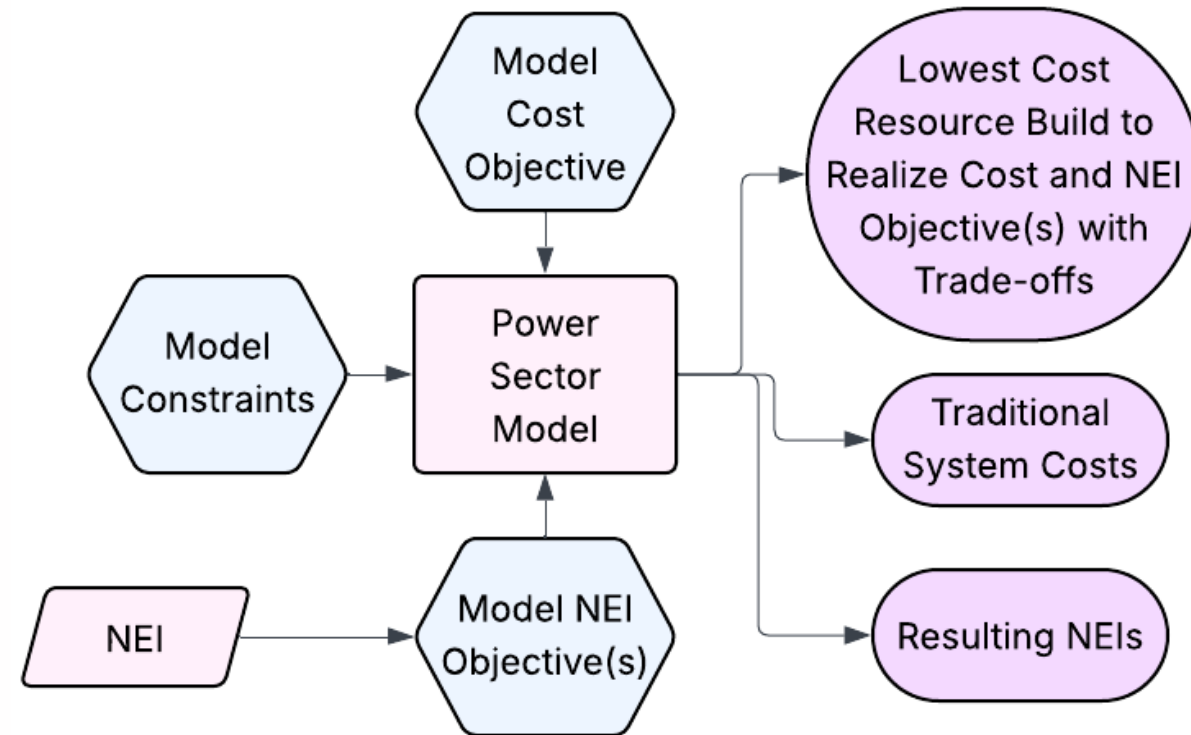
Strong option that should be explored for most NEIs. This approach is achievable and, for NEIs, novel.



# Approaches for Model Integration: Multiobjective

Approach	Description	Advantages and Disadvantages
<b>Multiple objective optimization</b>	Modeling frameworks exist to simultaneously optimize multiple separate objectives. This allows for cost minimization and NEI optimization within a model.	<p><b>Advantage(s):</b> Within one modeling workflow, users can identify solutions that account for multiple objectives simultaneously without monetization of NEIs by considering tradeoffs among objectives.</p> <p><b>Disadvantage(s):</b> More sophisticated approach is challenging to adapt using existing modeling packages. Limited studies exist for power system models.</p>

## Multiobjective Optimization

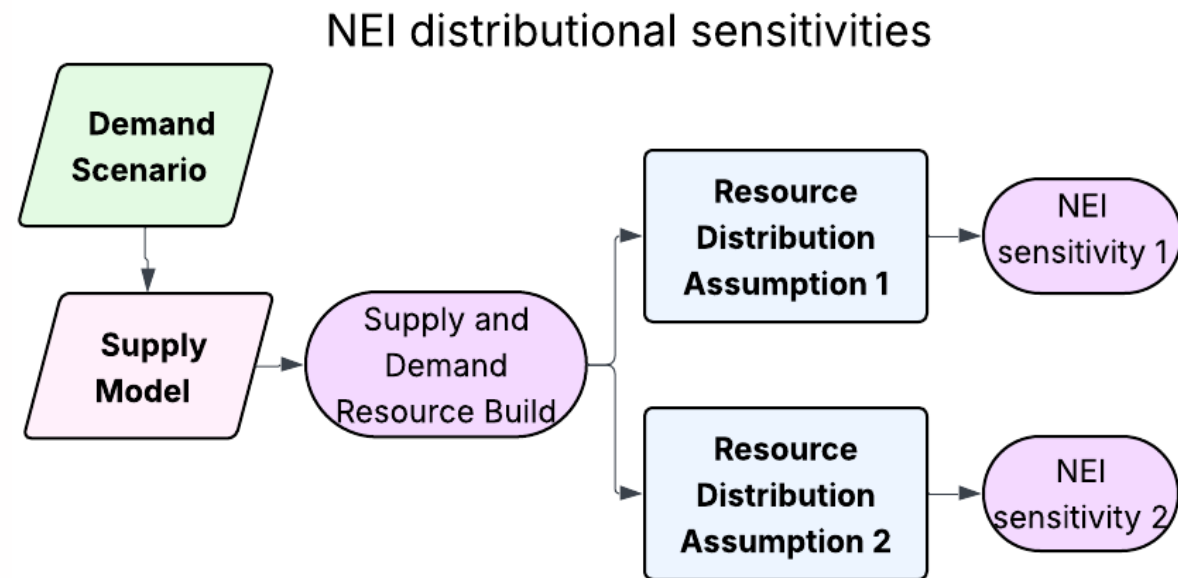


Not technically feasible for most models. Currently, these approaches are more academic and less practical.



# Approaches for Model Integration: NEI Distributional Sensitivities

Approach	Description	Advantages and Disadvantages
<b>NEI distributional sensitivities</b>	<p>The magnitude of a given NEI is often strongly dependent on location of resources and who adopts them. Average values fail to capture the wide spread in these impacts. Downscaling or bottom-up modeling can identify ranges of potential NEIs given aggregate resources.</p>	<p><b>Advantage(s):</b> Captures potential benefits from strategic integration of multiple programs and policies. Captures effects at scales smaller than typical model geographies.</p> <p><b>Disadvantage(s):</b> Depending on resource availability, increased complexities resulting in additional model runs and analysis under various distributional strategies.</p>





# Approaches for Model Integration: Strategies for Demand-side Integration

Approach	Description	Advantages and Disadvantages
<p><b>Integration of Demand Side Technologies</b></p>	<p>Demand side resources are added to resource portfolios as an input assumption. Modeling demand-side resources in supply models is complex as traditionally they are not dispatched by a system operator and, accordingly, their response and availability are uncertain relative to supply resources. Additionally, decisions of procurement and ownership are not centralized as with traditional procurement.</p>	<p><b>Advantage(s):</b> Captures potential impacts from DERs typically not accounted for in supply modeling.</p> <p><b>Disadvantage(s):</b> Depending on their availability, additional time/resources needed to develop and analyze additional demand-side resource scenarios with survey estimates of their associated NEIs and costs where feasible.</p> <p>Integrating demand side resources into supply side models is a longstanding challenge in power sector modeling. Demand side resources such as energy efficiency, load flexibility, and self-generation (e.g., behind-the-meter solar photovoltaics) impact supply side resource needs but have different NEIs than utility-scale resources. However, it is not clear how to fairly estimate costs and benefits for these resources, as they can both increase and offset investments in the existing power grid. This poses a major obstacle towards a full integration of demand and supply resources.</p>

# Workforce Calculation Detail





# Workforce

Coefficient	Definition	Source
<b>Job Intensity</b>	Job-years per MW	National Lab of the Rockies (NLR) Jobs and Economic Development Impact (JEDI) model, Rhodium Group, Princeton Net-Zero America Study
<b>Job Quality</b>	Compensation per MW	NLR JEDI
<b>Economic Intensity</b>	Economic Output per MW	NLR JEDI
<b>DERs</b>	Adjustment Ratios (Need to be developed)	CEC Distributed Generation statistics, Net Energy Metering, Self-Generation Incentive Program, Low Income Weatherization Program



# Workforce: Model Integration Strategy

- Workforce multipliers depend on **resource capacities** (MW).
  - All coefficients are derived for CA statewide impacts using NLR's JEDI that can be applied to small geographies to estimate **regional effects**.
  - For **DERs**, technology dependent adjustment ratios will need to be developed using available data sources and benchmarks.
- Workforce NEI will be integrated **post-hoc** to track impacts associated with scenarios resulting from other NEI integration.
- Workforce NEI might also be integrated as a **constraint** to prioritize scenarios with increased workforce benefits. Some constraints could include:
  - **Geographic distribution** of jobs compared to population or level of economic distress (e.g., unemployment rate, % living in poverty).
  - **Job quality** based on average worker compensation of a scenario's jobs



# Workforce: DER Job Impact Coefficients

## WORKSTREAM 1 Capacity-Based Segregation

Use CPUC's Distributed Generation Interconnection Program data to separate DER vs. utility scale capacity and derive DER job coefficients based on the share of installed MWs.

## WORKSTREAM 2 Labor-Duration- Based FTE Conversion

Use national level industry sources (Interstate Renewable Energy Council and Freeing Energy) to estimate differences in installation efforts between DER and utility scale projects and convert those differences into California based job coefficients based on the state's labor composition.

## WORKSTREAM 3 Industry Survey on Worker Efficiency

→ *Public data does not provide reliable values for labor duration, installation efficiency, or job allocation for DER projects.*

Conduct surveys/interviews with 7–10 leading DER companies (solar installers, battery integrators, commercial DER developers) in California.