Integrated System Planning: From Vision to Reality

ISP Webinar Series

September 26, 2024

Energy+Environmental Economics

Integrated System Planning Webinar Series

7/29 webinar:

Integrated System Planning:
A New Grid Planning Framework

Angie Bond-Simpson, Salt River Project
Arne Olson & Joe Hooker, E3

Today:

Integrated System Planning:
From Vision to Reality

Arne Olson, Lakshmi Alagappan, Joe Hooker, Aaron Burdick, E3

Agenda

ITEM	SPEAKER
Recap of motivation 5 min	**Arne Olson** E3, Senior Partner
High-Level process 10 min	**Joe Hooker** E3, Director
Analytical approaches 20 min	**Aaron Burdick** E3, Director
Making integrated planning a reality 10 min	**Lakshmi Alagappan** E3, Partner
Q&A 15 min	

Recap of Motivation for Integrated System Planning

Energy+Environmental Economics

The energy transition creates opportunities and challenges for meeting planning goals

- **Reliable**
- **Affordable**
- **Clean**
- **Equitable**

Need to ensure that planning identifies

- The right investments…
- in the right locations…
- at the right times

System planning should be customer-centric

+ **Customer energy needs are growing rapidly**
  - Large industrial and data center loads
  - Electrification
+ **Customers are adopting technologies that can provide flexibility to the system**
  - Electric vehicles
  - Smart thermostats
  - Storage
+ **Customers want choice!**
  - Manage bills
  - Onsite and offsite renewable generation
  - Programs and rate plans

Customers & DERs

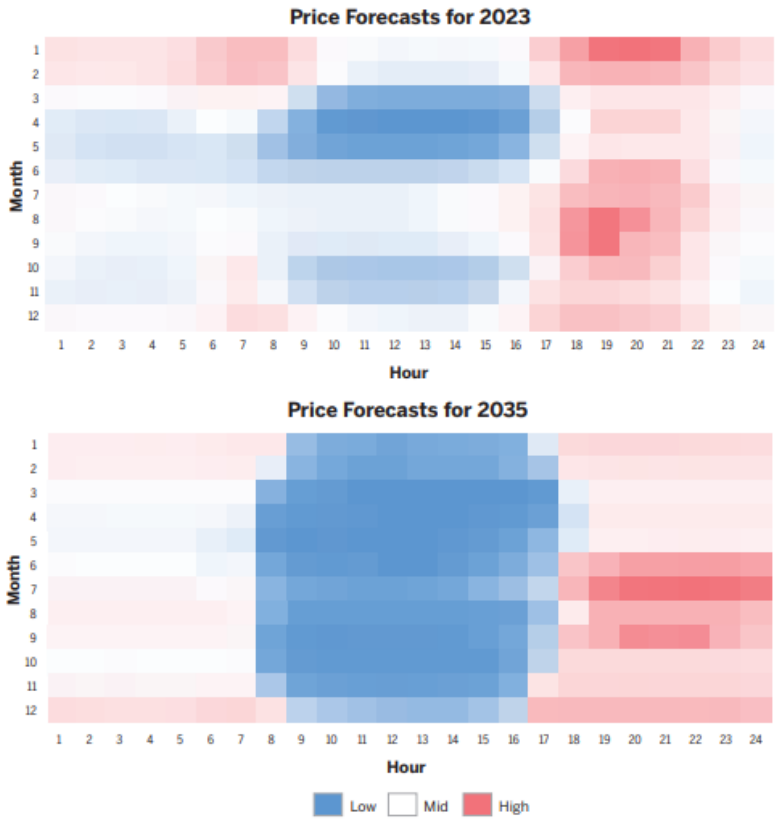




Generation and customer/DER planning should be integrated

Average prices in 2023 and forecast for 2035

CAISO SP15 zone



Utility-scale generation, customers, and DERs all have a role to play in the energy transition

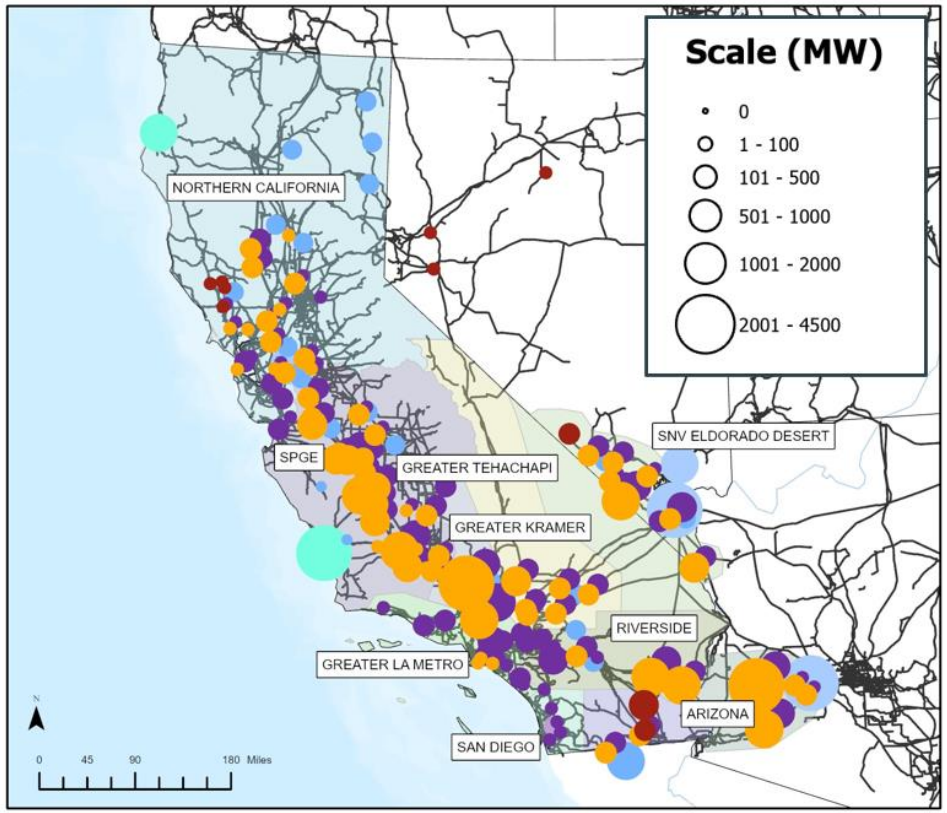
→ Customer actions and DERs can reduce the need for system investments

→ The cost and availability of utility-scale generation (and transmission) impacts the value of customer actions

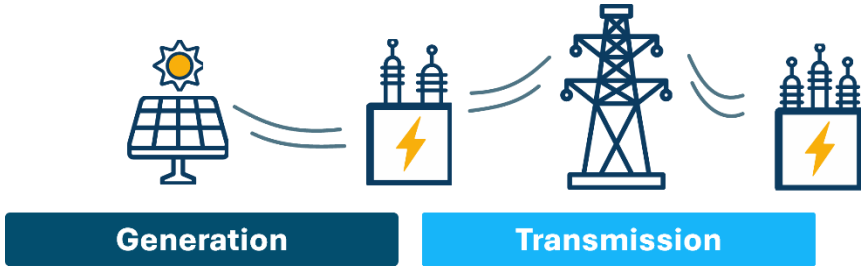
Generation and transmission planning should be integrated

CPUC IRP Resource Additions by Substation

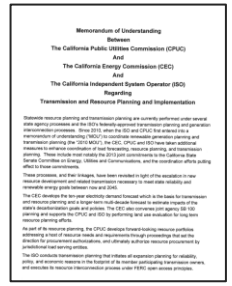
2024-25 Transmission Planning Process, 2039 Snapshot



Solar Battery Wind Offshore wind Geothermal



MOU

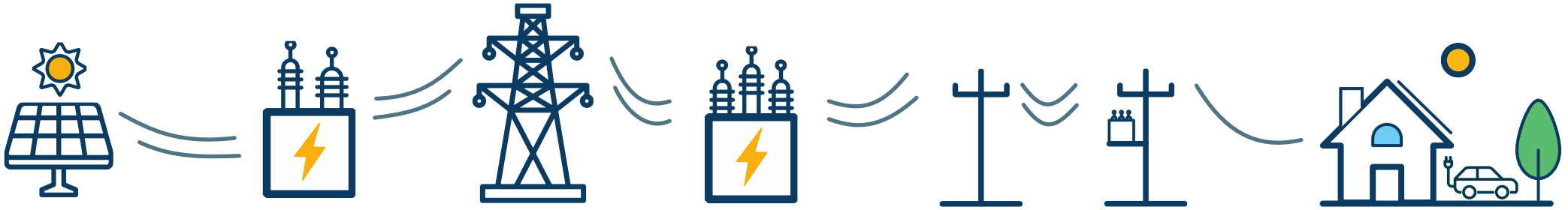


Significant amounts of new resources need to be integrated onto the transmission system

→ Existing transmission and future transmission options—including for remote renewable resources—should inform which generation resources are added and where

→ Resources, such as storage and local renewables, can be sited to reduce or mitigate transmission needs

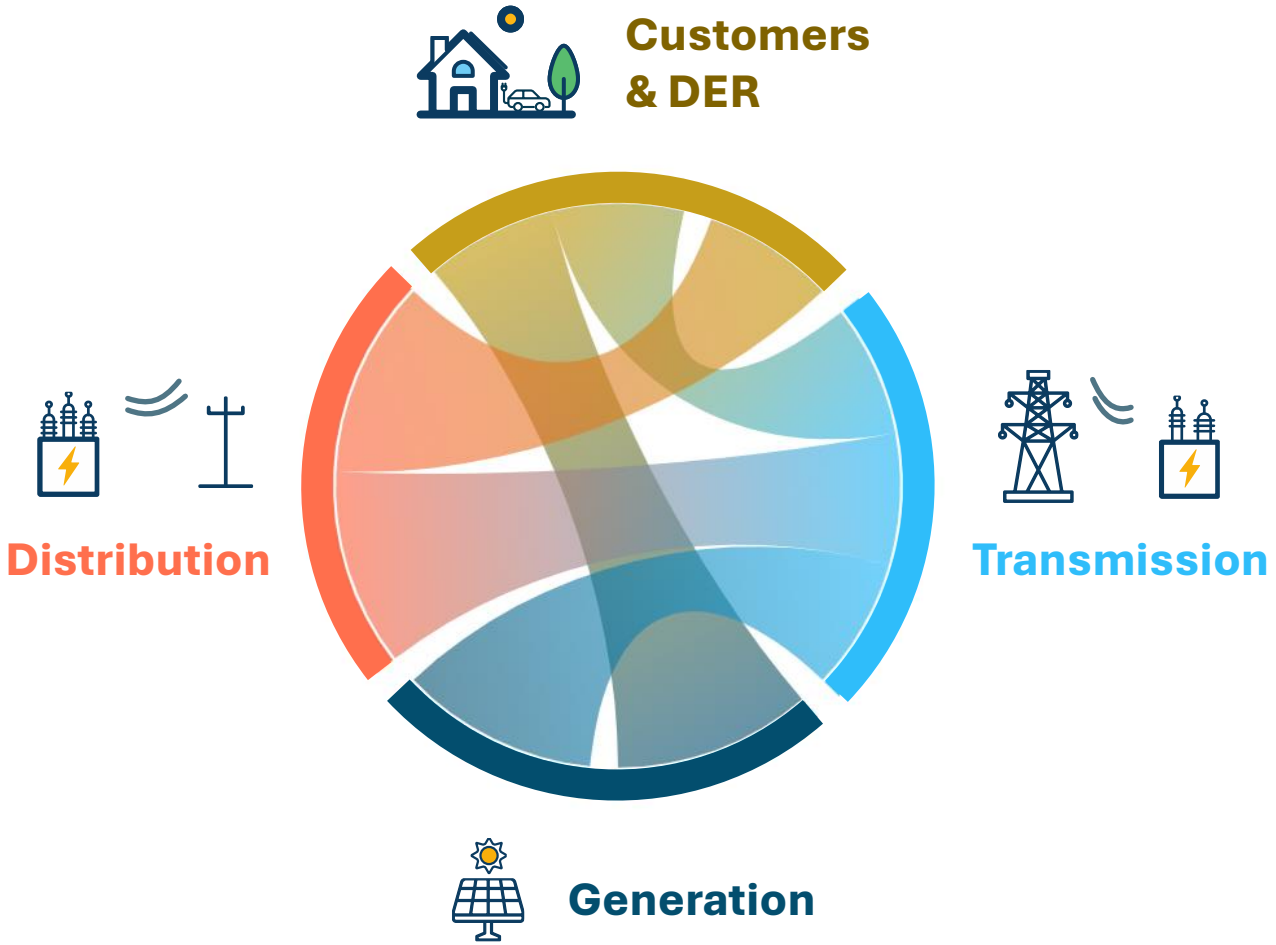
System planning is largely siloed today



Generation	Transmission	Distribution	Customers & DERs
• 20+ year IRP • Requests for proposals	• 10-year plan • Interconnection studies	• 3- to 10-year studies	• Simple, coarse forecast • Programs evaluation

Integrated system planning considers the system as a whole

The goal of integrated system planning is to **harmonize planning processes** to ensure that investments are optimal from a **system-wide planning perspective**



Integrated system planning is not just about utilities

Utilities

Harmonize planning across all parts of the system

Regulators

Ensure system planning considers a holistic perspective

Developers

Anticipate system needs and favorable locations for projects

Stakeholders

Allows transparency + input on how the entire system is planned

ISOs/RTOs

Proactively plan transmission to get ahead of grid needs

High-Level Process for Integrated System Planning

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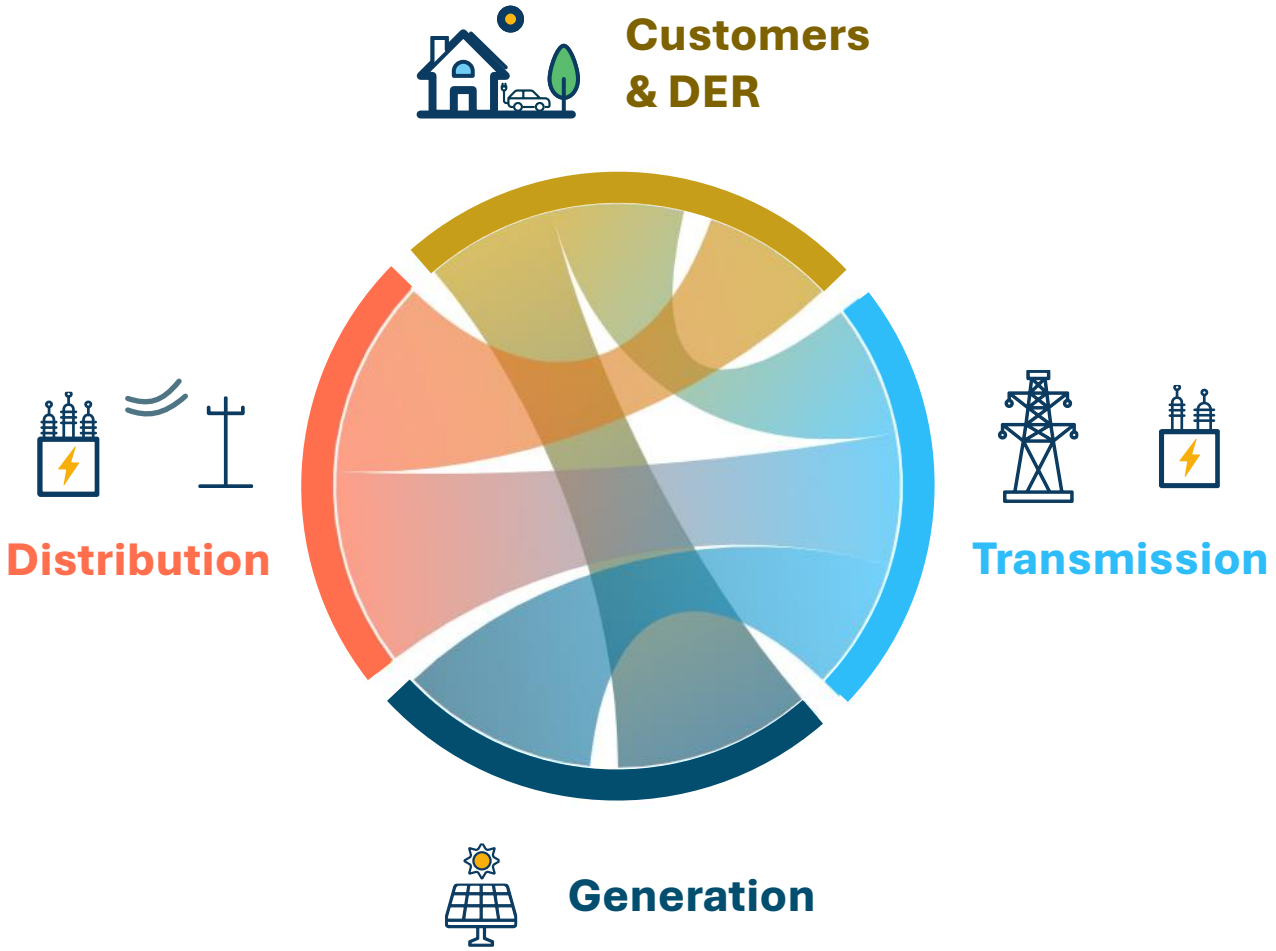
Integrated system planning harmonizes planning processes

- Scenario planning
- Common inputs & assumptions
- Coordinated system planning processes
- Harmonized action plans



Scenario design is the foundation of system planning

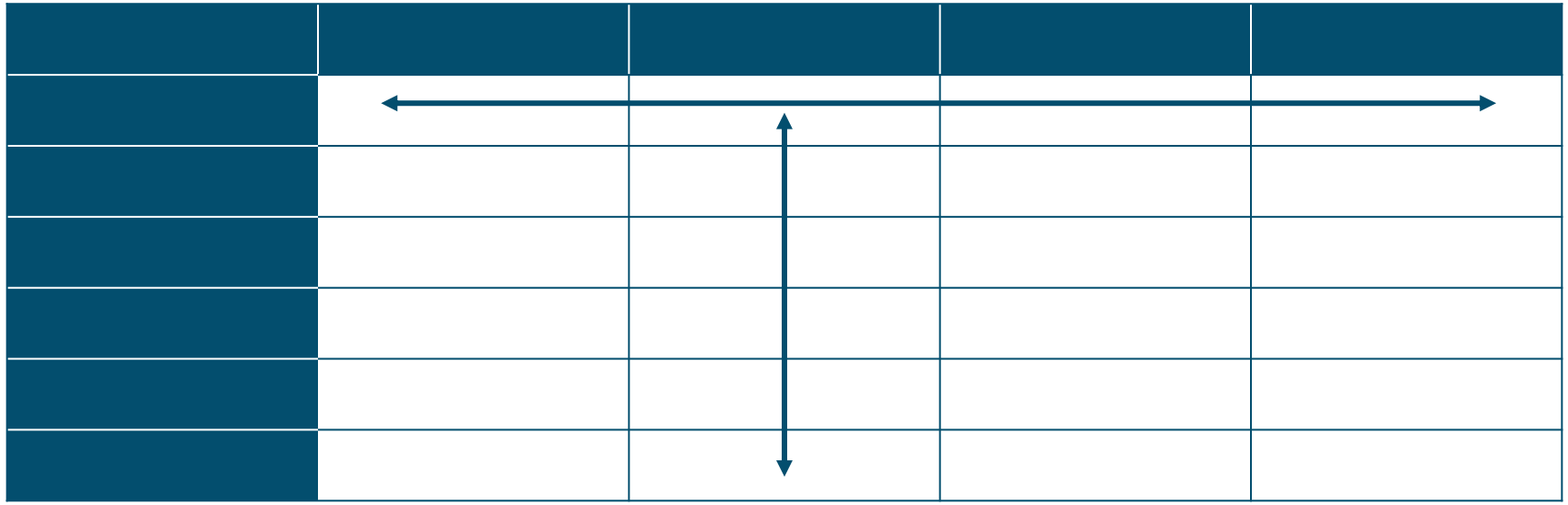
While there are many ways to design scenarios for system planning, scenarios should generally consider both sources of uncertainty that our uncontrollable and decisions controlled by system planners.

Decisions Controlled by System Planner

(e.g., plant retirements, large new transmission project, customer programs, etc.)

Futures Defined by External Factors

(e.g., load forecast, policy goals, electrification, technical costs, market prices, etc.)



Which decision provides the best outcome under a specific set of external circumstances?

How does the impact of a decision vary under different future conditions?

Identifying system needs across scenarios is the first step

1 Forecast system needs

- Load & DER forecast
- Reliability needs
- Clean energy needs

for each scenario

Identifying system solutions requires coordinating processes

1 Forecast system needs

- Load & DER forecast
- Reliability needs
- Clean energy needs

2 Identify system solutions

- Resource, transmission, distribution, customer & DER solutions
- Integrated modeling processes

for each scenario

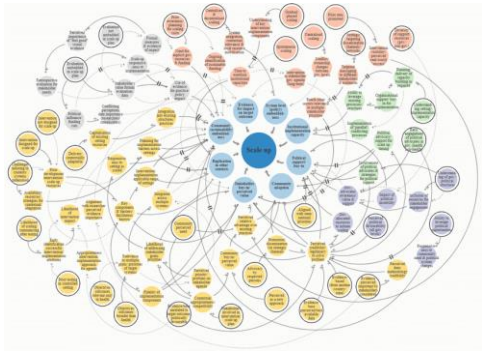
Integrated planning requires multiple modeling processes

Key challenge: how do we balance the complexity of interdependent parts of the system with the practical needs for modeling, decision making, and stakeholder engagement?

Single model that co-optimizes the full system

Due to the complex nature of the power system and the interdependent web of planning constraints and opportunities, it can be tempting to try to establish a single mega-model that optimally solves all system needs.

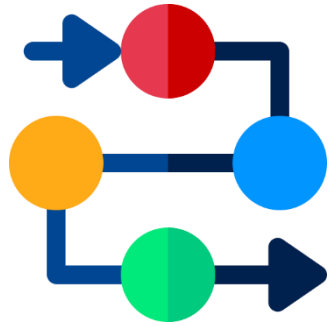
Such a model is not feasible for the foreseeable future due to data, modeling, and process constraints



Multiple, coordinated modeling processes

Performing system planning across multiple models allows for tractability, increased transparency for stakeholders and decisionmakers, planning processes with different requirements and timelines, etc.

Multiple modeling processes, if coordinated appropriately, can capture the interdependent nature of full system planning



To plan for the entire system requires coordinating across multiple analyses

ISP Analysis Component	Description	C/DER	D	T	G
Decarbonization Pathways	Forecasts alternative economy-wide decarbonization pathways and informs electrification impacts to the load forecast	●			
Load & DER Forecasts	Forecasts customer energy demand, incorporating electrification, and customer program + DER adoption forecasts	●			
Load & DER Downscaling	Downscales system-wide load forecast to distribution, transmission, and zonal levels	●	●	●	●
Resource Options Study	Evaluates resource options, potentials, costs, transmission costs for remote resources, etc.	●		●	●
Resource Adequacy Study	Determines system total resource need for ensuring resource adequacy and contributions of resources at various penetration levels	●		●	●
Distribution Studies	Identifies distribution infrastructure needed to accommodate load growth and distributed resources	●	●		
Capacity Expansion Optimization	Identifies generating resource portfolio, including bulk grid generators, enabling transmission investments, storage, distributed energy resources, etc.	●		●	●
Production Cost Modeling	Assesses zonal and/or nodal resource operations and quantifies production costs at granular hourly or sub-hourly timescales	●		●	●
Nodal Resource Mapping	Maps generation and storage resources across the network to help minimize transmission investment needs and inform detailed transmission studies			●	●
Transmission Studies	Identifies transmission infrastructure needed to accommodate load growth and resource additions, ensure reliability and system stability		●	●	●
Avoided Costs	Translates infrastructure planning needs into granular marginal avoided costs to value customer programs and inform rate design	●	●	●	●

Identifying near-term actions is the ultimate goal of planning

1 Forecast system needs

- Load & DER forecast
- Reliability needs
- Clean energy needs

2 Identify system solutions

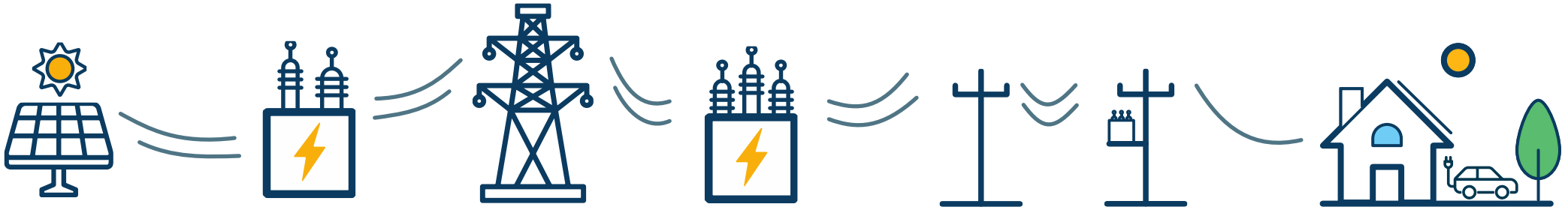
- Resource, transmission, distribution, customer & DER solutions
- Integrated modeling processes

3 Develop Action plans

- Generation
- Transmission
- Distribution
- Customers & DER

for each scenario

Resulting action plans will drive near-term investment actions as well as customer programs and rate design



Generation	Transmission	Distribution	Customers & DERs
Resource procurement plan • Procurement need accounts for customer / DER impacts • All-source RFPs • RFPs targeted by location	Transmission investment plan • Substation / wires investments • Storage as a transmission asset • Regional transmission project participation	Distribution investment plan • Substation / wires / grid mod investments • Targeted DER / customer programs • Non-wires alternative solicitations	Customer/DER programs and rates • Customer program evaluation and design for efficiency and equity • Pilot programs • Rate design

Action plans are consistent with integrated planning and require coordination across teams

Analytical Approaches

Establishing Key Data Linkages Between Planning Models

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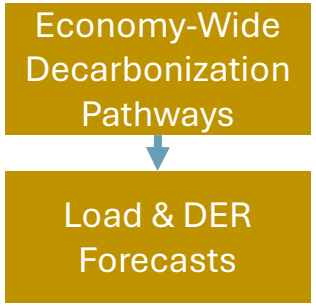
An integrated process ensures key data linkages between planning domains

1 Forecast system needs

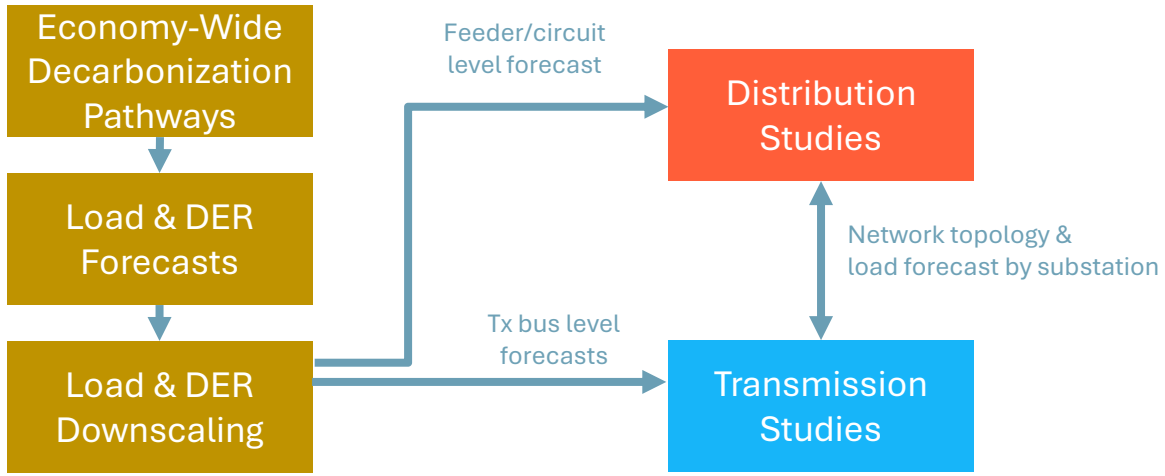
2 Identify system solutions

3 Develop Action plans



An integrated process ensures key data linkages between planning domains

1 Forecast system needs ▶ **2 Identify system solutions** ▶ **3 Develop Action plans**



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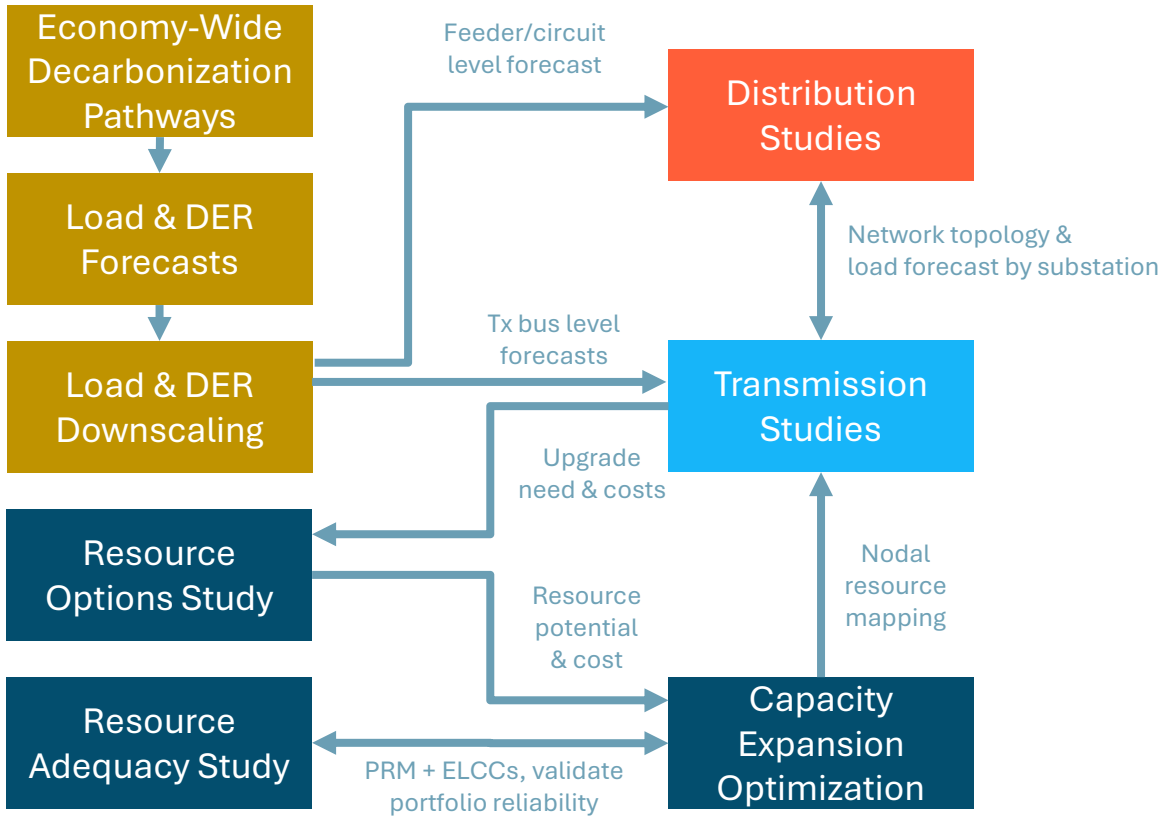

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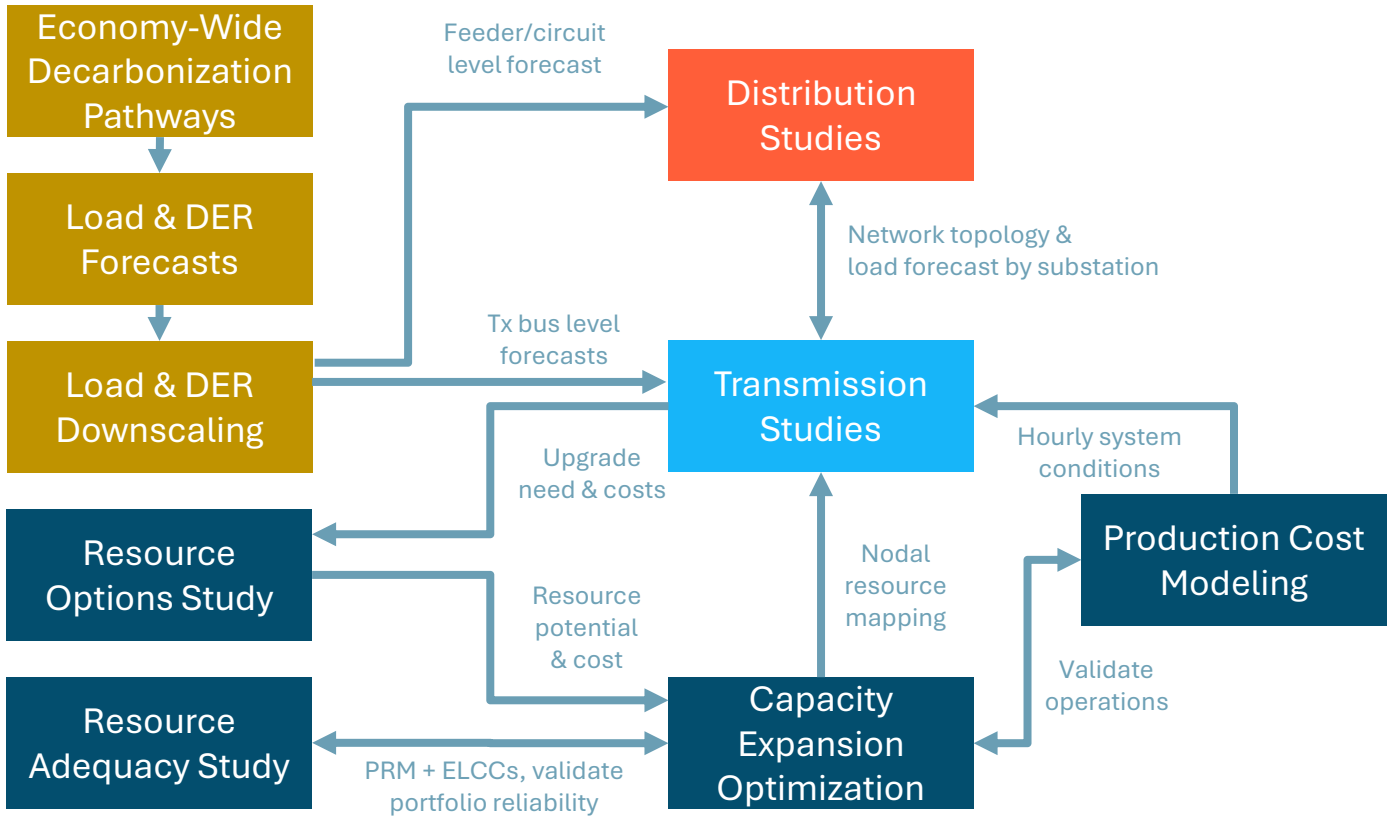

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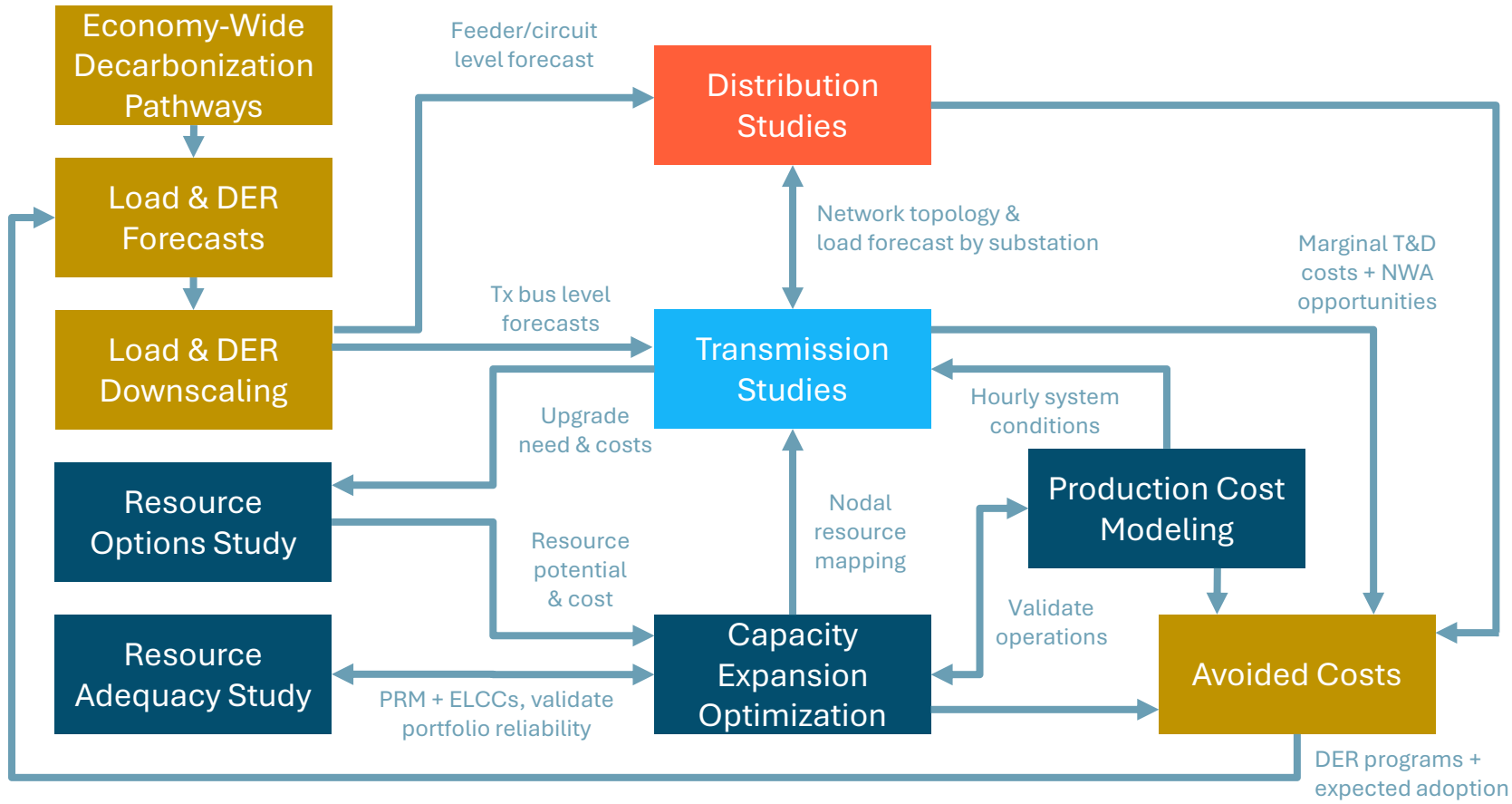

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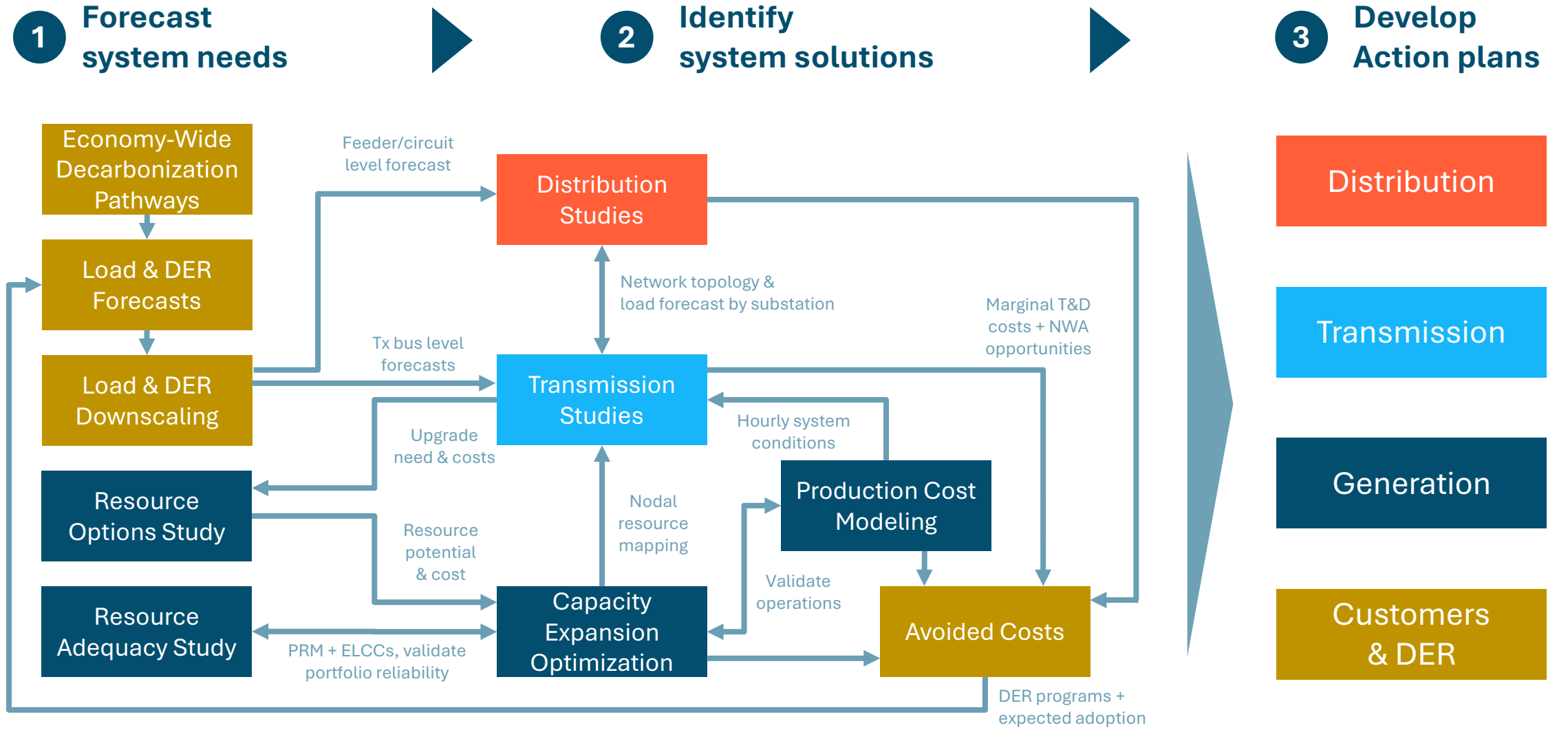
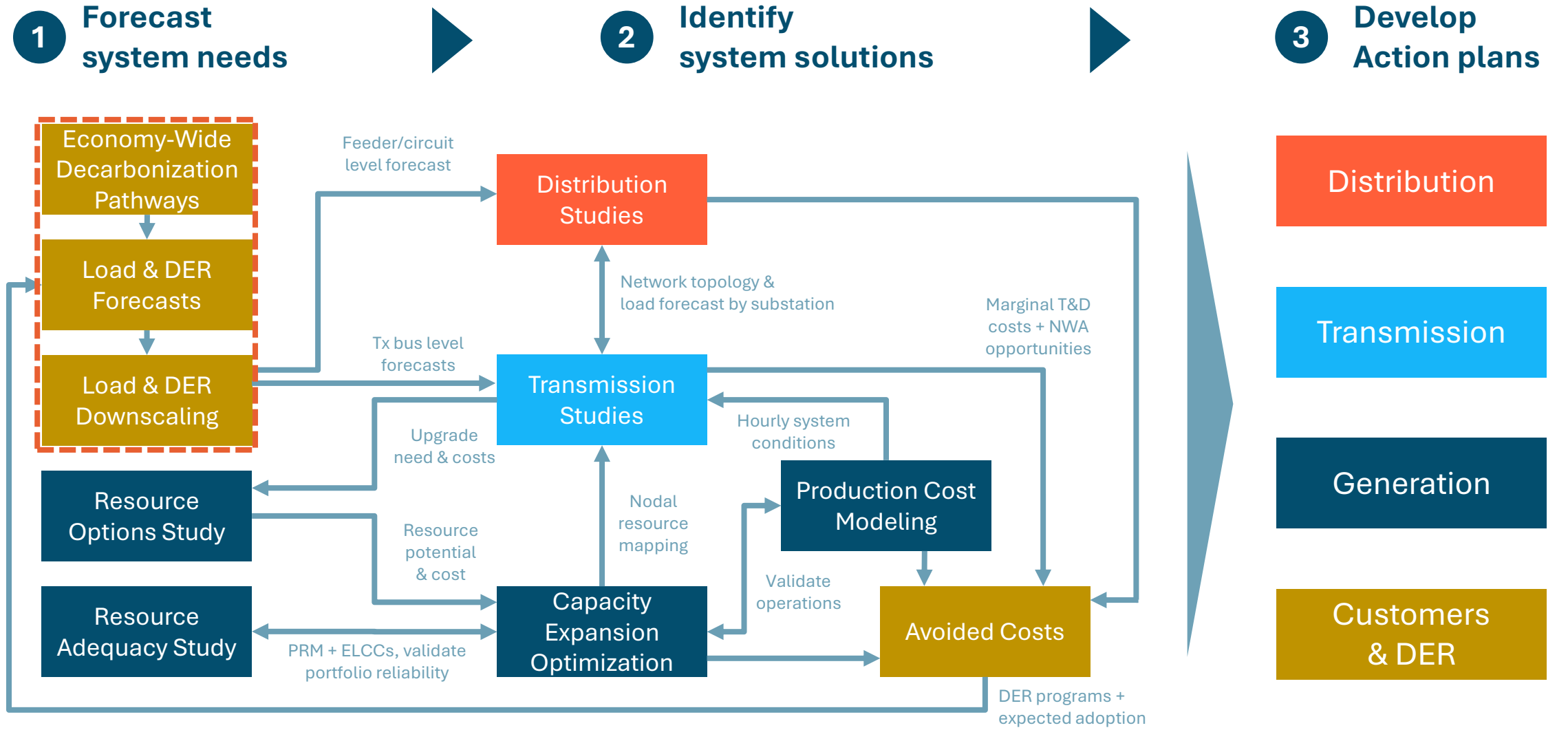


Load scenarios, including electrification and DERs, must be developed and downscaled for T&D planning



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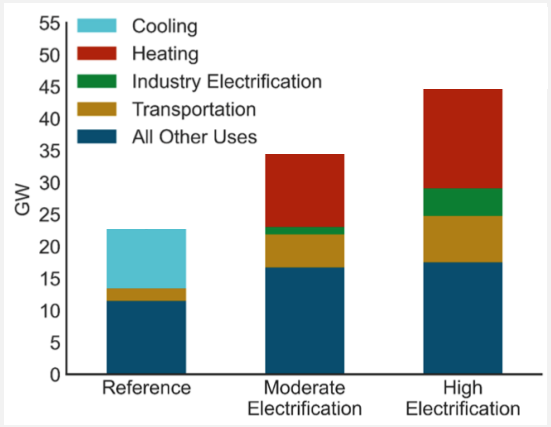
Economy-Wide Decarbonization Impacts

E3's PATHWAYS Model

Electrification Scenario Peak Impacts

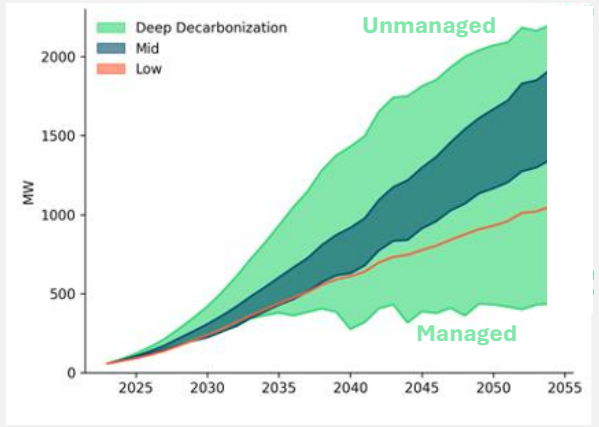


E3's Illinois Decarbonization Study for Commonwealth Edison

Load & DER Forecast

E3's EVGrid and RESHAPE Models

Electric Vehicle Peak Impact Forecast

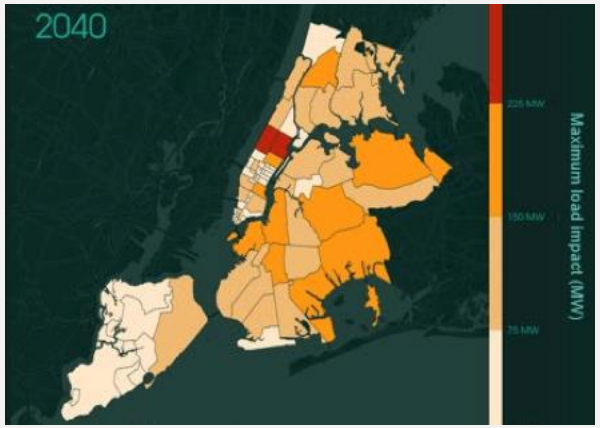


E3 support for NV Energy's 2024 Integrated Resource Plan

Load & DER Downscaling

E3 + IA's Forecasting Anywhere Model

Bldg. Electrification + EV Grid Impacts

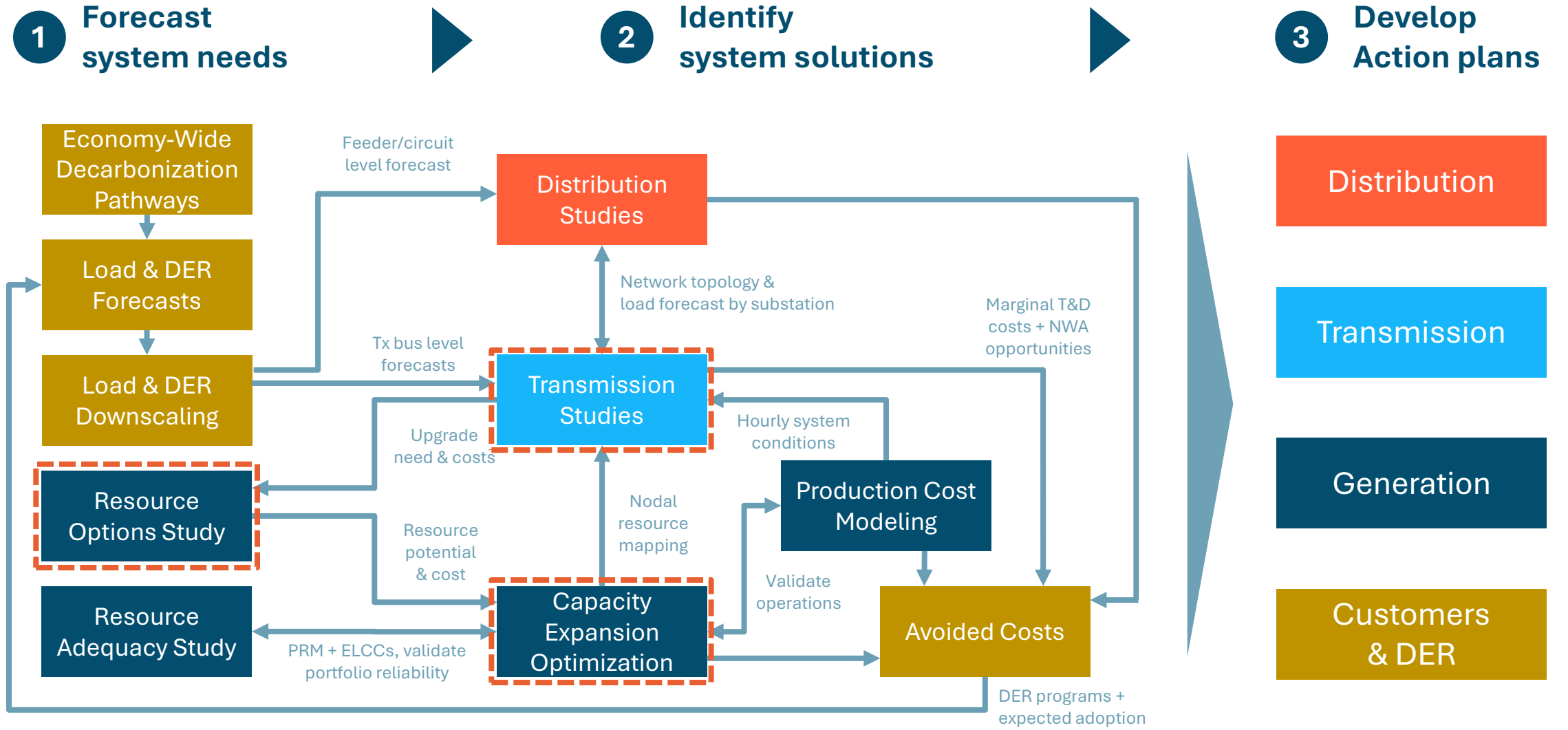


E3 support for Power Up NYC (on ConEd's distribution system)

System Modeling

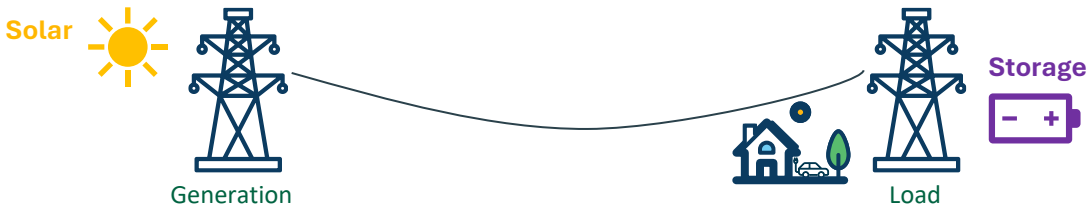
- Distribution
- Transmission
- Generation

Mapping of new generation resources to transmission needs facilitates resource planning and storage siting



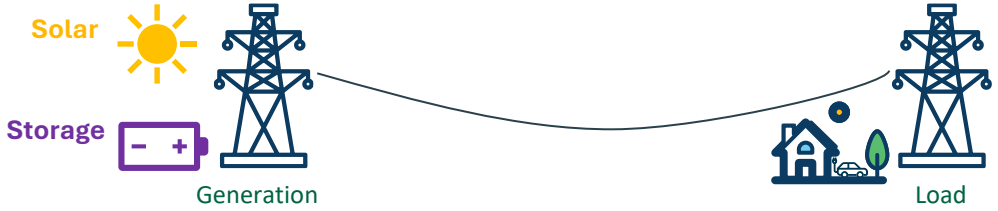
Optimizing battery storage siting can support right-sizing transmission investments for remote renewables

Option 1: Site storage in load centers



- Storage can displace thermal generation in load centers, which may support dual use applications (e.g., distribution deferral, customer applications, etc.)
- **Transmission sized to deliver remote renewables** to load centers (e.g., during mid-day solar production peak)

Option 2: Site storage with remote generation



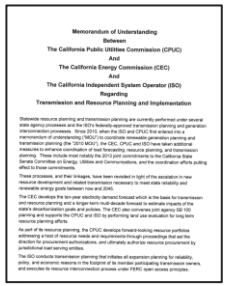
- Storage can be co-located with remote renewables → increases transmission utilization (lowering cost per delivered MWh) and reduces local curtailment
- **Transmission sized to deliver stored energy on-peak** (e.g., storage discharge during afternoon/evening system peak demand)

Generation, transmission, storage co-optimization can be achieved via multiple different methods

(Zonal capacity expansion w/ detailed transmission limits, nodal capacity expansion, busbar mapping + transmission studies, etc.)

Optimizing generation, storage, and transmission may require new data development and interagency coordination

MOU



Memorandum of Understanding
Between
The California Public Utilities Commission (CPUC)
And
The California Energy Commission (CEC)
And
The California Independent System Operator (ISO)
Regarding
Transmission and Resource Planning and Implementation

Statewide resource planning and transmission planning are currently performed under several state agency processes and the ISO's federally-approved transmission planning and generation interconnection processes. Since 2010, when the ISO and CPUC first entered into a memorandum of understanding ("MOU") to coordinate renewable generation planning and transmission planning (the "2010 MOU"), the CEC, CPUC and ISO have taken additional measures to enhance coordination of load forecasting, resource planning, and transmission for the ISO's balancing authority area, notably the 2013 joint commitments to the California State Senate Committee on Energy, Utilities and Communications, and the coordination efforts putting effect to those commitments.

These processes, and their linkages, have been revisited in light of the escalation in new resource development and related transmission necessary to meet state reliability and renewable energy goals between now and 2045.

The CEC develops the ten-year electricity demand forecast which is the basis for transmission and resource planning and a longer-term multi-decade forecast to estimate impacts of the state's decarbonization goals and policies. The CEC also convenes joint agency SB 100 planning and supports the CPUC and ISO by performing land use evaluation for long term resource planning efforts.

As part of its resource planning, the CPUC develops forward-looking resource portfolios addressing a host of resource needs and requirements through proceedings that set the direction for procurement authorizations, and ultimately authorize resource procurement by jurisdictional load serving entities.

The ISO conducts transmission planning that initiates all expansion planning for reliability, policy, and economic reasons in the footprint of its member participating transmission owners, and executes its resource interconnection process under FERC open-access principles.

CAISO Transmission Planning Process

Headroom and upgrade costs by substation and timing (gross peak, net peak, off-peak)

California PUC Integrated Resource Plan

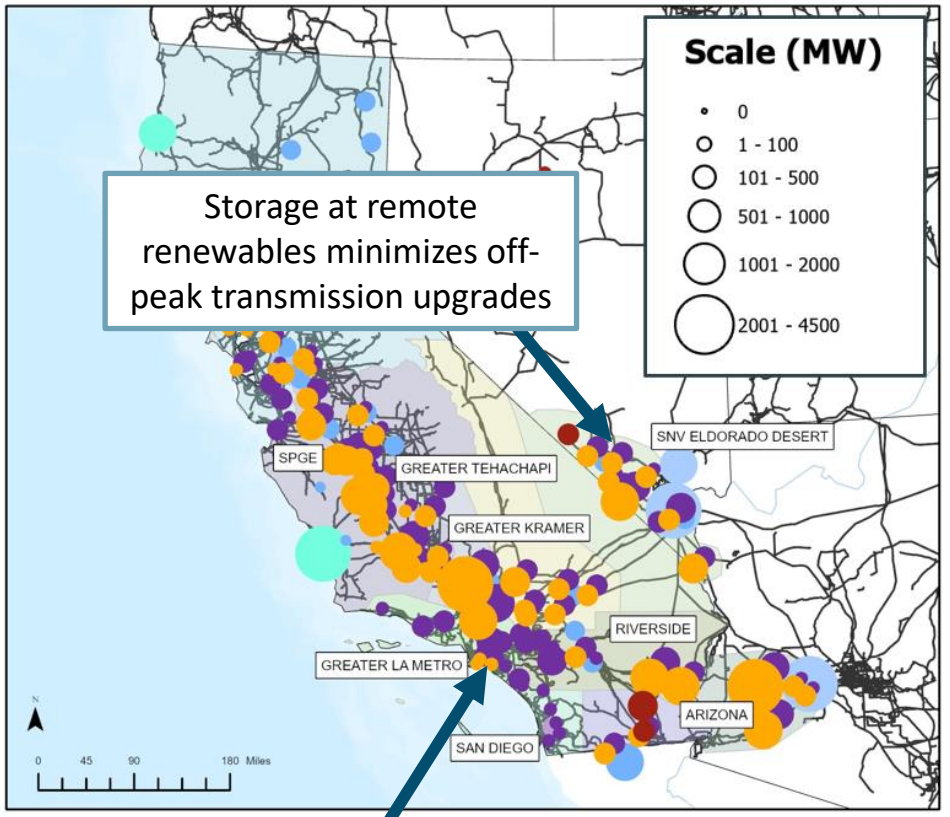
Capacity expansion modeling produces resource additions by substation

California PUC busbar mapping

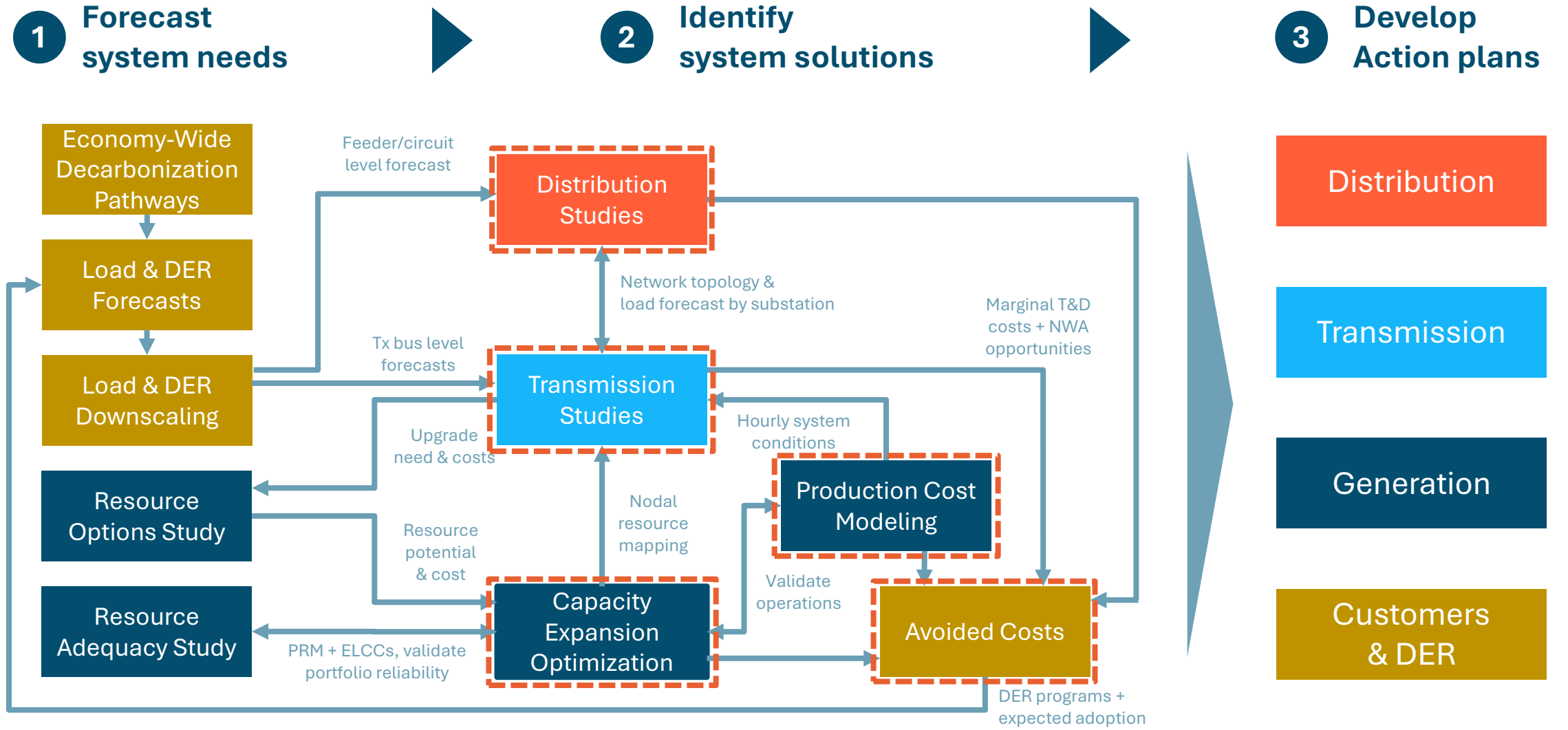
Resource additions mapped to busbars for detailed transmission analysis

CPUC IRP Resource Additions by Substation

2024-25 Transmission Planning Process, 2039 Snapshot



Properly valuing DERs requires coordination from G/T/D planning



Properly valuing DERs requires coordination with G/T/D planning

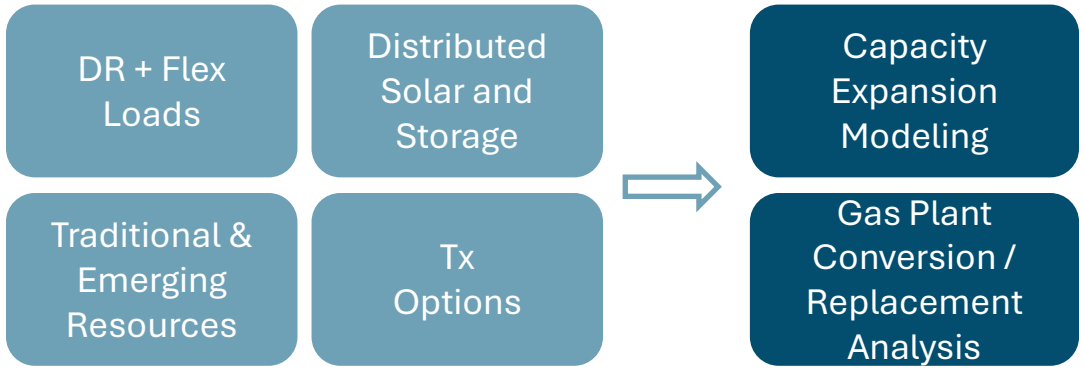
Load flexibility + DERs can be modeled as resources in capacity expansion

- Need to characterize (a) achievable potential, (b) cost, and (c) performance limitations
- For certain resource types (e.g., EE), this may require oversimplification of measure details and/or locational value

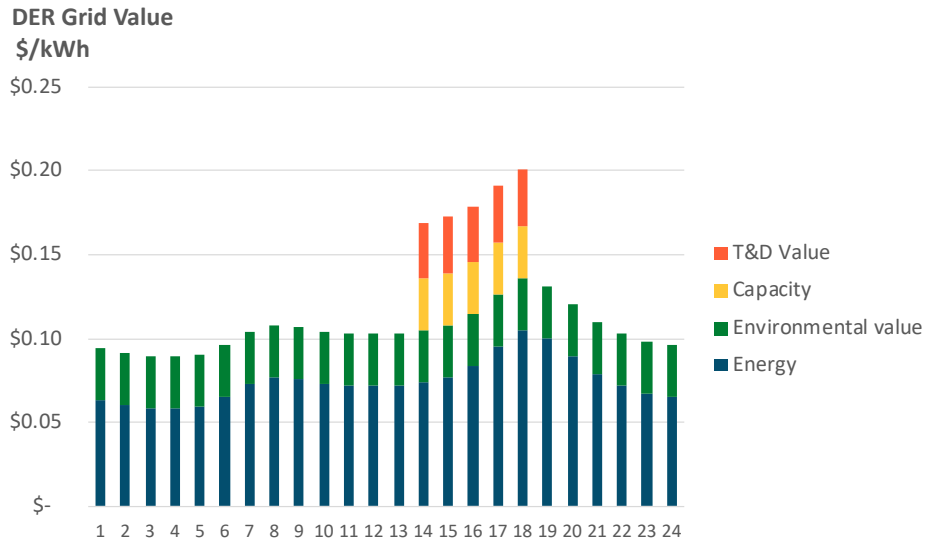
Avoided costs based on G/T/D plans can be used to value DERs & design electric rate

- DER, programs, and tariffs assessed using $/MWh avoided costs values that vary by hour/month
- System-wide ISP modeling informs values
- Allows for detailed DER & program assessments

Current E3 project supporting the City of Pasadena



E3's NY VDER Calculator (2030 hourly avoided costs)



Making integrated planning a reality

Energy+Environmental Economics

Many system planners are undertaking integrated system planning initiatives

In April 2024, SRP published its first-ever Integrated System Plan (ISP), which included full system planning through 2035. SRP is currently planning the next ISP cycle.

In 2023, Hawaiian Electric filed its first Integrated Grid Plan (IGP), which included detailed analysis of Hawaiian Electric's five island grids through integrated planning of utility-scale generation, distribution, transmission, and customer DERs.

In late 2022, Xcel Energy created a centralized Integrated System Planning (ISP) team – combining generation, transmission, distribution, and natural gas into a single department. The modeling function of each team was also combined under central leadership

The Australian Energy Market Operator (AEMO) produces an Integrated System Plan every two years to identify needed generation, storage, and network investments to transition to net-zero by 2050 and increase market benefits.

ESIG
ENERGY SYSTEMS INTEGRATION GROUP

This year, ESIG kicked off its Integrated System Planning Task Force, which provides a platform for planners and system operators to discuss and advance the integration of electric system planning for electric generation, transmission, distribution, and load. E3 is leading the Task Force Meetings for this initiative.

Planning doesn't look the same everywhere, requiring coordination across multiple organizations

Different actors in the industry have different responsibilities when it comes to system planning…

Organization type	C/DER	D	T	G
Vertically-integrated utility	●	●	●	●
Transmission & distribution utility	●	●	●	
Generation & transmission co-op			●	●
Federal power marketing administration (PMA)			●	●
Regional transmission organization (RTO)			●	
Non-RTO transmission planning regions			●	
Competitive supplier	●			●
Community choice aggregator	●			●
Distribution co-op / municipal utility	●	●		

…but all actors can improve planning processes with increased visibility and coordination across the system

Case Study : SRP's first Integrated System Plan

Objectives development

Aligned with senior leaders on gaps, opportunities, objectives, and priorities in performing integrated system planning

Stakeholder engagement

Developed a comprehensive stakeholder engagement plan, which included an Advisory Group, Large Stakeholder Group, Modeling Sub-Group, and Technical Working Sessions

Analytical framework

Translated objectives into a high-level analytical framework for how modeling processes interact, the timing of each, and the key outputs from each modeling process

System modeling

Performed full system modeling for 42 planning cases, spanning customer programs, distribution, transmission, and resource planning

Communication of outcomes

Met with stakeholders over the course of 31 meetings and presented to SRP's Board and Council over the course of a two-day work study session, resulting in approval of the ISP System Strategies

A staged approach to integrated system planning facilitates change management



	Walk Stage Get started	Jog Stage Increasing connections	Run Stage Full integration
Organizational Alignment	**Thought leaders drive integration** and increase cross-team coordination	Create an **integrated planning team**	**Fully integrate ISP function with other business units** (strategy, finance, rate design, etc.)
Scenario Planning	**Standardize scenarios and key inputs**	**Standardize planning process timelines and inputs** into an ISP cycle (data development, load forecasts, etc.)	Integrate scenario development across all planning processes
Technical Analysis	Improve each individual process to industry best practice Add connections between individual models	**Increase model + data connections** between processes	**Fully integrate modeling processes**
Procurement Integration	Increase planning to procurement connection (e.g., developing DER avoided costs using ISP preferred plan)	Initiate **new procurement pilots using ISP results** (e.g., flexible EV charging, non-wires alternatives, etc.)	**Fully integrate procurement processes** with feedback to and from the ISP process

Increasingly integrate planning over multiple planning cycles

Integrated System Planning: The Road Ahead

Thank You

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