WECC

Reliability & Scenario Development Planning

Arizona Tribal Energy Association

2018 Annual Meeting

January 25, 2018

Talking Points

- WECC Mission
- What is Reliability
- Study Horizons
- Production Cost Modeling & Methods
- Highlights from a High Solar Study
- Long Term Capital Expansion Modeling & Methods
- Scenario Development

WECC Mission

Mission

To assure the near and long-term reliability of the Bulk Electric System in the Western Interconnection.

Vision

To serve the public interest by assuring the Bulk Electric System is reliable; to best inform the Region's leaders in their decisions regarding critical electric reliability issues facing the Western Interconnection; and to partner with our stakeholders to help them plan, develop and operate the Bulk Electric System in accordance with industry-accepted reliability standards.

Culture

Together, we are building a culture that enables us to deliver against our critical reliability mission and provides for personal and professional fulfillment.

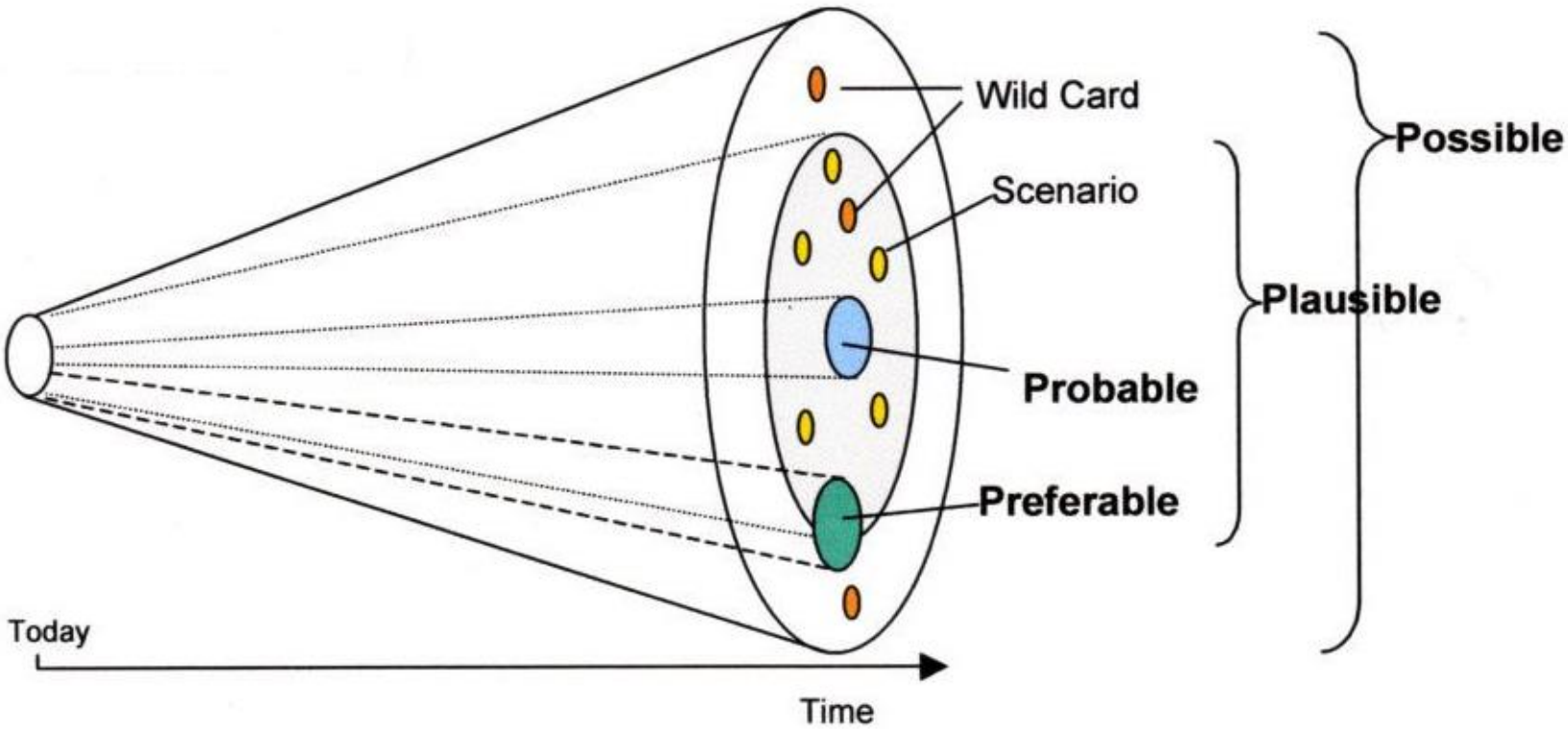
Membership

WECC membership is open to any person or entity that has an interest in the reliable operation of the Bulk Electric System in the Western Interconnection.

Toward Understanding

- **SEEK FIRST TO UNDERSTAND, THEN TO BE UNDERSTOOD**
  - Habit 5, THE 7 HABITS OF HIGHLY EFFECTIVE PEOPLE, Stephen R. Covey
- Stakeholder diversity and engagement.
- Paradigms – what's on "your" radar?
- Understanding, NOT predicting, the long term energy future.

Bookending, Not Predicting



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Methods to Understand

- Understanding Reliability
- Asking the Right Questions
- Stakeholder Diversity
- Paradigms
- Risks and Uncertainties
- Drivers and Trends
- Scenario Development

Focus on Reliability

- **BEGIN WITH THE END IN MIND**
  - Habit 2, THE 7 HABITS OF HIGHLY EFFECTIVE PEOPLE, Stephen R. Covey
- **WECC's Mission**
  - To assure the near and long-term reliability of the Bulk Electric System in the Western Interconnection.

Reliability

- What is reliability?
- How do we assure reliability?

Reliability

- What is reliability?
  - Serving load?
  - Minimizing Cost?
  - Minimizing Security Violations?
- How does one assure reliability?
  - Identifying Risks?
  - Identifying Needs?
  - Planning Strategies?

Year-10 Study Horizon

Production Cost Model

Production Cost Model (PCM)

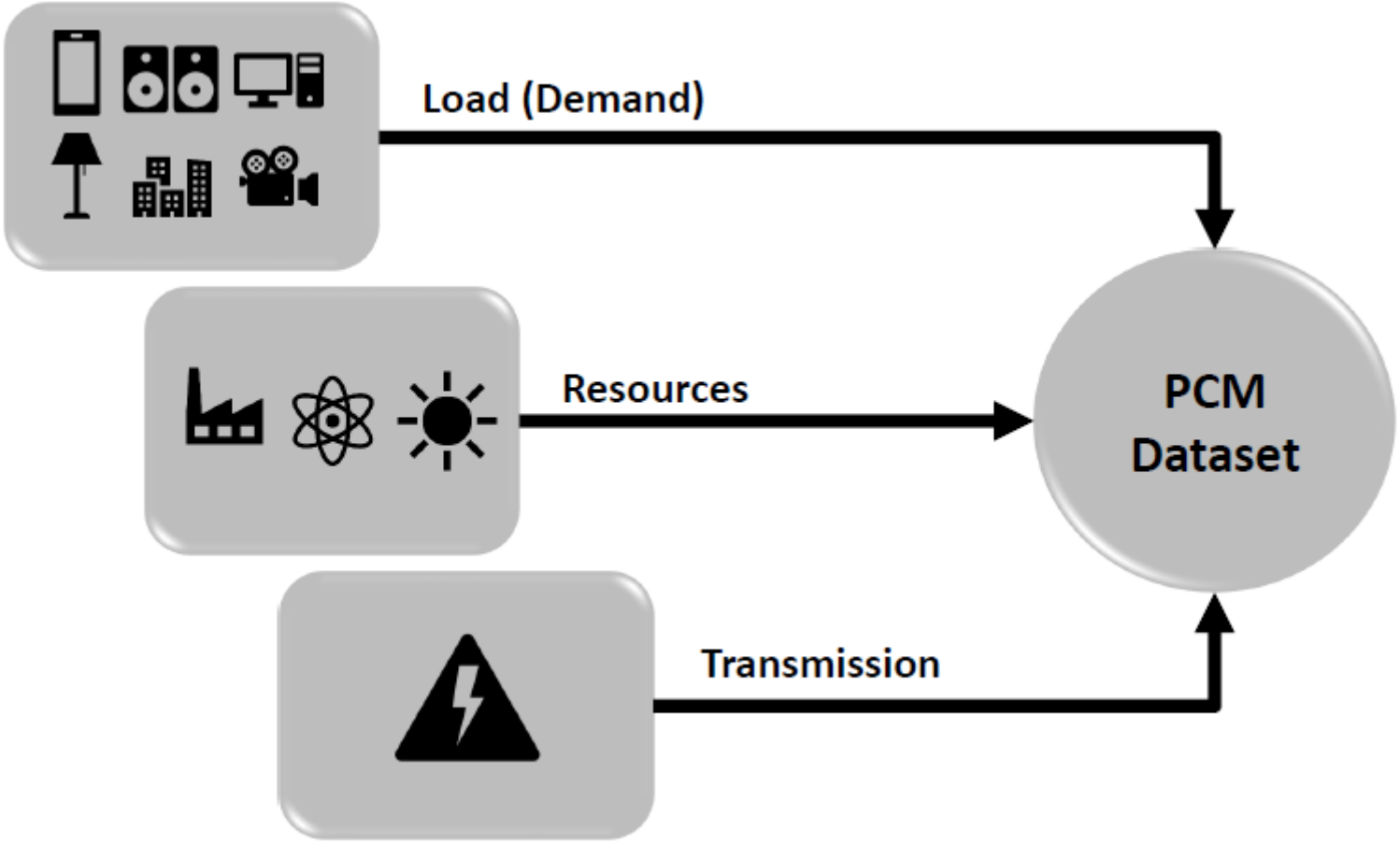
What is it?

- Hourly/sub-hourly production simulation tool.
- Unit commitment.
- Nodal steady state transmission network model.
- Security constrained economic dispatch.
- Minimized Locational Marginal Price (LMP) objective function.

What does it do?

- Combines generation, transmission, loads, fuels, and market economics into a single framework.
- Provides location-dependent market indicators, transmission system utilization measures and power system reliability and market performance indicators.
- Can be used to study various operational, planning, and competitive electric market scenarios.

Primary Inputs to PCM



Year-10 High Solar

Highlights From the Study

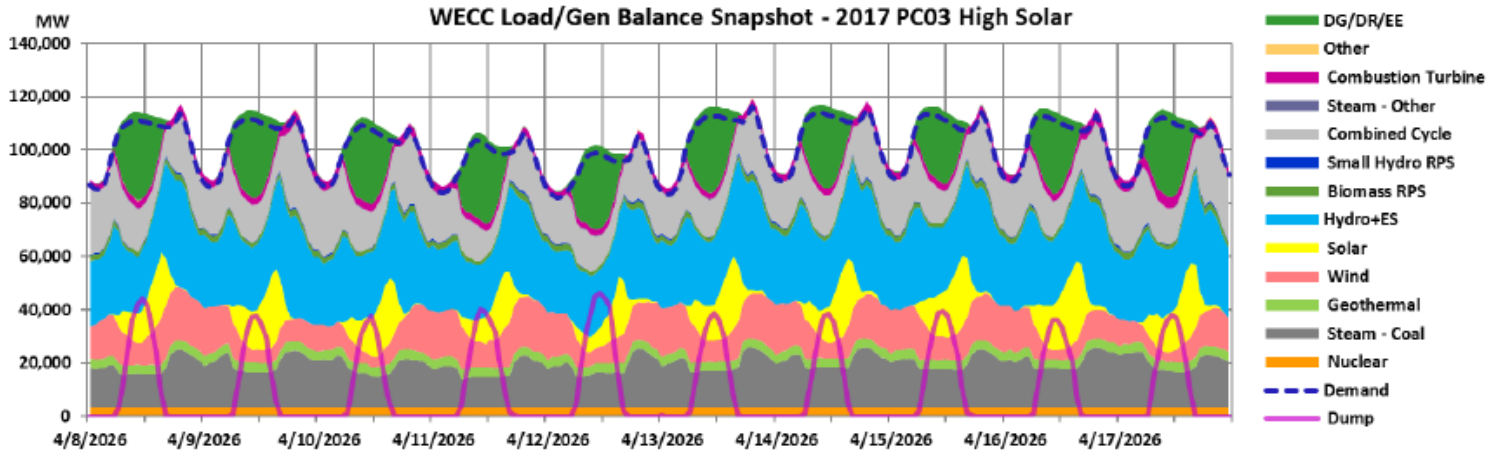
Goal of High Solar PCM Study

- Explore the impact on the WECC interconnection of 130 TWh (60.5 GW) increase in solar generation in year 10 PCM.

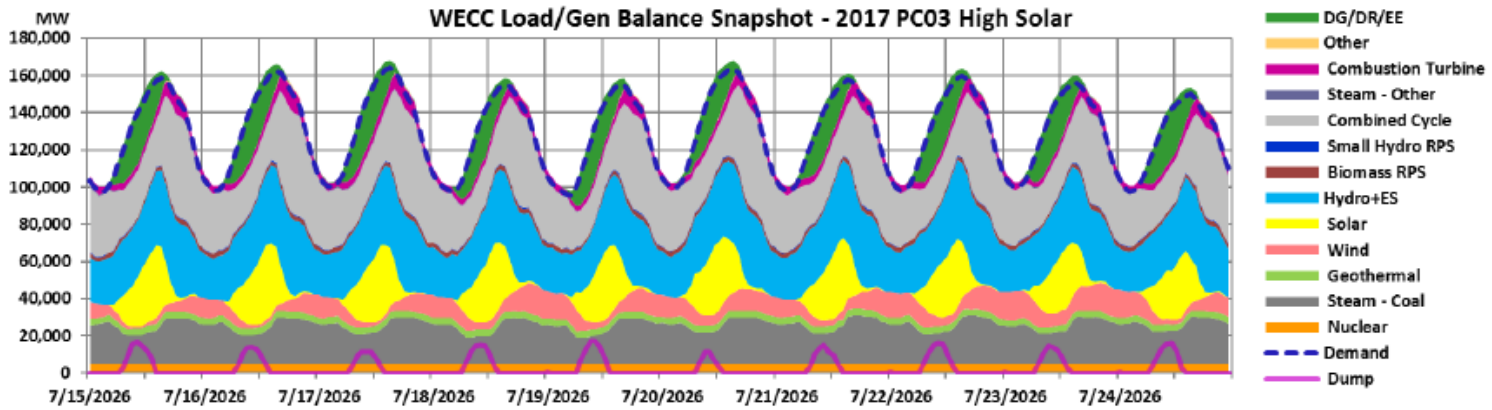
- This study was derived from version 2.0 of the 2026 Common Case. Comparisons are made to that version.

Dump Energy of High Solar PCM Study

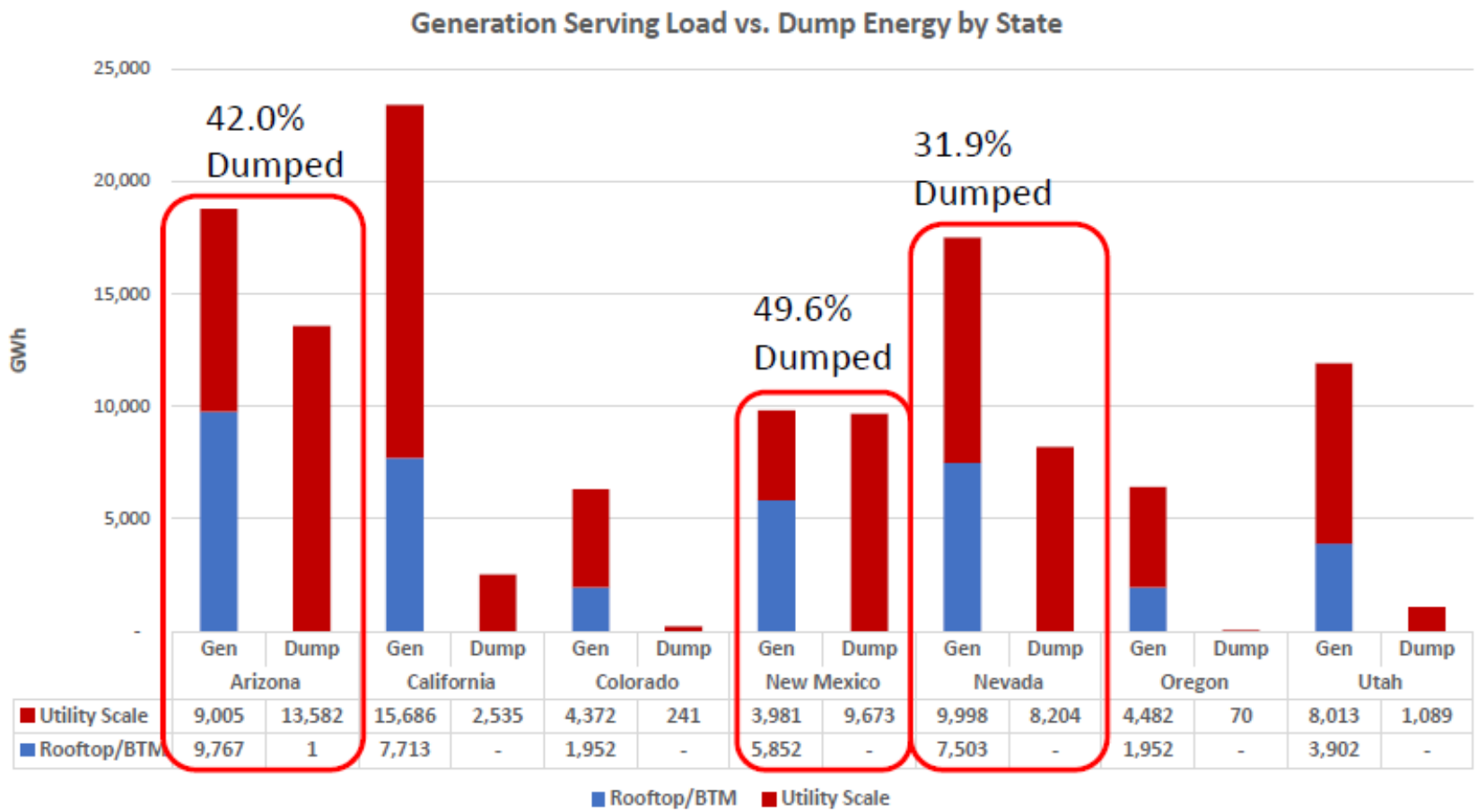
Low Load: April 8 – April 18



High Load: July 15 – July 25



Dump Energy of High Solar PCM Study



	Arizona Gen	Arizona Dump	California Gen	California Dump	Colorado Gen	Colorado Dump	New Mexico Gen	New Mexico Dump	Nevada Gen	Nevada Dump	Oregon Gen	Oregon Dump	Utah Gen	Utah Dump
Utility Scale	9,005	13,582	15,686	2,535	4,372	241	3,981	9,673	9,998	8,204	4,482	70	8,013	1,089
Rooftop/BTM	9,767	1	7,713	-	1,952	-	5,852	-	7,503	-	1,952	-	3,902	-

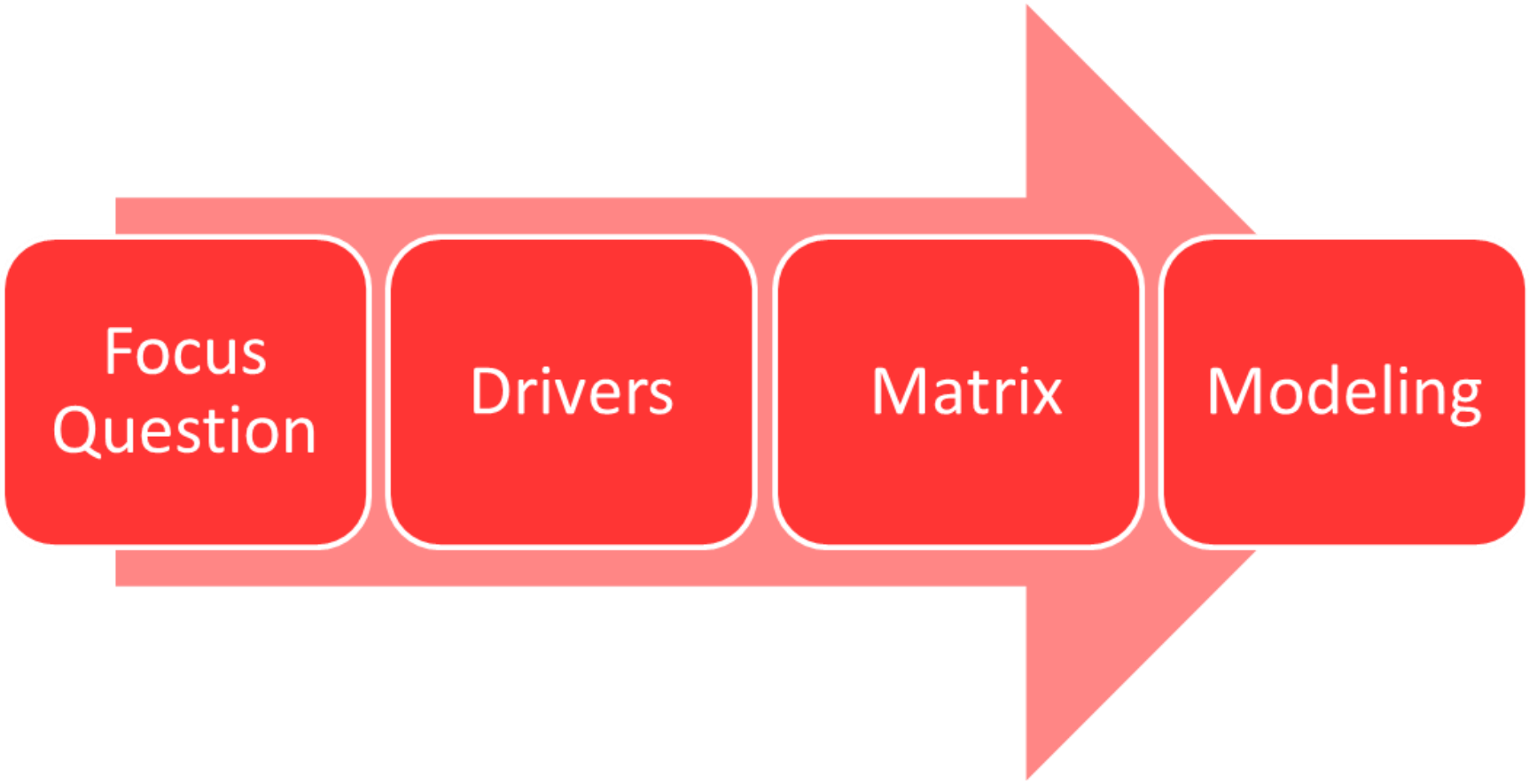
Key Observations of High Solar PCM Study

1. High levels of dump energy occurred due to high penetration of solar PV
   - Limited response by baseload fossil fuel resources
2. Solar PV (PC03) curtailment is higher than that of wind (PC02)
3. Key path flows were not heavily impacted
   - Path utilization was surprisingly higher in the northern portion of the interconnection

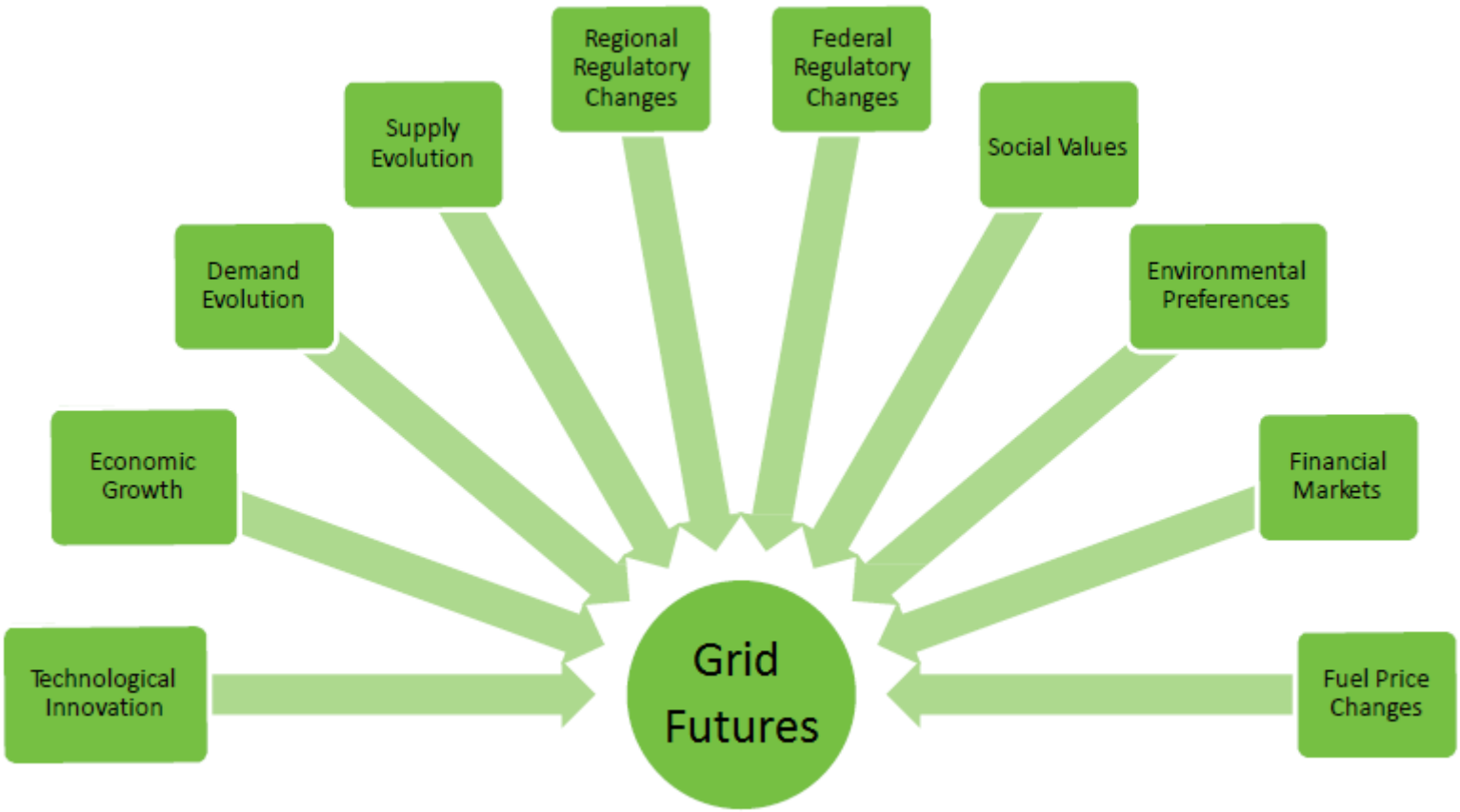
Scenario Development

Long Term Study Horizon

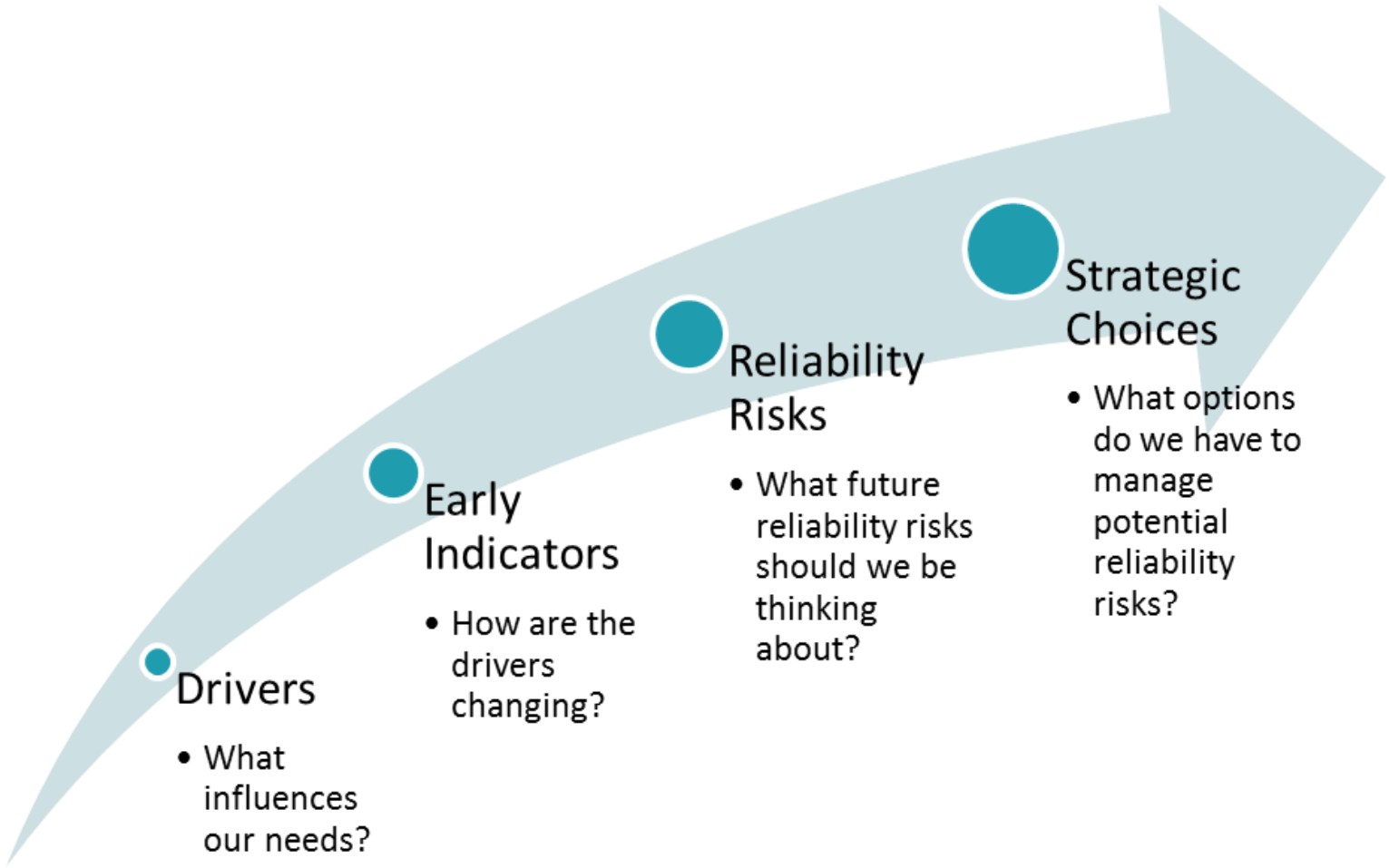
Scenario Development



Identifying Drivers



Gleaning Strategic Choices



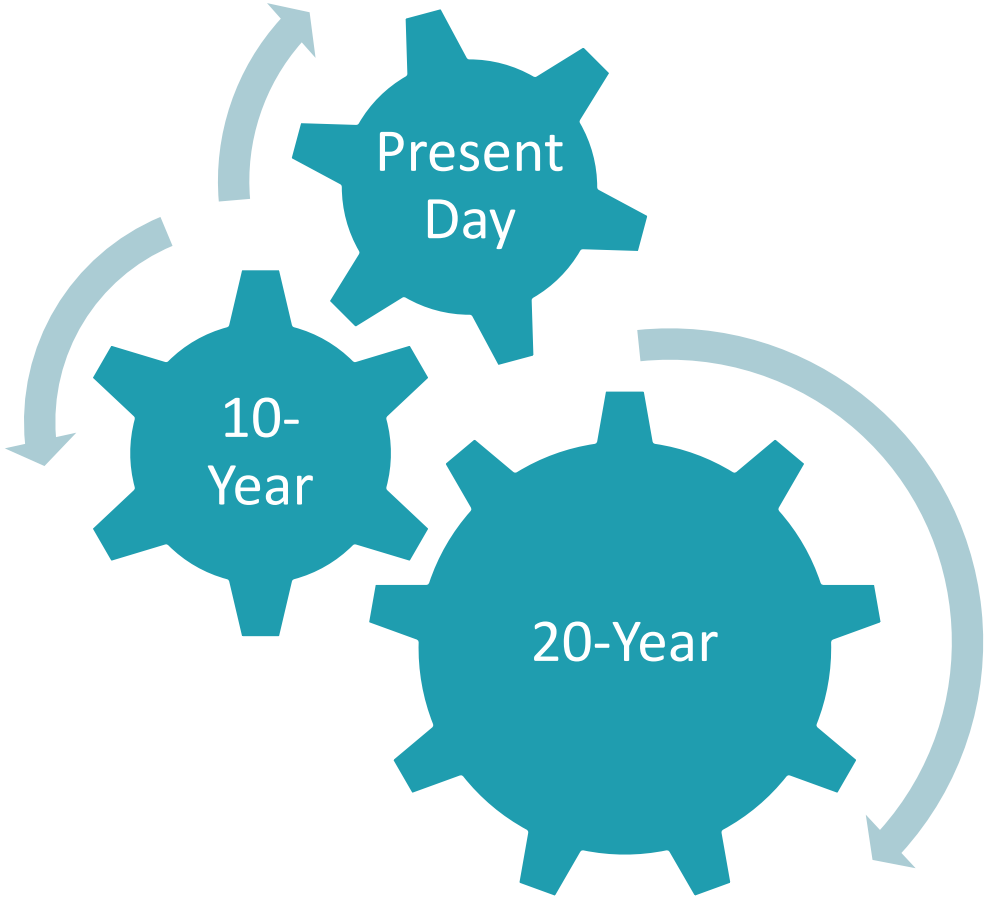
Year-20 Study Horizon

Long Term Modeling and Methods

Complementary Studies

- **One-size does not have to fit all**
- Agility
- Continuity
- Complementary
  - Models
  - Tools
  - Methods

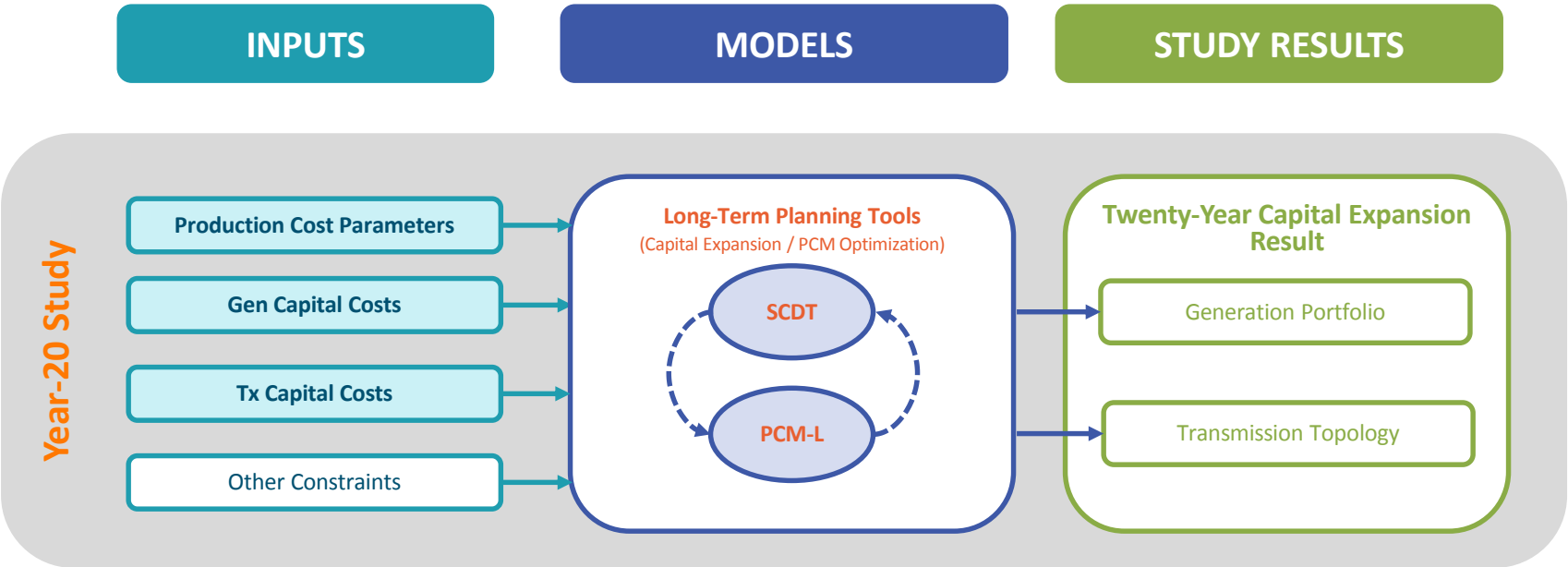
Holistic Study Horizons



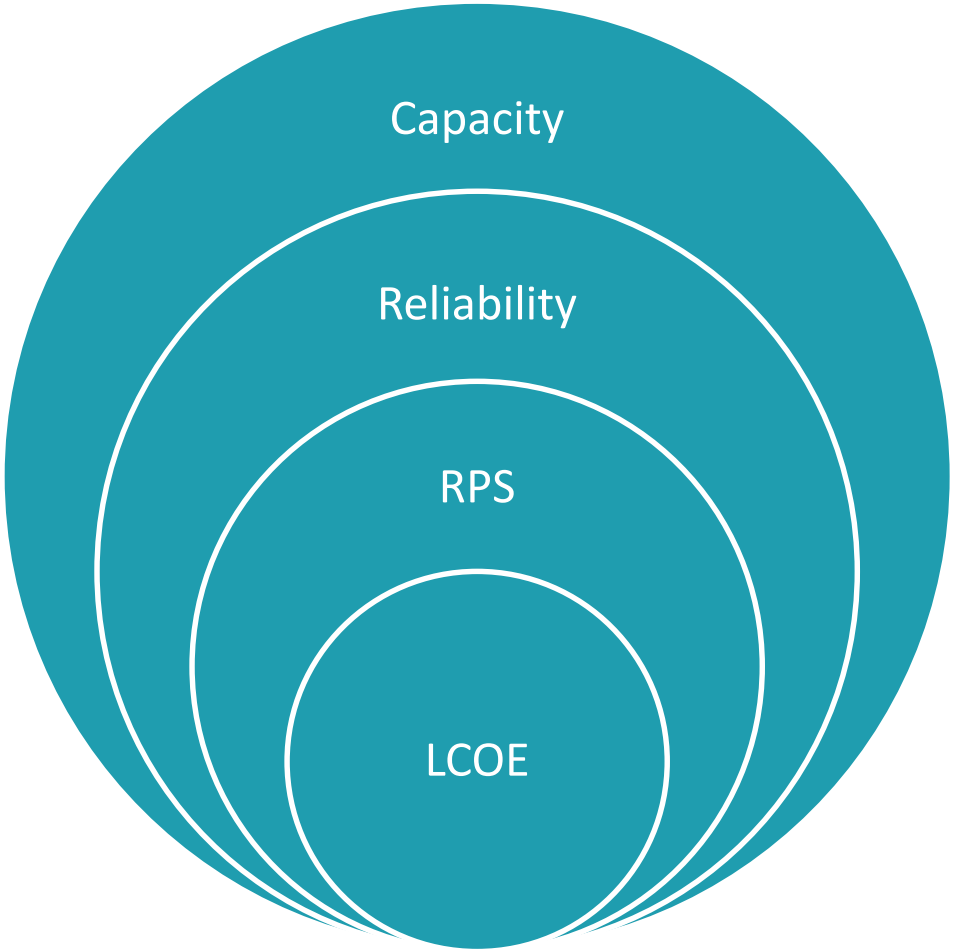
- Continuity across study horizons.
- Informational Synergy

LTPT – Proposed 2018 Methodology

- SCDT for a generation portfolio and transmission expansion.
- PCM-L determines commitments, dispatches, and utilizations.



Portfolio Optimization



10-Year & 20-Year Planning Processes

Attribute	10-Year Studies	20-Year Studies
Tool	Production Cost Model	Capital Expansion Model
Objective Minimization	Production Cost	Capital Cost
Focus	Capacity additions and specific projects, planned and in progress	Better understand drivers and trends that may influence the energy future
Model Informs	Energy production and system utilizations	Possible investment needs
Load	From balancing authorities w/ stakeholder adjustment	From balancing authorities w/ stakeholder adjustment
Resources	Specified as input; determine production characteristics	Determines possible future portfolios
Transmission	Specified as input; determine path utilizations	Determine path utilizations and enhancement needs
Time Granularity	Hourly / Sub-hourly	Annual / Seasonal Load Durations
Cost Model	Locational Marginal Price (LMP)	Levelized Cost of Energy (LCOE)
Interdependence	Starting point of 20-Year	Informs 10-Year

Review of Talking Points

- WECC Mission
- What is Reliability
- Study Horizons
- Production Cost Modeling & Methods
- Highlights from a High Solar Study
- Long Term Capital Expansion Modeling & Methods
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Questions?

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Western Electricity Coordinating Council
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Supplemental Information

WECC Region

- Non-profit corporation.
- Regional Entity for the Western Interconnection.
- Delegation Agreement with the North American Electric Reliability Corporation (NERC) and the Federal Energy Regulatory Commission (FERC).

Reliability Questions

- Adequacy?
- Operations?
- Infrastructure?
- Stability?
- Expectations?
- Economics?
- Risks?
- Drivers?

Other Studies & Planning Processes

- Power Flow
  - Steady State
  - Dynamic Stability
  - Performance & Event Analysis
- Loads & Resources
  - System Adequacy
  - Stochastics

Recent Updates to Year-10 PCM

- Wind generation increased in CA, OR, and WA
  - Updated wind profiles, newer turbine type, higher CF
- Increase in coal-fired generation in Alberta; decrease in Utah
  - Modeling issue fix; retirement dates during 2026 (Sundance 3, 4)
  - Planned retirement of Intermountain Coal Project
- Increased generation from combustion turbines in OR and WA; decrease in CA
  - Upon stakeholder request/consensus retired coal-fired generation replaced with gas-fired generation (Boardman, Centralia, Colstrip 1, 2)
- Solar generation decreased in CA
  - 2009 solar profile CF appear to be lower than prior dataset (2005)
  - Mixed profiles; 2005 shape used where/when 2009 not available
- No significant Increase in Dump Energy
  - Dump/Spillage: Spillage may be caused by either transmission constraints or over-generation conditions. Typically when Locational Marginal Prices (LMPs) are negative

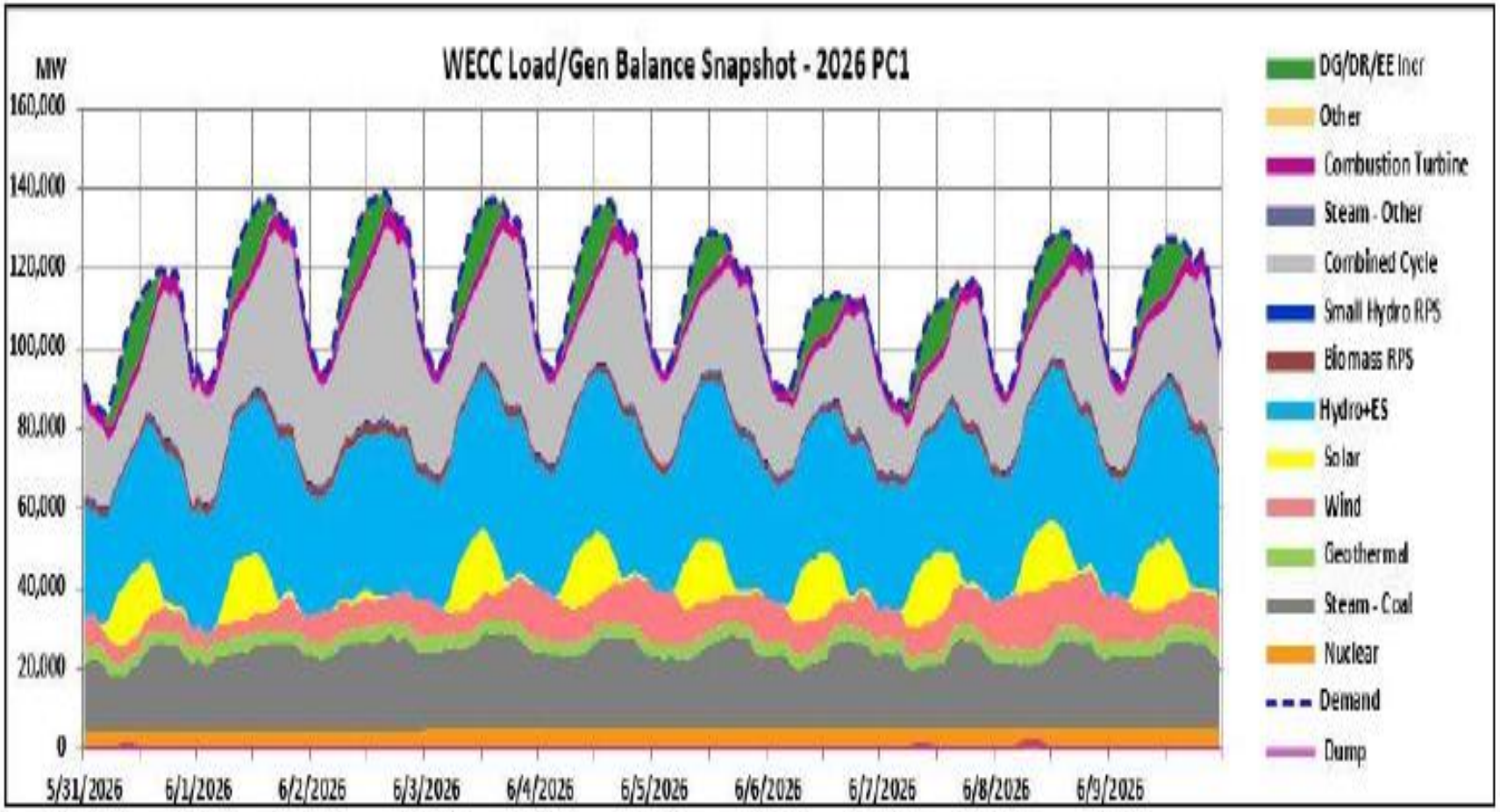
PCM Foundational Assumptions

- Dataset build begins with an imported power flow case
  - 2023HS1 (2024 Common Case)
  - 2025HS1 (2026 Common Case)
- Electric topology and resource definition
  - Generation/Transmission "where and what"
- Secondary/Hourly Assumptions
  - Fuels, fuel topology and pricing, fuel rates, emission rates, ramp rates and costs, heat rates (efficiency), hurdle rates (wheeling charges), startup cost, variable O&M cost, etc…

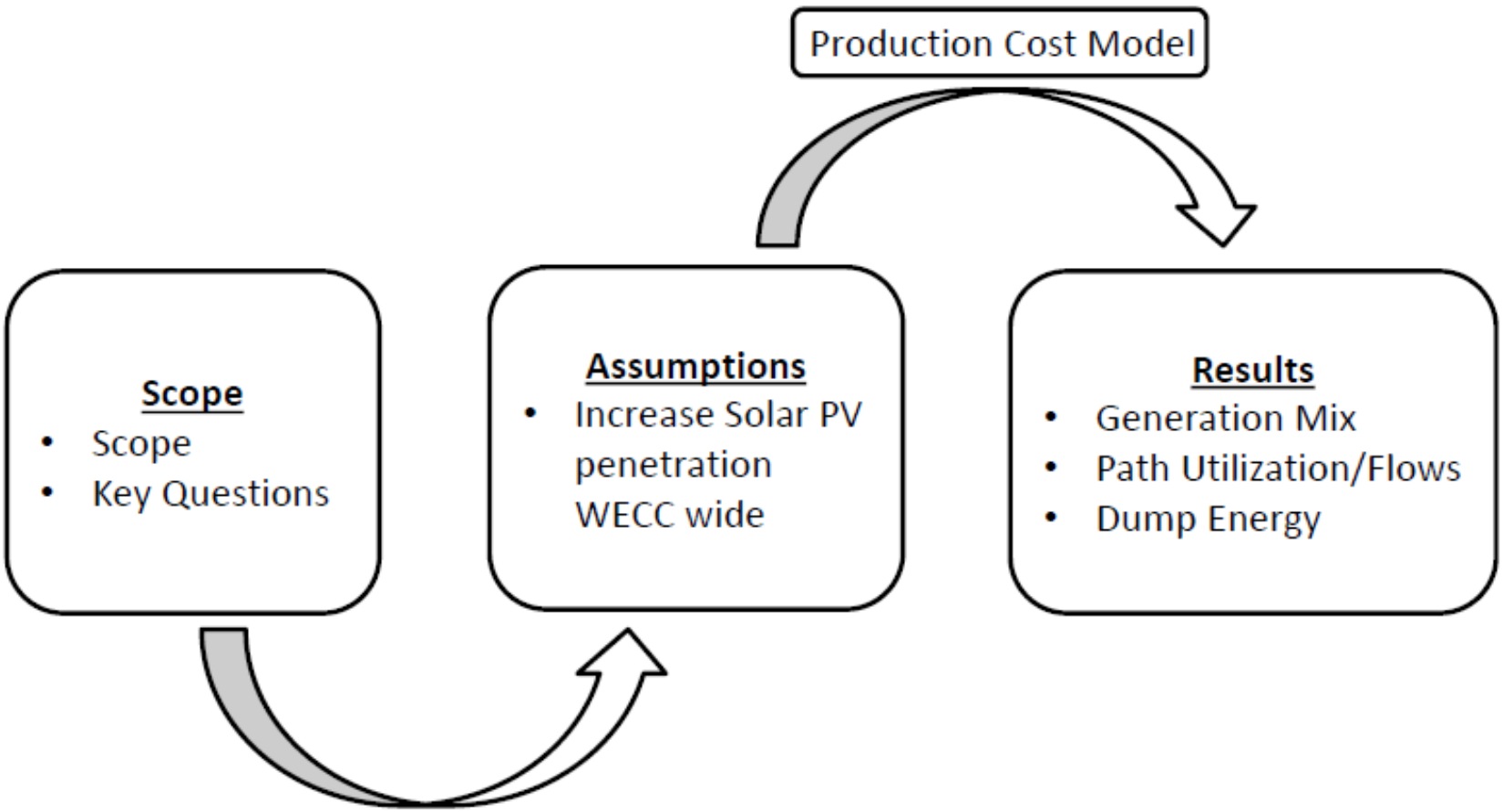
PCM Path Utilization

- "Most Heavily Utilized" = A path that meets any one of the following criteria (10-year plan utilization screening):
  - U75 > 50%
  - U90 > 20%
  - U99 > 5%
- Uxx = % of year that flow is greater than xx% of the path limit

Year-10 PCM Hourly Simulation



Year-10 High Solar PCM Study



Scope of High Solar PCM Study

- Study requesters: CREBC/WIRAB, PG&E
- Changes made from 2026 Common Case
  - Add Solar PV generation to AZ, CA, CO, NM, NV, OR, and UT
    - 30 % rooftop and behind the meter (BTM) PV
    - 70 % utility scale PV
- No other changes were made

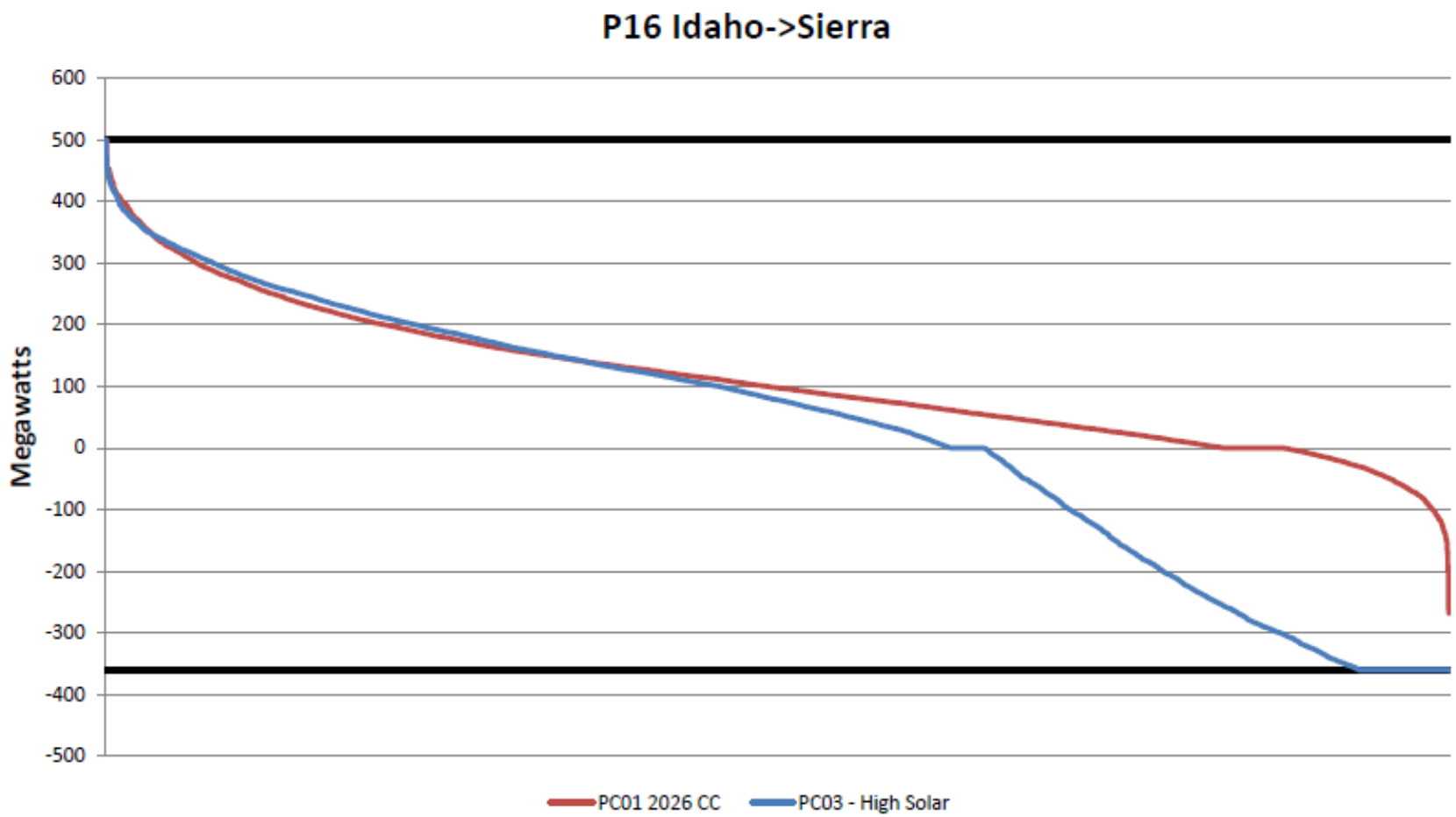
Key Questions of High Solar PCM Study

1. What is the impact on dump energy of renewables due to high solar penetration?
2. What is the level of curtailment compared to PC02 Wind High Renewables case?
3. Does the BES have sufficient flexibility to integrate the high solar portfolio without transmission expansion?
   - What is the resulting impact to path flows?

Location of Added Utility Scale Solar PV

State	Type	Capacity (MW)	Yearly Energy (GWh)	Percent of Total
Arizona	Rooftop	4,921	9,750	25%
	Utility	9,049	22,750	
California	Rooftop	4,296	7,800	20%
	Utility	7,893	18,200	
Colorado	Rooftop	1,078	1,950	5%
	Utility	2,174	4,550	
Nevada	Rooftop	3,821	7,500	20%
	Utility	7,849	18,200	
New Mexico	Rooftop	2,890	5,850	15%
	Utility	5,852	13,650	
Oregon	Rooftop	1,352	1,950	5%
	Utility	2,373	4,550	
Utah	Rooftop	2,293	3,900	10%
	Utility	4,743	9,100	
Total	Rooftop	20,650	38,700	100%
	Utility	39,934	91,000	

P16 Path Utilization – High Solar



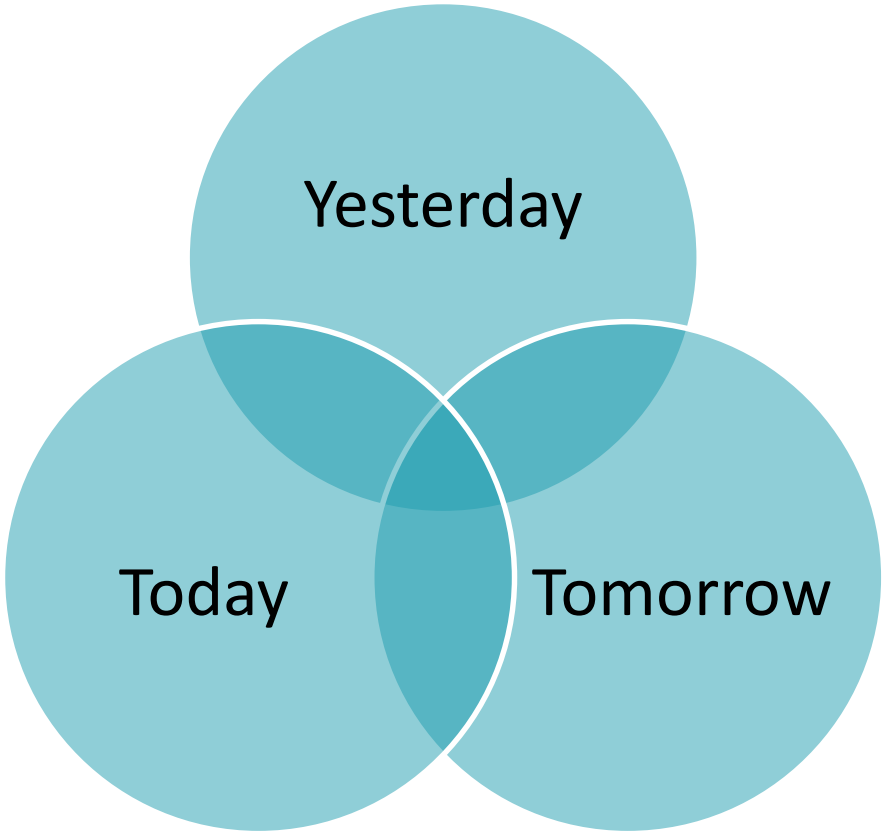
Year-10 vs Year-20

- Year-10
  - Production cost model
  - Hourly commitment and optimization
  - LMP cost model
- Year-20
  - Capital Expansion
  - Annual energy and seasonal capacity optimization
  - LCOE cost model

Year-10 vs Year-20

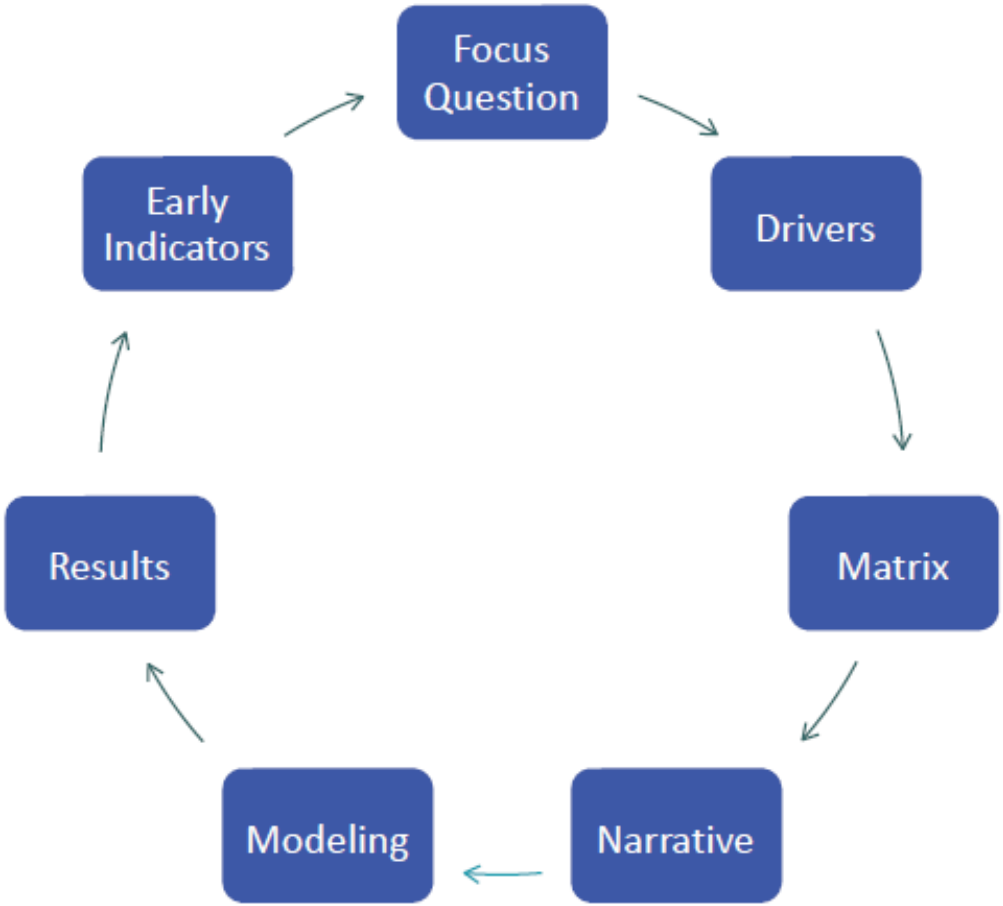
- Year-10
  - Generation portfolio assumed
  - Transmission infrastructure assumed
  - Understand transmission path utilizations and weaknesses
- Year-20
  - Drivers assumed
  - Constraints assumed
  - Understand possible generation portfolios, and corresponding transmission path utilizations and possible expansion needs

Is Timing Everything?

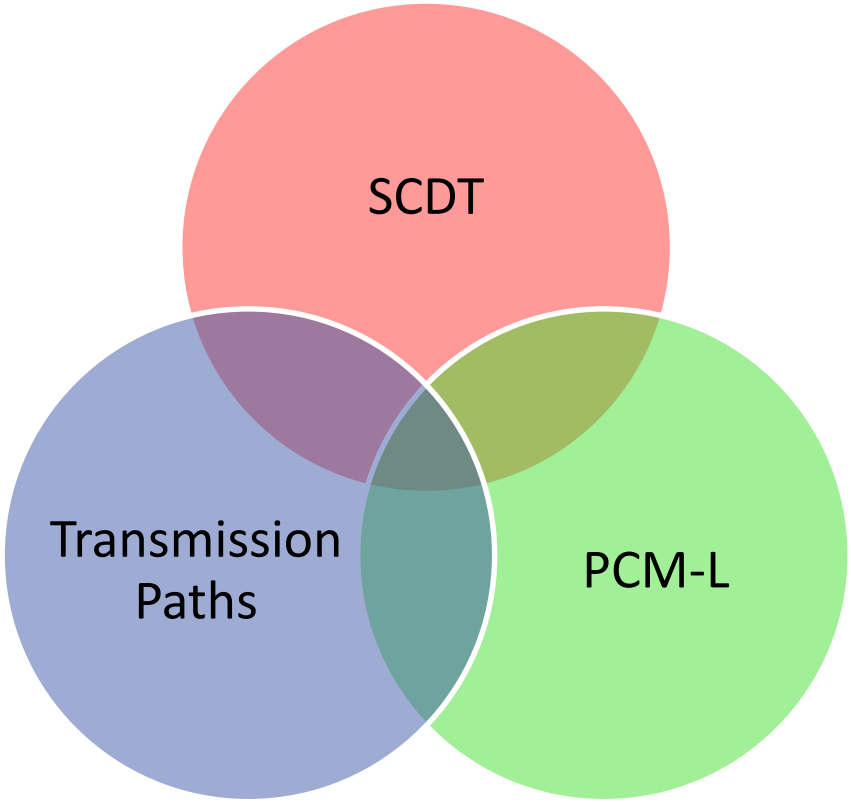


- Grid assessment study horizons have unique and shared considerations.
- Grid investment decisions require a long term (20 year) lead time.

The Learning Loop



LTPT – Proposed 2018 Methodology

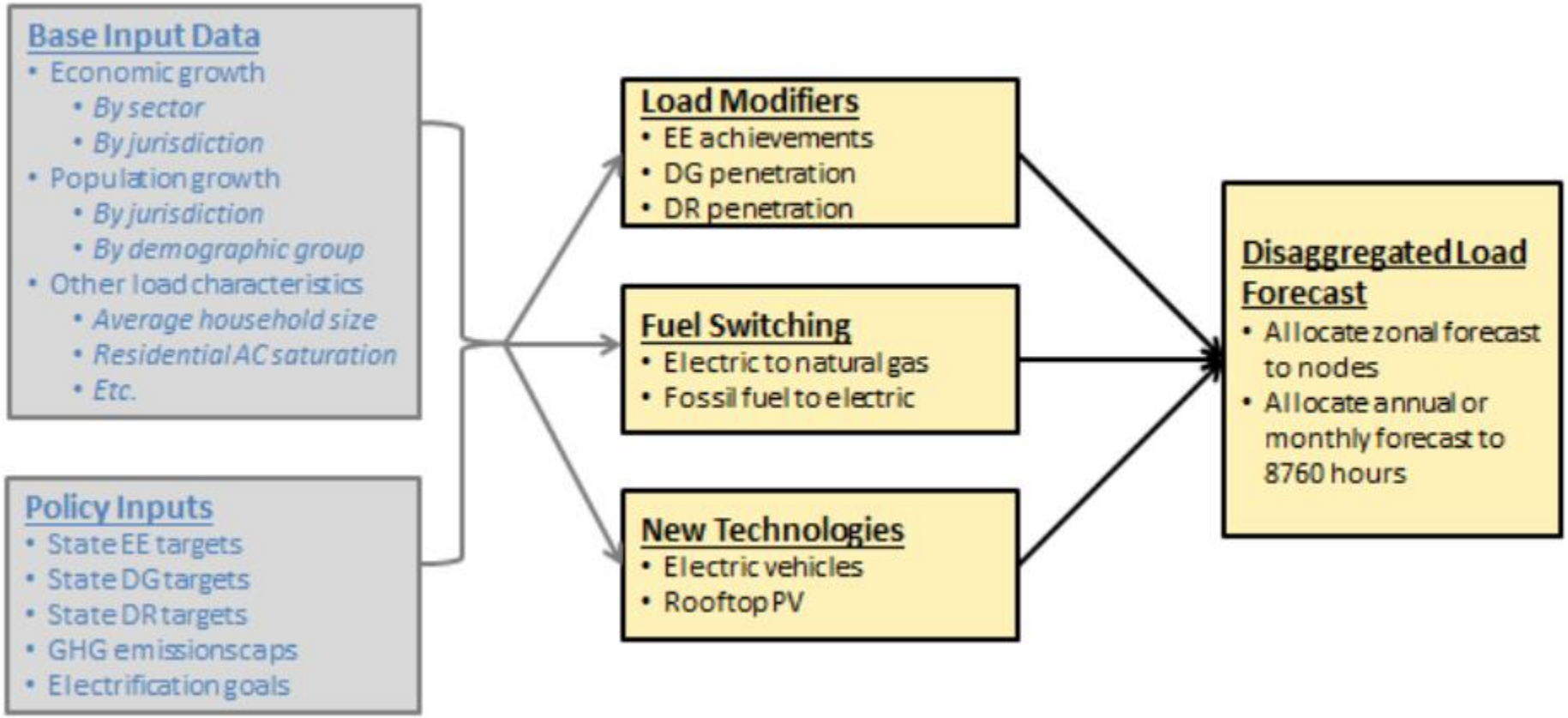


- Study Case Development Tool (SCDT)
- Production Cost Model – Light (PCM-L)
- Transmission Paths

Year-20 Screening Tool

- Year-20 long-term studies are meant to provide a high level screening of possible generation portfolios and transmission needs.
- Complementary use to inform Year-10 and other planning processes.
- Ideally, in the 2018 study program, the Year-20 studies will include a PCM component that can be studied in greater detail after an initial CapEx screening.

Year-20 Load Model



Year-20 Transmission Model

- Reduced Network Nodal Model
- Path Oriented
- Geospatial Corridor Proxies
  - Expansion Cost
  - Environmental Impact
- Determine Path Utilization & Expansion Needs
- Various Expansion Technology types
- Co-optimized with generation
- LCOE cost model

Year-20 Generation Model

- Year-10 Generation Portfolio Candidates
- Year-20 Generation Portfolio Candidates
- Annual Energy Production
- Seasonal Capacity ELCC
- RPS policy goals
- Reliability goals
- Security Constrained power flow
- Co-optimized with transmission
- LCOE cost model

Locational Pool Constraints

- CO_2 Emissions
- Water Availability
- Fuel Limits
- Renewable Potential