SRP Integrated System Plan
Technical Working Session: Study Plan Details

April 29, 2022

Meeting Objectives:

- Provide an overview of the Integrated System Plan's modeling ecosystem
- Discuss the analytical methods and data sources for Forecasting, Distribution, Transmission, Resource Planning and Customer Programs

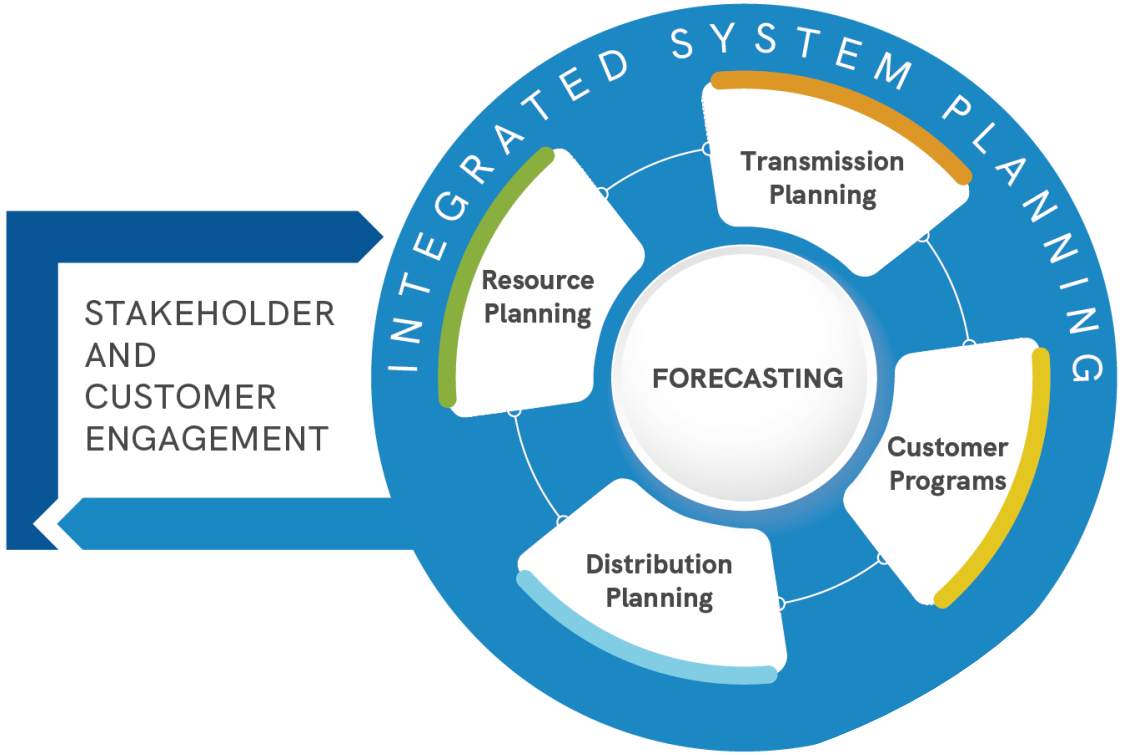
Agenda

Time		Topics	Presenter
10:15 – 10:30	15 mins	Overview of Modeling Ecosystem and Study Plan	Lakshmi Alagappan (E3) Joe Hooker (E3)
10:30 – 11:00	30 mins	Load Forecasting (Includes Customer Programs)	Harry Sauthoff (SRP) Nathan Morey (SRP)
11:00 – 11:25	25 mins	Resource Planning Models	Michael Reynolds (SRP)
11:25 – 11:40	15 mins	Distribution Planning Methods	Melissa Martinez (SRP)
11:40 – 11:55	15 mins	Transmission Planning Methods	Justin Lee (SRP)
11:55 – 12:00	5 mins	Recap and Next Steps	Lakshmi Alagappan (E3)

Overview of Modeling Ecosystem

Lakshmi Alagappan & Joe Hooker
ISP Consultants (E3)

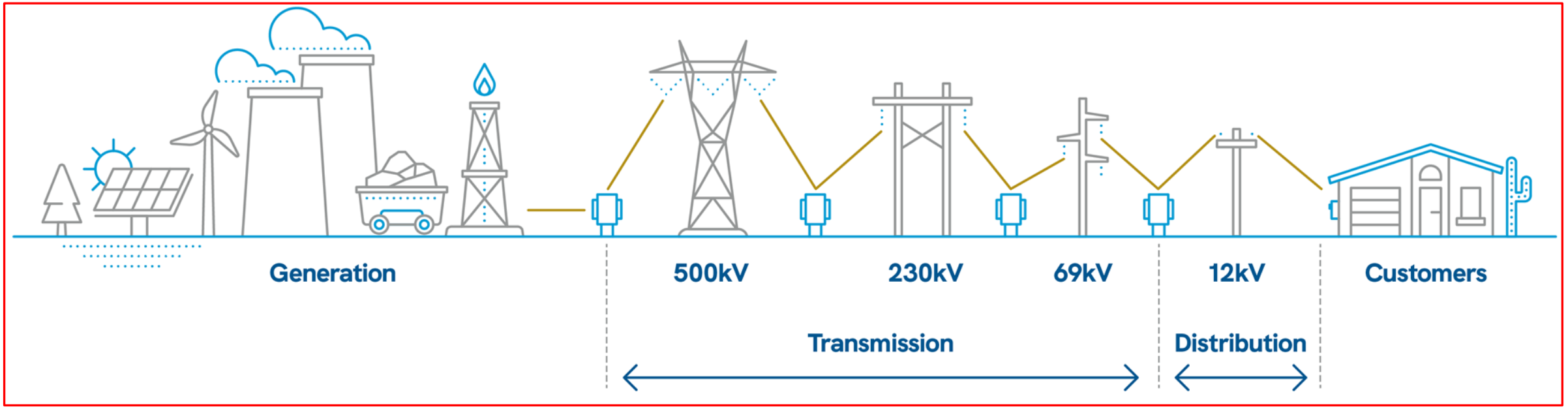
The Integrated Planning Process at SRP



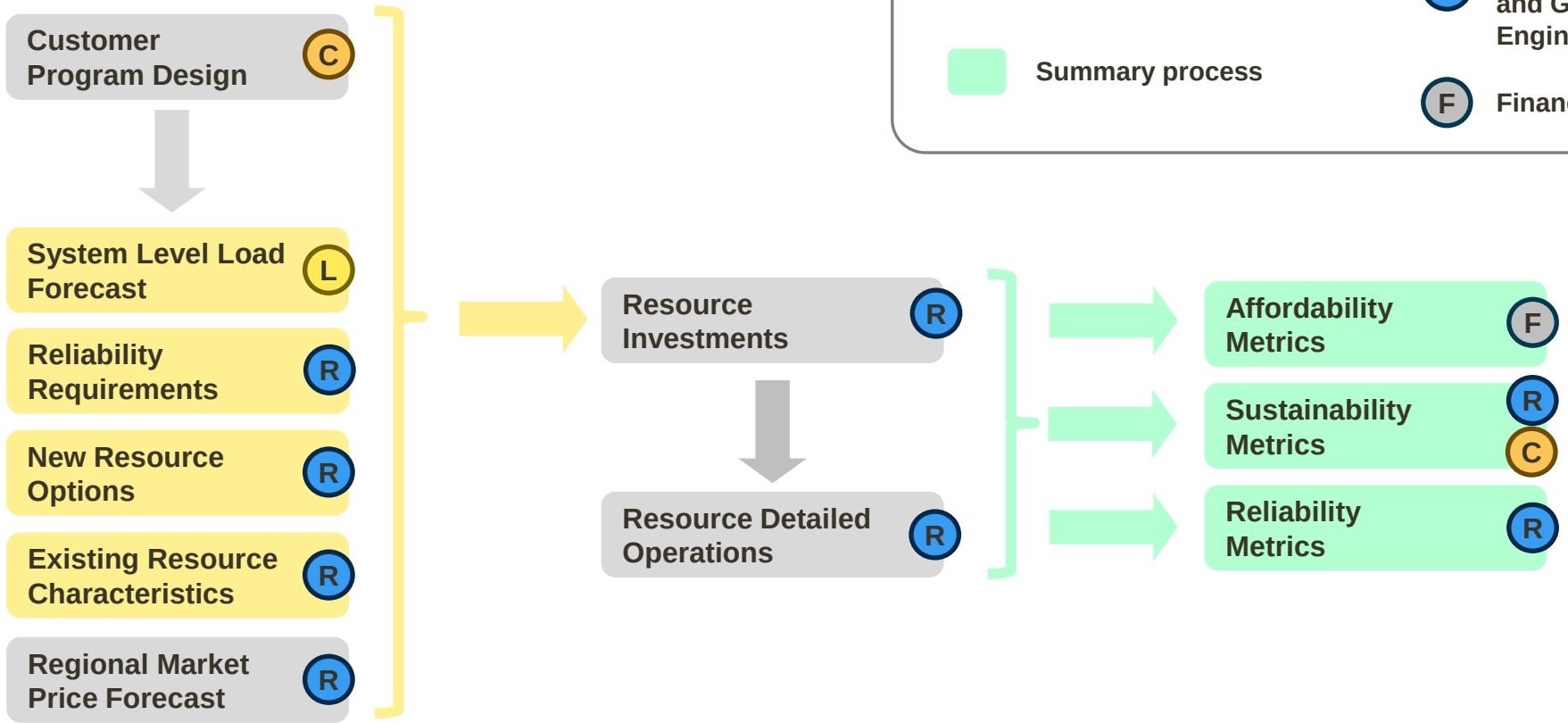
The Integrated Planning Process at SRP

Integrated System Planning: A Holistic System-wide Approach

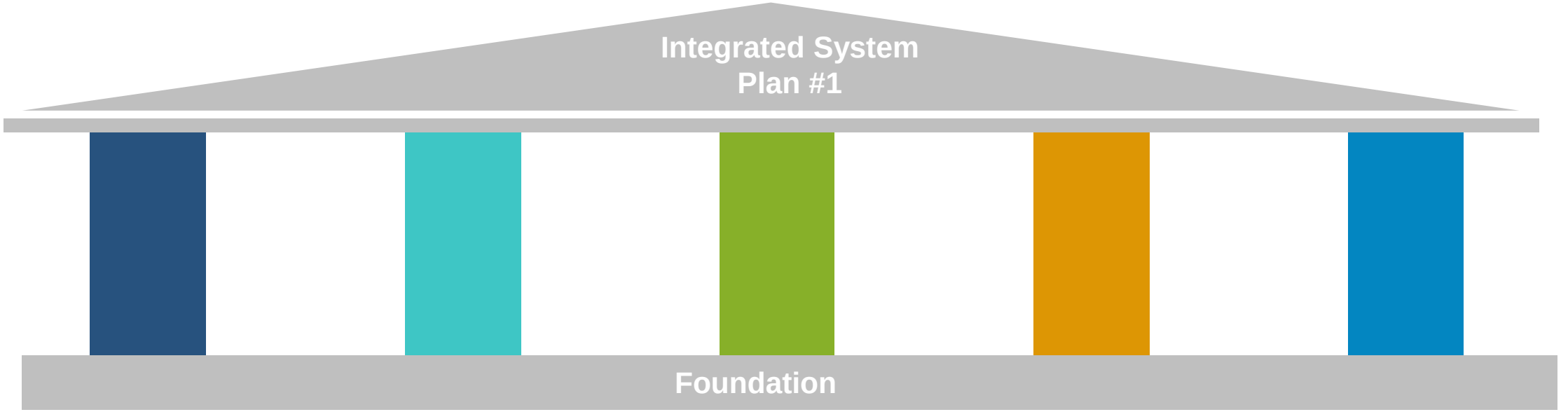
Focus Area



Integrated Resource Plan



Developing a Foundation in the First Integrated System Plan



Quantify system-wide **outputs and metrics** that can help assess the tradeoffs of different system plans

Capture the **interdependencies** of different components of the system plan

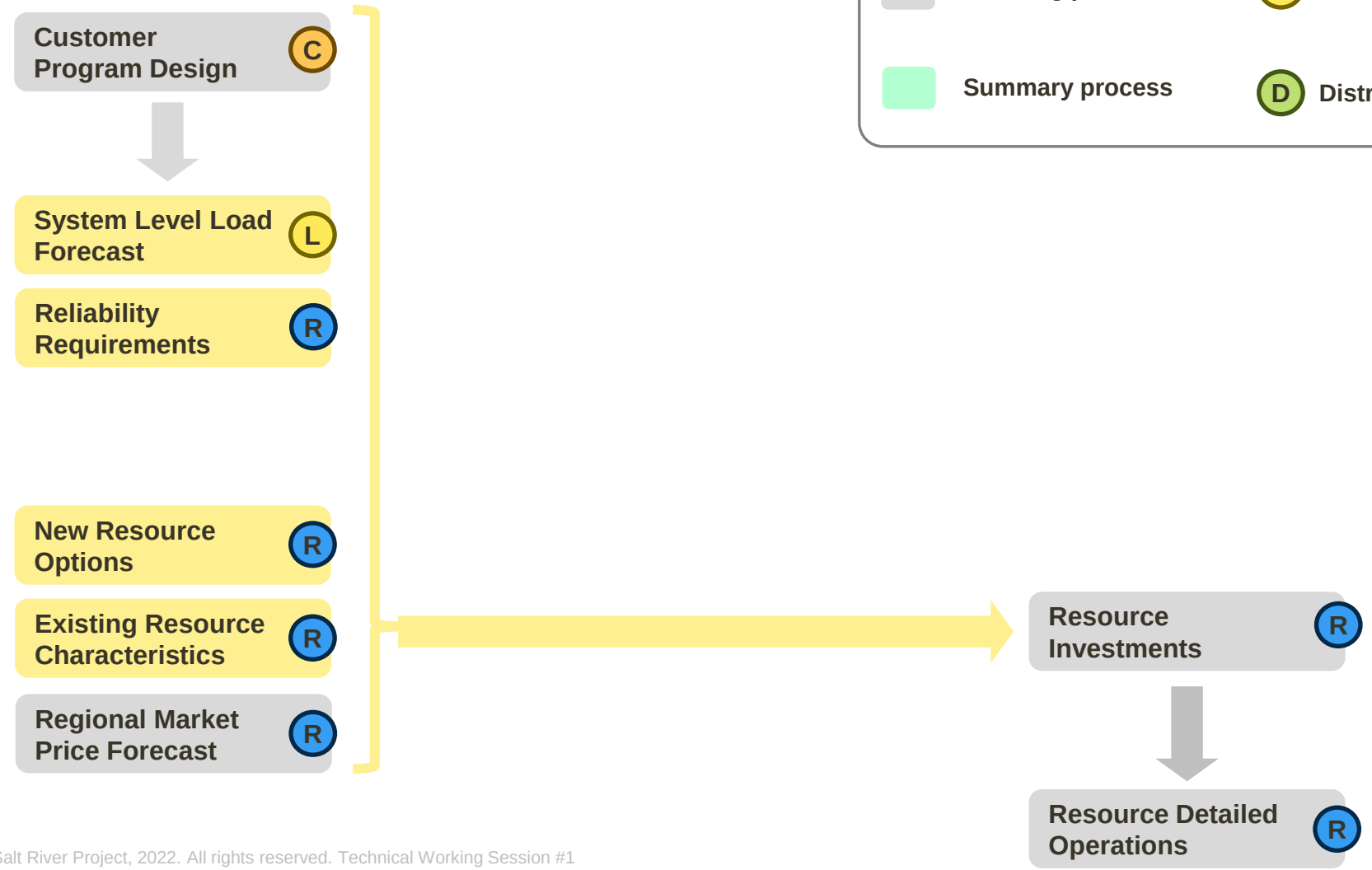
Harmonize the inputs, assumptions, and modeling horizon across planning groups

Assess a **common set of scenarios and strategic approaches** across planning groups

Develop a **system plan** that considers customer programs, distribution, transmission, and resource decisions

Integrated System Plan

Resource Planning



Input and assumptions development process

Planning process

Summary process

C Customer Programs

L Load Forecasting

D Distribution Planning

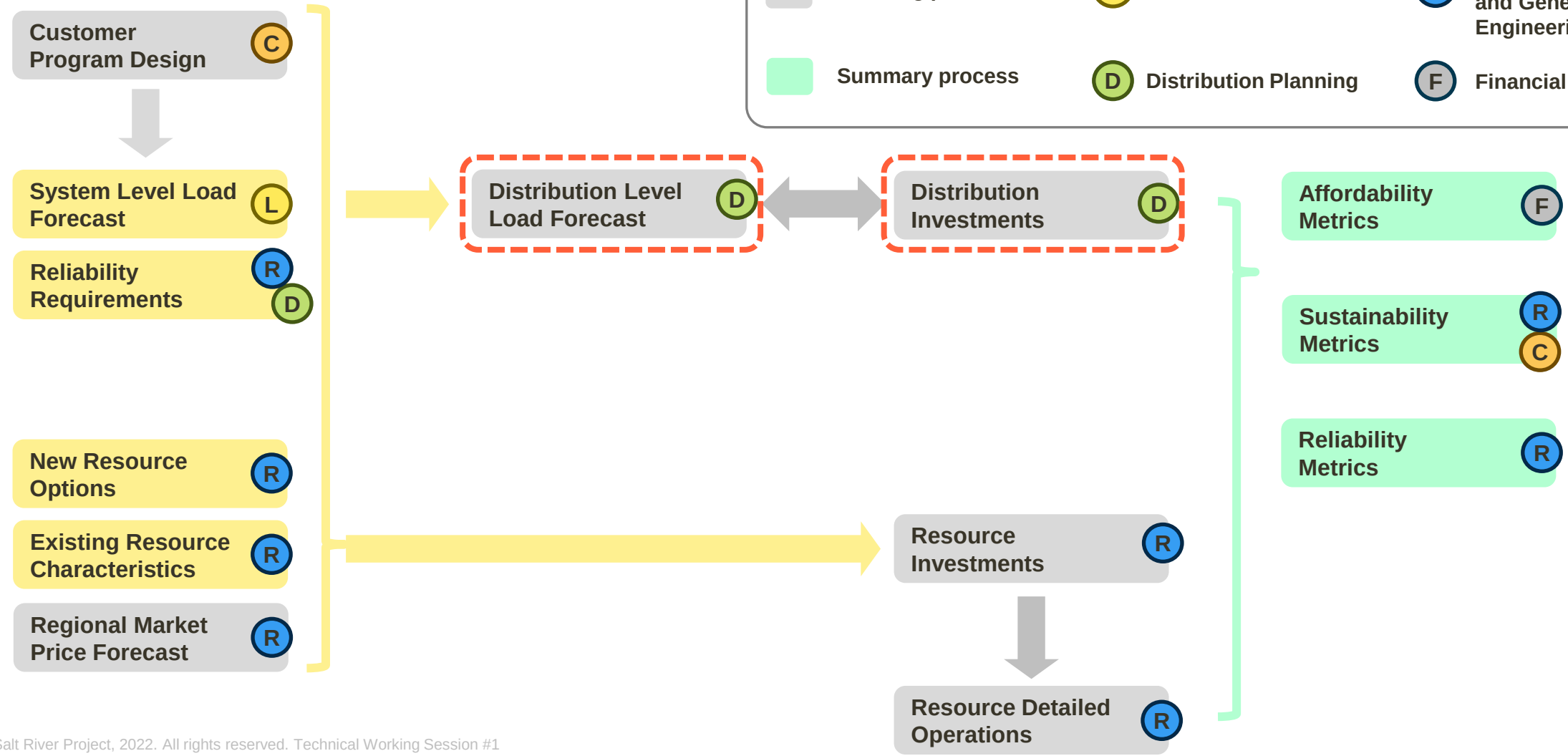
T Transmission Planning

R Resource Planning, Resource Acquisition, and Generation Engineering

F Financial Services

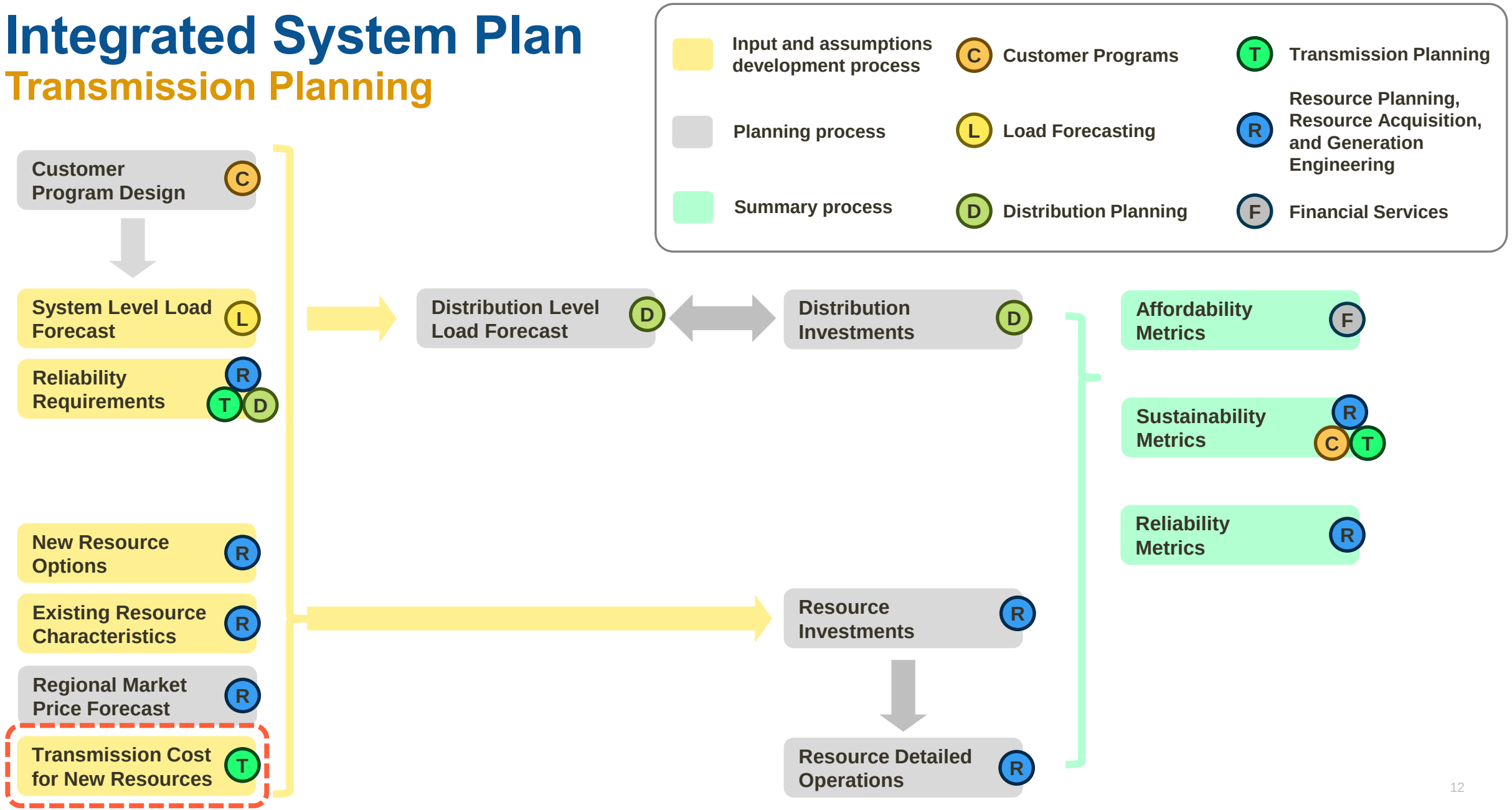
Integrated System Plan

Distribution Planning



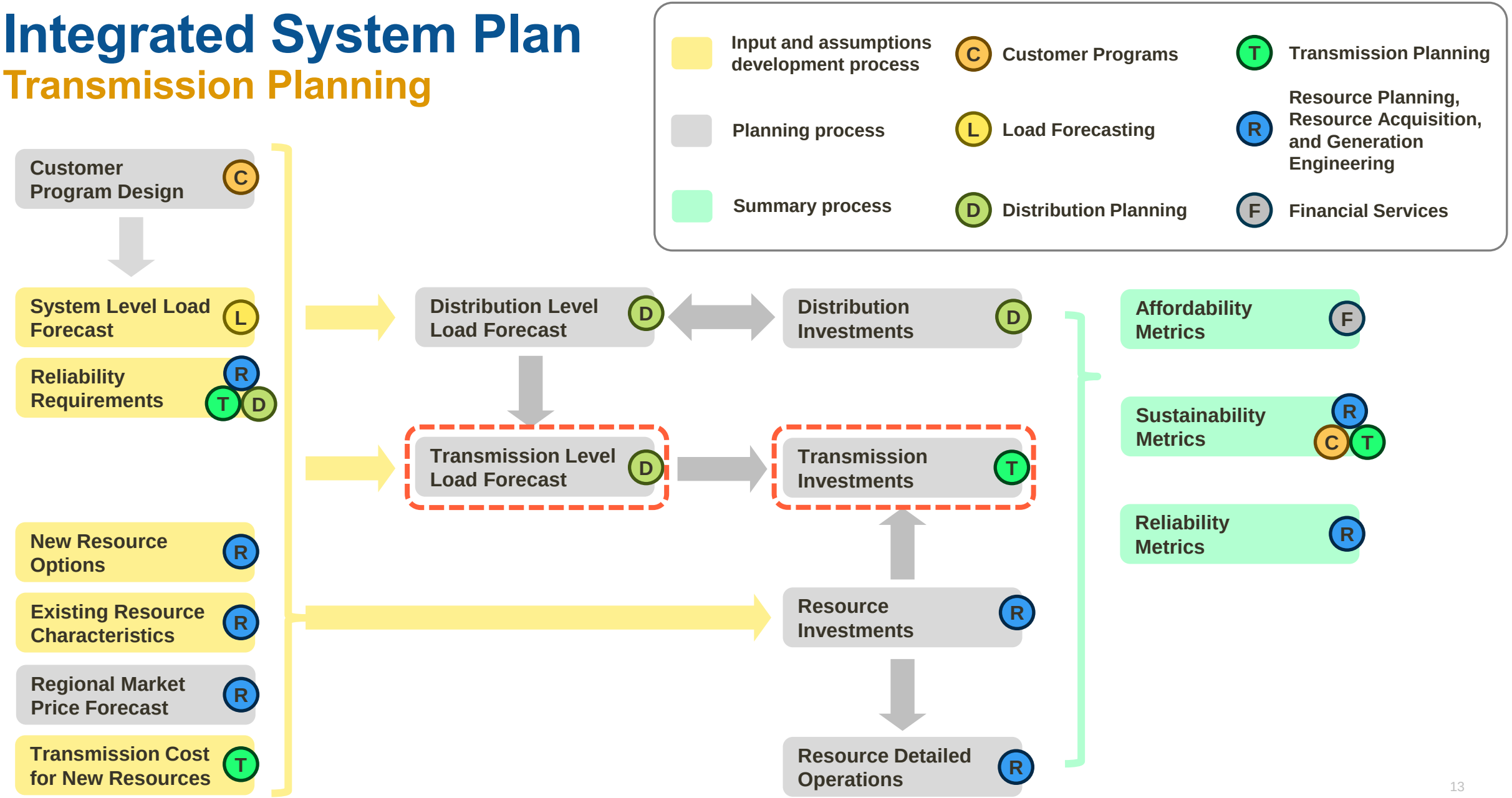
Integrated System Plan

Transmission Planning



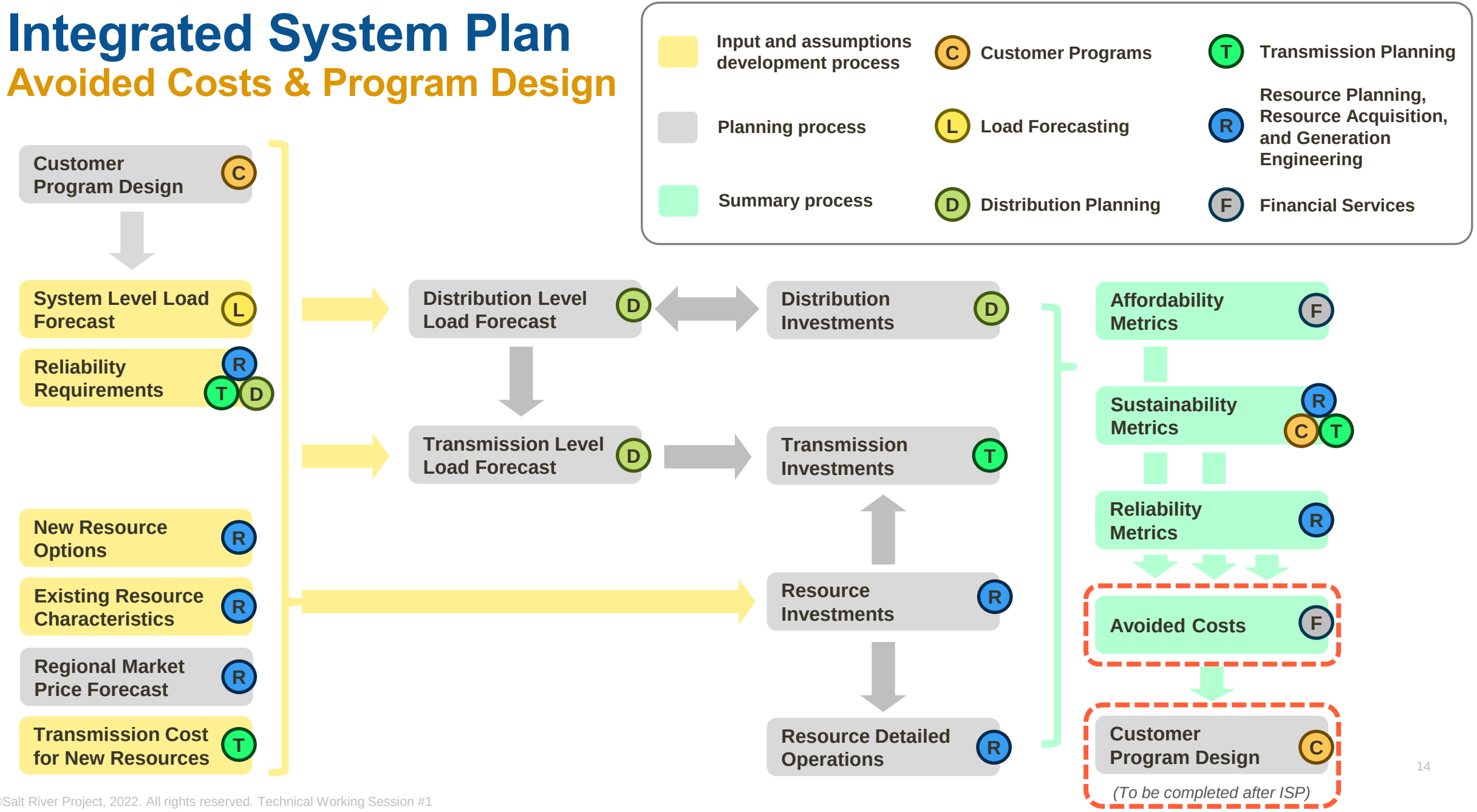
Integrated System Plan

Transmission Planning



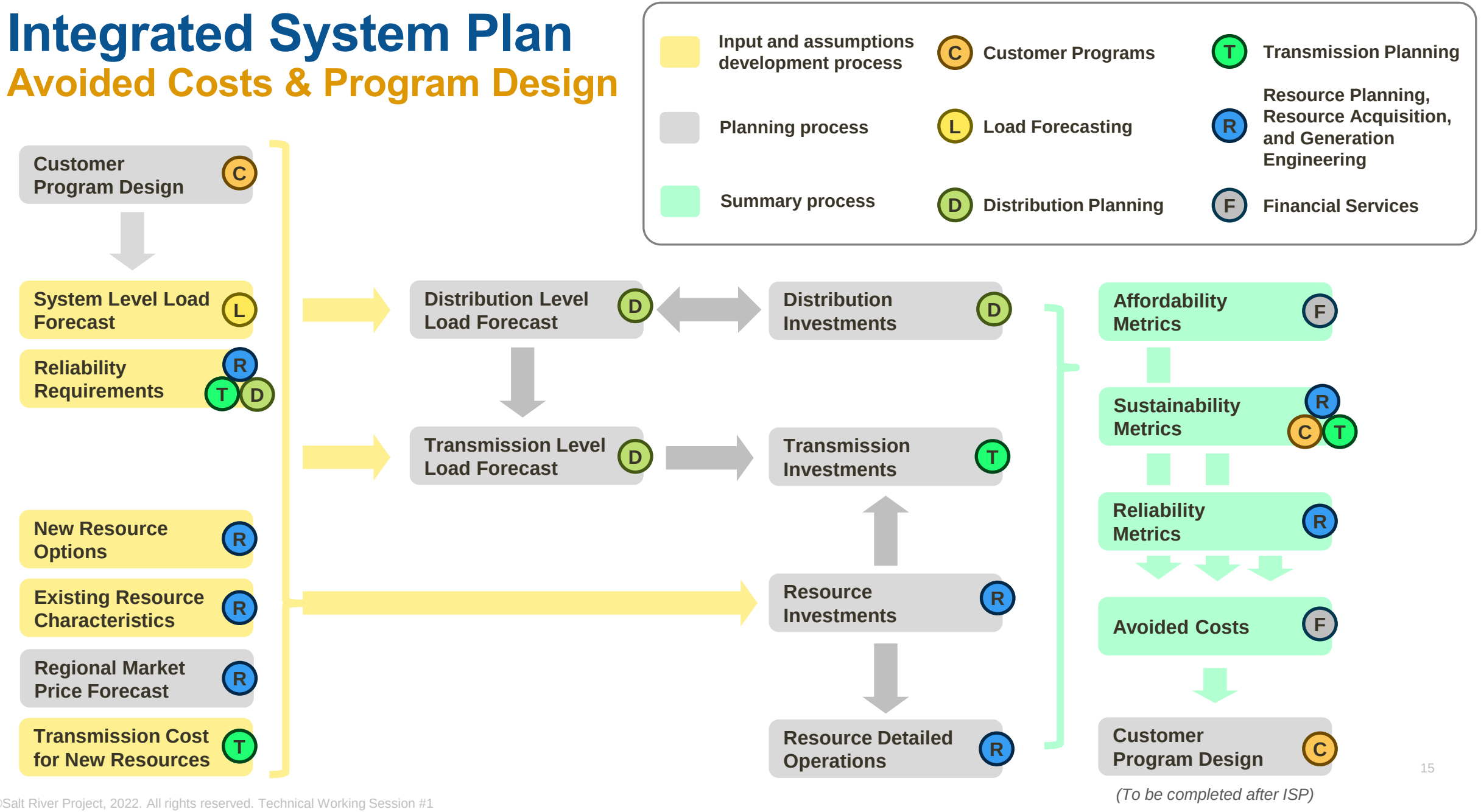
Integrated System Plan

Avoided Costs & Program Design



Integrated System Plan

Avoided Costs & Program Design

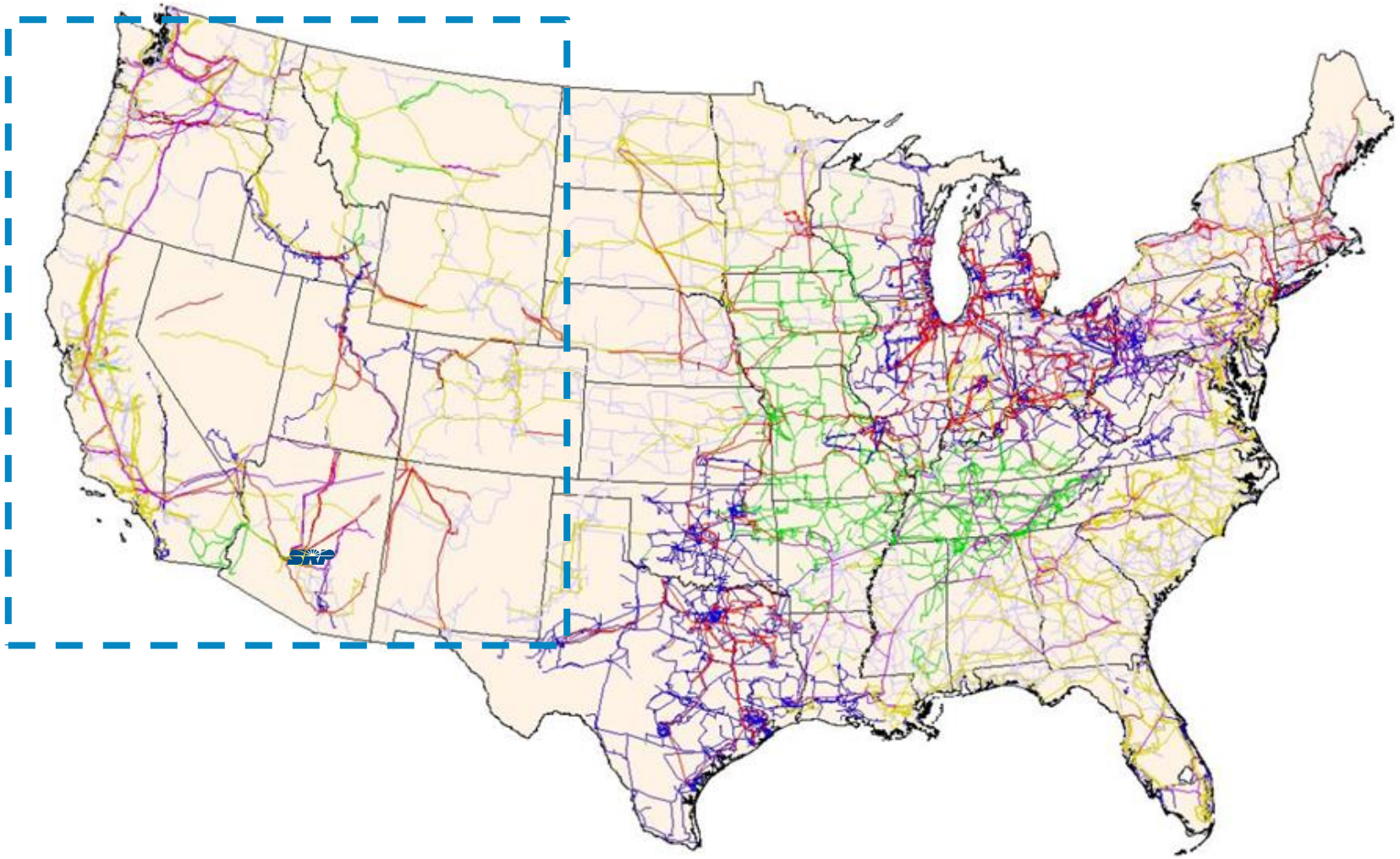


Regional Planning

SRP planning within a broader system

Western Interconnection

The Western Electricity Coordinating Council (WECC) promotes bulk power system reliability and security in the Western Interconnection

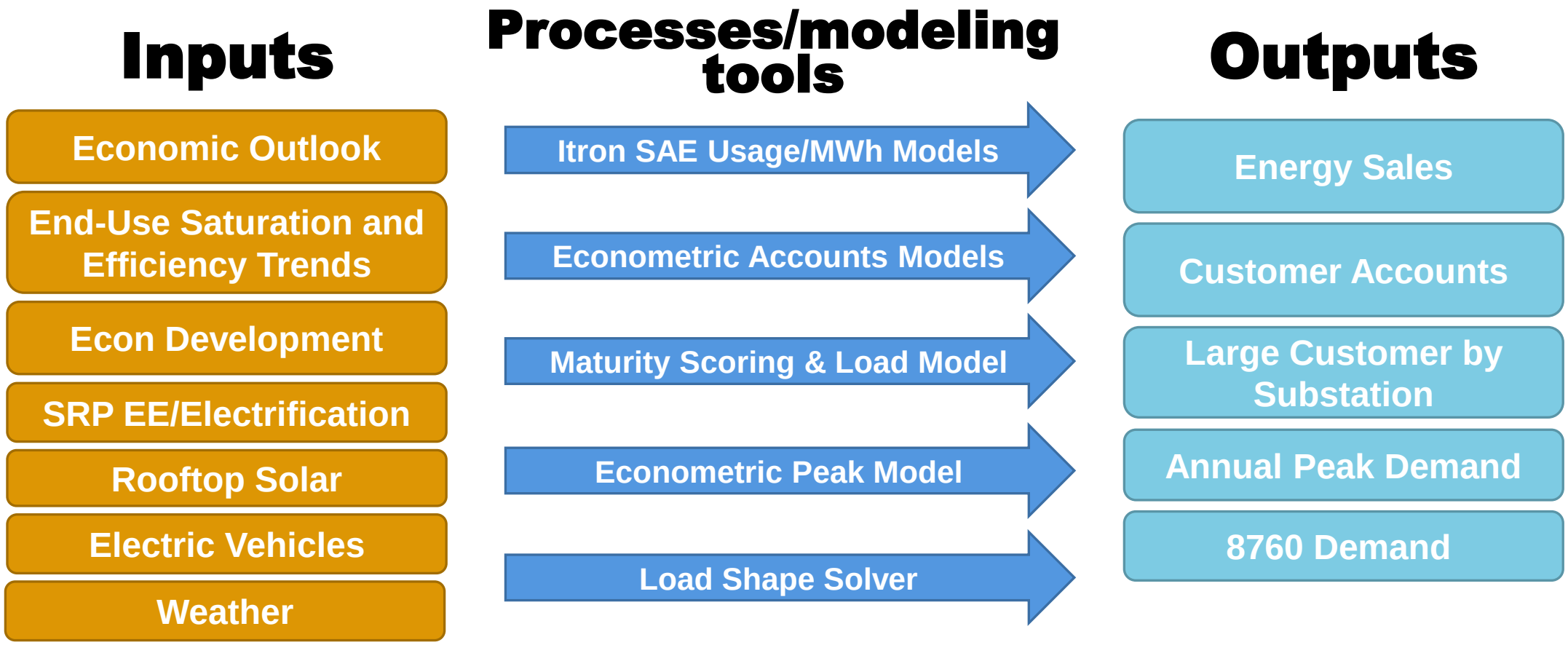


Load Forecasting Analysis (Includes Customer Programs)

Harry Sauthoff
Manager, Load Forecasting (SRP)

Nathan Morey
Manager, Product Development (SRP)

Forecasting Process Overview



Forecast Inputs

Consensus Economic Outlook
Source: UofA, ASU, Moody's, Woods & Poole (W&P), RL Brown

SRP EE & Electrification
Source: SRP Customer Programs, CADMUS, SRP Load Research

Rooftop Solar and Battery Forecast
Source: EPRI, NREL, SRP Distribution Enablement, SRP Distributed Energy Programs, SRP Load Research

Electric Vehicle
Source: EPRI, SRP Load Research

Econ Development Forecast
Source: Strategic Energy Managers, Economic Development, Itron 3rd party data center forecast, Dominion Energy, JLL, Greater Phoenix Economic Council (GPEC), Historical Trends

End-Use Saturation and Efficiency Trends:
Source: Itron partnering with the Energy Information Administration

Weather: Cooling Degree & Heating Degree Hours and Peak Demand Weather Conditions
Source: National Oceanic and Atmospheric Administration (NOAA), Intergovernmental Panel on Climate Change (IPCC), SRP Weather Experts

Forecast Input: Customer Program Planning

EE & Electrification Planning Inputs:

Corporate Commitments & Priorities: 2035 Goals & Action Plans, spending targets, customer equity priorities, etc.
Source: SRP 2035 Sustainability Goals, Corporate Strategy

Measure-Level Assumptions: unit impacts, savings persistence, assigned load shape, etc.
Source: Guidehouse, CADMUS, EPRI, SRP Load Research

Program-Level Assumptions: rebate & admin costs
Source: SRP Product Development, Measurement & Evaluation

Participation Forecasts
Source: Resource Innovations, ICF, SRP Product Development, Forecasting

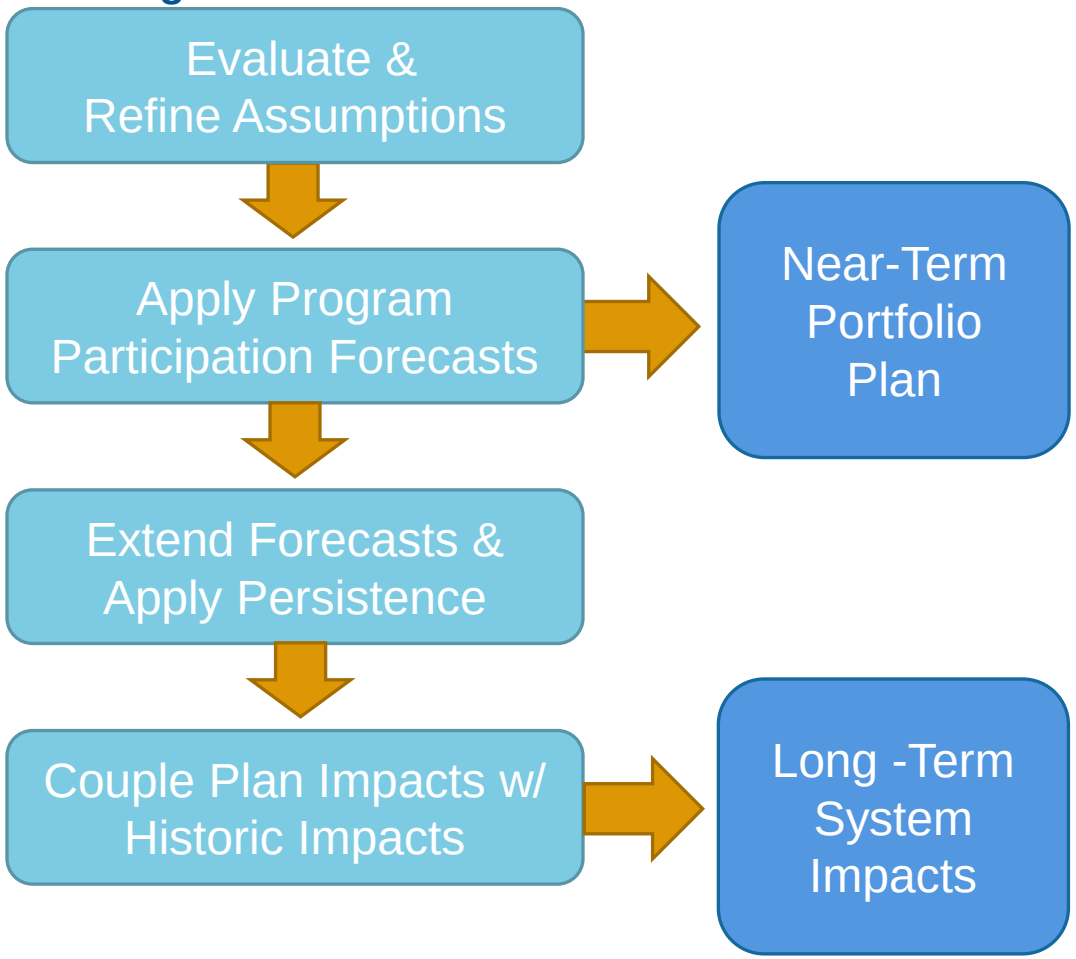
Forecasting Outputs: M-Power & wired units forecast
Source: SRP Load Forecasting

Historic Impacts
Source: Guidehouse, SRP Measurement & Evaluation

End-Use Load Shapes
Source: CADMUS, SRP Load Research

Forecast Input: Customer Program Planning

Planning Process:



Planning Outputs:

Near-Term Portfolio Plan: 6-year Operational Plan

- Annual Program Participation & Marketing Targets
- Annual Incremental Energy & Peak Demand Impacts
- Annual Rebate & Admin Expenses
- Financial Planning Inputs

Long-Term System Impacts: Aggregate Impact Projections

- 30-year Load Forecasting Inputs
  - Annual Aggregate Energy Impacts from EE & Electrification
  - Associated End-Use Load Shape Mix
- 30-year Resource Planning Inputs
  - Annual Demand Response Capacity Projections
- 15-year Financial Planning Inputs
  - Annual O&M Cost Projections

Processes/modeling tools

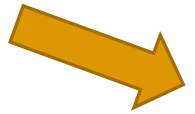
Res Use-per-Customer Forecast

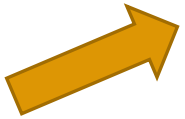
Comm Energy Sales Forecast

Maturity Scoring Model

Residential Customer Forecast

Commercial Customer Forecast



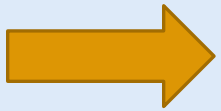


Residential and Commercial Energy Sales and Customers

Load & Timing Forecast

Large Customer Energy Sales Forecast

Large, Res/Commercial Customer Forecast
Weather
Impacts: Price Plans, EVs, Rooftop Solar/Batteries
Energy Sales



Regression Model

Load Shape Solver

Annual Peak Demand

8760 Demand

Forecast Outputs

Energy Sales: Monthly energy sales by Price Plan/Customer Class
Use: Pricing

Customer Accounts: Monthly Customer Accounts by Price Plan /Customer Class
Use: Pricing and Distribution Planning

Large Customer Forecasts by Substation (Large Industrial)
Use: Transmission Planning

Peak Demand: Highest Annual Demand
Use: Resource, Transmission and Distribution Planning

8760 Hourly Demand: demand for each hour of each year of the forecast
Use: Resource and Distribution Planning and Pricing

Rooftop Solar and Customer-Owned Batteries: Forecast of adoption, MWh and MW AC capacity
Use: Distribution Planning

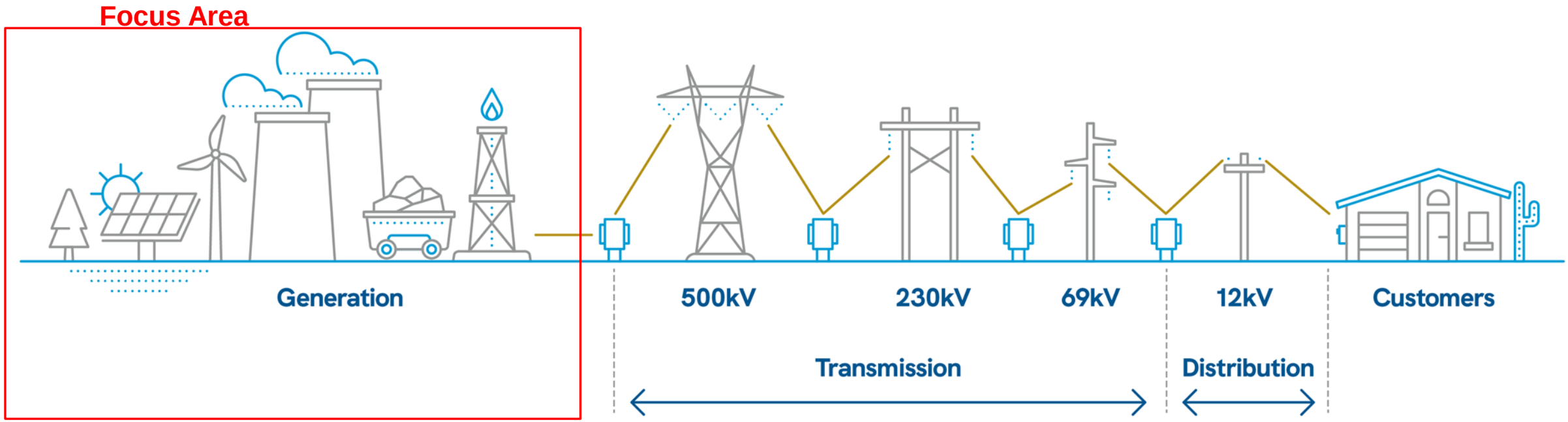
Electric Vehicles (EV) Forecast: Adoption and MWh forecast for EVs in SRP territory
Use: Distribution Planning

Forecasts are created for various scenarios & sensitivities in the Integrated System Plan to recognize uncertainty

Resource Planning Methods

Michael Reynolds
Manager, Resource Analysis & Planning (SRP)

Resource Planning: Power Generation



Resource Planning Challenges

Reliability

- Load growth paired with coal retirement
- Evolving load profile – distributed solar, electrification, industrial loads
- New resources are intermittent or have limited energy
- Regional capacity needs
- Extreme weather

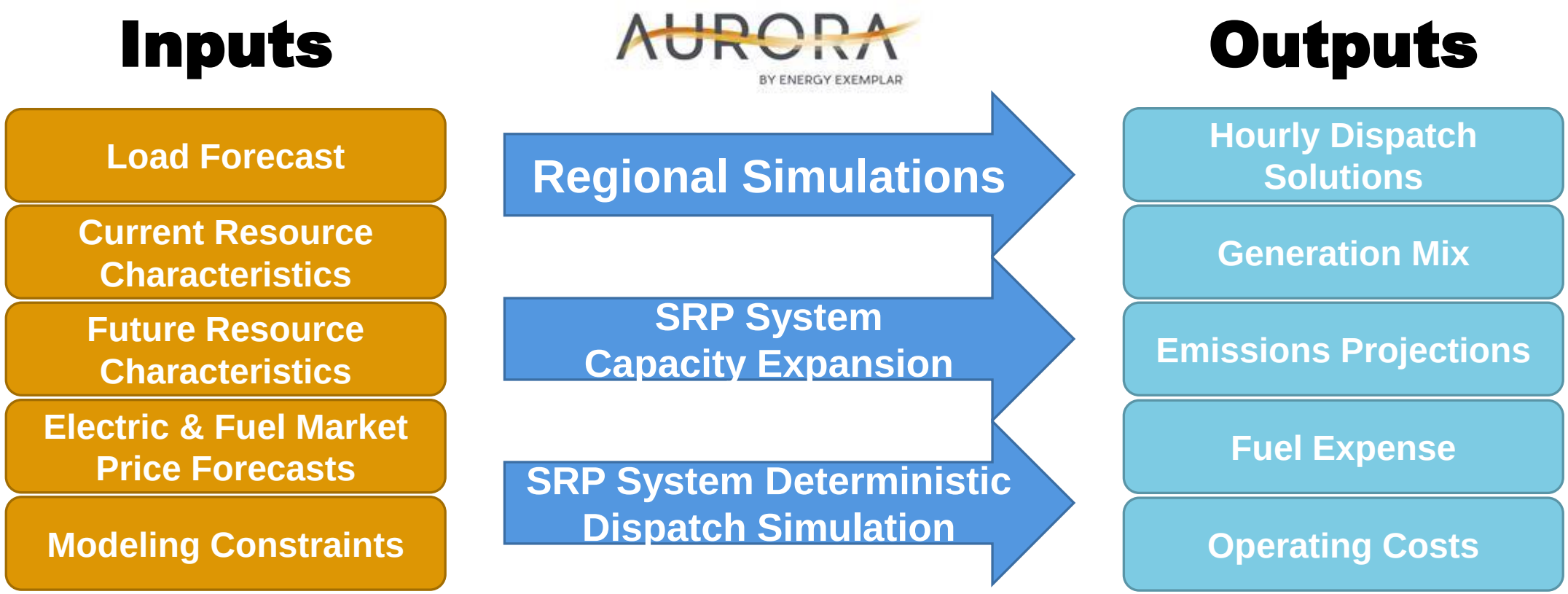
Affordability

- Unknown future costs for fuel
- Rapidly changing costs for emerging technologies
- Volatile regional electricity market prices
- Long-life investments

Sustainability

- Need for reduced carbon emissions
- Water considerations
- Land use
- Community impacts

Integrated System Plan: Resource Planning Process



Resource Analysis Inputs

Regional Loads and Resource Data
Source: Energy Exemplar database (sourced from various publicly available data)

Electric Price Forecast
Source: SRP analysis, market quotes

Hourly Load Forecast
Source: SRP Forecasting, contracted external sales

SRP Resource & PPA Characteristics (heat rates, flexibility metrics, outage rates, cost elements, emissions, etc.)
Source: SRP Generation Engineering, SRP contracts

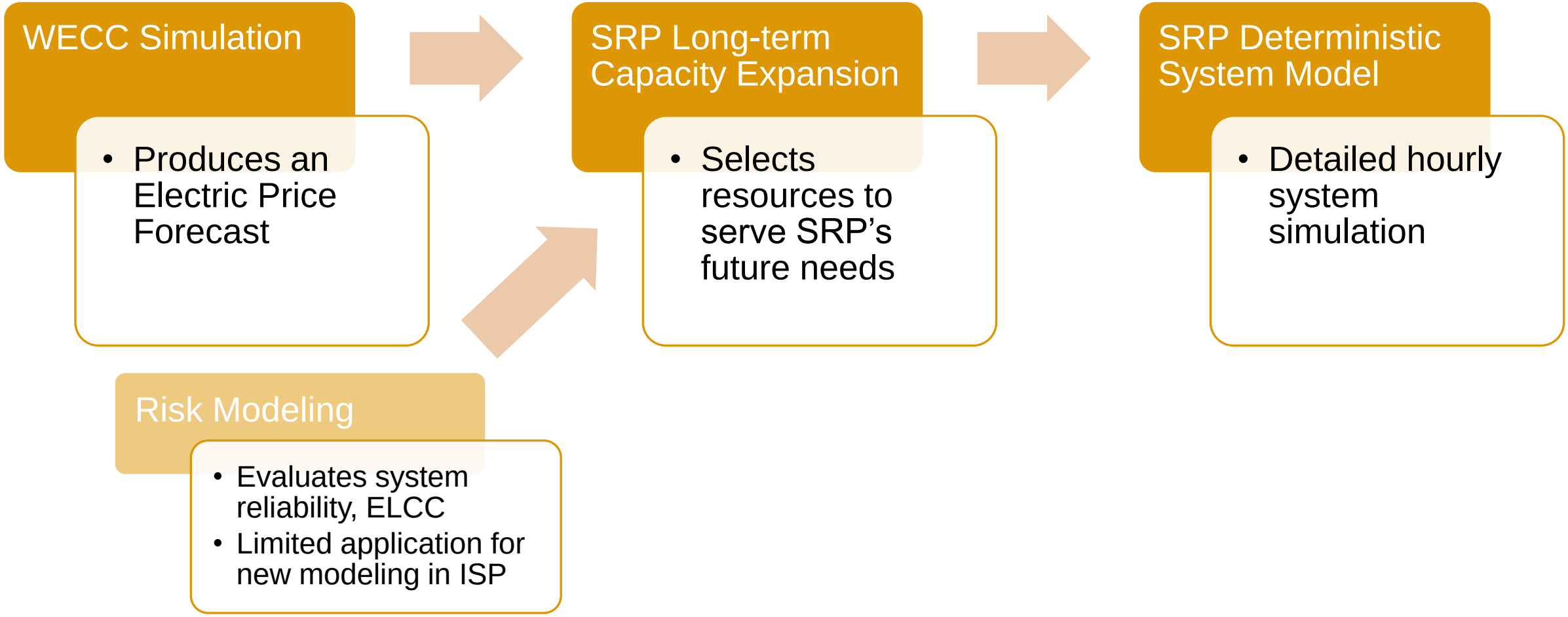
Effective Load Carrying Capability (ELCC)
Source: SRP analysis

Fuel Costs
Source: SRP Fuels (existing contracts), Consulting Groups, Publicly Available Sources (EIA Annual Energy Outlook, etc.), market quotes, SRP analysis

Potential Resource Technologies & Costs
Source: SRP Procurement Activities, SRP Transmission Planning, EPRI, Publicly Available Sources (EIA Annual Energy Outlook, NREL Annual Technology Baseline, etc.)

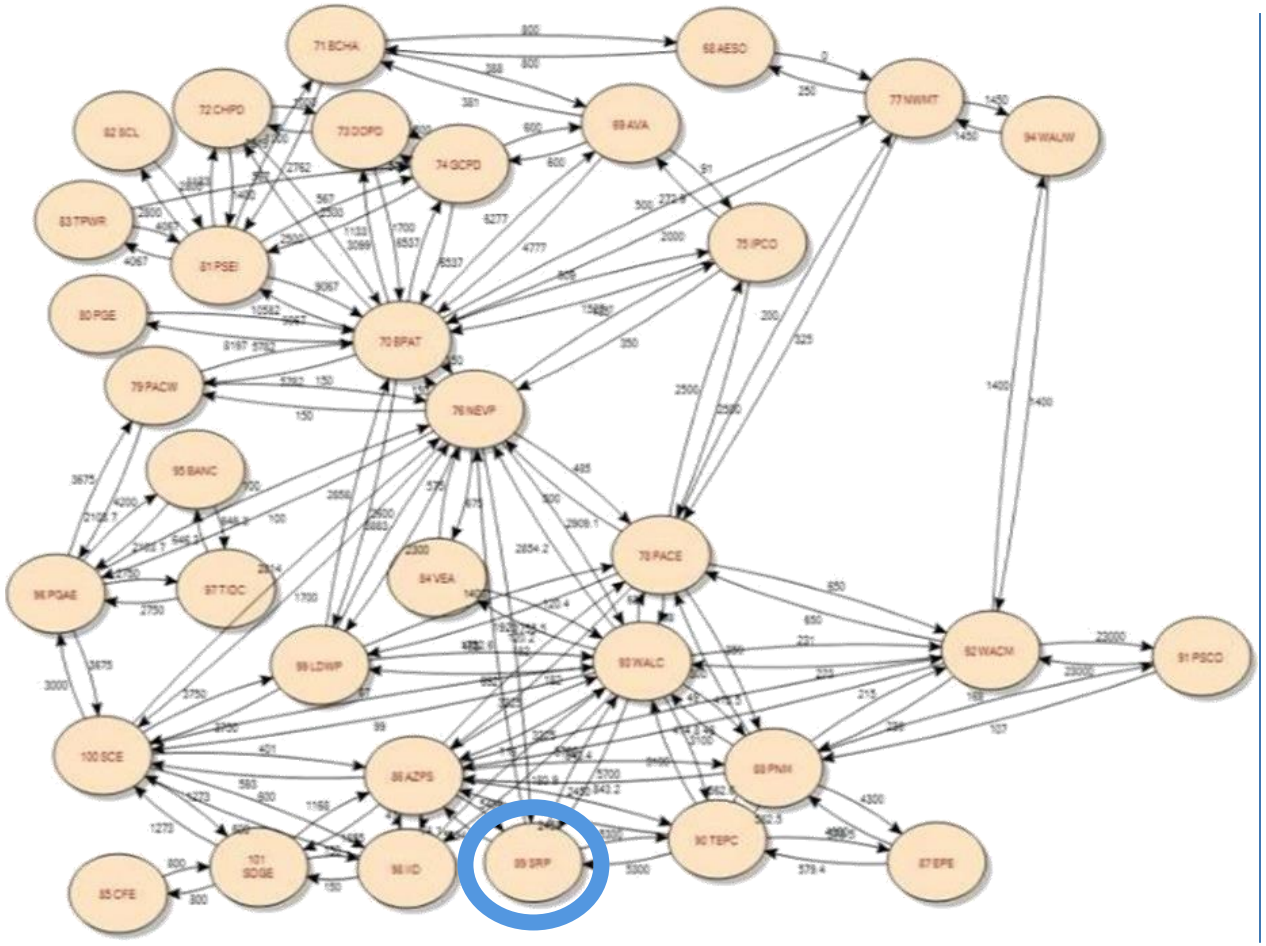
Other Modeling Constraints
Source: SRP Board Policy, SRP Fuels (existing contracts), transmission limits for new resources (“renewable energy zones”)

Process & Methodology



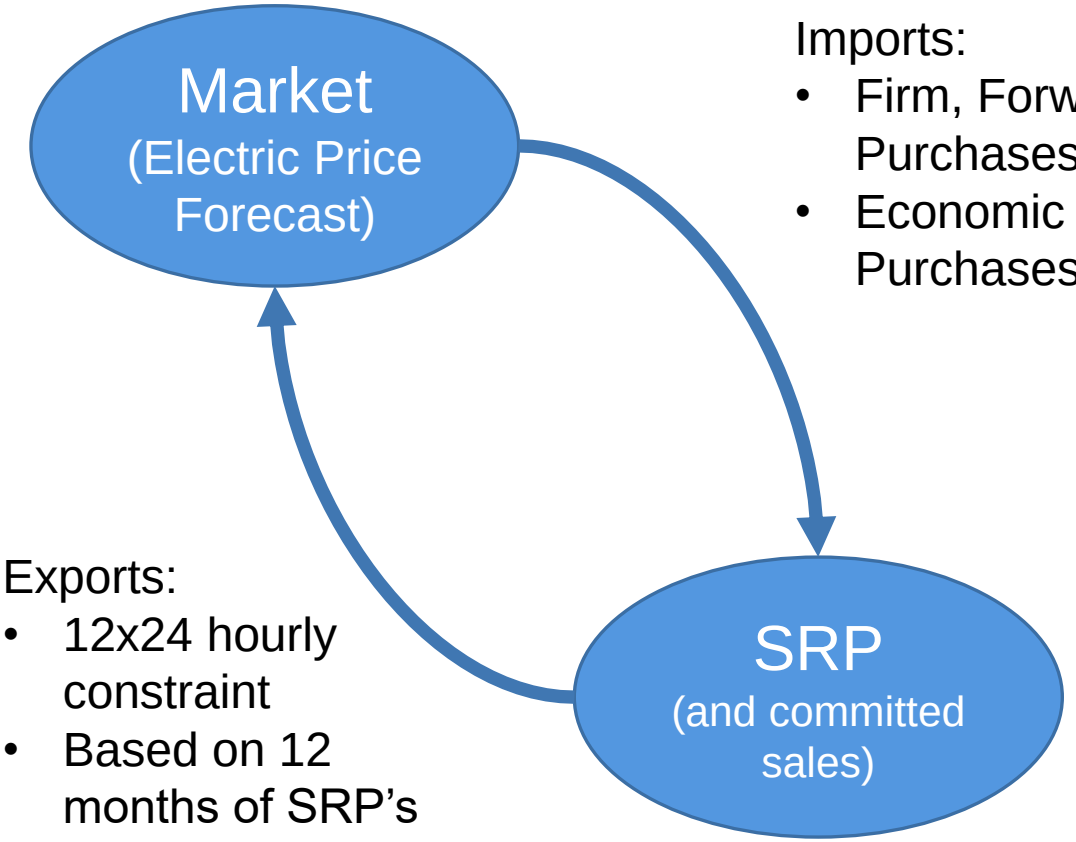
Process & Methodology: Zonal Configurations

WECC Modeling (electric price forecast)



Source: Aurora

SRP 2-Zone Modeling (all else)



Imports:
- Firm, Forward Purchases
- Economic Purchases

Exports:
- 12x24 hourly constraint
- Based on 12 months of SRP's actual exports (~2021)

Resource Analysis Outputs

Electric Price Forecast: hourly price to be applied to SRP's 2-zone models

Resource Selection: Resources identified as part of a future SRP resource portfolio

Hourly Resource Dispatch Detail

Resource system cost metrics

- Fuel expenses
- O&M expenses
- Capital costs for new resources

Resource system sustainability metrics

- Carbon emissions (mass and intensity)
- Water emissions (mass and intensity)
- Other metrics (e.g. air emissions)

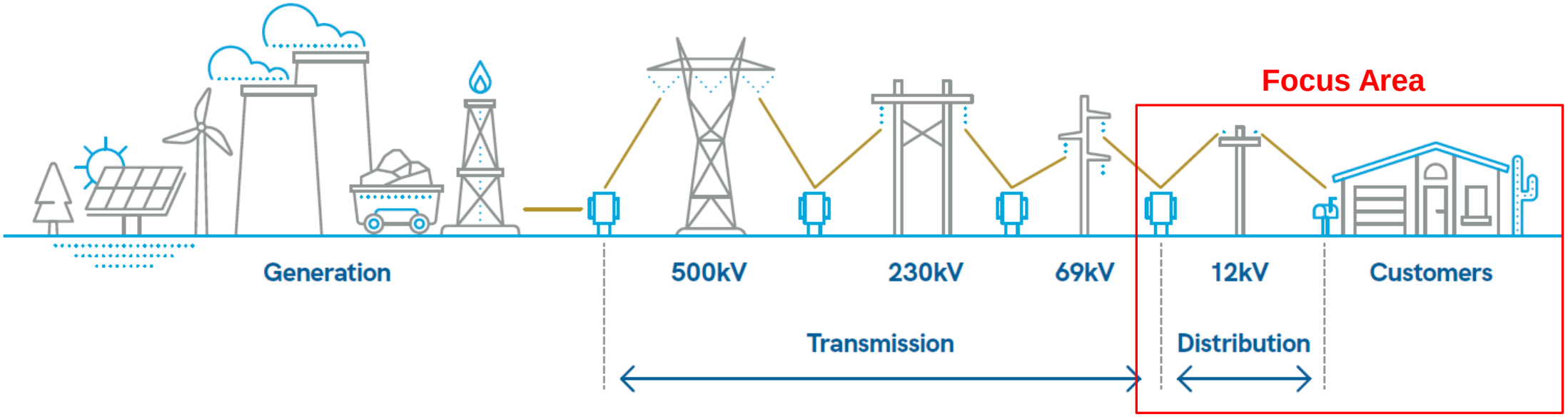
Reliability metrics

- Loss of Load Expectations/Loss of Load Hours
  - All modeled portfolios will be designed for resource-adequacy
  - This may be a final check for strategic conclusions, but would not be simulated along the way

Distribution Planning Methods

Melissa Martinez
Manager, Distribution Planning (SRP)

Distribution System and Planning



Distribution Planning Process

Inputs

- Load Forecast
- Distribution System Model
- New Customer Load Information
- Hourly Load Shapes
- DER Interconnections
- DER/EV Adoption

Load Allocation

Load Flow Analysis

Outputs

- Forecasted Load by Substation
- Distribution System Infrastructure Upgrade Plan

*Key Distribution Planning Tool

Distribution Planning Analysis Inputs

Advanced Metering Infrastructure (AMI) data: 15-minute load data from each meter
Source: Customer meter data

Load forecast: forecasted peak load for each year
Source: Load Forecast

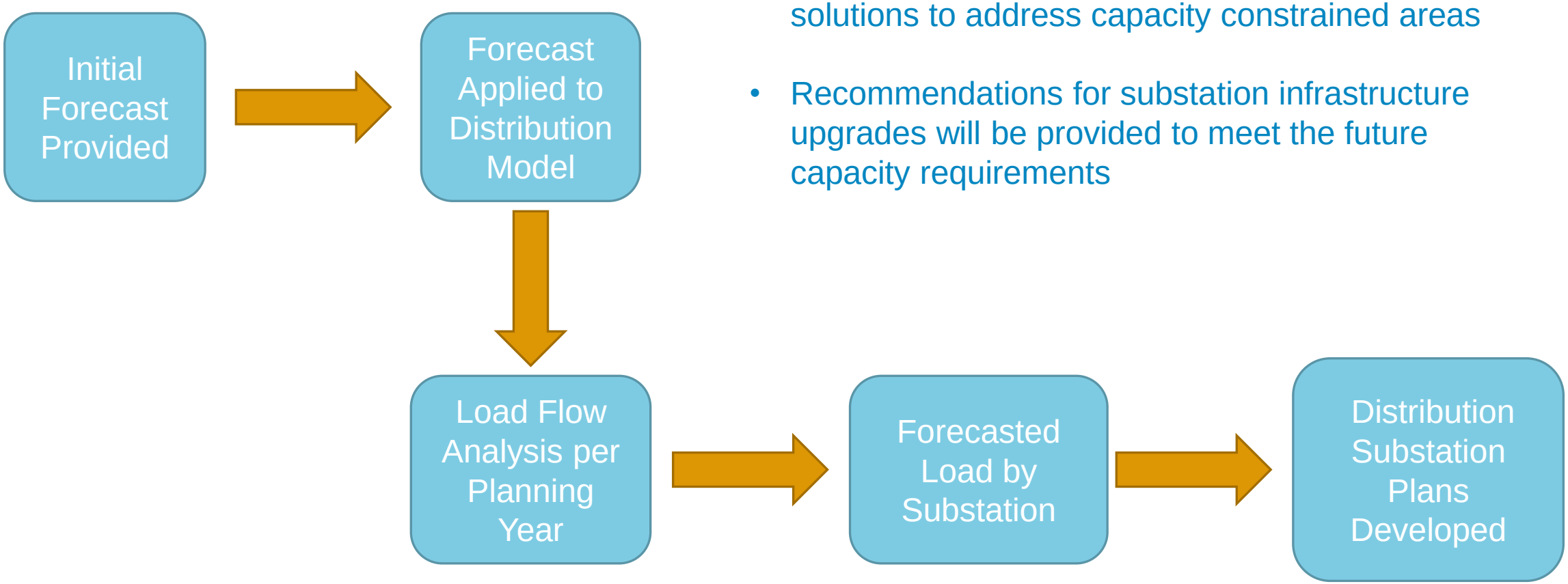
Customer Load Growth data: anticipated and known load growth data for residential and commercial/industrial customers
Source: Economic Development, System Requirement Requests, Initial Plan Review, Customer Construction & Design Contracts

Distribution System topology: geographic representation of SRP's distribution system
Source: Internal geographic information systems database

Supervisory Control and Data Acquisition (SCADA) data: 15-minute snapshots of load data from the feeder and substation transformer, this includes MW and MVars
Source: Transducer or Relay

Distribution Energy Resources (DER): Location and AC rating of all DER
Source: Customer Interconnection Requests

Process and Methodology



- Results of load flow analyses will be used to create solutions to address capacity constrained areas
- Recommendations for substation infrastructure upgrades will be provided to meet the future capacity requirements

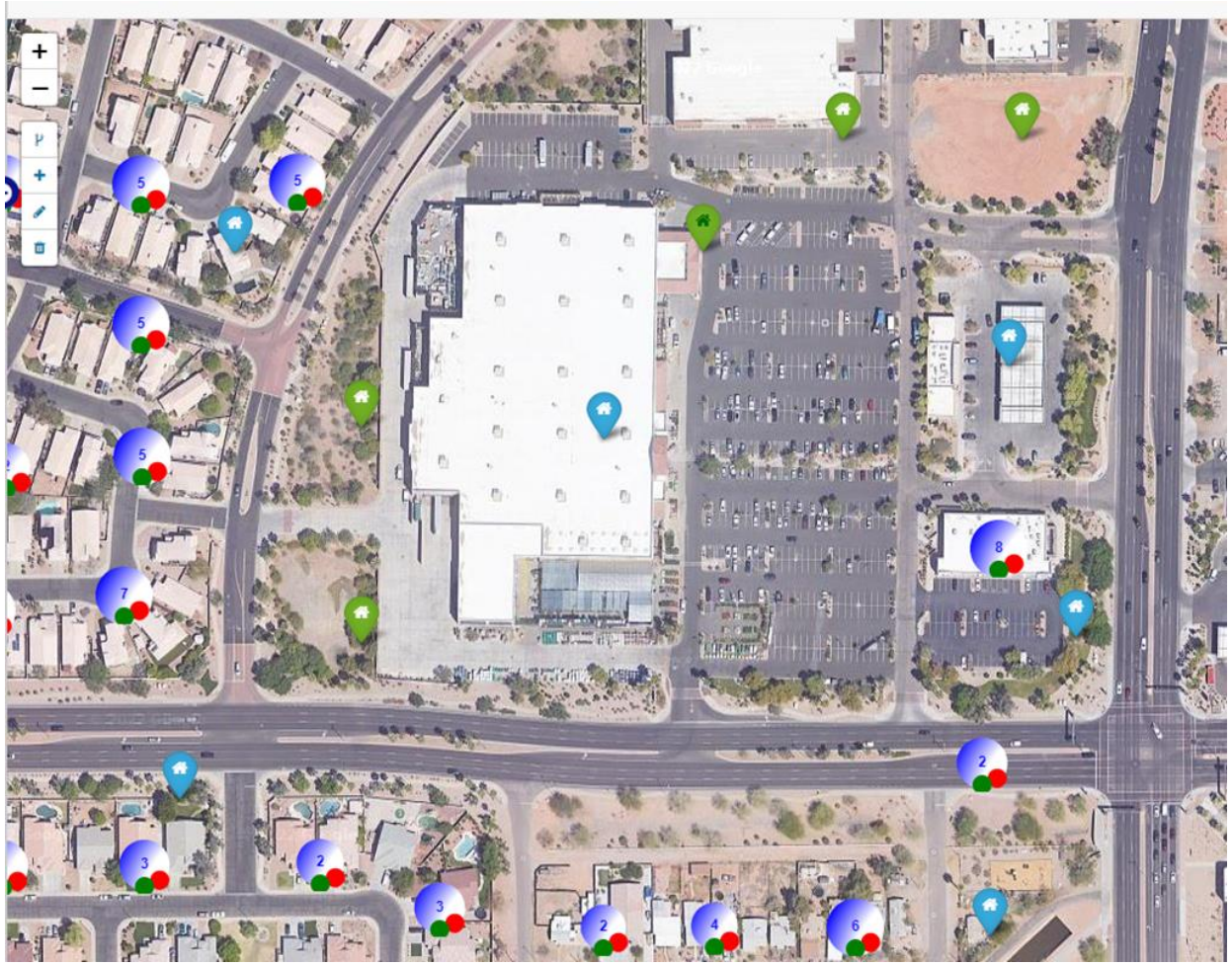
Process and Methodology – Load Allocation

Develop Local Area Forecast

- Annual Corporate Forecast allocated to local level
- Future Load Allocated via
  - New Service Requests (1-3 years)
  - Area growth trends
  - Available vacant land
  - Long-term special studies

Apply Local Area Forecast to Base Case

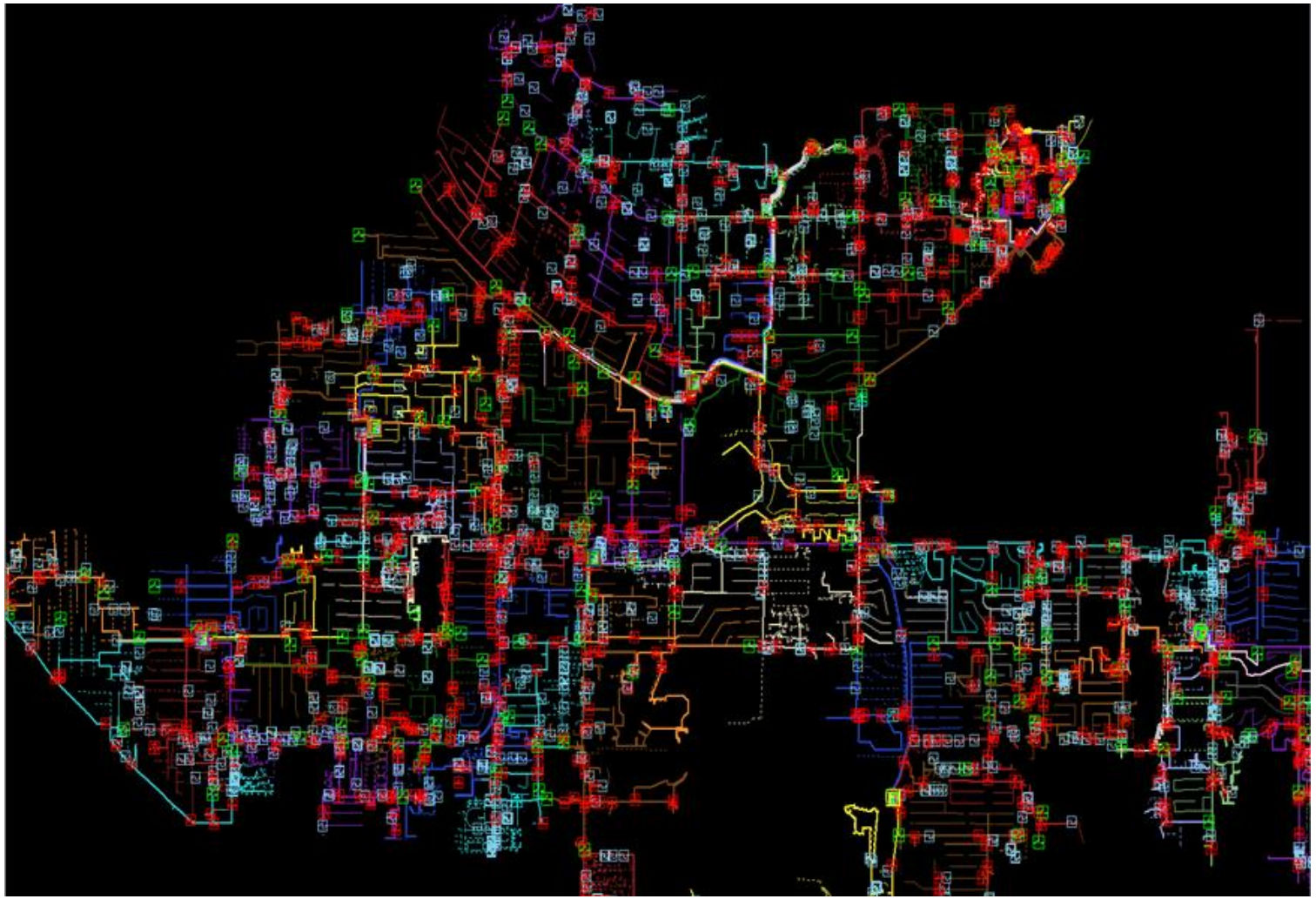
- Normalized to corporate forecast



Process and Methodology – Load Flow Analysis

Load Flow Analysis

- Load flow
- Distributed Energy Resources (DER) impact analysis
- Electric Vehicles (EV) impact analysis
- Infrastructure upgrade placement



Analysis Outputs

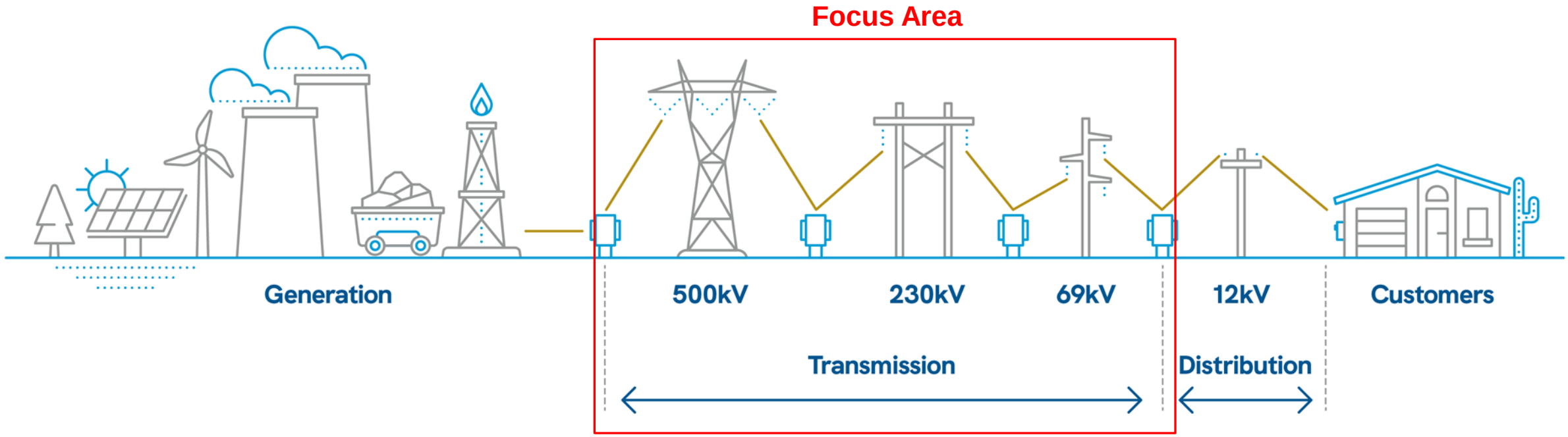
Forecasted Load by Substation: provides forecasted distribution substation load information as an input to Transmission Planning process and used to decide where future substation bays and substations should be built

Distribution infrastructure upgrade plan: provides recommended infrastructure upgrades to serve projected load needs and capacity margin for unexpected loads

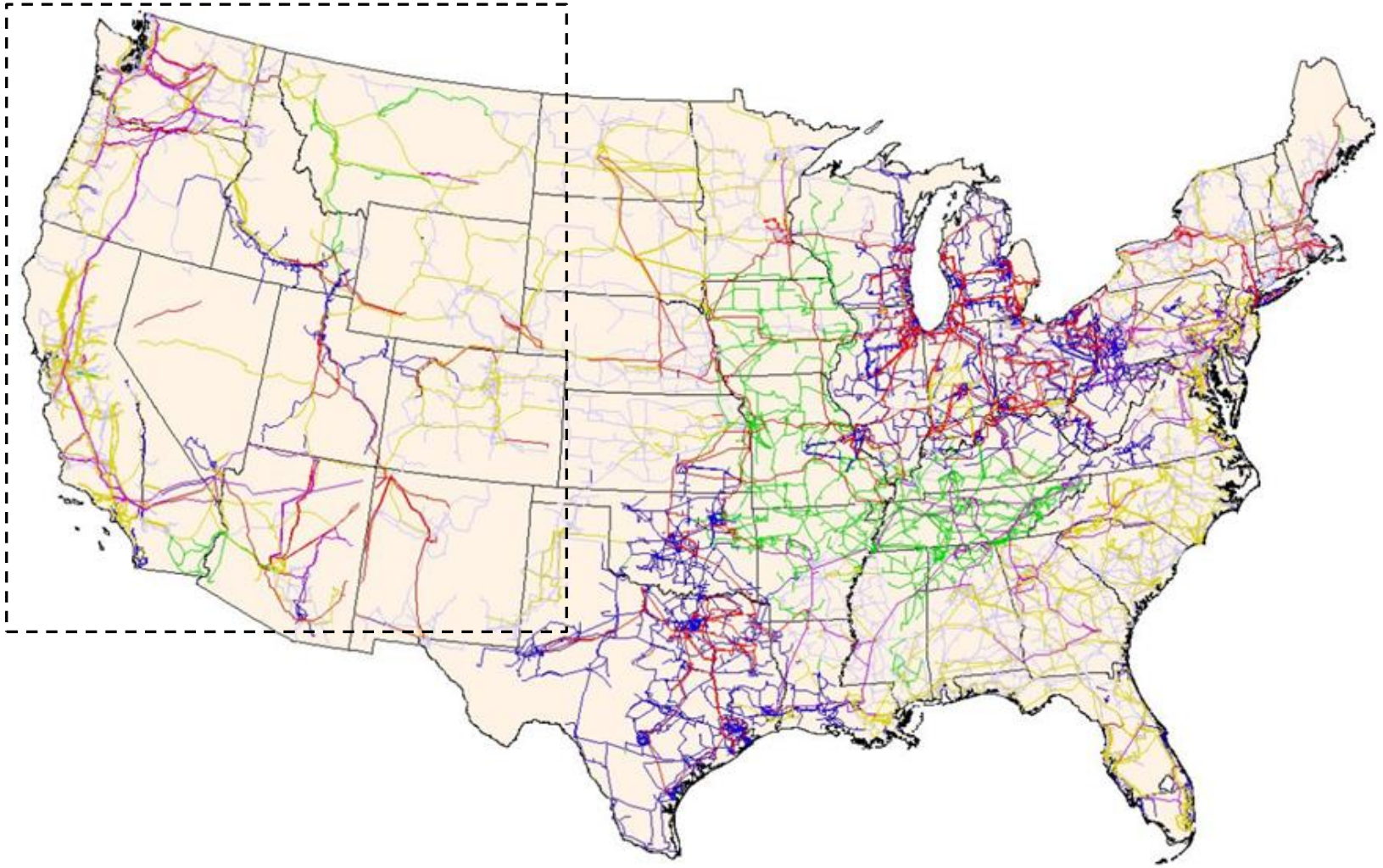
Transmission Planning Methods

Justin Lee
Manager, Transmission Planning (SRP)

Transmission Planning: Generation to Load



Transmission Planning: The Western Interconnection



Transmission Planning Process Overview

Inputs

- Grid Topology
- Contingency List
- Equipment Settings & Characteristics
- Equipment Ratings (normal & emergency)
- Forecasted Load (Levels and location)
- Generation Location & Dispatch

Analysis
(Single Snapshot in Time)

Transmission Investment

Outputs

- Steady State Flows
- Voltage at Each Station
- Transmission Solutions

Transmission Investment: Analysis Inputs

Grid Topology: How the transmission system is connected.
Sources: Internal - TSM database
External – WECC base case, Neighboring Utilities

Contingency List: Defined list of outages to be studied
Source: Created per NERC TPL-001-4

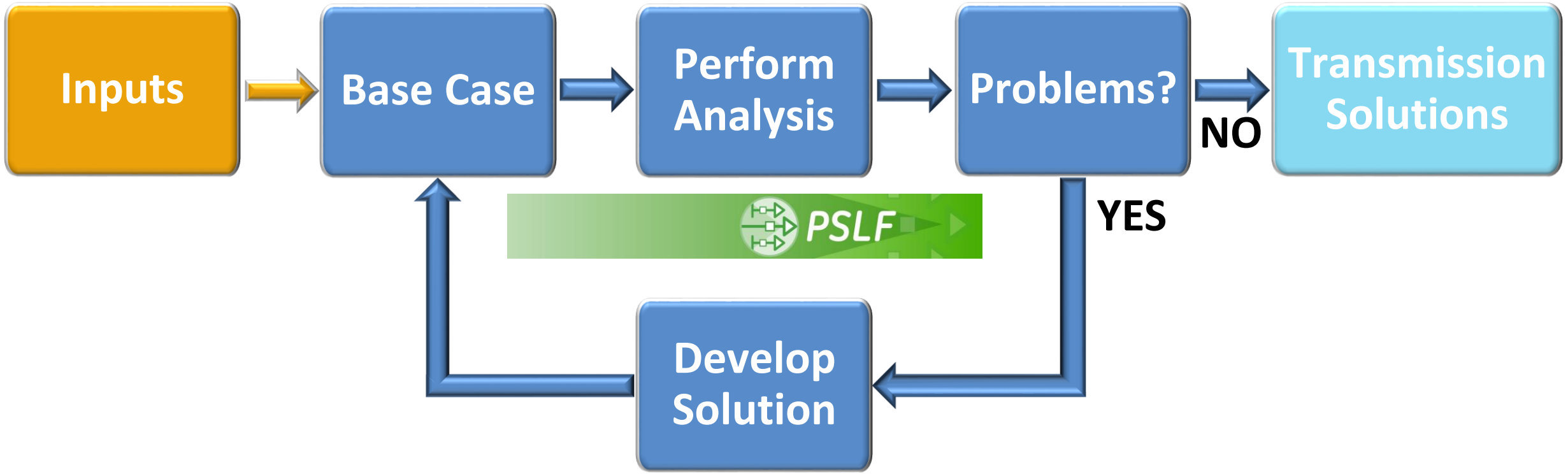
Equipment Settings & Characteristics: Technical information and data used to model elements of the power system
Sources: Internal - Cascade database, ASPEN Line database, generator and transformer test reports
External – WECC base case, Neighboring Utilities

Equipment Ratings: Ratings of each element of the power system
Sources: Internal - Cascade database, ASPEN Line database, generator and transformer test reports
External – WECC base case, Neighboring Utilities

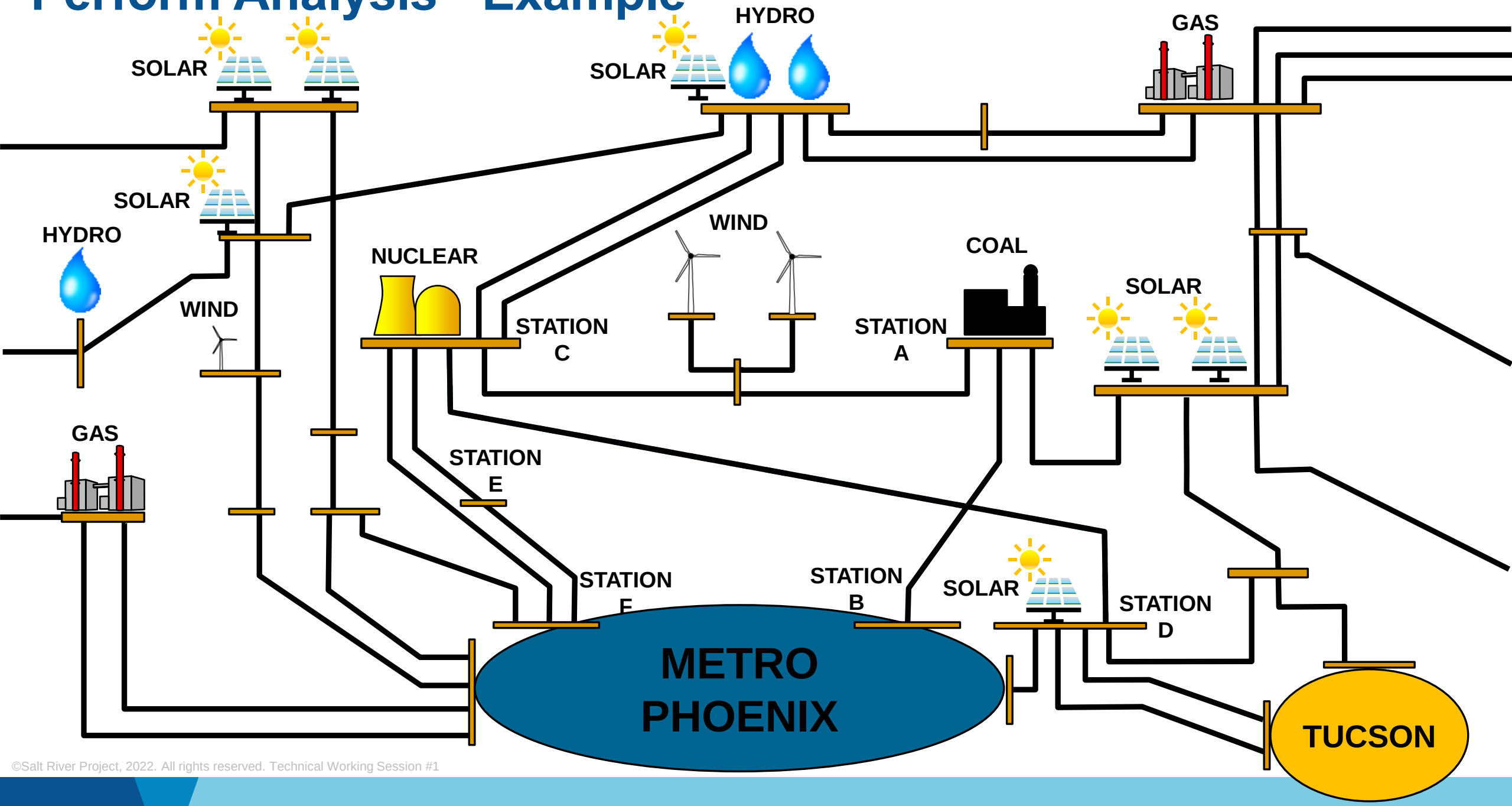
Forecasted Load: Forecasted electric load for the timeframe of the study
Sources: Load Forecasting, Distribution Planning

Generation Location and Dispatch: Planned generation to be in-service for the timeframe of the study
Source: Resource Planning

Transmission Investment Process



Perform Analysis - Example



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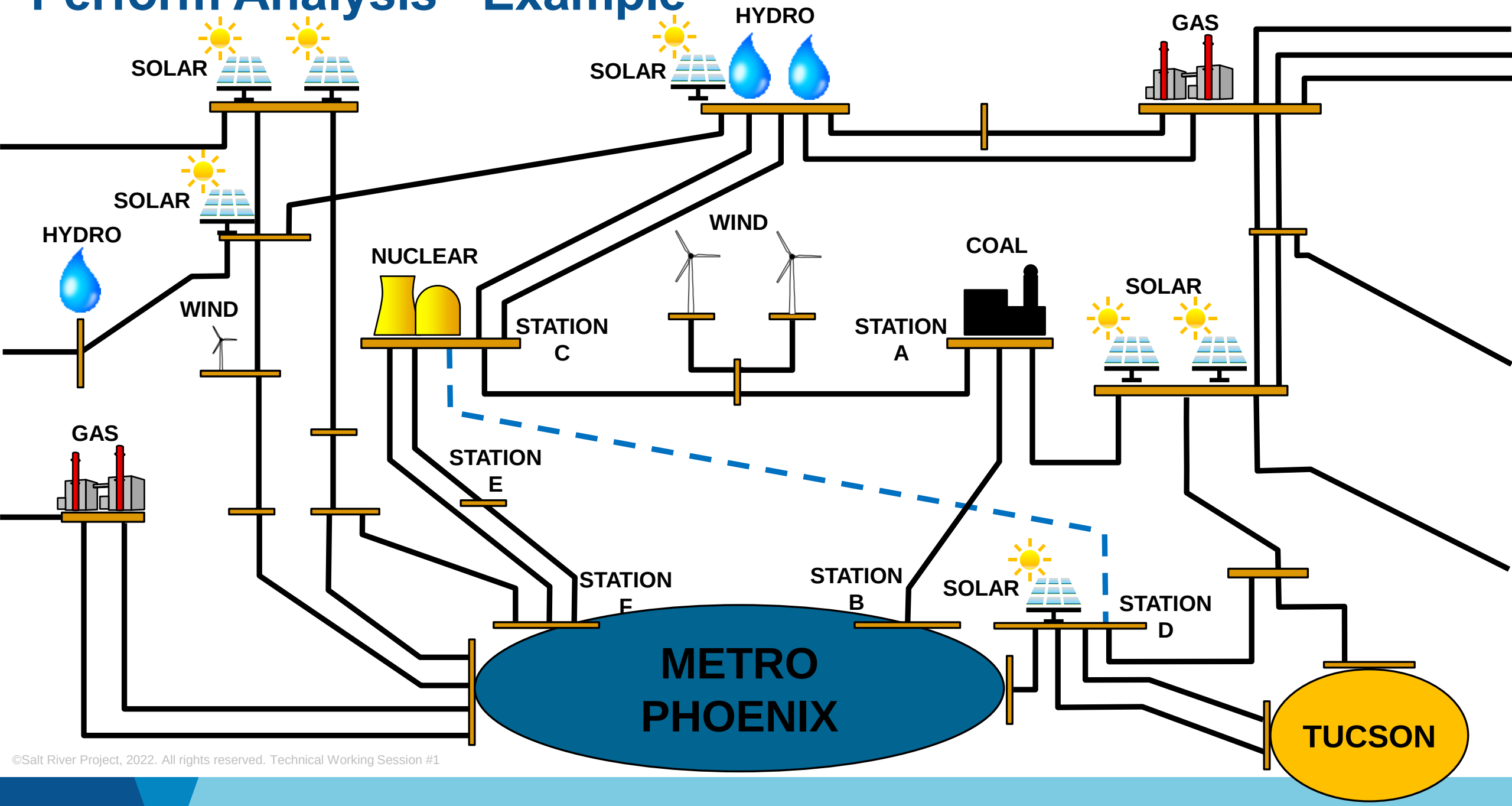

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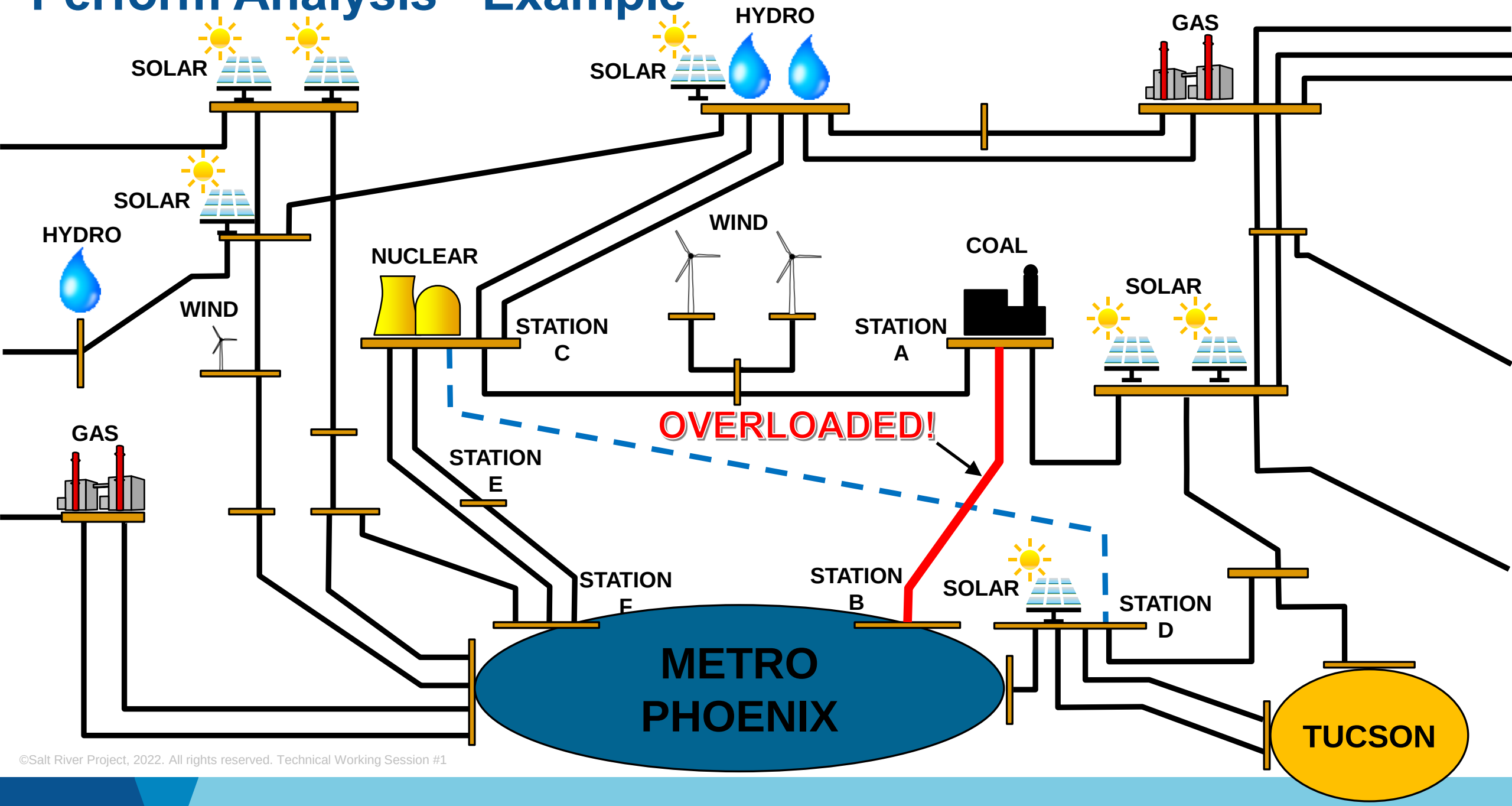

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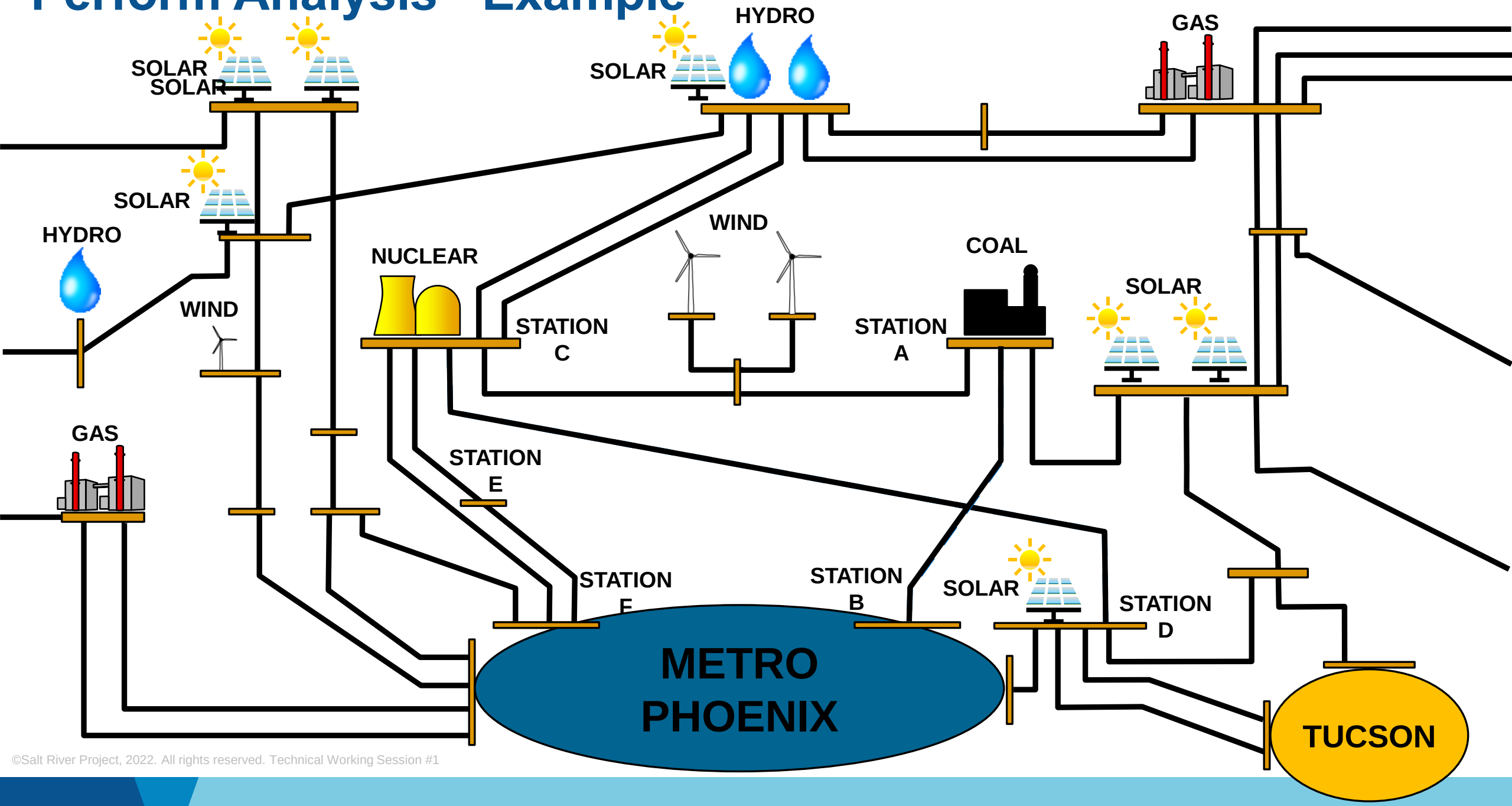

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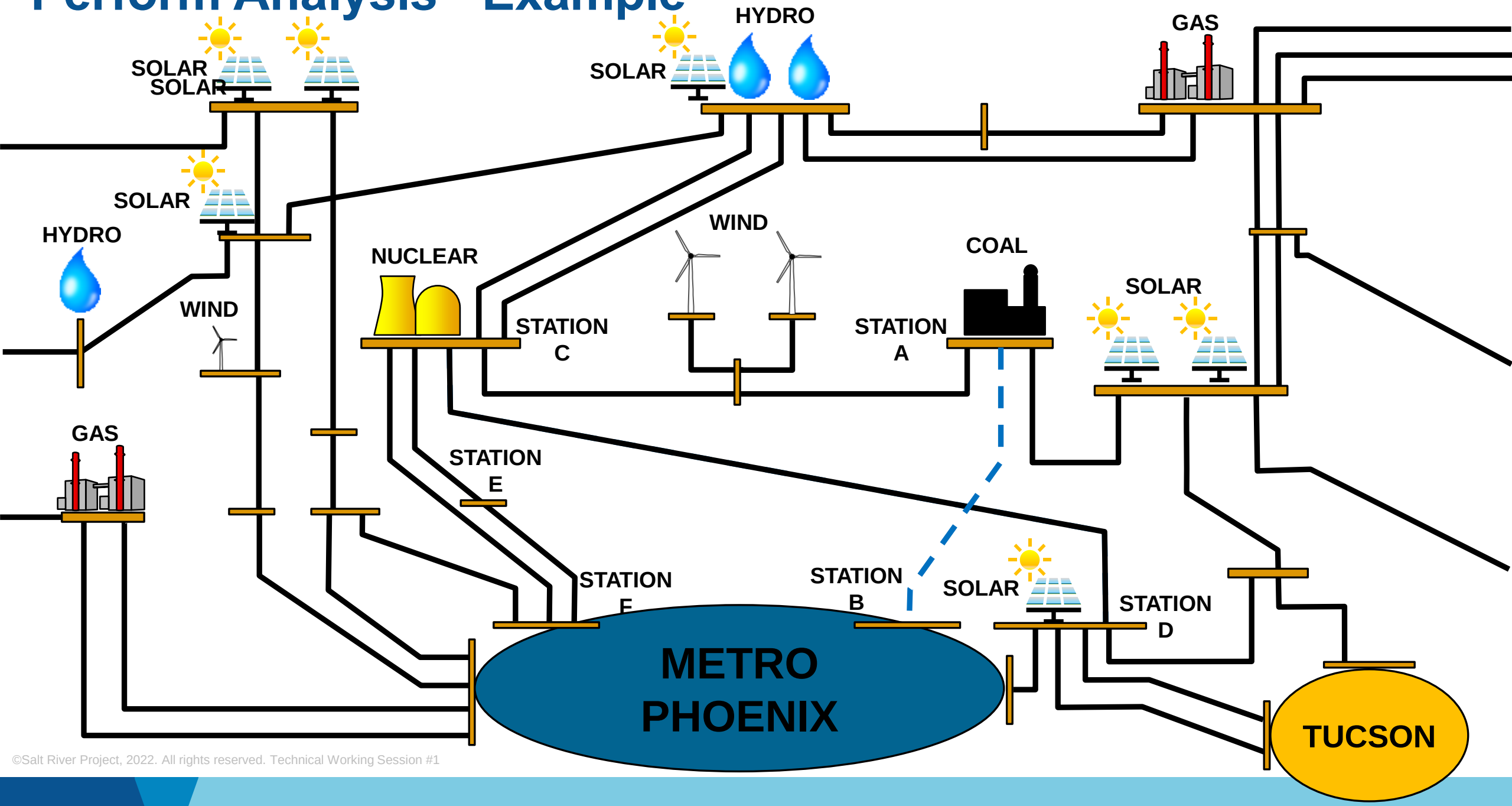

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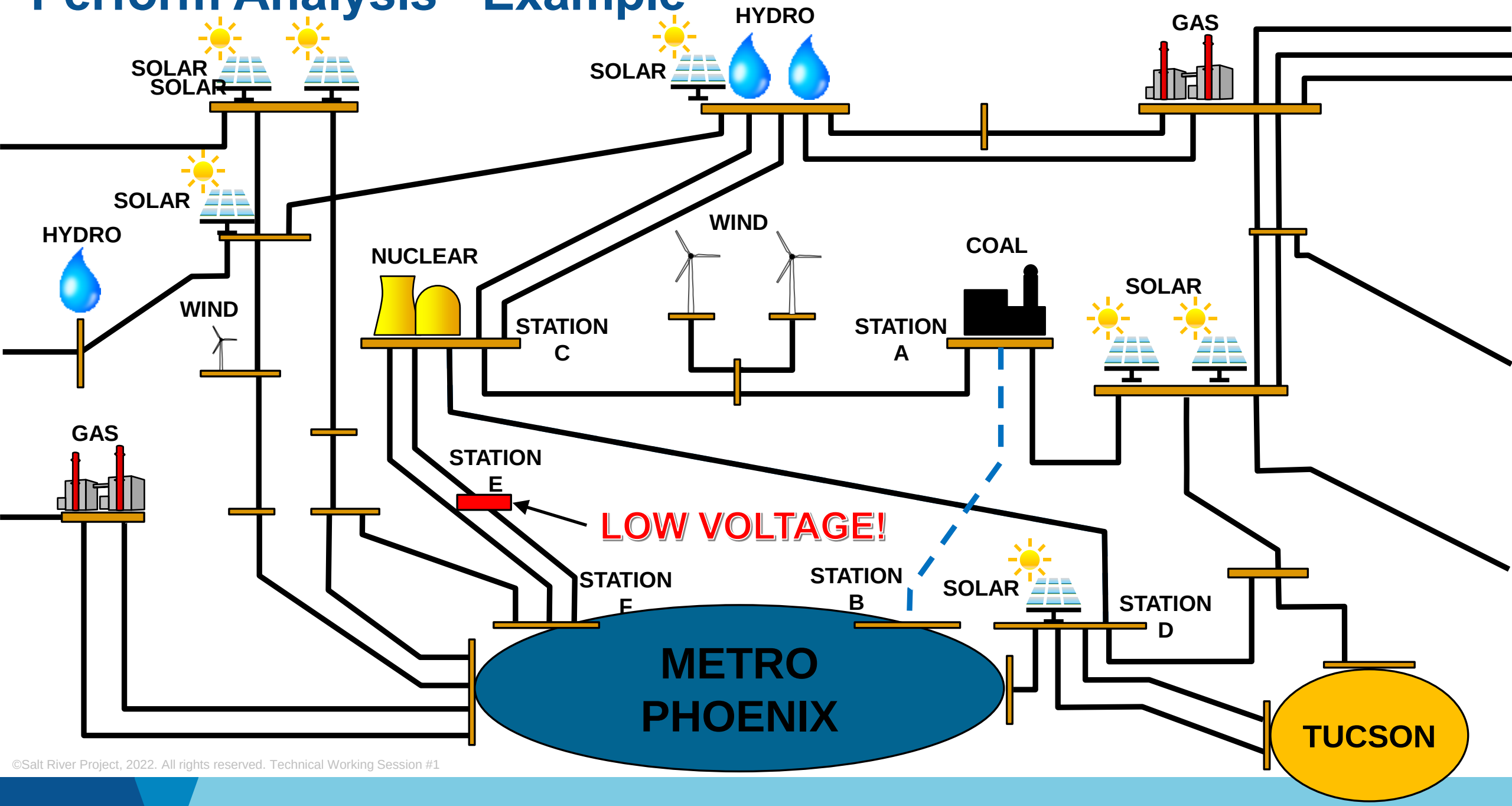

Transmission Investment: Analysis Outputs

Steady State Flow: How the power flows on all transmission system elements either pre or post contingency

How it's used : To determine if overloads exist on a transmission system element either pre or post contingency

Voltage at each Station: The calculated voltage at each station

How it's used : To determine if high or low voltage conditions exist either pre or post contingency

Transmission Solutions: Required upgrades to the power system to fix overloads and voltage issues

How it's used: Costs of these upgrades included in overall system plan cost

Recap and Next Steps

Lakshmi Alagappan
Partner (E3)

Next Steps

Large Stakeholder Group

Tentative Schedule:

- Meeting #3: **ISP Study Results** – Fall / Winter 2022
- Meeting #4: **ISP Path Forward** – Spring 2023

Stakeholder Communication Email:

IntSysPlan@srpnet.com

Integrated System Plan: Informational Portal

https://srpnet.com/about/integrated-system-plan.aspx

thank you!