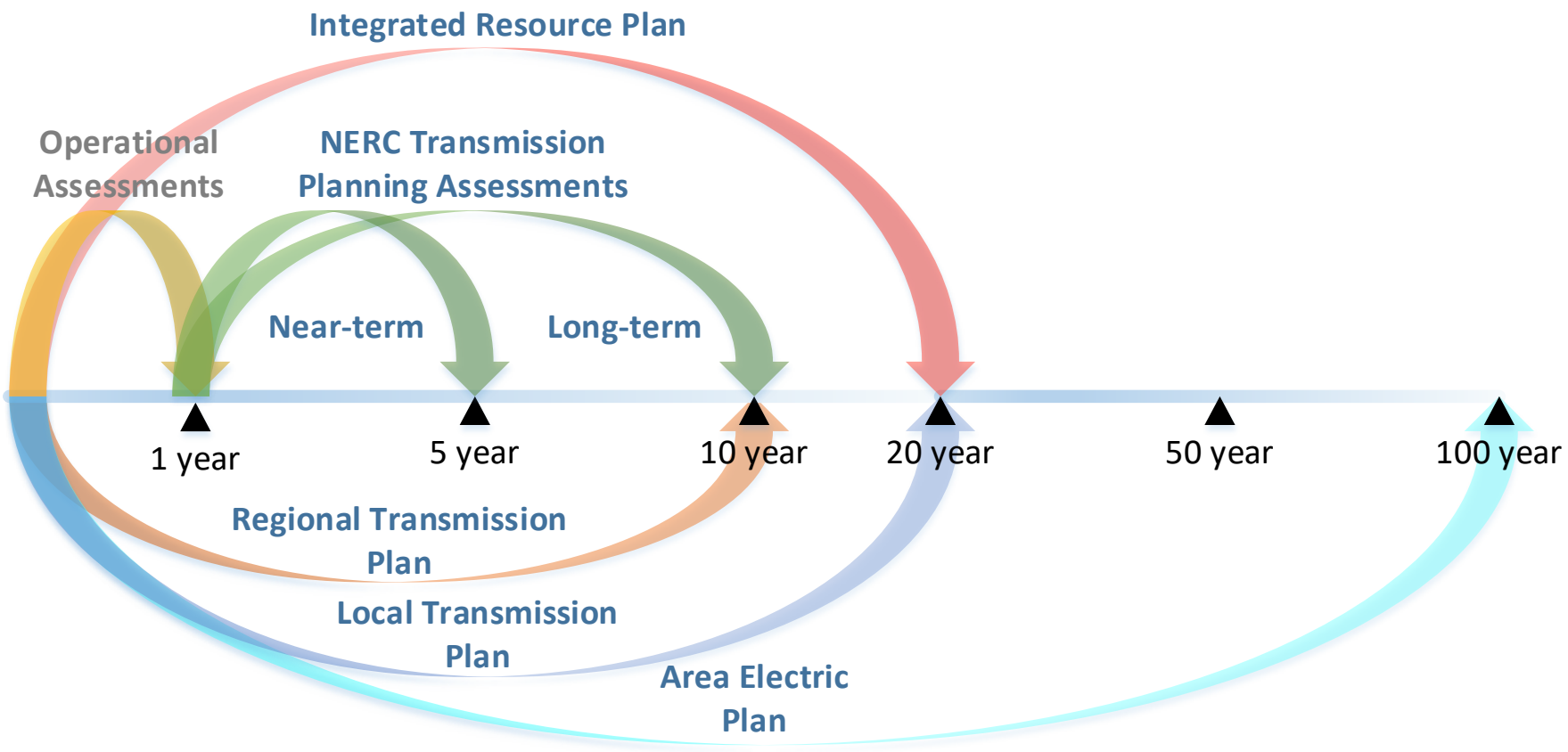
Oregon Public Utility Commission Workshop

Transmission Planning

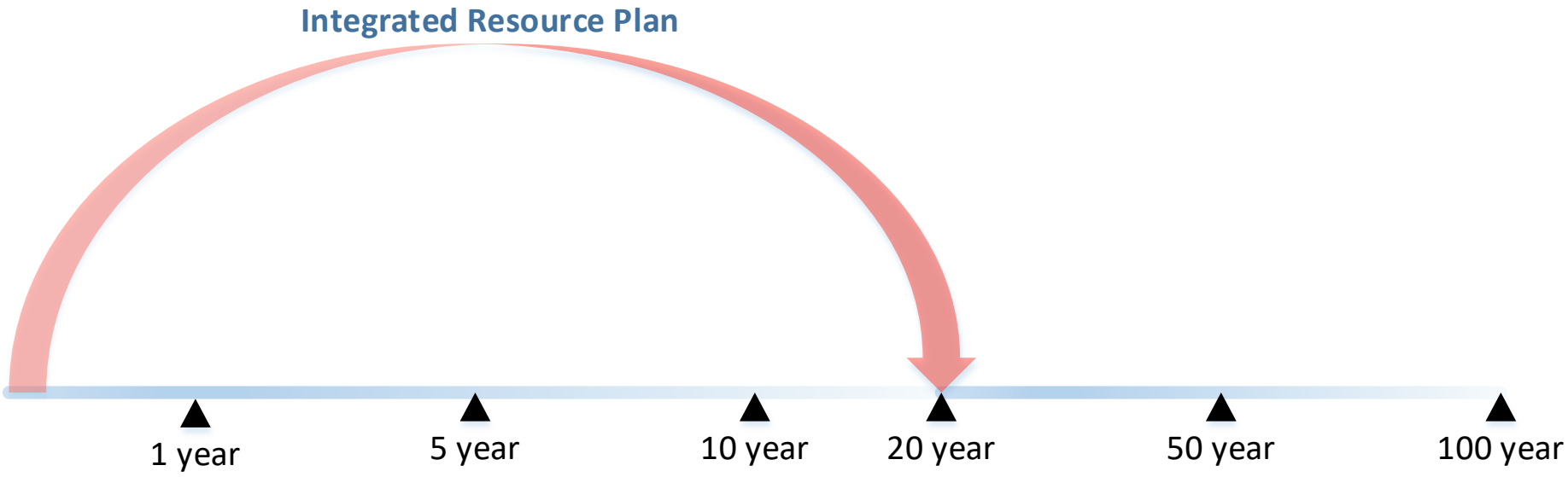
Dave Angell

May 23, 2019

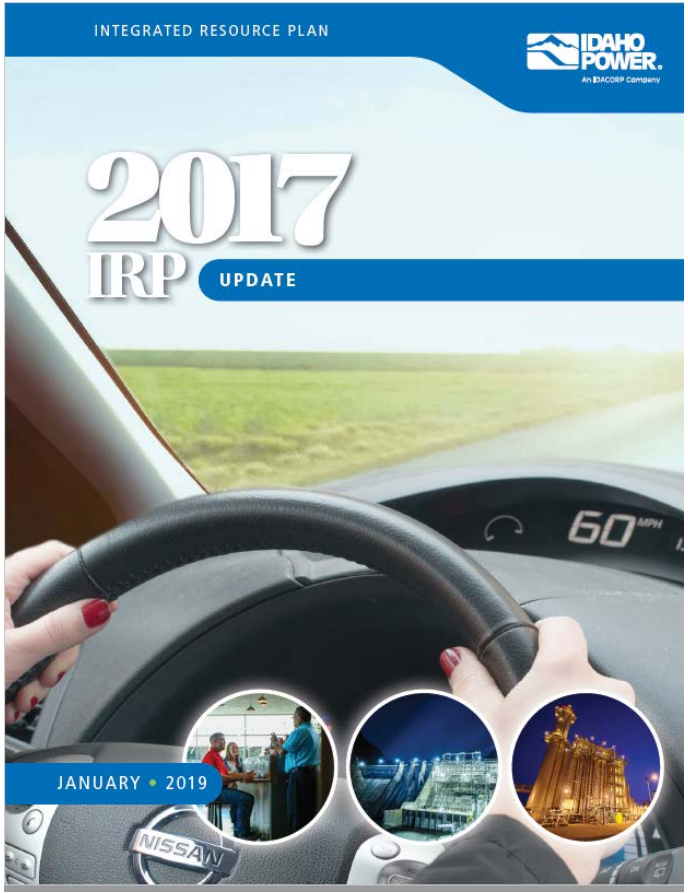
Planning Periods



Integrated Resource Plan Period



Integrated Resource Plan (IRP)



- Identify sufficient resources to reliably serve the area energy demand through a 20-year period
- Balance cost, risk, and environment
- Equal treatment of supply-side resources, demand-side measures, and transmission resources
- Biennial analysis of a resource stack to effectively balance loads & resources

Transmission Modeling in the IRP

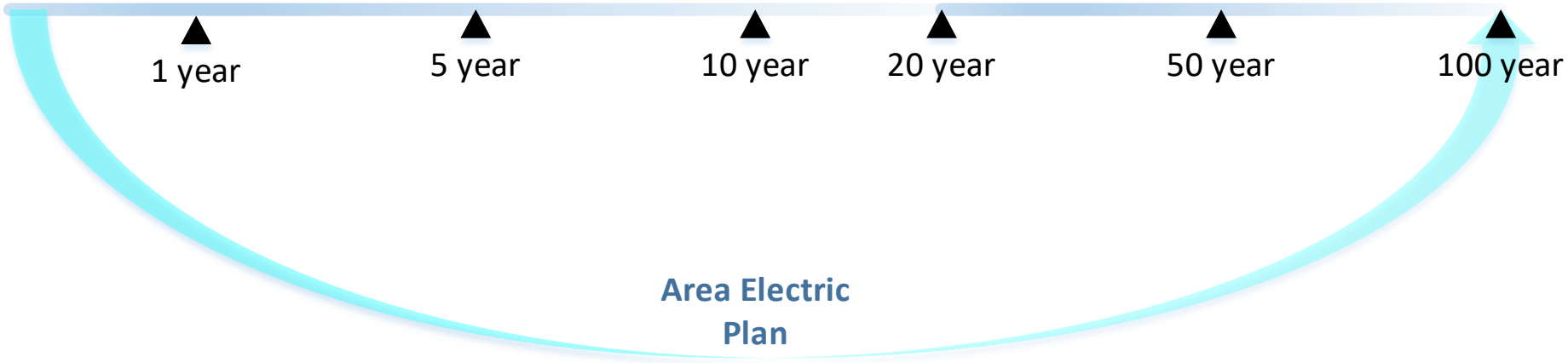
- IRP analysis solves a Power Cost Model for the entire West – selecting the lowest cost resources to serve the load
- Constrained transmission in the model will limit the ability to transfer energy from certain resources to the load
- Transmission additions that reduce these constraints will allow for a more economic dispatch of resources

IRP & Transmission Plan Comparison

Planning	Integrated Resource Plan	Transmission Plan
Objective	Resource Sufficiency	Service Reliability
Period	20 years	1, 5, 10, 20 and 100+ years
Driver	8760 demand	Peak annual demand
Considerations	Capacity and Energy	Capacity
Factors	Cost, risk, and environment impact	Cost and siting impact
Analysis	Production Cost	Power Flow

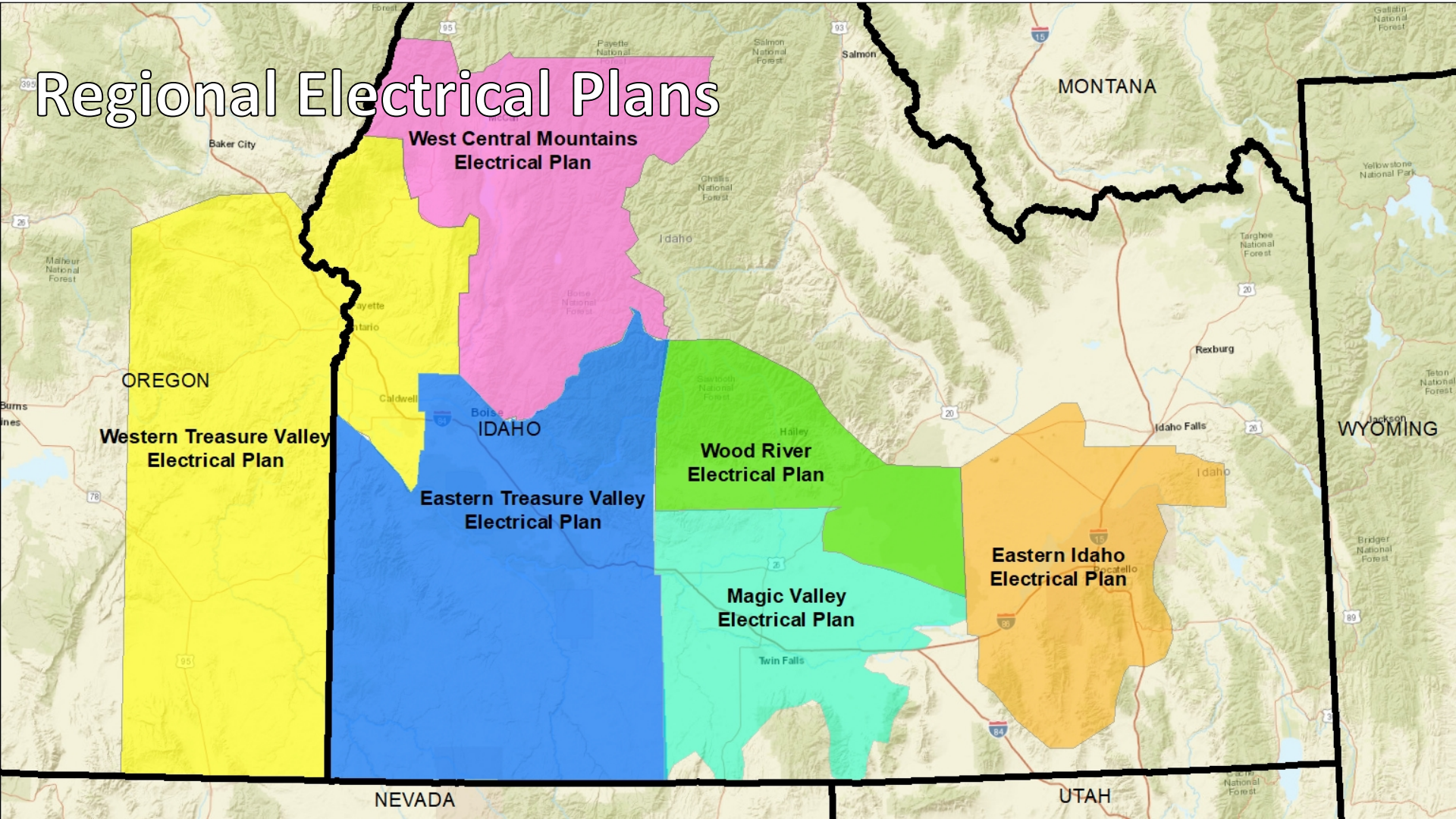
Local Planning
Area Electric Plans
Community Advisory Committees

Planning Periods



Afghan Transmission Line Protest

Regional Electrical Plans

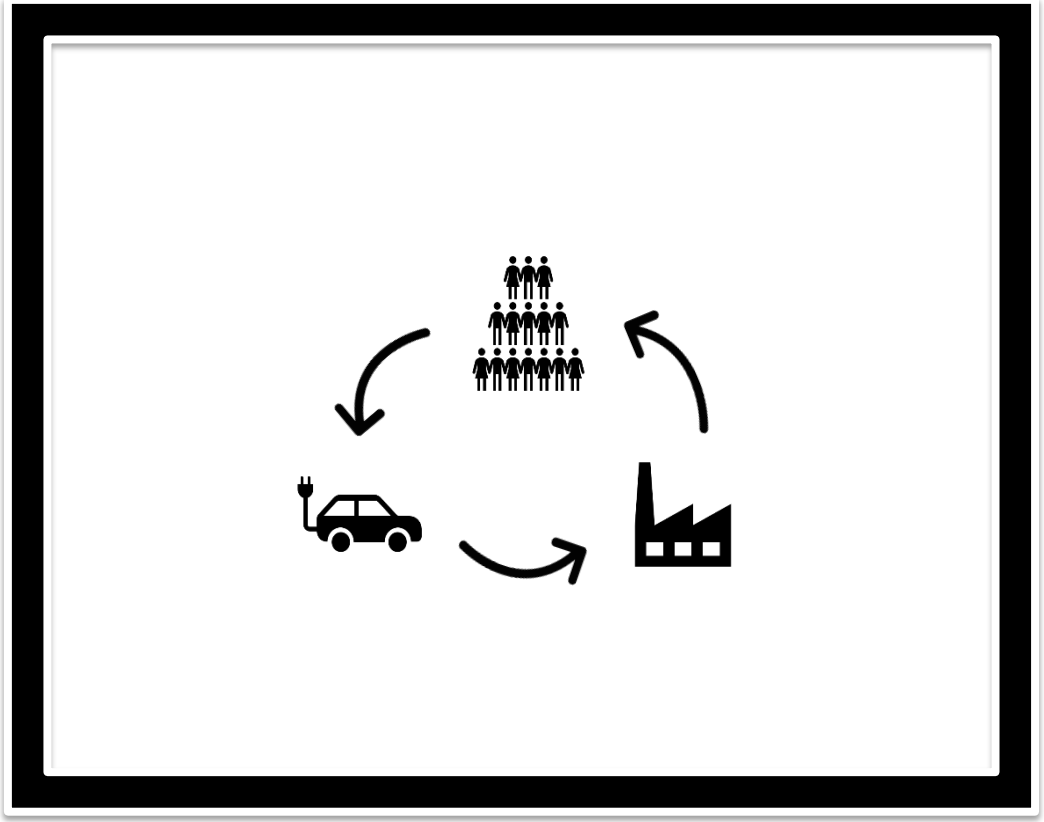


Build Understanding

- Describe need
- Develop siting criteria
  - Along major transportation corridors
  - Avoid schools, downtown, etc.

Buildout

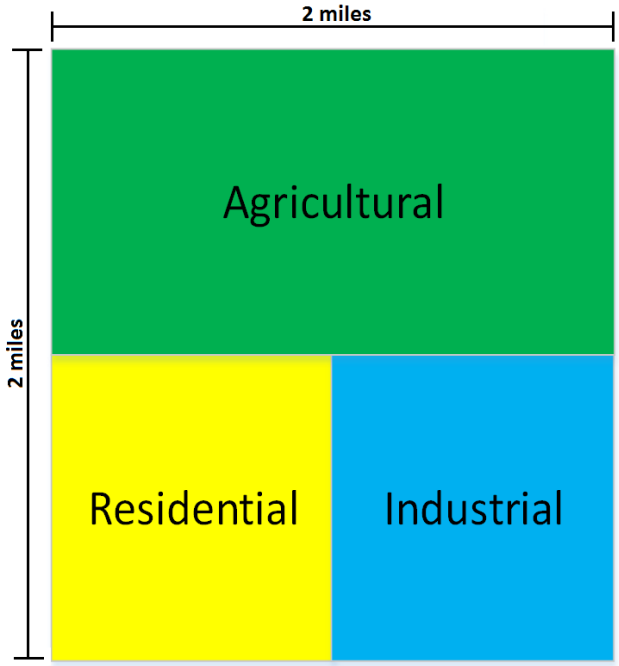
Land



Water

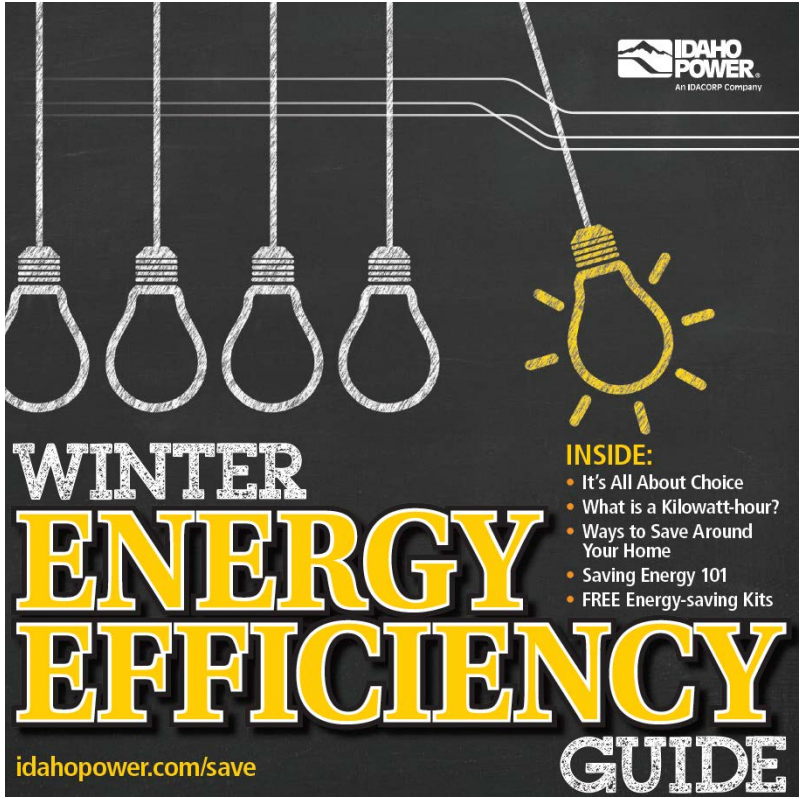
Load Density

Assign load density (MW/mi^2) to land use/zoning designations

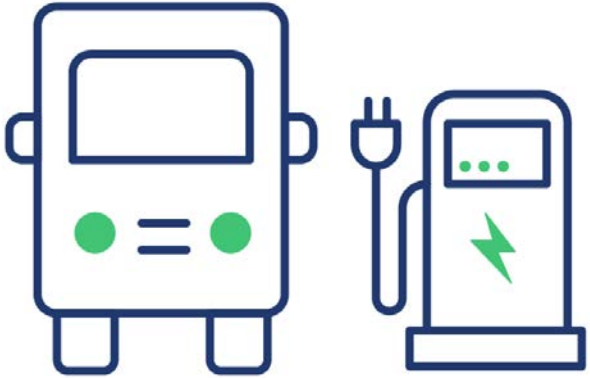


Zoning Description	Load Density (MW/mi^2)	Zone Area (mi^2)	Load (MW)
Agricultural	0.4	2	0.8
Residential	5	1	5
Industrial	45	1	45
Total		4	50.8

Energy Efficiency



Electrification

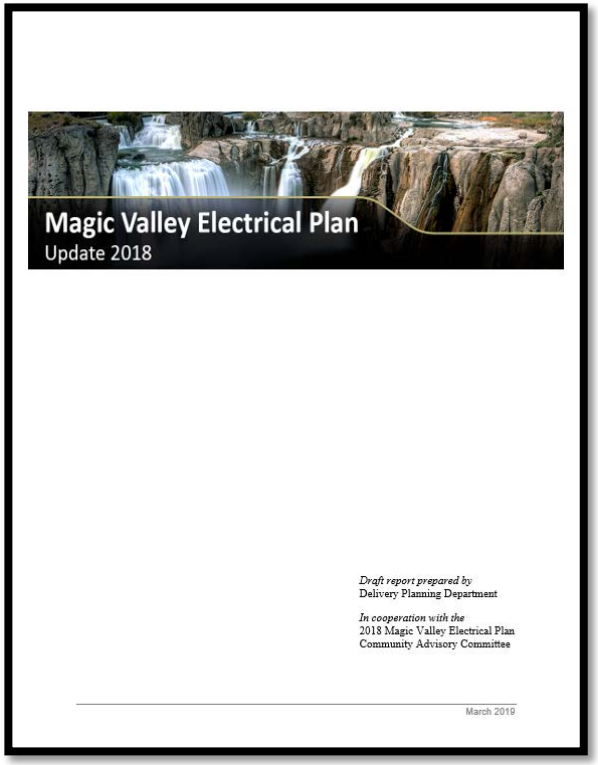


Buildout Demand

County	Current Demand (MW)	Buildout Demand (MW)
Cassia	124	303
Gooding	75	292
Jerome	125	524
Lincoln	37	203
Minidoka	112	231
Twin Falls	237	1019
Total	710	2572

Develop a Plan Together

Working Together



Public Involvement

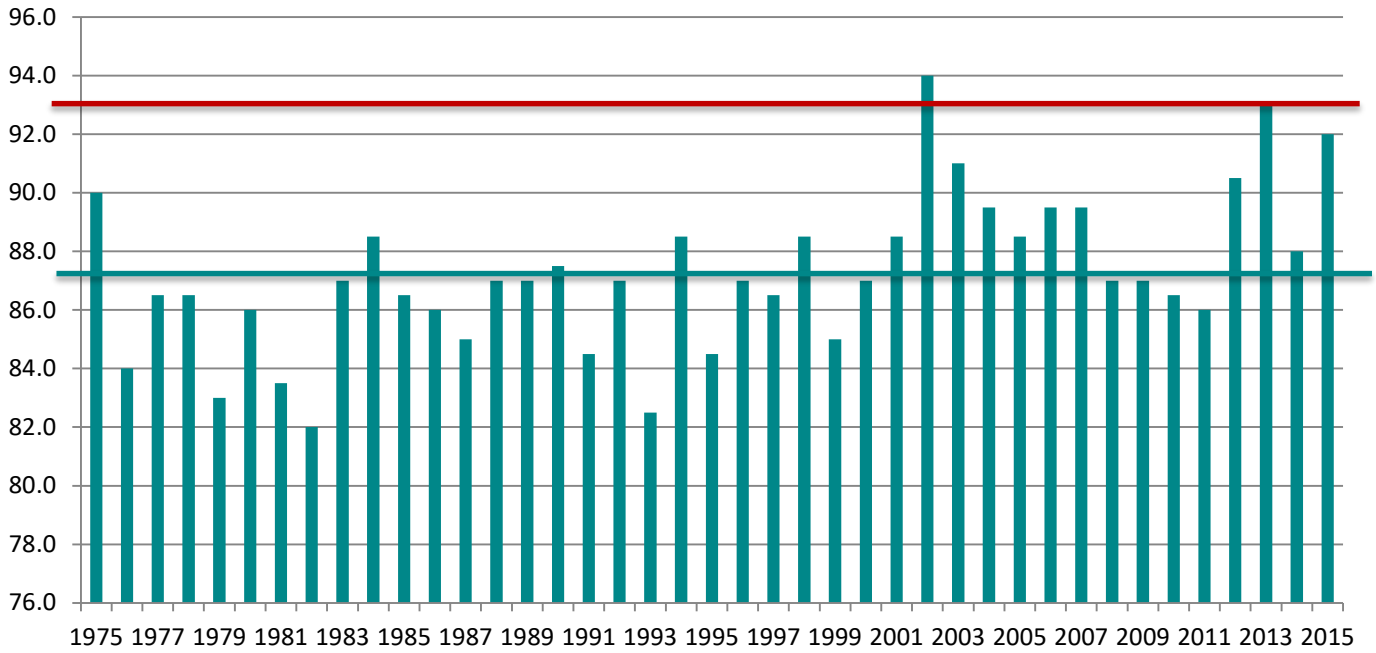
Transmission Planning
Demand Forecasting

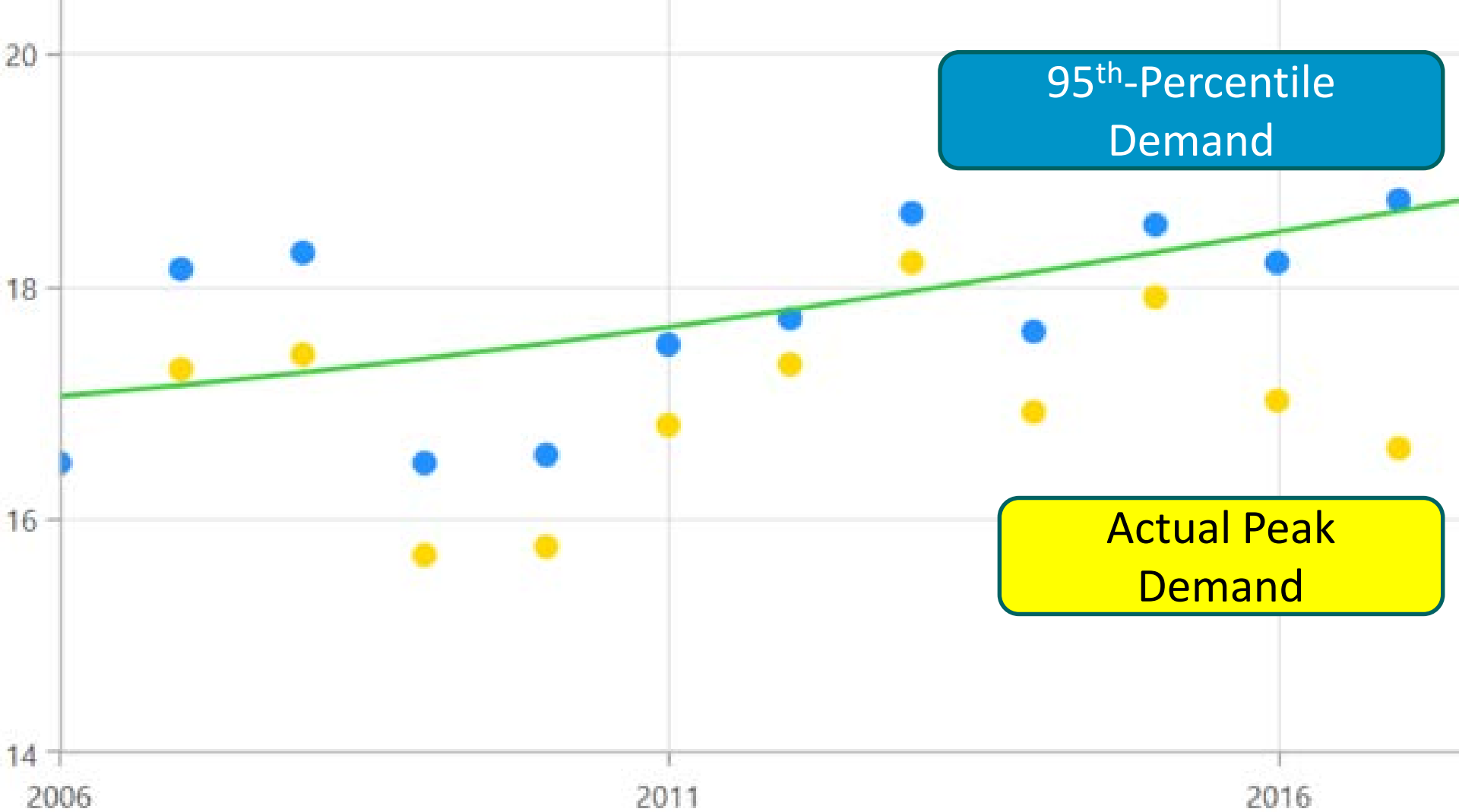
Demand Forecasting

95th–Percentile Average Peak-Day Temperature Adjustment

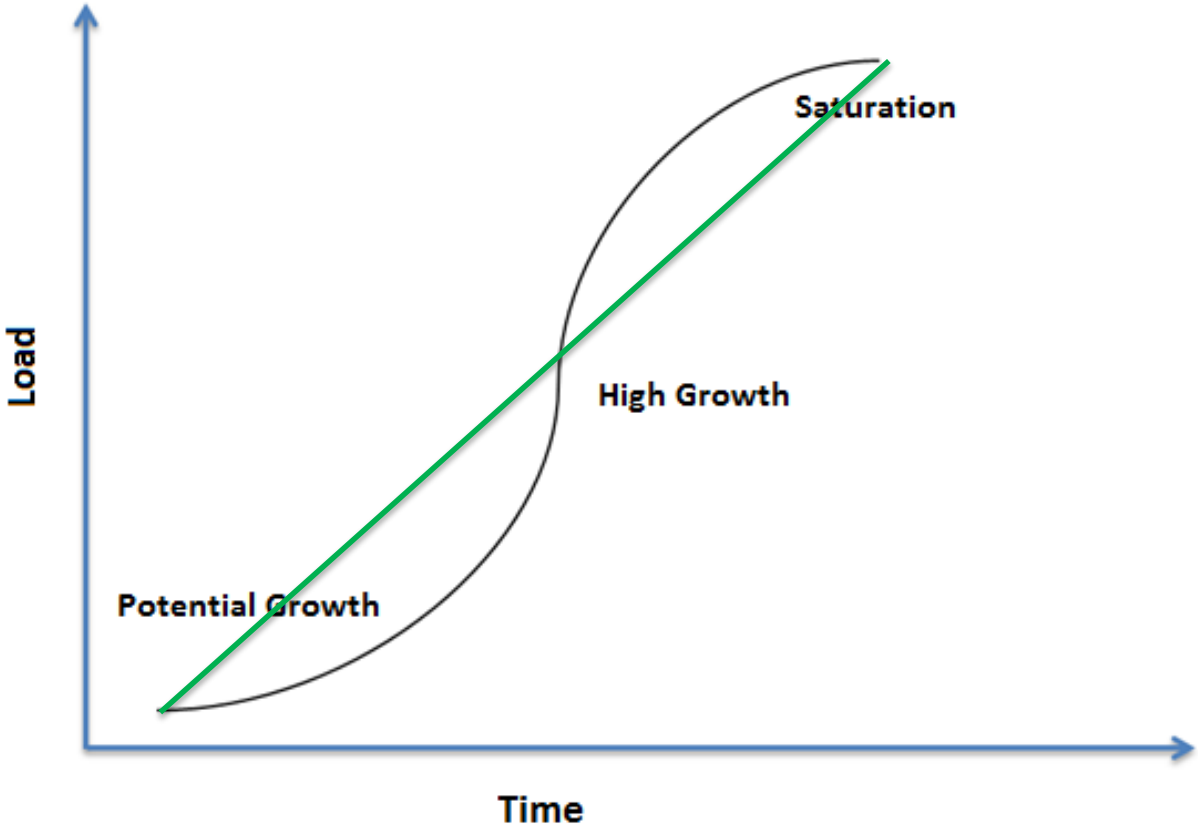
Cubic Regression with Horizon Loads

40 Years – Average Temperature on Peak Day

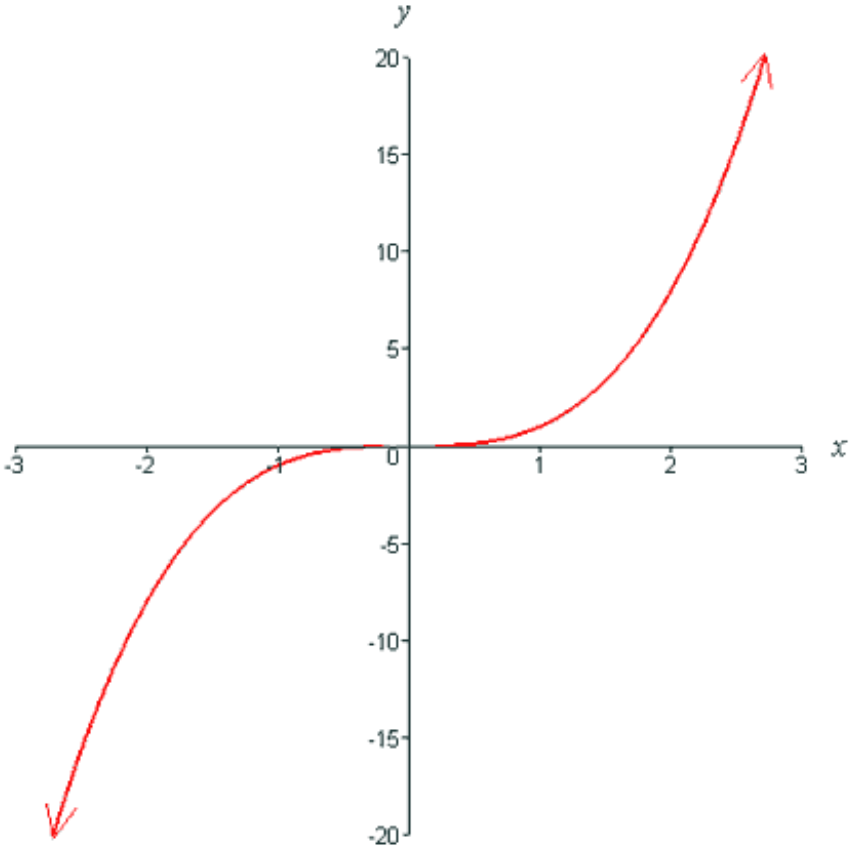


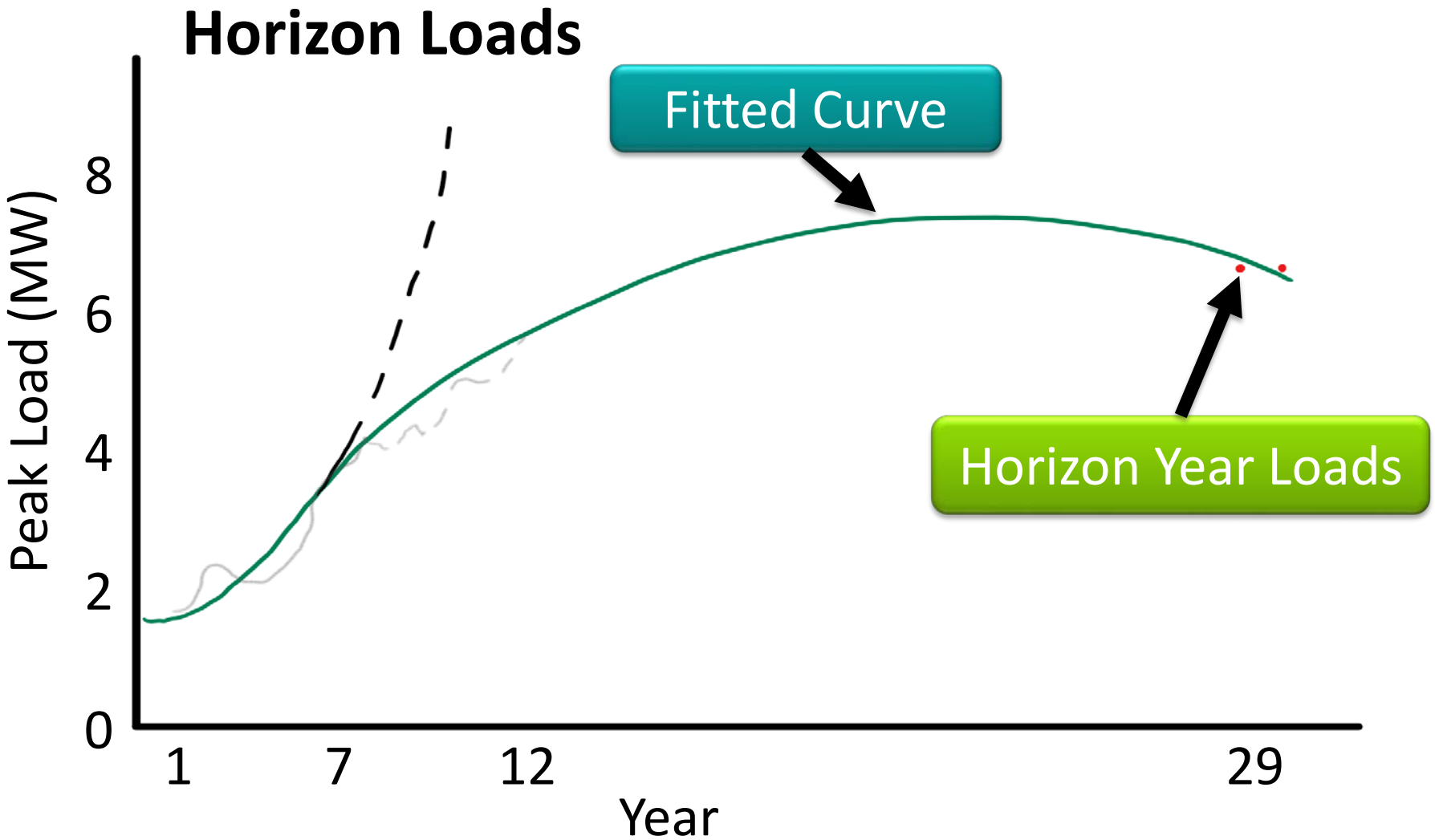

95th-Percentile Demand
Actual Peak Demand
20
18
16
14
2006
2011
2016

S-Curve



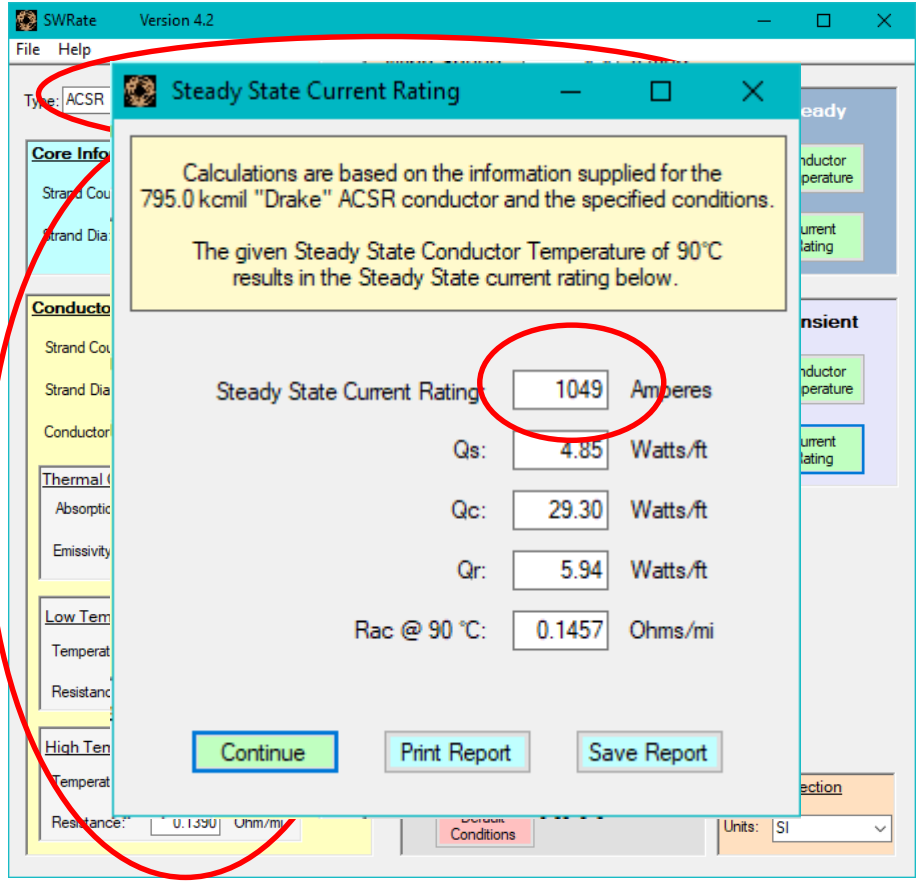
Cubic Function




Horizon Loads
Fitted Curve
Horizon Year Loads
Peak Load (MW)
0
2
4
6
8
1
7
12
29
Year

Transmission Planning Analysis

Line Limits: Conductor Thermal Limits



Southwire company software

Select Conductor

Conductor characteristics

IPC's Std. environmental assumptions

Conductor current rating

Path Limits: Aggregate of lines

- Limit rating obtained through the WECC Path rating process
  - Open process with analysis reviewed by other WECC entities
- Approved rating when
  - exiting parallel paths are operating at their approved rating and
  - there are no overloaded elements following all credible contingencies*

- Credible contingencies are likely outages of facilities or combination of facilities base on proximity

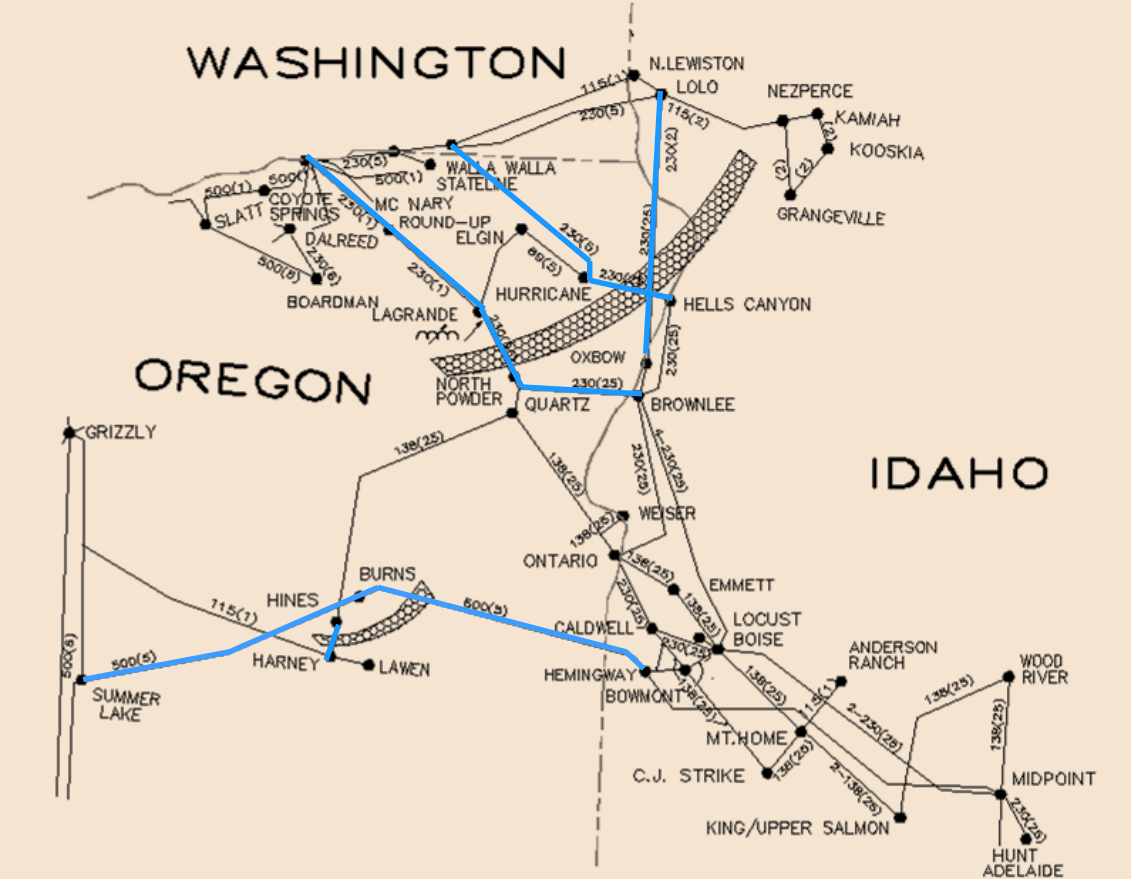
Example: Idaho to Northwest Path

Line Thermal Limits

Oxbow-LOLO:	415 MW
Hells Canyon –Walla Walla:	398 MW
Brownlee-LaGrande:	370 MW
Hines-Harney:	50 MW
Hemingway-Summer Lake:	1500 MW

Sum of individual lines: 2733 MW

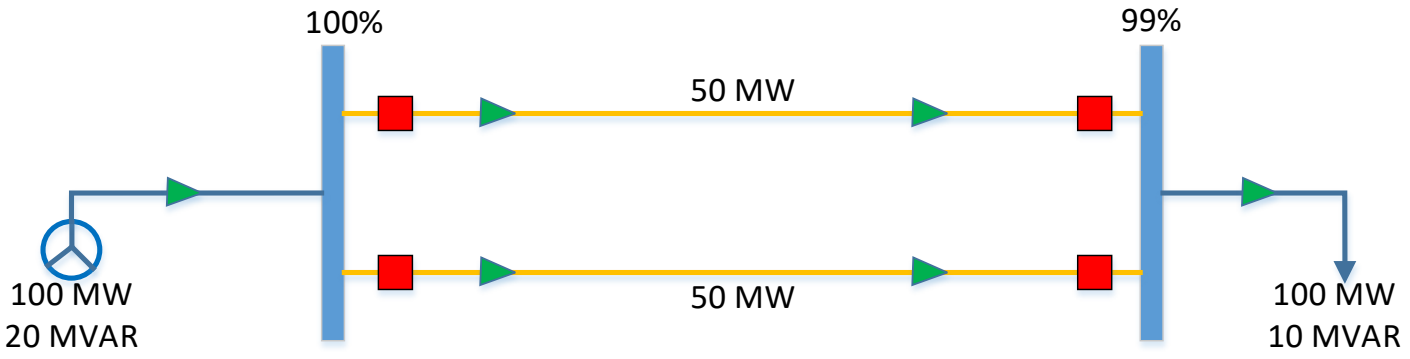
Accepted WECC Path Limit: **1200** MW

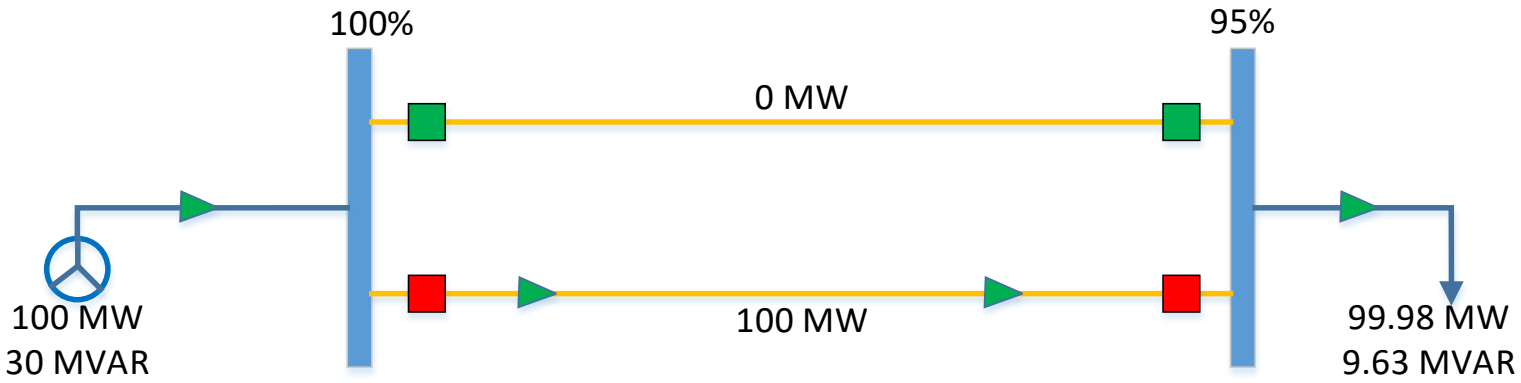


Steady State Voltage Limits

Condition	Percent of Nominal Voltage
System Normal	95 to 105
Post Contingency	90 to 110
Post-Contingency deviation from normal	Less than 8

Post Contingency Voltage Change

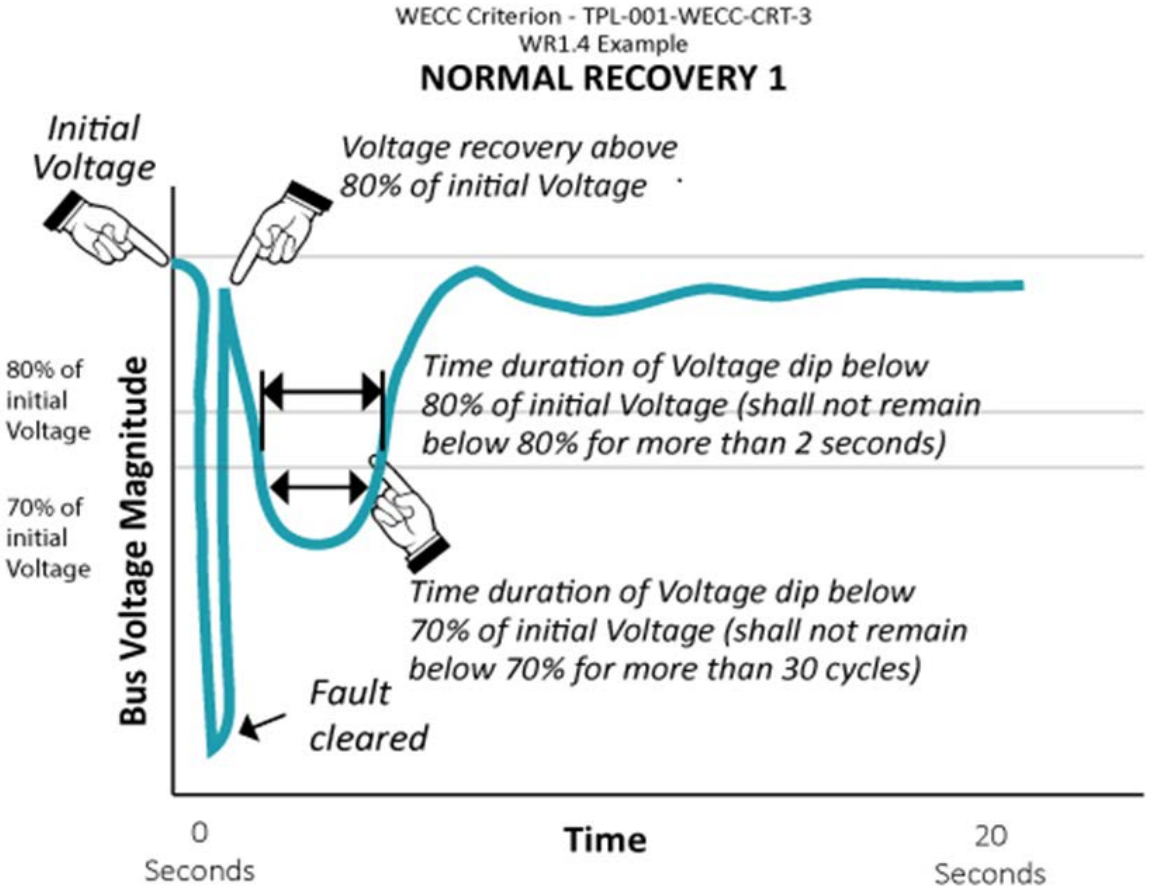




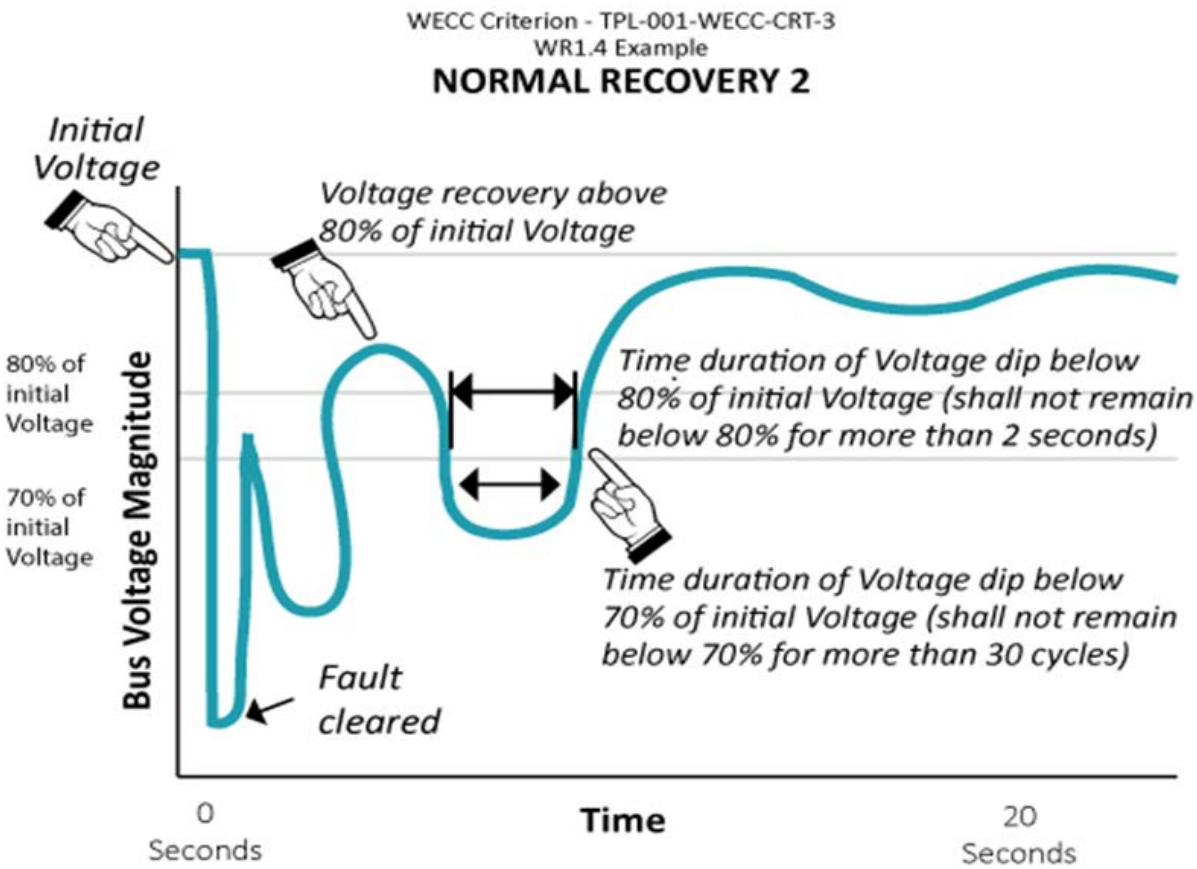
Voltage Stability

- The ability of power system to maintain steady voltages at all buses in the system after being subjected to a disturbance
- Demonstrated when no voltage collapse occurs under the following:
  - single contingency:
    - flow is increased to 105% of path rating or
    - load is increased to 105% of forecast peak
  - multiple contingencies:
    - flow is increased to 102.5% of path rating or
    - load is increased to 102.5% of forecast peak

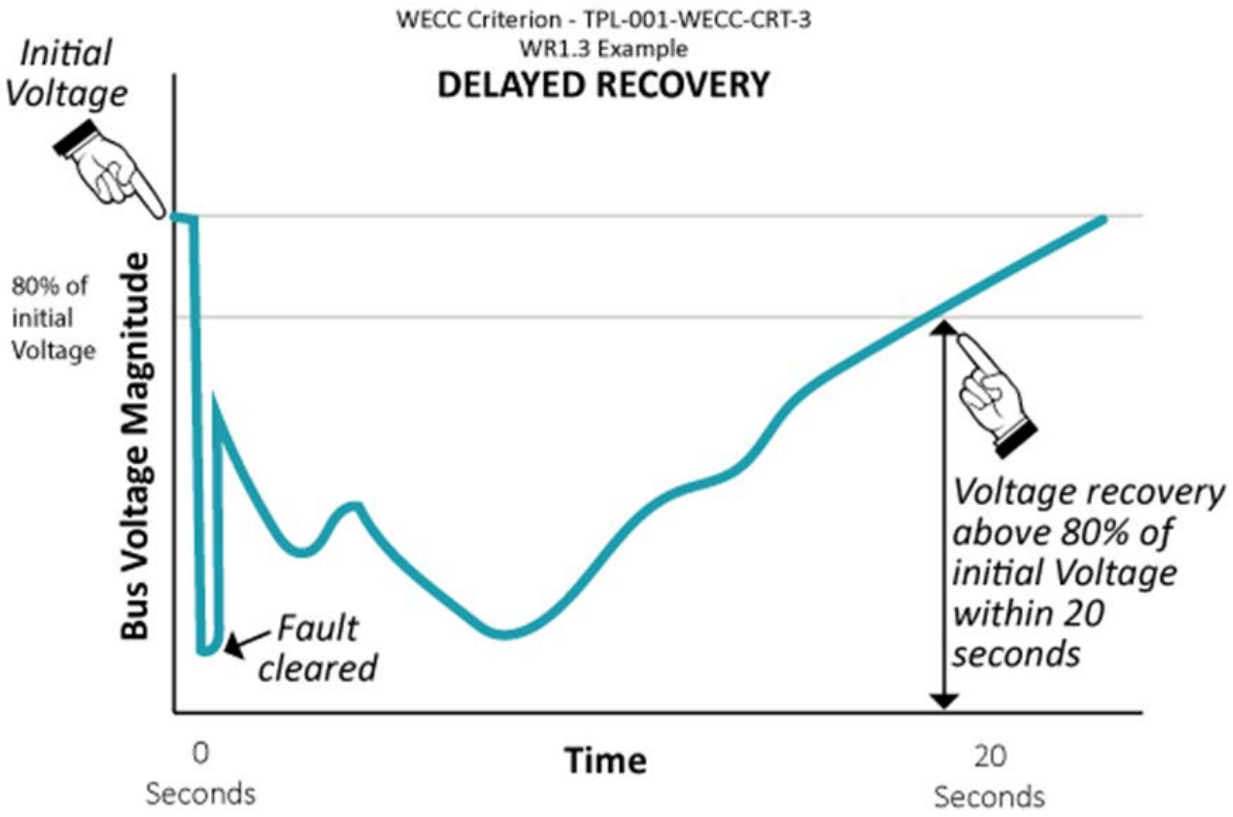
Transient Voltage Performance



Transient Voltage Performance



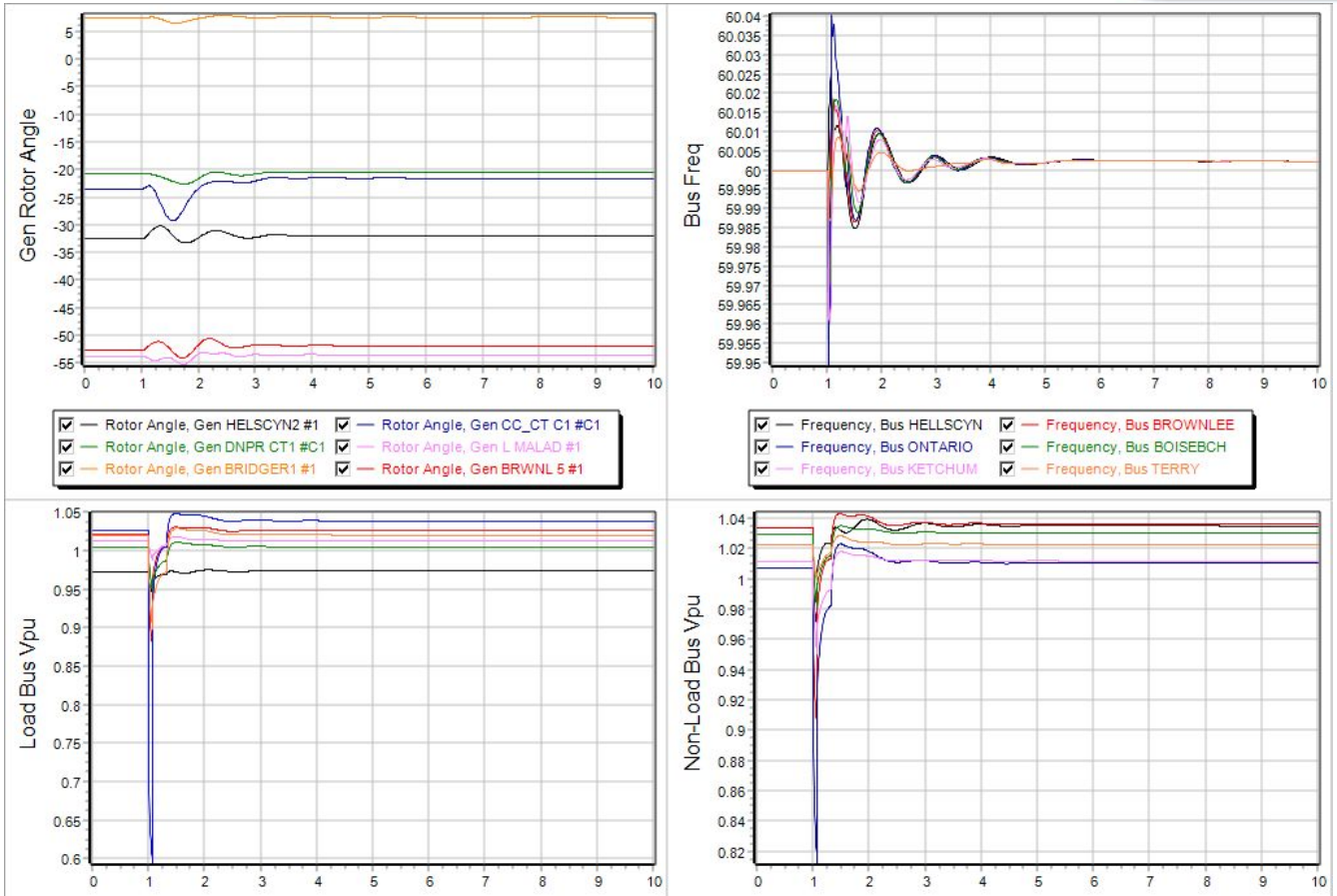
Transient Voltage Performance



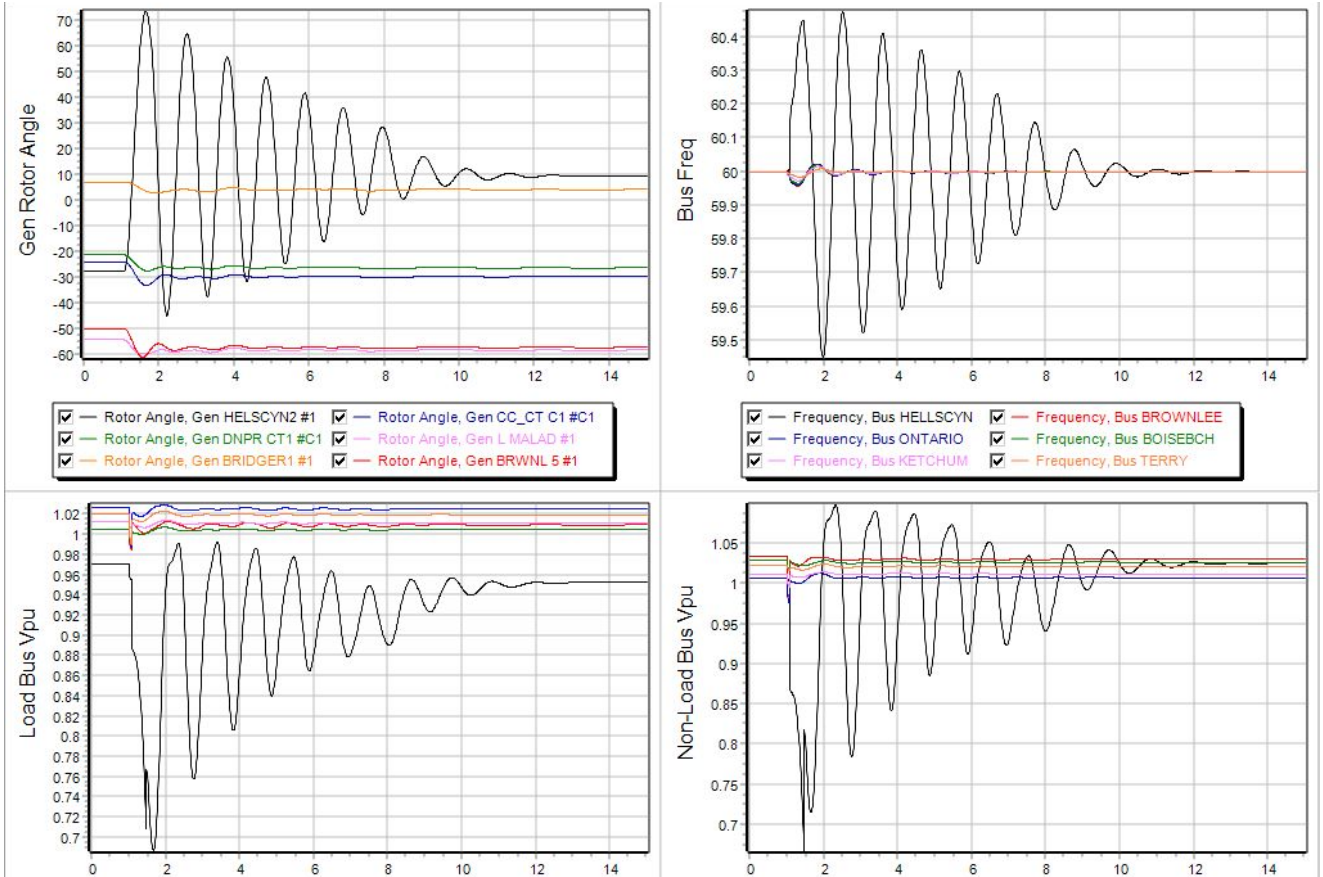
Transient Stability Analysis

- The ability of the system to maintain synchronism following the occurrence of a short circuit
- Dynamic controls of all generators and inverters modeled in WECC power flow cases to enable stability analysis
- Post fault stability performance driven by:
  - Severity and duration short circuit
  - Local area topology – how tightly connected and robust
  - Response of the generators, inverters and load

Transient Stability: Damped Response

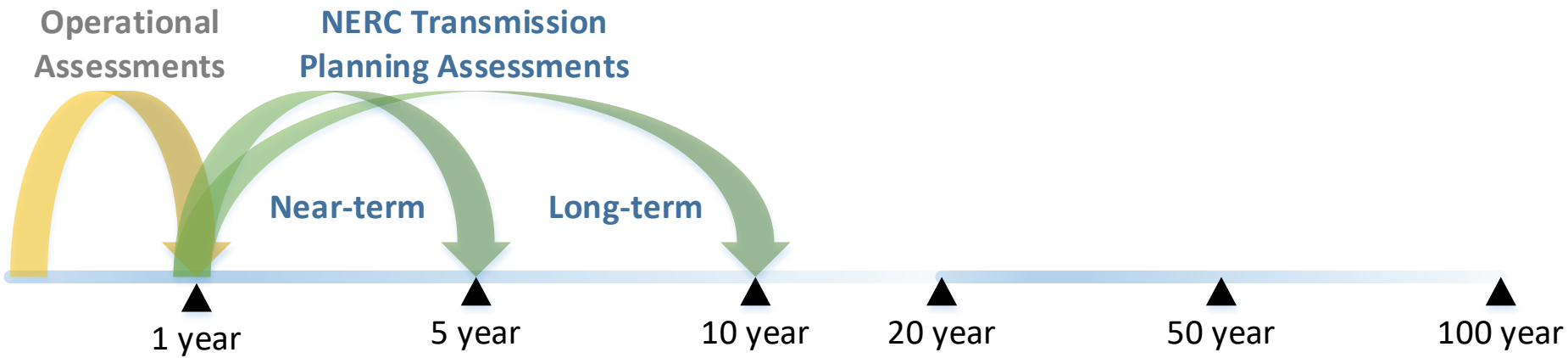


Transient Stability: Less Damped Response



NERC Transmission Planning Reliability Standard TPL-001-4

TPL-001-4 Planning Period



TPL-001-4 Purpose

- Establish Transmission system planning performance requirements within the planning horizon to develop a Bulk Electric System (BES) that will operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies.

TPL-001-4 Requirements

- Annual assessments of transmission system
- 10 year time horizon with different seasons
  - 1 -2 year Heavy Load & Light Load cases
  - 5 year Heavy Load case
  - 6 - 10 Year Heavy Load case
- Study sensitivity to modeled conditions
- Study impact of spare equipment availability
- Perform contingency analysis
  - Steady State
  - Stability
- Develop corrective action plans for violations

- Audited every three years!

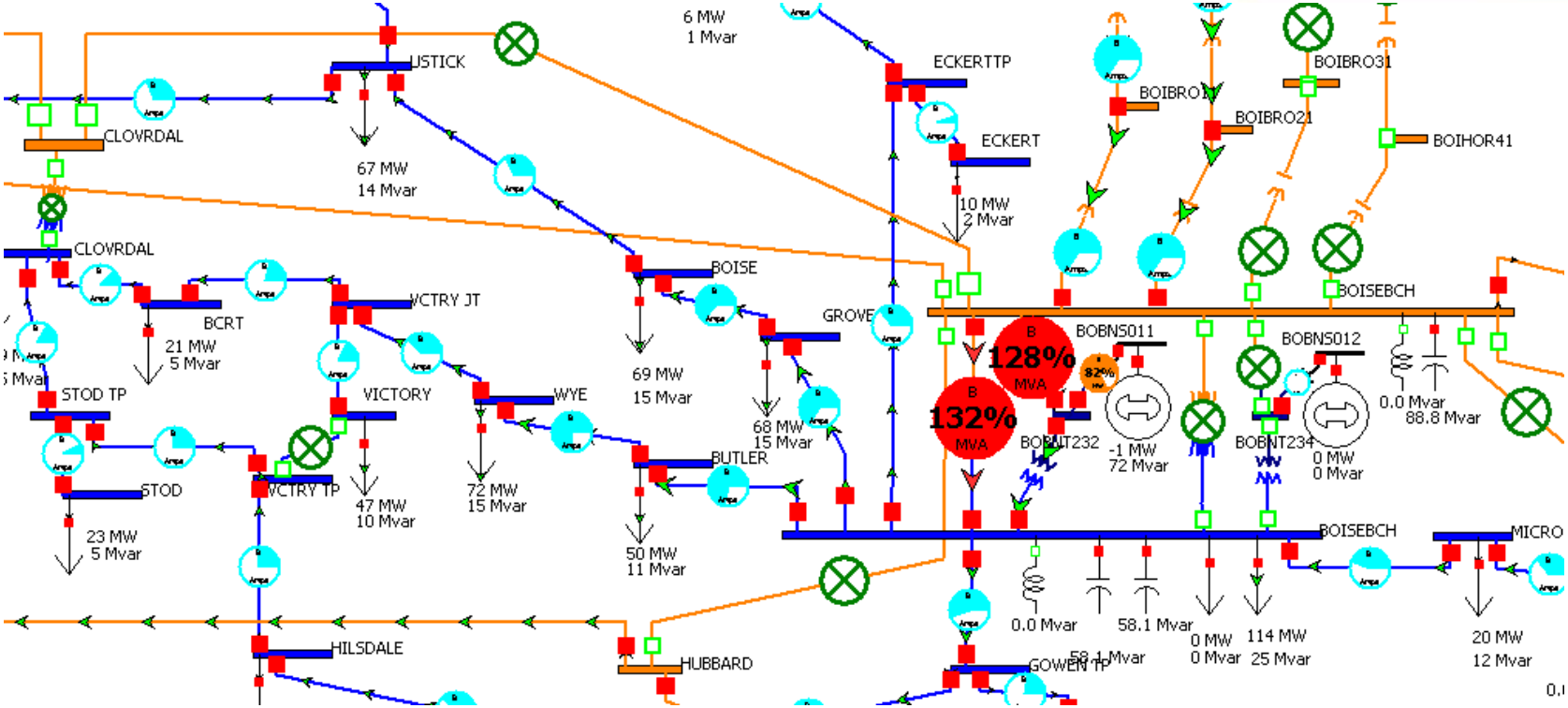
IPC's TPL-001-4 Assessments

- WECC power flow cases
- Planned projects are included if in-service date is on or before the and year of study
- Known planned outages are modeled
- 40,000 contingencies run

Contingency Analysis Results

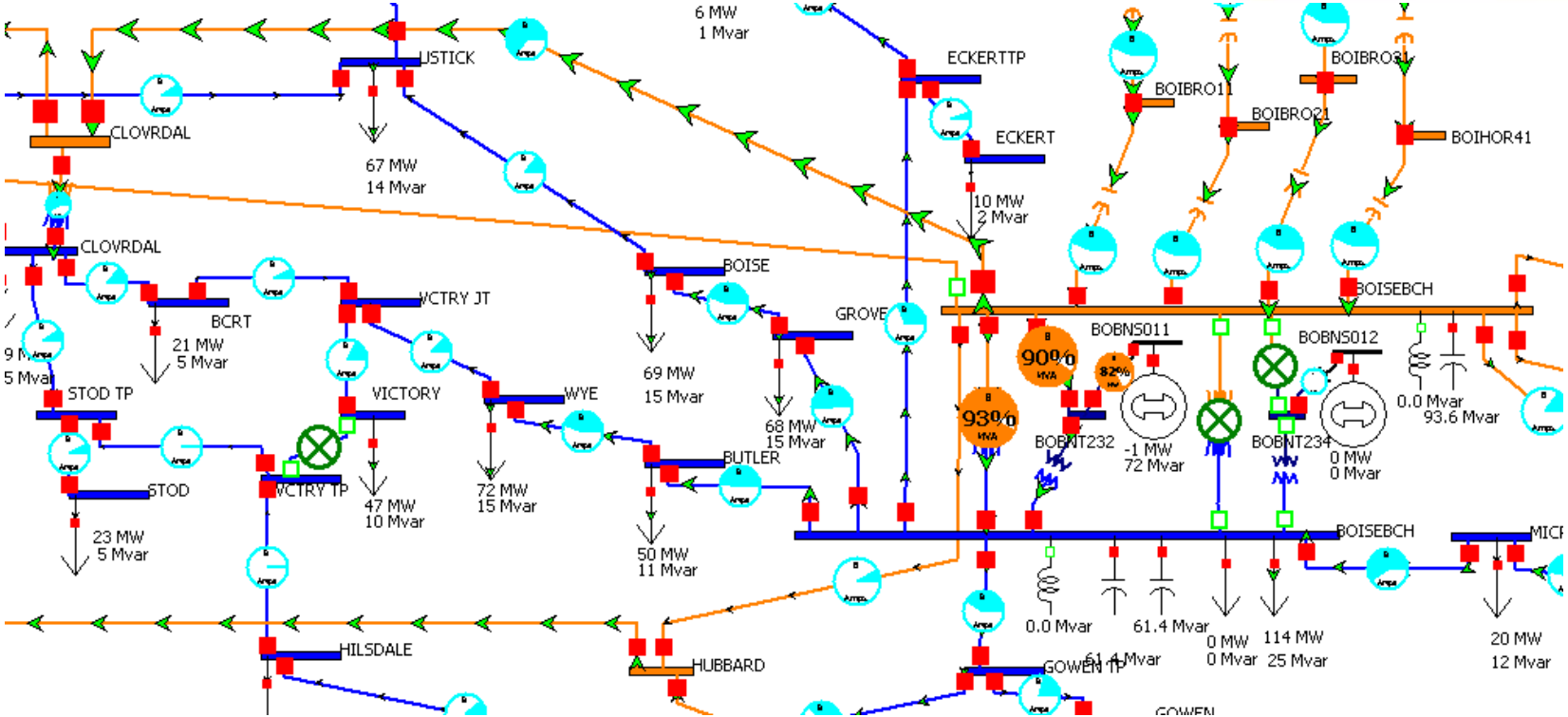
Case	Contingency name	Limited element	Violation	Proposed Project	Proposed In-Service Date
22hs1_TPL, 22hs1_TPL_stressed_Path_14_55 & 22hs1_TPL_ADEL_XFMR	P2-2_B_KING	MIDPOINT T231	Thermal	Replace T231 at Midpoint with a 300 MVA transformer	2020
22hs1_TPL, 22hs1_TPL_stressed_Path_14_55 & 22hs1_TPL_ADEL_XFMR	P2-3_BF_BOBN 105Z	GROVE-BOISE 138	Thermal	Cloverdale 230 kV tap	2020
22hs1_TPL, 22hs1_TPL_stressed_Path_14_55 & 22hs1_TPL_ADEL_XFMR	P2-3_BF_BOBN 114Z	BOISEBCH T231 BOISEBCH T232	Thermal	Install PCBs at BOBN 233J & 234H positions Cloverdale 230 kV tap	2019 2020

Corrective Action Plan Example



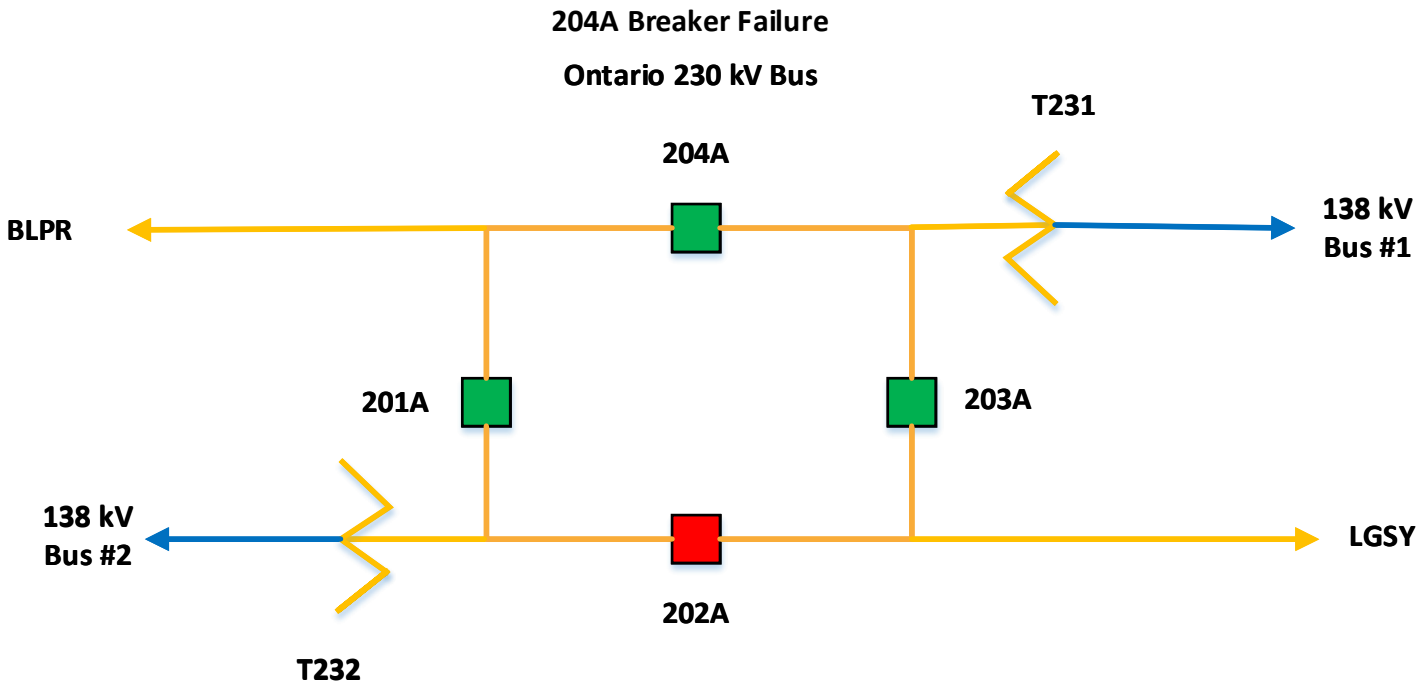
Boise Bench Bus Tie Breaker Internal Fault

Proposed Solution



Install two breakers at Boise Bench and connect the Boise Bench-Locust 230 kV line into Cloverdale

Breaker Failure Contingency



WECC Delegated Responsibilities

Compliance	Reliability Planning and Performance Analysis
Ensure compliance with NERC reliability standards Conduct audits every one to three years	Reliability Assessments 0-20 years in the future Event Analysis Situational Awareness Performance Analysis

WECC Role in TPL-001-4

Model Building

- WECC is the Western Interconnection's power flow and production cost model builder

Reliability Analysis

- WECC uses both models to evaluate reliability risks to the grid

Planning Coordination

- Interconnection-wide planning processes are coordinated (e.g., the path-rating process)

WECC Near-Term Priorities

Representation of Inverter-Based Resources

- Improve modeling representation
- Data collection for utility-scale, battery storage and DER

Impacts of the Changing Resource Mix

- Impacts on path ratings
- Modeling transmission-distribution interface
- Impacts on essential reliability services

Expansion of RC and Market Service Providers

- Potential reliability risks and mitigations
- Consider regional standards

Clarify Roles in BPS Planning

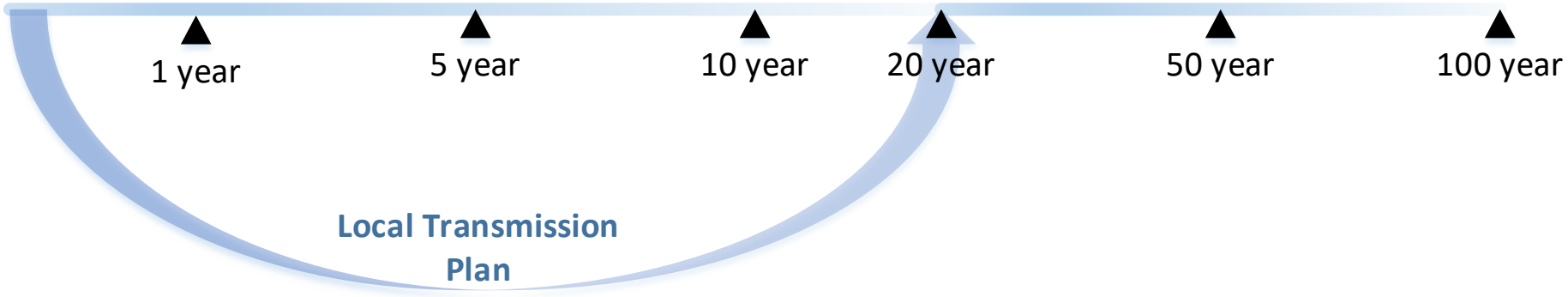
- Improve coordination by clarifying roles and responsibilities

Local Transmission Planning
FERC Order 890

FERC Orders 890

- Principles
  - Open, Transparent, etc.
- Process described in our Open Access Transmission Tariff - Attachment K

Local Transmission Planning Period



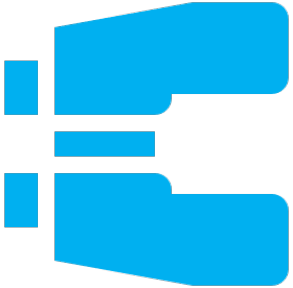
Local Transmission Plan Purpose

- Identifies, through the planning horizon, the transmission facility additions and demand resources required to reliably satisfy:
  - Network Customers' resource and load growth expectations
  - Transmission Provider's (TP's) resource and Native Load growth expectations
  - TP's transmission obligations driven by Public Policy Requirements
  - TP's Transmission Customers' projected Point-to-Point service needs

Local Transmission Plan Timing

- Two – year study cycle

- Twenty – year planning horizon



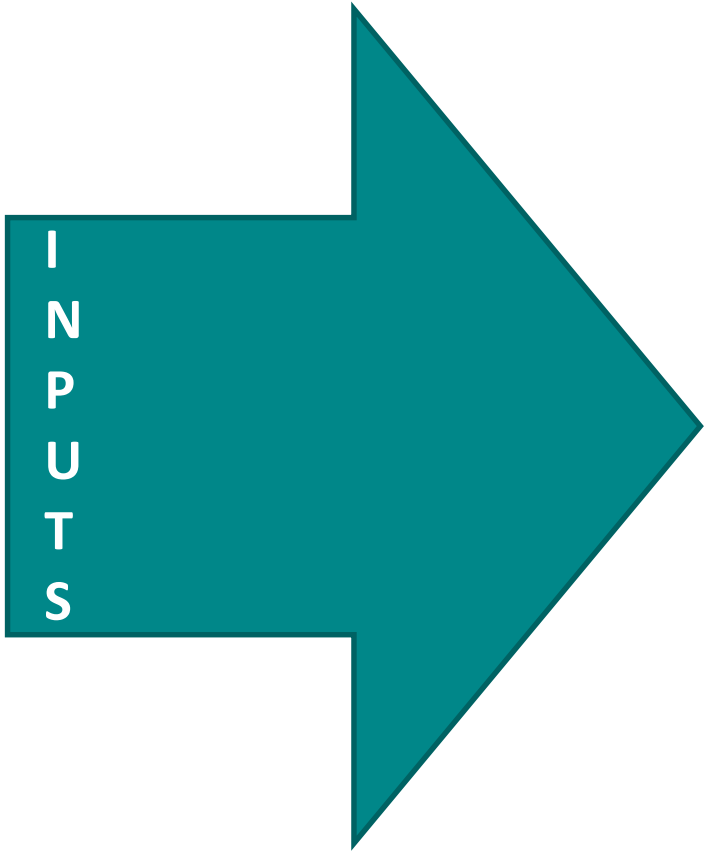
Local Transmission Planning Cycle

Biennial Planning Cycle and Schedule

	Biennial Transmission Planning Cycle			Economic Study Cycle
	Months	Quarter	Activity	Activity
Even Years	JAN-MAR	Qtr 1	Information Gathering	Receive and Prioritize Requests
	APR-JUN	Qtr 2	Study Plan and Assumptions	Study
	JUL-SEP	Qtr 3	Draft Plan Analysis	Report/Review Results
	OCT-DEC	Qtr 4		
Odd Years	JAN-MAR	Qtr 5	Draft Study Results and Review	Receive and Prioritize Requests
	APR-JUN	Qtr 6	Economic Studies and Cost Allocation Process	Study
	JUL-SEP	Qtr 7	Final Plan Report and Review	Report/Review Results
	OCT-DEC	Qtr 8	Final Plan	

Local Transmission Planning Inputs

- Load Forecasts
  - Native and Network Customers
- Resource Forecasts
  - IRP Preferred Portfolio
  - Network Resource Submittals
- Transmission Service Use Forecast
- Public Policy Requirements (RPS, Clean Power, etc)



Stakeholder Involvement

- Stakeholders may submit data to be evaluated as part of the Local Transmission Plan.
  - Alternative solutions
  - Public Policy

- Quarterly public meeting to review status and development of the Plan

Local Transmission Plan Output

- Study output identifies areas with projected performance violations

Case	Number of Contingencies w/violations*	Thermal Issues	Voltage Issues
2023 Heavy Summer	4	4	1
2028 Heavy Summer	5*	4	1
2028 NTTG Heavy Winter	0	0	0
2038 Heavy Summer	46	40	14

* Some contingencies result in both a thermal issue and voltage issues.

- Determine system improvements needed for reliable operation

<u>Improvement Plan</u>

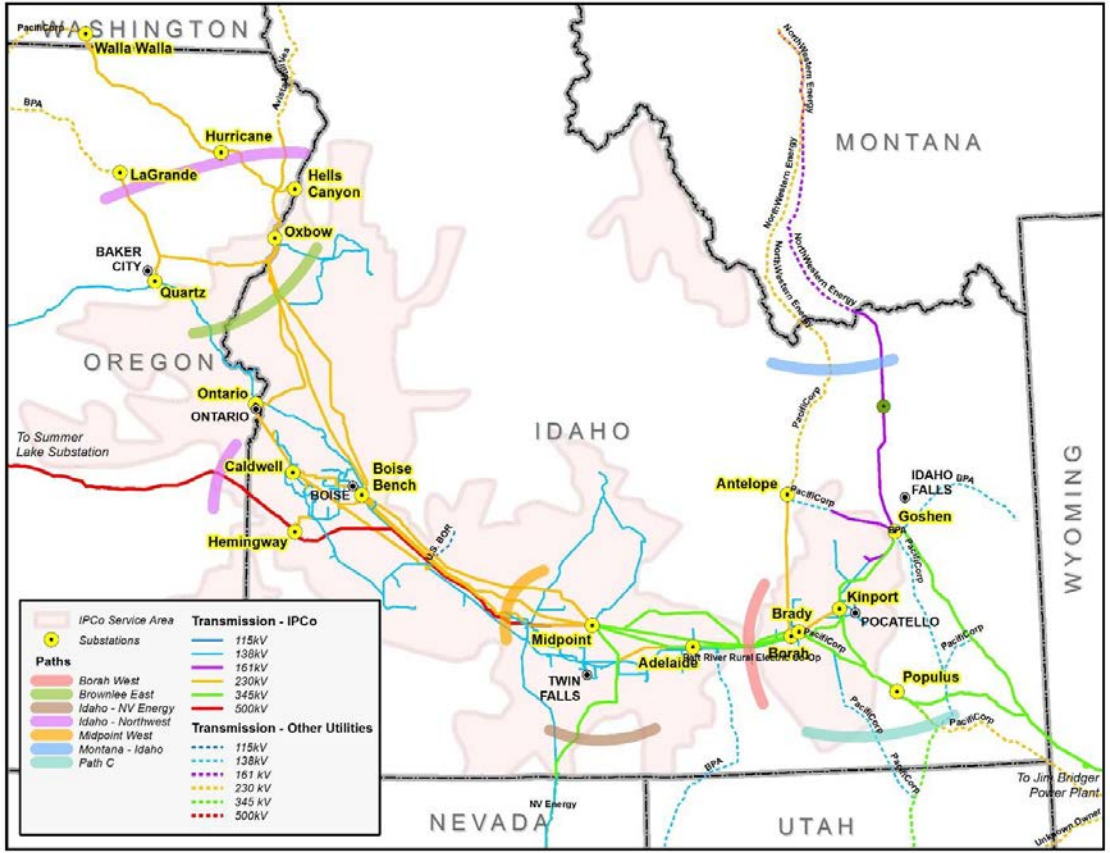
5 Year → 10 Year → 20 Year

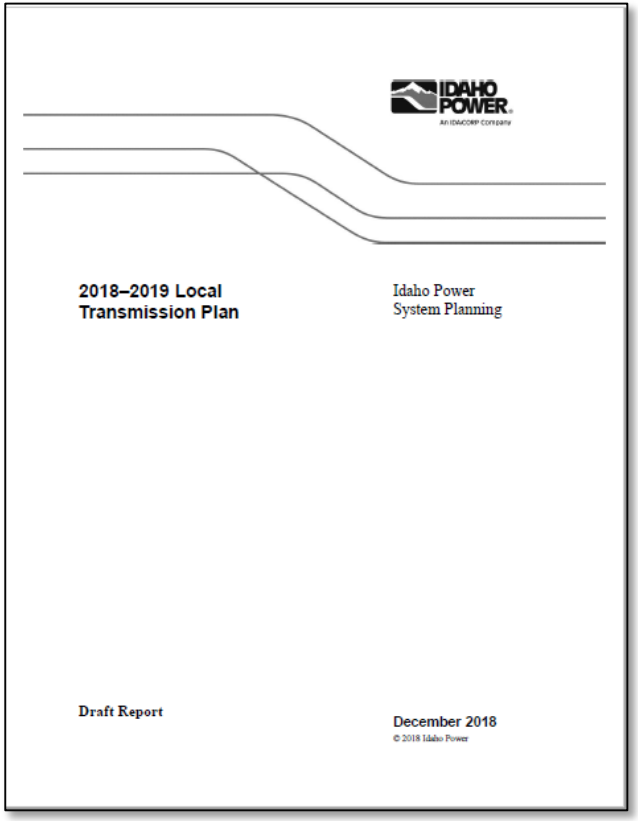
Economic Studies

- Economic Study – Assessment to determine whether transmission upgrades can reduce the overall cost of reliably serving forecasted needs

- Requests accepted during Q1 or Q5 of the planning cycle

Local Transmission Plan



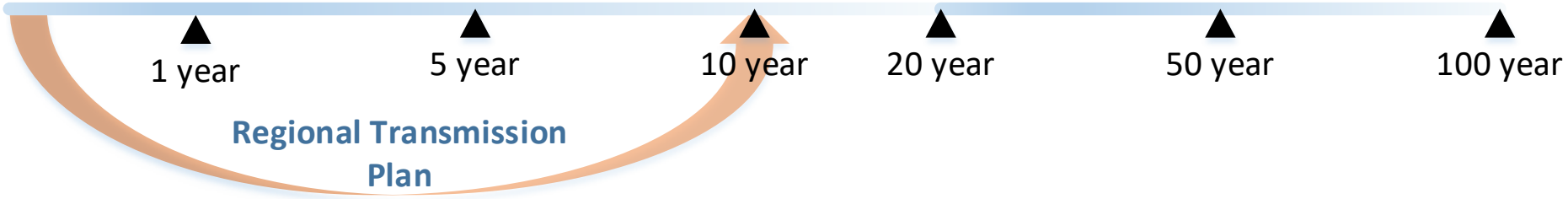


Regional Transmission Planning
FERC Order 1000

FERC Order 1000

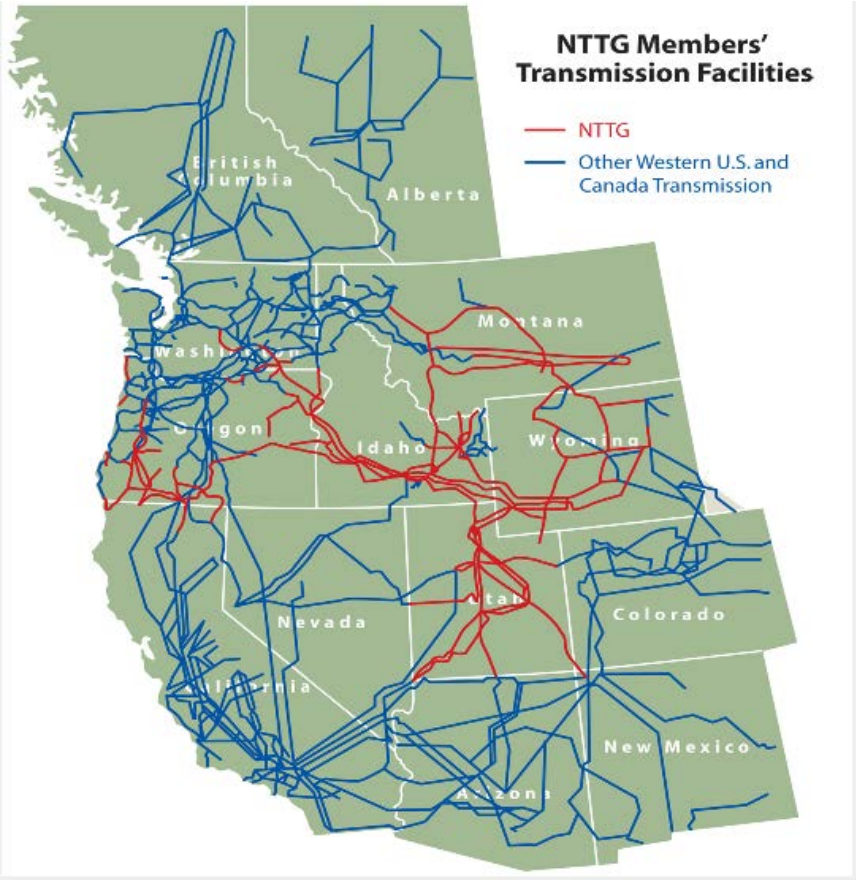
- Requirements
  - Regional Planning Process
  - Cost Allocation
  - Interregional Coordination
- Open Access Transmission Tariff - Attachment K

Regional Transmission Planning Period



Northern Tier Transmission Group (NTTG)

- Deseret G&T
- Idaho Power
- Northwestern Energy
- PacifiCorp
- Portland General Electric
- MATL LLP



Regional Transmission Planning Purpose

- Evaluates whether transmission needs within the regional footprint may be satisfied on a regional or interregional basis more efficiently or cost effectively than through the Local Planning Process

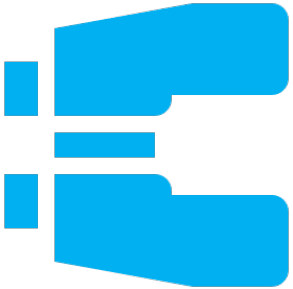
- Open planning process that provides valuable insight and information for all stakeholders

- Regional transmission planning process required by FERC

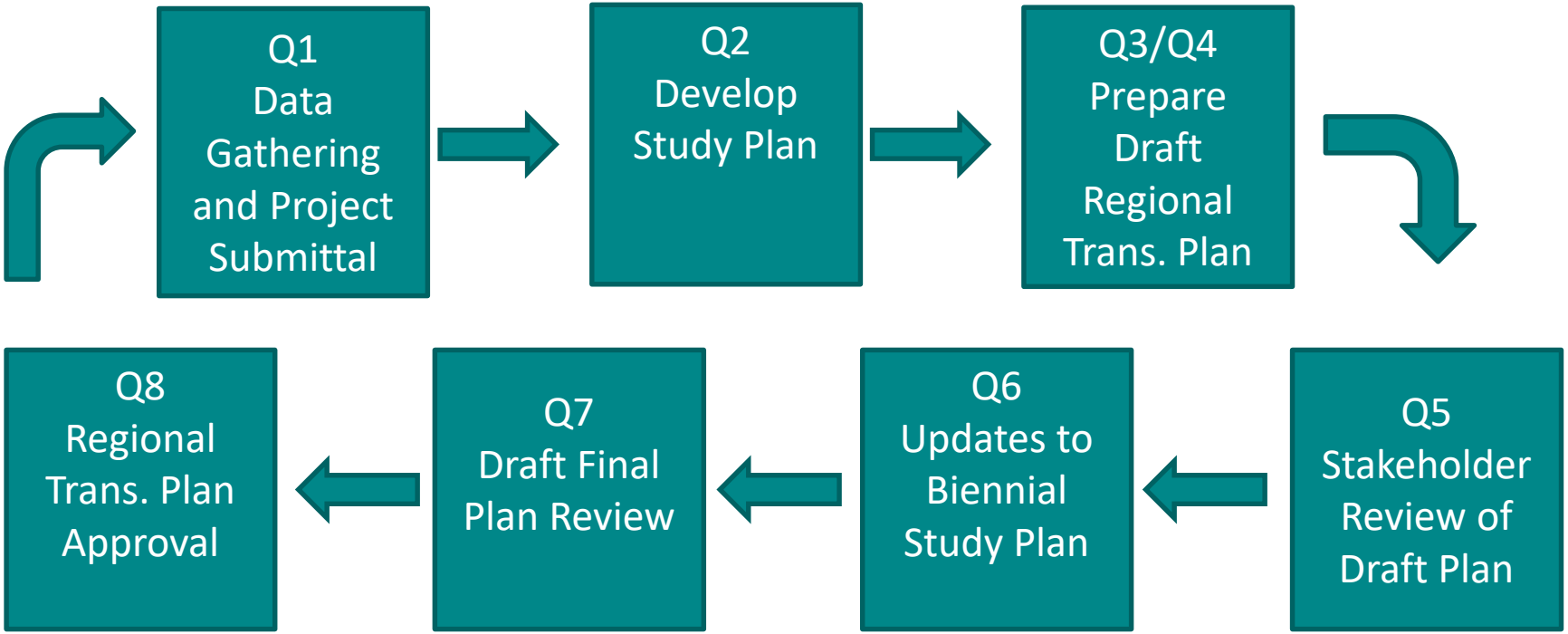
NTTG Planning Process Timeframe

- Two – year study cycle

- Ten – year planning horizon



NTTG Planning Process



NTTG Stakeholder Involvement

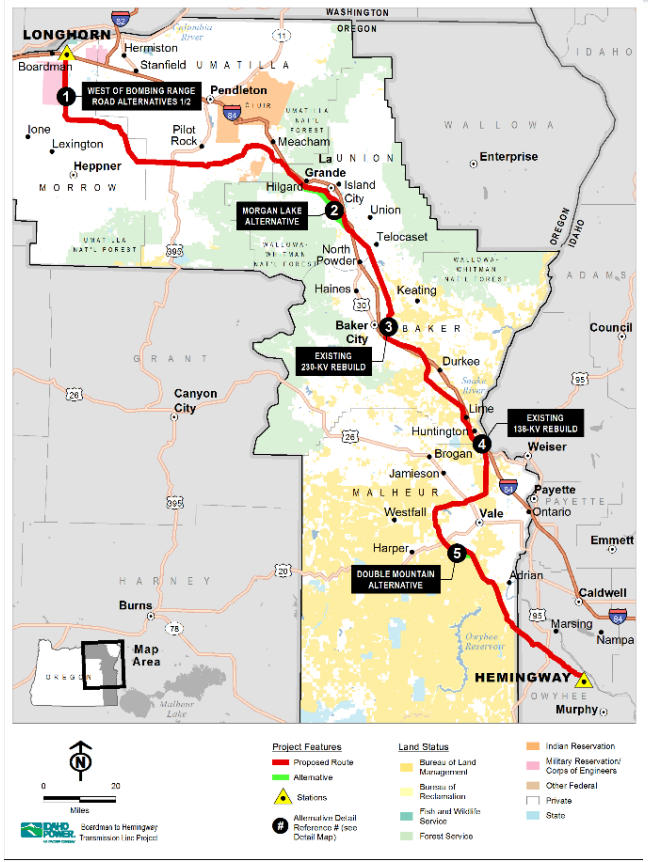
- End of Quarter Stakeholder Meetings
  - Status Reports of Progress and Receive Comments

- Stakeholders may also participate in public committee meetings
  - Steering Committee
  - Planning Committee
  - Cost Allocation Committee

- Stakeholder participation also through commenting

NTTG Planning Inputs

- Forecasted Loads and Resources
- Transmission Projects
  - Rolled up from Local Transmission Plans
  - Projects submitted for consideration by Project Sponsors, Stakeholders, or Merchant Developers
- Public Policy Requirements and Considerations



NTTG Study Method

- Production Cost Model run for year 10 utilizing Anchor Data Set
- Review of the results and selection of stressed hours for reliability analysis in power flow model
  - Round Trip Process

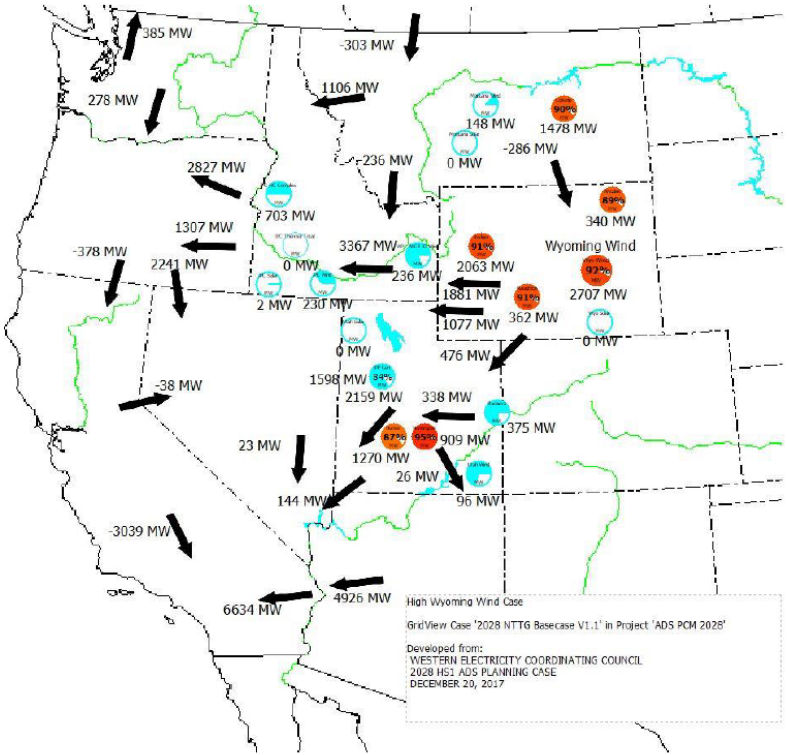


Figure 16 – Other flows for High Wyoming Wind Case (February 24, 2028 at Midnight - NTTG Case F)

NTTG Study – Change Case Analysis

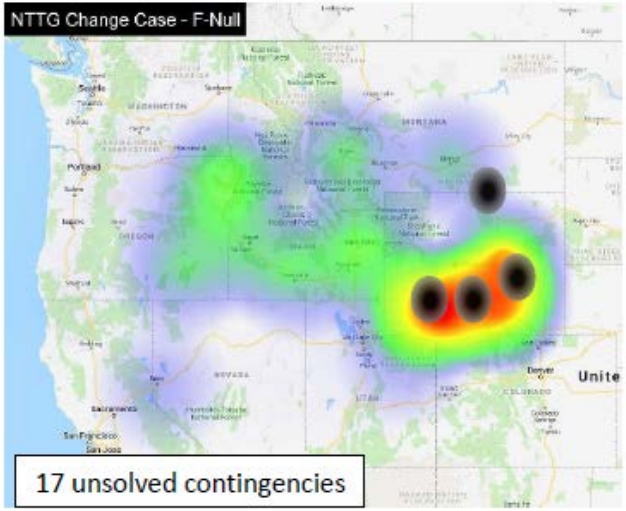
- Change case analysis
- Study multiple combination of submitted projects including Null (no added transmission case)

Case	B2H	Gateway S	Gateway W	Antelope Projects	SWIP N	Cross-Tie	TWE DC	TWE DC/AC	Stressed Conditions:
null									A B C F G H I
pRTP	✓	✓	a	✓					A B C E F G H I
iRTP	✓	✓	✓	✓					A B C E F G H I
CC1	✓								A B C F G I
CC2		✓		✓					A C E F I
CC3		✓	a						A C E F I
CC4	✓		a	✓					A C E F I
CC5	✓	✓		✓					A C E F I
CC6	✓	✓	a						A B C E F G H I
CC7								✓	A B C E F I
CC8							✓		A B C E F I
CC9						✓			A B C F I
CC10					✓				A B C F
CC11				✓				✓	(E)+RPS@1500
CC12		✓		✓				✓	(E)+RPS@1500
CC13			a	✓				✓	(E)+RPS@1500
CC14		✓	a	✓				✓	(E I)+RPS@1500
CC15				✓			✓		(E)+RPS@1500
CC16		✓		✓			✓		(E)+RPS@1500
CC17			a	✓			✓		(E)+RPS@1500
CC18		✓	a	✓			✓		(E)+RPS@1500
CC19				✓		✓			(E)+RPS@1500
CC20		✓		✓		✓			(E)+RPS@1500
CC21		✓	a	✓		✓			(E I)+RPS@1500
CC22			a	✓	✓				(E)+RPS@1500
CC23		✓	a	✓	✓				(E I)+RPS@1500
CC24		✓	a	✓	✓	✓			(E I)+RPS@3000
CC25			a	✓	✓			✓	(E)+RPS@3000
CC26		✓		✓		✓		✓	(E)+RPS@3000
CC27		✓	a	✓	✓	✓		✓	(E)+RPS@4500
CC28			a	✓	✓		✓		(E)+RPS@3000
CC29		✓		✓		✓	✓		(E)+RPS@3000
CC30		✓	a	✓	✓	✓	✓		(E)+RPS@4500
CC31	✓	✓	b	✓					E F G I
CC32	✓	✓	c	✓					F G I
CC33	✓	✓	d	✓					E F I

	The change case does not include the non-Committed Project
✓	The change case includes the non-Committed Project
a	Gateway West without Midpoint-Hemingway #2, Cedar Hill-Midpoint and Populus-Borah
b	pRTP less Populus-Cedar Hill-Hemingway
c	pRTP less Populus-Cedar Hill-Hemingway plus Populus-Borah
d	pRTP less Populus-Cedar Hill-Hemingway and Anticline-Populus
	The change case was run with and without B2H

NTTG Study – Results

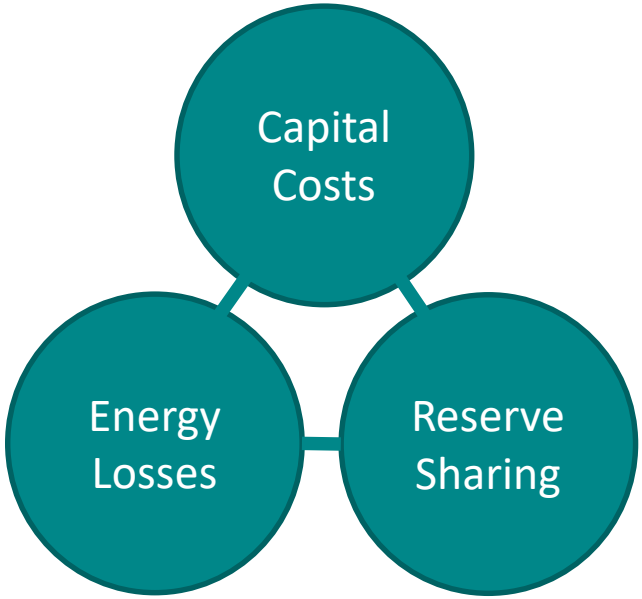
- Study result performance violations presented in heat maps
  - Maps show geographical problem performance areas for various change case combination of projects



Economic Evaluations

- Determine which plan with acceptable performance that meets regional needs is more efficient or cost effective.

- Metrics
  - Capital Related Costs
  - Energy Loss
  - Reserves



Cost Allocation

- Project Sponsors may request cost allocation consideration during project submission

- Project Qualification
  - Was proposed for cost allocation or was an unsponsored project
  - Selected in the Draft Regional Transmission Plan
  - Exceeds $20M

- Determine and allocate project costs
  - Costs allocated only if benefit/cost ratio is no less than 1.1

Regional Economic Study Requests

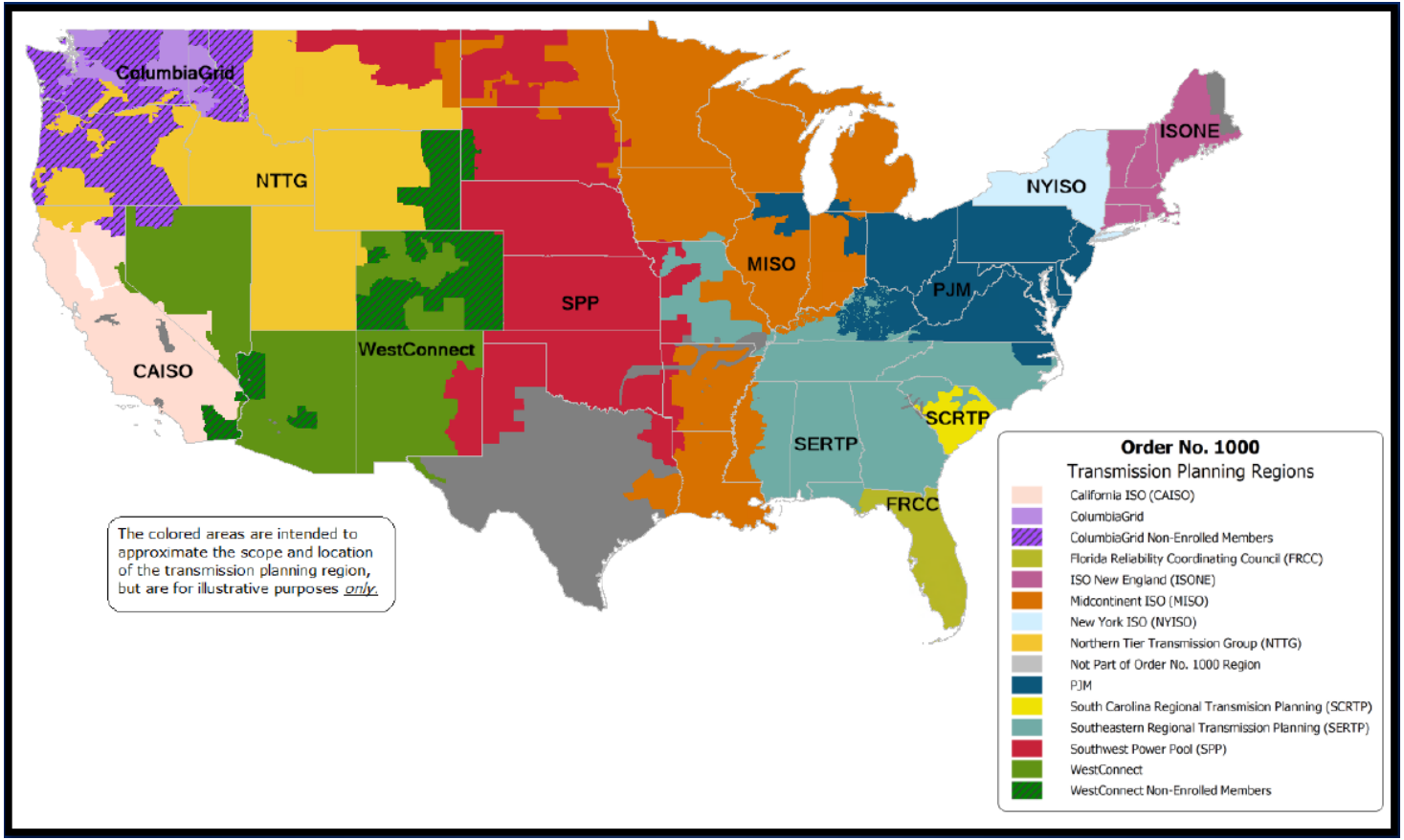
- Accepted During Q1 or Q5
- Up to two (2) Regional Economic Studies per cycle

WECC Role in Regional Planning

Model Building

- WECC is the Western Interconnection's power flow and production cost model builder.

Interregional Coordination



Western Regions Coordinated Tariff

- Common provisions adopted by California Independent System Operator Corporation, ColumbiaGrid, NTTG Transmission Group, and WestConnect
  - Annual Interregional Information Exchange
  - Interregional Transmission Project Joint Evaluation Process
  - Interregional Cost Allocation Process

WECC Role in Interregional Planning

Model Building

- WECC is the Western Interconnection's power flow and production cost model builder.

Markets

- Market expansions in the West are incremental market designs focused on leveraging CAISO's existing market capabilities to deliver optimized dispatch savings to additional customers and helping to efficiently integrate renewable resources
- Examples
  - Energy Imbalance Market (EIM)
  - Potential future Extended Day Ahead Market (EDAM)

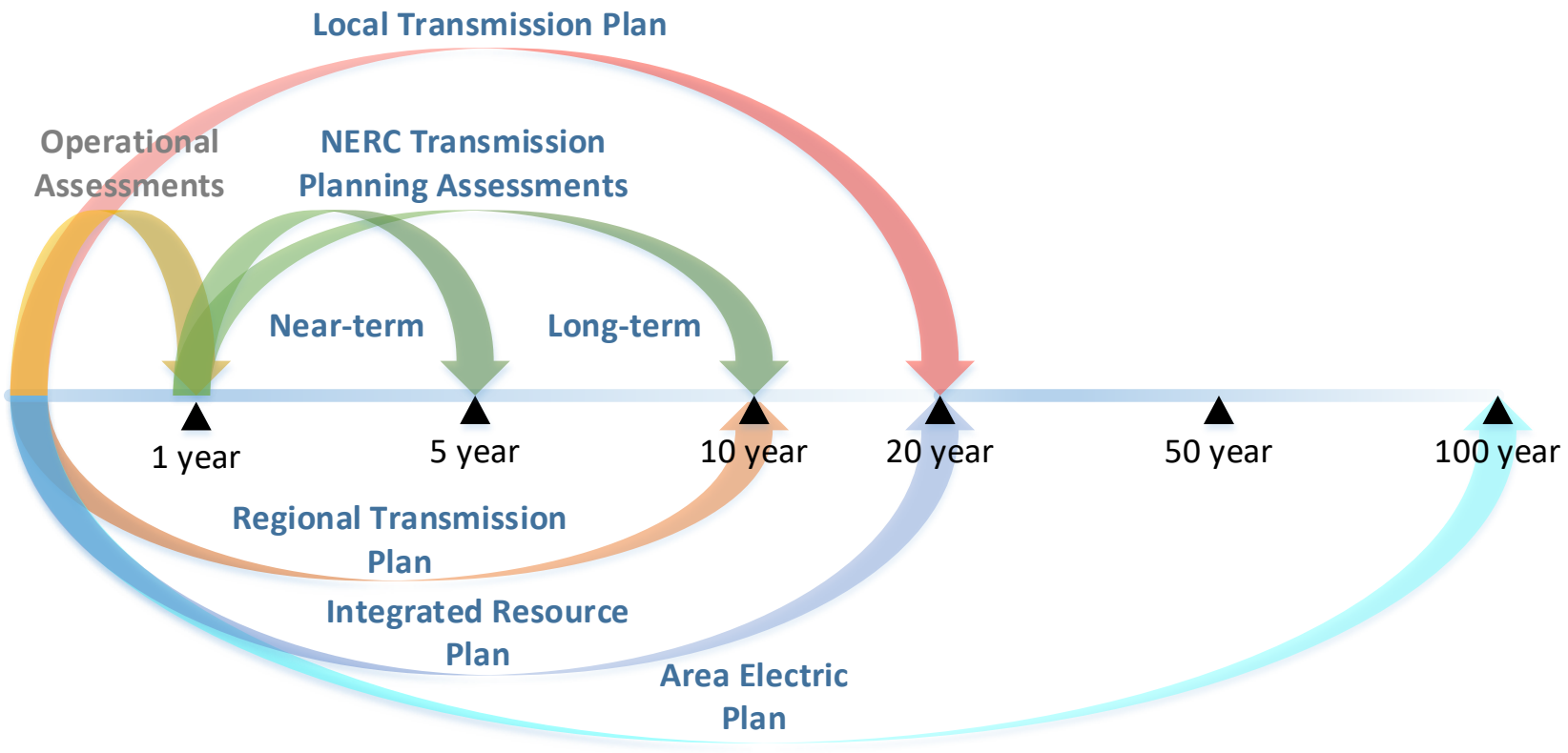
EIM (and EDAM) Implementation

- NOT full markets like an Regional Transmission Organization (RTO)
  - Does not include consolidated Balancing Authority Area operations, integrated transmission planning, and transmission cost allocation
    - *intentionally designed* not to include these elements, as these have been some of the issues that have made market expansion very challenging to implement in the past

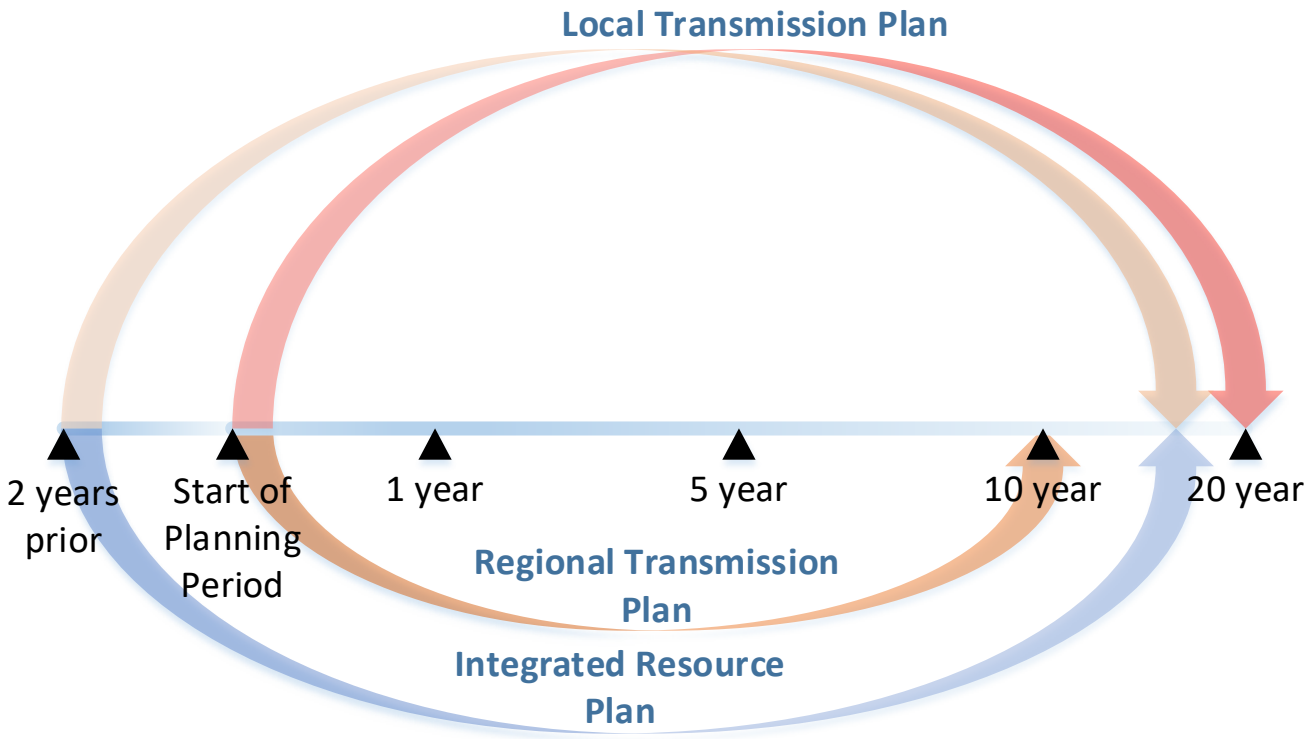
EIM (and EDAM) Benefits

- Produce granular Locational Marginal Prices (LMPs) and LMPs do include “congestion” as a price element
- Congestion shows where the transmission is constrained and could be contributing to less than optimal dispatch
  - Regional Planning Organizations outside of RTOs are not required by FERC to use LMP data in regional planning
  - However, the presence of this data from EIM may be useful in future planning processes

Planning Periods

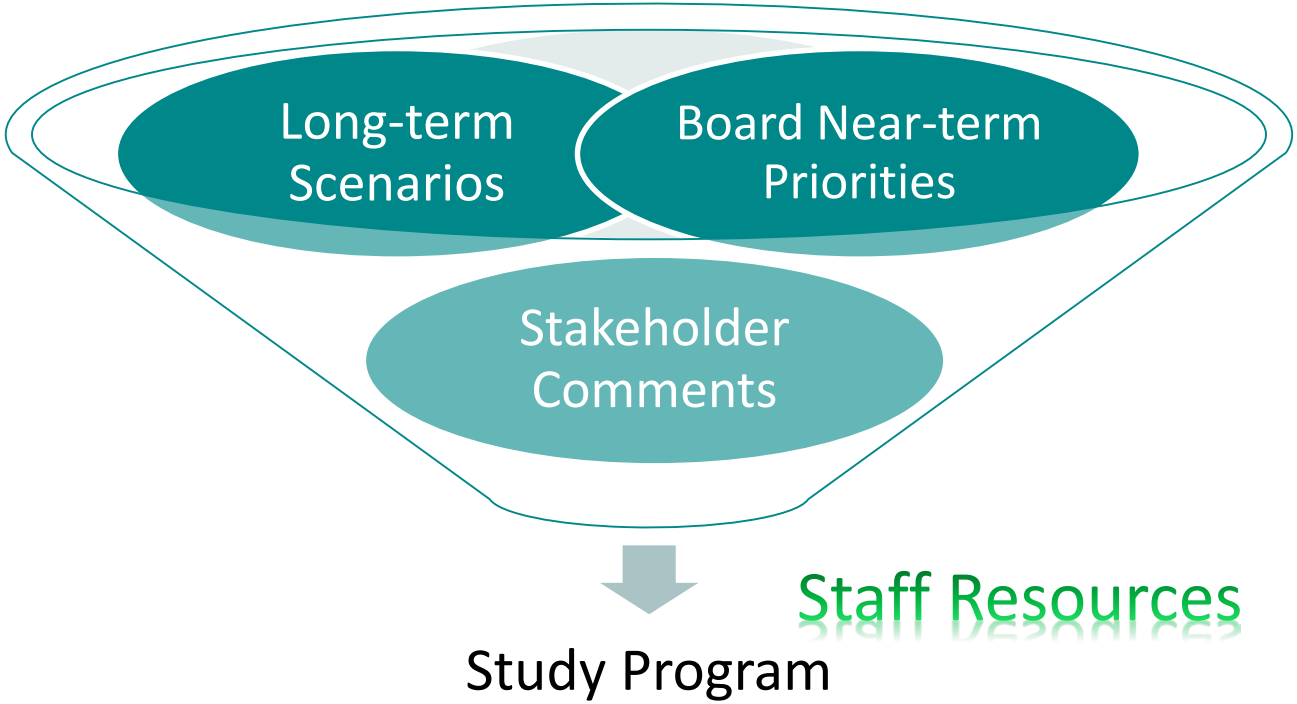


Planning Cycle Overlap

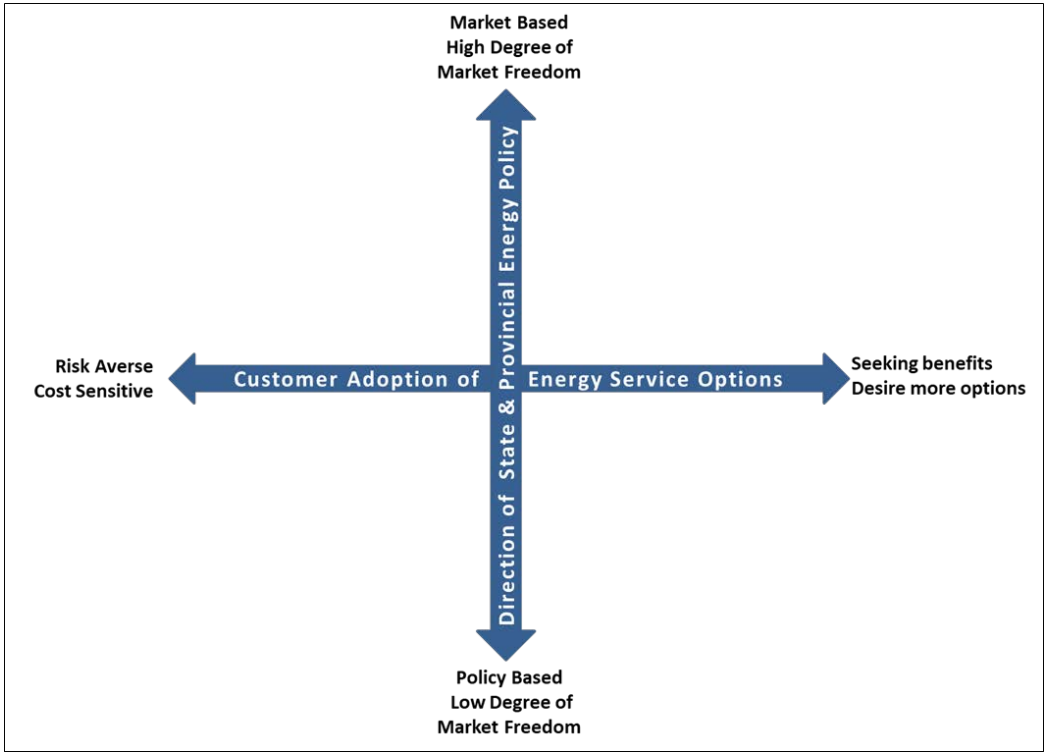


WECC Scenarios

WECC Study Development



WECC Scenario Development



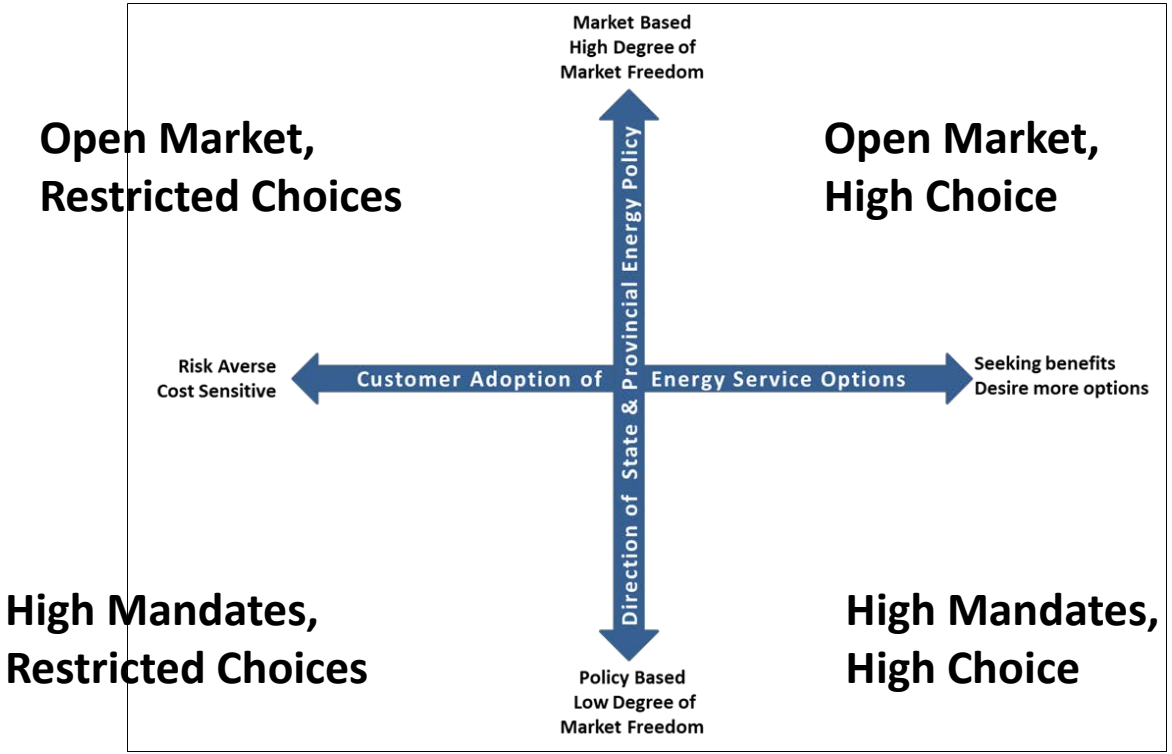
WECC Phase 1 Assessments

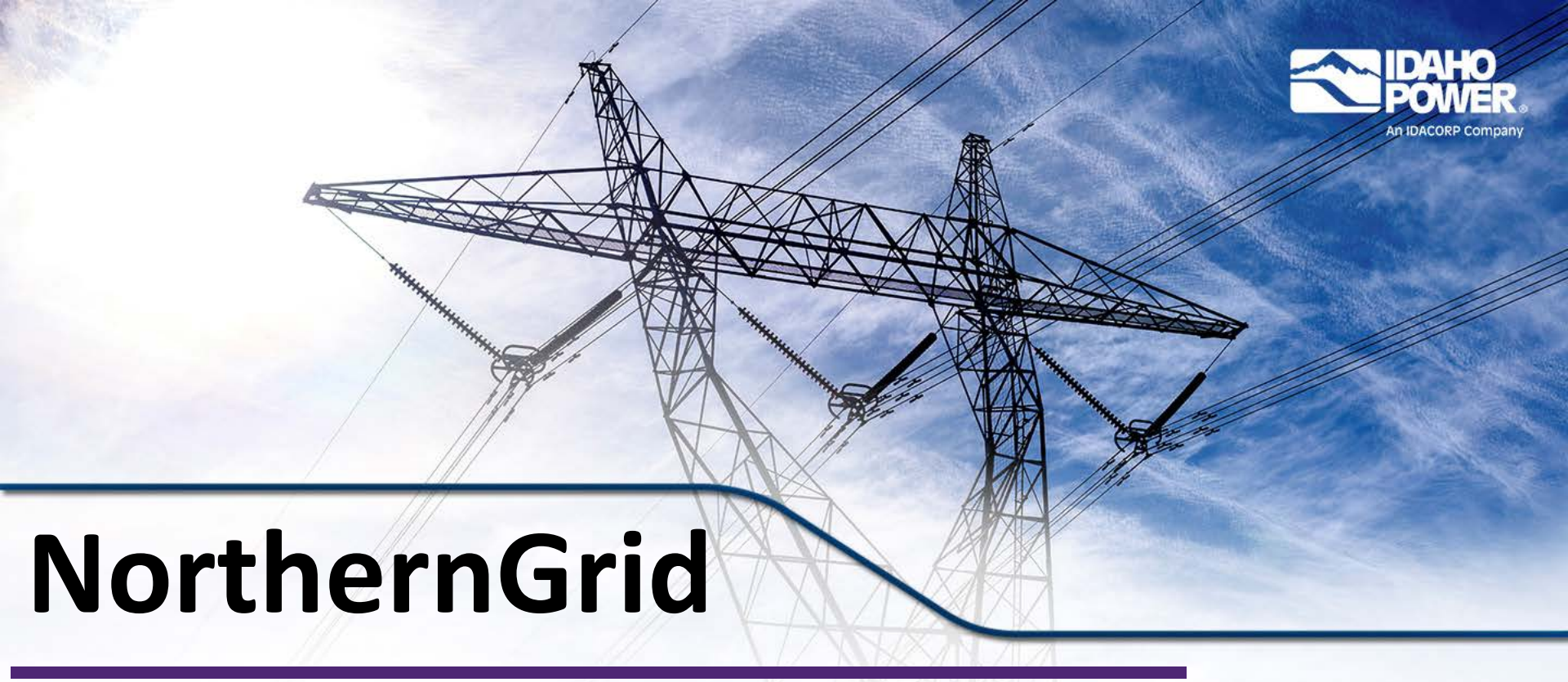
- Changes to System Inertia with High Renewable Implementation
- Significant Electrification
- System Resilience Under Extreme Natural Disaster
- El Paso Natural Pipeline Disruption
- Water Availability Issues
- Reliability Impacts of Most Likely Year 10 Future

Scenarios

- Open Market, Restricted Choices
- Open Market, High Choice
- High Mandates, Restricted Choices
- High Mandates, High Choice

Scenarios


Market Based
High Degree of
Market Freedom
Open Market,
Restricted Choices
Open Market,
High Choice
Risk Averse
Cost Sensitive
Customer Adoption of
Energy Service Options
Seeking benefits
Desire more options
Direction of State & Provincial Energy Policy
High Mandates,
Restricted Choices
High Mandates,
High Choice
Policy Based
Low Degree of
Market Freedom



NorthernGrid

State Engagement Updates

- NorthernGrid proposes the following state engagement tunings:
  - ***Representation***: each state may have up to two representatives on the Enrolled Parties and States Committee; and
  - ***Transparency:*** each state may participate on the Cost Allocation Taskforce and will be represented on the Planning Committees;
  - ***Decision-making***: consensus is the goal with supermajority vote when necessary

NorthernGrid Purpose

- Regional planning for the Pacific Northwest and Intermountain West region
- Single stakeholder forum for coordinated regional transmission planning
- Facilitate FERC Orders 890 and 1000 planning compliance for FERC jurisdictional companies

Committees and Responsibilities

Member Committee
Membership, Budget, Vendor Management

Enrolled Parties and States Committee (EPSC)
Stakeholders, Contribute to Scope, Comment on Plan

Member Planning Committee
Stakeholders, Coordination, Study Scope, Transmission Plan Approval

Enrolled Parties Planning Committee
Facilitate Compliance Determine eligibility for cost allocation

Cost Allocation Task Force
Facilitate Compliance Prequalification, Benefit and cost allocation

Committee Representatives

Member Committee
Representation
One per Member

Enrolled Parties and States Committee (EPSC)
Representation
One per Enrolled Party,
Up to two per State

Member Planning Committee
Representation
One per Member,
EPSC Co-Chairs

Enrolled Parties Planning Committee
Representation
One per Enrolled Party
EPSC Co-Chairs

Cost Allocation Task Force
Representation
One per Enrolled Party
One per State

Committee Leadership/Decisions

Member Committee
Consensus
Supermajority

Jurisdictional and non-Jurisdictional Co-Chairs

Member Planning Committee
Consensus
Supermajority

Enrolled Parties Chair

Enrolled Parties Planning Committee
Consensus
Supermajority

Enrolled Parties and States Committee
Consensus
Supermajority of both classes

Enrolled Parties and States Co-Chairs

Cost Allocation Task Force
Consensus
Unanimous in both classes

EPSC Decision-Making

- Co-Chairs try to achieve consensus
  - Consensus does not mean unanimous; agreement must be reasonably met by the vast majority of the committee
- If no consensus:
  - Form Enrolled Parties and States classes
  - Each class must approve the proposal by a supermajority of three-quarters (75%)
    - If only one class approves, then an advisory minority report provided to the Planning Committee

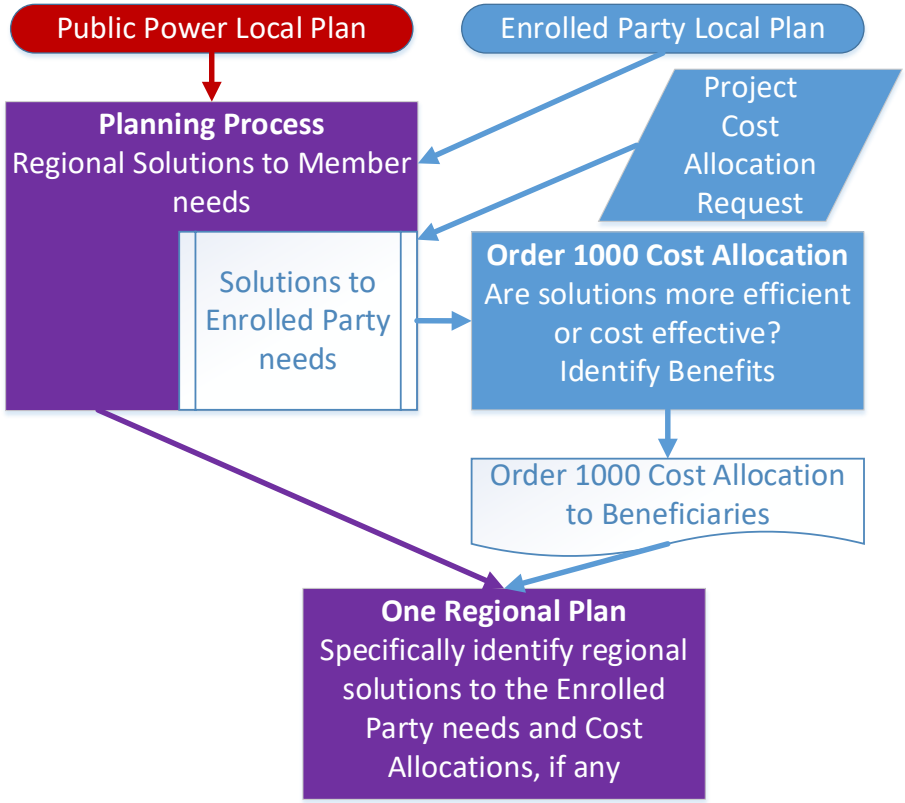
Cost Allocation Decisions

- Unanimous agreement required for decisions pertaining to a FERC Order 1000 cost allocation

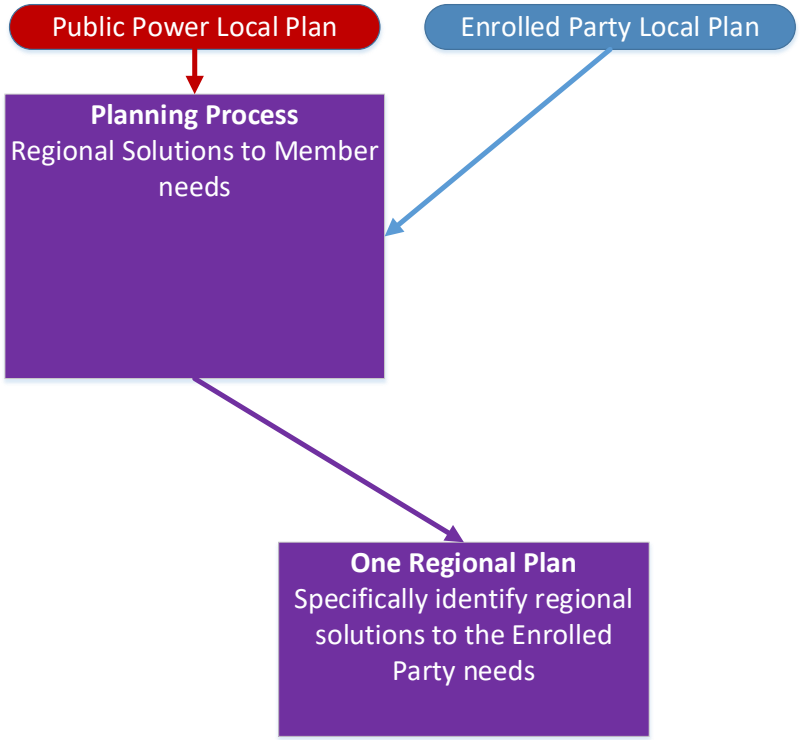
Planning Committee Decisions

- Co-Chairs try to achieve consensus
  - Consensus does not mean unanimous; agreement must be reasonably met by the vast majority of the committee
- If no consensus:
  - Each NorthernGrid representative has a vote
  - The Co-chairs of the Enrolled Parties and States Committee have one vote each
    - Co-chairs must represent the positions developed by the Enrolled Parties and States Committee
  - Approval requires 75% supermajority

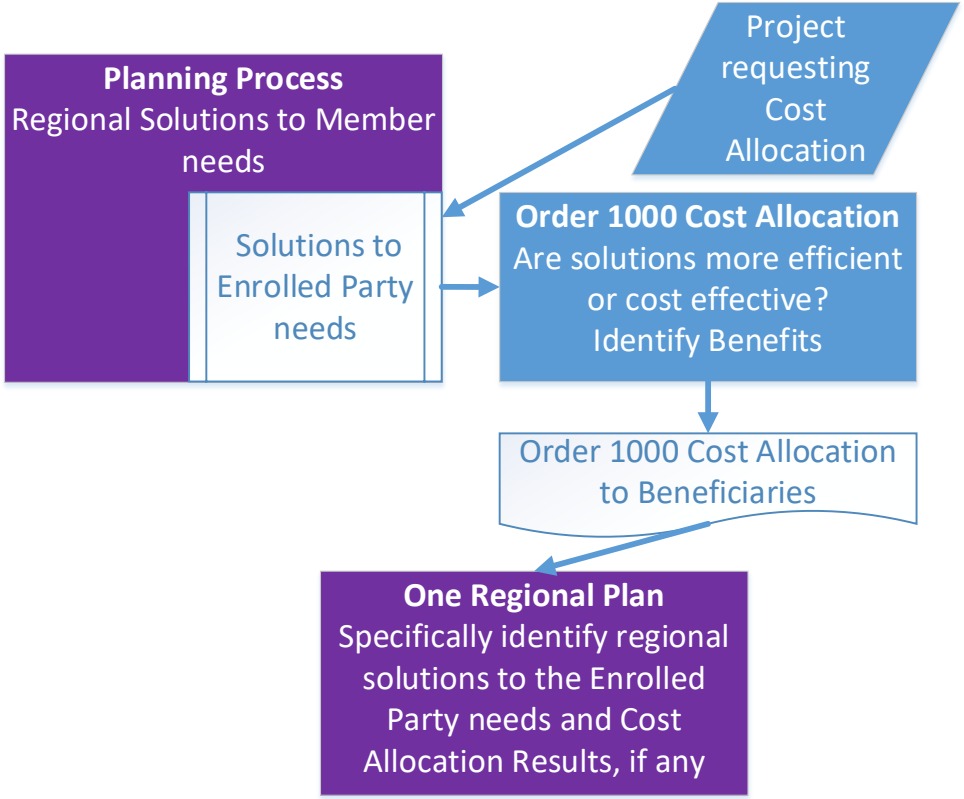
Planning Process Overview



Local Plan Project



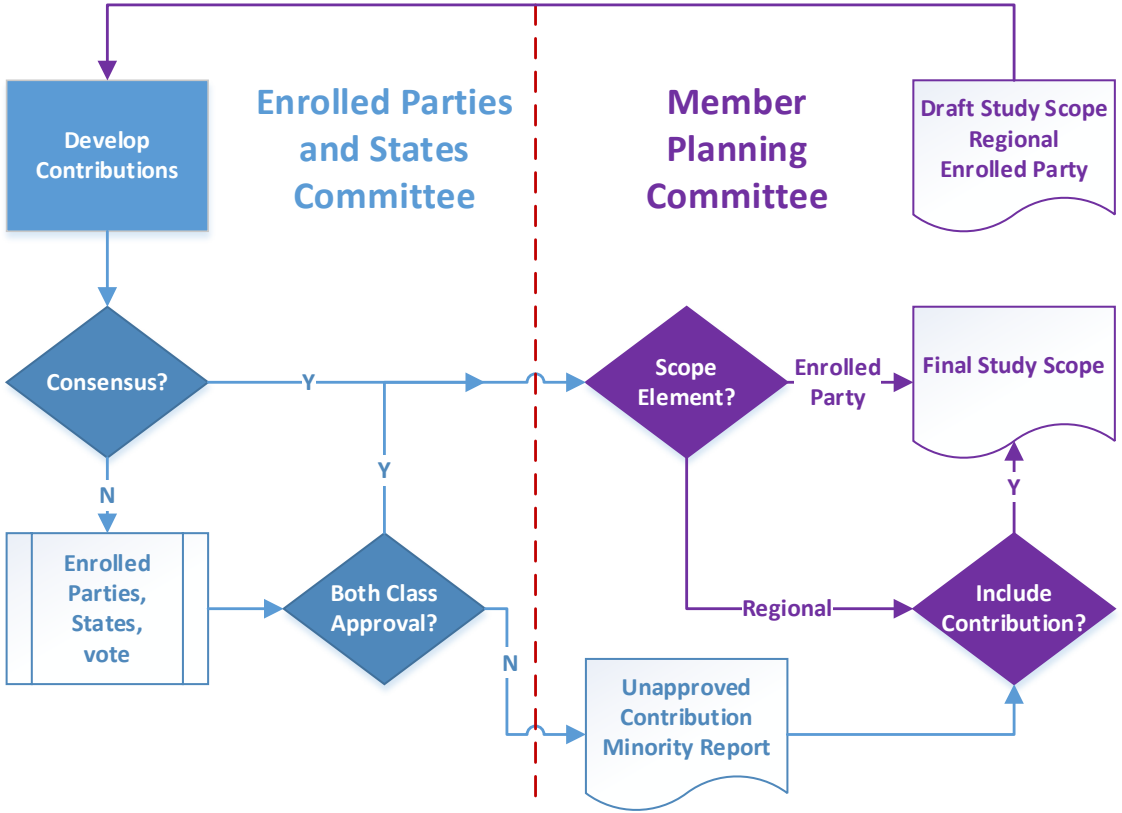
Project Requesting Cost Allocation



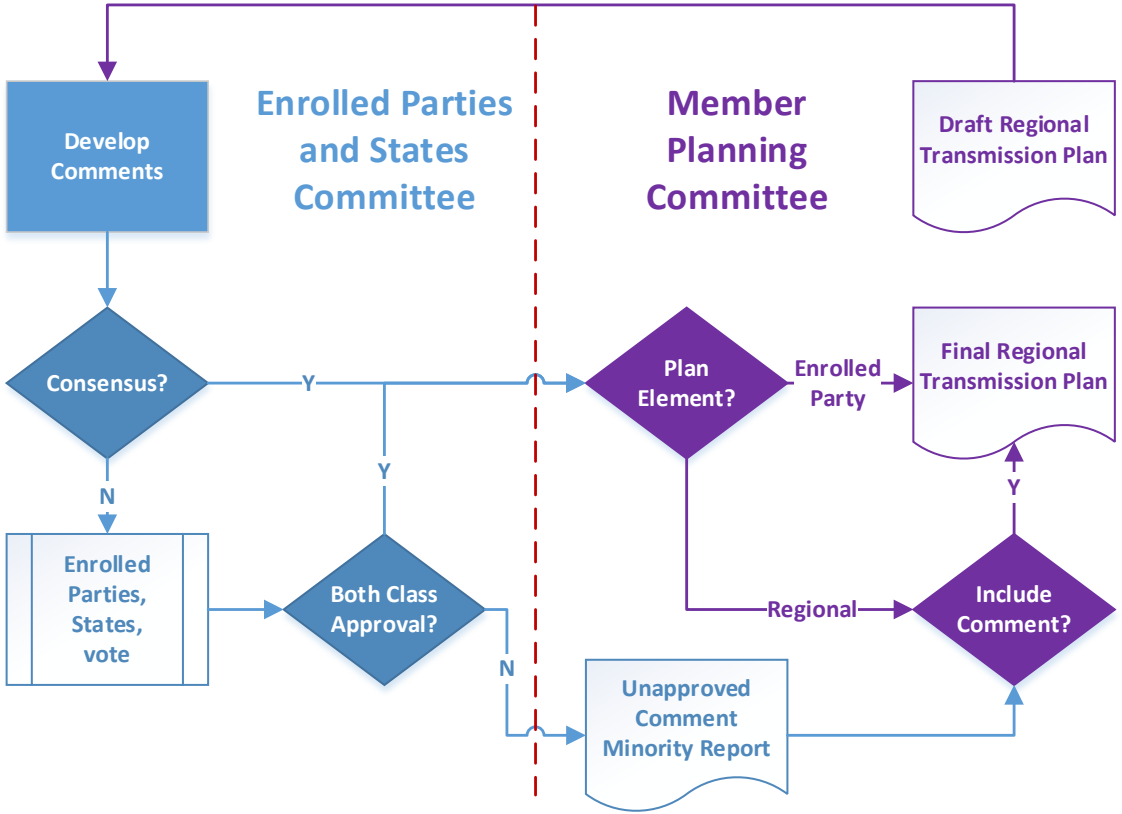
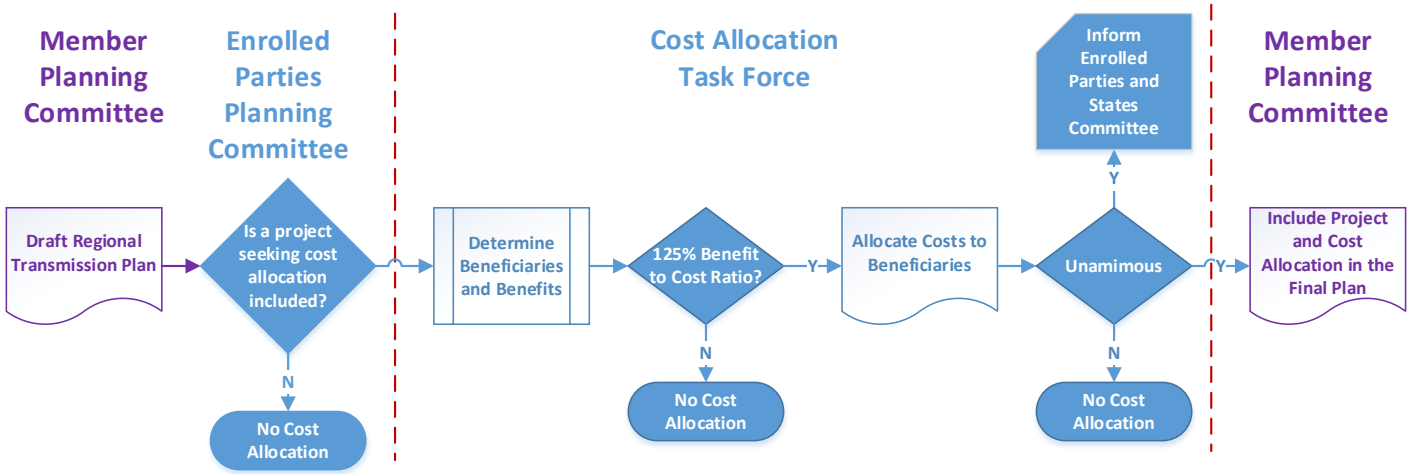
Committee Processing

- Study Scope
- Comments on the Plan
- Projects Seeking Cost Allocation

Contributions to Study Scope



Comment on Regional Plan



Cost Allocation Request Process