



**Keegan Moyer**

**Interim Manager, Transmission Expansion Planning**

Transmission Planning at WECC

NAWEA – 2013 Symposium

July 7<sup>th</sup>, 2013

# Topics

- *WECC Overview*
- *Transmission Expansion Planning at WECC*
- *Wind Modeling and Transmission Planning*

# *What is WECC?*

***Hint: It's not the Western Interconnection***



## **Stats**

- ❑ 14 states, 2 provinces, Baja CA
- ❑ 78 million people
- ❑ 230 GW of generation
- ❑ 122k miles of transmission
- ❑ HQ: Salt Lake City, UT

# WECC Functions

WECC's mission is to promote and foster a reliable and efficient bulk electric system

## Non-Planning Functions

- Compliance Monitoring and Enforcement
- Standards Development
- Market-Operations interface
- Operator training
- WREGIS
- Reliability Coordination\*

## Planning Functions

- Loads and Resources Assessments
- Reliability studies
- **Transmission Expansion Planning**



# Why is Transmission Planning Important?



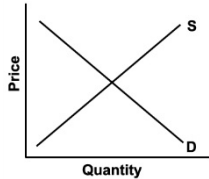
**Reliability**



**Policy**

**Tx Planning**

**Economics**



**Environment**



**Now**

**+10  
Years**

**+20  
Years**

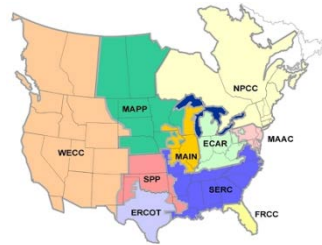
# Transmission Planning in the West [there is a lot of it]

**Who**

**Footprint**

**Precision**

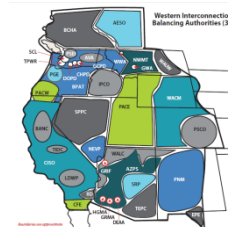
**Interconnection-  
Wide**



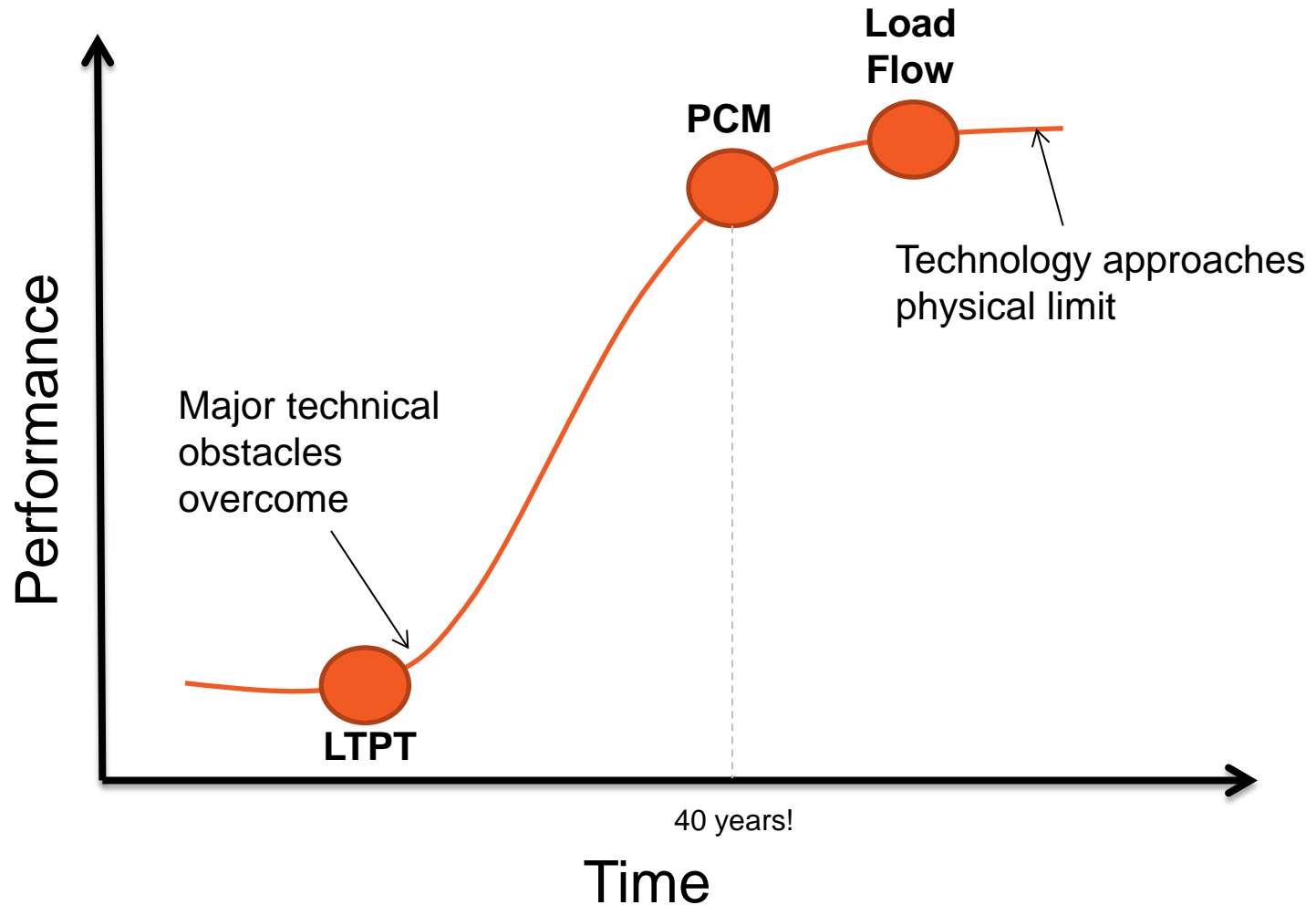
**Regional**



**Utility/LSE/IPD**



# *Transmission Planning Software and Technology S-Curve*

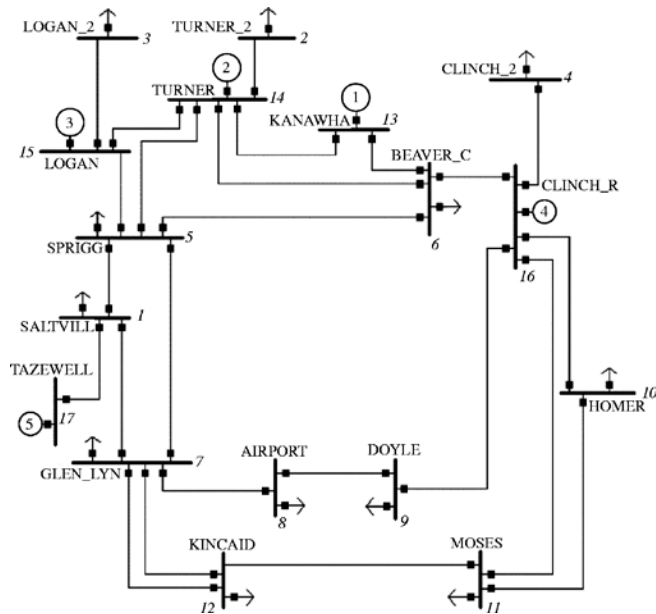


# 10-Year Studies Production Cost Model

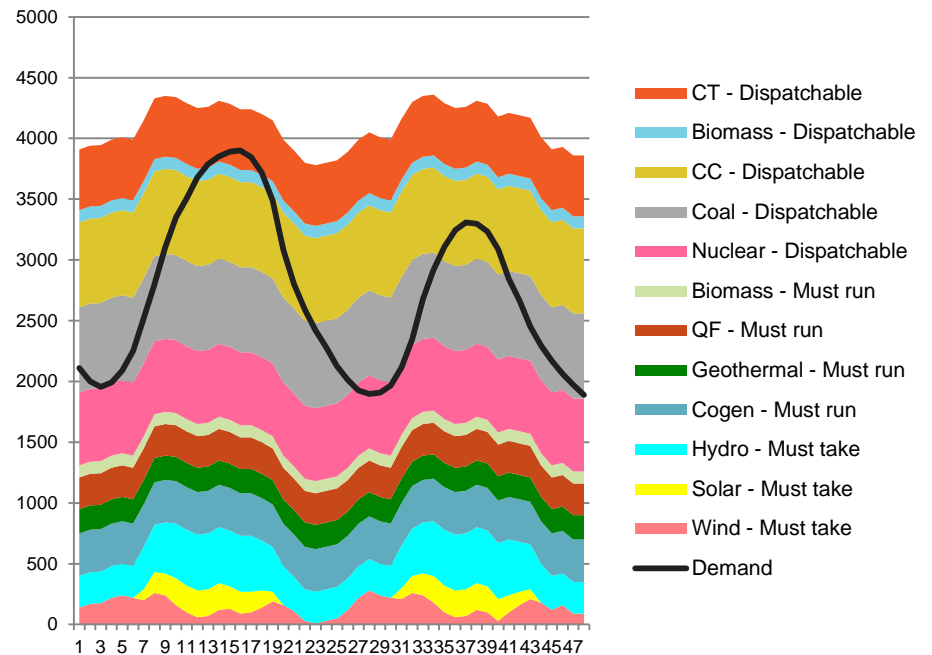
Security constrained

+

Economic dispatch



Hypothetical Resource Availability -  
Friday/Saturday

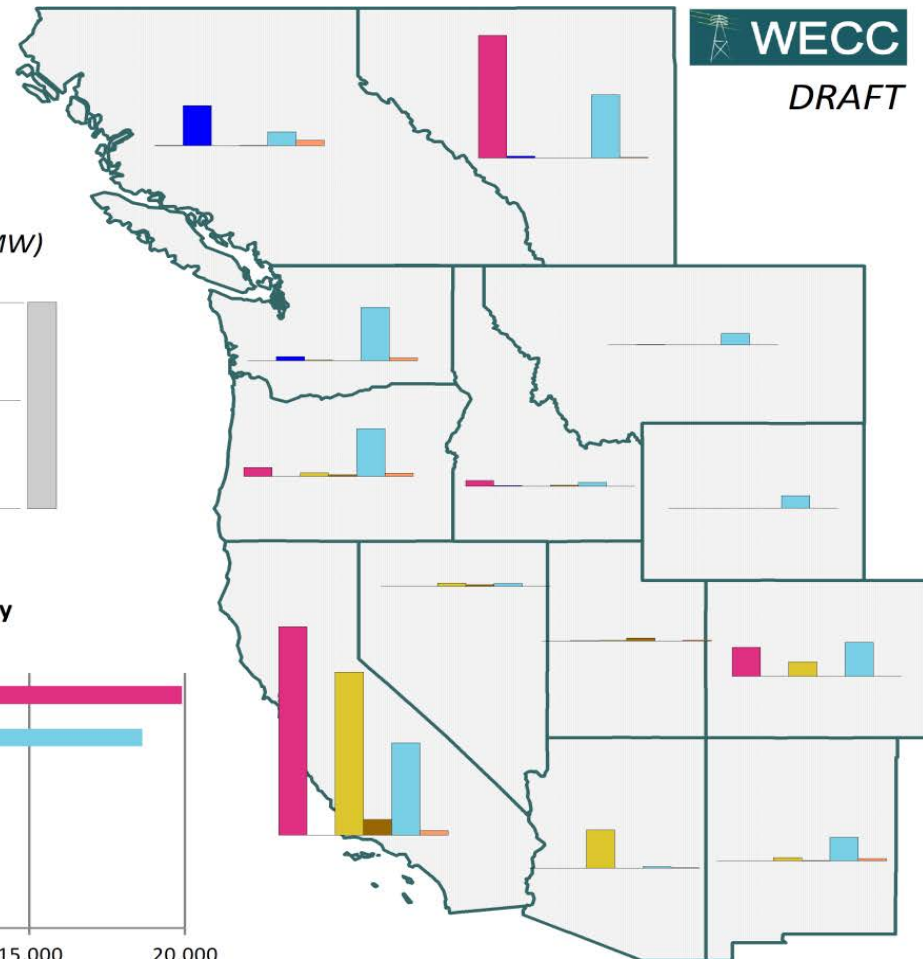
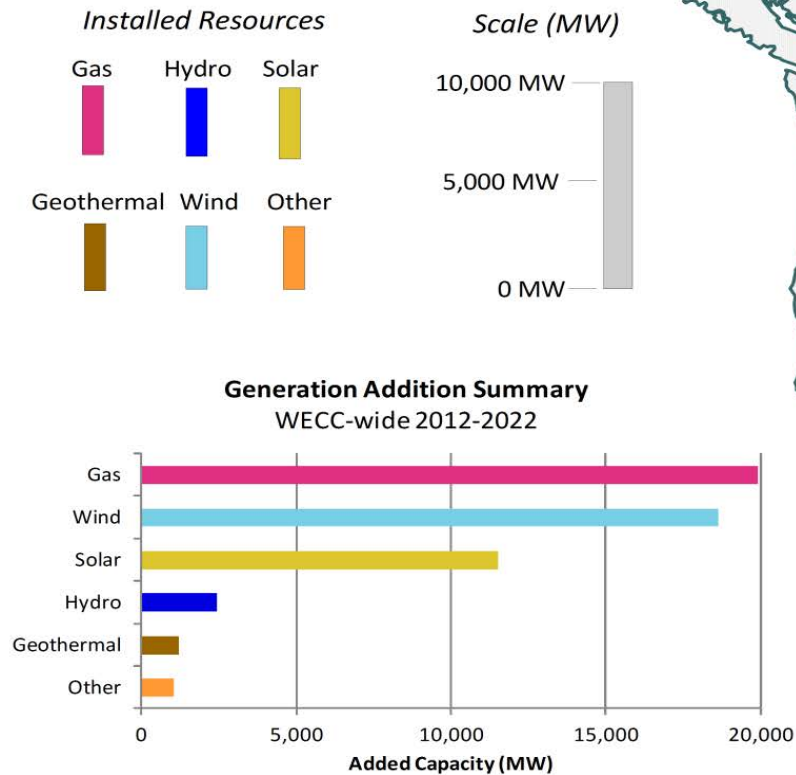




# 10-Year Studies

## Lots of Wind and Gas Added

### Generation Capacity Additions 2012-2022



Note: CC, CT, and Steam Boiler included in "Gas" category.  
"Hydro" includes large and small. "Other" includes biomass, IC, and Pumped Storage.

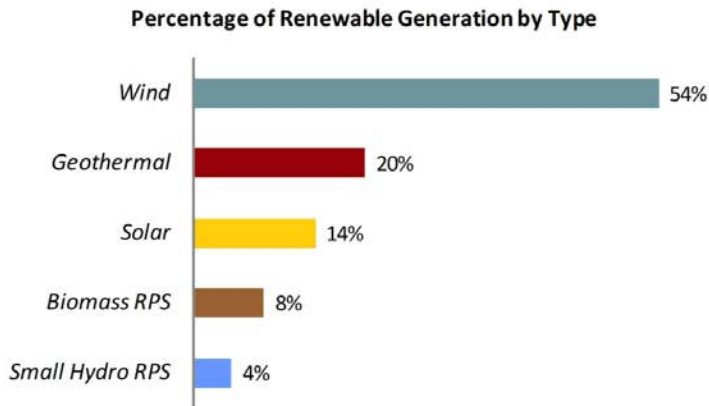
# 10-Year Studies

## RPS Compliant Future

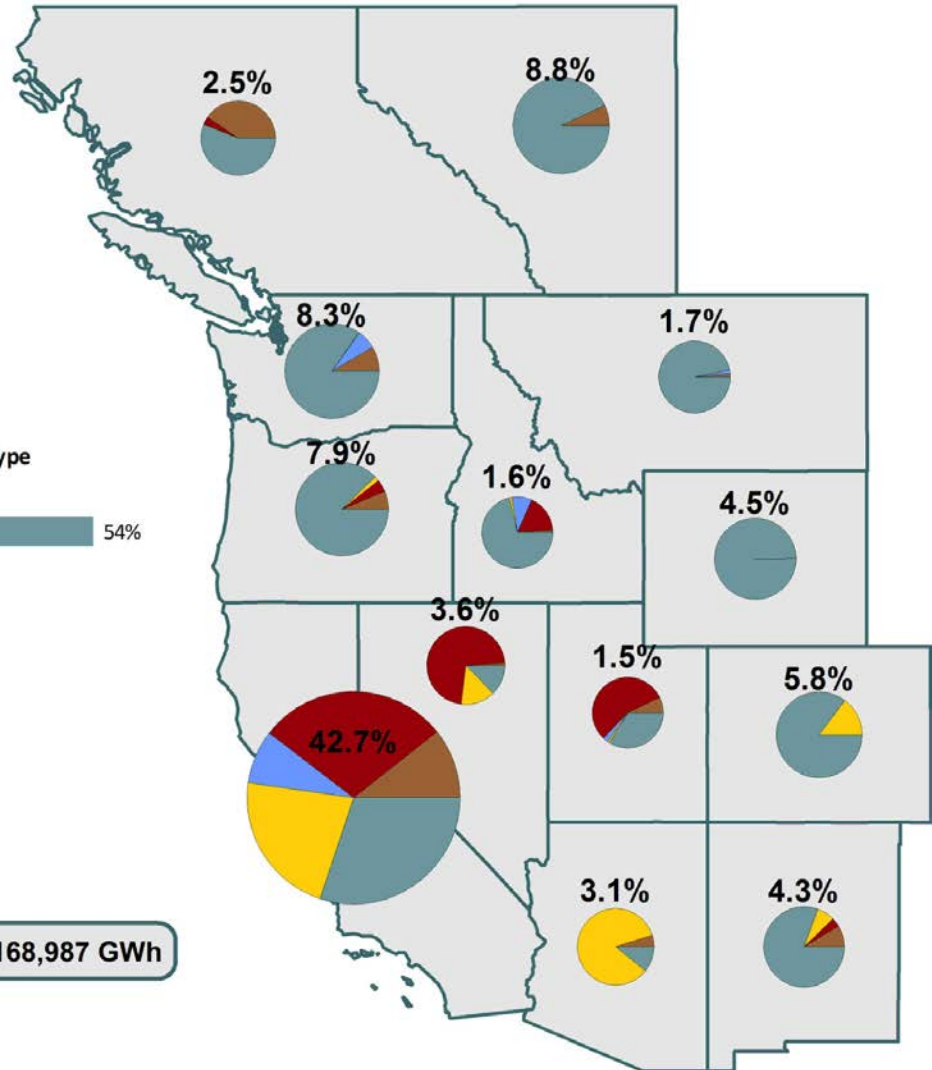
**Percentage of 2022 Total Renewable Energy Generation by Type and State/Province**



Note: Mexico (CFE) = 3.7%  
Texas (El Paso) = 0%



**2022 WECC Renewable Generation: 168,987 GWh**



# 10-Year Studies

## Transmission Assumptions are Key

### 2022 Common Case Transmission Assumptions (CCTA)

The purpose of the CCTA is to provide a basic set of transmission facilities that TEPPC can use as a starting point for their own studies. The CCTA is a list of facilities that have a high probability of being in service by 2022.

- 1 Boardman-Hemingway (B2H)
- 2 Cascade Crossing
- 3 Central Ferry - Lower Monumental (Little Goose Area Reinforcement)
- 4 Delaney - Palo Verde Line
- 5 Delaney - Sun Valley Line
- 6 Devers - Colorado River (DCR) Project
- 7 Gateway Central Project: Mona to Oquirrh (Segment C)
- 8 Gateway Central Project: Sigurd - Red Butte
- 9 Gateway South Project: Segment 2 (Aeolus - Mona)
- 10 Gateway West Project: Segment 1A (Windstar to Jim Bridger)
- 11 Gateway West Project: Segment 1B (Bridger - Populus single circuit)
- 12 Gateway West Project: Segment 1C (Populus - Midpoint)
- 13 Gateway West Project: Segment E (Midpoint - Hemingway)
- 14 Hassayampa - North Gila #2 Line
- 15 I-5 Corridor Reinforcement Project (Castle Rock - Troutdale)
- 16 Interior to Lower Mainland Transmission (ILM) Project
- 17 Montana Alberta Tie Project (MATL)
- 18 Morgan - Sun Valley Line
- 19 Midway-Waterton
- 20 Path 8 Upgrade/Colstrip Transmission Upgrade (western portion only)
- 21 Pawnee-Smoky Hill
- 22 Pinal Central-Tortolita
- 23 Pinal West-Pinal Central-Browning (SEV)
- 24 San Luis Valley-Calumet-Comanche
- 25 Sunrise Powerlink
- 26 SWIP South
- 27 Tehachapi Renewable Transmission Project
- 28 Walla Walla to McNary (Energy Gateway Segment A)
- 29 West of McNary Reinforcement Project Group 1 (McNary - John Day)
- 30 West of McNary Reinforcement Project Group 2 (Big Eddy - Knight)

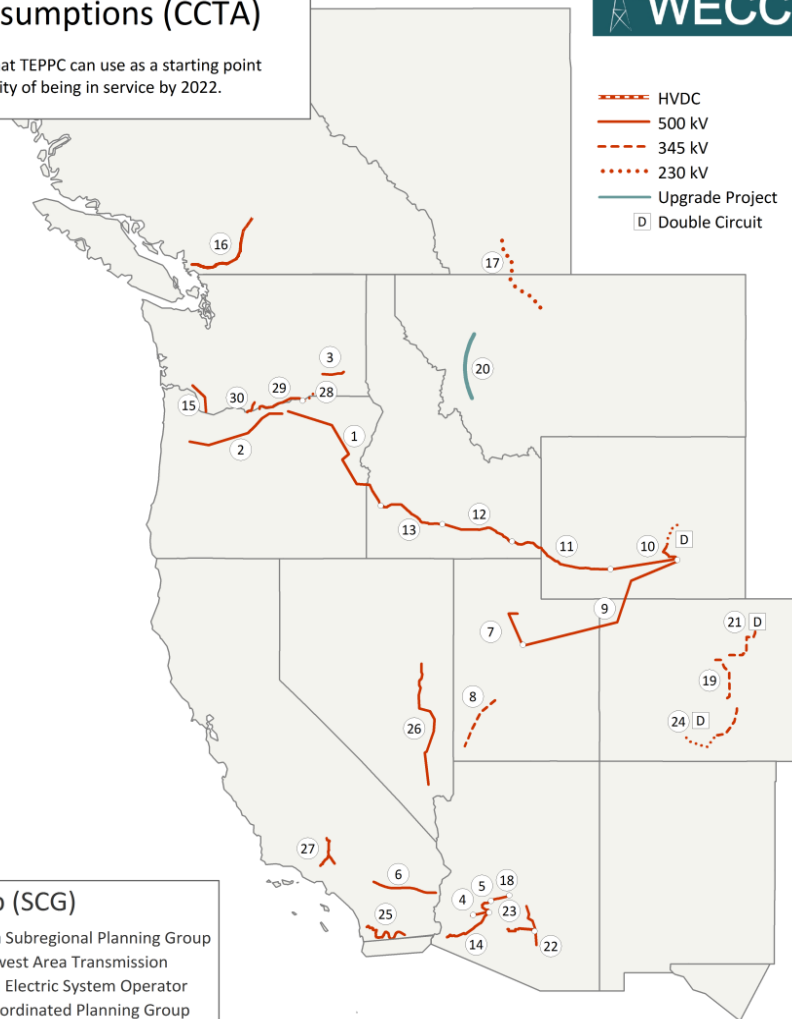
### Subregional Coordination Group (SCG)

CAISO - California Independent System Operator  
 CTPG - California Transmission Planning Group  
 CG - ColumbiaGrid  
 CCPG - Colorado Coordinated Planning Group  
 NTTG - Northern Tier Transmission Group

SIERRA - Sierra Subregional Planning Group  
 SWAT - Southwest Area Transmission  
 AESO - Alberta Electric System Operator  
 BCCPG - BC Coordinated Planning Group



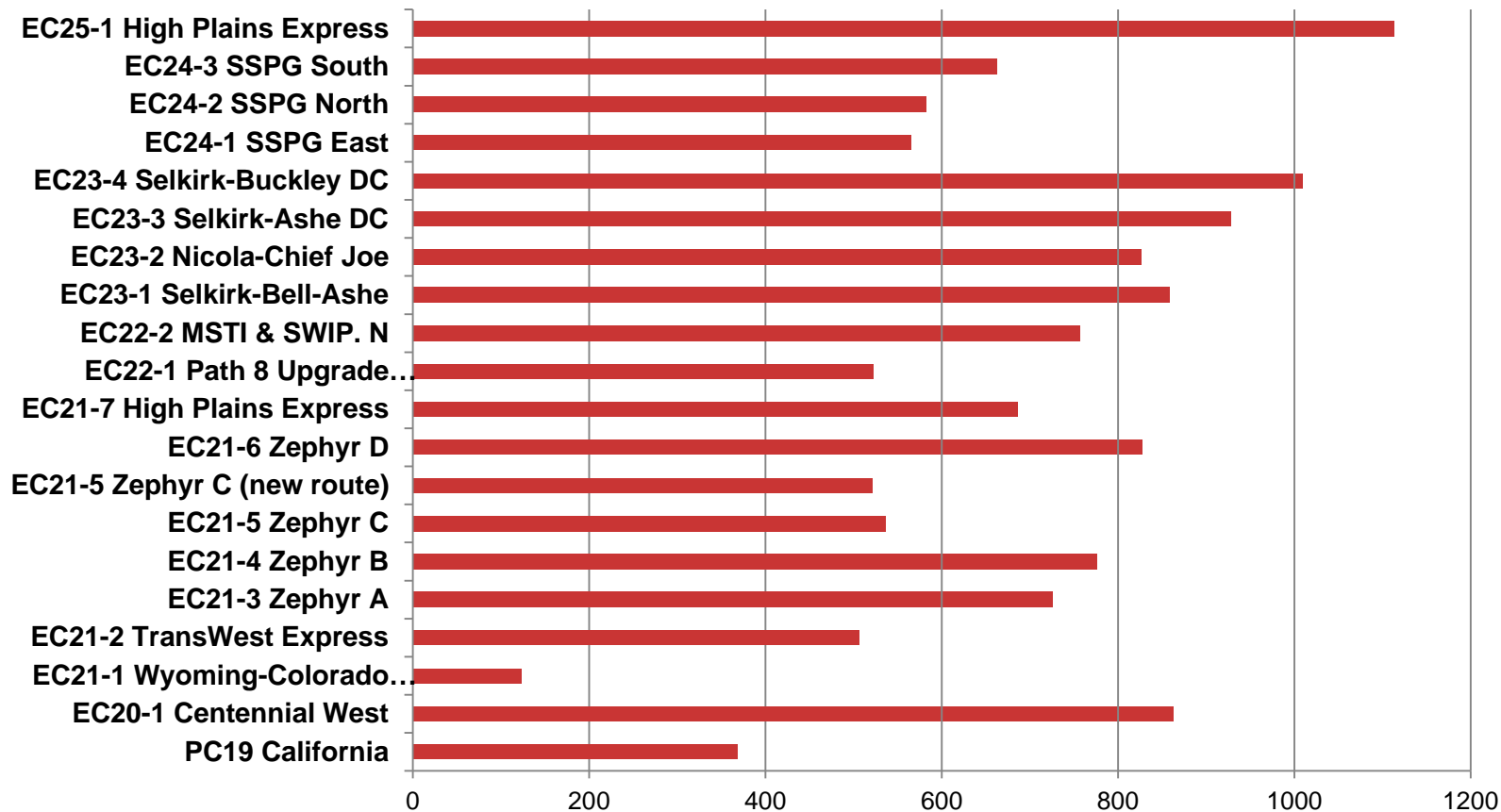
- HVDC
- 500 kV
- - - 345 kV
- · · 230 kV
- Upgrade Project
- D Double Circuit



# 10-Year Studies Case Studies

## Change in Total Cost (\$M) to Achieve RPS-Compliance under High Loads

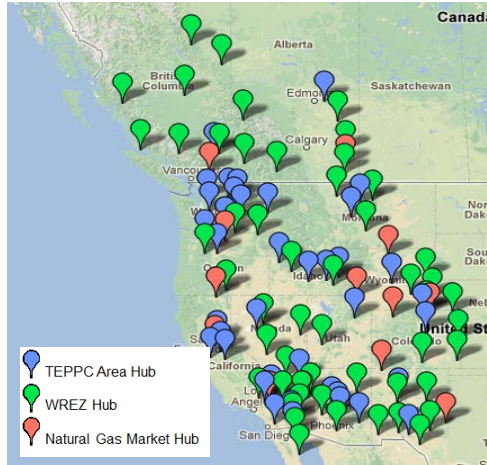
(comparison with PC1-5 High Load non-RPS compliant case)



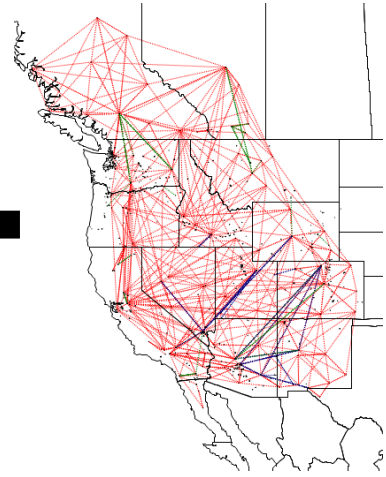
# 20-Year Studies

## New WECC “Long-Term Planning Tool”

**Dataset  
(2032)**



+



+

Capital cost assumptions  
Water nexus  
Environmental GIS

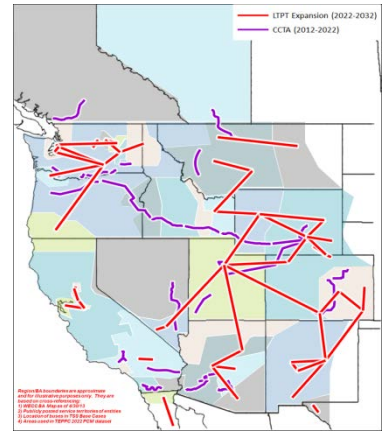
**Tools**

Resource Optimization

+

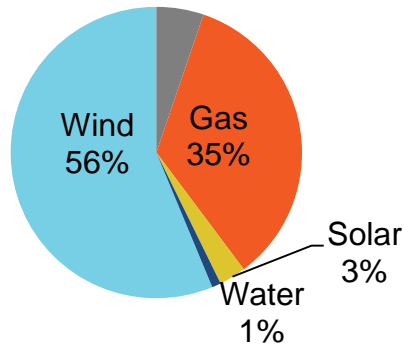
Transmission Analysis and Expansion

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# 20-Year Studies LTPT Capabilities

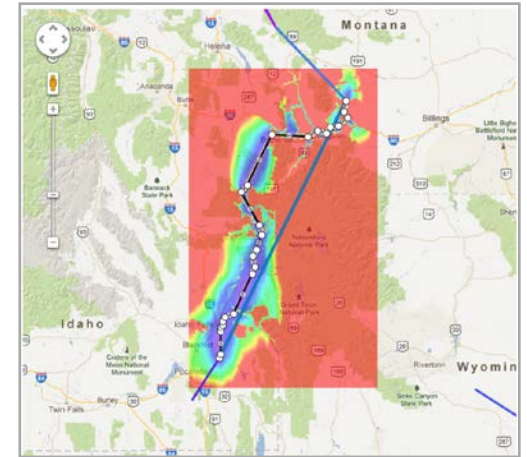
## Resource Additions



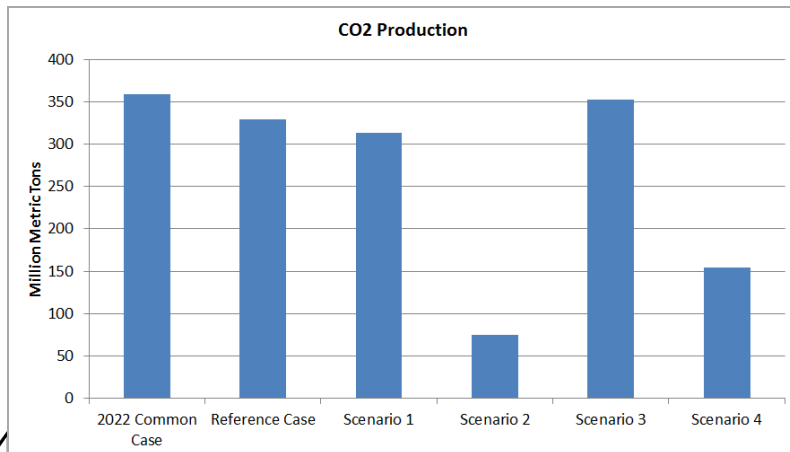
## Transmission Expansions



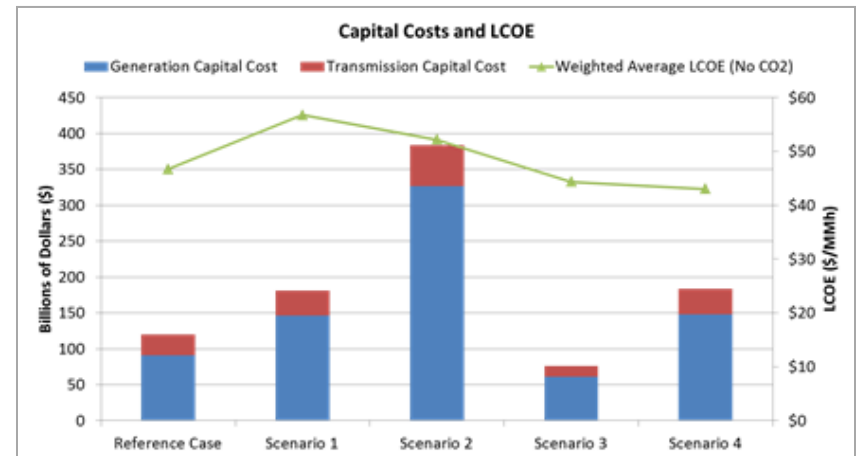
## Line Bending



## CO2 Production



## Costs

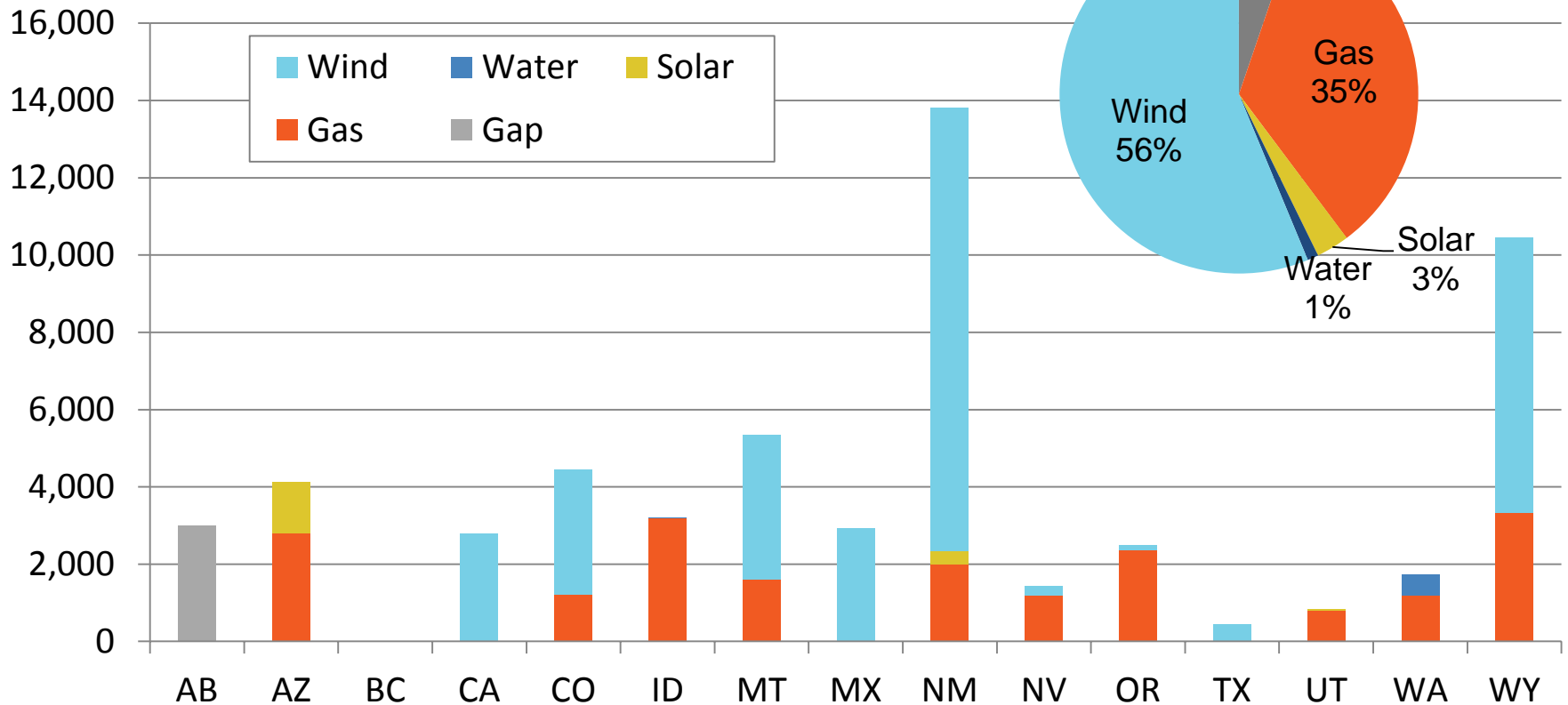


# 20-Year Studies

## *Renewables Added for Energy (not Policy)*

### 2022-2032: Added Capacity

(by state and fuel in MW)

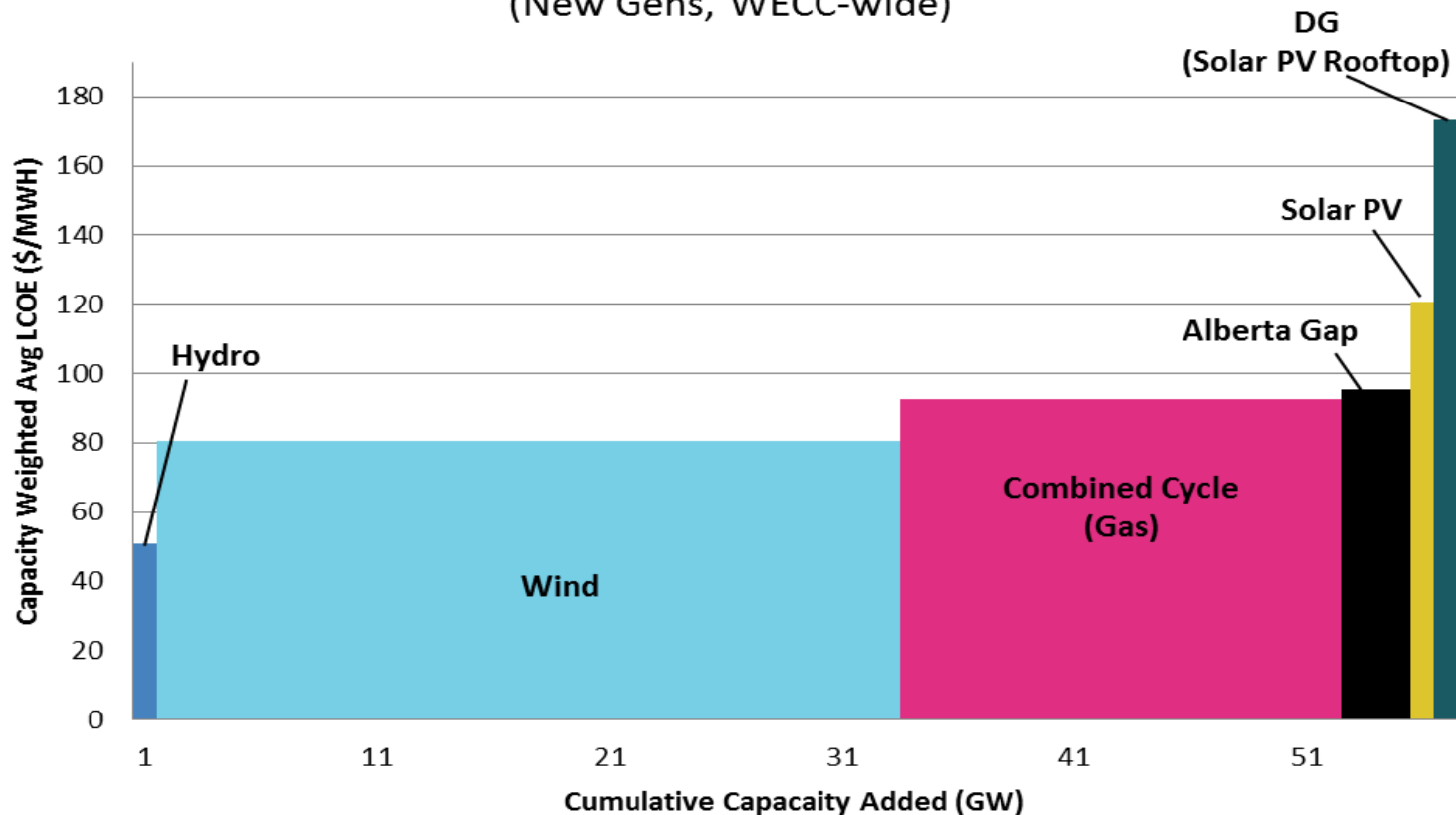


**Added 57,000 MW from 2022-2032**

# 20-Year Studies Uncertainty Dominates

## 2022-2032 Additions: LCOE Supply Curve

(New Gens, WECC-wide)

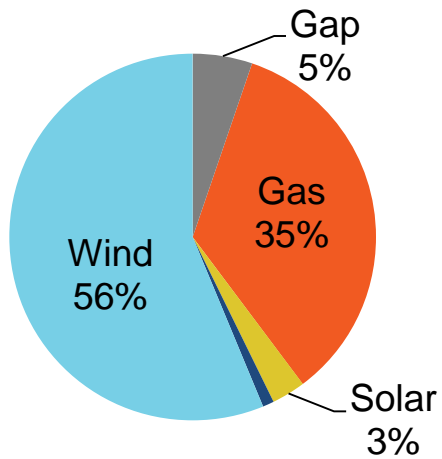




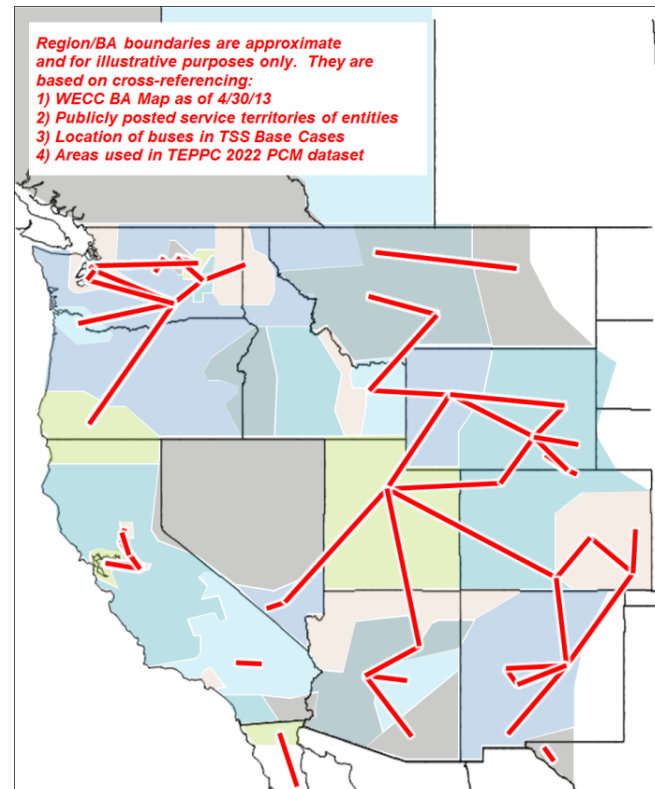
# 20-Year Studies

## Remote Resources = Transmission

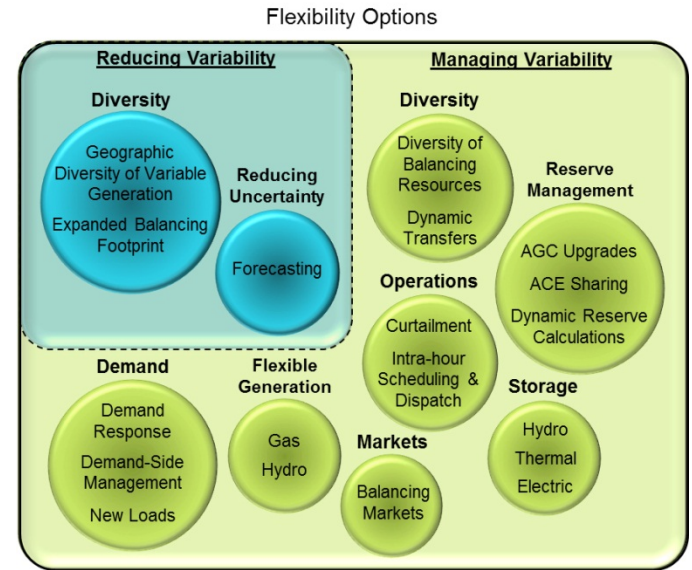
**Resources Added  
2022-2032**



**Transmission Added  
2022-2032**

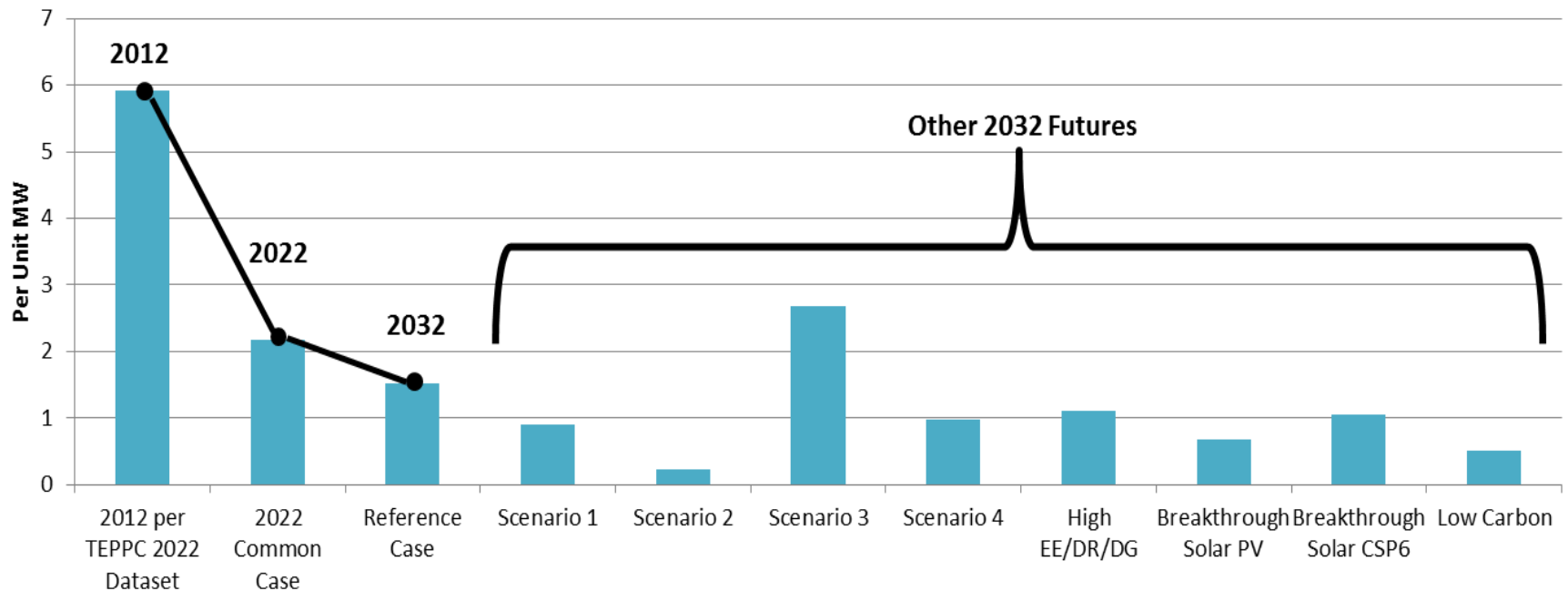


# 20-Year Studies Future System Flexibility



## Flexible Resource Indicator

$$= [\text{Total Gas} + 15\% \text{ Total Hydro Capacity (MW)}] / \text{Total VG Capacity (MW)}$$



# What does WECC do with this analysis?

The screenshot shows a Google Maps interface with the search query "boulder co to denver airport". The map displays a route from Boulder, CO (marked with a green 'A') to Denver International Airport (marked with a green 'B'). A large orange arrow labeled "WECC" originates from Boulder and points towards the airport. The sidebar on the left provides route options and driving directions.

**Get directions** | My places

Google | boulder co to denver airport | Keegan Moyer | + Share

Get directions | My places

Car | Bus | Walking | Bicycling

**A** boulder co  
**B** denver airport  
Add Destination - Show options  
**GET DIRECTIONS**

**Suggested routes**

Route	Distance	Time	Notes
E-470 S	43.8 mi	46 mins	In current traffic: 47 mins
US-36 E and Peña Blvd	44.8 mi	49 mins	In current traffic: 49 mins
US-36 E	47.1 mi	54 mins	In current traffic: 54 mins
Or take Public Transit (Bus)		1 hour 16 mins	

**Driving directions to Denver International Airport**

This route has tolls.  
This route has restricted usage or private roads.

**A** Boulder, CO

1. Head south on 19th St toward Arapahoe Ave  
138 ft
2. Take the 1st left onto Arapahoe Ave  
0.6 mi
3. Turn right onto US-36 E/28th St  
Continue to follow US-36 E  
9.1 mi
4. Take the Storage Tek Dr exit  
0.3 mi

2 mi / 5 km

# *2013 Interconnection-Wide Plan*

## *Key Messages*

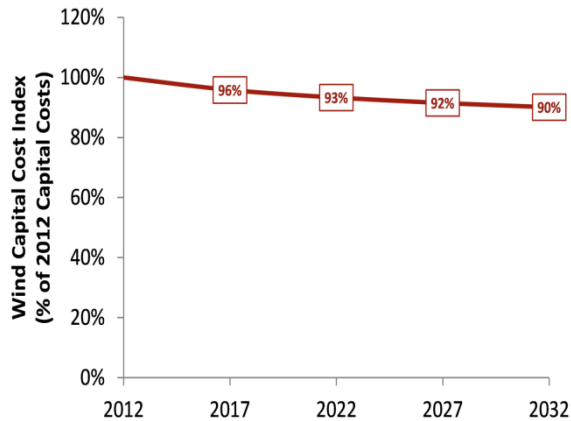
- Interconnection-wide perspective of the transmission system under a wide variety of futures
  - 10-Year: Bottom-up approach, impact of near-term decisions
  - 20-Year: Top-down, drivers of energy futures
- Stakeholder-driven and approved
- Informational, not instructions or orders
- Limitations in scope and intended uses
- The Plan and WECC's reliability mission

*Understanding the impacts of decisions, not determining what should be done*

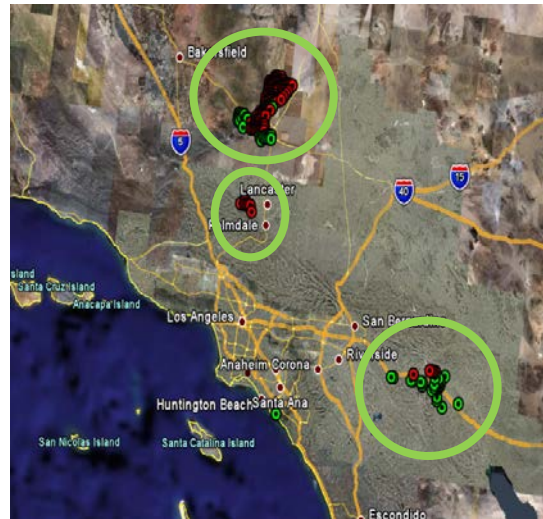
# Wind and Transmission Planning

## Key Considerations

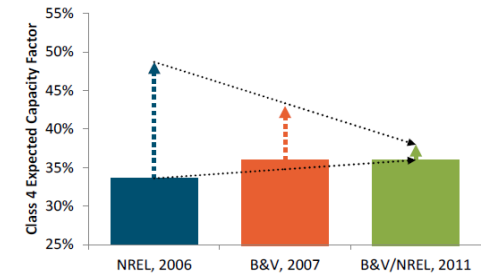
### Capital Cost



### Generation Profiles



### Performance Improvements





# Questions?

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## Work for WECC

[www.wecc.biz](http://www.wecc.biz)

## 2013 Interconnection-Wide Transmission Plan

[http://www.wecc.biz/committees/BOD/TEPPC/Pages/2013\\_Plans.aspx](http://www.wecc.biz/committees/BOD/TEPPC/Pages/2013_Plans.aspx)



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