LA100

The Los Angeles 100% Renewable Energy Study

“No In-Basin Combustion” Scenarios

Brady Cowiestoll, Ph.D.

Los Angeles Department of Water & Power

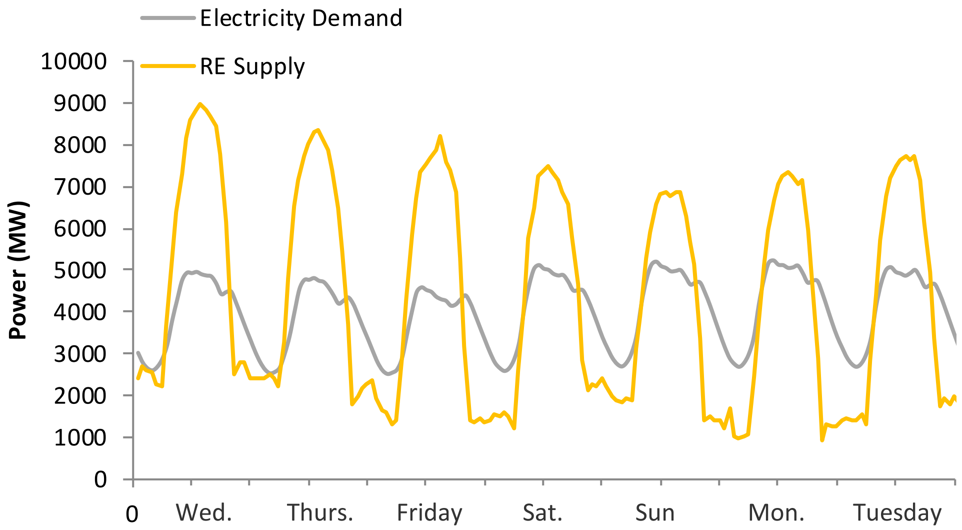
NREL Transforming ENERGY

Three Supply-Side Challenges of a 100% RE System

1. When there **isn't enough** renewable energy
2. When we cannot get it **into the basin**
3. When we cannot get it to the **right places** in basin

Challenge – Not Enough Renewables

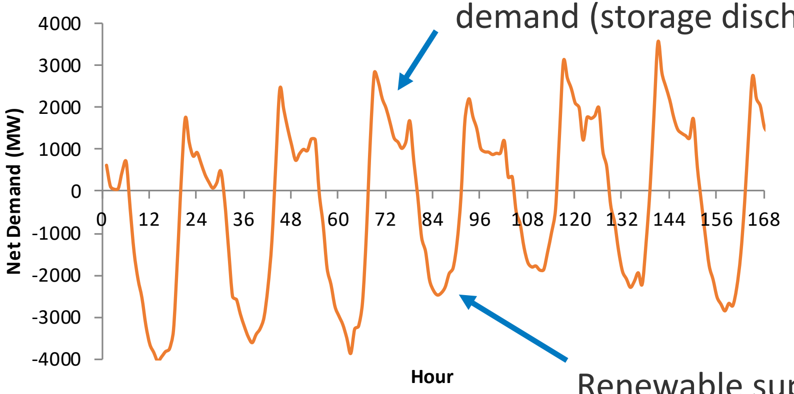
What we want to see: this nice sunny week in July



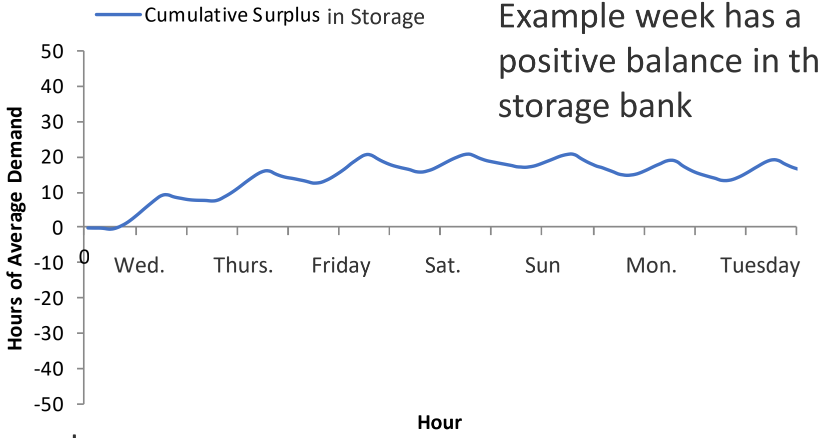
Challenge – Not Enough Renewables

We can balance this net demand with diurnal (day-to-night) shifting technologies

Renewable supply less than demand (storage discharge)



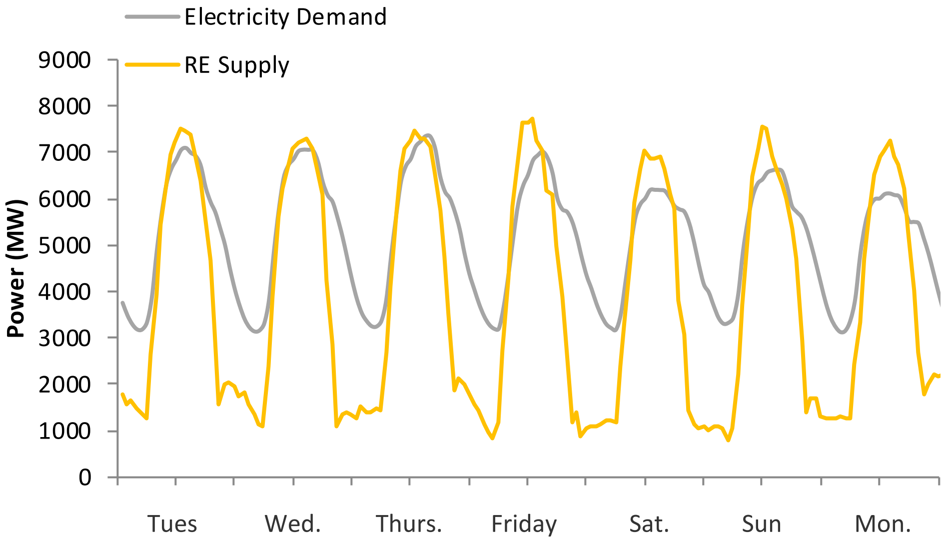
Renewable supply exceeds demand (storage charge)



Example week has a positive balance in the storage bank

Challenge Not Enough Renewables – But Periods of Extended High Demand

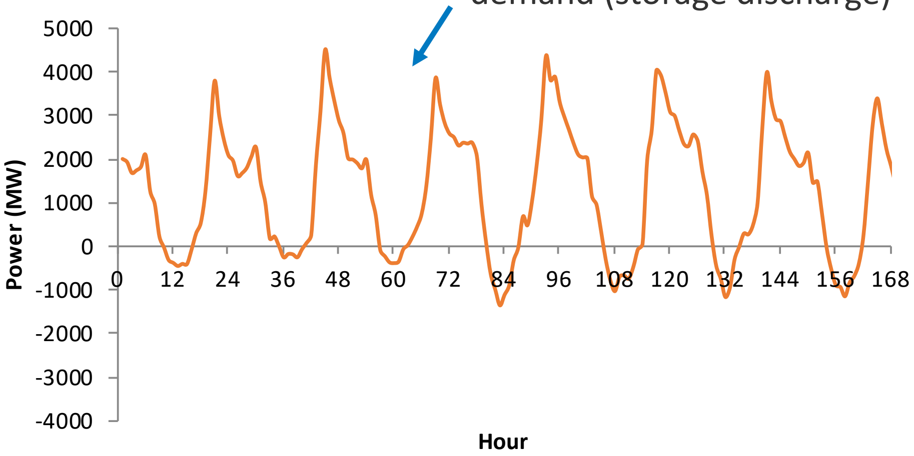
It's nice and sunny, but there isn't very much wind, and demand is very high



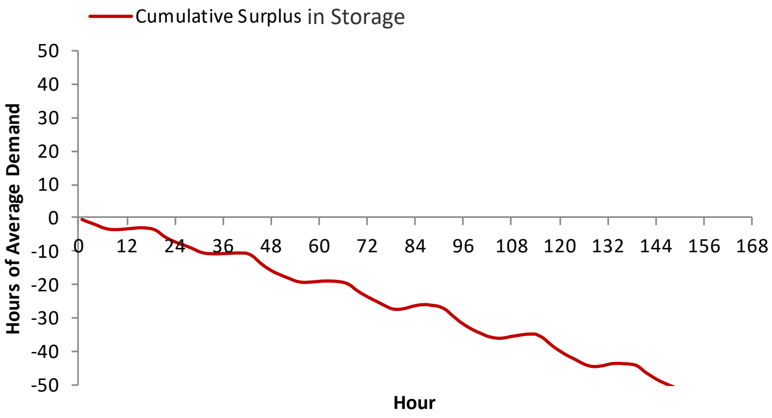
Challenge – Not Enough Renewables

There isn't enough energy to charge our storage

Renewable supply less than demand (storage discharge)

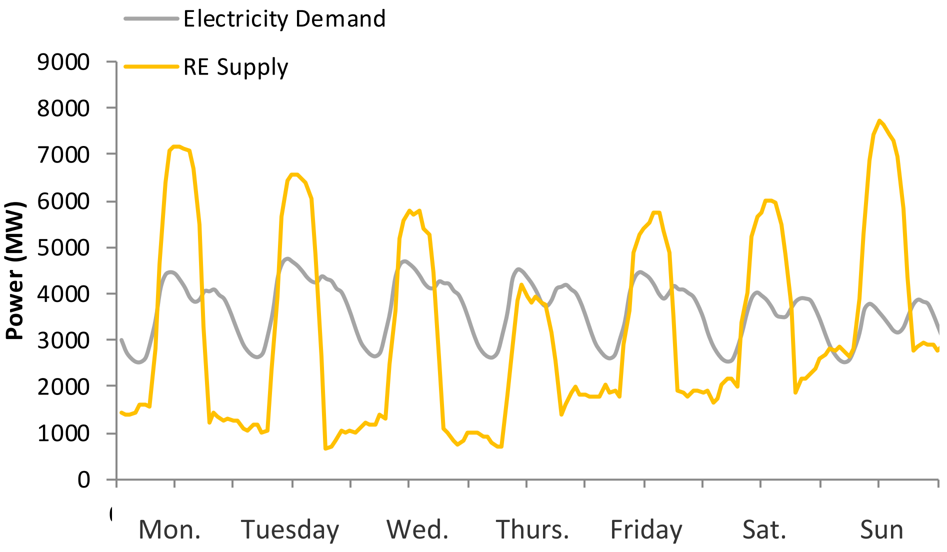


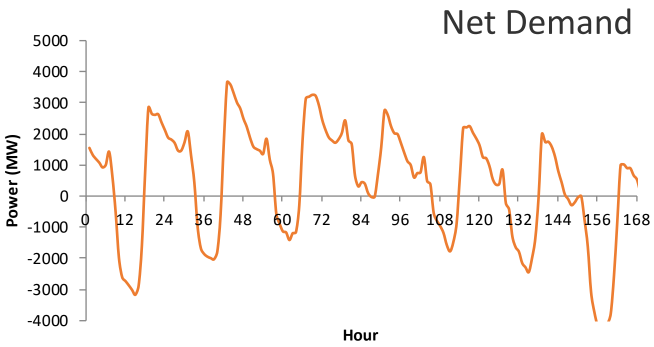
Net Demand

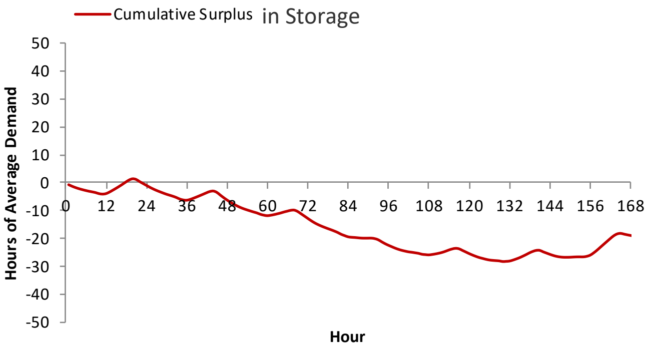


Storage "in the bank"

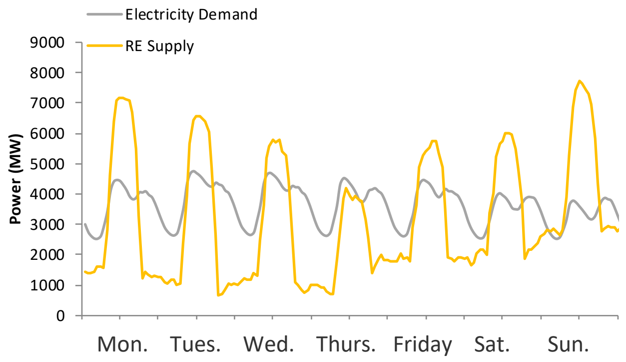
Challenge Not Enough Renewables – This Also Occurs During Lower Demand Periods

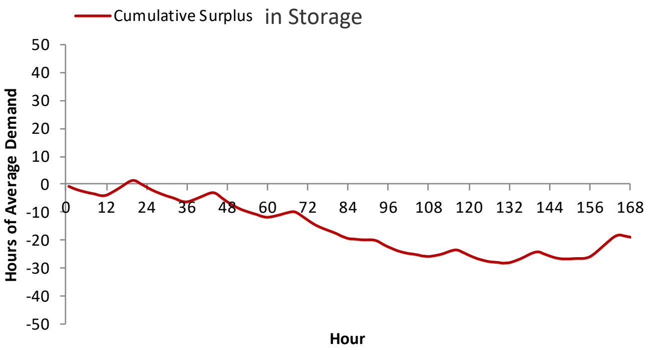


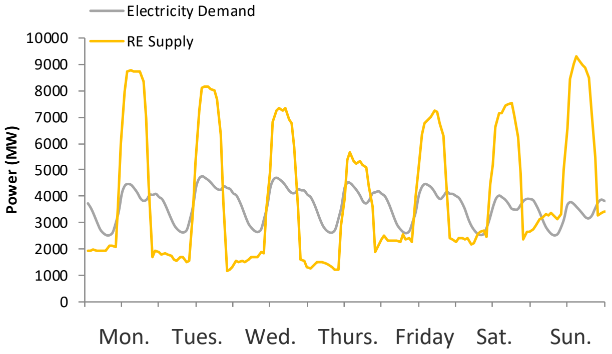


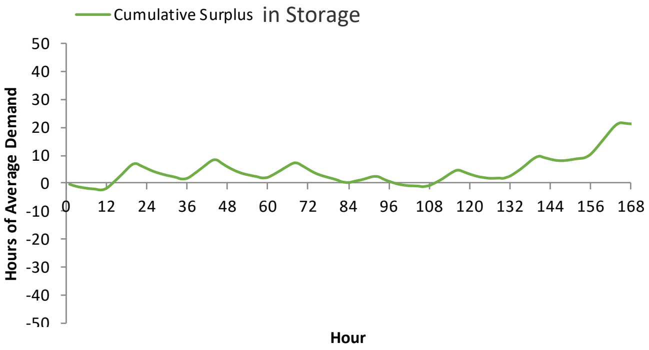


Can't We Just Build More Wind and Solar?





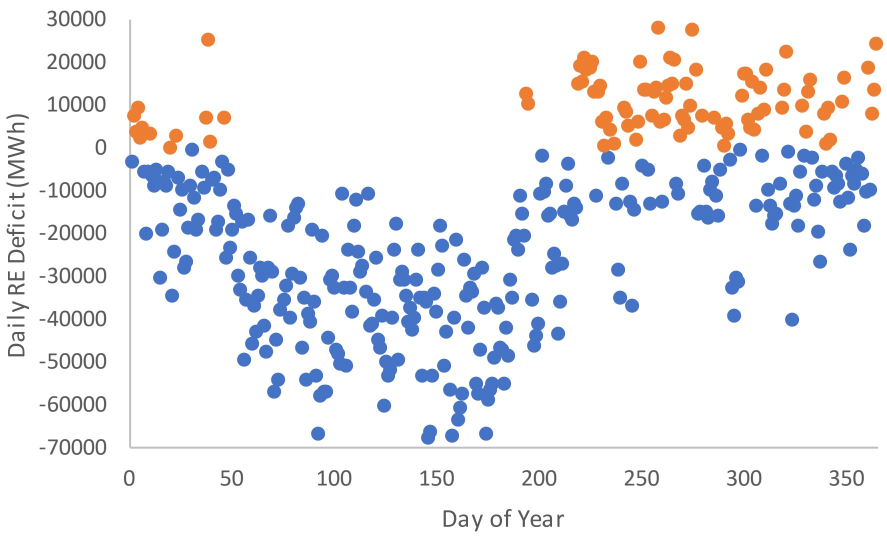




We can throw more PV and batteries at the problem

But we have a utilization problem…

Can’t We Just Build More Wind and Solar?



We don’t really need more **energy**

We need **capacity**

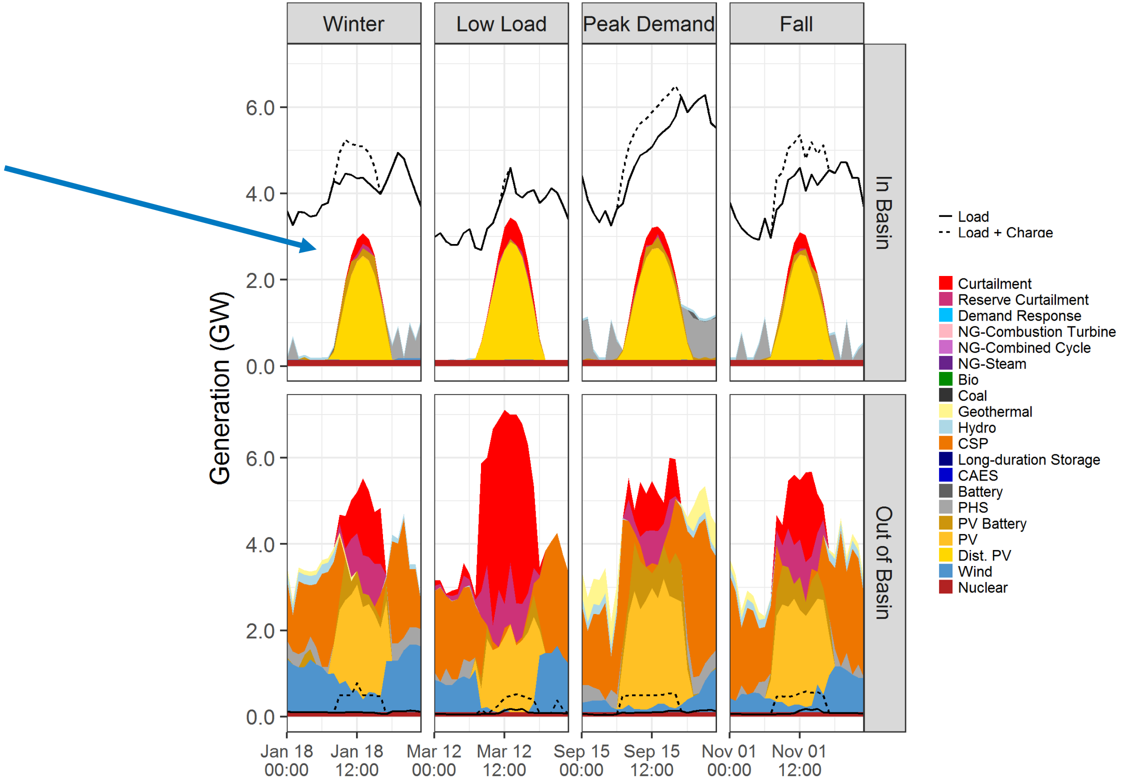
The utilization of these additional renewable resources will be very low (only a few days per year)

Takeaways for Challenge *Not Enough Renewables*

1. It is technically possible but **economically difficult** to get to 100% relying solely on wind, solar and traditional storage (12 hours or less capacity)
2. There are a few days where we don’t have enough supply. If relying on additional solar and wind, they would have a **low utilization rate**, and therefore high cost per kWh
3. But all this depends on **transmission access**, which may be an even bigger challenge

Challenge – Getting it to the Basin

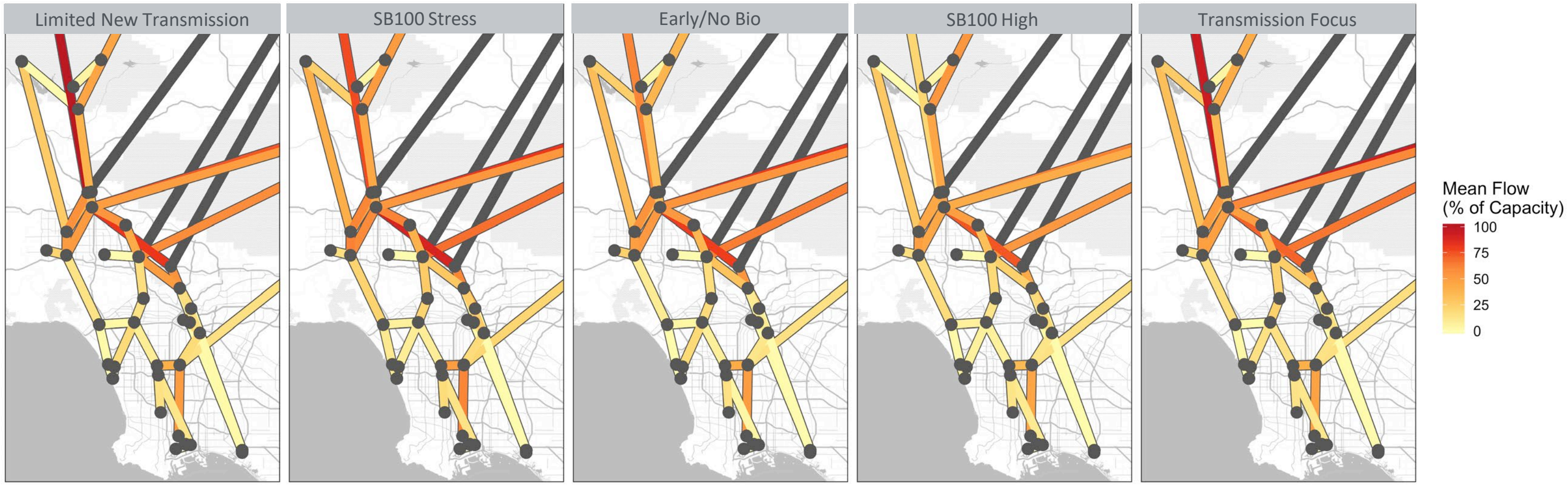
During many hours of the year we are deriving a large fraction of total demand from out-of-basin resources



Challenge – Getting it to the Basin

Leading to large flows on the existing transmission networks

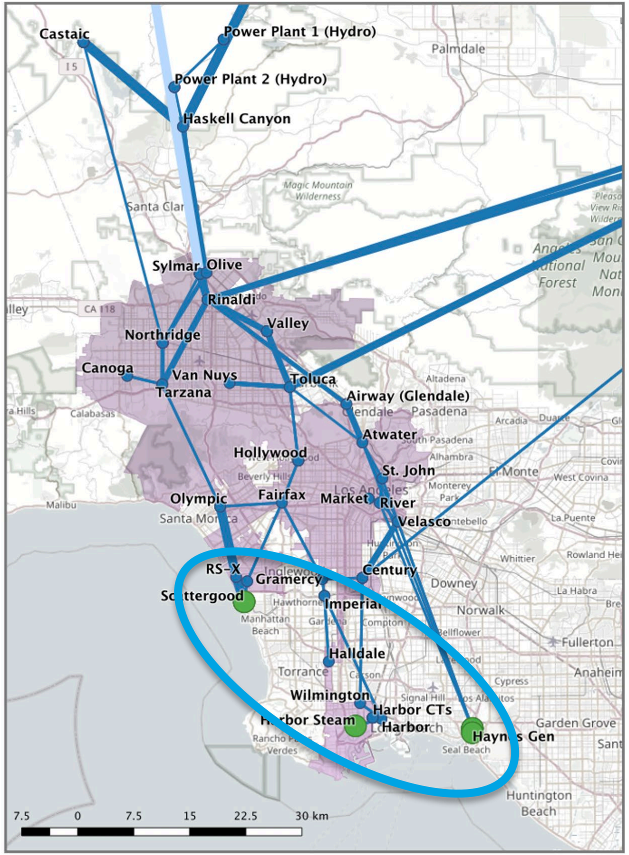
Transmission Flows for Top 500 Hours in 2045



Takeaways for Challenge *Getting it to the Basin*

1. Sometimes transmission **breaks**
2. We either need **new transmission for out-of-basin resources**, or **something in basin** to replace out-of-basin resources for a few days

Challenge – Right Places In-Basin



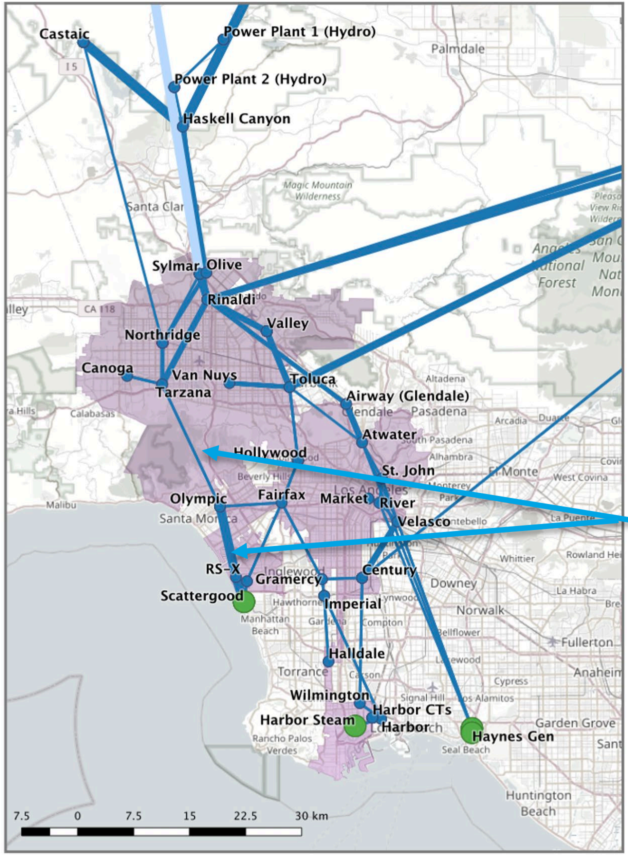
Transmission from the north

The LADWP transmission network was designed in part around power plants at specific locations in the basin.

Transmission limits/outages can be addressed by running generators in the southern part of the system (at OTC sites)

Existing generators in the south

Challenge – Right Places In-Basin



Outages of in-basin transmission make it difficult to meet load in the South

Even without fires, there are still transmission outages for maintenance. (Yes, there are moving parts in the transmission system!)

Takeaway for Challenge *Right Places In-Basin*

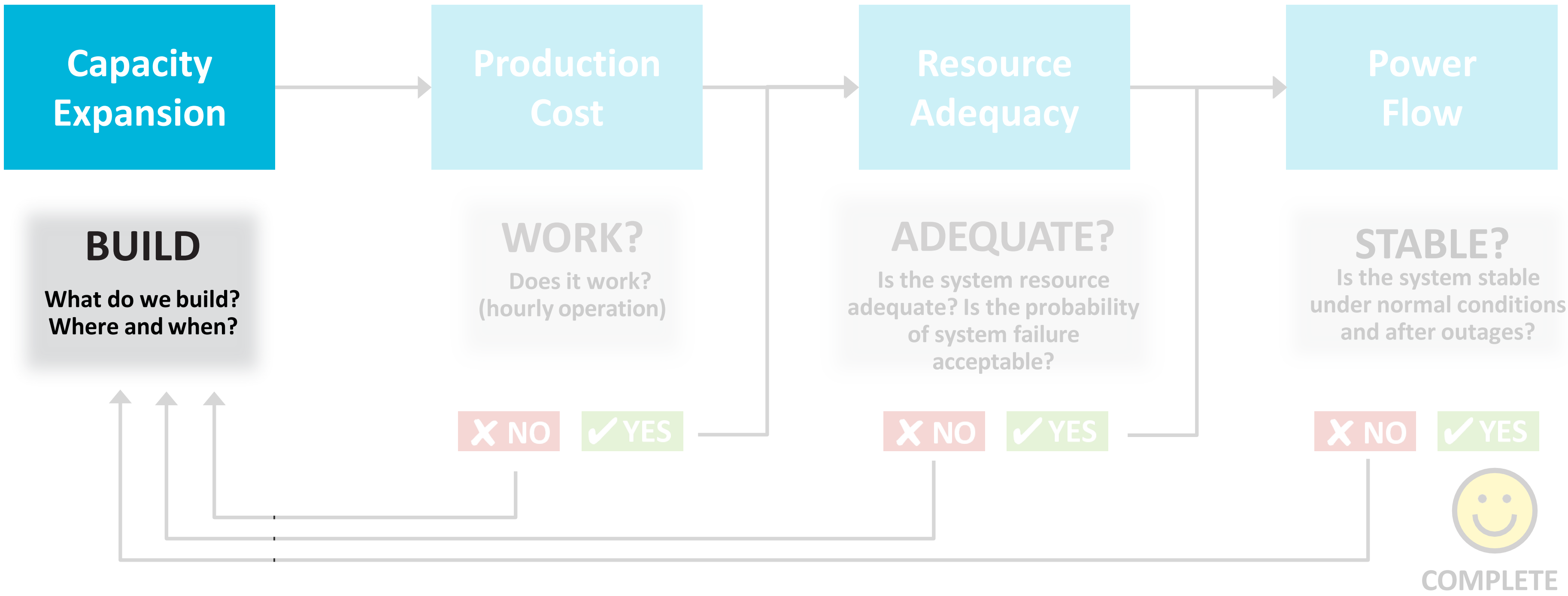
It may be difficult to deliver energy to all points within the basin without **new transmission or in-basin generation at specific locations**

LA100 Analysis of In-Basin Combustion

LA100 looked at “No Combustion” scenarios at two points of the study: early on and as a final sensitivity

- Initial scenario definition of Early/No Biofuels scenario did not include hydrogen of any sort.
  - Reliability challenges were seen, so the AG allowed the inclusion of hydrogen at all locations
- Final scenario sensitivity around Early/No Biofuels scenario included no combustion resources within the LA basin.
  - This sensitivity was not fully analyzed through all tools used for the main scenarios

Bulk System Modeling Approach: Estimate, Then Refine



Key Takeaways

- In-basin long-term dispatchable resources are used infrequently under *normal* grid conditions, but may be heavily relied upon during *stressed* grid conditions
- Lack of in-basin long-term dispatchable resources leads to increased reliance on the transmission system, which creates vulnerability to transmission outages
- Unexpected or low probability events (e.g. wildfires) can be very disruptive in systems with heavy reliance on transmission

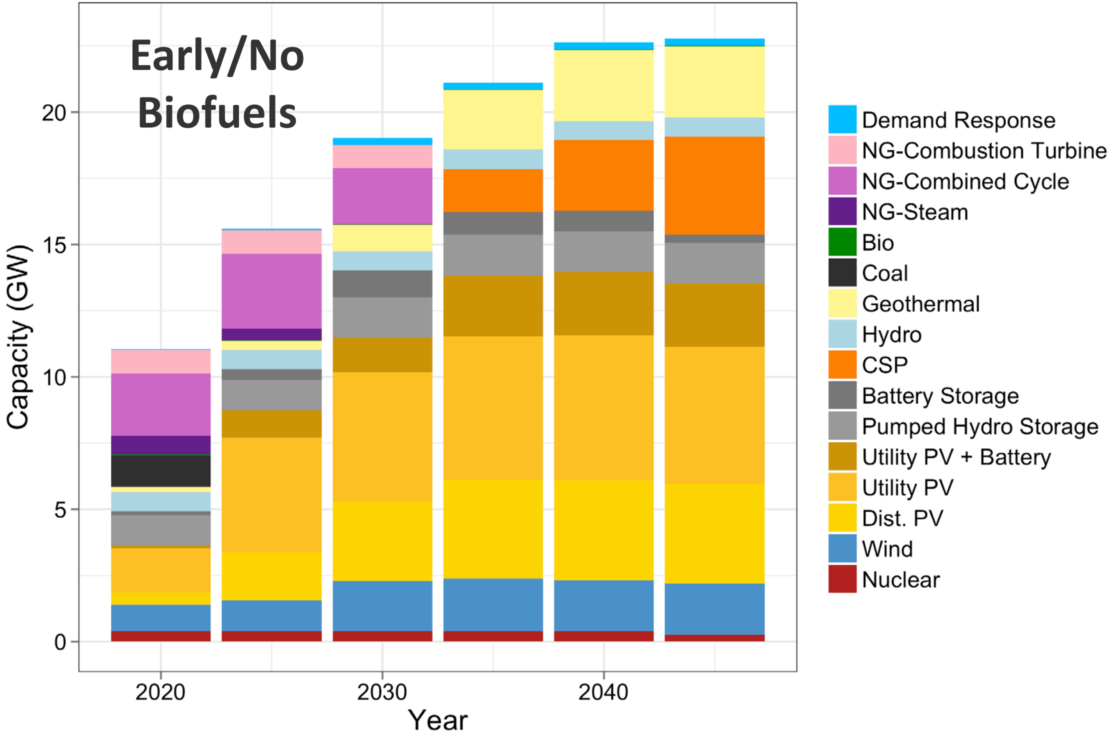
Preliminary scenario analysis without H2

The following results are early results from the LA100 study, were not fully studied and are *not* conclusions of the study.

We are presenting them here to show the discussion and preliminary findings of LA100 around the discussion of combustion in the basin

Restricting the eligibility of natural gas and biomass requires reliance on storage and other dispatchable renewable generation

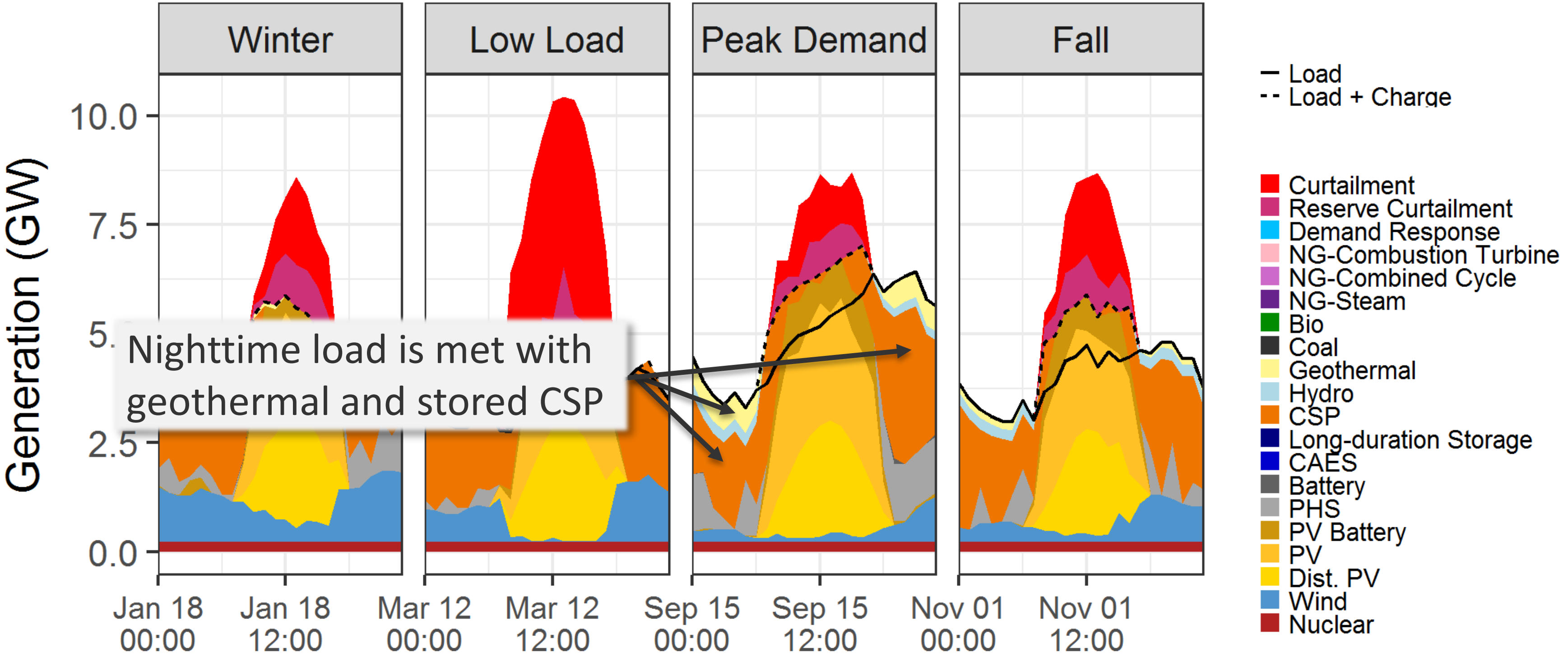
EARLY RESULTS, NOT PART OF FINAL LA100 ANALYSIS



Initial Run – For Discussion Purposes Only; Subject to Change

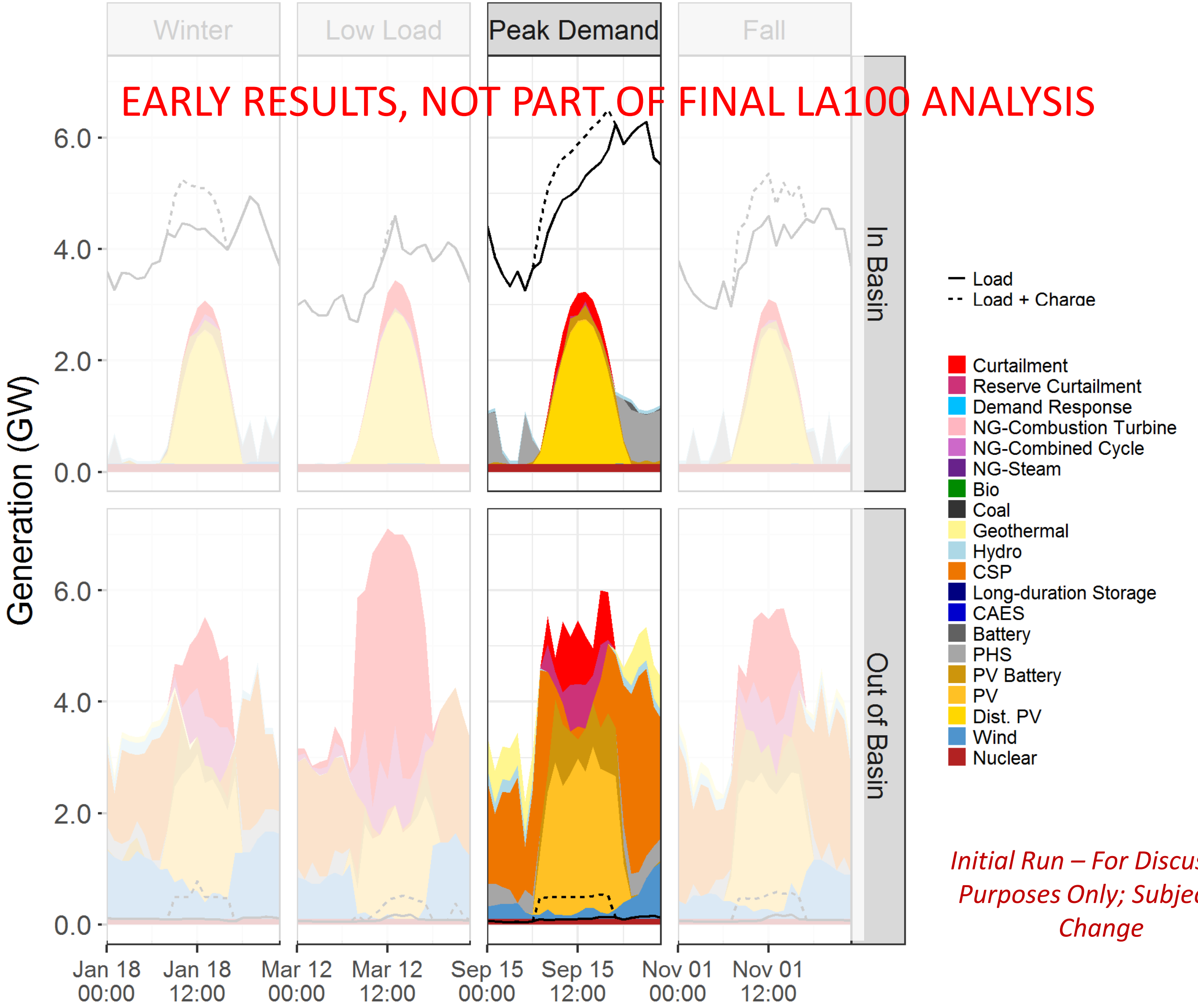
Initial Run, **Early/No Biofuel**: Morning, evening, and night hours met with wind, storage, and geothermal

EARLY RESULTS, NOT PART OF FINAL LA100 ANALYSIS



Initial Run – For Discussion Purposes Only; Subject to Change

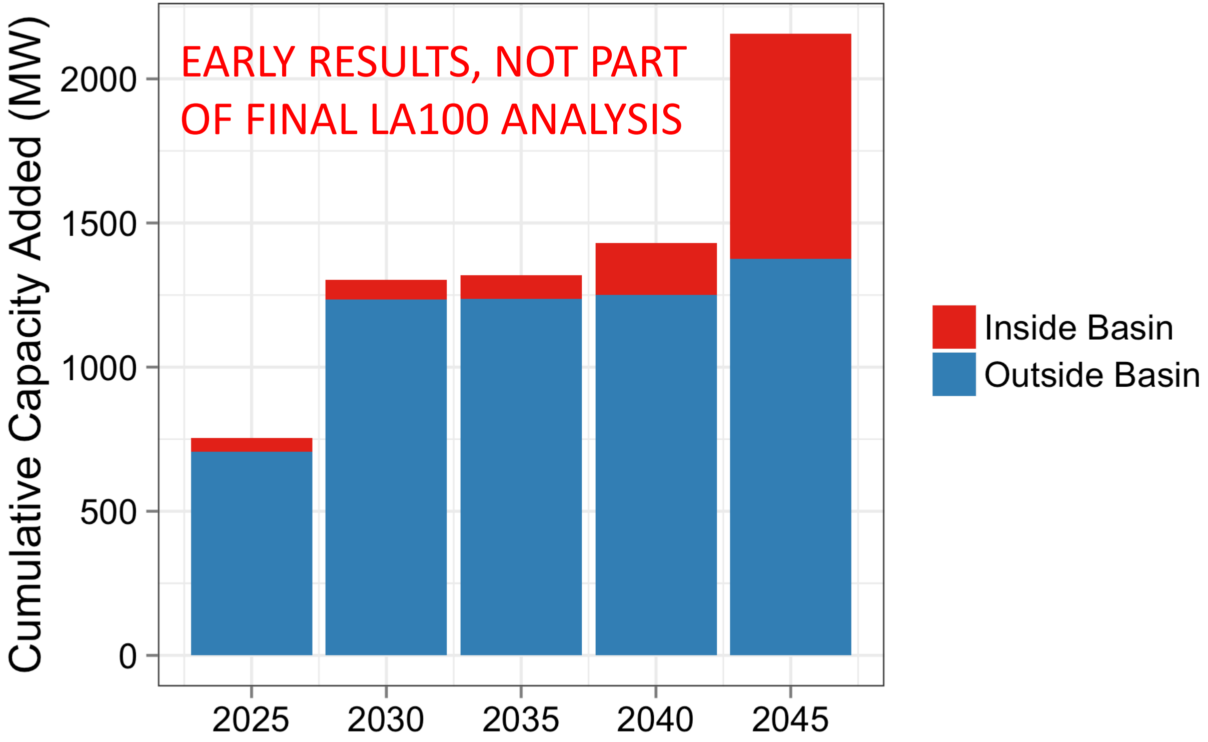
Initial Run, **Early/No Biofuels**: Relying on a greater share of out-of-basin storage resources during morning, evening, night hours



Initial Run – For Discussion Purposes Only; Subject to Change

Initial Run, ***Early/No Biofuels***: Greater reliance on out-of-basin resources requires more out- and in-basin transmission

Early/No Biofuels, Transmission Upgrades



Initial Run – For Discussion Purposes Only; Subject to Change

Although substantial transmission capacity is available to carry energy into the basin, in the absence of mitigating options, longer-duration transmission outages could be challenging

This applies to outages both in and out of the basin outages

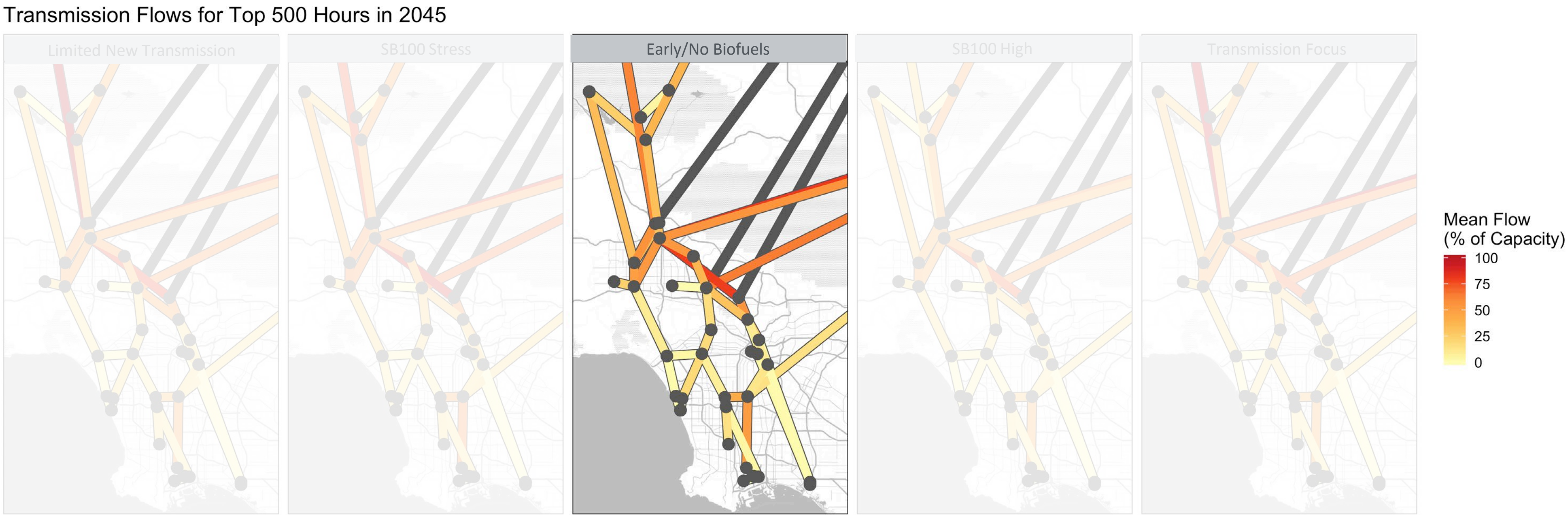
Existing Transmission: Out- to In-Basin

Thermal Capacity Ratings:

- PDCI (connects in north: Sylmar): 1,240 MW
- Barren Ridge to Haskell Canyon: 2,850 MW in 2022
- Adelanto/Victorville—LA lines (VIC-LA):
  - To Rinaldi (north): 1,592 MW (from Vic), 1,593 MW (from Adelanto)
  - To Toluca (adjacent to Glendale): 1,845 MW
  - To Century (Watts): 866 MW
- **TOTAL: 9,986 MW**
- **Power flow issues can reduce effective ratings**

Initial Run, **All Scenarios**: Transmission flows

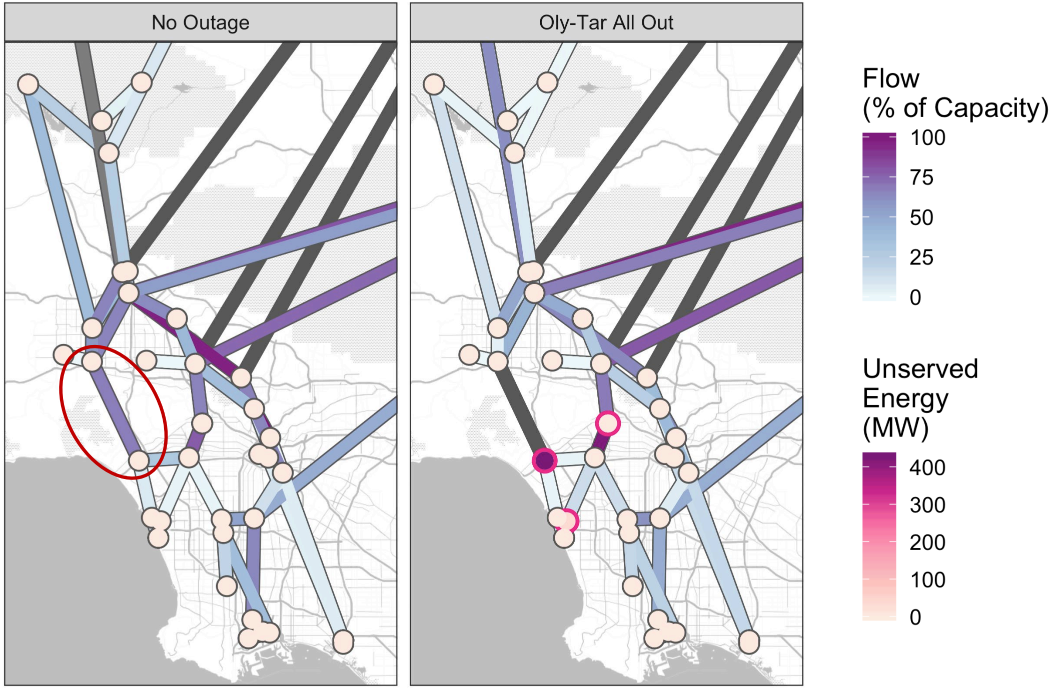
EARLY RESULTS, NOT PART OF FINAL LA100 ANALYSIS



Initial Run – For Discussion Purposes Only; Subject to Change

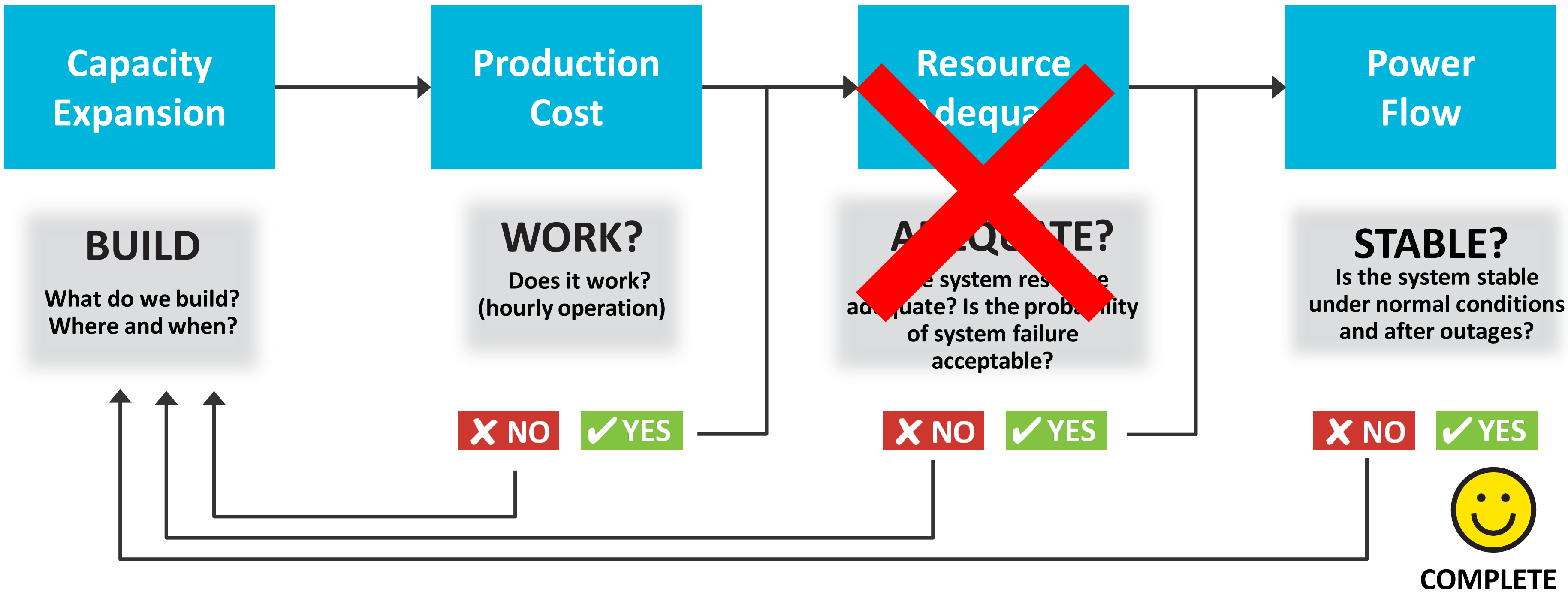
Initial Run, **Early/No Biofuels**: What happens if a long-duration outage occurs along a key transmission pathway?

EARLY RESULTS, NOT PART OF FINAL LA100 ANALYSIS



Initial Run – For Discussion Purposes Only; Subject to Change

Bulk System Modeling Approach: Estimate, Then Refine



Sensitivities on Final Scenarios

Early/No Biofuels High, Core

Early/No Biofuels High, No In-basin Combustion

Early/No Biofuels High, Allow RECs

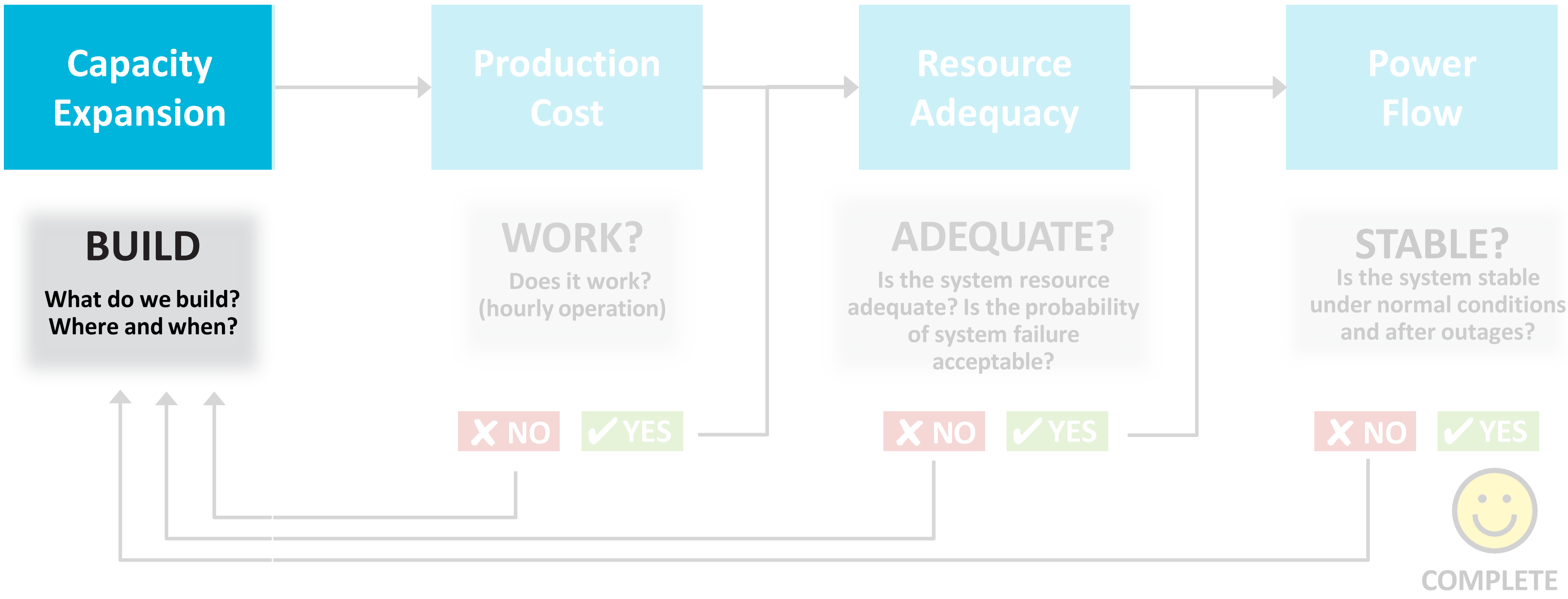
Sensitivities on Final Scenarios

Early/No Biofuels High, Core

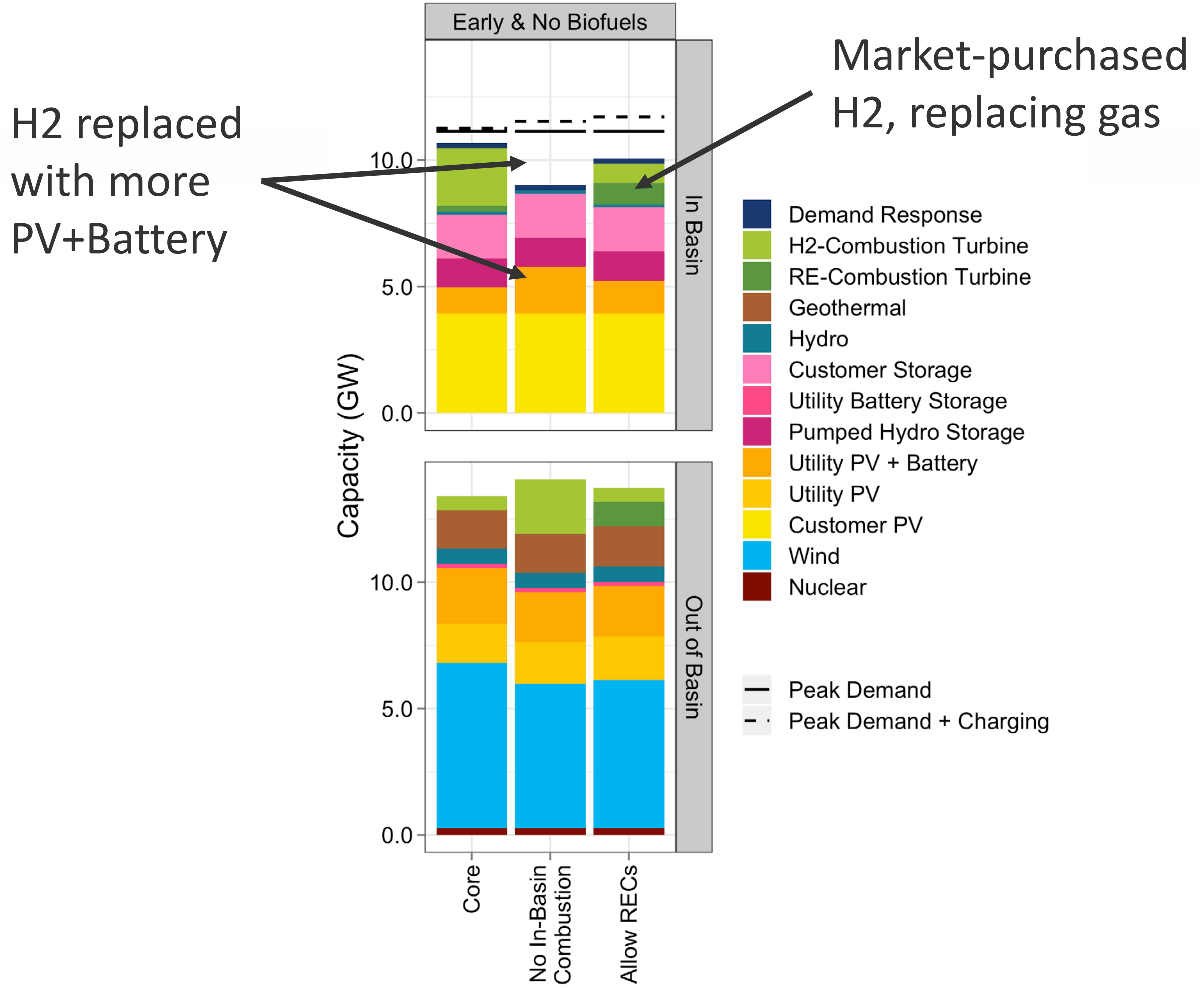
Early/No Biofuels High, No In-basin Combustion

Early/No Biofuels High, Allow RECs

Bulk System Modeling Approach: Estimate, Then Refine



Early/No Biofuels Sensitivities: Disallowing combustion shifts capacity outside the basin



Greater reliance on out-of-basin resources requires more out- and in-basin transmission

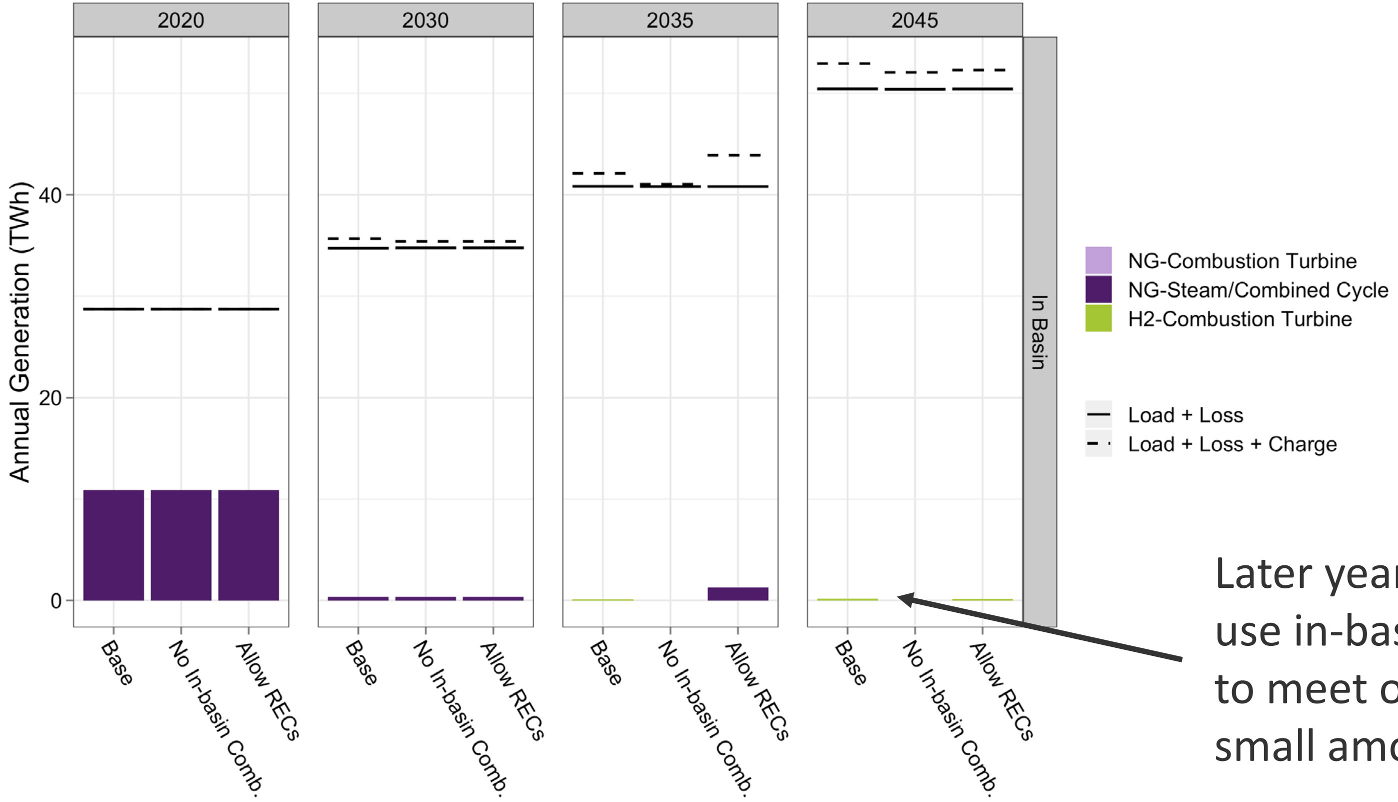
Location	Core	No In Basin Combustion	Allow RECs
In Basin	468 MW 3 lines 24.8 km	1,457 MW 8 lines 90 km	143 MW 3 lines 38 km
Out of Basin	2,354 MW 3 lines 379 km	2,032 MW 2 lines 107 km	

Use of in-basin hydrogen generally small

Capacity Factor of All Combustion, Hydrogen

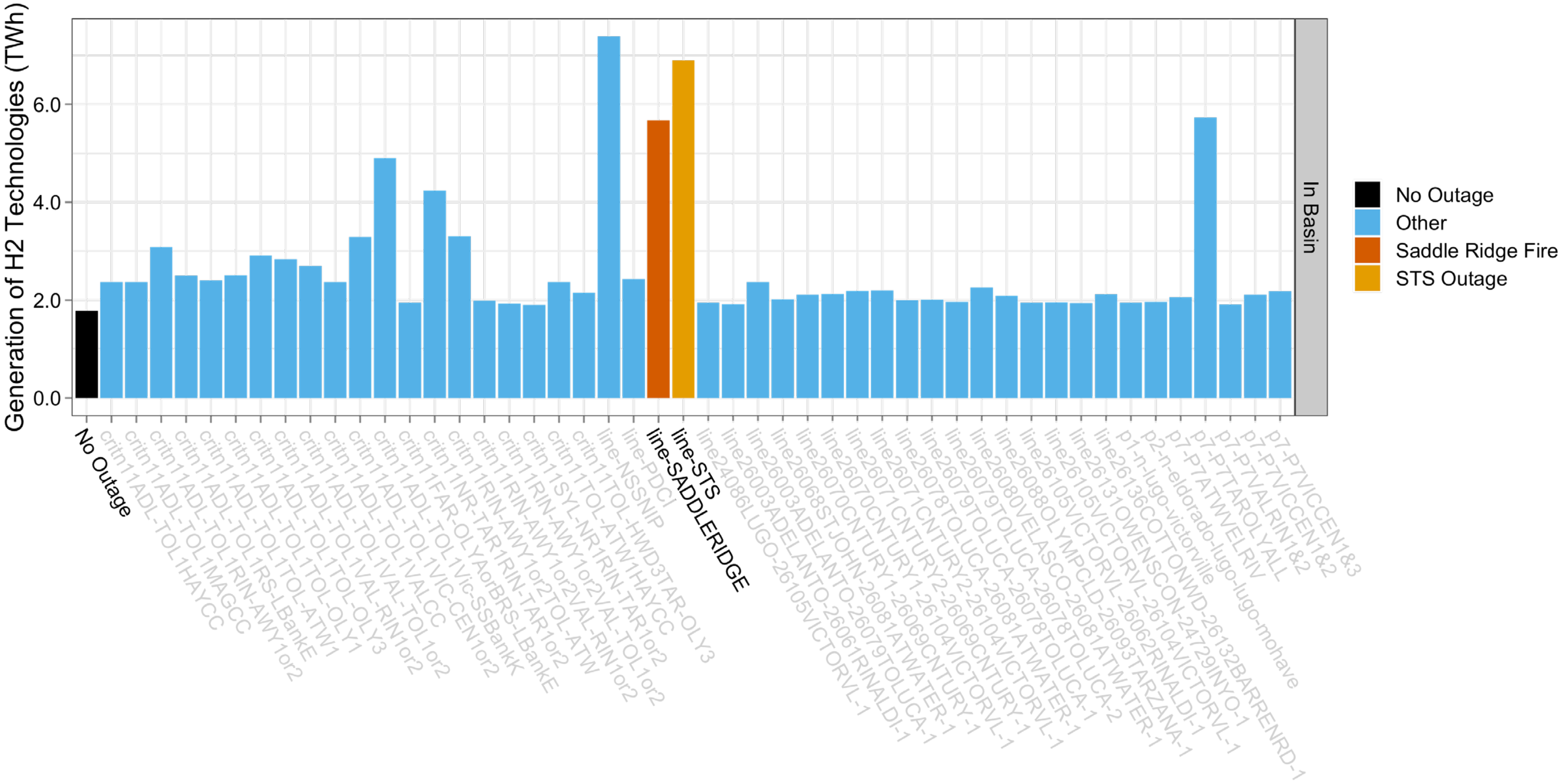
Year	RPM, Core	RPM, No In-Basin Comb.	RPM, Allow RECs
2025	10%, 0%	14%, 0%	14%, 0%
2030	2%, 0%	2%, 0%	2%, 0%
2035	0.5%, 0.5%	0%, 0%	8%, 0%
2040	0.4%, 0.4%	0%, 0%	4%, 1%
2045	1%, 1%	0%, 0%	2%, 2%

In-basin combustion units are not used regularly in standard operating conditions



Later years expect to use in-basin hydrogen to meet only a very small amount of load

Hydrogen is used much more during certain outage conditions on the grid



Key Takeaways

- In-basin long-term dispatchable resources are used infrequently under *normal* grid conditions, but may be heavily relied upon during *stressed* grid conditions
- Lack of in-basin long-term dispatchable resources leads to increased reliance on the transmission system, which creates vulnerability to transmission outages
- Unexpected or low probability events (e.g. wildfires) can be very disruptive in systems with heavy reliance on transmission