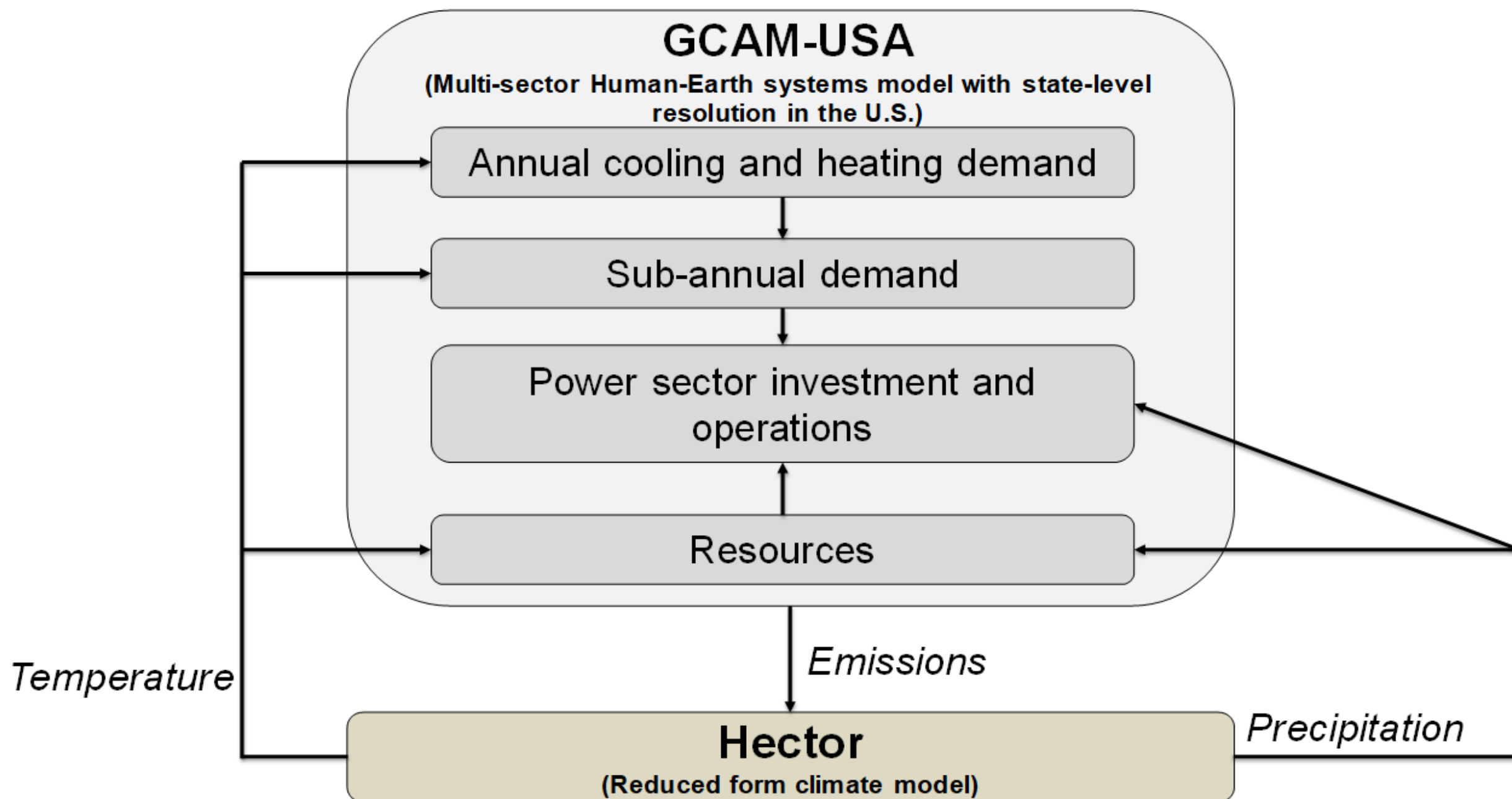


GCAM-USA Energy Modeling

Gokul Iyer



Overarching vision



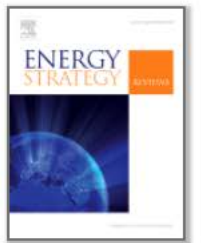
Paper on Electric Capacity and Dispatch Modeling in GCAM-USA

- New analysis capabilities (endogenous in GCAM-USA)
 - Sub-annual electricity demand and production
 - Separate demands (and markets) for electric capacity and electricity demand
 - Capacity investment based on imperfect expectations, non-linear cost distribution
 - Dispatch (or short-term supply) based on linear cost minimization given capacity constraints



Energy Strategy Reviews

Volume 26, November 2019, 100411



Representing power sector detail and flexibility in a multi-sector model

Marshall Wise , Pralit Patel , Zarrar Khan , Son H. Kim , Mohamad Hejazi , Gokul Iyer 

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<https://doi.org/10.1016/j.esr.2019.100411>

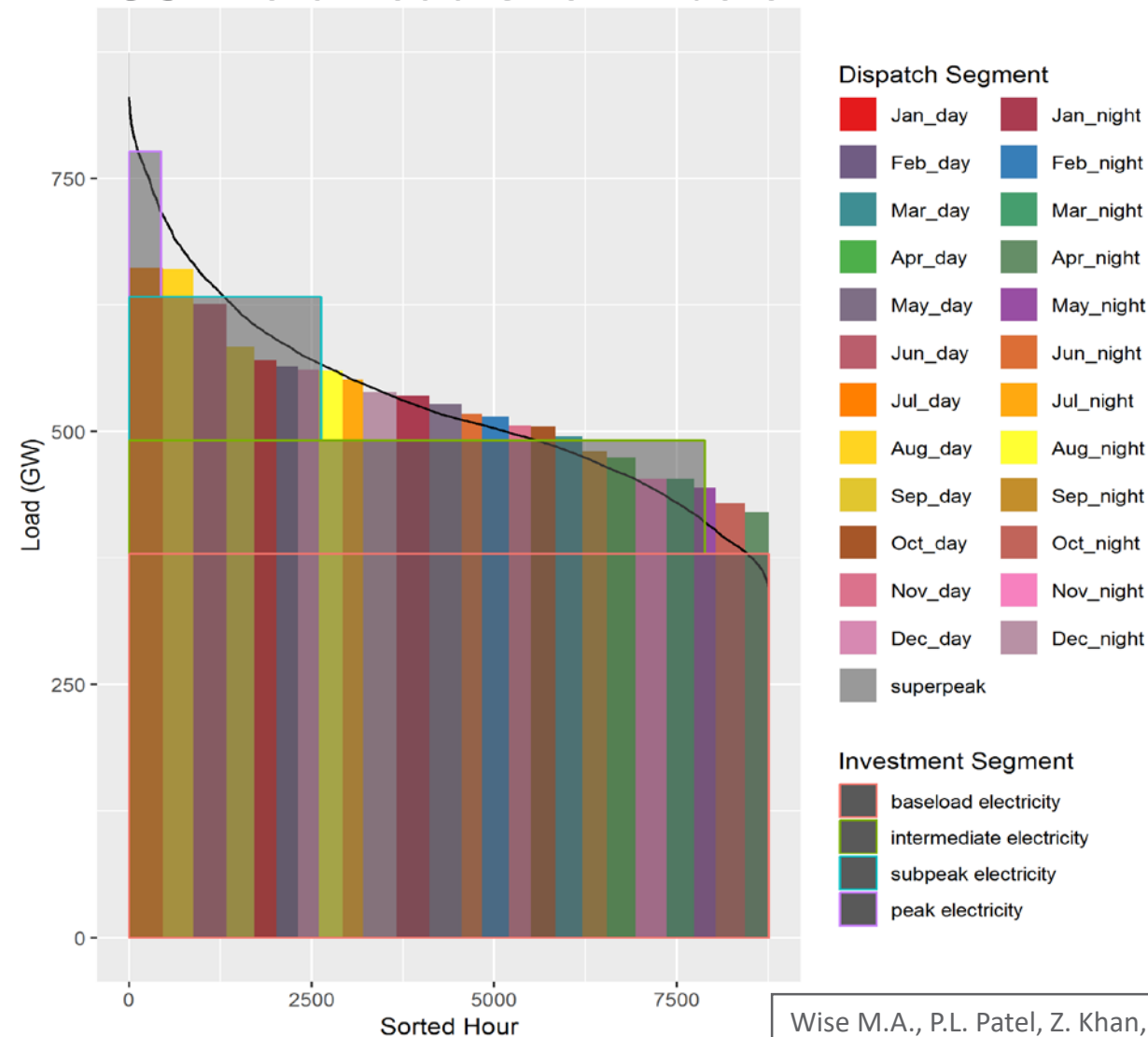
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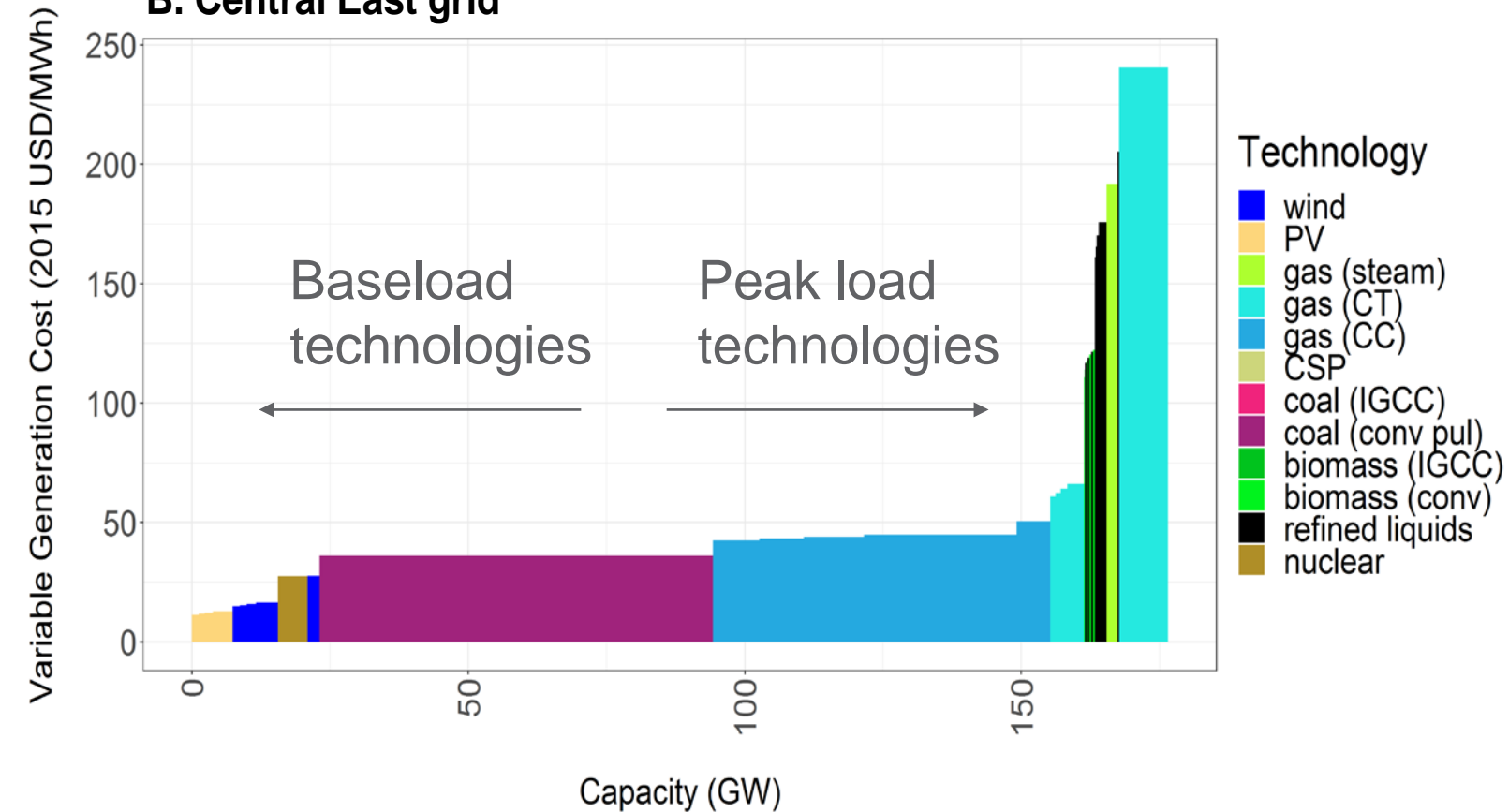
Capability to separate investment and dispatch decisions and improved sub-annual dynamics in GCAM-USA

Region specific sub-annual load profiles (load duration curves):
USA total load shown below



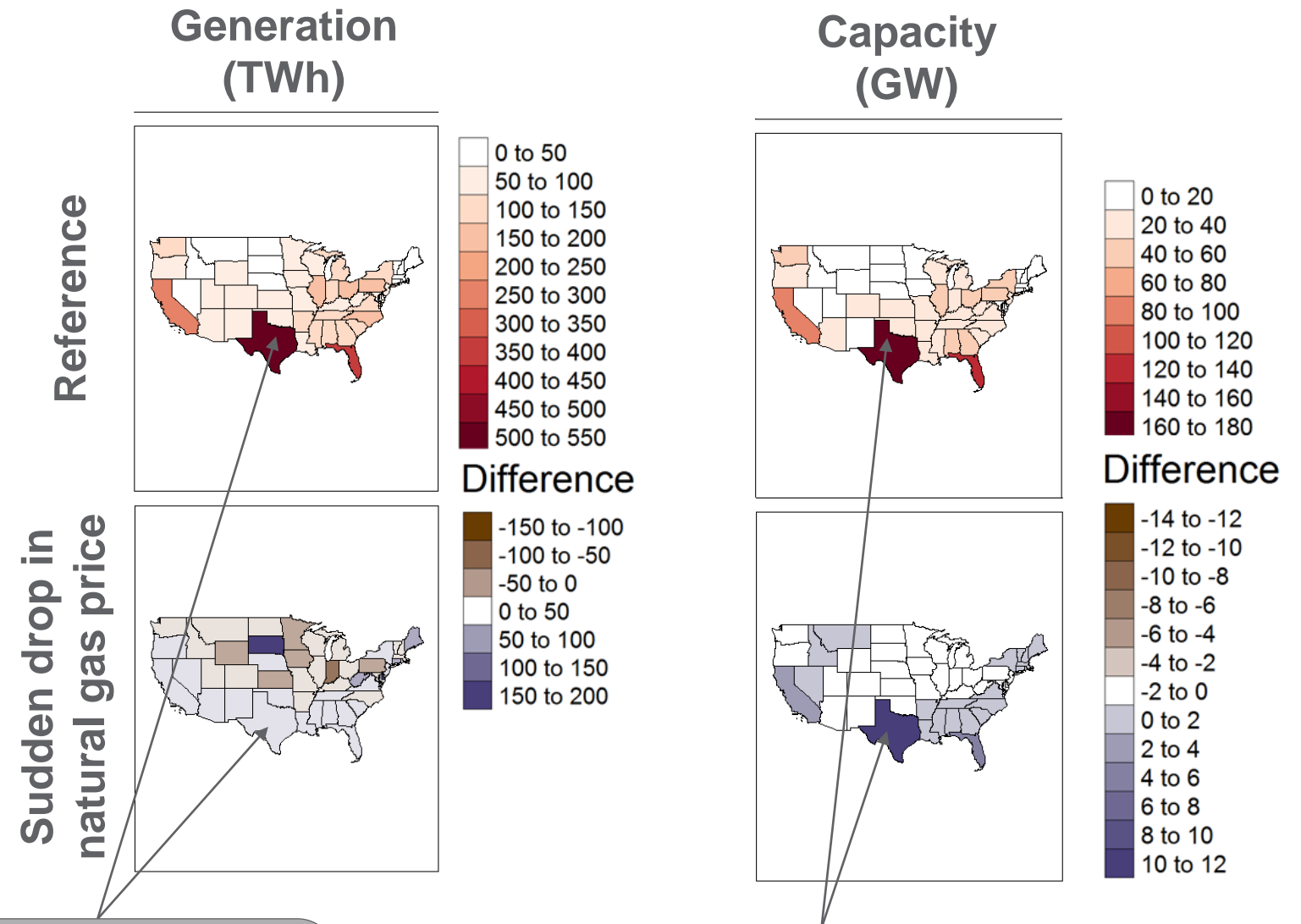
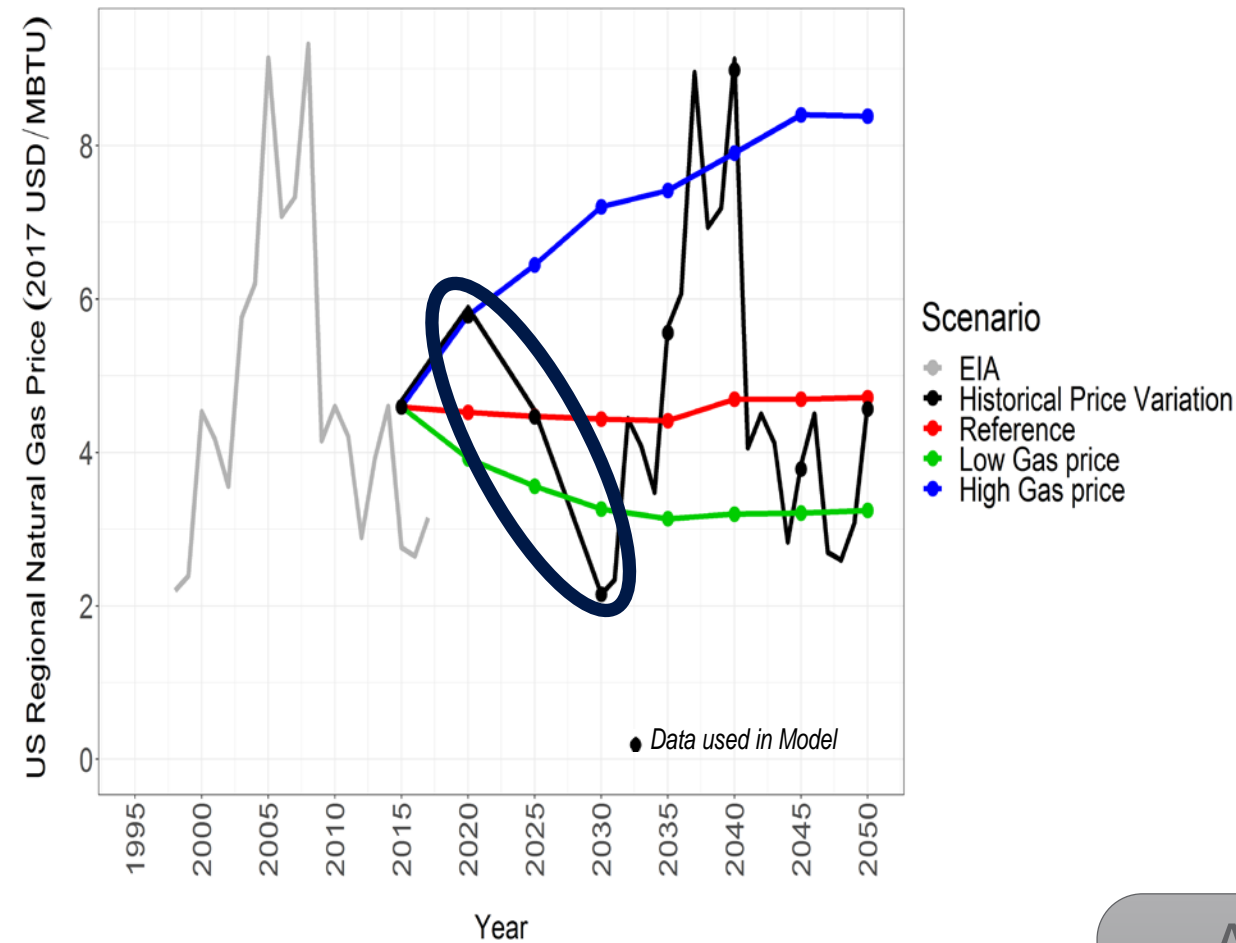
Dispatch decisions based on merit order (i.e., least to highest operating or variable cost)

B. Central East grid



Improved operational flexibility under unexpected future changes (e.g. rapid change in natural gas prices)

U.S. Natural Gas Prices



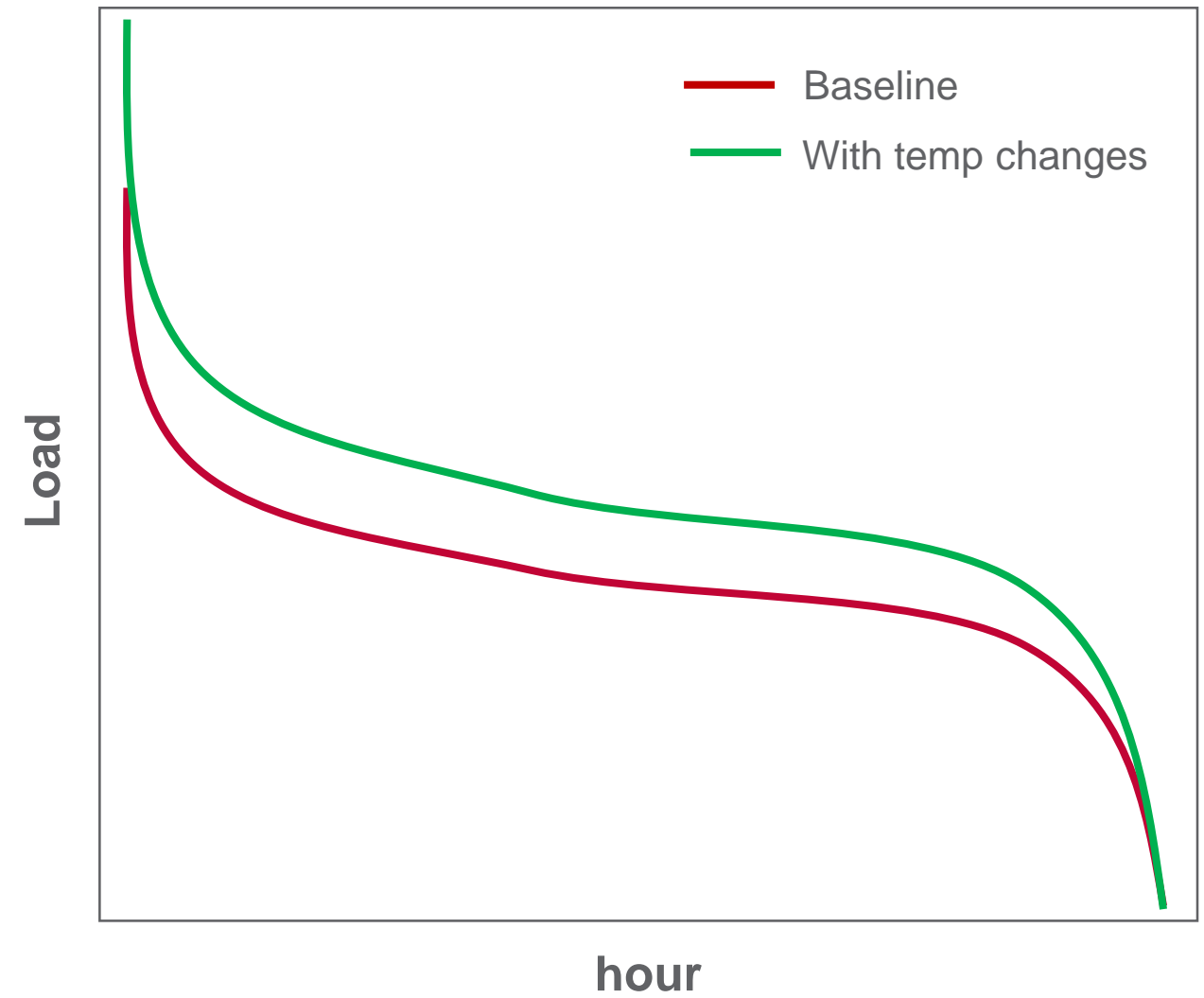
About 50% increase in generation

<10% increase in capacity

Capability to explore climate impacts on power sector investments and dispatch endogeneously

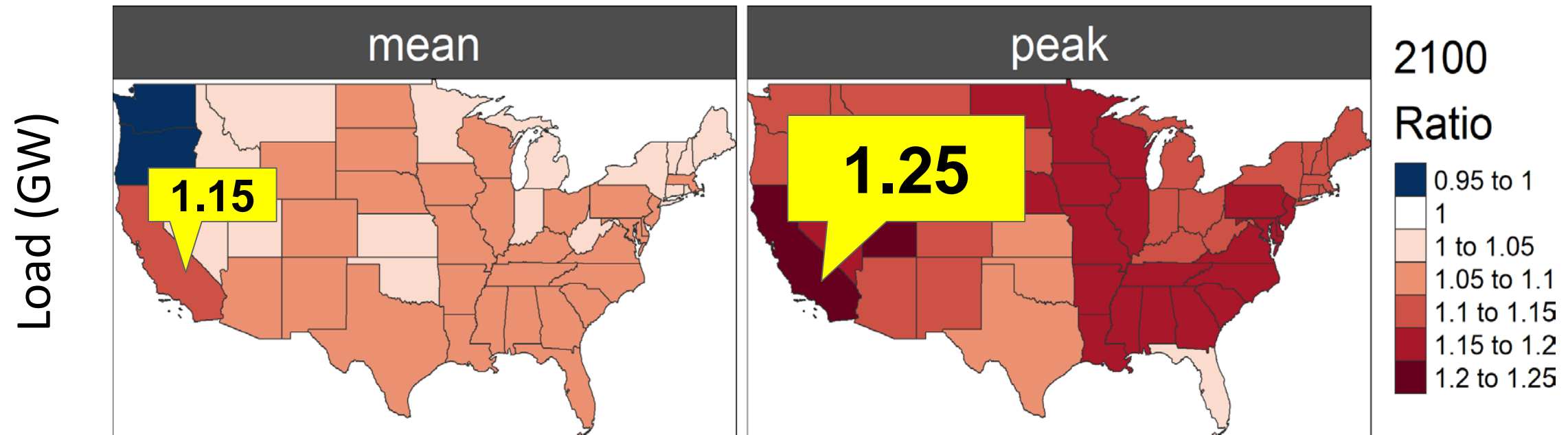
Conceptual LDC shifts with Temperature change

- We have developed the capability for load duration curves (LDC) to change endogeneously in response to temperature changes.
- The model endogeneously resolves capacity requirements to meet peak load increases in ten hours in
- Using this updated model, we are able to show that:
 - Impacts of temperature change on peak load is greater than the mean.
 - These differential impacts have important implications for capacity expansion.

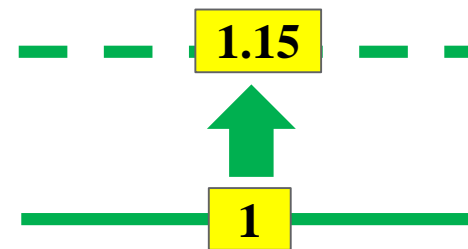


Impact of temperature change on peak load is greater than mean

Ratio of load in 2100 in *RCP8.5 w/ climate impacts* to load in *RCP8.5 w/o climate impacts*

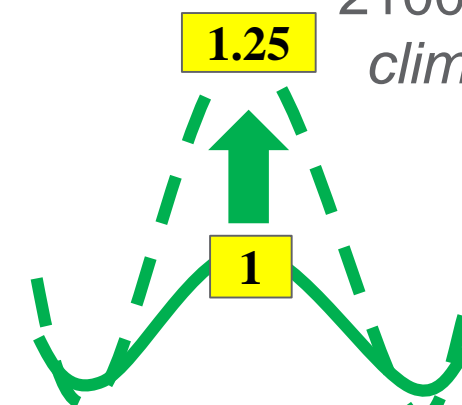


2100 *RCP8.5 w/ climate impacts*



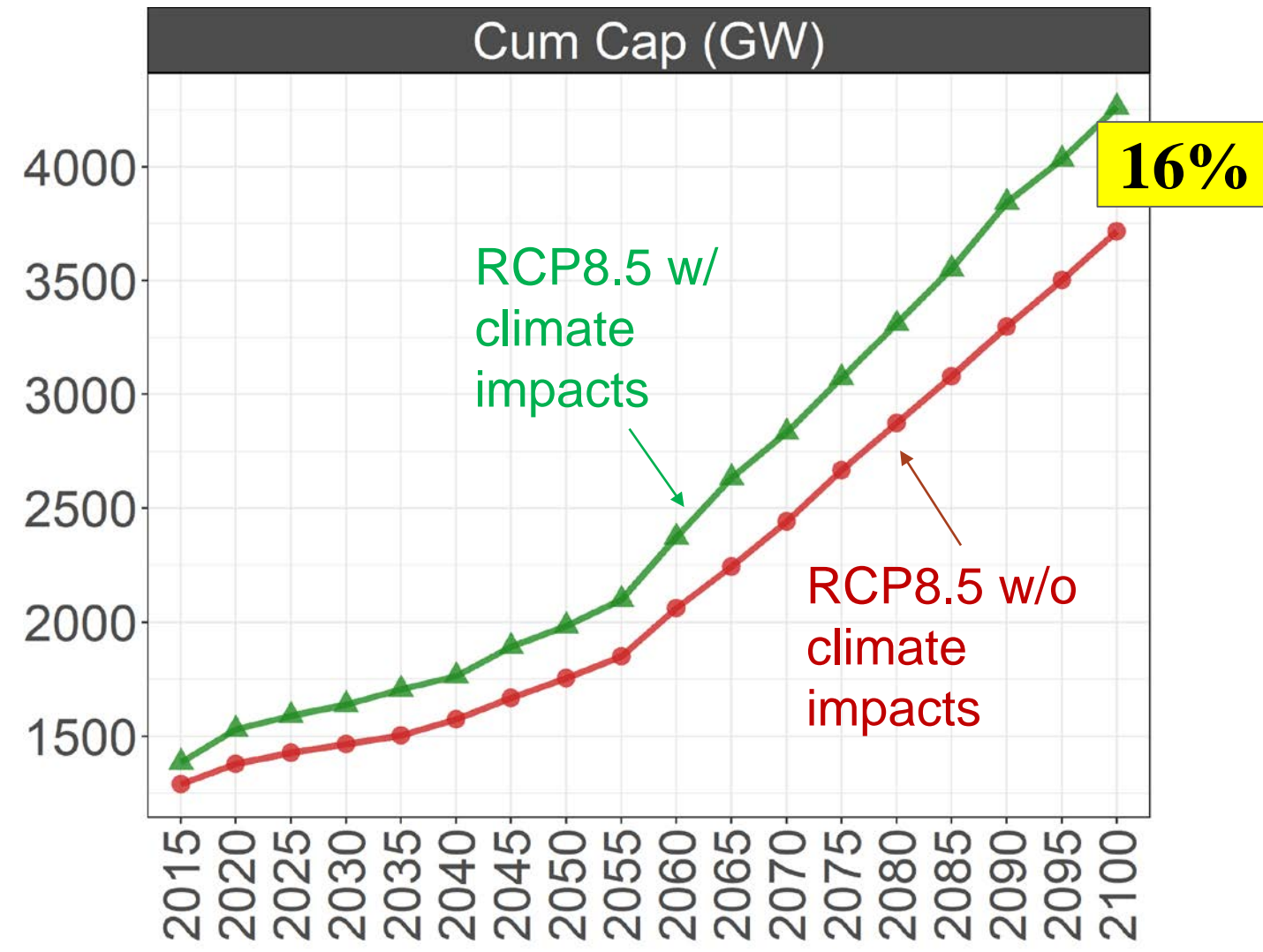
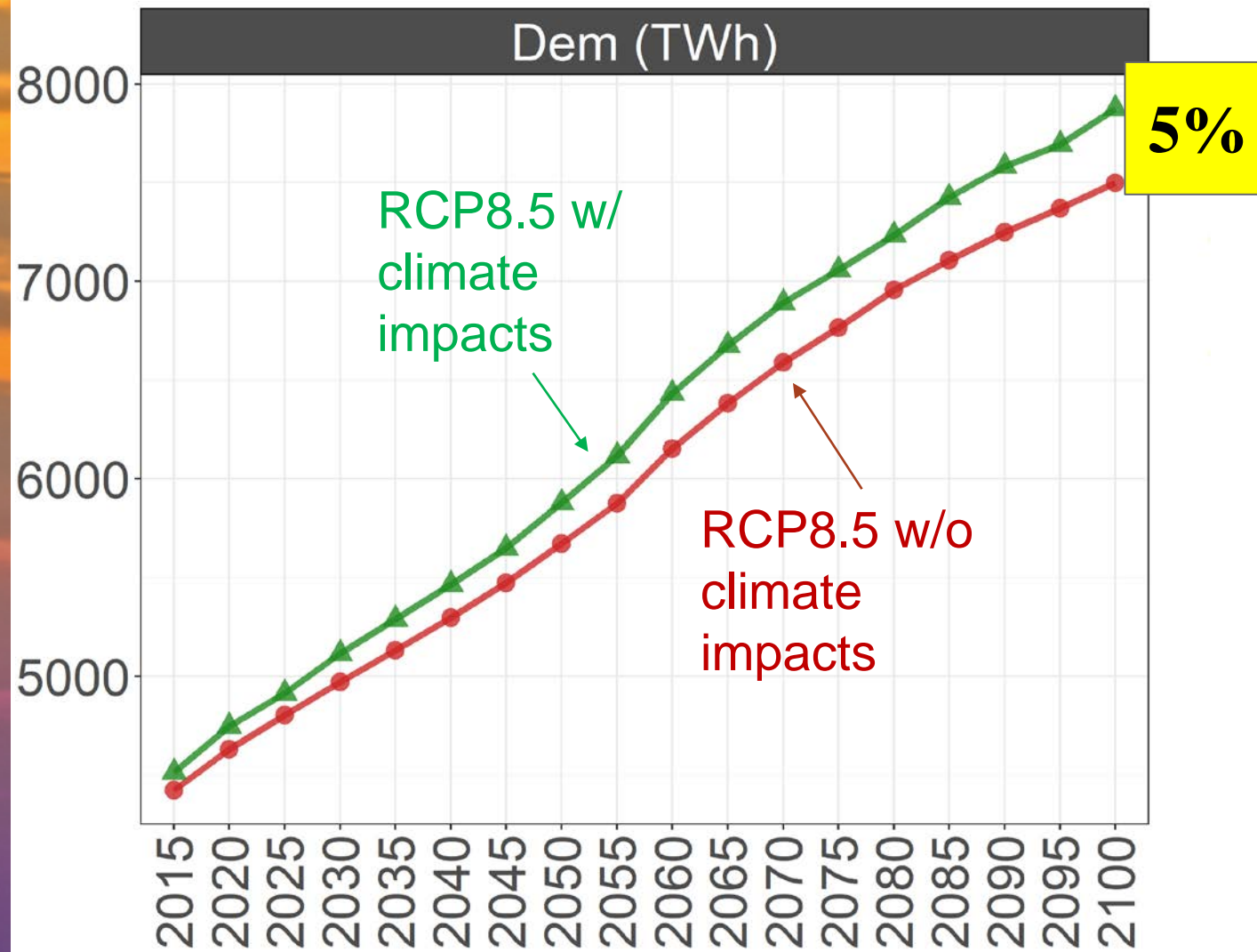
2100 *RCP8.5 w/o climate impacts*

2100 *RCP8.5 w/o climate impacts*



2100 *RCP8.5 w/o climate impacts*

Greater changes in peak loads leads to greater changes in installed capacity compared to annual generation



Ongoing Work: Adding Water demands (All sectors) at state-level and water constraints at basin level

