The Increasing Competitiveness of CCUS Under Deep Decarbonization

By: Jared Moore, Ph.D.
Independent Energy Tech/Policy Advisor
jared@MeridianEnergyPolicy.com

National Coal Council Fall Meeting, Nov. 5th, 2015
Commissioned by the Energy Innovation Reform Project

Are we pursuing the right goal?

Cost effective *modest* decarbonization (< 60% low carbon):

→ Wind, solar, and natural gas

Cost effective *deep* decarbonization (> 80% low carbon):

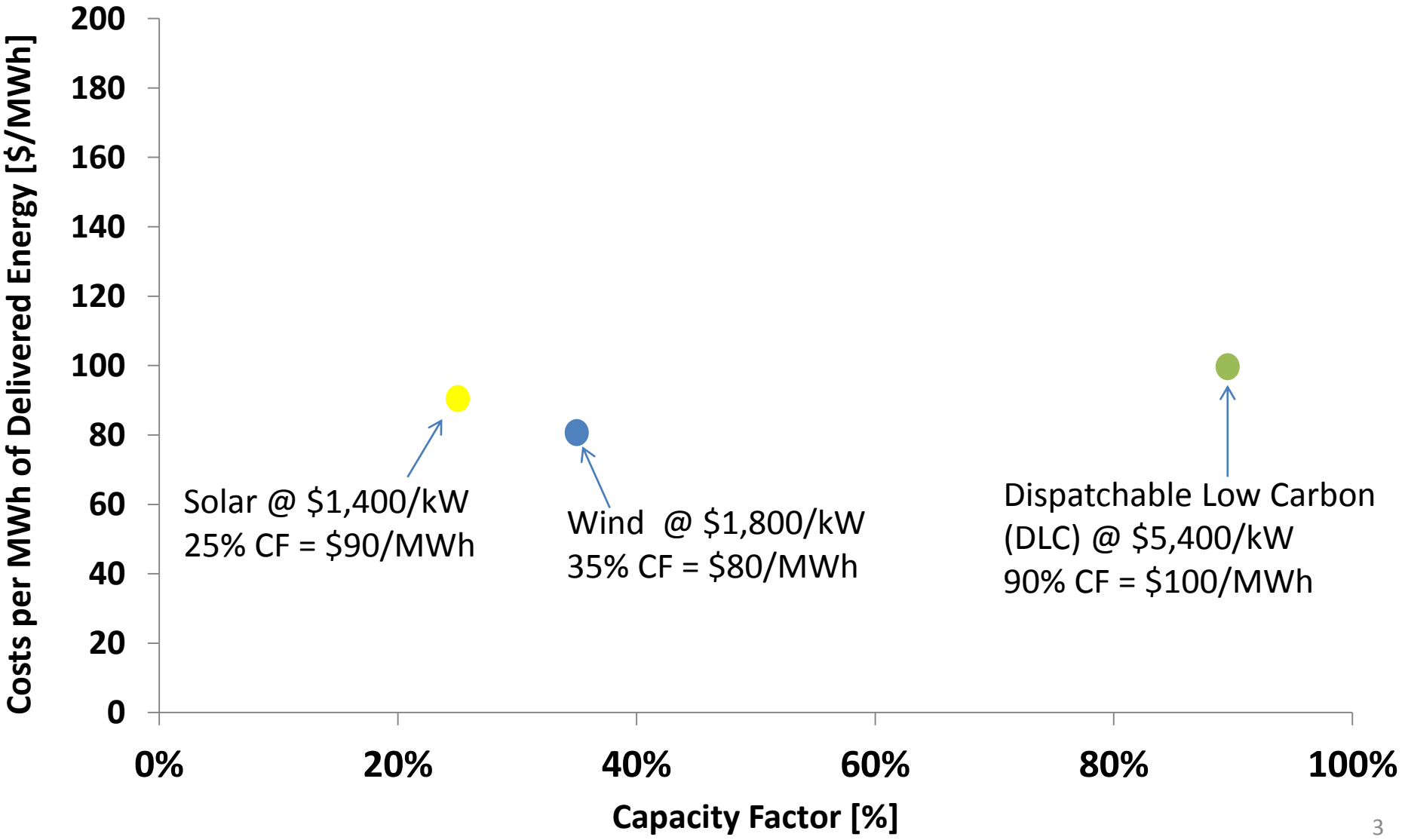
→ Exclusive reliance on capital intense generators increases importance of utilization

→ Lack of coincidence between supply and demand on seasonal and diurnal basis creates utilization challenge

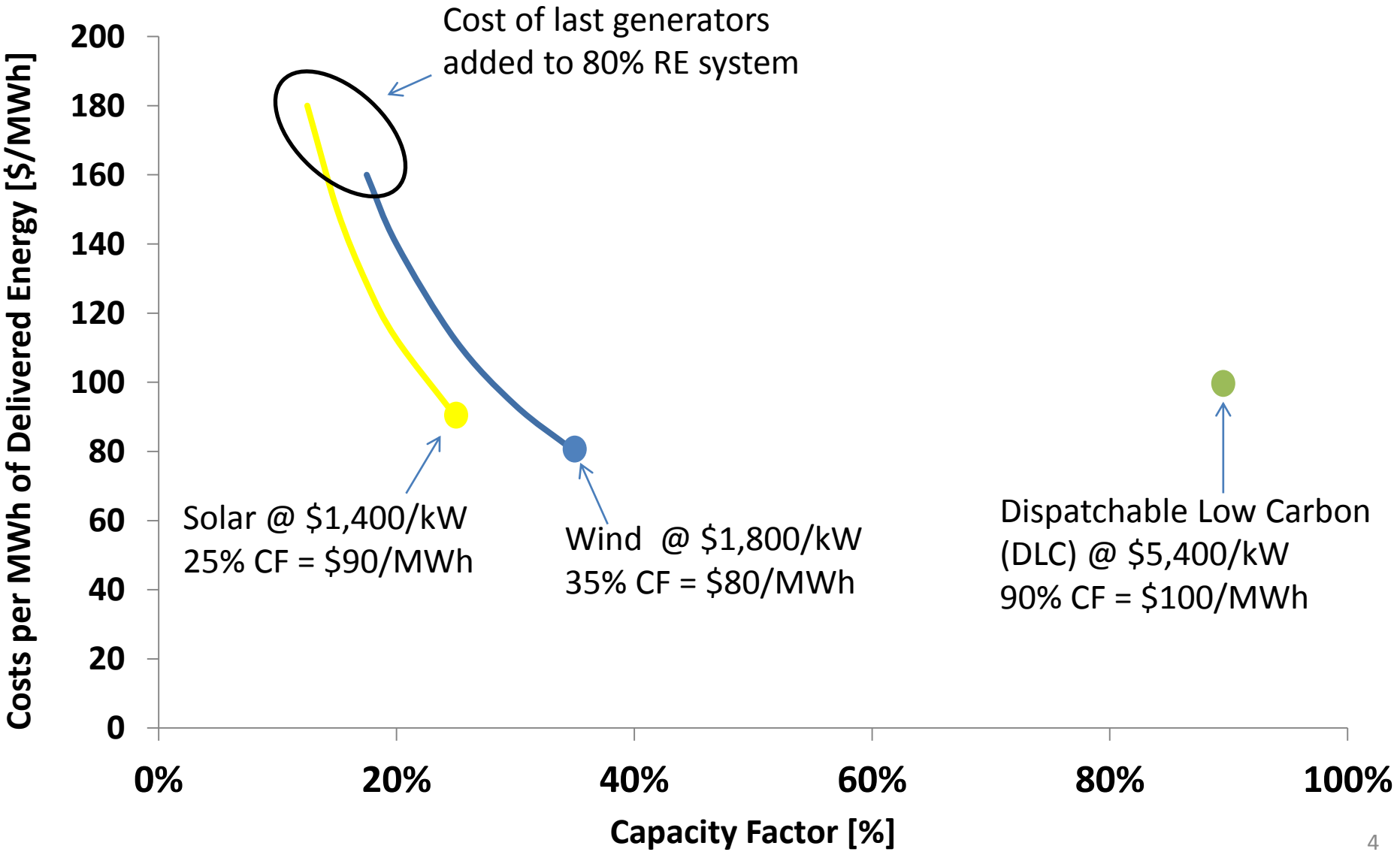
→ CCUS/Nuclear, solar, wind (& storage)

Dispatchable Low Carbon (DLC)

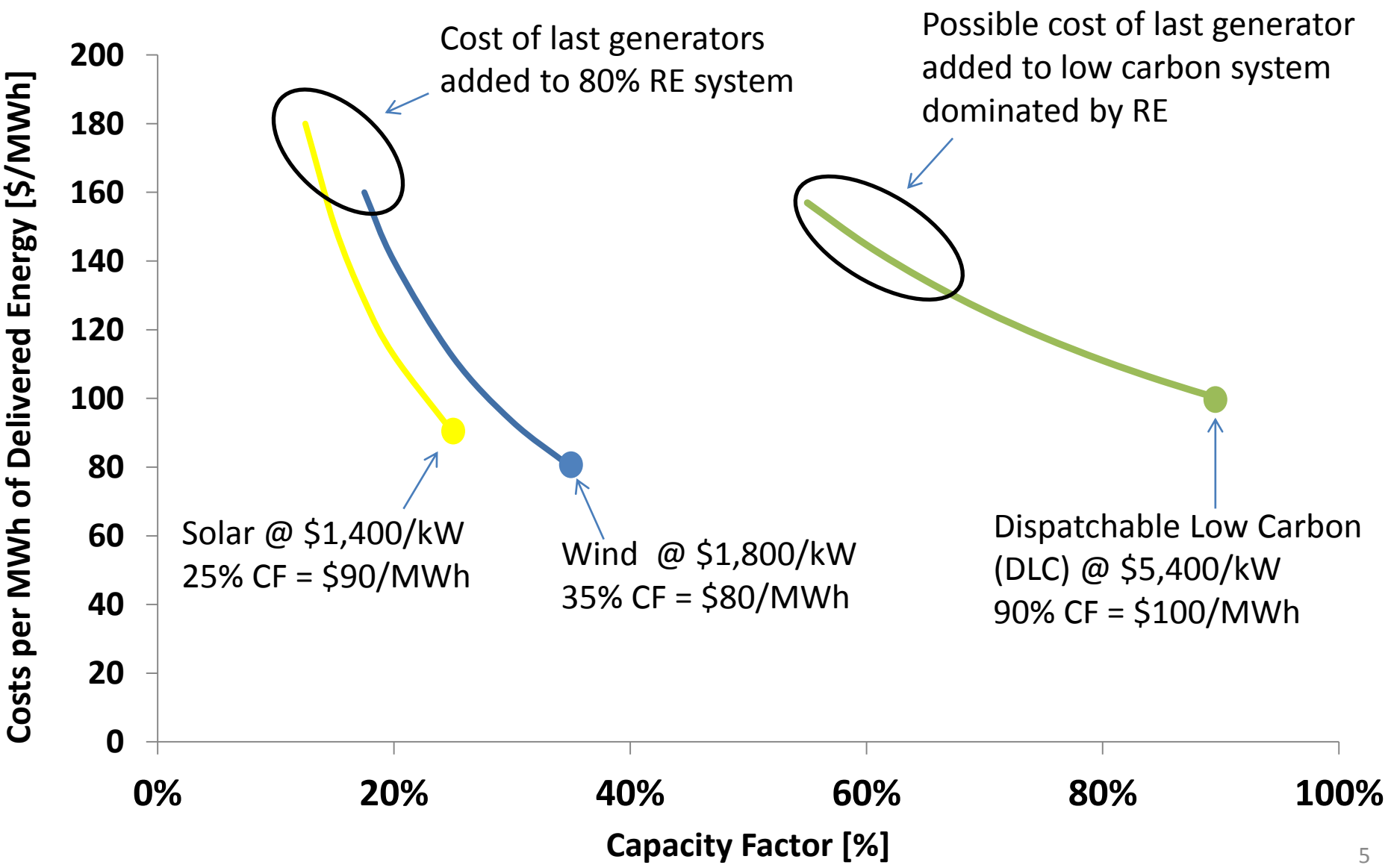
LCOE highly dependent on utilization (or capacity factor)



LCOE highly dependent on utilization (or capacity factor)



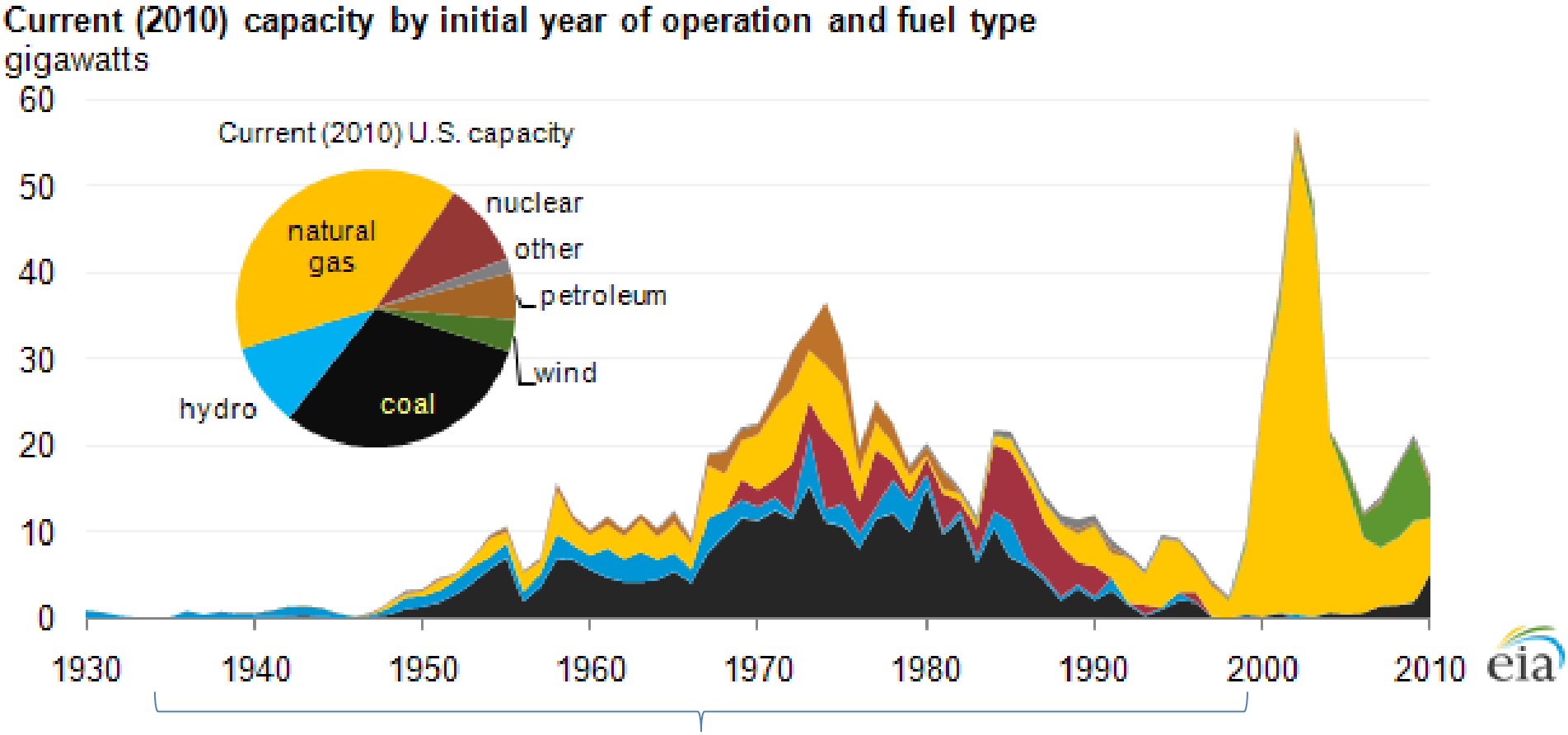
LCOE highly dependent on utilization (or capacity factor)



Perception vs. Reality: *Divestment* … or Investment?

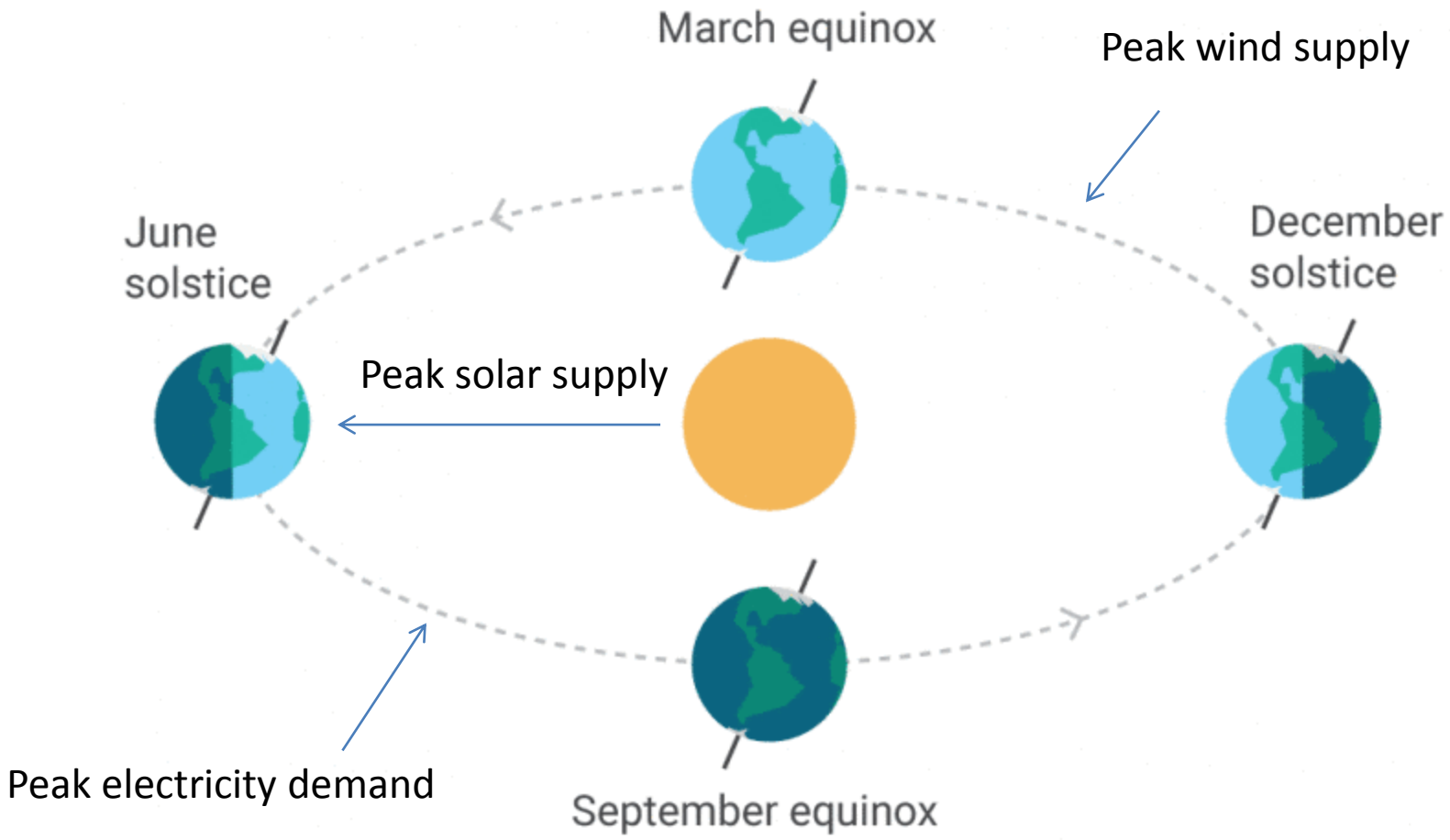
1) *Decarbonization → renewables*
   … Renewables → Modest decarbonization
   … Deep decarbonization → Diversity → Fossils/RE/storage
2) *Fossil fuels carbon emitting, even CCUS-EOR. Future electricity loads will help alleviate RE timing problem.*
   … Peak oil demand will occur before peak supply.
   … CCUS only path for past and future combustion to be sequestered.
   … Direct air capture and zero carbon liquid fuels are base loads. VMT not correlated seasonally with RE supply.
3) *Markets mechanisms alone can solve climate*
   … "Right price signals" are difficult to quantify. Capacity markets still not mature.

Long term thinking needed for long term problem

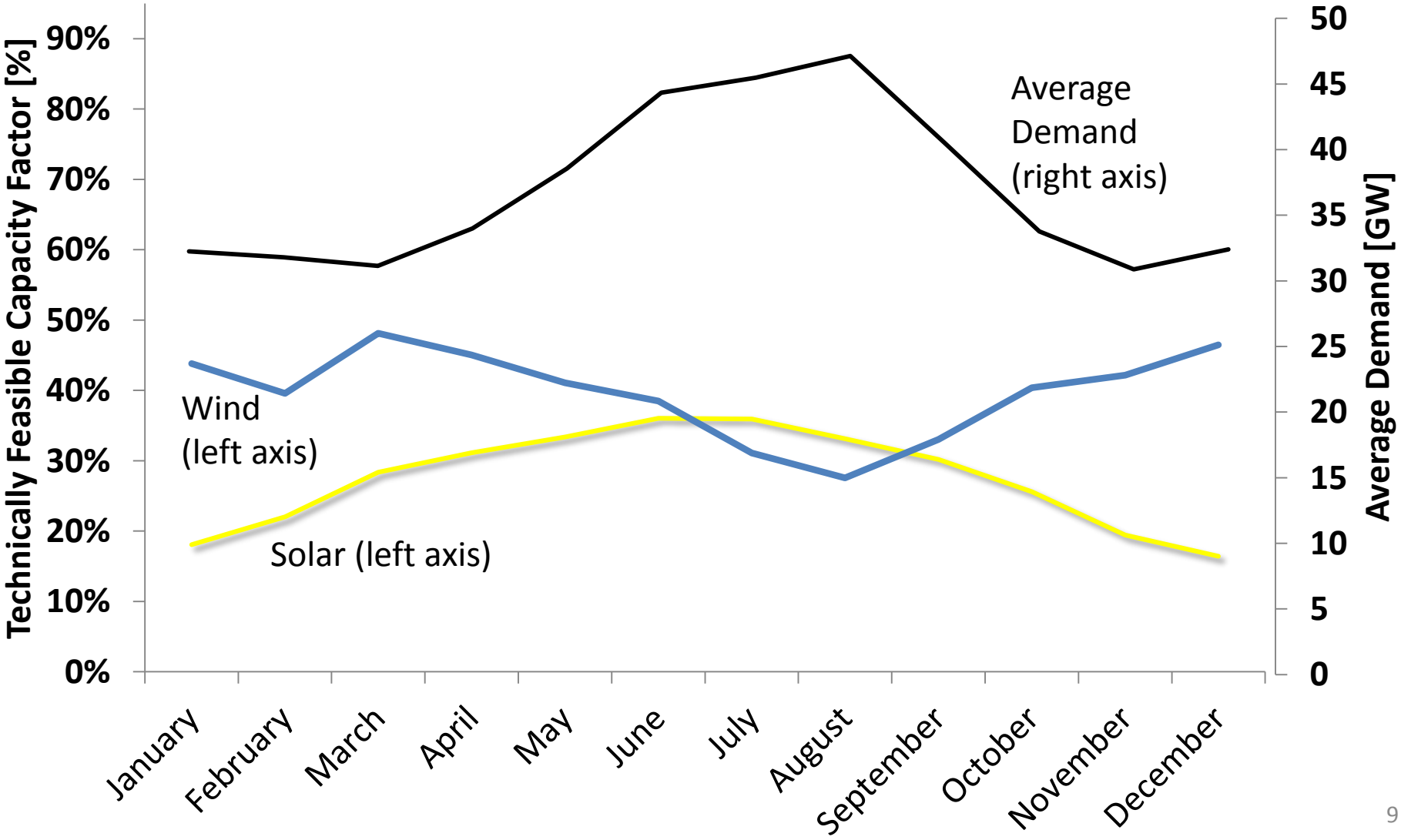


National Academy of Engineering:
Greatest Engineering Achievement of 20th Century

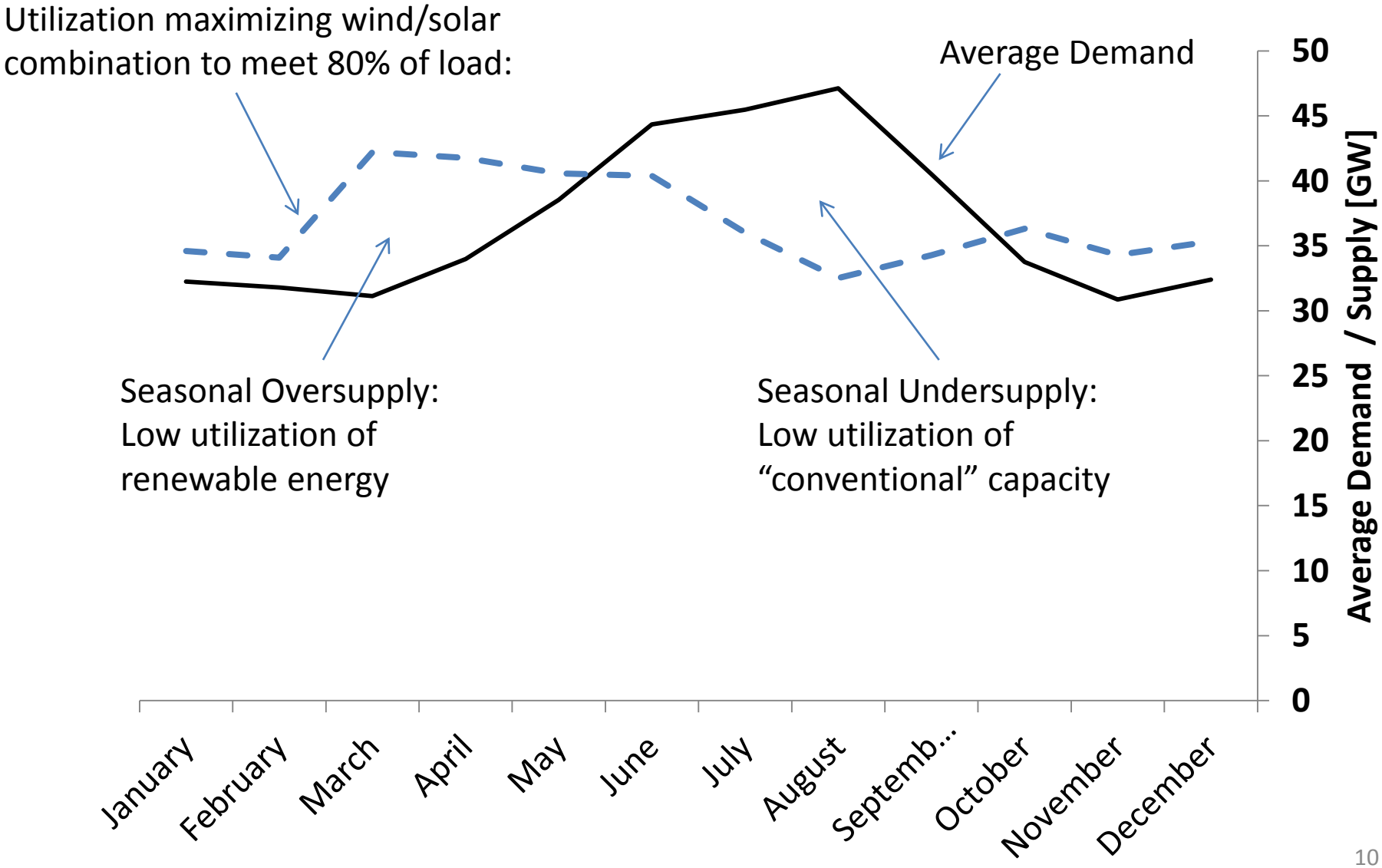
Thermal inertia of earth drives diurnal and seasonal mismatch between renewable supply and electricity demand



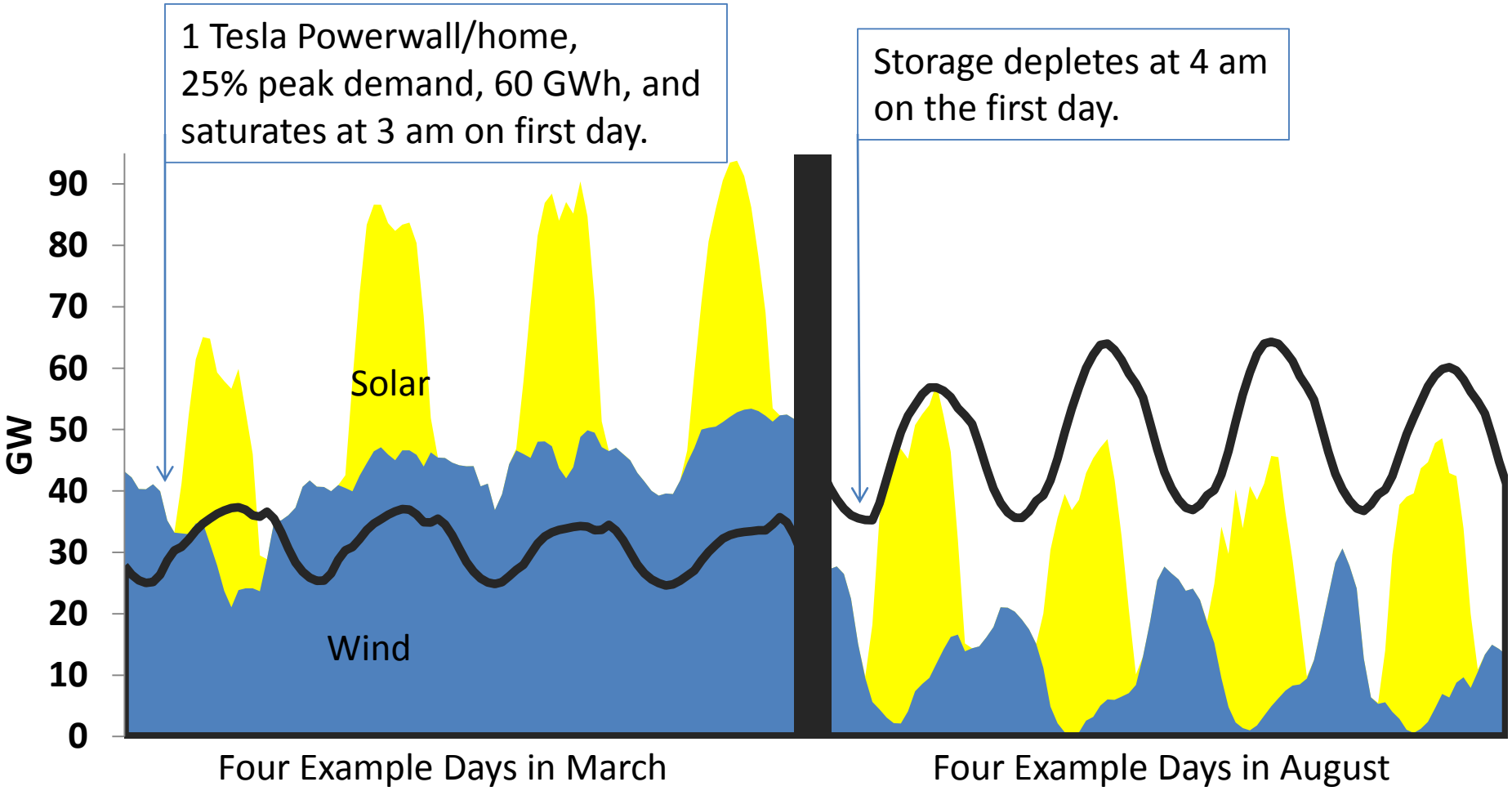
Seasonal Mismatch between Supply and Demand (ERCOT)



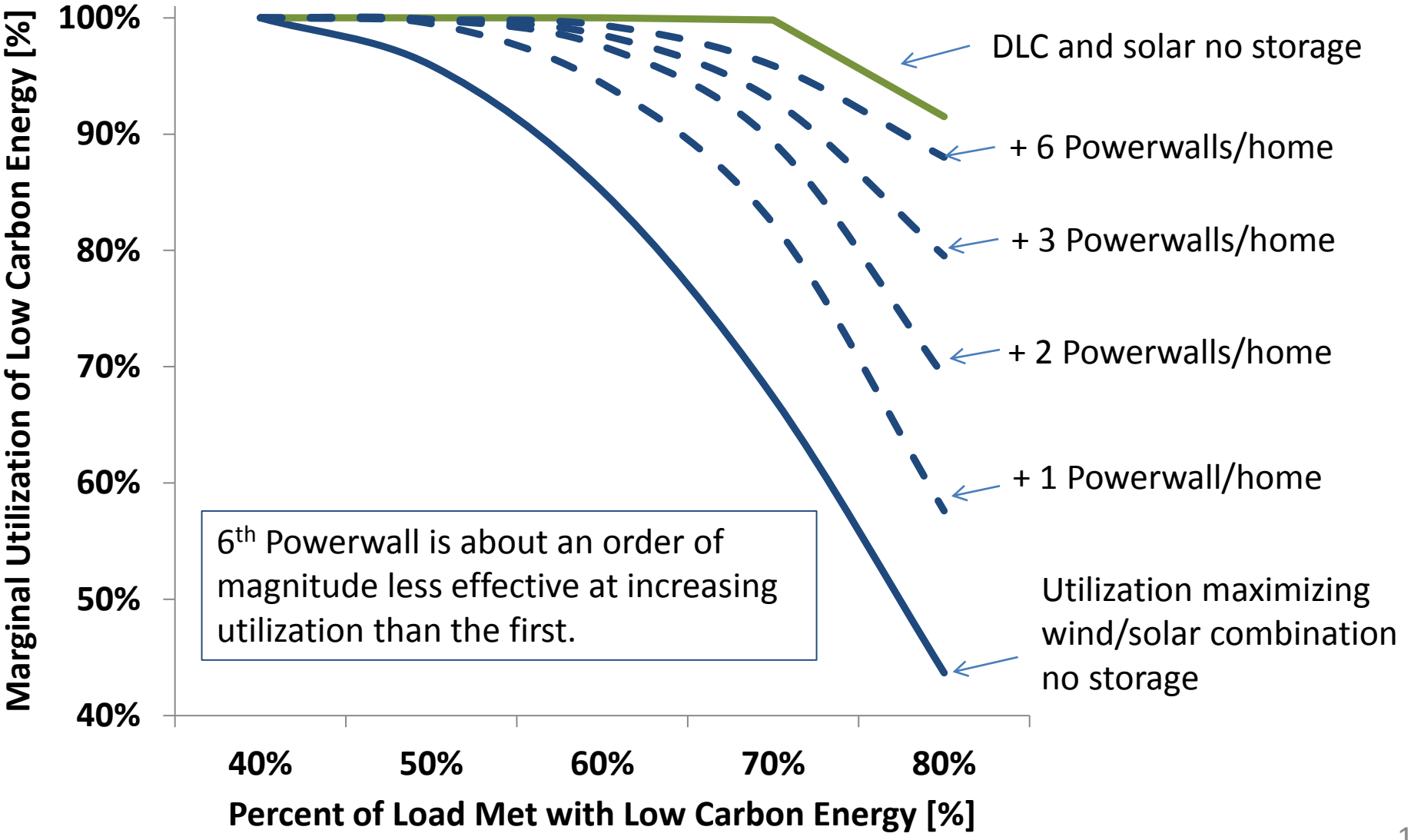
Seasonal Mismatch between Supply and Demand (ERCOT)



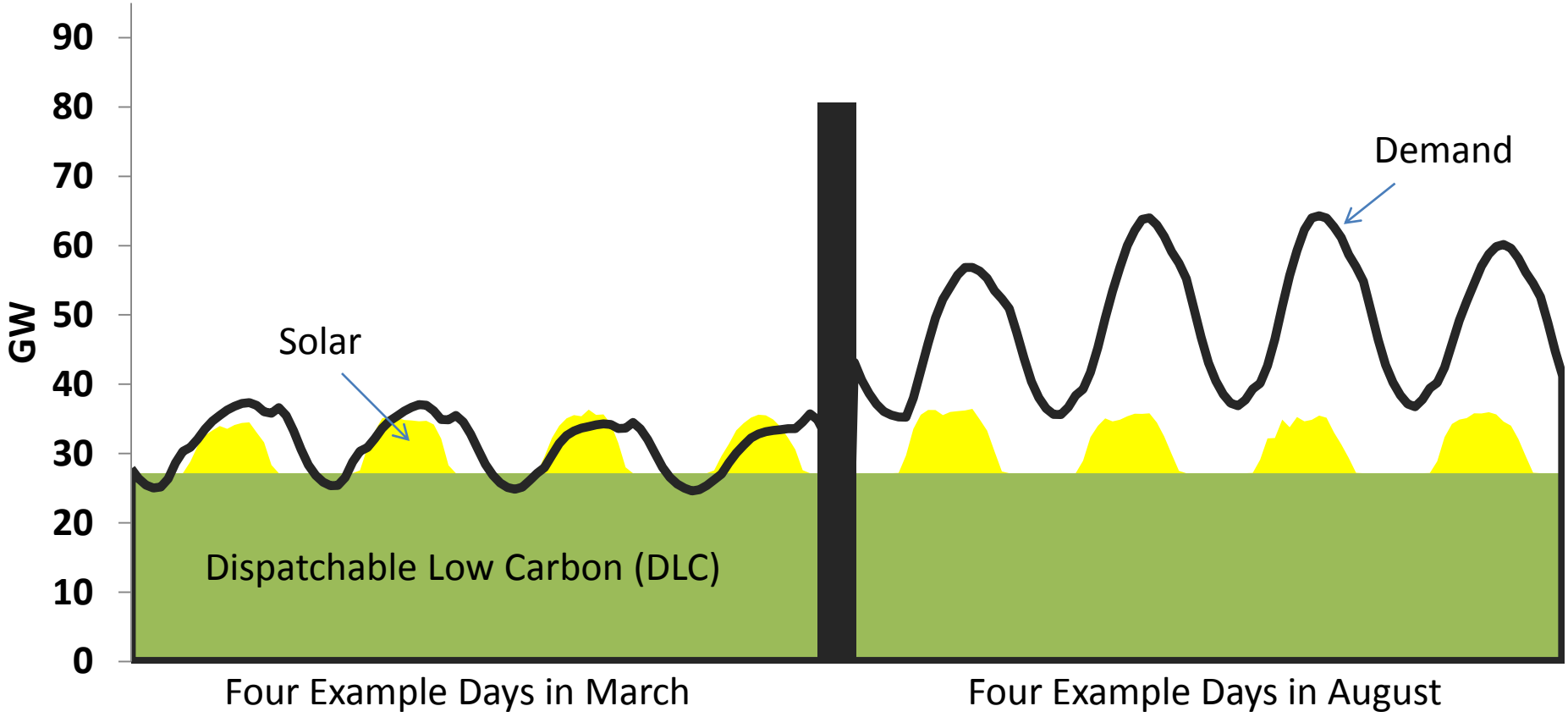
Resolving persistent periods of oversupply and undersupply would require seasonal utilization of storage or demand response.



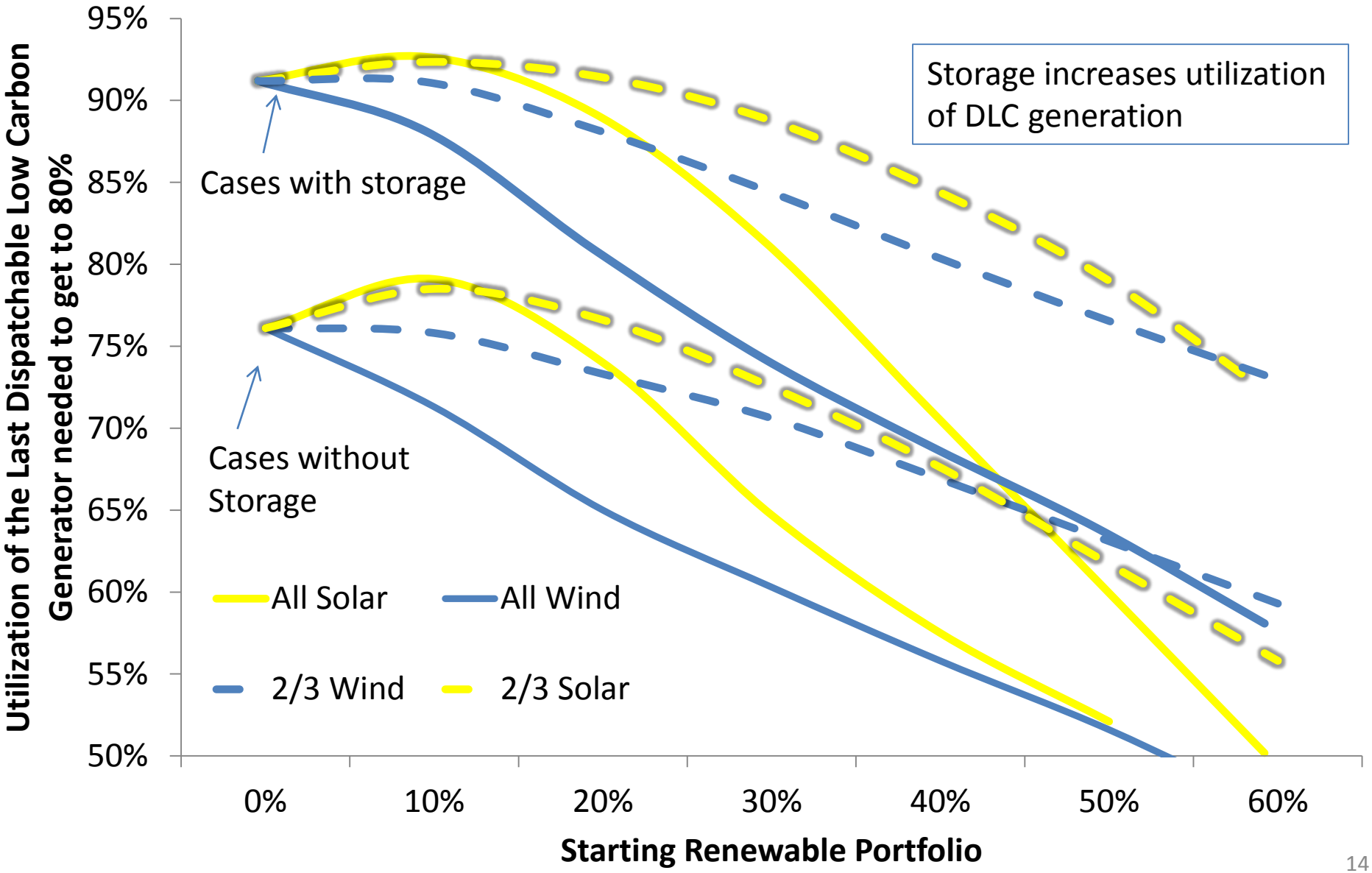
More storage can increase utilization of low carbon energy, but then takes on problem of low utilization itself



Utilization Maximizing Combination of Low Carbon Energy: 90% DLC, 10% Solar, and 0% Wind



Renewable deployment, especially if dominated by wind, decreases utilization of future DLC generators

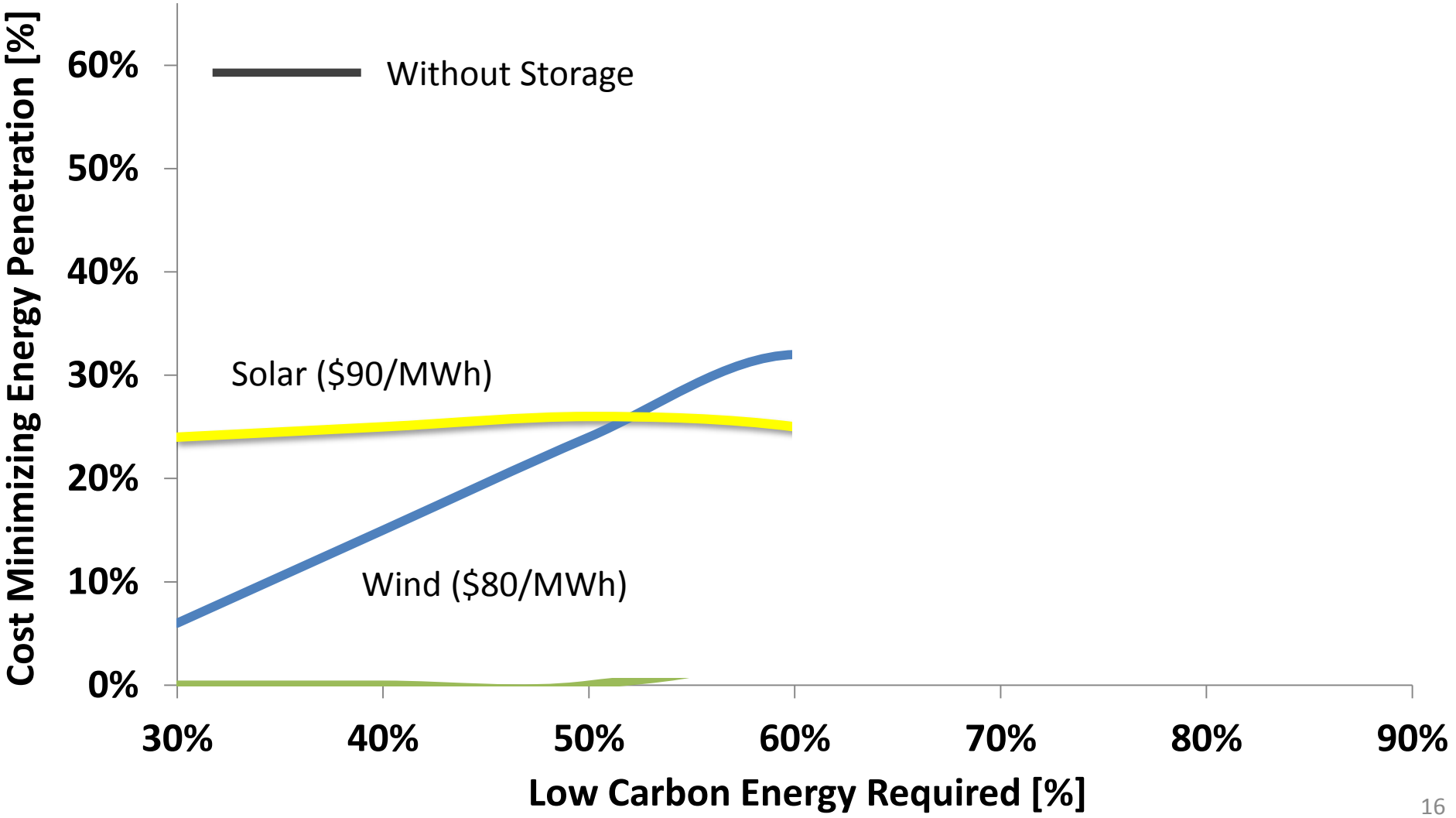


Which Combination of Wind, Solar, and DLC Minimizes Costs?

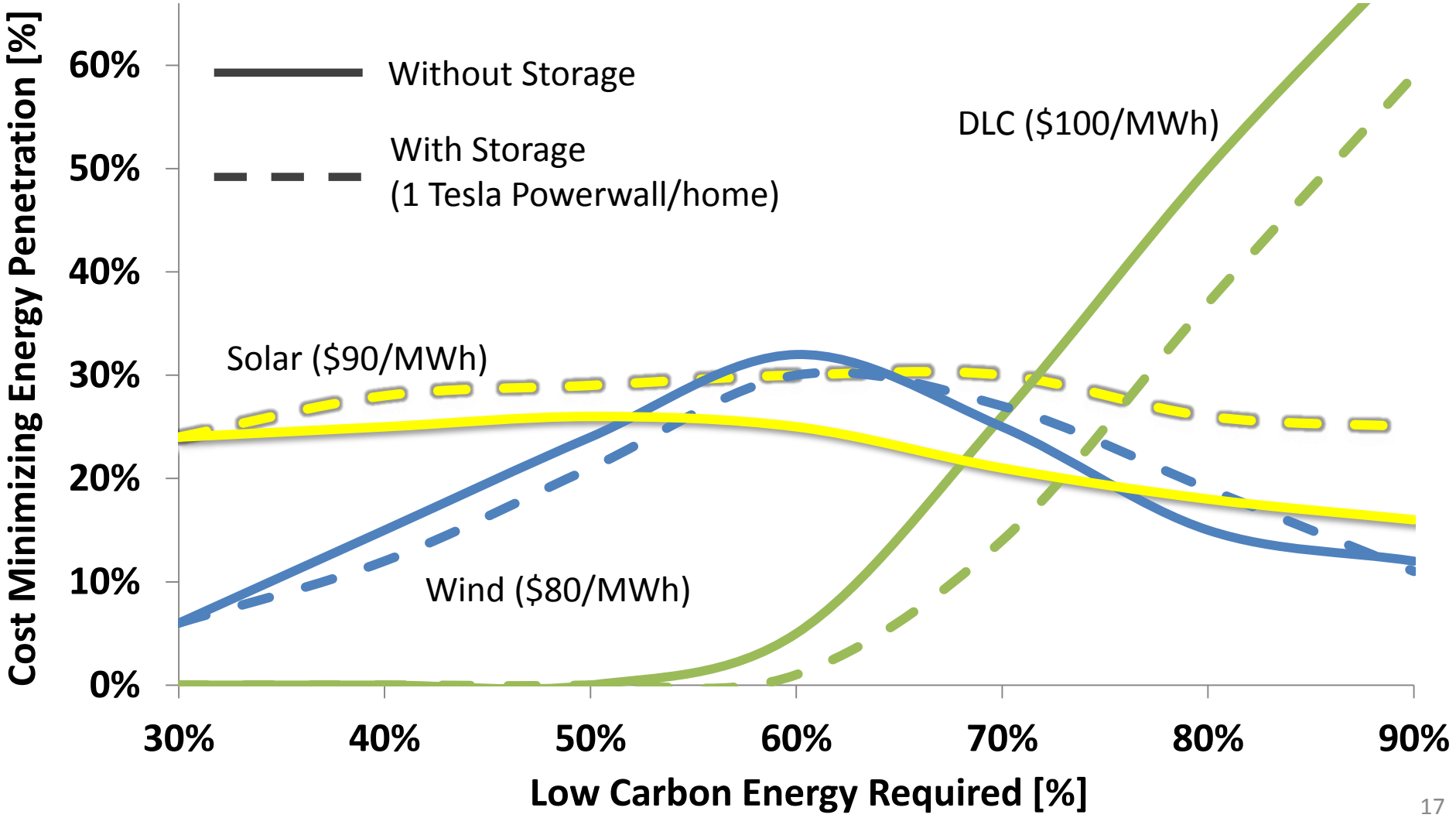
1) Scale wind, solar, or DLC output within an Excel-based, hourly economic dispatch model using hourly (8760) demand from ERCOT

2) Assume:
   - Value of reliability or Equivalent load Carrying Capability (ELCC) @ $330/MW-day
   - Wind LCOE @ $80/MWh, ELCC starting at 25%
   - Solar LCOE @ $90/MWh, ELCC starting at 50%
   - DLC LCOE @ $100/MWh, ELCC of 95%

Contribution of Generators Dependent on Decarbonization Desired



Contribution of Generators Dependent on Decarbonization Desired




DEAD
END
Decarbonization
with just RE
Deep
Decarbonization

Policy Implications:

- Cost effective modest decarbonization is not necessarily the path to cost effective deep decarbonization

- Weak carbon price does not send adequate price signals to incent DLC generation. Instead, may create low utilization problem for these generators.

- Policy intervention, such as “Capacity Portfolio Standard”, may be more cost effective for deep decarbonization