Deep Decarbonization, Renewables and Systems Thinking

Armond Cohen, Executive Director
Clean Air Task Force

IEA-EPRI Workshop: “Integrating New Technology While Maintaining Resource Adequacy”

Paris, France

September 28, 2015

July 2015 Workshop in Cambridge MA: Deep Decarbonization and Systems Analysis

- Two dozen EU and US energy system researchers, renewable energy advocates, environmental organizations, renewable companies, utility executives, and grid experts.
- Chatham House rules.
- Commissioned papers and panels.
- Some key insights follow.

1 – Ask the right question

How can we adapt the grid to achieve a high penetration of wind and solar on electric grids while maintaining resource adequacy?

OR

What strategies give us the best shot at virtually eliminating carbon emissions from the world's electric grids at an affordable cost while meeting energy growth and maintaining high reliability?

These two questions are often confused in the public policy discussion, but they are likely to yield very different answers.

#2 – Strategies will likely differ between shallow to moderate carbon reduction goals (30-50%) and deep carbon reduction goals (70-95%) .

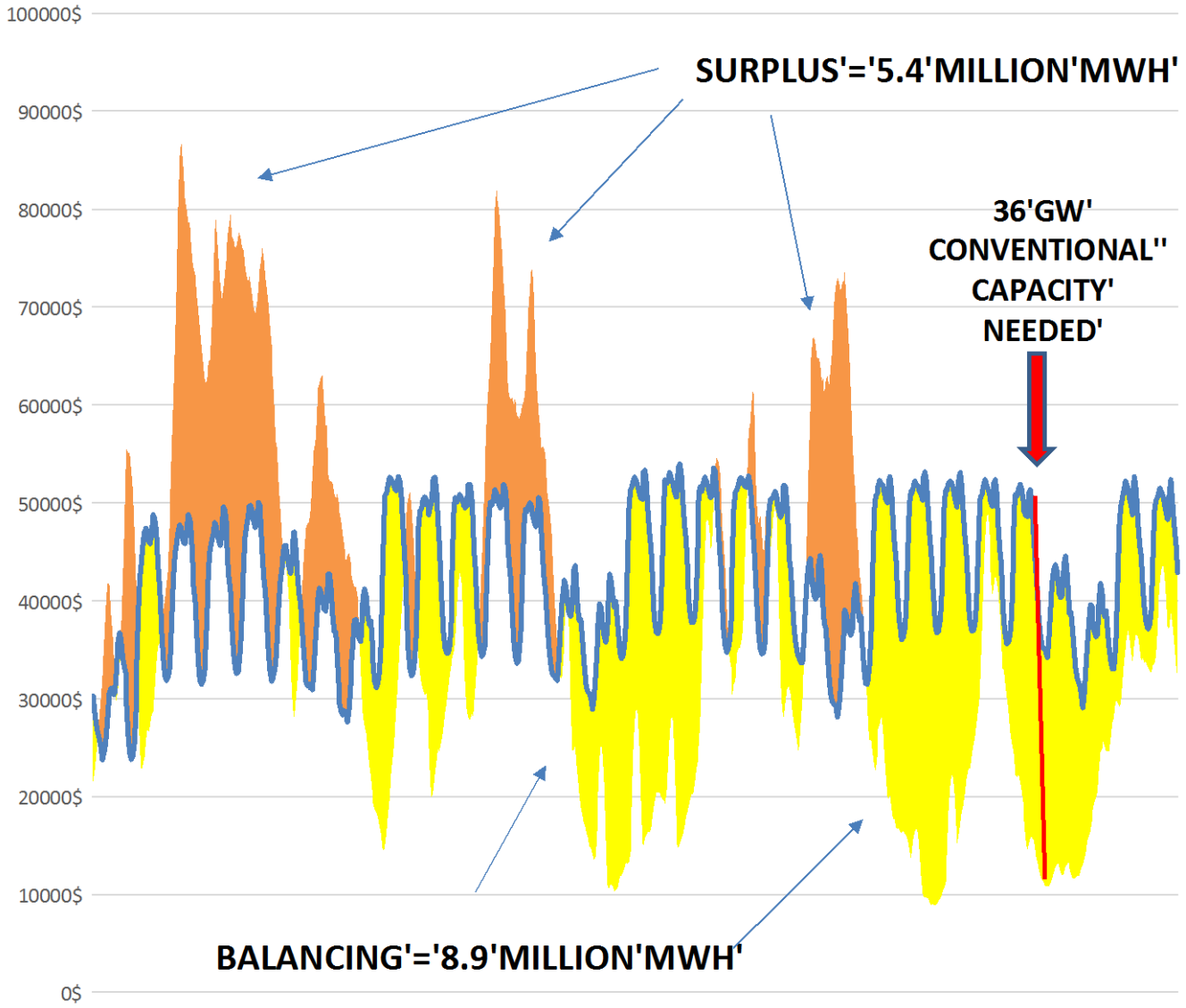
#3 -The only useful way to think about this is through systems analysis.

#5 – High renewables systems (70-90% VRE) as modeled tend to require a very large amounts of back up dispatchable capacity, even assuming the availability of affordable storage. (This adds a lot of cost compared to more balanced systems that include zero carbon baseload like nuclear.)

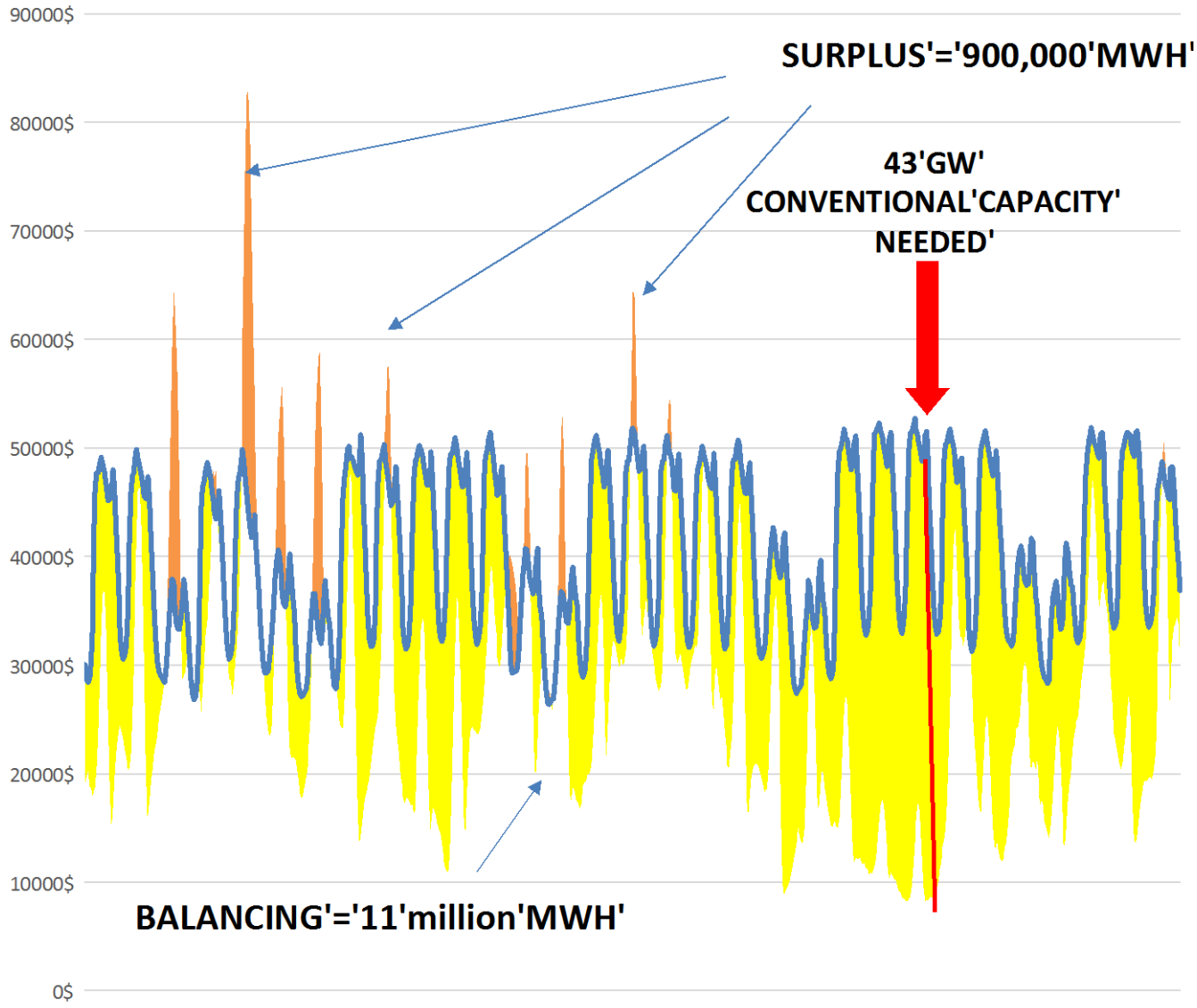
Example: Germany 2050

- Drop energy demand by 25%
- Renewables at 80% of annual energy
- Nuclear out of mix

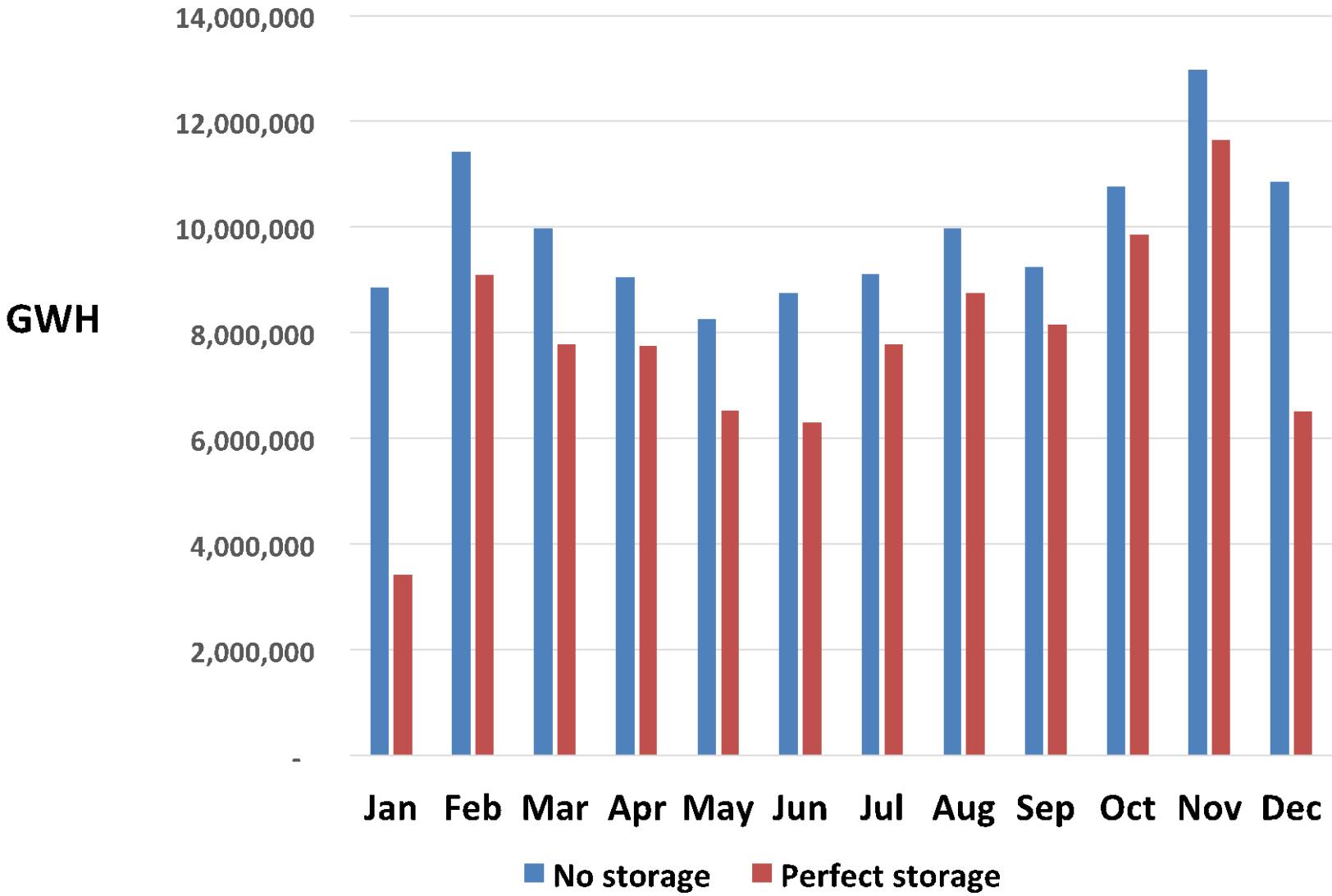
JANUARY'2050' GERMAN'POLICY'SCENARIO'

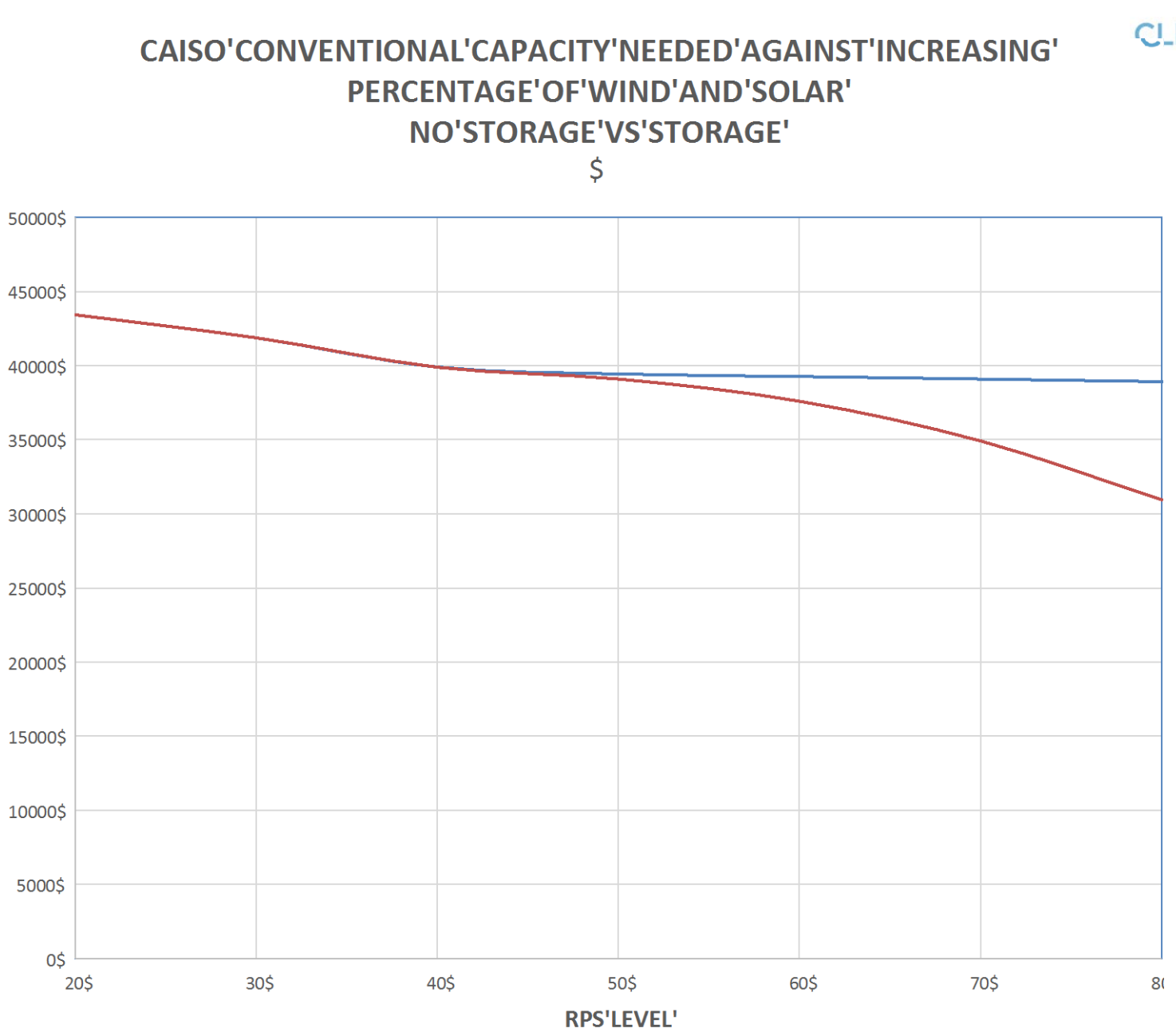


OCTOBER'2050''
GERMAN'POLICY'SCENARIO'



CONVENTIONAL GENERATION NEEDED WITH AND WITHOUT "PERFECT" STORAGE




CAISO'CONVENTIONAL'CAPACITY'NEEDED'AGAINST'INCREASING'
PERCENTAGE'OF'WIND'AND'SOLAR'
NO'STORAGE'VS'STORAGE'
$
50000$
45000$
40000$
35000$
30000$
25000$
20000$
15000$
10000$
5000$
0$
20$
30$
40$
50$
60$
70$
RPS'LEVEL'

GERMANY'2050' INCREMENTAL'POWER'COST'($B'ANNUAL)'

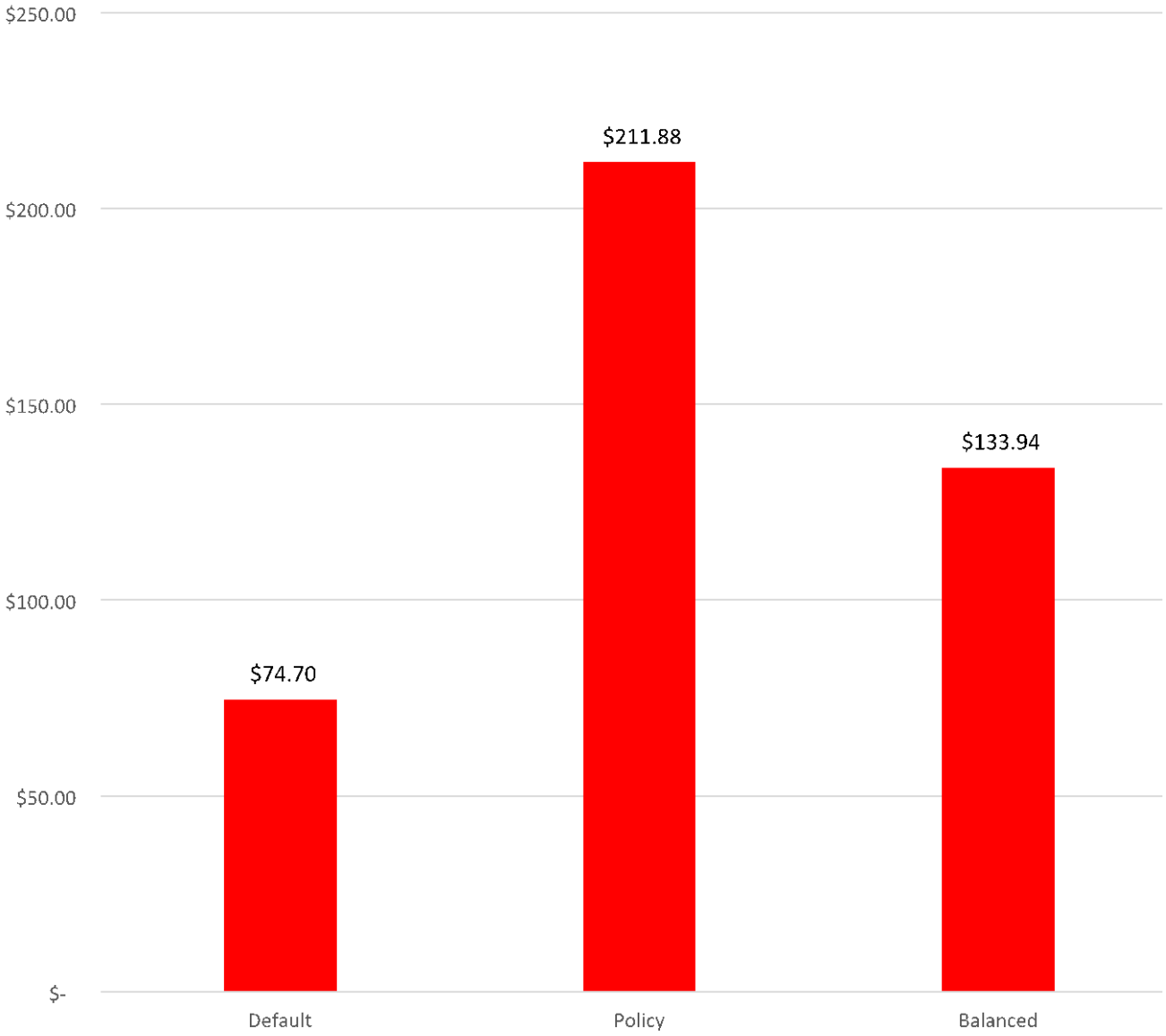
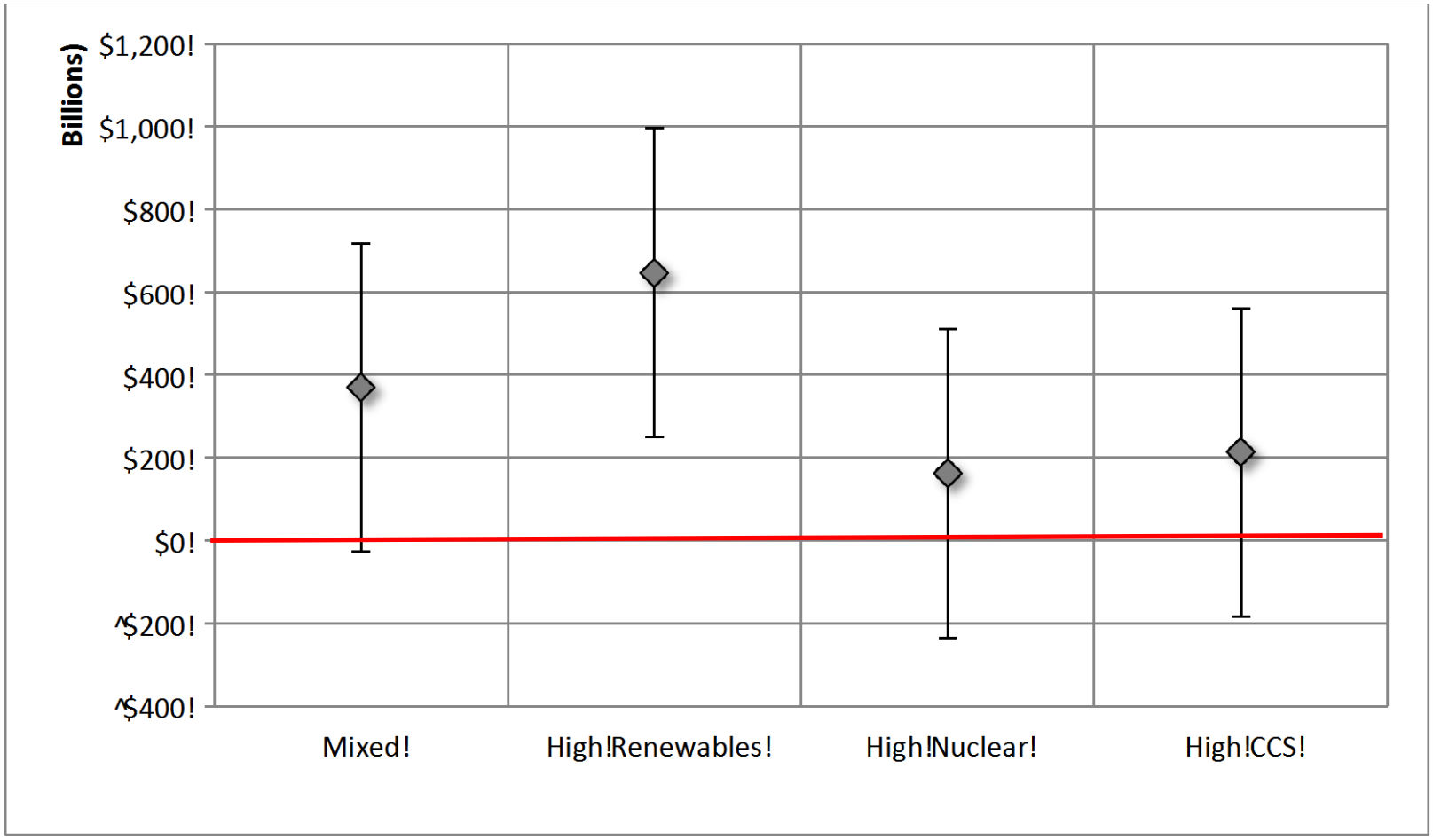
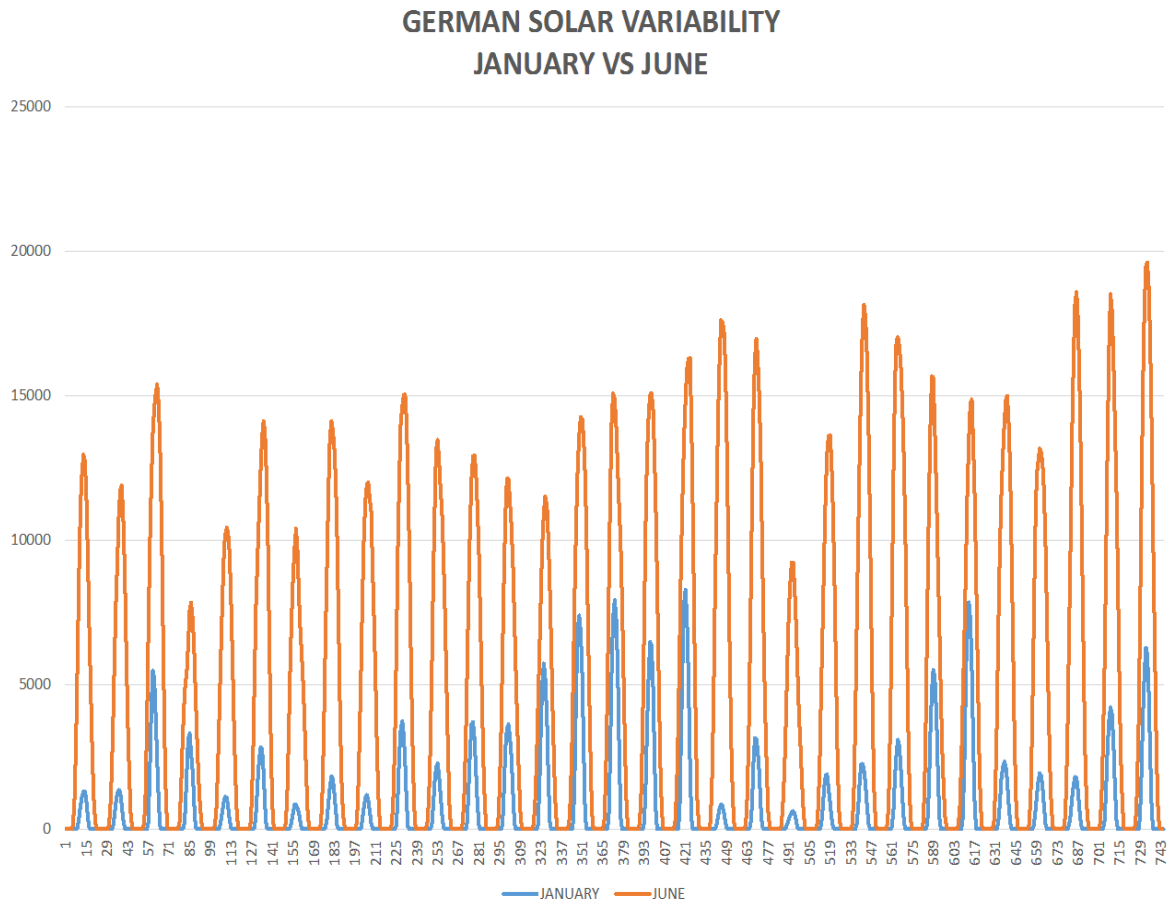


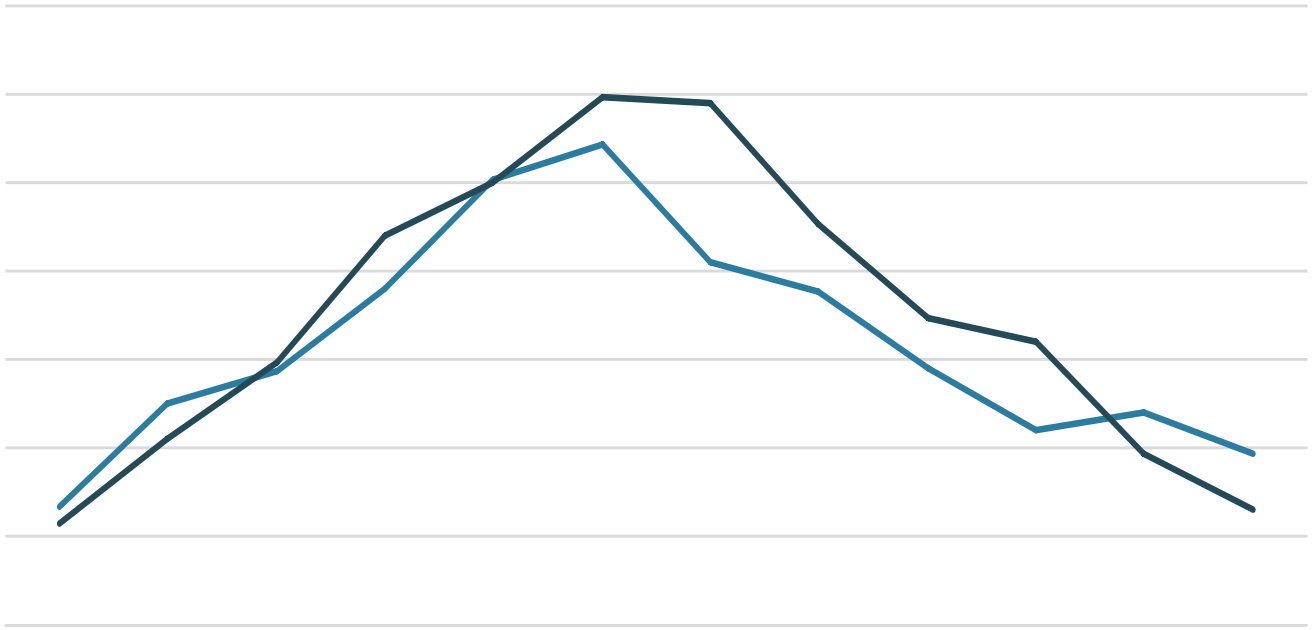
Figure 12. Incremental Energy System Costs in 2050



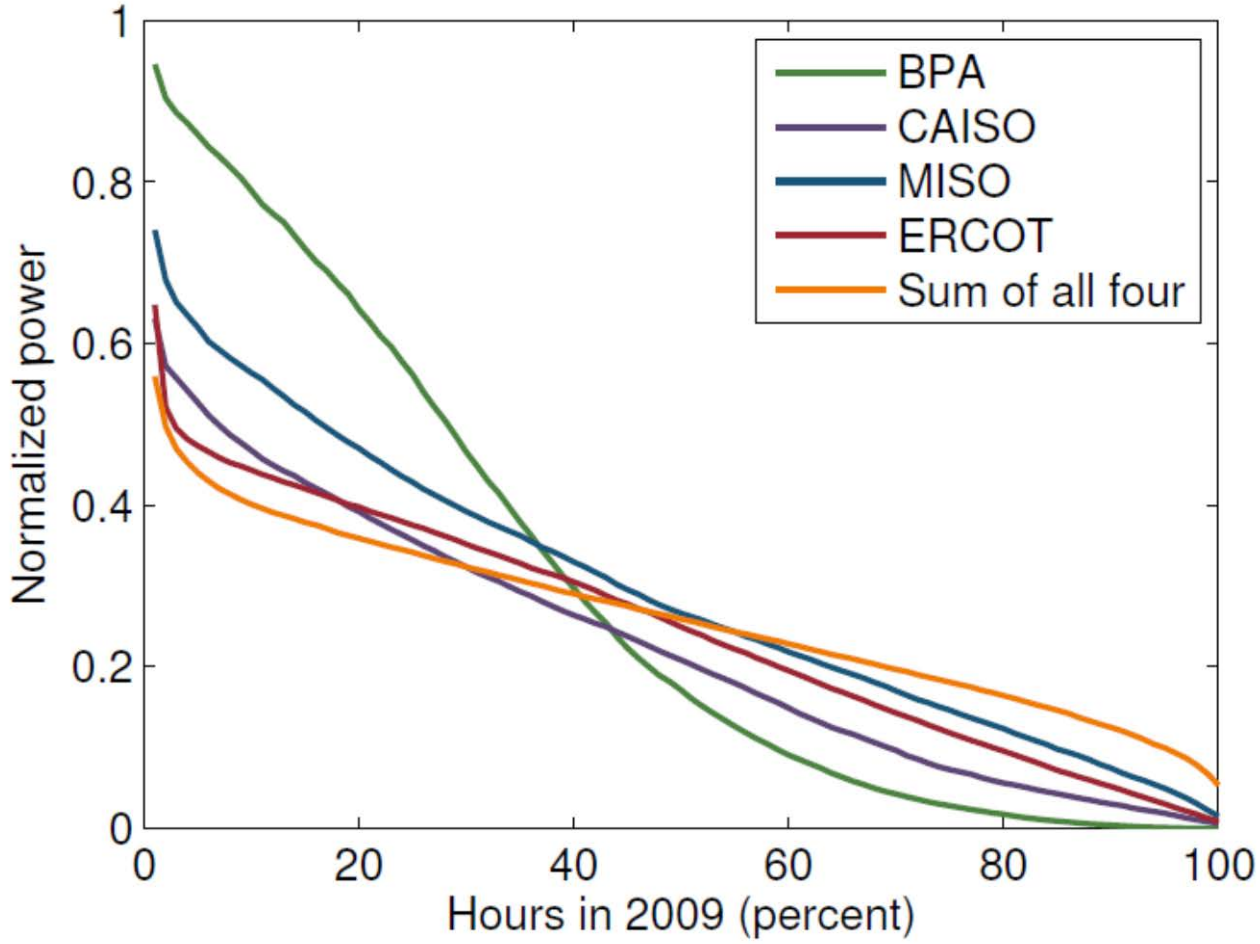
Deep Decarbonization Pathways Project – US Analysis (E3, LBL, PNNL, 2014)

#6 – Seasonality rules!





Interconnection only partly mitigates the problem due to high seasonal correlation



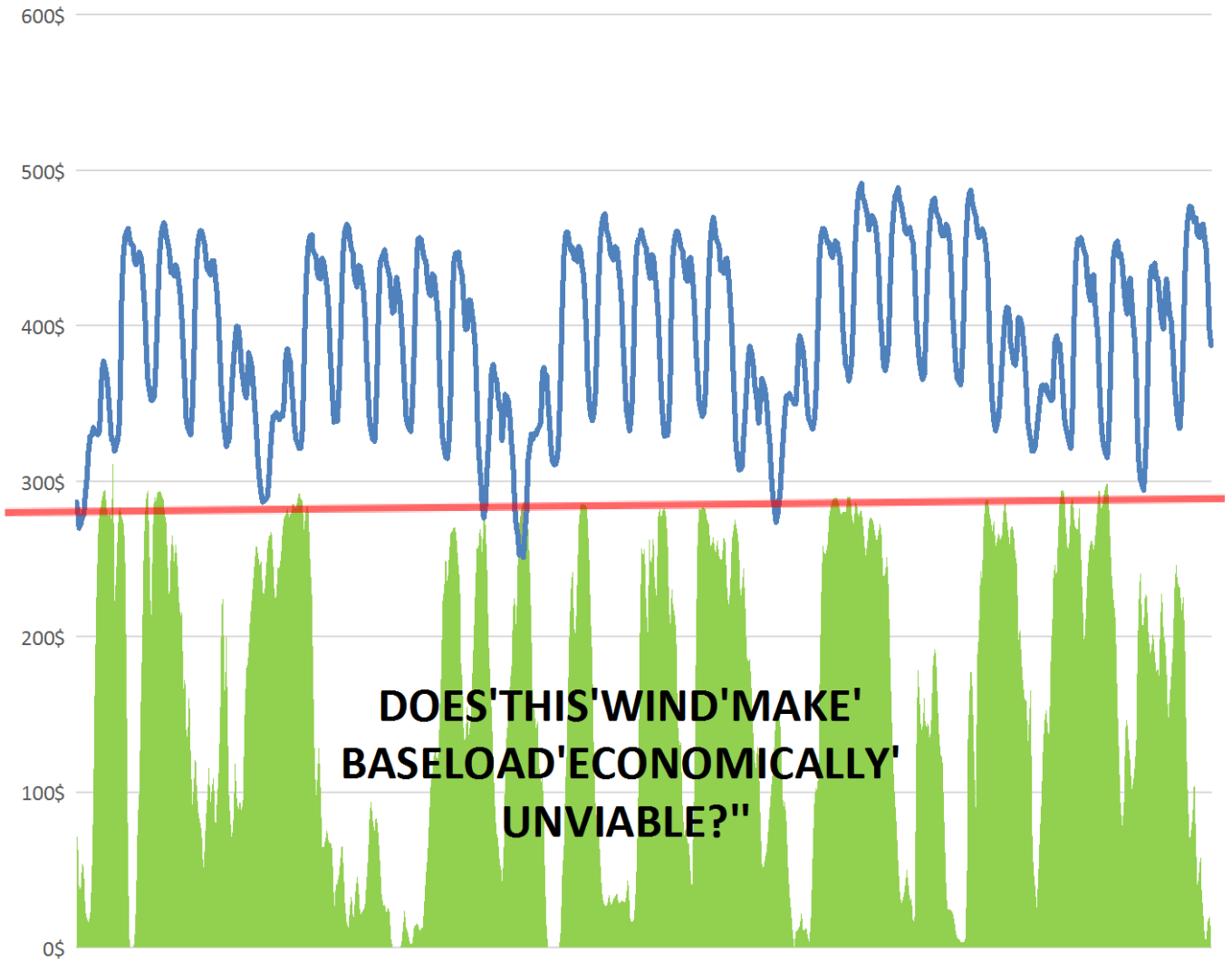
Fertig, Apt, Katzenstein et al.

Likewise, as with storage and interconnection, demand response can help manage diurnal and perhaps even multi-day variability, but not likely weekly or seasonal variability.

#7 – Unless we think about the deep decarbonization end goal, a sole focus on intermittent renewables can be a cul-de-sac rather than a throughway.

CLEAN AIR TASK FORCE

WISCONSIN'STUDY' 30'PERCENT'WIND' JANUARY'



#8 – A renewables-dominant system requires a lot more capacity, land area and infrastructure than a more balanced low carbon system – risk of not achieving?

Source: Loftus, Cohen et al (2014)

9 – Policy implications for ***deep decarbonization***

- Renewables policy is not necessarily equivalent to climate policy.
- Prudent risk management suggests a diverse portfolio is more likely to succeed.
- We seem to be under-invested in developing affordable zero carbon dispatchable options such as advanced nuclear and CCS as well as storage.