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# Achieving Operational Flexibility and $CO_2$ Emissions Reductions

**Revis James, EPRI**

USEA Energy Supply Forum:

"Technologies and Corporate Approaches to Implement the Paris Agreement"

National Press Club

**October , 2015**

# Concurrent Goals

- The integrated grid of the future will require both:
  - significantly increased operational flexibility
  - significant reductions in CO2 emissions

- "Operational flexibility" means ability to generate reliably and cost-effectively at a wide range of output levels, while complying with environmental requirements.

- The need for more operational flexibility is driven by increasing generation from non-dispatchable resources and increased automation in load management.

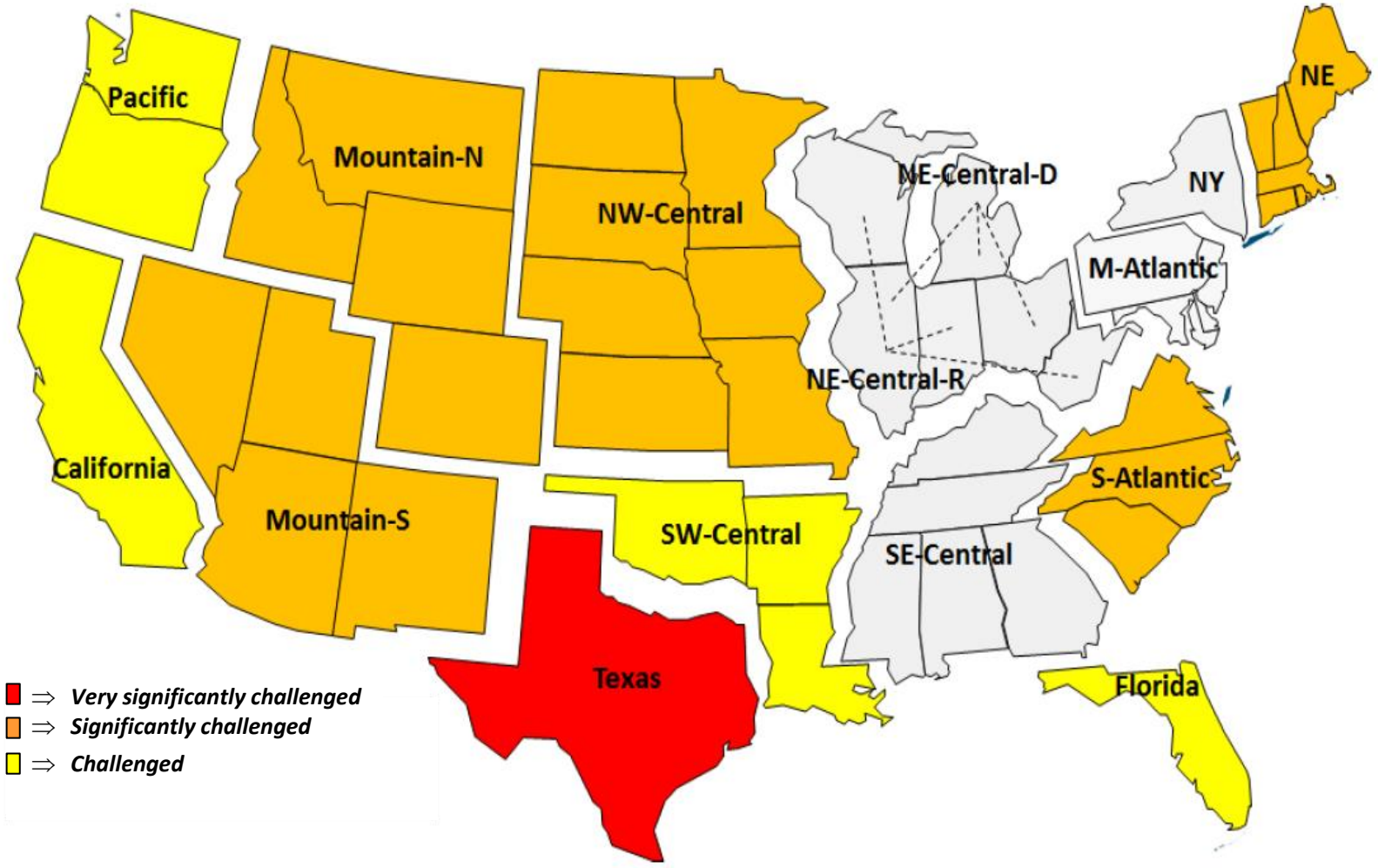
- R&D is needed in technology, operations, and maintenance to enable the above.

# Significant Future Needs for Flexible Operations

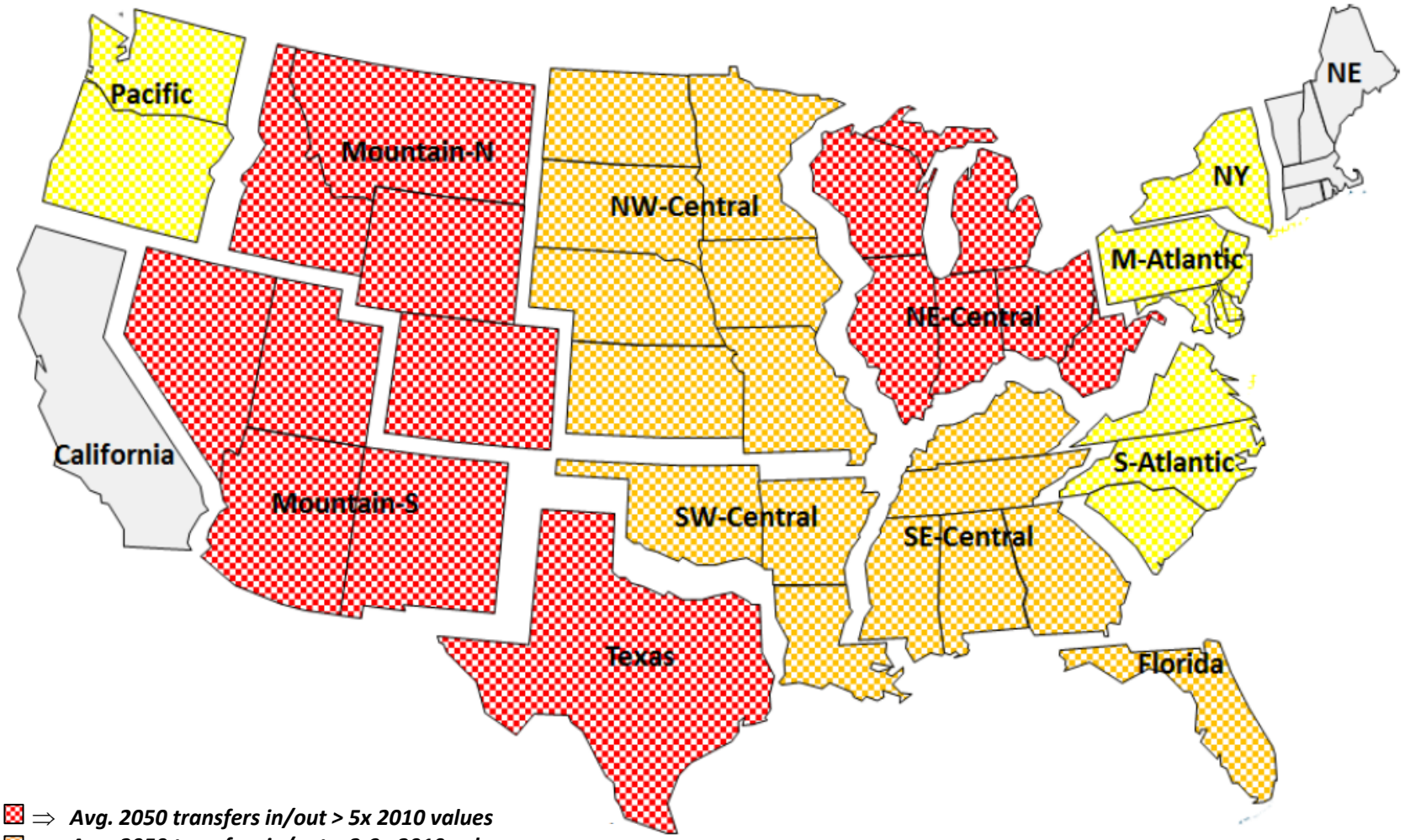
- Flexible operations
  - Examples: minimum load, prolonged layup, two shifting
  - Technical challenges: equipment damage, more operational complexity, adverse effects on environmental controls
  - Dispatchable, flexible assets needed => more complex asset management decisions

- Trends
  - EPRI/DOE study of long-term (2050) U.S. generation fleet
  - Significantly higher levels of hour to hour variation in generation output compared to historical data.
  - Significantly higher levels of inter-regional energy transfer.

# Potential Levels of Increased Operational Flexibility (2050)



# Potential Levels of Increased Inter-Regional Electricity Import/Export (2050)




⇒ *Avg. 2050 transfers in/out > 5x 2010 values*

⇒ *Avg. 2050 transfers in/out > 2-3x 2010 values*

⇒ *Avg. 2050 transfers in/out > 2x 2010 values for one or more scenarios*





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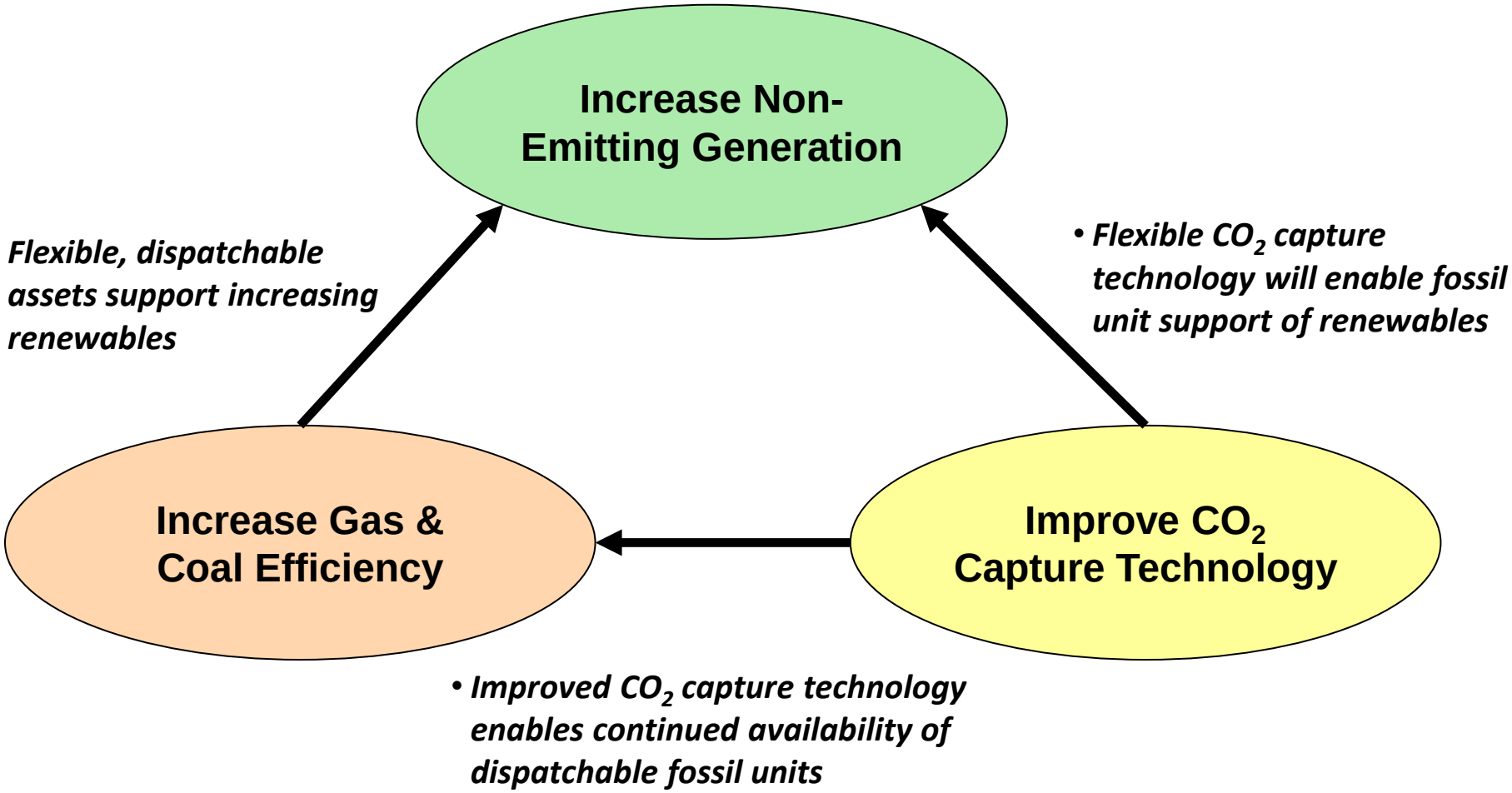
# Key Options for Reducing $CO_2$ Emissions

- Increase generation from non-emitting resources, e.g. wind, solar, nuclear => R&D needs:
  - ensure flexibility of fossil assets to support
  - potentially some nuclear flexibility? (à la France)
  - focus on better renewable resource forecasting

- Increase thermodynamic efficiency of gas and coal generation => R&D needs:
  - Better materials permitting higher temperatures, pressures
  - Advanced cycles, e.g. super-critical $CO_2$ Brayton, oxy-combustion

- Increase cost-effectiveness, efficiency of $CO_2$ capture, even under flexible operations => R&D needs:
  - More efficient capture technologies, e.g. sorbents
  - Engineering designs which “decouple” capture operations from load levels

# Interconnected Strategy Needed for $CO_2$ Emissions Reductions



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