Revised Wind Energy Potentials in MESSAGE

Preliminary Results and Some Thoughts

Volker Krey, Oscar van Vliet, Keywan Riahi

International Institute for Applied Systems Analysis (IIASA)

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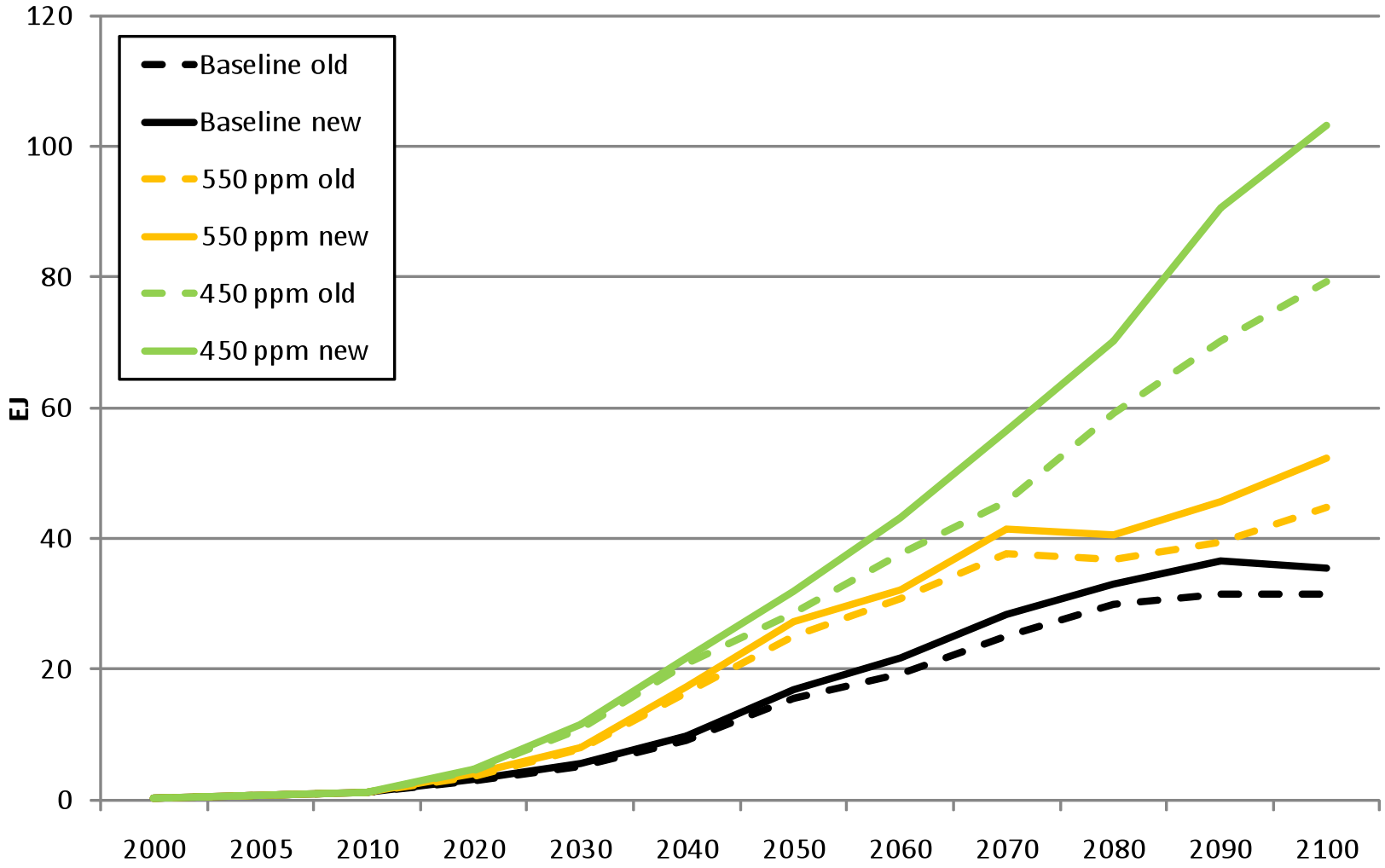
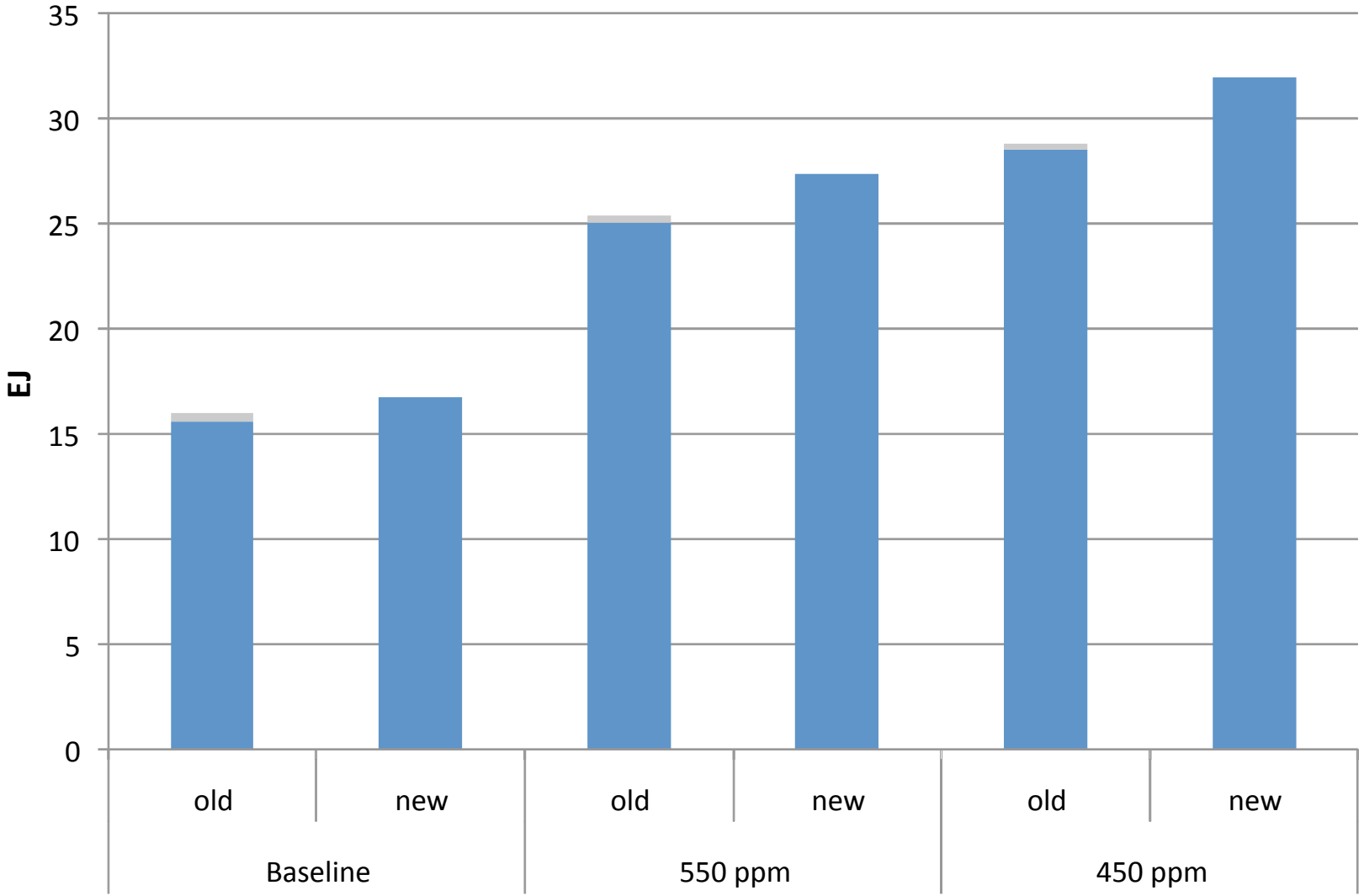
Global Wind Energy Deployment



Global Wind Energy Deployment in 2050



Uptake of Wind Energy Potential

- 3 scenarios based on Asian Modeling Exercise (AME):
  - Baseline (no climate target)
  - 550ppm not to exceed (no overshoot)
  - 450 ppm by end century (with overshoot)

- Sensitivity runs to compare with changes in
  - Operational flexibility effect of wind
  - Reserve capacity contribution of wind

Adaptation of Wind Potential Data for Use in MESSAGE

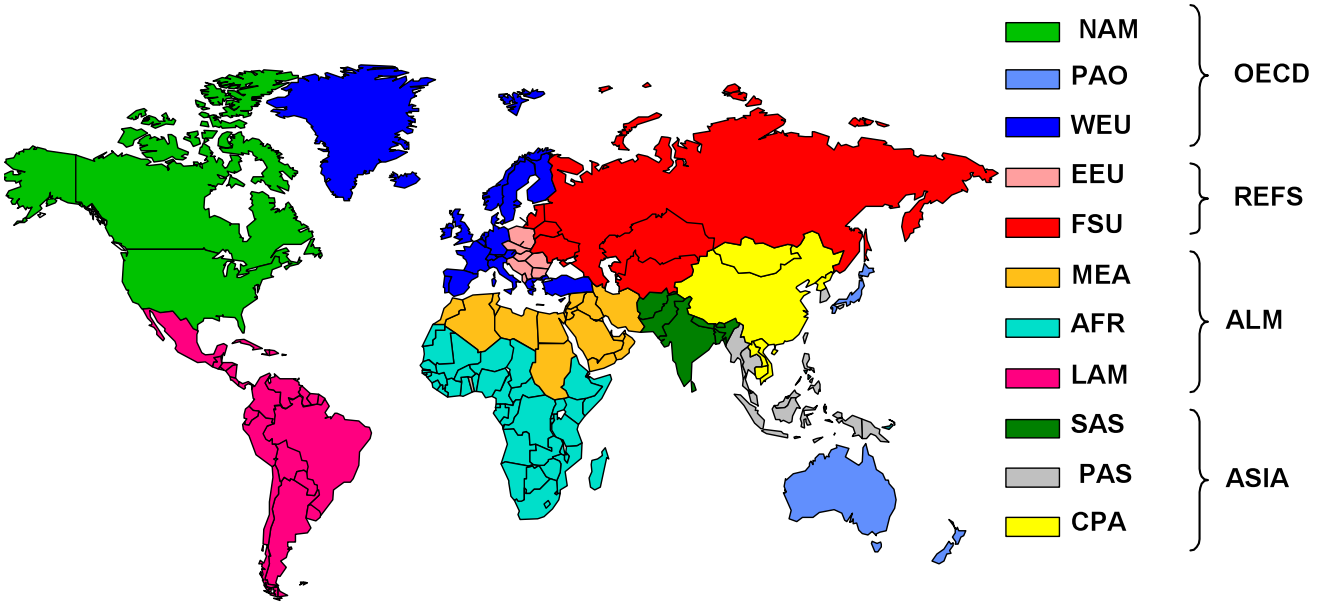
- Original data set based on Hoogwijk et al. (IMAGE)

- Potentials aggregated to 4 bins, based on CF
- Bin potentials by weighted average $potential_{CF}$ x CF

- Uniform minimum 20% CF for new potentials
- Equal bin size scaled to highest CF with potential >0

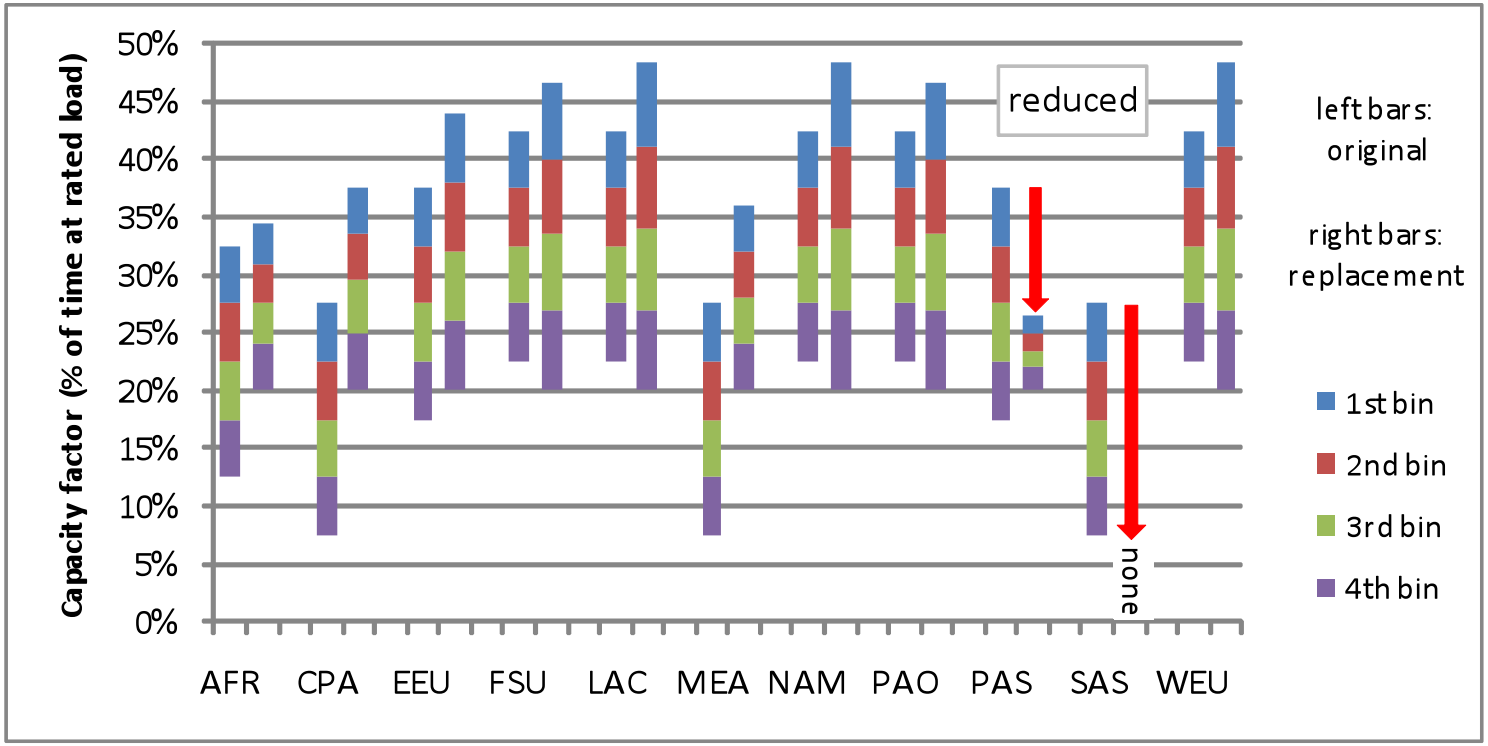
- Varying minimum CF for old potential, lowest of 10%
- Uniform bin size of 5%, starting from highest CF

Regional Representation in MESSAGE



1 NAM North America
2 LAM Latin America & The Caribbean
3 WEU Western Europe
4 EEU Central & Eastern Europe
5 FSU Former Soviet Union
6 MEA Middle East & North Africa
7 AFR Sub-Saharan Africa
8 CPA Centrally Planned Asia & China
9 SAS South Asia
10 PAS Other Pacific Asia
11 PAO Pacific OECD

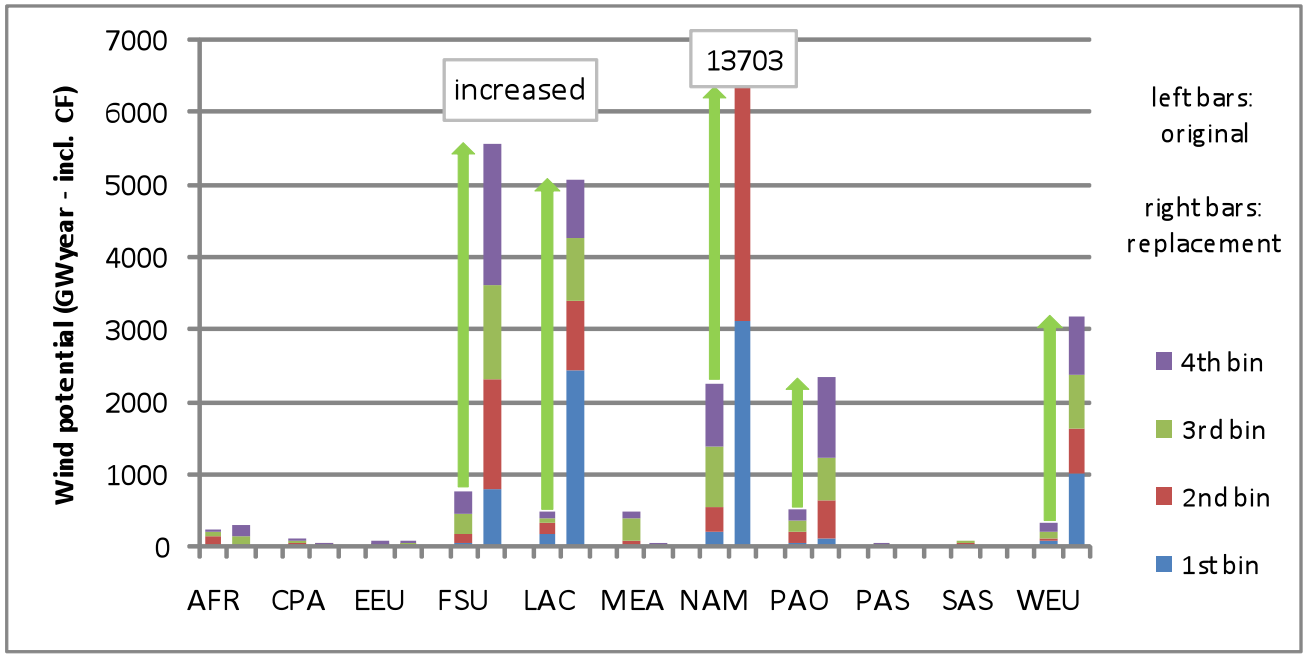
Binning the Wind Potential by CF



Most regions see expanded range of CF

- AFR, CPA, EEU, MEA: all bins higher CF
- PAS, SAS: all bins reduced

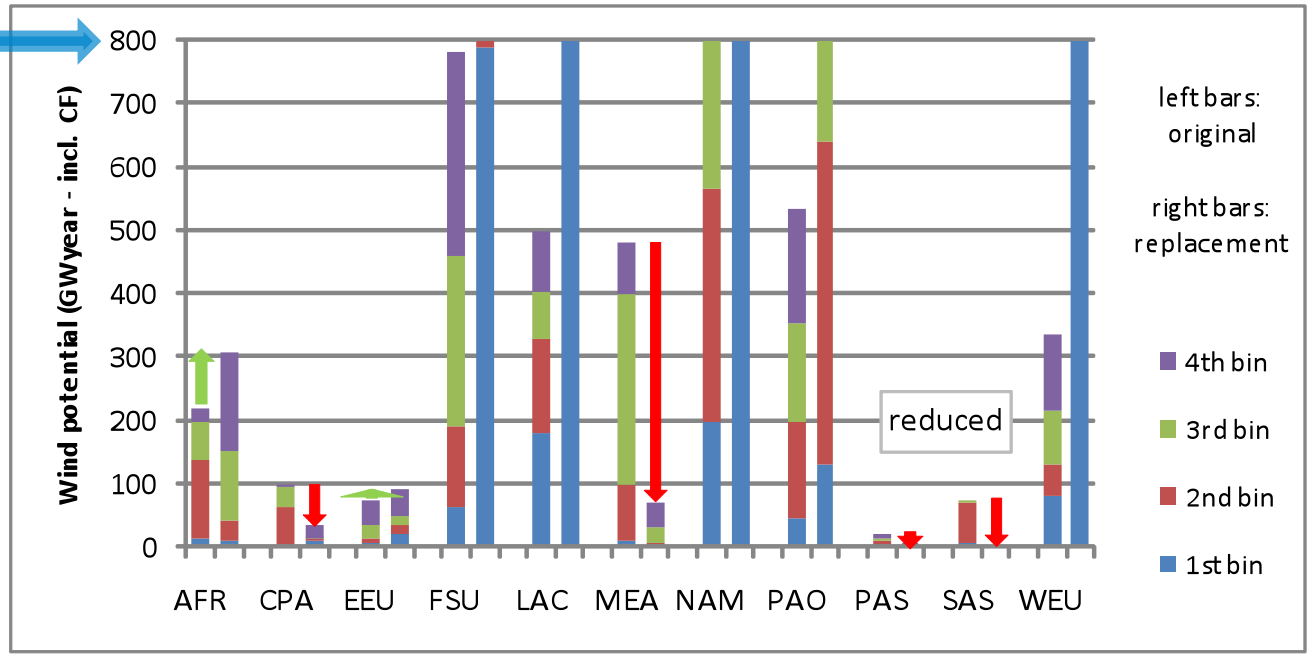
Binning the Wind Potential by CF
High Potential



Regions with already large wind potential (compared to other regions) gain a lot.

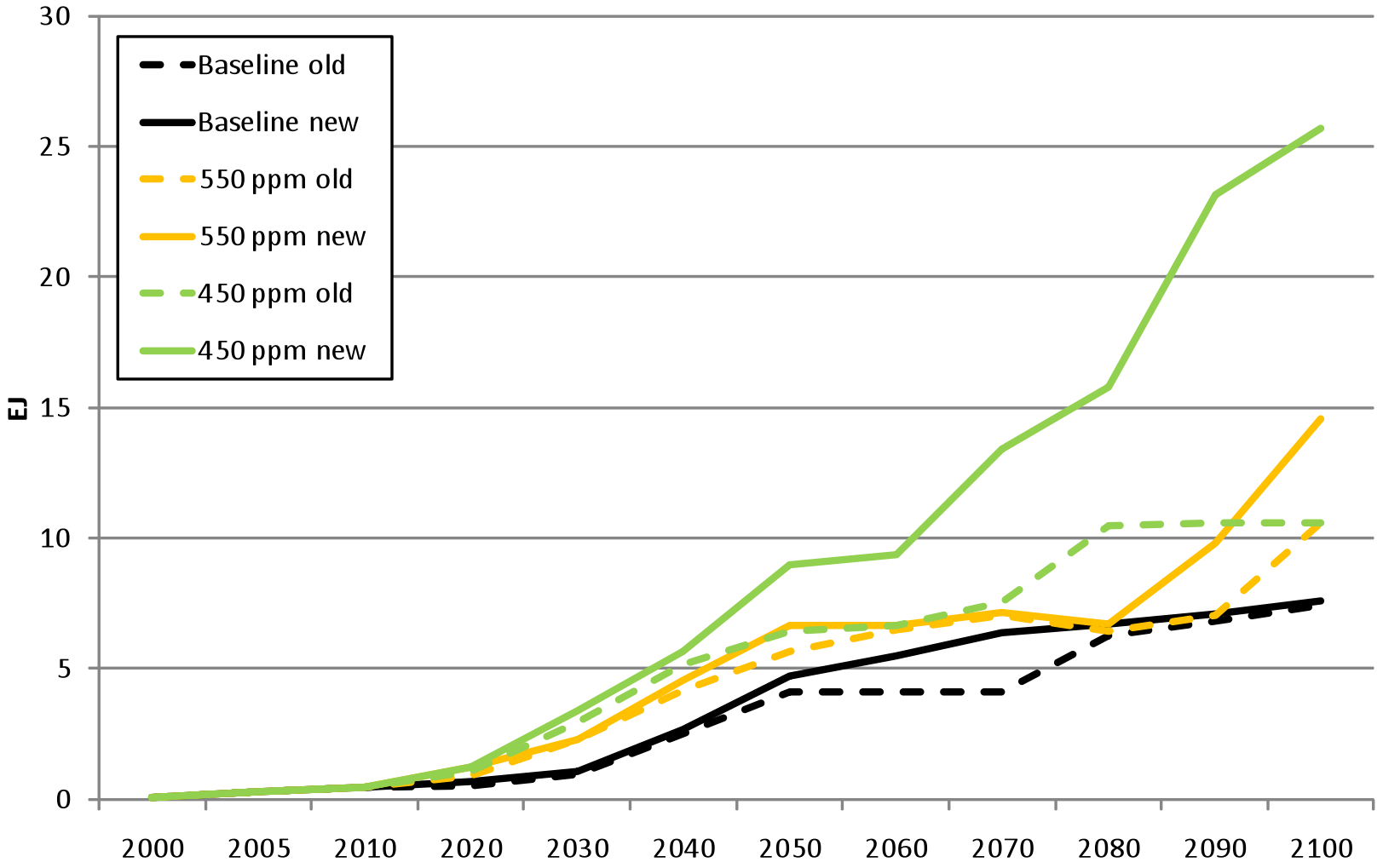
Binning the Wind Potential by CF Low Potential

Same data, vertical axis strechted

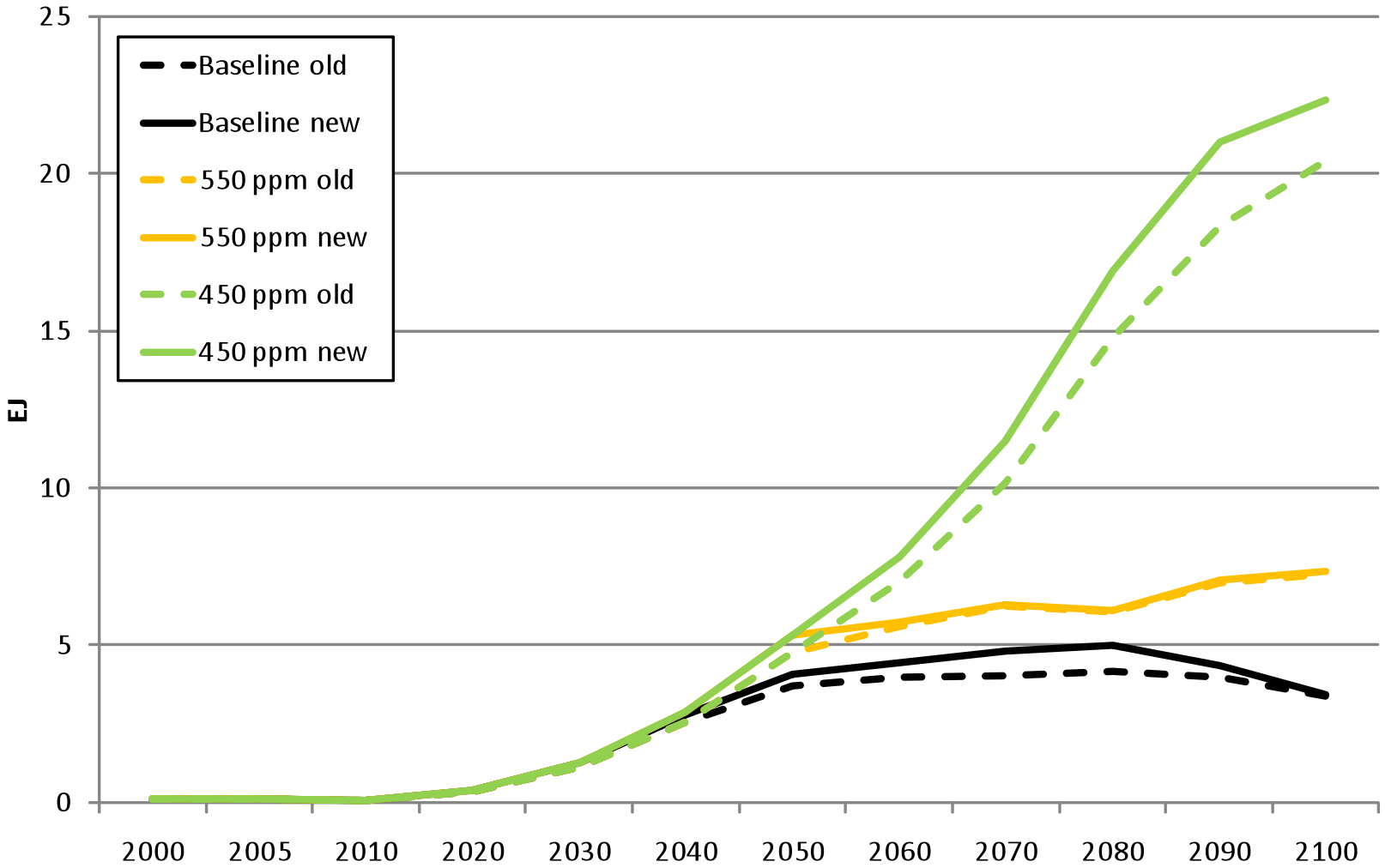


Regions with initially small and further reduced wind potential were not implemented ! (CPA, MEA, PAS, SAS)

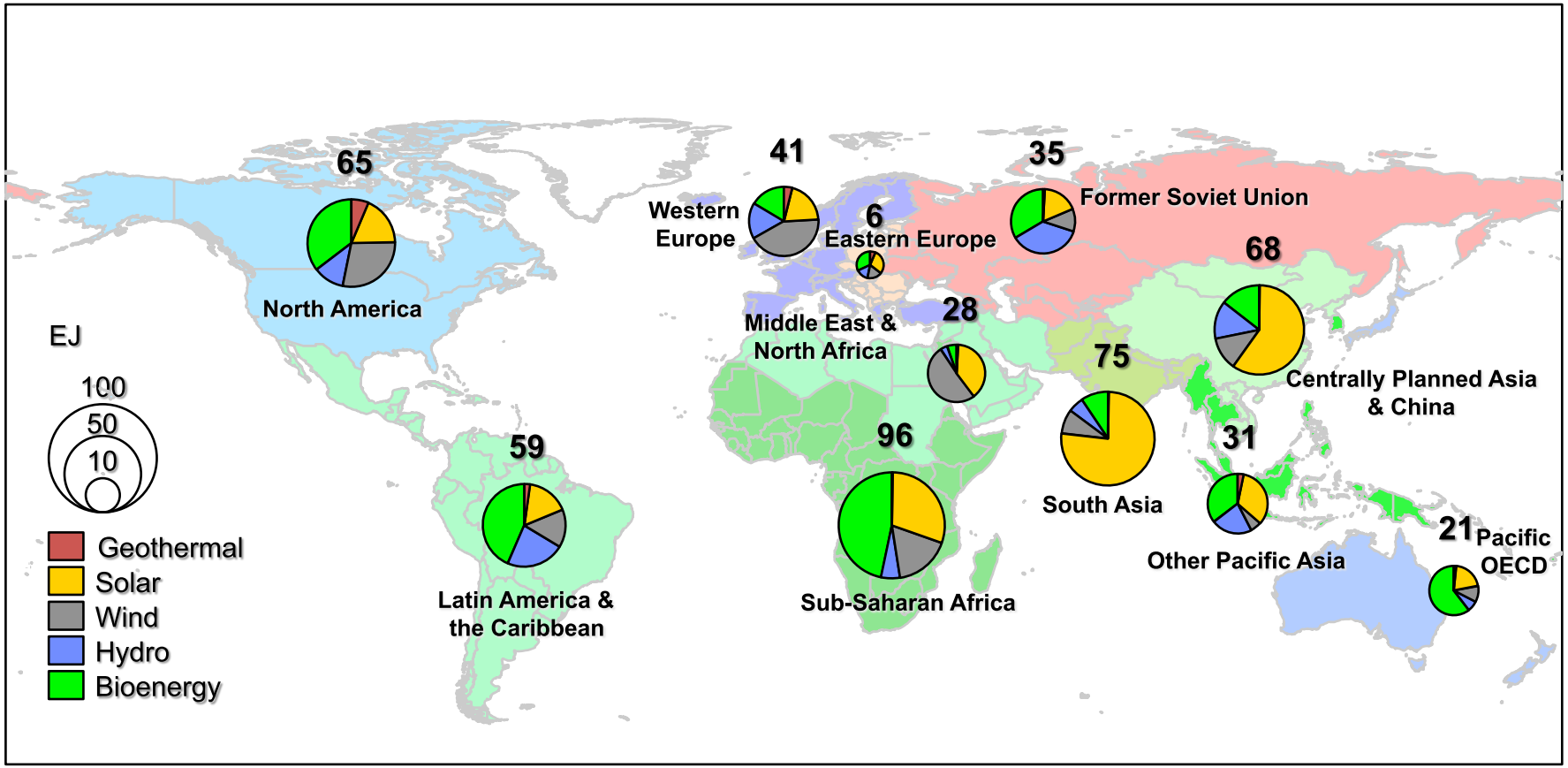
Western Europe
Wind Energy Deployment



North America
Wind Energy Deployment



Renewable Energy Deployment in 2050 under 450 ppm stabilization



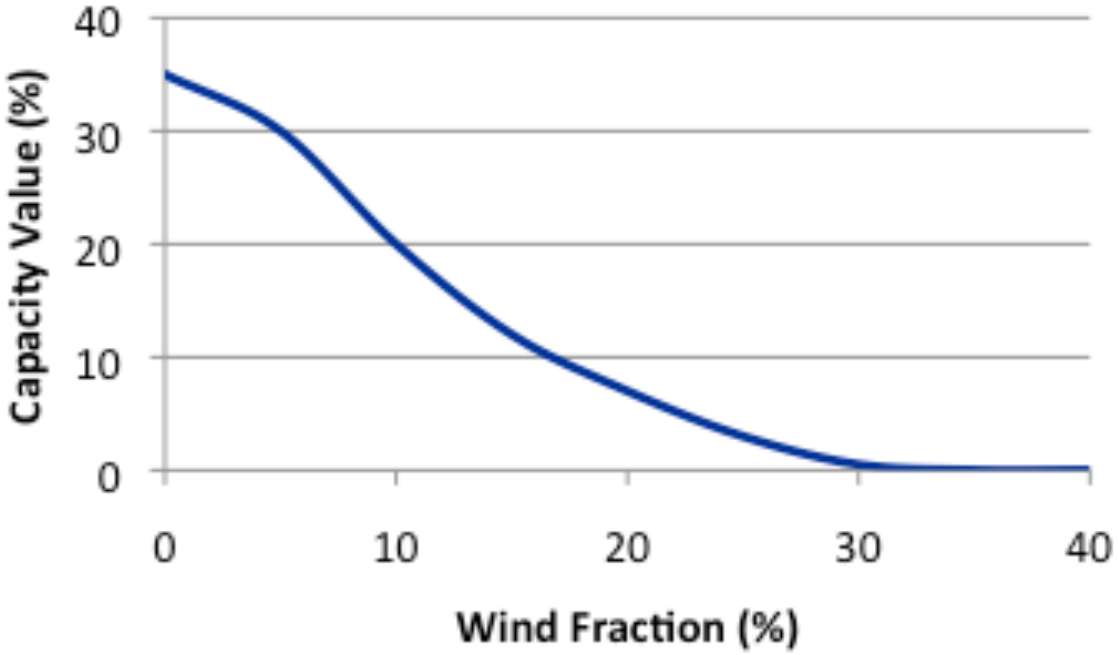
Some Forward Looking Thoughts

- 2 Dimensional Supply Curves:
  - Keep it simple – IAMs run out to 2100
  - Still useful to try different setups on the resource side
- Cross-border transmission (e.g. Desertec) – more relevant for national level data then for large regions
- Joint treatment of different renewable sources and their transmission/distribution needs?
- Other constraining factors then resources and transmission (e.g. water for cooling)
- Data preparation in different form
  - National level
  - Gridded form (e.g. CF supply curve maps)
  - Original resource data

Thank You!

Additional Material

Capacity Reserve in MESSAGE

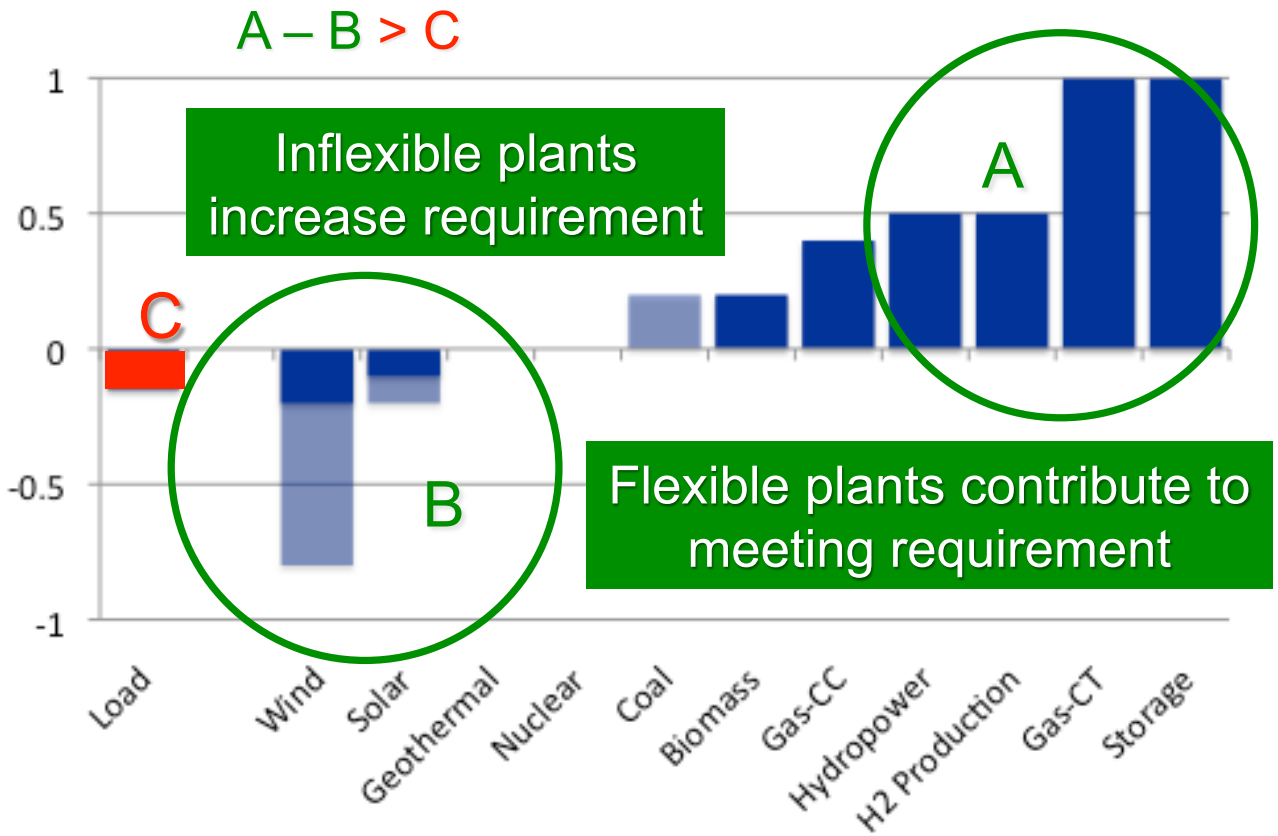


- Dispatchable plants get nameplate credit
- Contribution of intermittent renewables decreases with it's share in the system

Sullivan et al., 2010

Operating Reserve in MESSAGE (balancing equation)

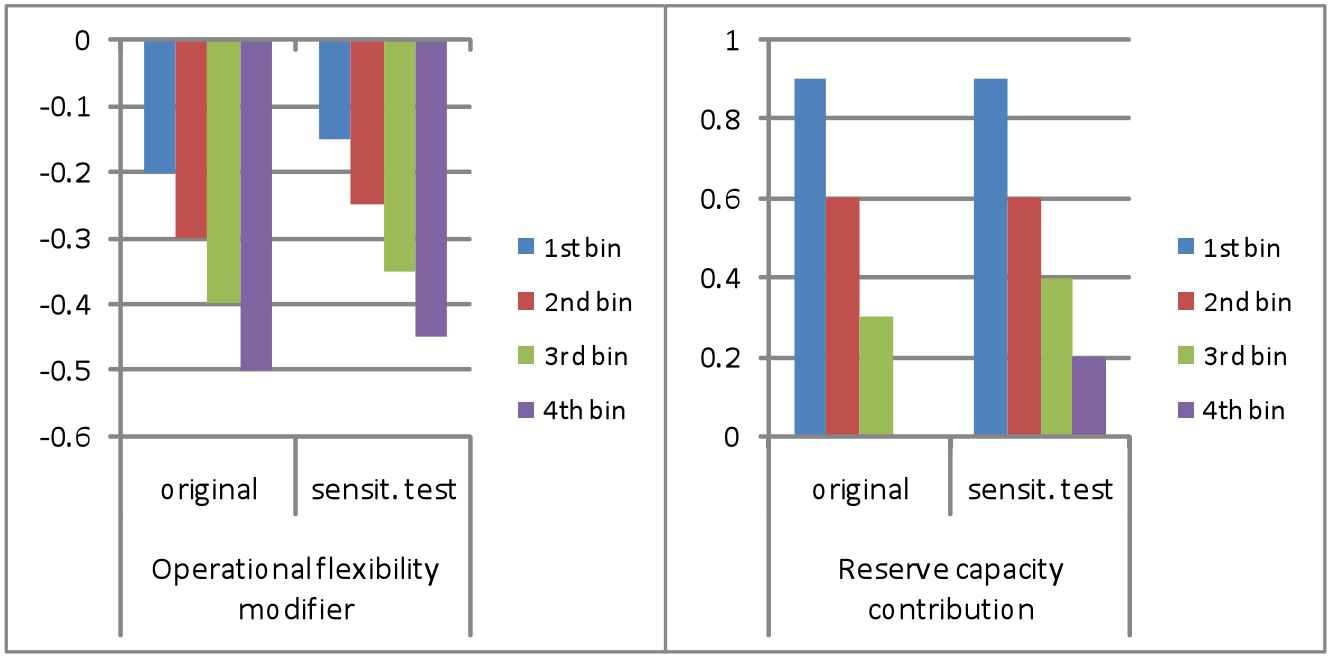
Coefficients (and ranges) for operating reserve constraint



The system requires a basic amount of flexibility to account for load variance

Sullivan et al., 2010

Sensitivity



Small test to see if improving the integration of wind power in the energy system increases adoption.