POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

The IAM perspective on wind resource potentials

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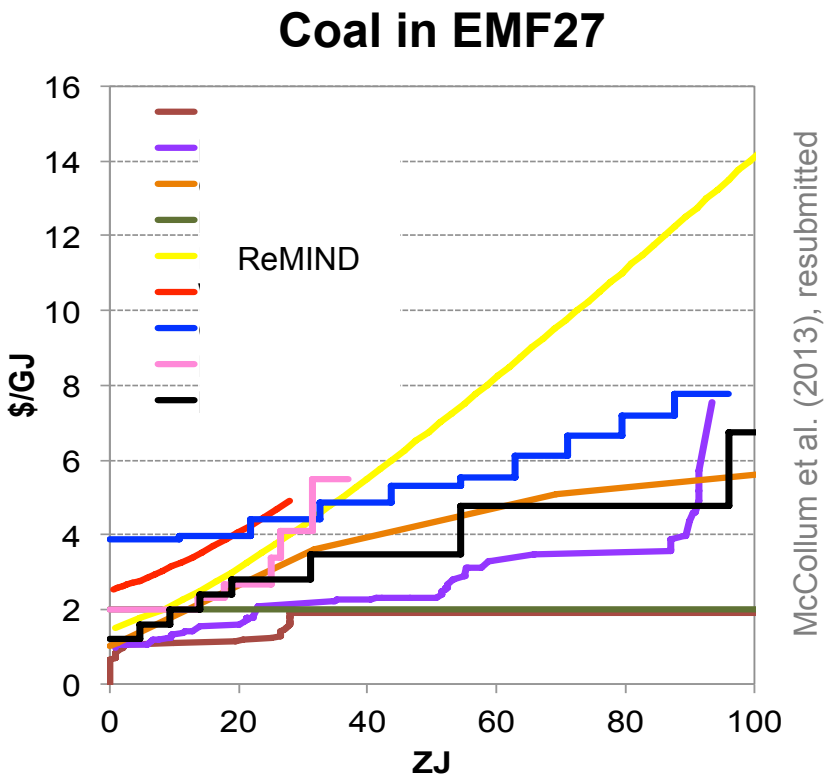
Resource assessments and IAM assumptions

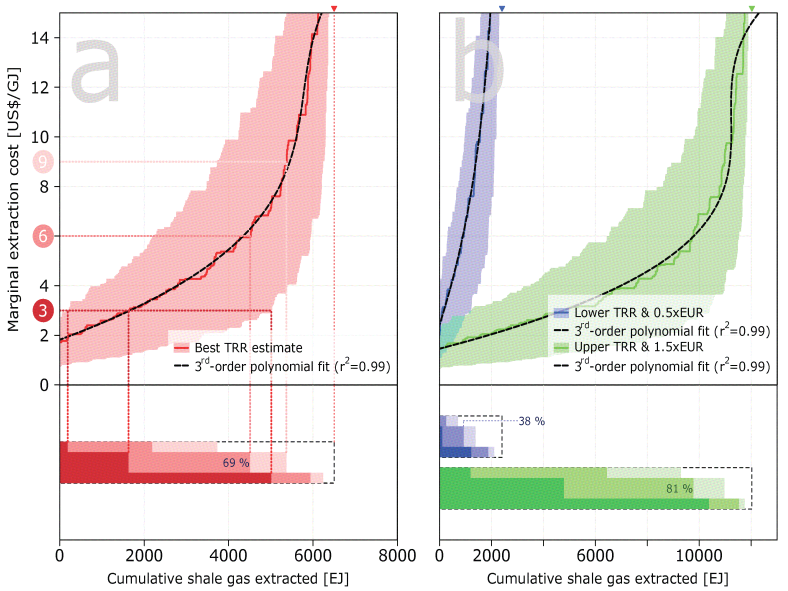
- Fossil fuels



Resource assessments and IAM assumptions

- Fossil fuels
  - E.g. shale gas

Shale gas

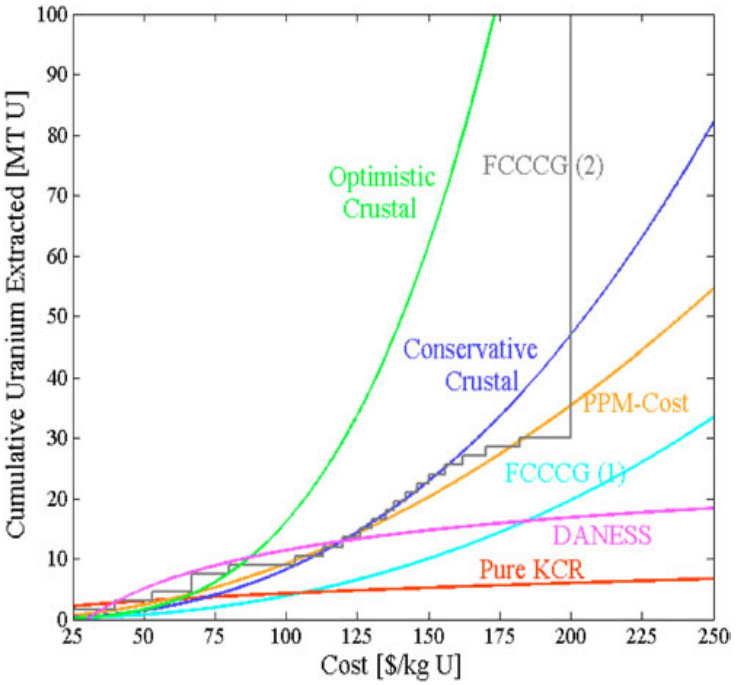


Hilaire et al. (2013), submitted

Resource assessments and IAM assumptions

- Fossil fuels
  - E.g. shale gas
- Uranium

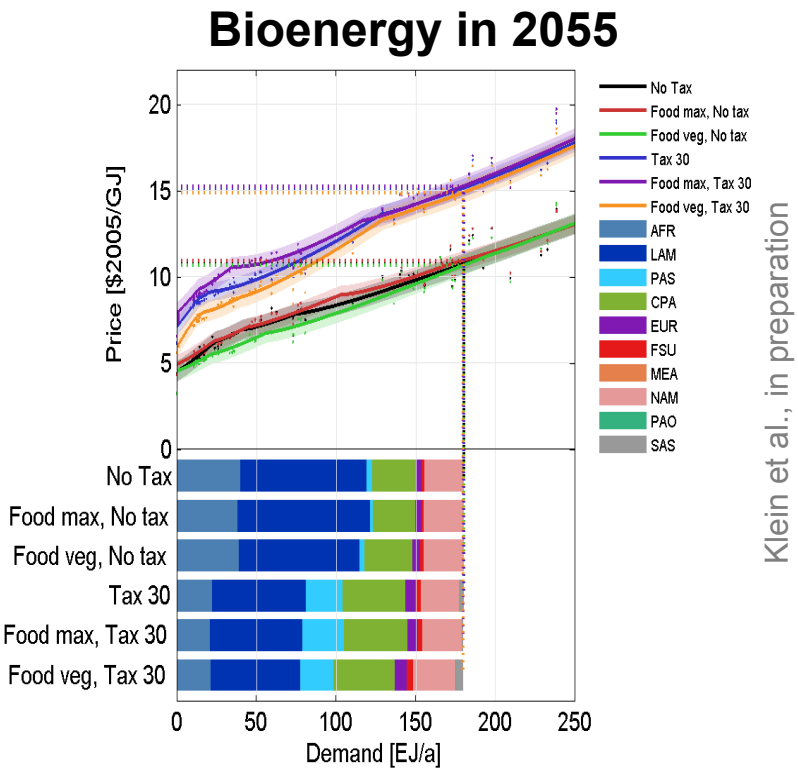
Uranium



Schneider and Sailor (2007, p. 387)

Resource assessments and IAM assumptions

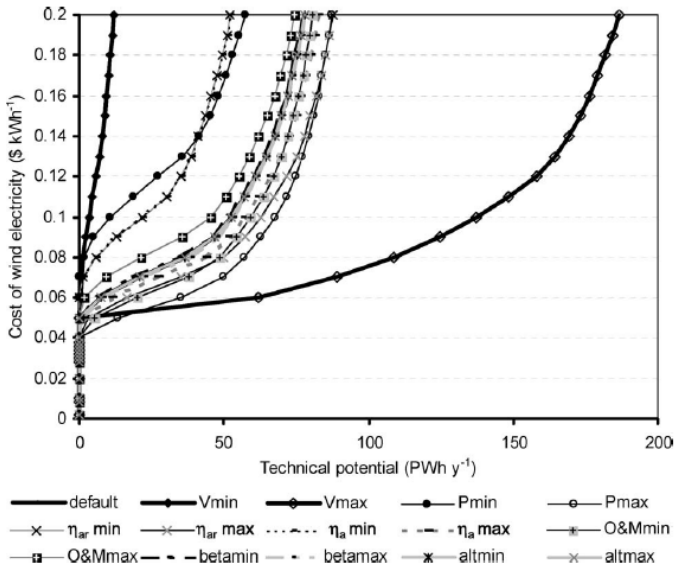
- Fossil fuels
  - E.g. shale gas
- Uranium
- Bio-energy



Resource assessments and IAM assumptions

- Fossil fuels
  - E.g. shale gas
- Uranium
- Bio-energy
- Wind, solar, geo-thermal, hydro, ocean, …

Wind – onshore



Hoogwijk et al. (2004, p. 911)

- Resource assumptions crucial for IAM scenarios
- No generally accepted methodology for resource assessments

Wind Power

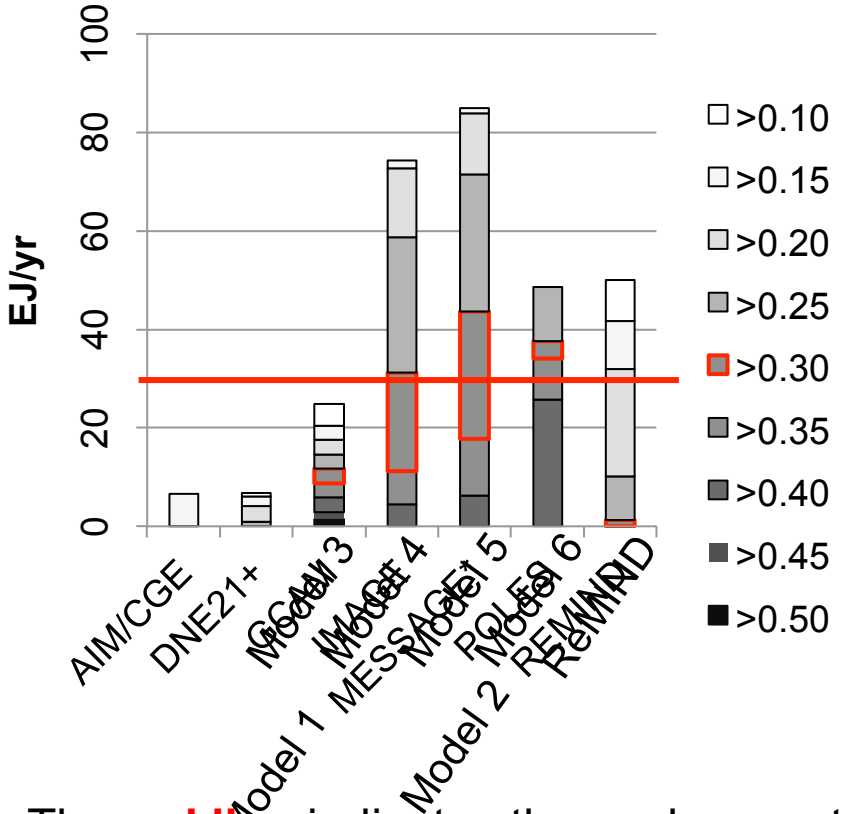
EJ/pa		Lu et al. (2010) CF > 20%		NREL CF>20%		
	Electricity 2010	On-shore	Offshore	On-shore	Off-shore	Area all classes
	EJ pa	EJ pa	EJ pa	EJ pa	EJ pa	%
USA	14	266	50	107	46	39
China	9	140	17	58	**35**	38
India	2	10	4	**18**	**12**	34
Japan	4	2	10	**3**	**23**	26
Russia	3	430	80	103	**123**	13
Germany	2	12	3	4	2	29
UK	1	16	22	6	**29**	45

Three major issues:

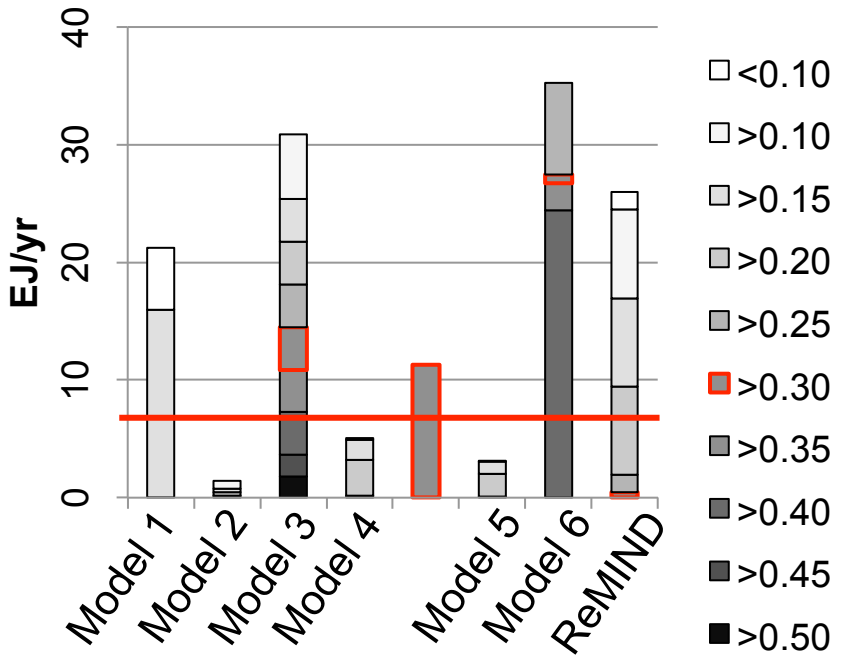
1. **Quantity** of potentials
2. **Quality** of potentials (capacity factor)
3. **Consistency** across countries

Wind Power – Total Potentials

USA (14EJ in 2010)



China (9EJ in 2010)

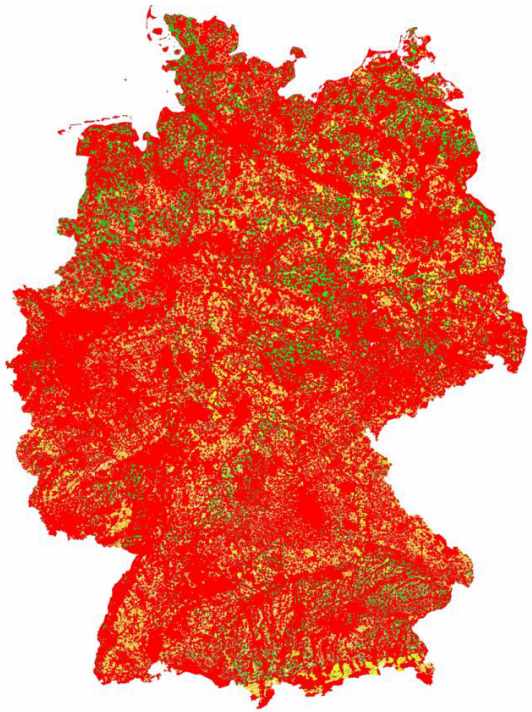


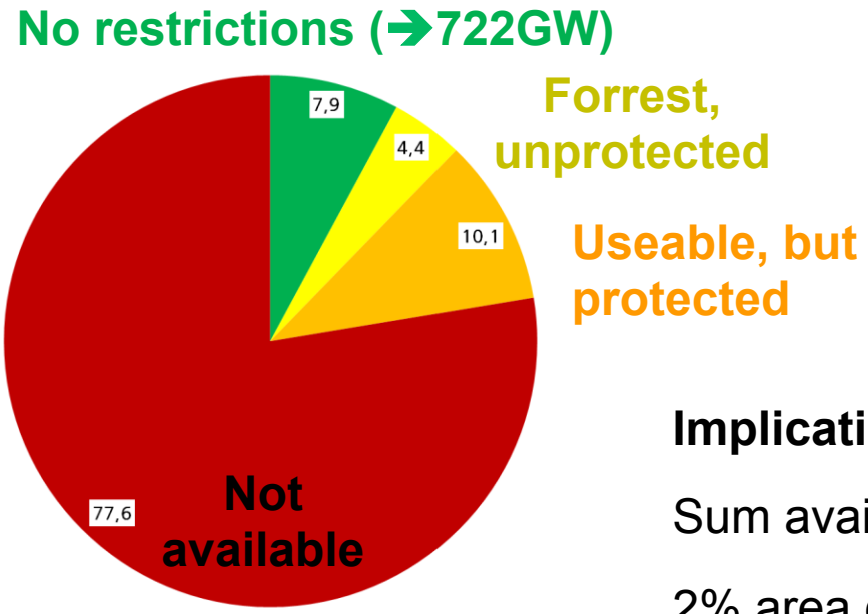
Source: Luderer, Krey et al. (2013), EMF27

The **red line** indicates the onshore potential in the NREL data-set with a CF >30%

Wind Power – Total Potentials

- Study by IWES (2011) on German on-shore potential
- Assumptions: 1000m buffer, CF >18% and ~25MW per km²
- Population density 225 per km² (Colorado 19)





Implication for potential

Sum avail. area: 1500GW

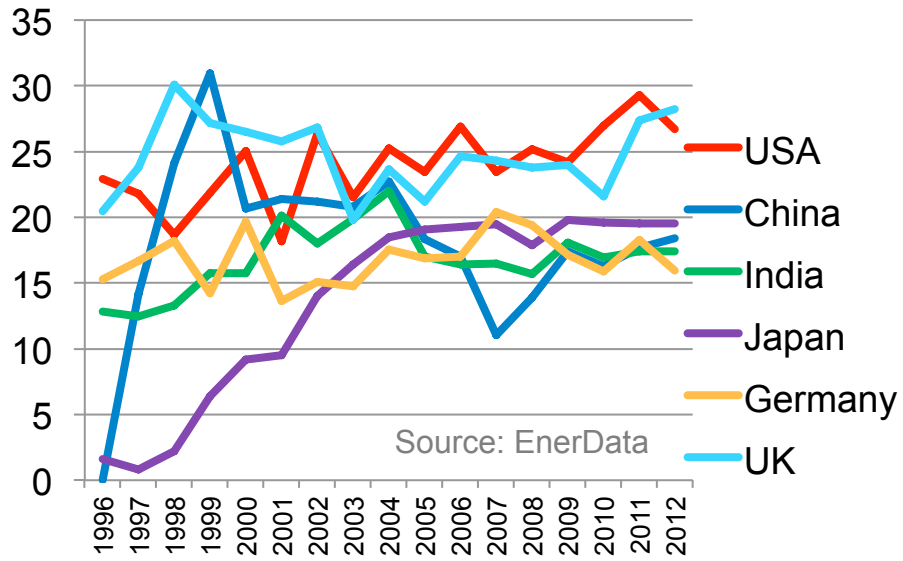
2% area constraint implies 198GW @ CF 24%

NREL: 570GW @ CF 24%

P I K

Wind Power – What is the Capacity Factor?

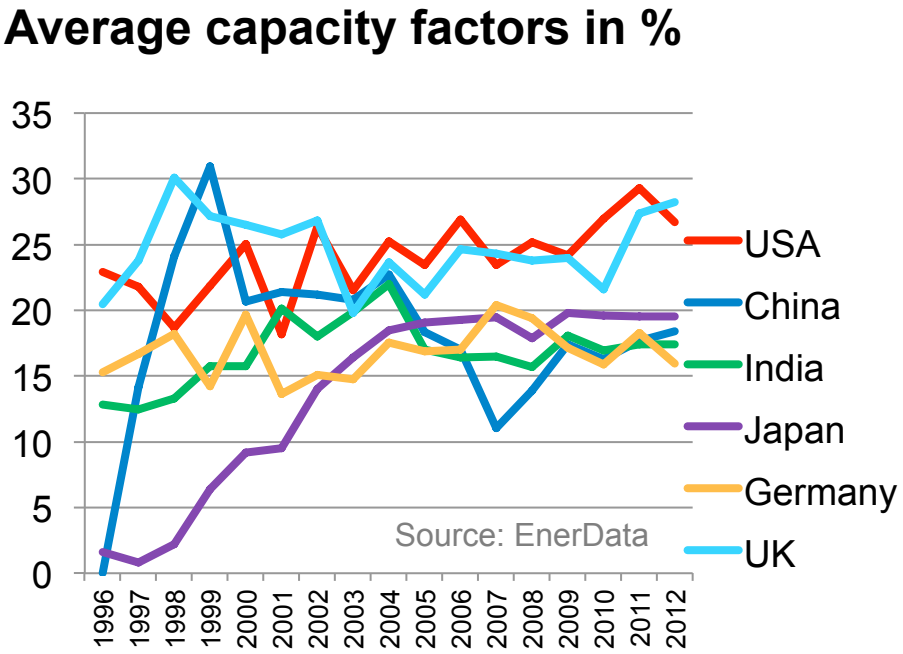
Average capacity factors in %

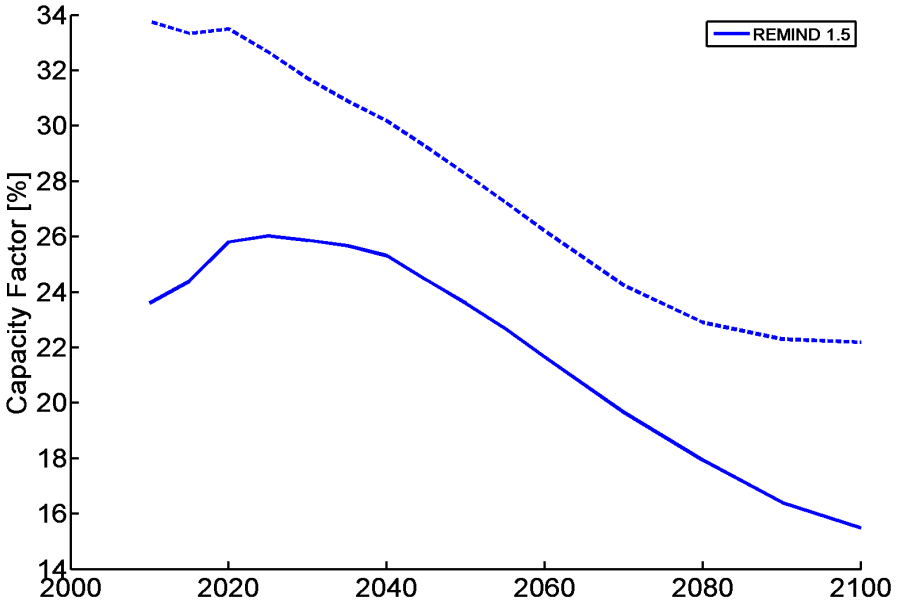


	NREL			
Generation wind 2012	C8 >42%	C7 >38%	C6 >34%	C5 >30%
TWh/yr	TWh/yr	TWh/yr	TWh/yr	TWh/yr
140		3	10	6100
100		41	790	2000
28			68	172
4				37
44			32	207
21	11	101	964	1600

Moreover: Are the different potentials consistent across countries?

Wind Power – What is the Capacity Factor?





Summary

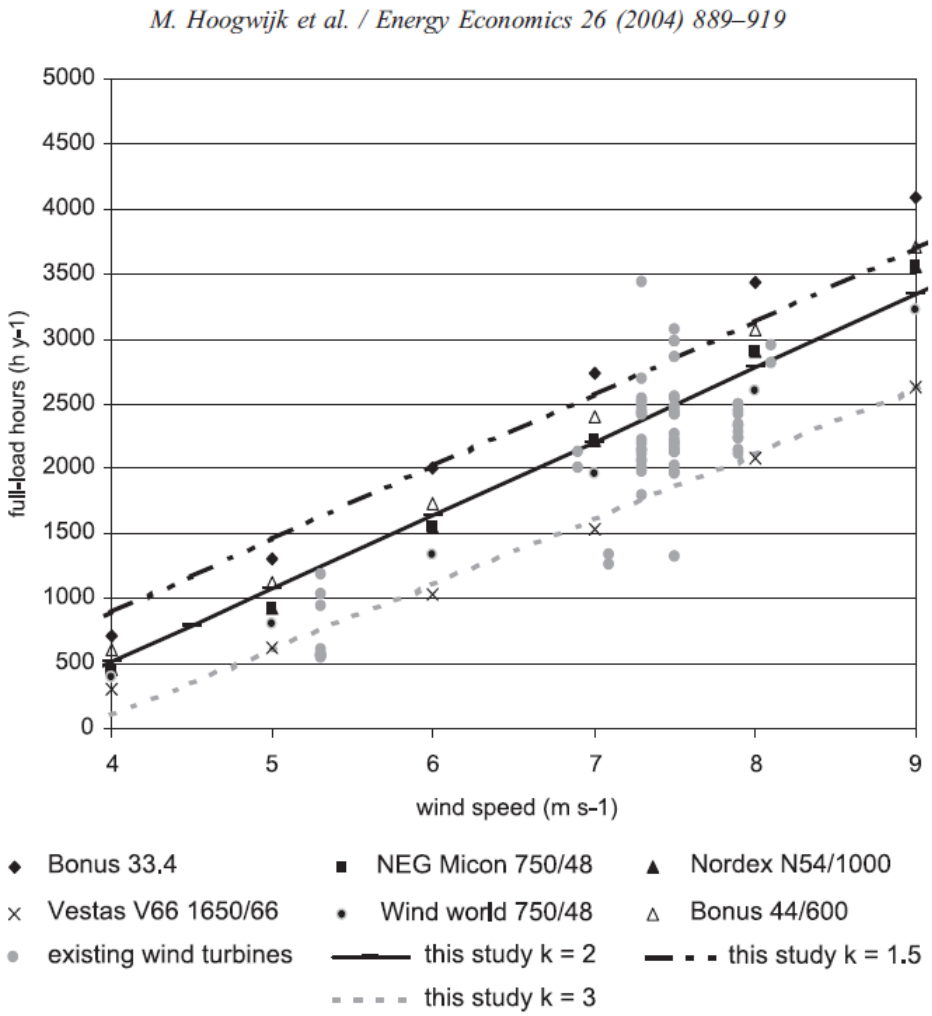
- Ressource assessments are crucial for IAM scenarios
- Huge differences across models for all primary energies
- Result of assumptions, judgements and methodologies

- Also wind potentials depend on uncertain factors incl. hard/ technical and soft/socio-political
- Validation of capacity factors is needed
- Diversity in existing models is enormous

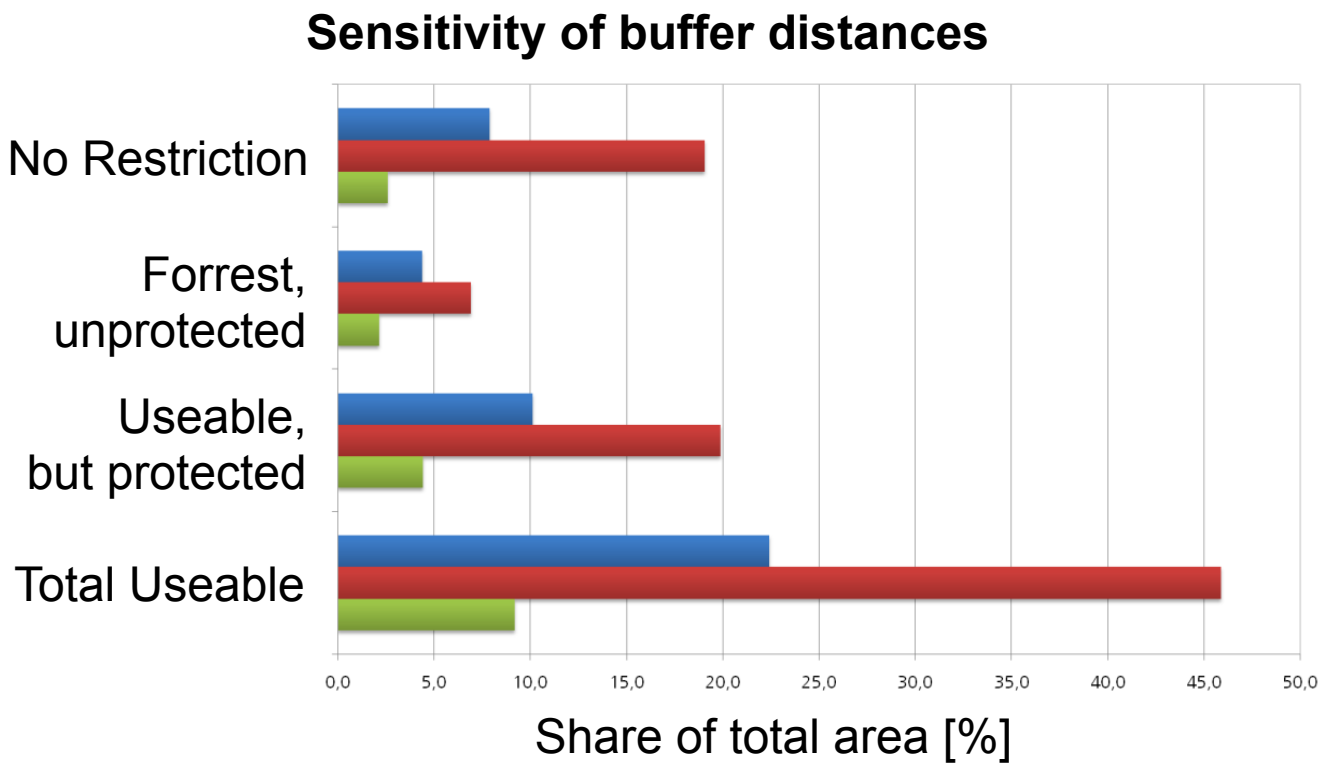
- Systematic exploration of uncertainties in resource potentials is warranted
- Mobilization of potentials is also a policy target/constraint
- IAMs assess the implications of this input uncertainty

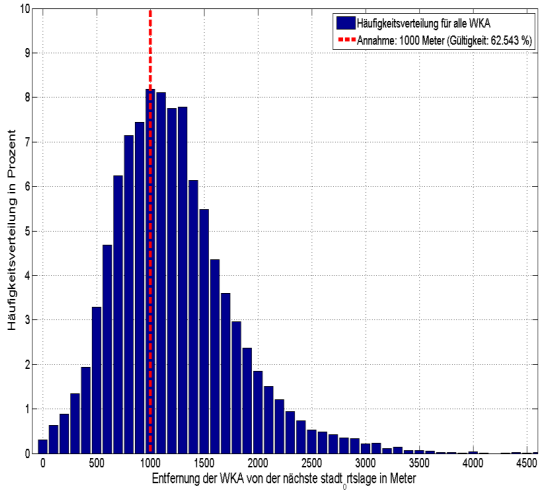
Additional Material

Wind Power – Capacity Factor

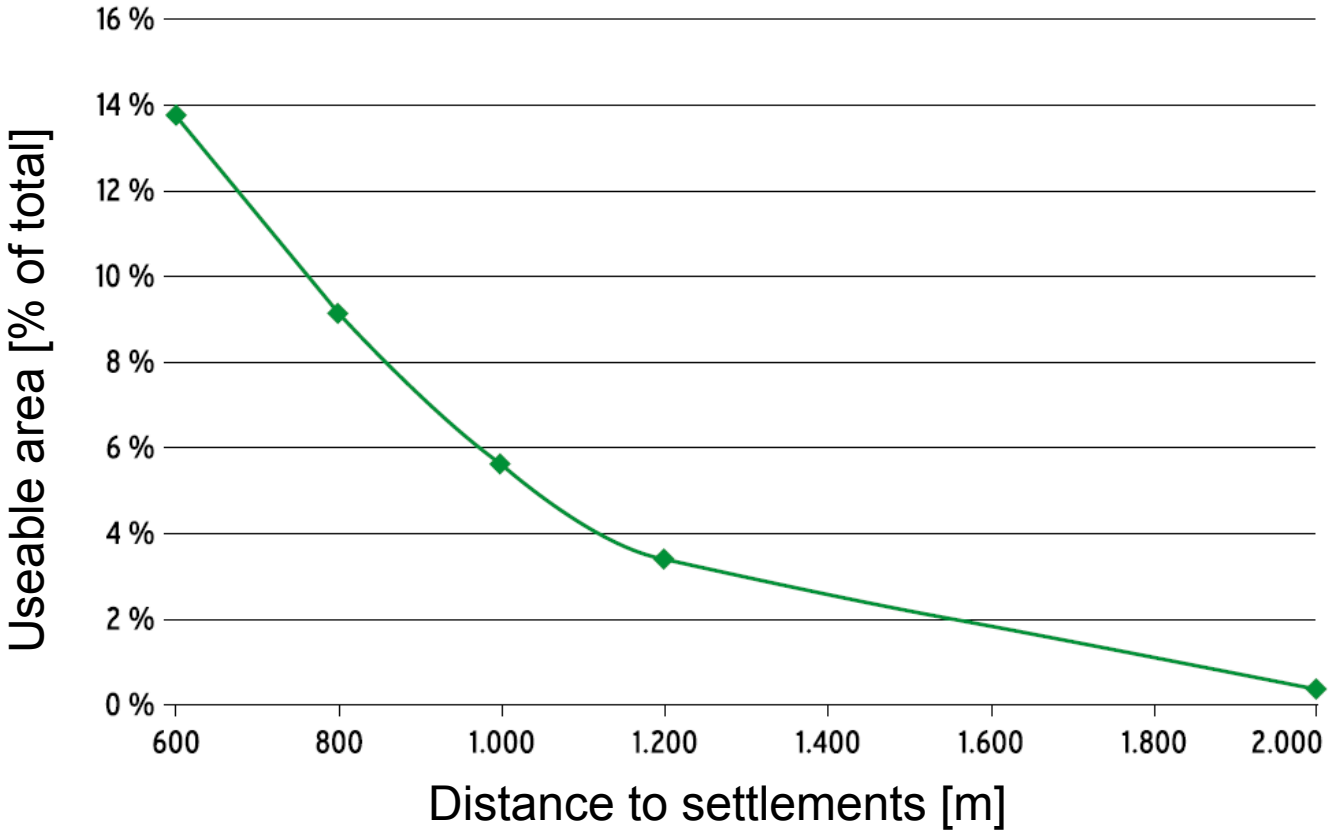


Wind Power – Total Potentials

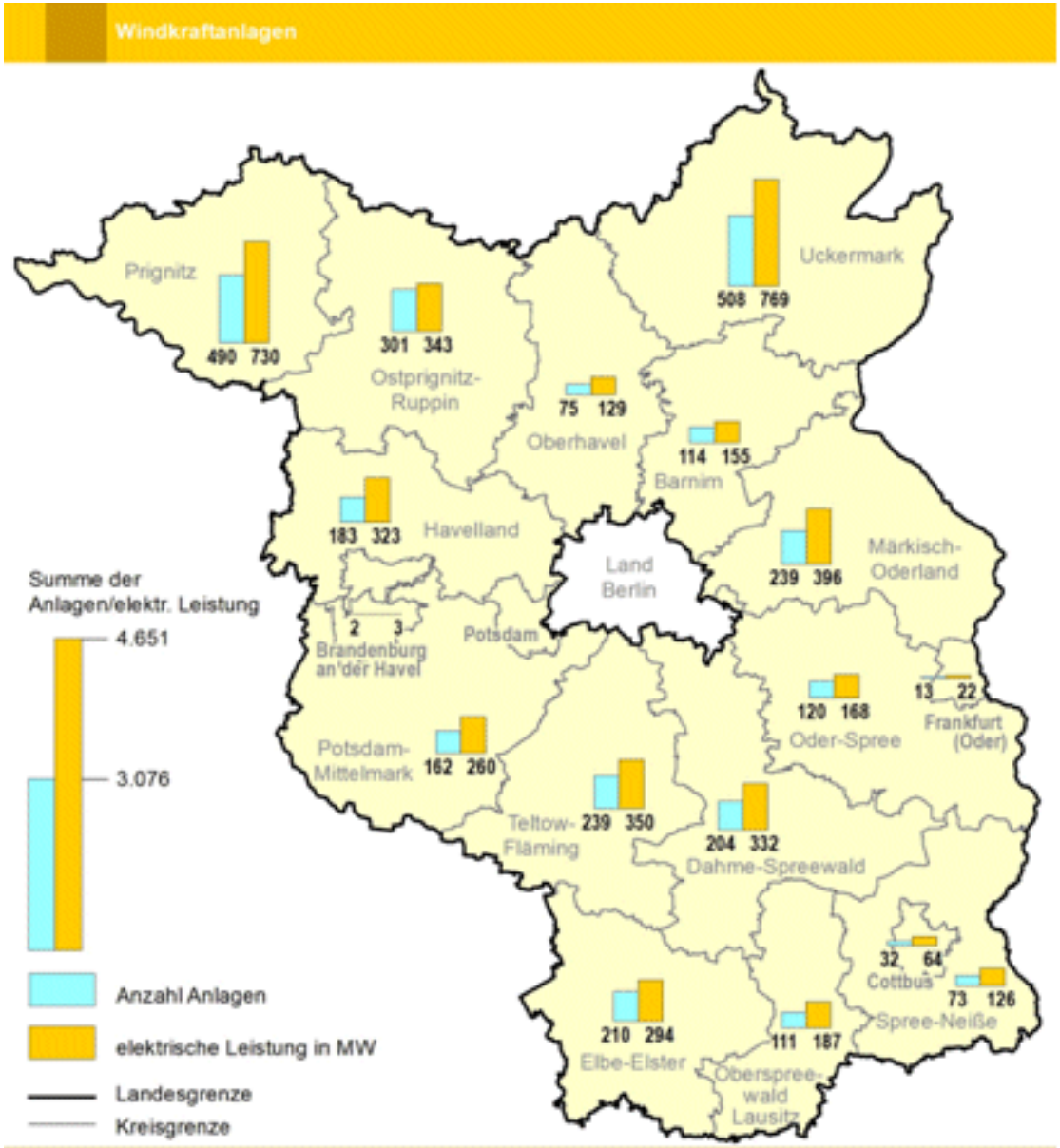




Buffer zones and potential area



UBA (2013)



Quelle: LUGV, 2013; Datenstand: 31.12.2012