THE TRANSITION OF THE AUSTRIAN ENERGY SYSTEM TO A HIGH PENETRATION OF WIND ENERGY: VISIONS, VALUES AND COSTS

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What is the problem?

The acceptance or non-acceptance of a particular renewable energy technology is depended on complex set of

economical incentives,

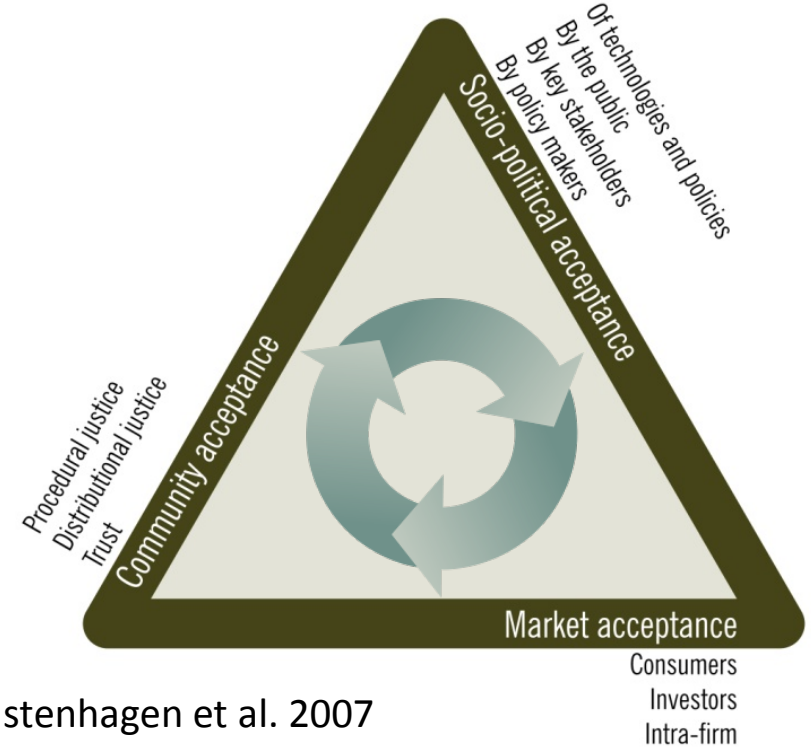
costs,

social norms,

individual values, preferences,

and beliefs

at various levels of decision-making.



Wüstenhagen et al. 2007

Research Questions of TransWind

Market & Socio-political Acceptance

✓ What is the techno-economical potential for wind energy in Austria?

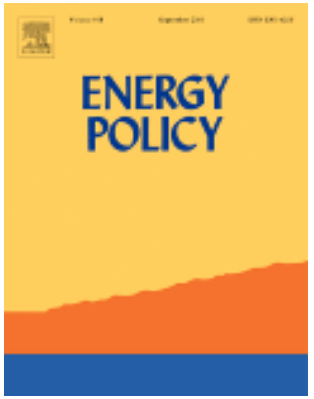
S. Höltinger et al. / Energy Policy 98 (2016) 49–61

Community & Socio-political Acceptance

✓ What are the decisive patterns of acceptance and non-acceptance?

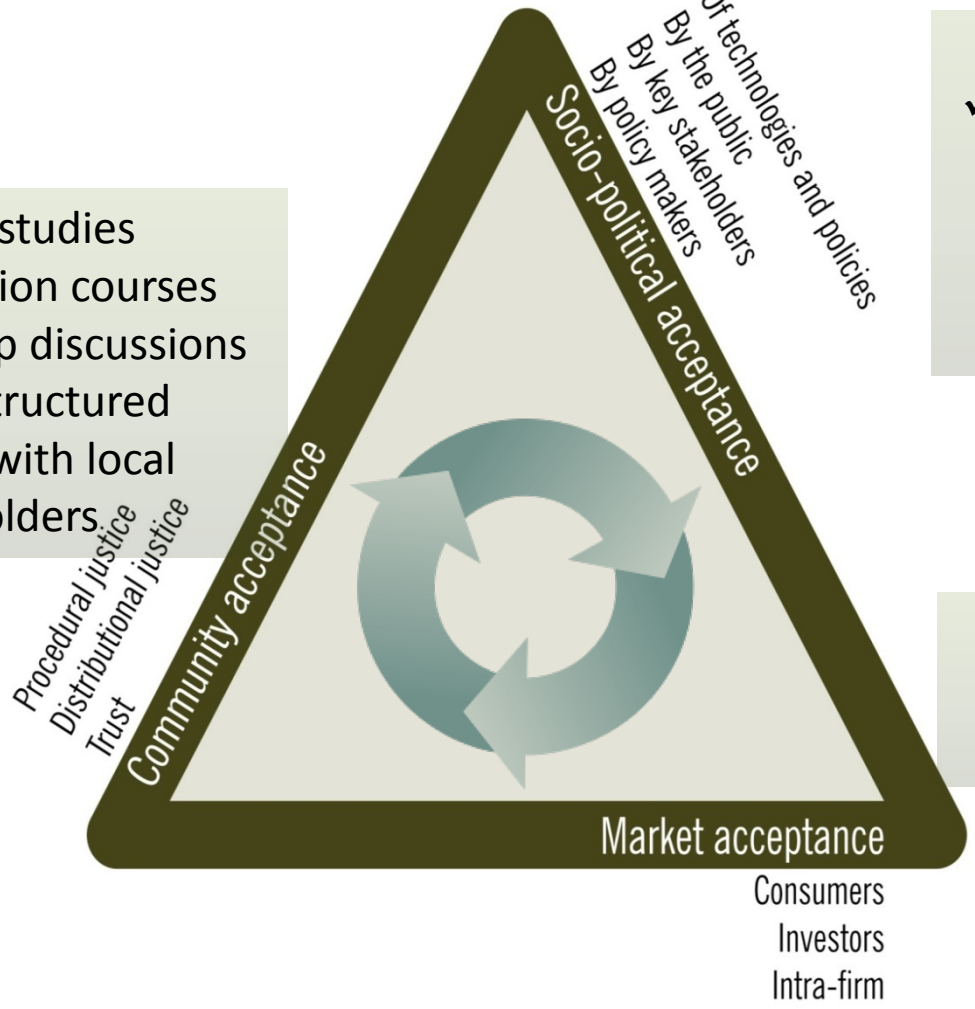
P. Scherhaufer et al. Energy Policy 109 (2017) 863–870

❖ How are interests, rationales and beliefs embedded in different narratives (stories) about renewable energy?



Materials & Methods: A participatory integrated assessment

- ✓ 6 case studies
- ✓ 4 visualisation courses
- ✓ 8 focus group discussions
- ✓ 8 semi structured interviews with local stakeholders



- ✓1 WorldCafé
- ✓28 semi structured interviews
- ✓1 questionnaire
- ✓3 participatory workshops with experts from the stakeholder group

- ✓Participatory modelling: Techno-economical wind energy potential

Triangle based on Wüstenhagen et al. 2007

The techno-economical potential: Overview of the modelling steps

Participatory modelling of area potentials

- Online questionnaire
- Stakeholder workshops

criteria catalogue

4 scenarios for area potentials

Theoretic wind potential

- Site specific wind conditions at a 100x100m resolution
- Weibull distribution of wind speeds

Technical wind potential

- Turbine specifications
  - Rated power
  - Rotor diameter
  - Hub height

Minimum distance between turbines

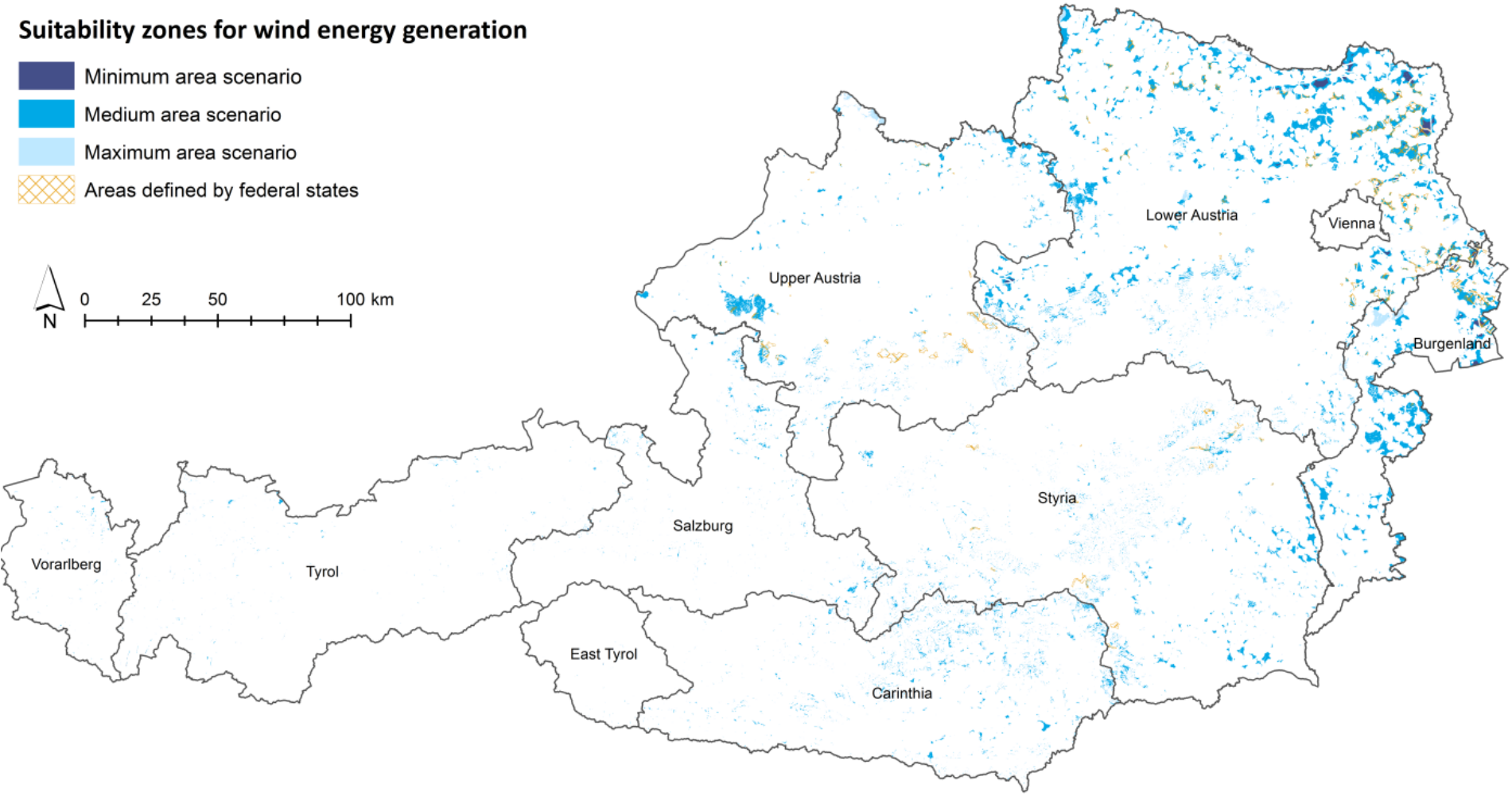
Economic wind potential

- Levelized cost of energy (€/MWh) for all sites
  - Investment and operation cost
  - Lifetime
  - Disount rate
- Regional supply curves for all scenarios

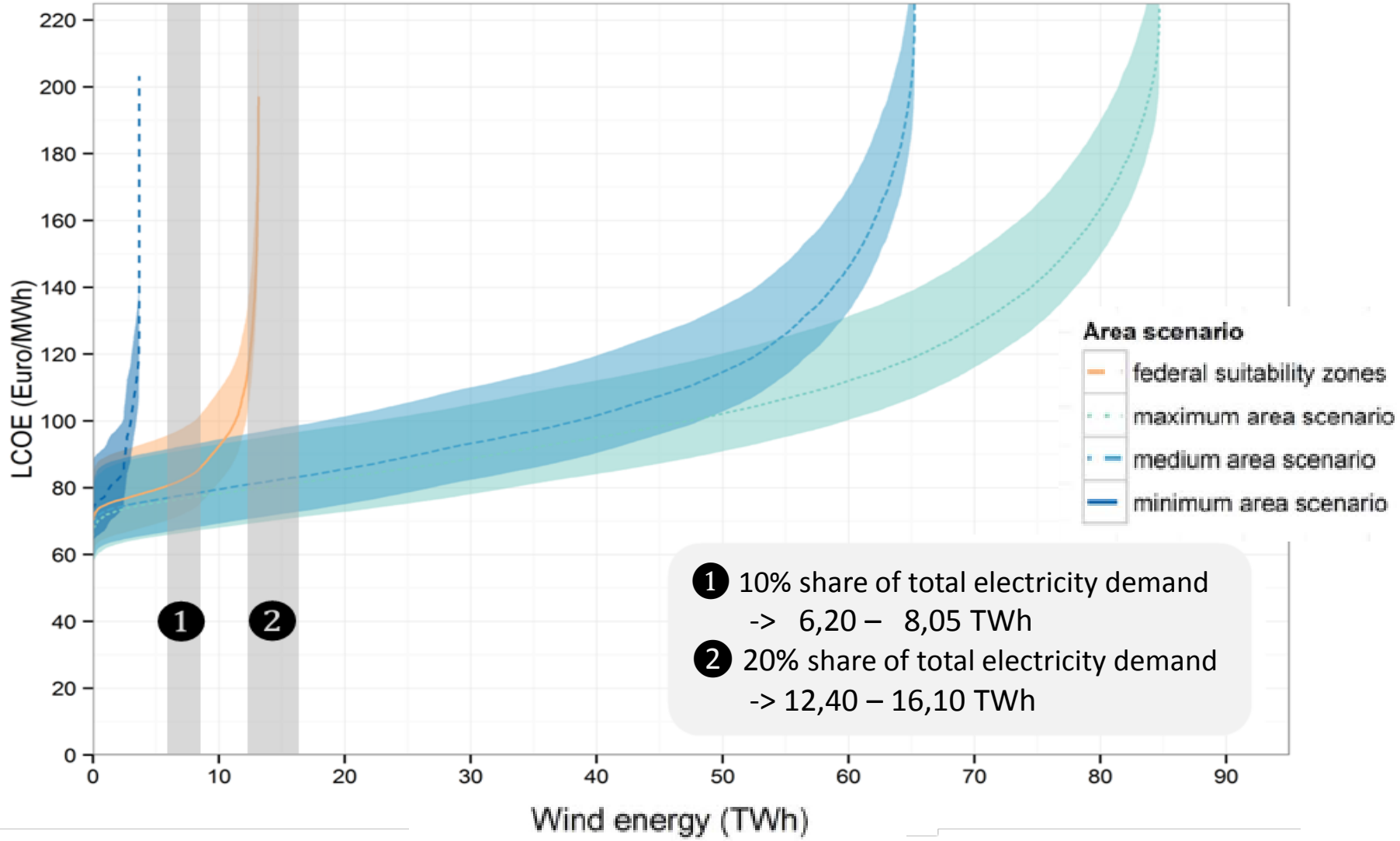
The techno-economical potential: Criteria catalogue for the 3 participatory scenarios

	scenarios of potential wind turbine sites			GIS data-set
	min	med	max	
topological restrictions				
Areas above alpine forest line	excluded	excluded	excluded	Kilian et al. (1994)
maximum slope (degrees)	5.7	8.5	11.3	SRTM DEM 90m
water bodies	excluded	excluded	excluded	Corine LC 5
offset distance to settlements and infrastructure				
settlement areas (m) [a]	2000	1200	1000	IACS
buildings outside of settlement areas (m) [b]	1000	750	750	OSM buildings
building land outside of settlement areas (m)	1000	750	750	federal land use plans
built-up areas [c]	300	300	300	federal land use plans
railways	300	300	300	OSM
motorways, primary and secondary roads	300	300	300	OSM
airport public safety zones [d]	5100	5100	5100	AustroControl
power grid (>110kV)	250	250	250	OSM
suitability of protected areas and offset distances				
national parks (m)	no (3000)	no (2000)	no (1000)	CDDA
Natura 2000 -habitats directive sites (m)	no (2000)	no	potentially[f]	Natura 2000
Natura 2000 - birds directive sites (m)	no (2000)	no	no	Natura 2000
other protected areas (m) [e]	no (2000)	no	no	CDDA
important birdlife areas	no	potentially[f]	potentially[f]	IBAs
major migration routes for wild animals	no	potentially[f]	potentially[f]	ACC, Köhler (2005)
forest areas	no (1000)	yes[g]	yes	Corine, AFDP
lakes >50ha (m)	3000	1750	1000	Corine LC 512

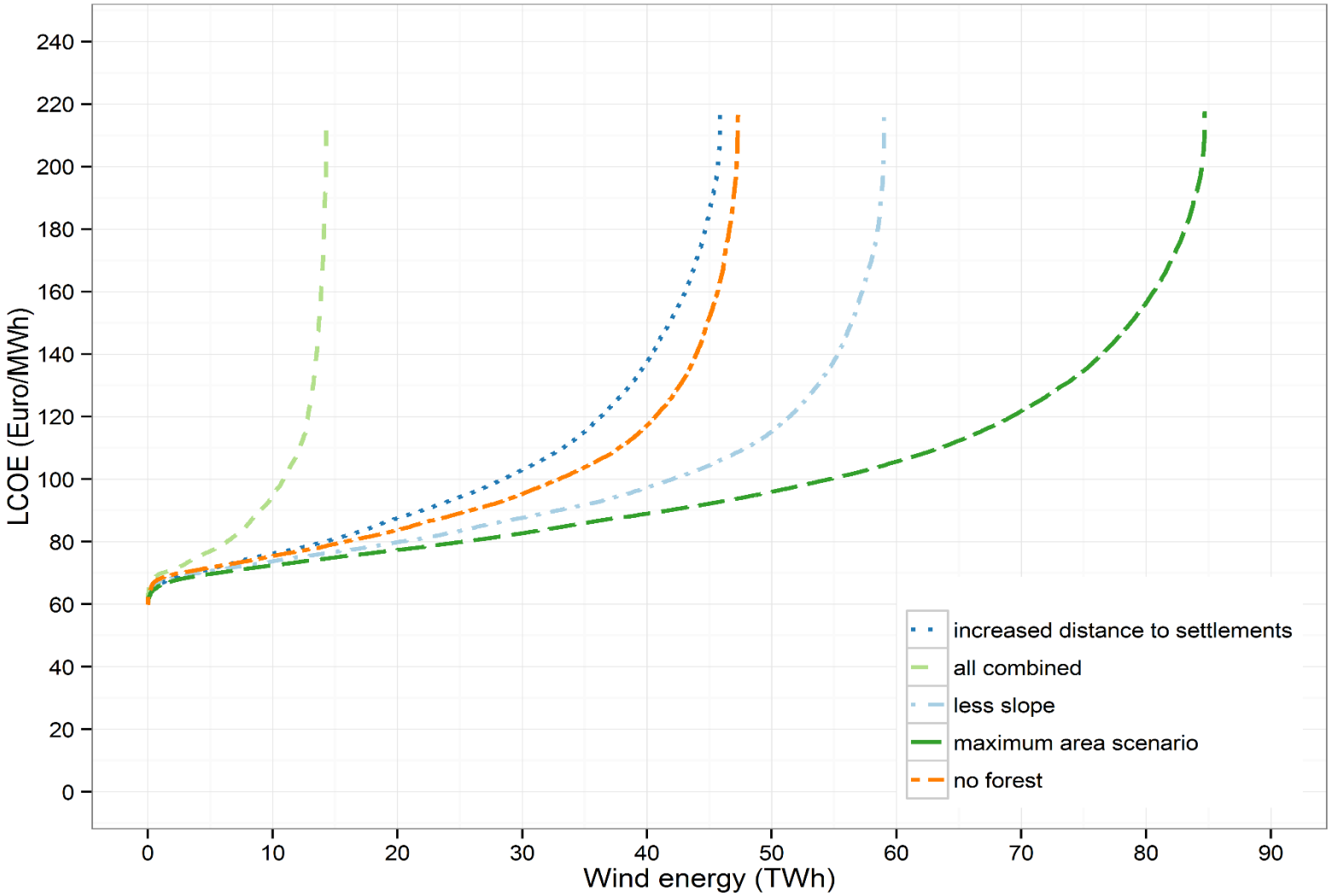
Spatial distribution of potential areas for wind turbines in the four scenarios



Supply curves showing the economic wind energy potential for the four scenarios

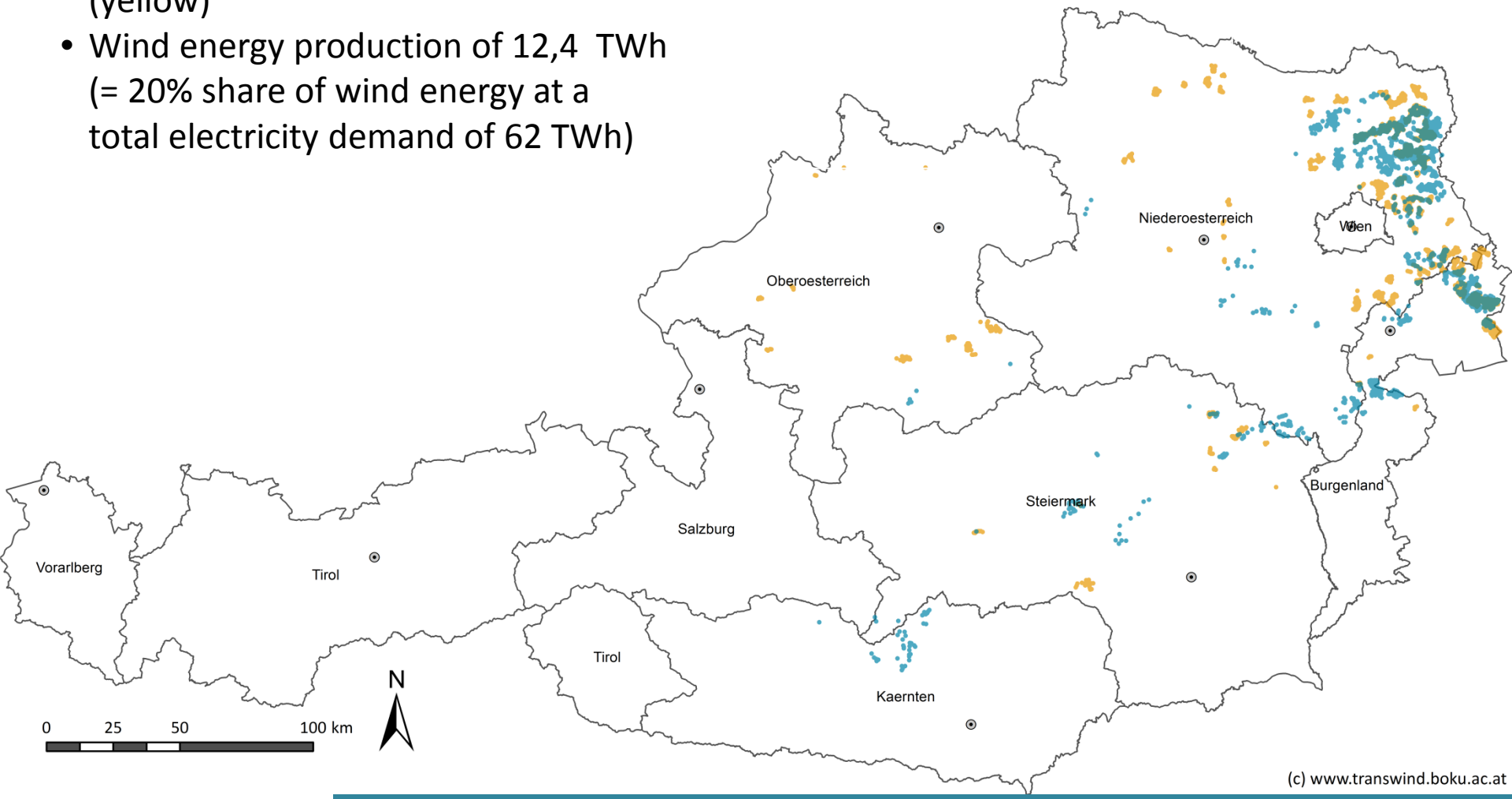


Sensitivity analysis



Spatial distribution of optimal wind sites

- Comparison of medium scenario (blue) with federal suitability zones (yellow)
- Wind energy production of 12,4 TWh (= 20% share of wind energy at a total electricity demand of 62 TWh)



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The techno-economical potential: Policy Conclusions

- The already existing suitability zones exclude many optimal sites, which are possible in our medium scenario.
- It is important to harmonize the legal framework conditions for defining suitable areas for wind energy in Austria. Applying them for all federal states could avoid economic inefficiencies and reduce wind energy expansion costs.
- The challenge for policy makers will be to find the right balance between
  - limiting wind production to sites with minimal negative effects on landscape scenery, human health and the environment; and
  - providing enough potential wind turbine sites to allow the deployment of wind energy at feasible costs.

Many thanks for listening!

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Overview of participating organisations in TransWind

group	organizations
public authorities	Austrian Ministry for Transport, Innovation and Technology; Federal Ministry of Science, Research and Economy; Austrian Energy Market Regulator – E-control; Chamber of Labour; Chamber of Commerce
federal state authorities	Federal State Government Offices of Burgenland, Lower Austria, Salzburg and Styria; Ombuds Offices for Environmental Protection (Umweltanwaltschaft) of Burgenland, Lower Austria and Styria
wind park developers and operators	Energie Burgenland Windkraft GmbH; EVN Naturkraft GmbH; Ökostrom AG; PÜSPÖK Group; WEB Windenergie AG; Windkraft Simonsfeld AG
environmental and nature conservation groups	Austrian Environmental Umbrella Association (Umweltdachverband); BirdLife Austria; Coordination Centre for the Study and Protection of Bats
others	Austrian Power Grid (APG); Austrian Wind Energy Association (IG-Windkraft); the processing and administration centre of the subsidies for eco-electricity (OeMAG)

Mean and range of parameter values for assessing the economic potential

cost element	unit	mean value	range	references
capital expenditures	EUR kW^{-1}	1675	1600-1900	1, 2, 3, 7
operational expenditures	EUR MWh^{-1}	26.4	18.5-34.2	3, 2, 4, 5
lifetime	years	20	-	5, 6, 7
discount rate	%	5	-	4, 5, 7

References: (1) Arántegui, 2014 (2) Gass et al., 2013 (3) Hantsch et al., 2009 (4) Rehfeldt et al., 2013 (5) Kost et al., 2013 (6) McKenna et al., 2014; (7) Falkenberg et al., 2014

Potential capacity and annual wind energy generation in Austrian federal states

	Min scenario		med scenario		max scenario		Suitability zones	
	GW	TWh	GW	TWh	GW	TWh	GW	TWh
Burgenland	0.7	1.9	4.9	**10.9**	6.1	13.5	1.4	**3.6**
Carinthia			3.2	**4.9**	5.5	8.3		
Lower Austria	1.0	2.0	19.5	**38.9**	22.0	43.8	3.6	**8.4**
Upper Austria	0.0	0.0	4.4	**6.8**	6.4	9.8	0.9	**1.4**
Salzburg			1.2	1.6	2.2	2.7		
Styria			5.0	**7.8**	8.4	13.1	0.5	**0.9**
Tyrol	0.0	0.0	0.4	0.5	0.9	1.0		
Vorarlberg	0.0	0.0	0.2	0.3	0.4	0.4		
Austria	1.7	**3.9**	38.8	**71.6**	51.8	**92.8**	6.3	**14.3**