Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN
Ufficio federale dell'energia UFE
Swiss Federal Office of Energy SFOE

Wind Energy in Switzerland
The Framework
I

IEA Wind Task 34, Trondheim, 3-5 December 2013; Markus Geissmann, SFOE

Wind Energy in Switzerland
Overview

1. Strategy and Goals
2. Potentials and Restrictions
3. Present state of deployment
4. Planning and Permitting

Switzerland
Facts and Figures

- 40‘000 km^2
- 8 Mio People
- 4 national languages

- electrical demand: 60 TWh/a
- 36% nuclear power (5 plants)
- 59% hydropower
- 5% fossile and new renewable

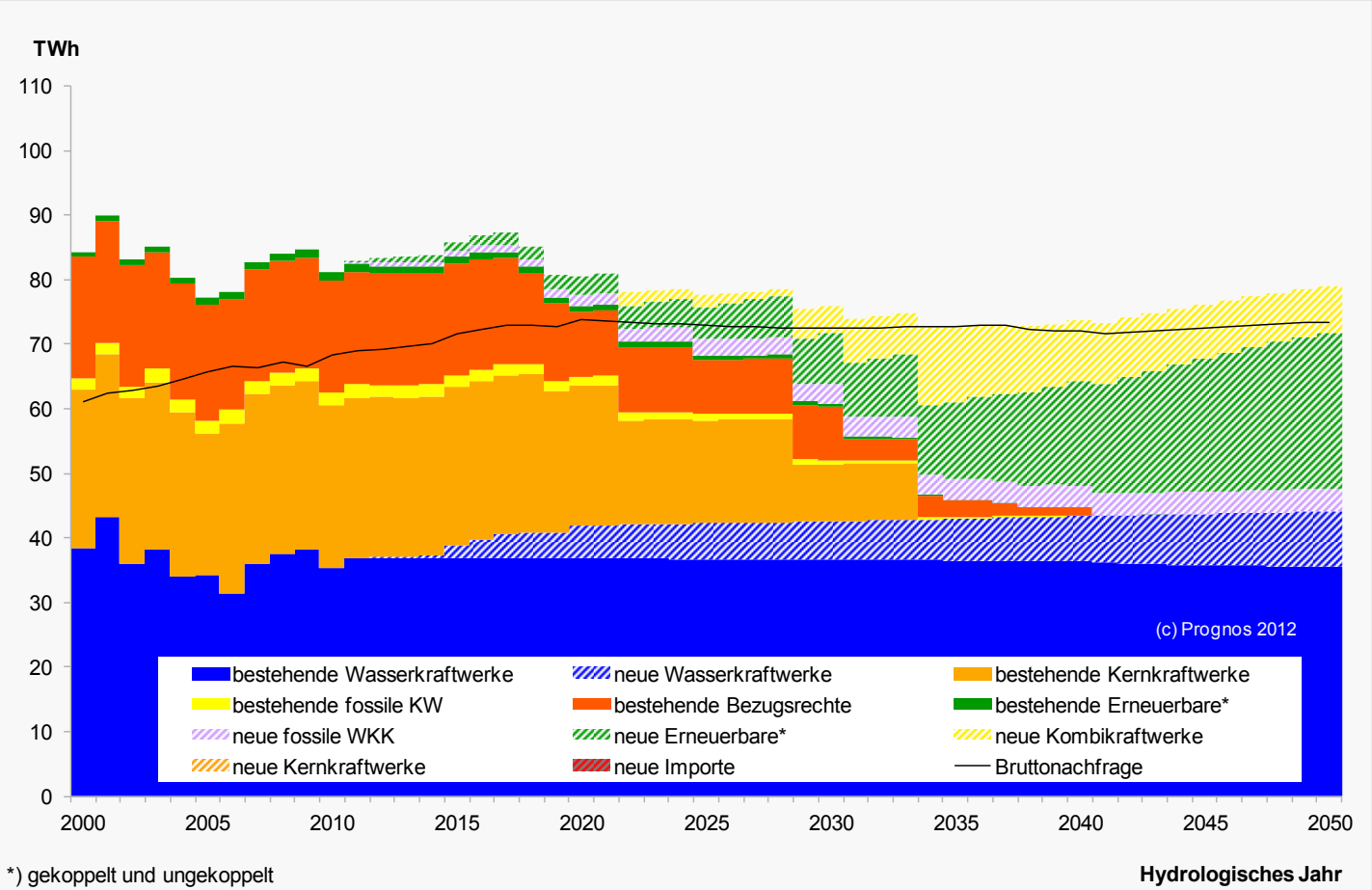
Energy Strategy 2050: Main Topics 1

1. **Phase out of Nuclear Power**
2. **Increase Energy Efficiency**
3. **Develop Renewable Energies**
   - Hydro Power + 3,2 TWh,
     (+ pump storage plants for grid integration of renewable energies)
   - ‚New' Renewable Energies: Develop sustainable Potential (24,2 TWh)
4. **Cover gaps by**:
   - Natural Gas fired Plants
   - Importing

Energy Strategy 2050: Main Topics 2

5. **Ausbau Stromnetze**
   - Optimierung, Erneuerung und Ausbau der Übertragungs- und Verteilnetze
   - Umbau Richtung Smart Grid
6. **Verstärkte Energieforschung**
7. **Vorbildfunktion des Bundes**
8. **Verstärkung des Programms EnergieSchweiz**
9. **Stärkung der internationalen Zusammenarbeit** im Energiebereich

Timeline of Electrical Power Production/Demand

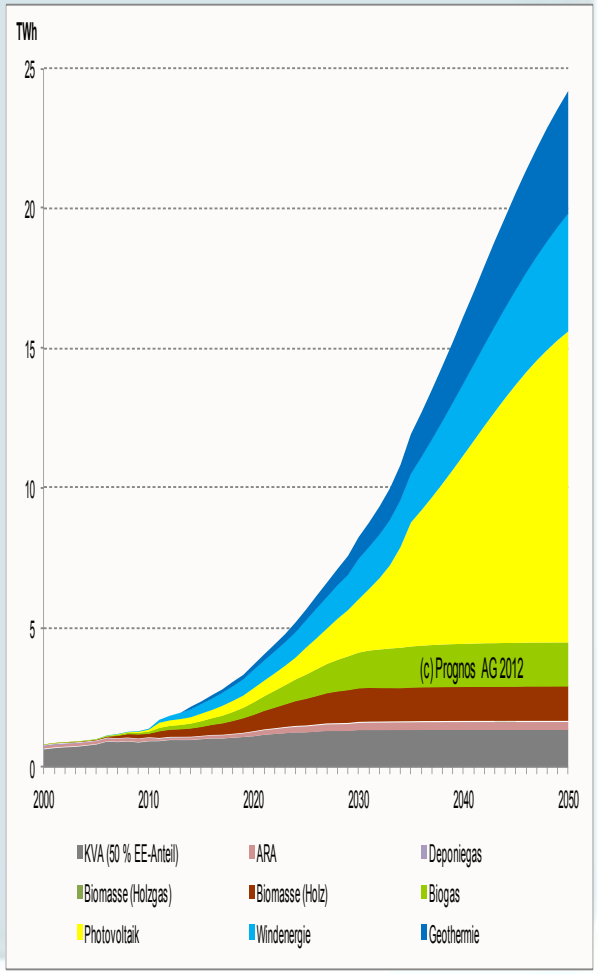


Elektrizitätsangebot Szenario Politische Massnahmen, Variante C&E

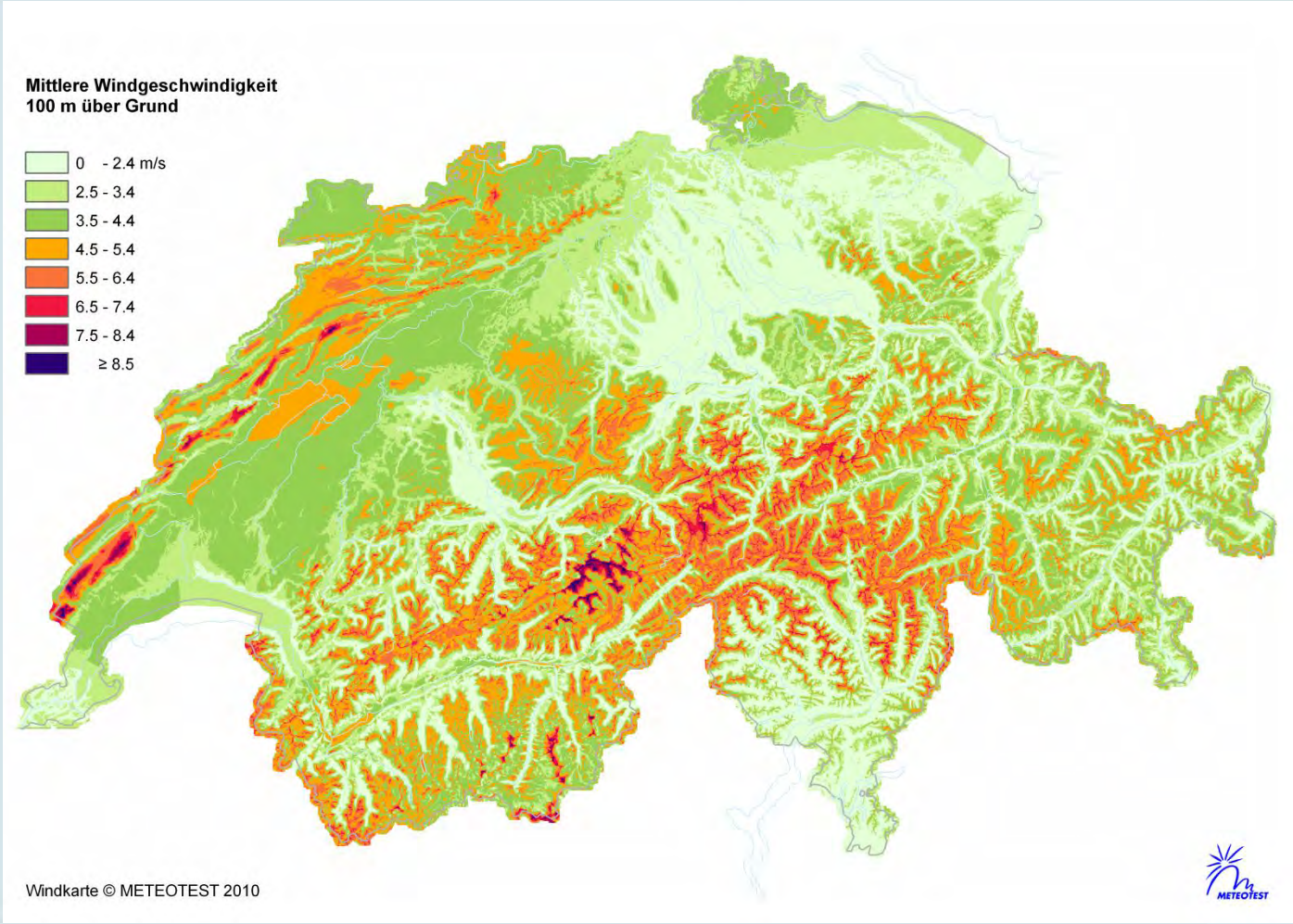
Energy Strategy 2050
Development of ‚New' Renewable Energies

Objective 2050:	**24.2 TWh**
PV	11.1 TWh
Wind	**4.3 TWh**
Geothermal	4.4 TWh
Biomass	1.2 TWh
Biogas	1.6 TWh
Waste Water Plants	0.3 TWh
Waste Incineration	1.3 TWh
Cogeneration	~ 2 TWh

2020:	**600GWh**
2035:	**1'500GWh**
2050:	**4'300GWh**



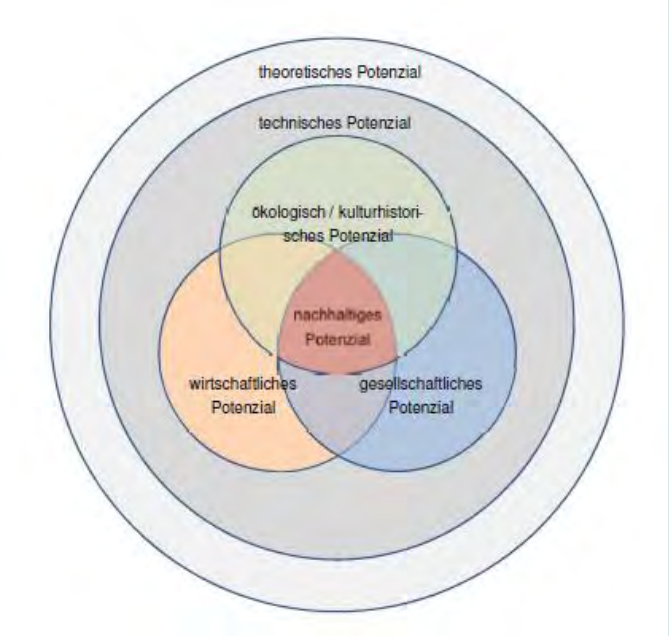
Wind Energy Resources



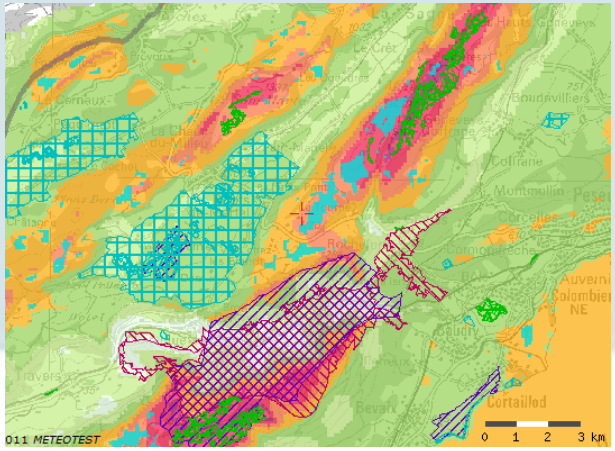
Wind Energy Potentials

For the Calculation of the Wind Energy Potential the following Restrictions have been applied cumulatively:

- **Wind Turbine 2MW, 100m Hub Height**
- **Exclusion of : unstable building grounds, lakes, inclination >20%, inhabited areas, non accessible areas**
- **Exclusion of : Protected Marshland Areas, National Park, Landscape Protection Areas, ISOS, wetland areas, federal game reserves, Water/Migratory Bird Protection Areas, Ground Water Protection Areas, etc.**
- **Wind Speed ≥ 4.5 m/s at Hub Height**
- **300m buffer around inhabited areas (Noise Protection)**



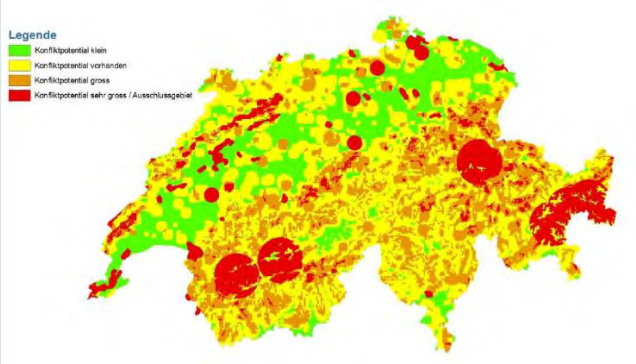
Wind Energy Potential for Switzerland : 5.3 TWh/a

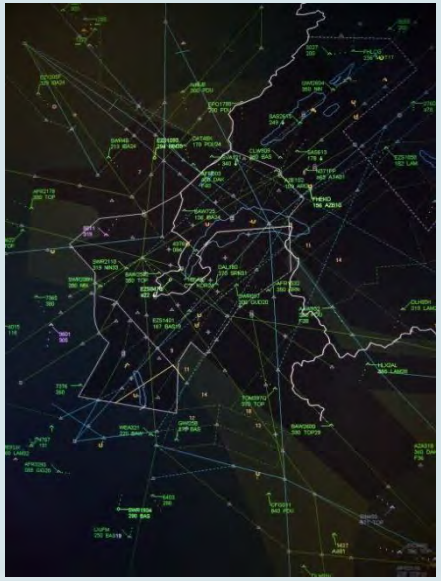


Wind Energy Potentials more Restrictions

For the Calculation of the Wind Energy Potential the following Restrictions have NOT been applied :

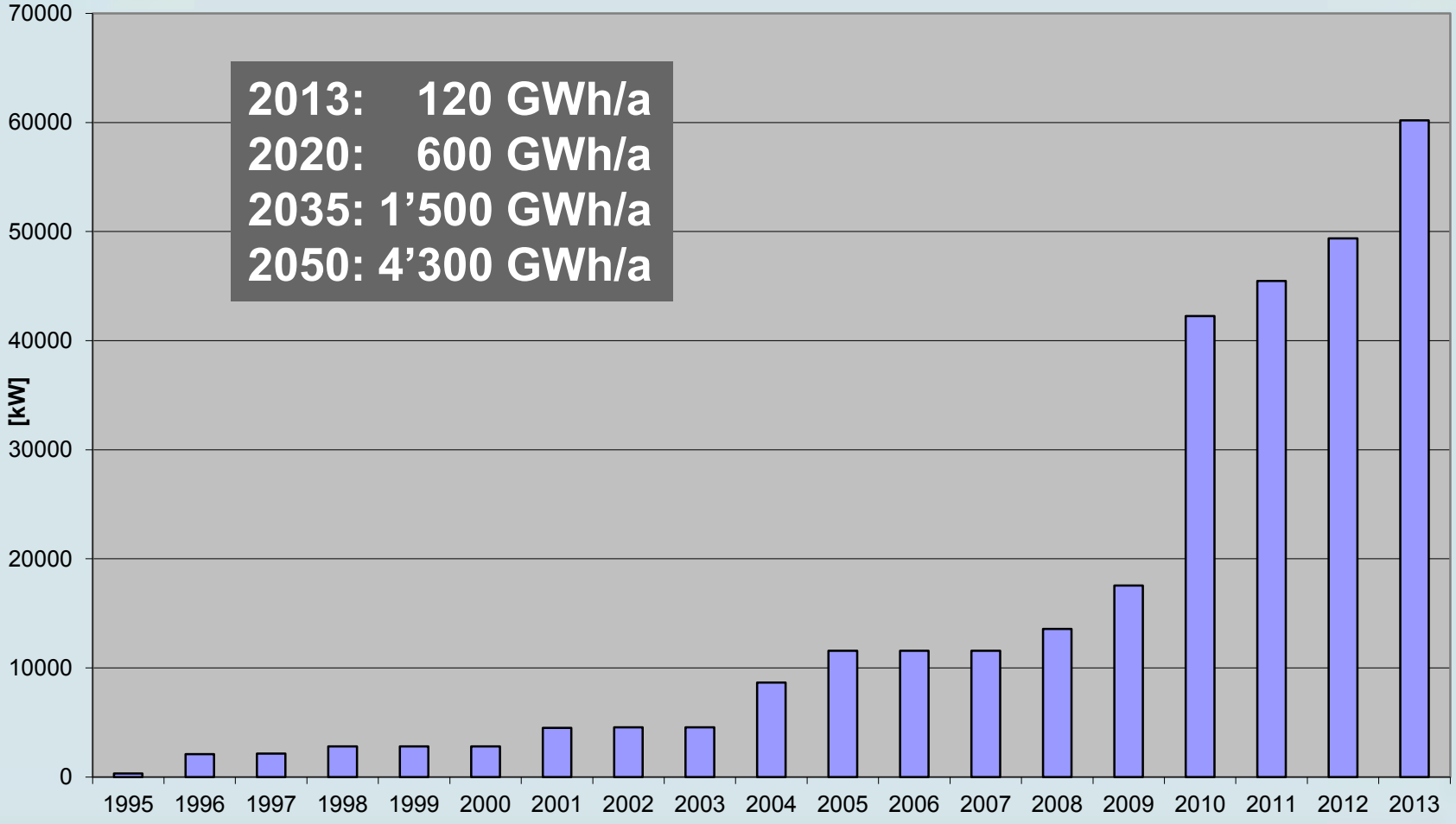
- **Conservation of Species (Birds, Bats)**
- **Civil Aviation: PSR, VOR, ILS**
- **Communication: Directional Beam Links**
- **Security: Military Aviation, Communication and Sensors**
- **Meteorological RADAR**





Wind Energy Potential for Switzerland : < 5.3 TWh/a

Present State of Wind Energy Deployment
Installed Power



Present State of Wind Energy Deployment
Feed-in Tariff System

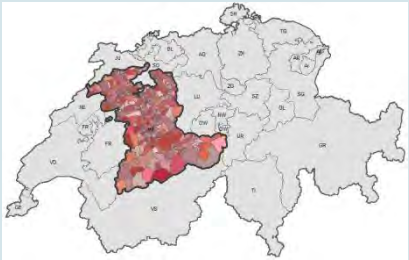
FIT System based on German Model

- Reference Production; FIT is fixed definitively after five years of production
- FIT Wind: 16.8 – 23.4 US¢/kWh (12.5 – 17.5 €ct/kWh)
- Premium for Wind Turbines >1‘700 masl: max. 2.7 US¢/kWh (2.0 €ct/kWh)

Technologieart	noch nicht realisiert (?)			in Betrieb (?)		
	Anzahl	El. Leistung [kW]	Projektierte Produktion [kWh]	Anzahl	El. Leistung [kW]	Projektierte Produktion [kWh]
Wasserkraft	348	346'445	1'217'163'263	324	144'524	593'171'512
Biomasse	69	33'173	183'788'360	209	196'068	867'432'696
Geothermie	< 4	2'700	11'617'600	0	0	0
Wind	436	949'701	1'730'411'897	17	29'534	55'858'977
Photovoltaik	784	34'191	32'265'459	6'035	178'549	171'514'244

Technologieart	Warteliste (?)		
	Anzahl	El. Leistung [kW]	Projektierte Produktion [kWh]
Wasserkraft	427	339'246	1'409'778'978
Biomasse	233	151'884	946'566'834
Geothermie	< 4	1'850	15'910'000
Wind	394	852'203	1'521'264'184
Photovoltaik	28'513	1'491'382	1'432'028'106

Planning and permitting of wind energy projects



Federal Government
- Overall energy strategy

↓

Cantons
- Define wind areas in structure plan

↓

Communites
- Implement areas in their zoning plans

↓

Construction permit

Wind Energy Concept
EIA Handbook

Federal Government
- Overall energy strategy

Cantons
- Structure plan

Community
- Zoning plan

Construction permit

Wind Energy Concept as a planning aid:
- defines NO-GO Areas from a federal view
- conservation of species (birds)
- landscape
- aviation
- …

EIA handbook as a methodological guideline:
- how to assess impact on birds and bats
- avoid, mitigate, compensate
-…

Wind Energy in Switzerland

Markus Geissmann, SFOE
Hans Buser, nateco

Content

- Status of wind activities in Switzerland
- **Research in Switzerland**
- Key conflicts, uncertainties, regulatory needs
- Outcomes

Research

- Participants in Switzerland:
  - Swiss Federal Office of Energy (SFOE)
  - Swiss Federal Office for the Environment (FOEN)
  - Swiss Ornithological Institute
  - Foundation for protection of bats
  - Suisse eole: Swiss corporation for supporting wind energy
  - Developers
  - Universities (ETH, ZHAH Zurich University of Applied Sciences)

Research

- Research activities: Quite few
  - Map of potential risks for breeding and hibernating birds
  - Modeling migration of birds in Switzerland
  - Map of potential risks for migratory birds
  - Radar data of migratory birds on Schwyberg
  - Radar data of migratory birds on Gotthard

Content

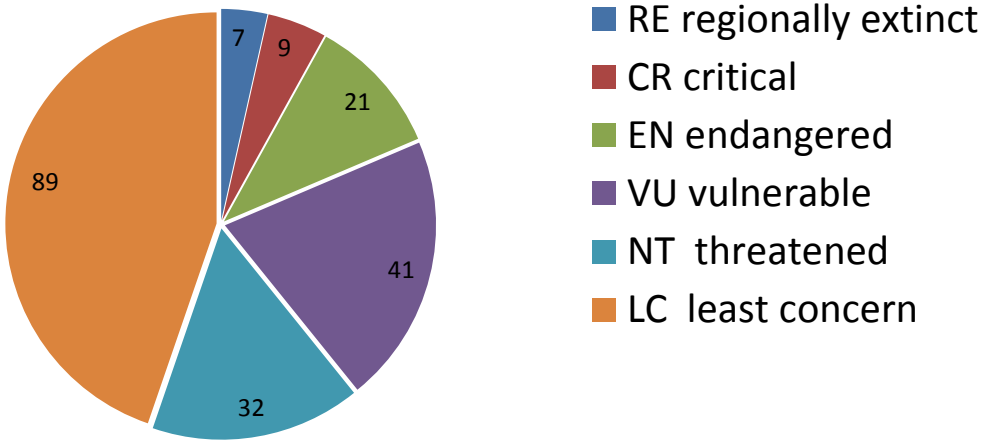
- Status of wind activities in Switzerland
- Research in Switzerland
- **Key conflicts, uncertainties, regulatory needs**
- Outcomes

Conflicts, uncertainties, regulatory needs

- Key topics
  - Breeding and hibernating birds
  - Migratory birds
  - Bats
  - Biotopes
  - Landscapes

Conflicts, uncertainties, regulatory needs

- breeding birds
  - 199 species breeding



  - 38 species with high responsibility for Switzerland

Conflicts, uncertainties, regulatory needs

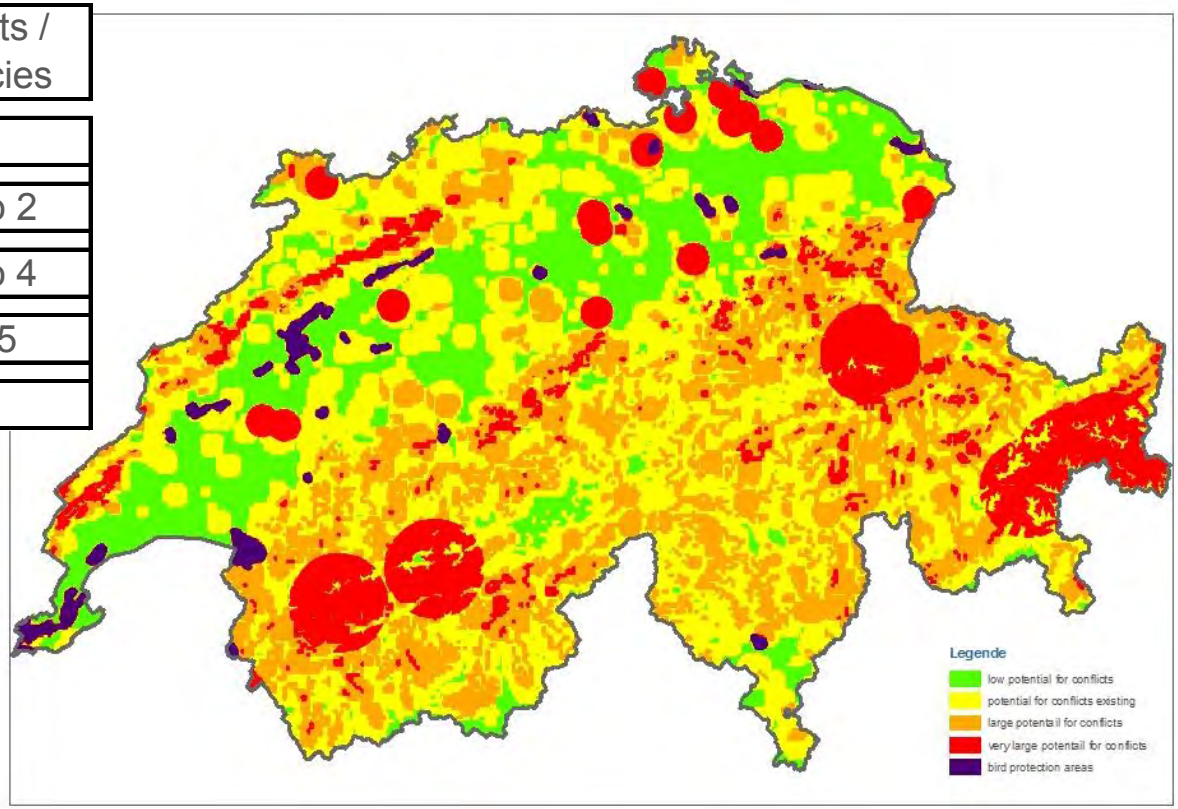
- Breeding birds: 15 species are considered as specially affected by wind turbines

Weissstorch	White Stork	Ciconia ciconia
Bartgeier	Bearded Vulture	Gypaetus barbatus
Steinadler	Golden Eagle	Aquila chrysaetos
Rotmilan	Red Kite	Milvus milvus
Wanderfalke	Peregrine Falcon	Falco peregrinus
Alpenschneehuhn	Rock Ptarmigan	Lagopus muta
Auerhuhn	Western Capercaillie	Tetrao urogallus
Birkhuhn	Black Grouse	Tetrao tetrix
Grosser Brachvogel	Eurasian Curlew	Numenius arquata
Waldschnepfe	Eurasian Woodcock	Scolopax rusticola
Lachmöve	Common Black-headed Gull	Larus ridibundus
Uhu	Eurasian Eagle-Owl	Bubo bubo
Alpenseegler	Alpine Swift	Apus melba
Heidelerche	Woodlark	Lullula arborea
Alpenkrähe	Red-billed Chough	Pyrrhocorax pyrrhocorax

Conflicts, uncertainties, regulatory needs

- Breeding and hibernating birds

	risk	points / species
	low	0
	existing	1 to 2
	high	3 to 4
	very high	> 5
	taboo	



Conflicts, uncertainties, regulatory needs

- Breeding and hibernating birds: questions
  - Which species are really endangered by wind turbines
  - Which dangers are significant:
    - Crashes
    - Turbulences
    - Disturbance
    - Others
  - How big are the losses
  - How big are the losses compared with other hazards
  - Which impacts on populations have to be expected

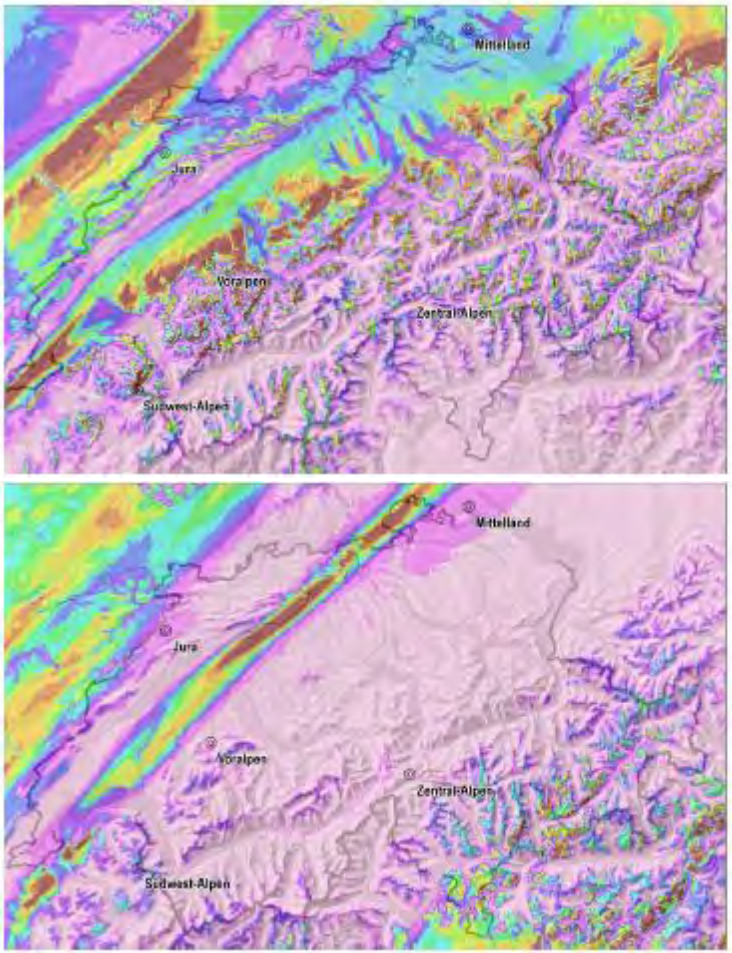
Conflicts, uncertainties, regulatory needs

- Migratory birds
  - Migration in autumn: 50 to 100 million birds
  - Migration in spring: 20 to 70 million birds
  - Modeling the intensity of the migration as a function of
    - Direction of flight
    - Topography
    - Flight altitude
    - Weather conditions

Conflicts, uncertainties, regulatory needs

- Migratory birds
  - Density of migratory birds (lowest 200 m)

< 20 MTR	Birds / h and km
21–40 MTR	
41–60 MTR	
61–80 MTR	
81–100 MTR	
101–120 MTR	
121–140 MTR	
141–160 MTR	
161–180 MTR	
> 180 MTR	

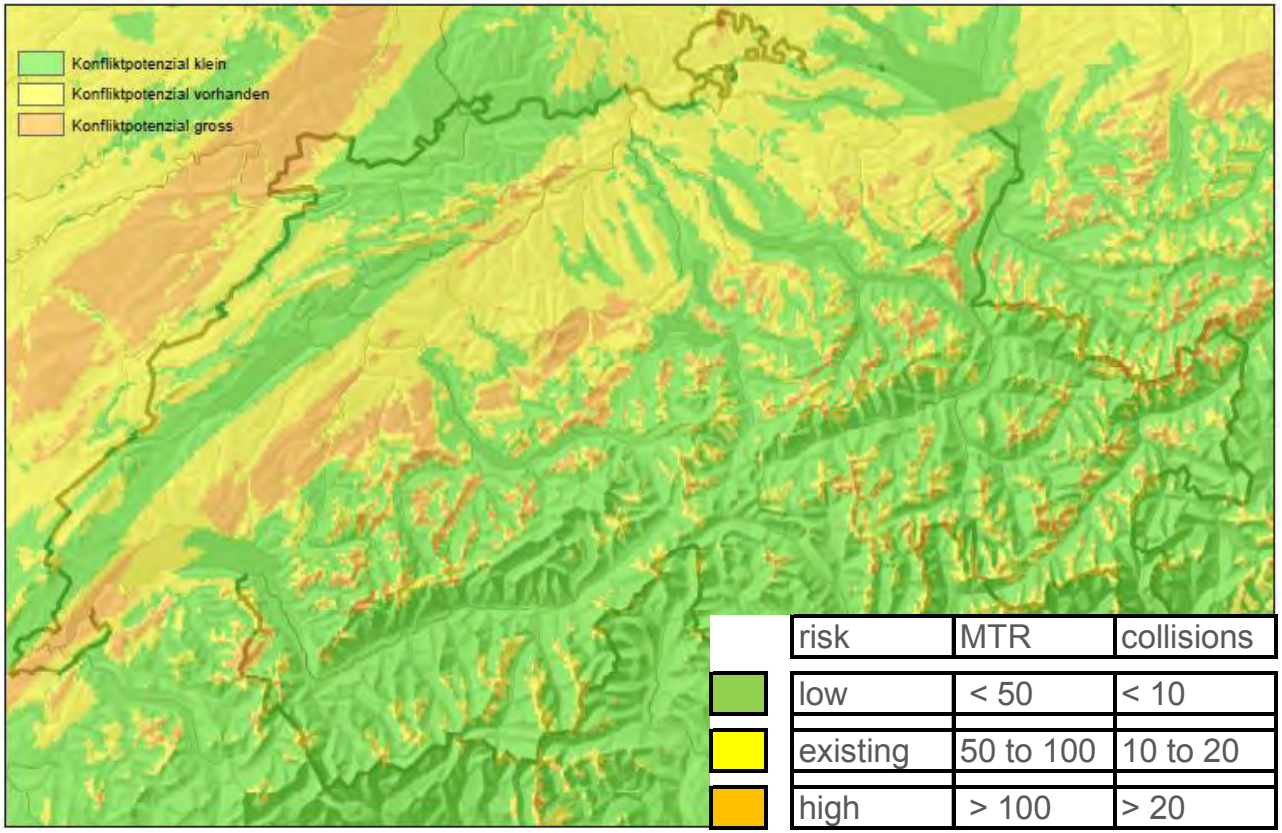


autumn

spring

Conflicts, uncertainties, regulatory needs

- Migratory birds



risk	MTR	collisions
low	< 50	< 10
existing	50 to 100	10 to 20
high	> 100	> 20

Basis:

- 1’000 turbines →
- <10’000 collisions/y

Conflicts, uncertainties, regulatory needs

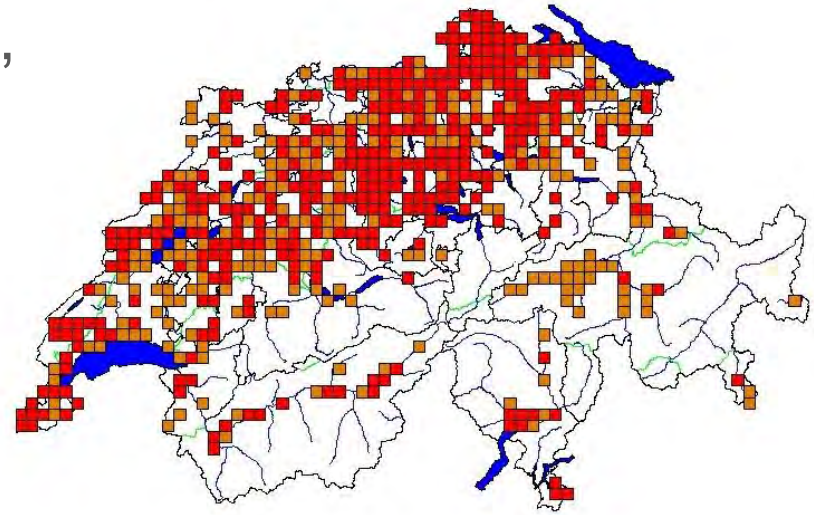
- Migratory birds: questions
  - Is this kind of modeling suitable to predict losses
  - How big are the losses really
  - On an international scale: what rate of losses can be accepted without affecting the populations
  - How big is the loss compared with other hazards
  - Which impacts on populations have to be expected
  - Is there a significant difference between impact on autumn migration respectively spring migration

Conflicts, uncertainties, regulatory needs

- Bats
  - 30 species in Switzerland (only 2 not endangered)
  - Mainly personal knowledge of specialist
  - Data of distribution throughout the country (e.g. Grosses Mausohr - greater mouse-eared bat, Myotis myotis)

until 2000

after 2000



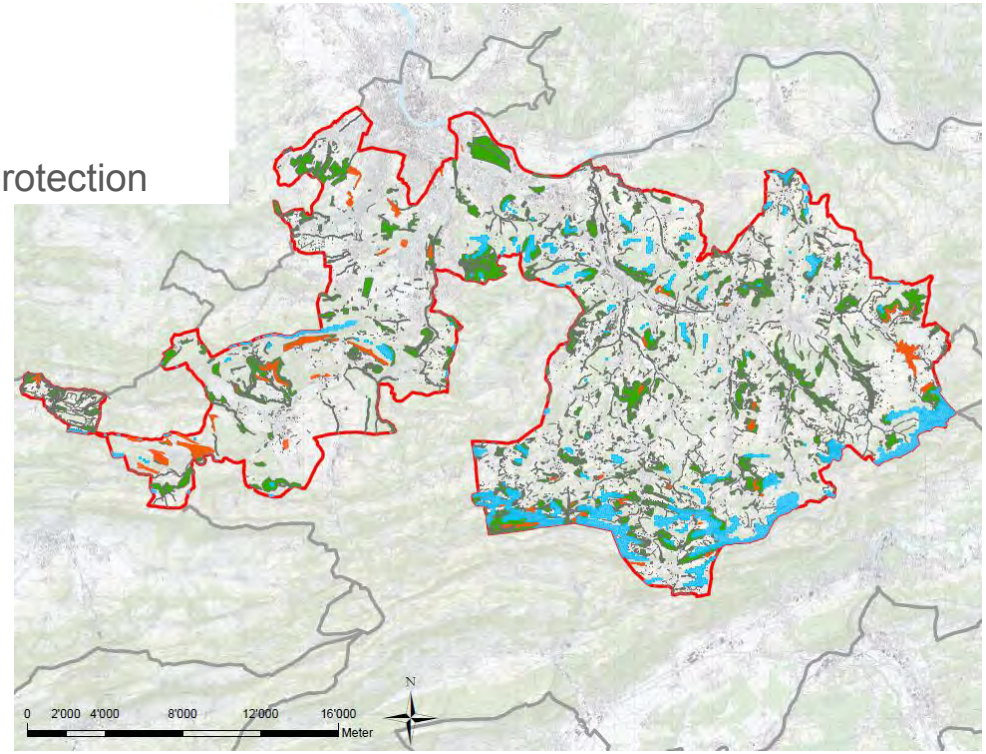
Conflicts, uncertainties, regulatory needs

- Biotopes
  - Biotopes are protected on three institutional levels: national, regional or local protection

windspeed >5m/s

national protection

regional and local protection



Conflicts, uncertainties, regulatory needs

- Biotopes
  - Regulatory rules
    - avoid
    - mitigate
    - replace
  - It is up to the investor to prove that he has done enough
  - Under discussion: national importance of wind energy parks from a certain level of production → Until now: national protected areas are taboo

Conflicts, uncertainties, regulatory needs

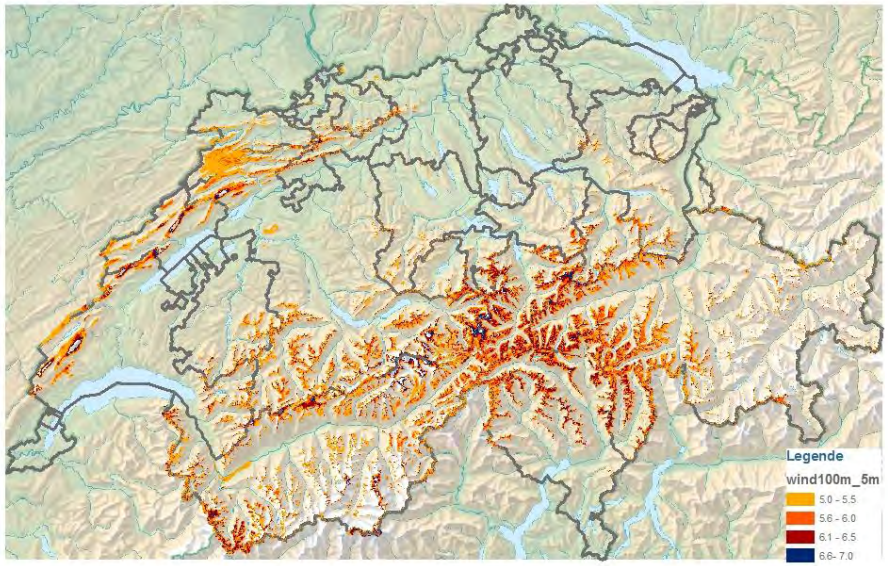
nateco

- Biotopes: questions
  - How do other countries regulate the protection of biotopes
  - We think about stating a strong protection of wetland biotopes and a weak protection of dryland biotopes
  - Are there any similar regulations or any research which support this idea

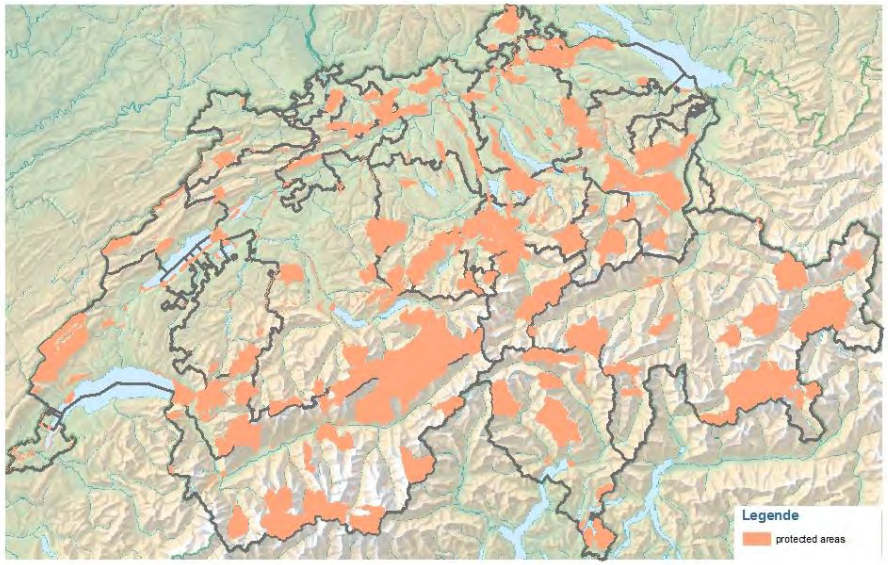
Conflicts, uncertainties, regulatory needs

- Landscapes

Wind velocity >5m/s



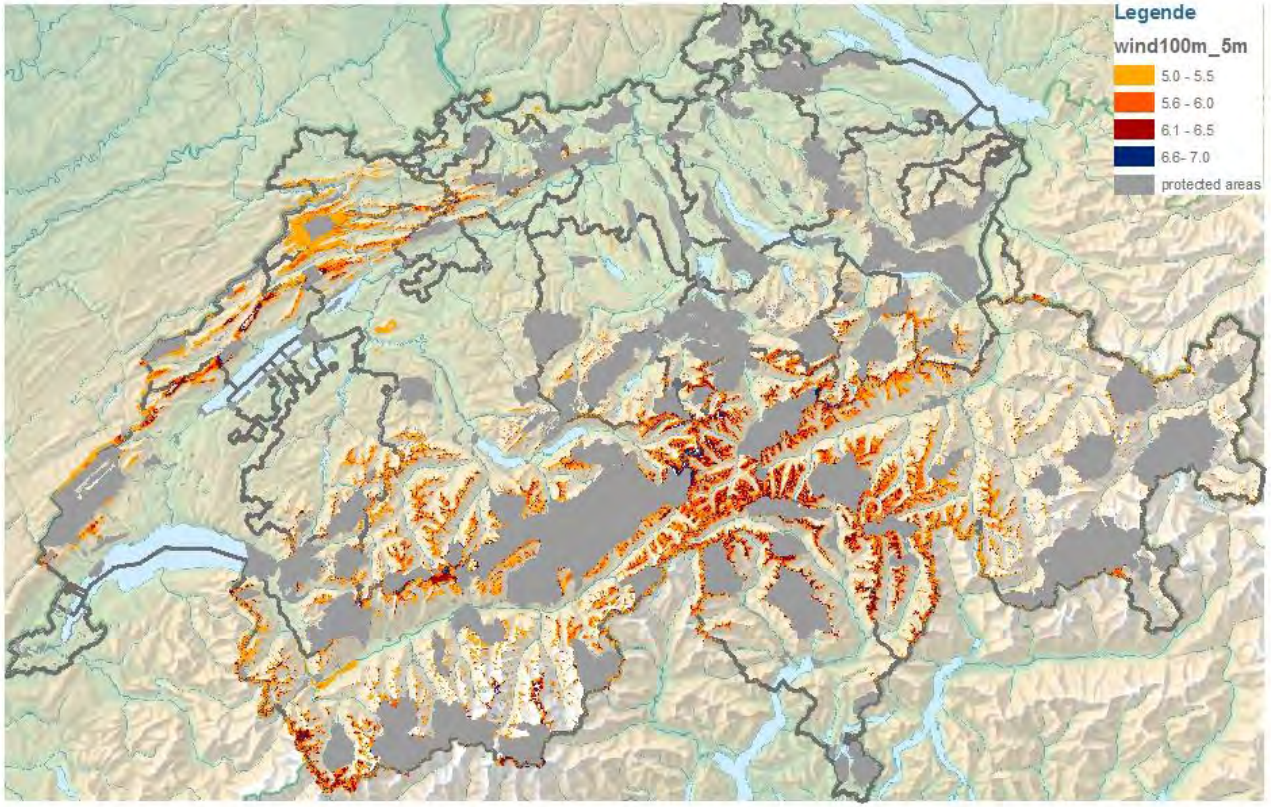
Protected areas



Conflicts, uncertainties, regulatory needs

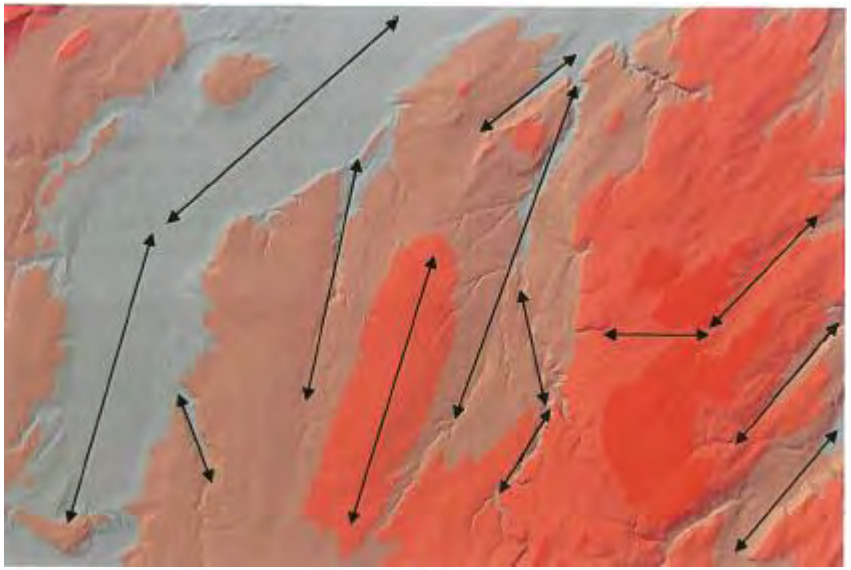
- Landscapes

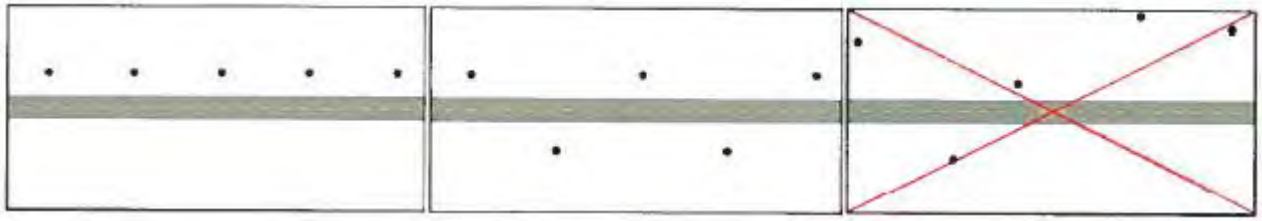
Wind outside protected areas



Conflicts, uncertainties, regulatory needs

- Landscapes
  - “Lines of power“ and positioning of wind energy turbines





Conflicts, uncertainties, regulatory needs

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windspeed >5m/s

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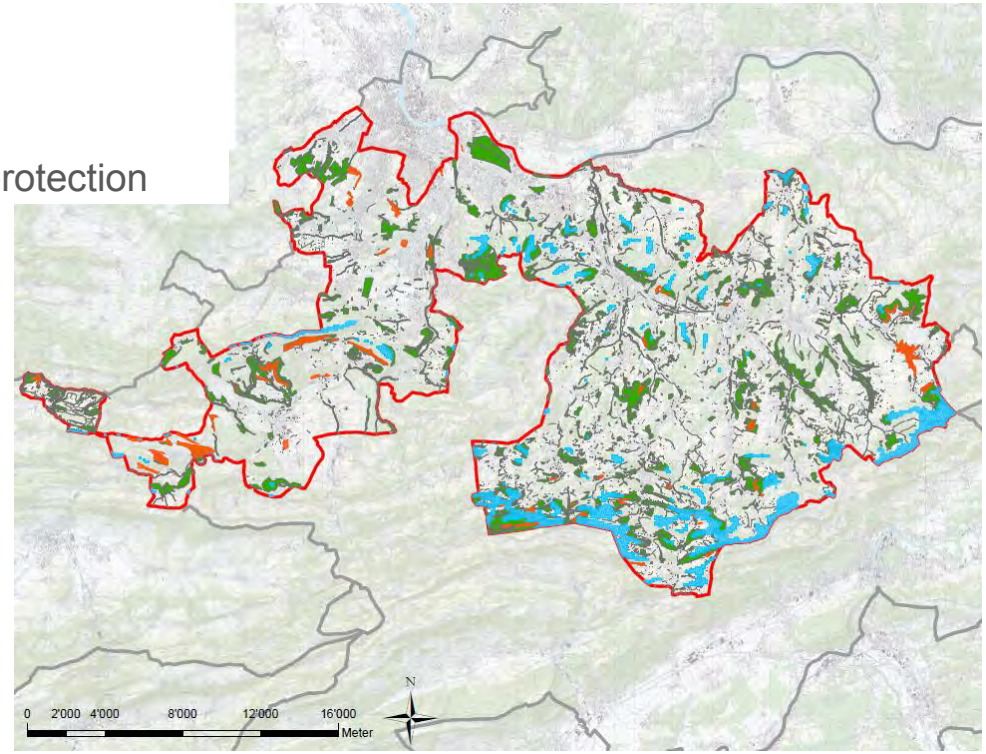
regional and local protection



Conflicts, uncertainties, regulatory needs

- Landscapes: questions
  - How do other countries deal with question of protection of landscape vs. wind energy towers
  - How do other countries combine the protection of landscape – the protection of biotopes and the protection of species

Content

- Status of wind activities in Switzerland
- Research in Switzerland
- Key conflicts, uncertainties, regulatory needs
- **Outcomes**

Outcomes

- International standards for dealing with the issue
- More knowledge, less assumption
- Guidelines for practice (clear, easy to understand, user-friendly, realistic)
- Best practice for monitoring the influence of turbines on species, biotopes and landscape

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