

MORE

Mobile Remote Energy for heated wind measurement systems

Winterwind
INTERNATIONAL WIND ENERGY CONFERENCE



Andreas Krenn

Energiewerkstatt



1. INTRODUCTION

2. CHALLENGES HEATED MEASUREMENTS

3. IMPROVED APPROACH - MORE

4. EXPERIENCES AND RESULTS



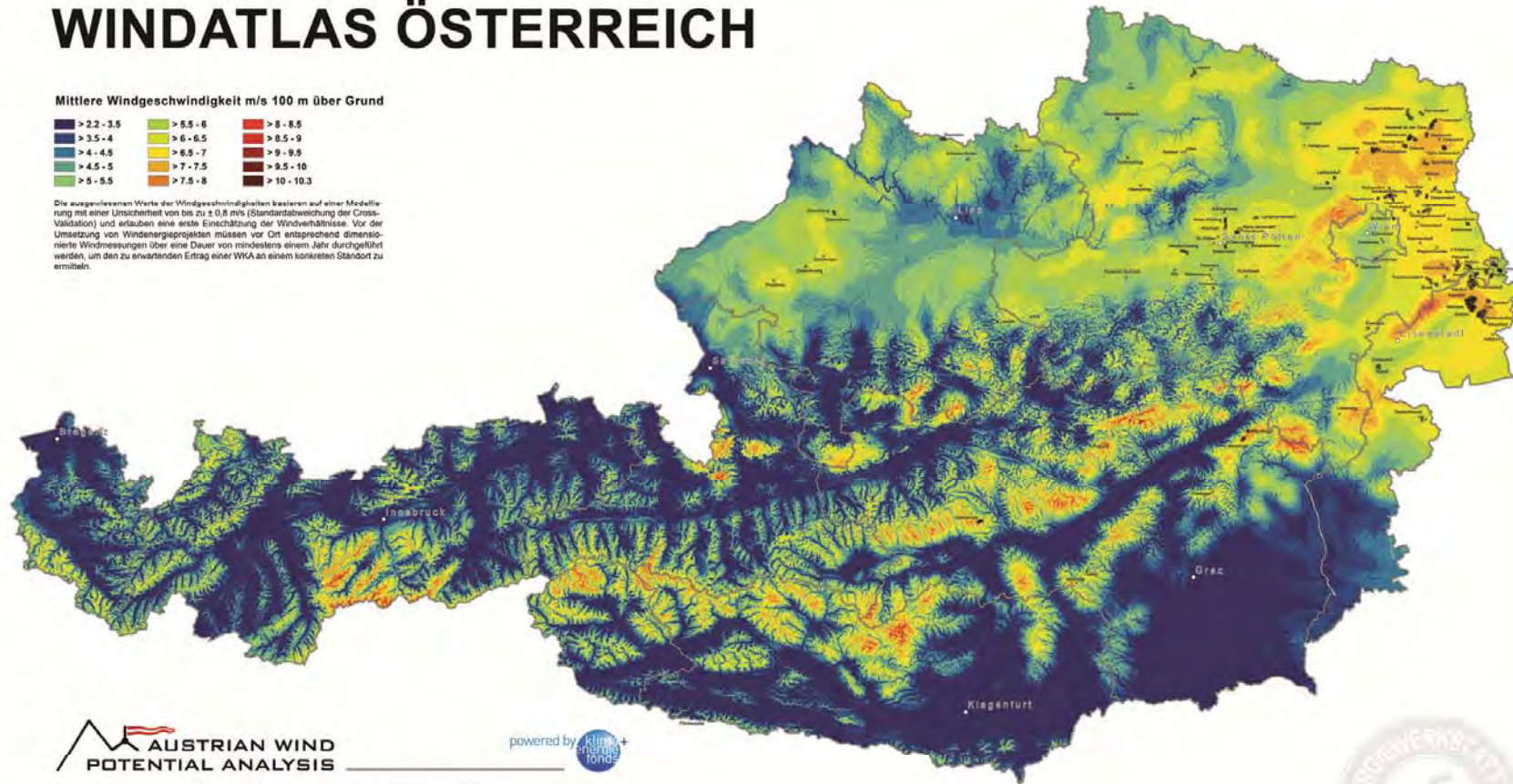
Fig. Source:
Energiewerkstatt

WINDATLAS ÖSTERREICH

Mittlere Windgeschwindigkeit m/s 100 m über Grund

> 2.2 - 3.5	> 6.5 - 8	> 8 - 8.5
> 3.5 - 4	> 6 - 6.5	> 8.5 - 9
> 4 - 4.5	> 6.5 - 7	> 9 - 9.5
> 4.5 - 5	> 7 - 7.5	> 9.5 - 10
> 5 - 5.5	> 7.5 - 8	> 10 - 10.3

Die ausgewiesenen Werte der Windgeschwindigkeiten basieren auf einer Modellierung mit einer Unsicherheit von bis zu $\pm 0,8$ m/s (Standardabweichung der Cross-Validation) und erlauben eine erste Einschätzung der Windverhältnisse. Vor der Umsetzung von Windenergieprojekten müssen vor Ort entsprechend dimensionierte Windmessungen über eine Dauer von mindestens einem Jahr durchgeführt werden, um den zu erwartenden Ertrag einer WKA an einem konkreten Standort zu ermitteln.



**AUSTRIAN WIND
POTENTIAL ANALYSIS**

powered by Klimafonds

Der Windatlas Österreich wurde im Rahmen des Projektes AUWIPOT von vier Partnern mit jahrzehntelanger Erfahrung im Bereich Windenergie & Forschung erstellt. Für die Berechnung der Windkarte wurde erstmals ein kombinierter Berechnungsansatz aus geo-statistischer und numerischer Modellierung angewendet. Dadurch ist eine detaillierte Darstellung der mittleren Windgeschwindigkeit in einer Auflösung von 100 x 100 Metern und für unterschiedliche Höhen über Boden möglich. Insgesamt sind in die Simulation des Windpotenzials Daten von mehr als 250 Windmessungen eingeflossen, wobei die Ergebnisse mit den Ertragsdaten von bestehenden Windkraftanlagen in Österreich validiert wurden.

Der Windatlas und eine WebGIS Applikation mit der Möglichkeit der dynamischen Simulation des Windenergiepotenzials für die einzelnen Bezirke Österreichs anhand frei wählbarer Kriterien werden unter www.windatlas.at zur Verfügung gestellt. Das Projekt wurde aus dem Klima- und Energiefonds unterstützt.

rs&ispace

Verein energiewerkstatt^o

METEOTEST

Wipac Climate and Energy

UNI GÖTTINGEN



Verein **energiewerkstatt^o**
www.energiewerkstatt.org

Company Profile

Wind Energy: Special Focus on
Complex Terrain and Cold Climates

- Wind Measurement
- Project Development
- Planning & Implementation
- Research & Demonstration

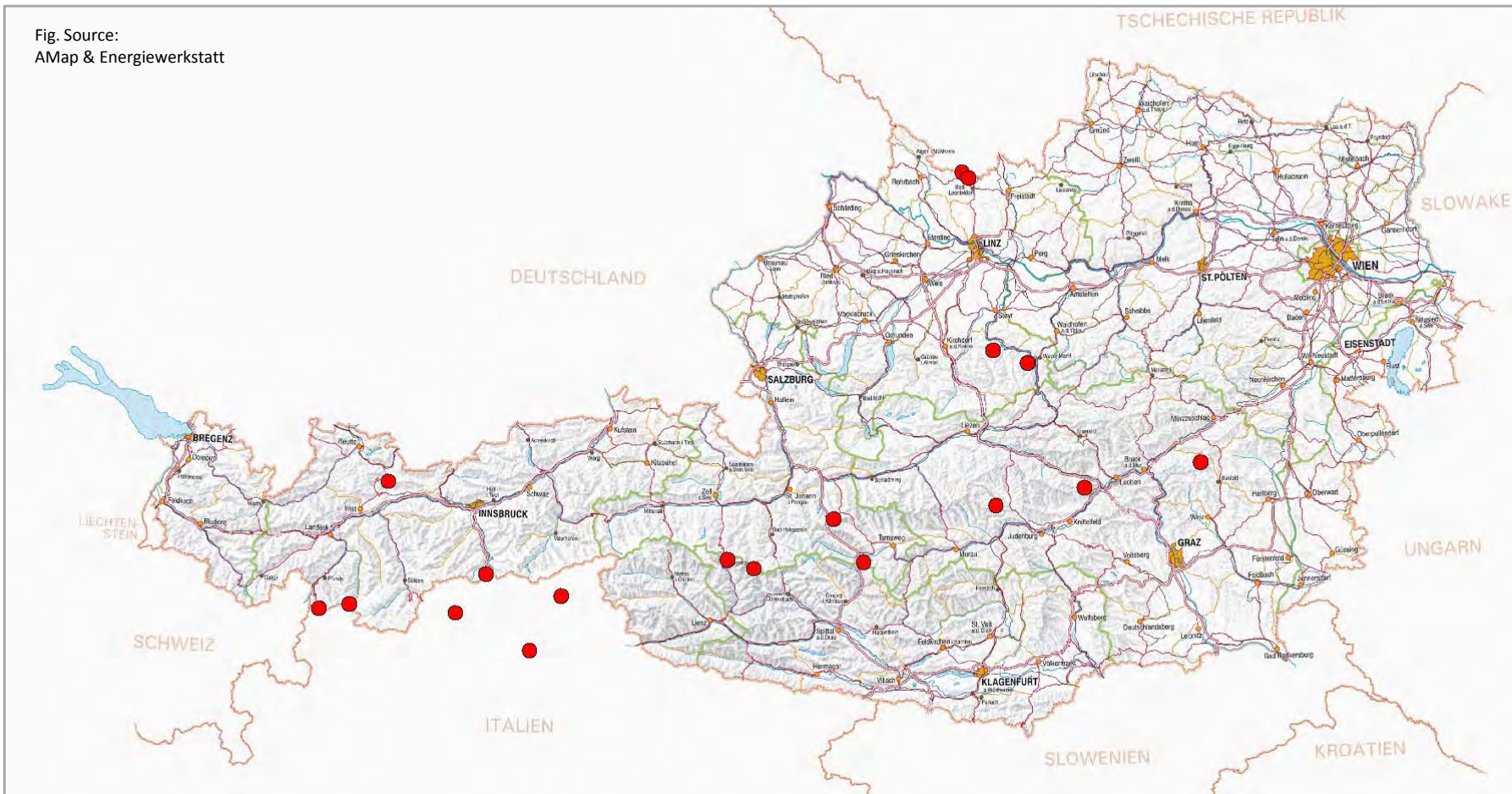
energiewerkstatt^o
www.energiewerkstatt.org



Heated Measurements with remote power supply

● ~20 Measurements since 1999

Fig. Source:
AMap & Energiewerkstatt



1. INTRODUCTION

2. CHALLENGES HEATED MEASUREMENTS

3. IMPROVED APPROACH - MORE

4. EXPERIENCES AND RESULTS



Challenges with anemometers

- Shaft heated: Wrong / influenced data
- Fully heated: Partial icing due to heating (e.g. cup edge)

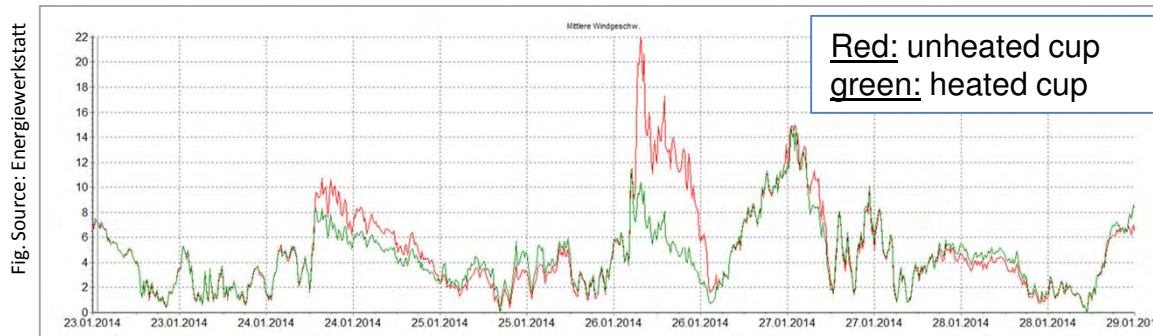


Photo Source: www.lidar.tropos.de

- Heated Ultrasonics: Problems with invalid data

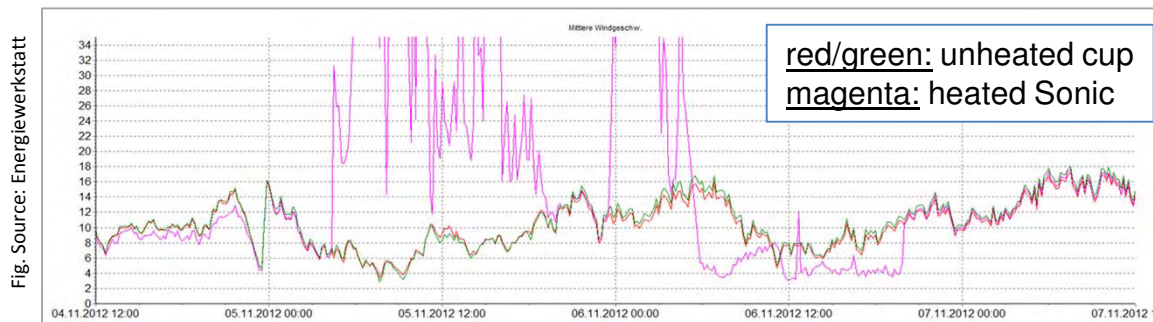


Photo Source: www.lidar.tropos.de

→ Often no clear picture about the actual situation / poor data availability & quality

Challenges with supply components

- Investment costs for good-quality products
 - O&M efforts & costs
 - Provision of certain ambient conditions
 - High fuel consumption during winter period, if sensors are heated permanently
 - Example: 2x Ultrasonics; permanently heated for 4_M
→ ~2x starts per day à 2,5h → 600h operating hours
→ 100l diesel for 4kW machine → refuelling ?!
 - Maintenance depending on operational hours
 - Oil change every 250 hours → 2-3x
 - Power of diesel engine vs. capacity of battery pack
- System costs vs. data availability
- Careful selection of components
- Reduction of energy demand



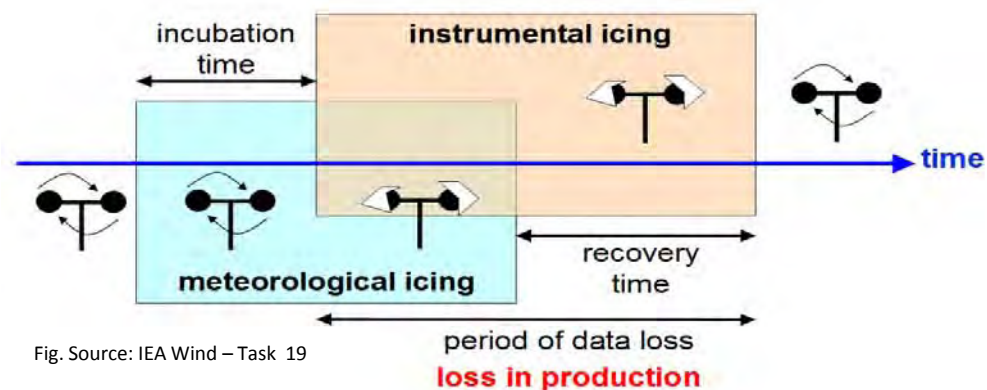
Photo Source: EWS Consulting



Photo Source: Energiewerkstatt

Challenges with ice detection

- Meteorological icing vs. instrumental icing



- Ice sensors
 - Positioning (different icing conditions on the ground and the top of the mast)
 - Power demand of sensors during heating (Labko 350W)
 - Costs
- Synoptic approach: Site-specific variation, overestimation

→ Adaptive approach based on synoptic consideration and webcam observations

1. INTRODUCTION
2. CHALLENGES HEATED MEASUREMENTS
- 3. IMPROVED APPROACH - MORE**
4. EXPERIENCES AND RESULTS



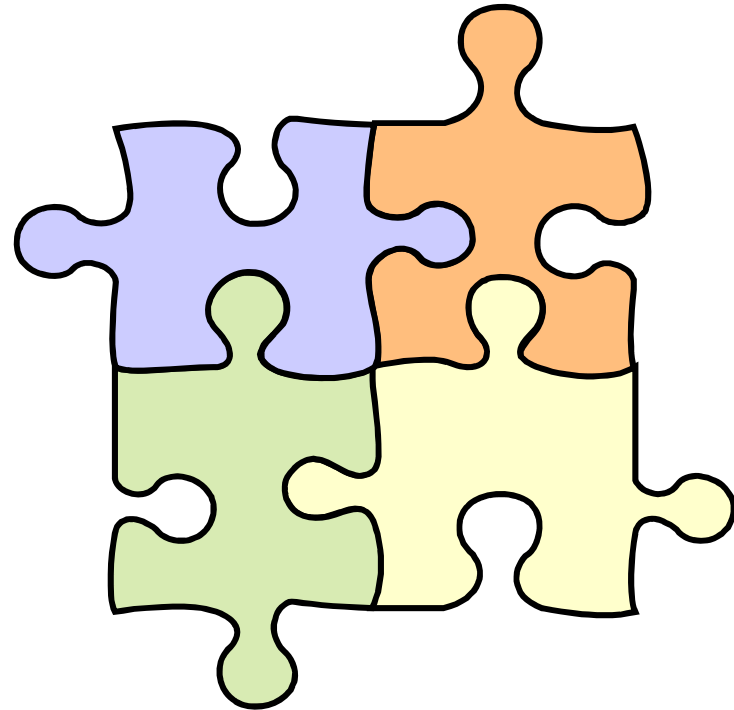
Objectives MORE

Main aims:

- High data availability
- High data quality
- Cost effectiveness

Secondary aims:

- Maintenance-free
- Low energy demand
- Intelligent heating
- Thermal management
- Site specific adoptable design
- Easy to transport
- Remote monitoring and access



Interplay of hard- and software

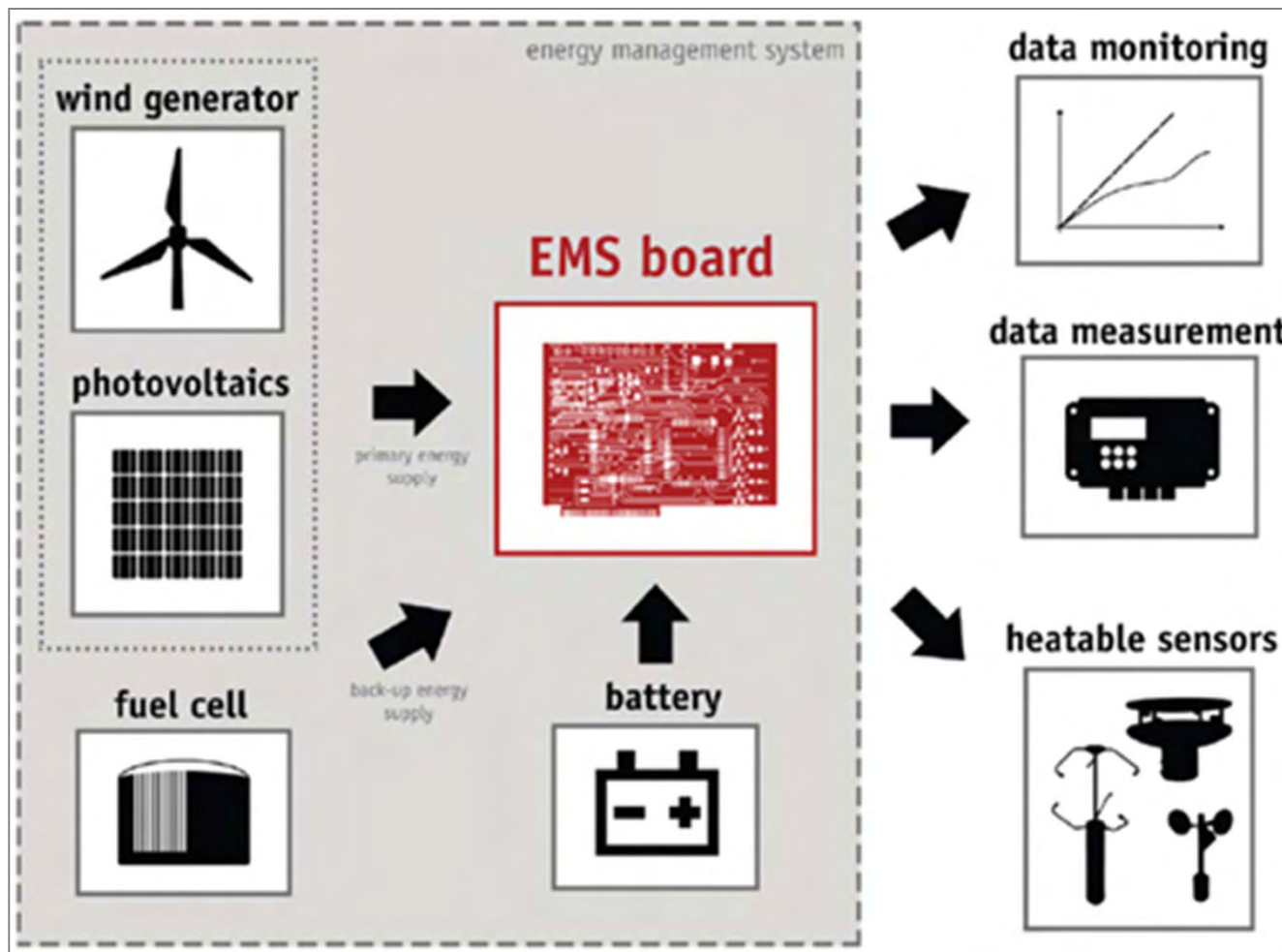


Fig. Source: Energiewerkstatt

Selection of Hardware

- Long-term test (5 years) with different components
 - Wind generators in different performance classes and according to MORE requirements
 - No mechanical brake; utilisation of excess energy
 - Installation up to 40m height
 - Fuel-cells with output from 90 W up to 300 W
 - EMS-board tested over 3 years with an hardware update for more output signals
- Webcam up to 100m for monitoring sensors
 - Tests with separate Heating for front part of camera



1. INTRODUCTION
2. CHALLENGES HEATED MEASUREMENTS
3. IMPROVED APPROACH - MORE
- 4. RESULTS AND EXPERIENCES**



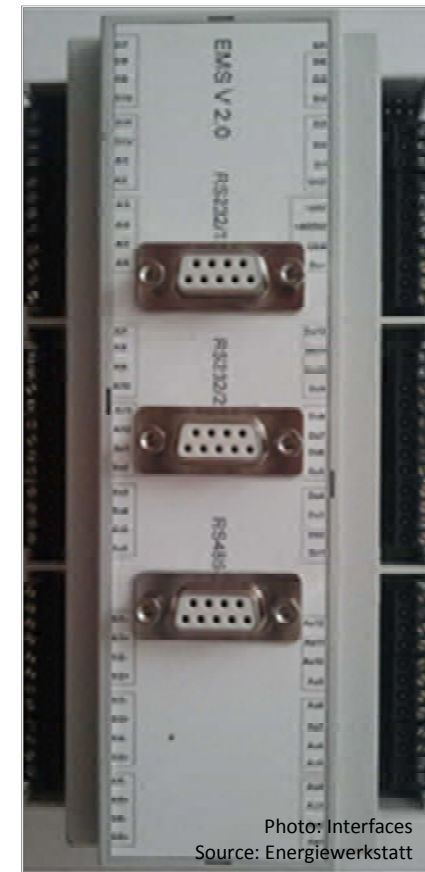
System components



- PV generator nominal power 1.0 kWp up to 2.0 kWp
- Wind generator nominal power 350W-1000W
- Fuel cell nominal power 110W-220W
- Battery capacity 660Ah
- EMS board intelligent regulation system control
- Container isolated Box with thermal management

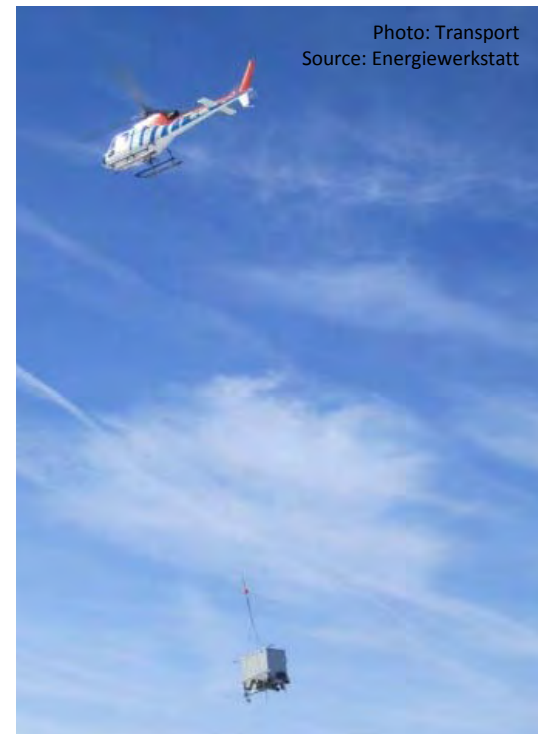
Key benefits of the EMS

- Intelligent sensor heating
 - Demand-driven
 - Adaptive: Parameter setting depending on the meteorological conditions
 - Control of up to 8 heated sensors including load shedding by priority
- Thermal management
 - Use of excess energy from PV and small wind turbine
 - Automatic protection against overheating: Ventilators, ventilation flaps...
- Data monitoring and Remote Control
 - Automatic record of operational data (producers, sensors...)
 - Automatic SMS alerts at critical operational values
 - Settings can be changed via PC or mobile phone



Key benefits of components

- Industry standard
- Optimally aligned hardware items
- Easy transportable to the sites
 - Container on trailer system
 - Weight allows pulling with common vehicle
 - Slots for Forklift
 - Eyebolts for the helicopter
- Site specific adoptable design
 - At forest sites → 2 small wind turbines on the mast up to 40 m
 - Weak solar radiation → 2 Fuel cell's
 - At exposed / windy sites → 1 powerful wind turbine and PV



Experience from Practice – Location No.1

- Site Specification
 - 1.433 m above sea level
 - Measurement point in the forest
- Measurement Setup
 - 85m HD mast
 - 4 x Cup Anemometer
 - 1 x 3D-Ultrasonic heated
 - Webcam heated
 - Meteorological sensors
- Energy supply system
 - PV generator (1.000 Wp)
 - 2 x small wind turbines (2x 350W)
 - Battery bank
 - Fuel cell (90W, backup)
 - EMS-Board



Results Site No.1 (October13-January14)

16% instrumental icing in 4 months, 52% in November

100% technical system availability, no maintenance required

100% filtered data availability (no data losses)

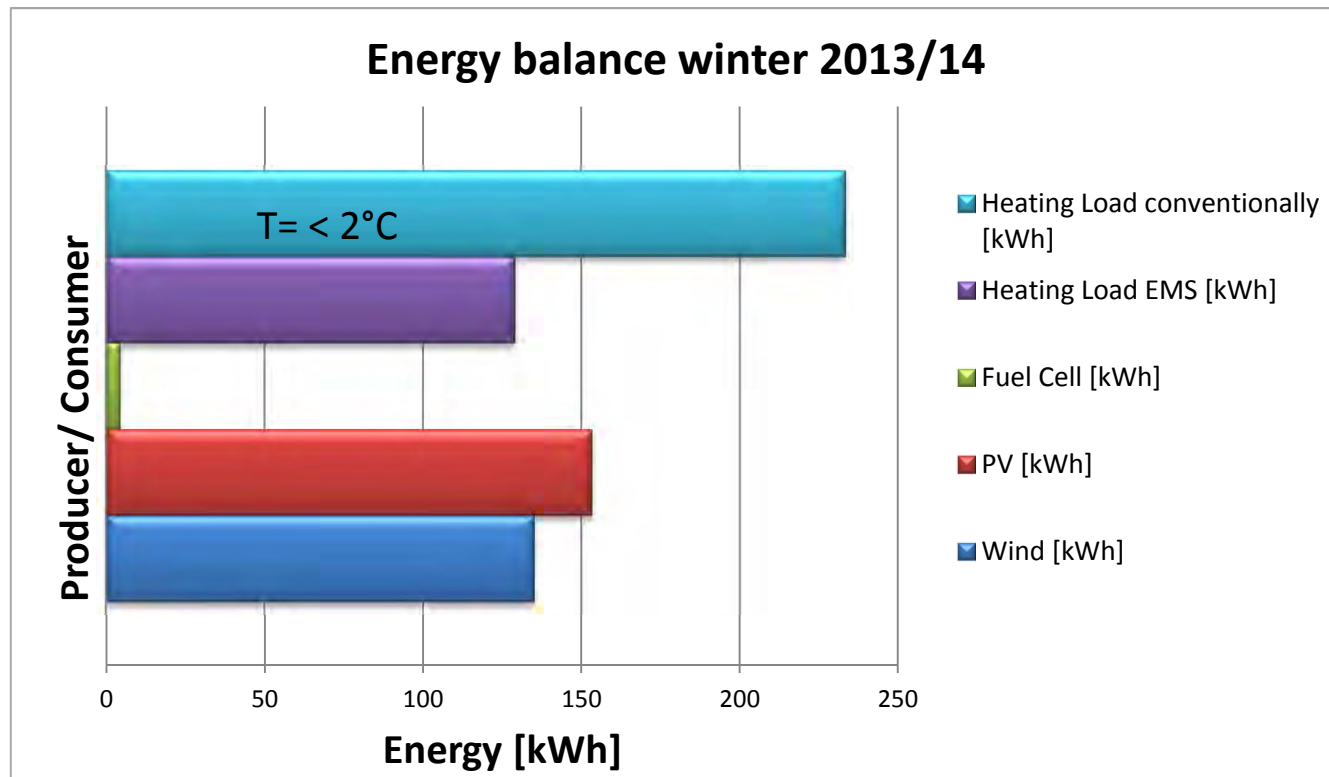


Fig. Source: Energiewerkstatt

Experience from Practice – Location No.2

- Site Specification
 - 1.474 m above sea level
 - Measurement point in the forest
- Measurement Setup
 - 85m HD mast
 - 4 x Cup Anemometer
 - 1 x 3D-Ultrasonic heated
 - Webcam heated
 - Meteorological sensors
- Energy supply system
 - PV generator (780 Wp)
 - 1 x small wind turbines (350W)
 - Battery back
 - EMS-Board



Results Site No.2 (October13-January14)

23% instrumental icing in 4 months, 42% in January

100% technical system availability, no maintenance required

100% filtered data availability (no data losses)

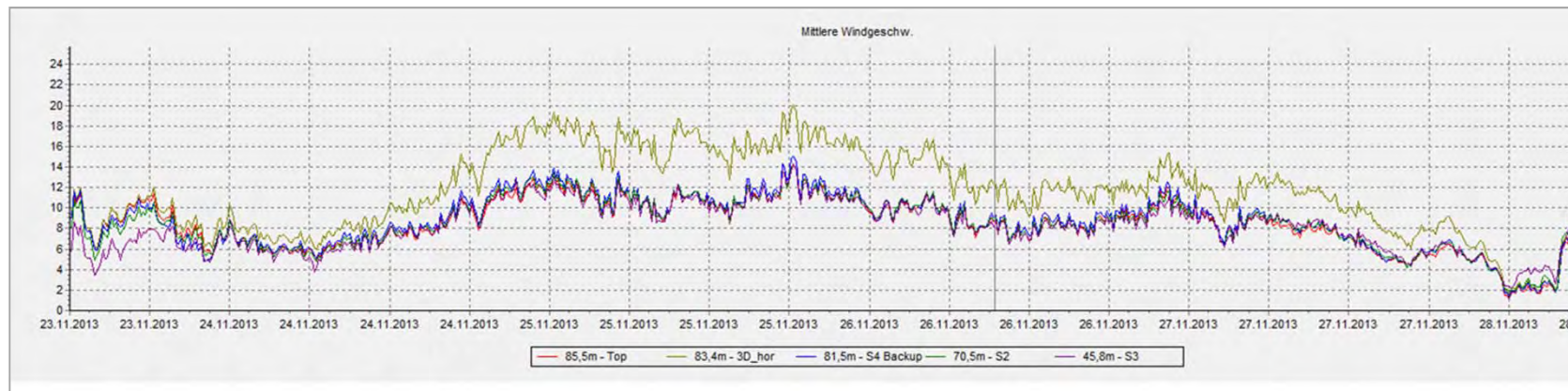


Fig. Source: Energiewerkstatt

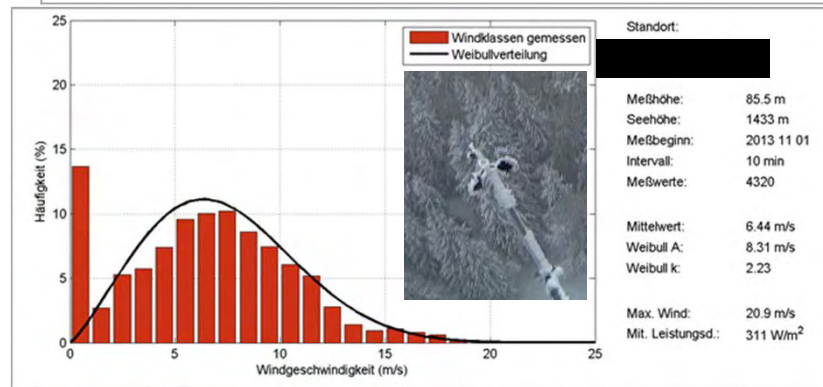


Fig. Source: Energiewerkstatt

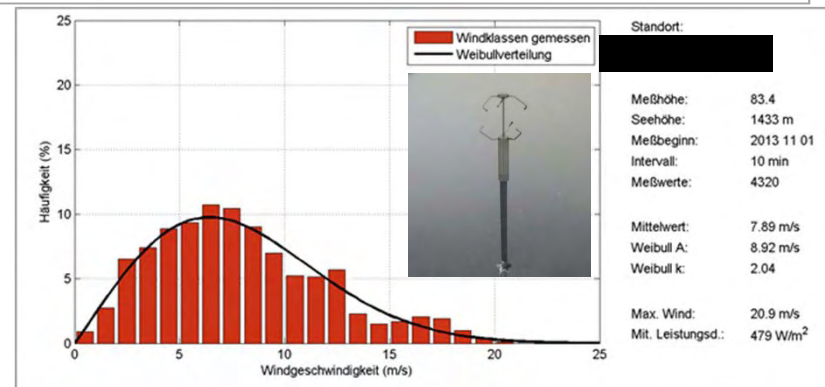
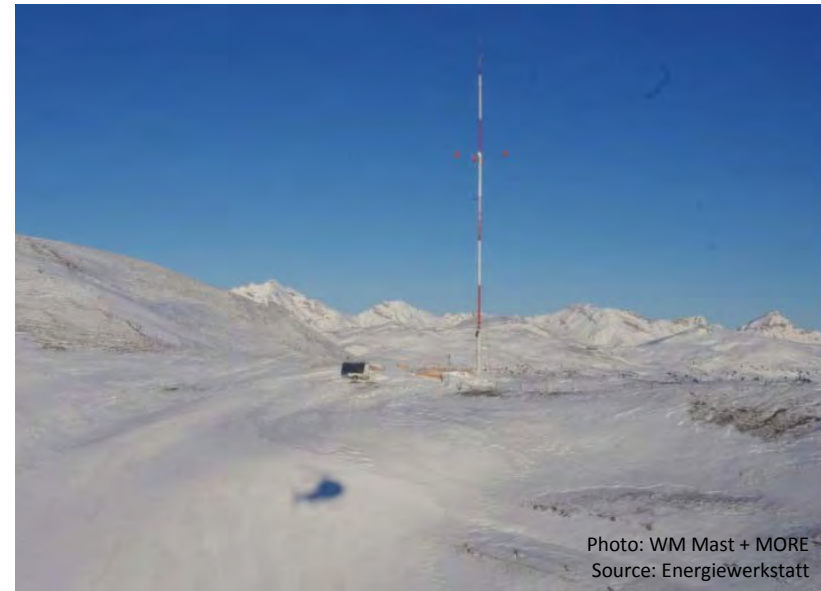


Fig. Source: Energiewerkstatt

Outlook

- Small wind turbines – partly heated
- Integration of an ice sensor in the control unit
- Sites with further challenges (low solar radiation...)



MORE

Mobile Remote Energy for heated wind measurement systems



Thanks for your Attention.