MORE

Mobile Remote Energy for heated wind measurement systems

Winterwind
INTERNATIONAL WIND ENERGY CONFERENCE


Photo: WM Sternstein
Source: Energiewerkstatt

Andreas Krenn

Energiewerkstatt


Photo: MORE
Source: Energiewerkstatt

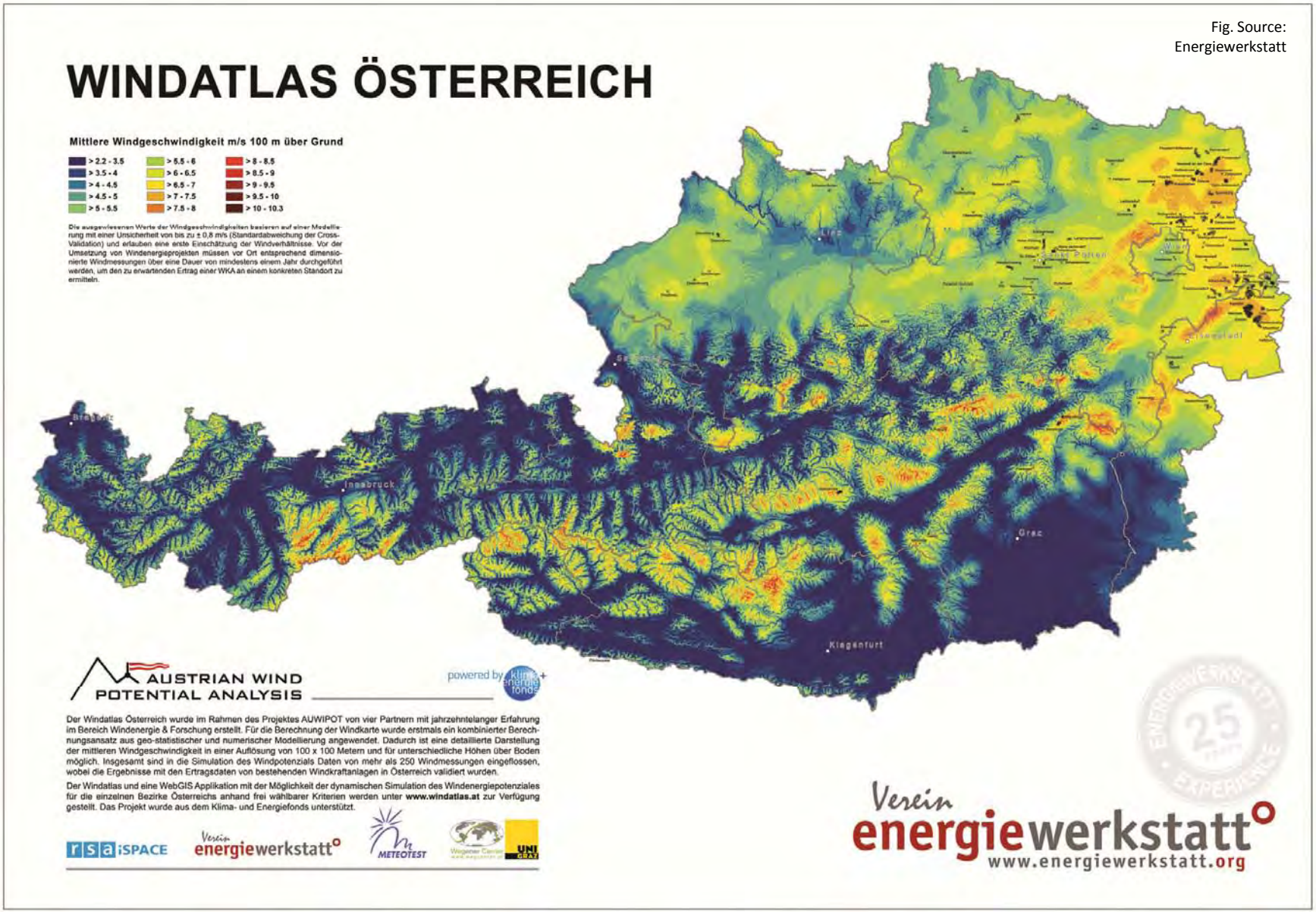
1. INTRODUCTION

2. CHALLENGES HEATED MEASUREMENTS

3. IMPROVED APPROACH - MORE

4. EXPERIENCES AND RESULTS

Fig. Source: Energiewerkstatt



Company Profile

Wind Energy: Special Focus on Complex Terrain and Cold Climates

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

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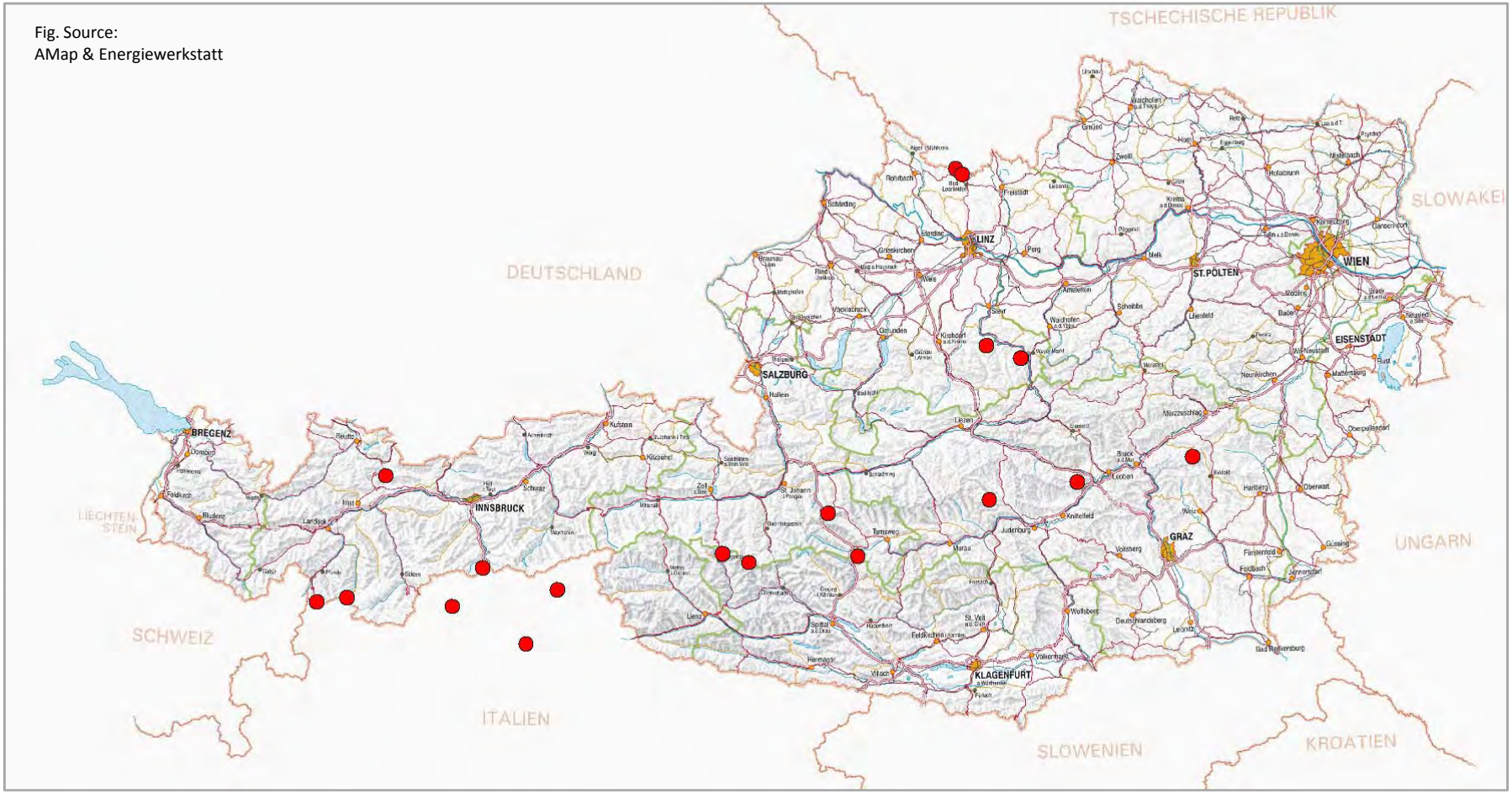
www.energiewerkstatt.org

Photo: WP Haindorf
Source: Energiewerkstatt

Heated Measurements with remote power supply

- ~20 Measurements since 1999



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Challenges with anemometers

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

Fig. Source: Energiewerkstatt

Photo Source: www.lidar.tropos.de

- Heated Ultrasonics: Problems with invalid data

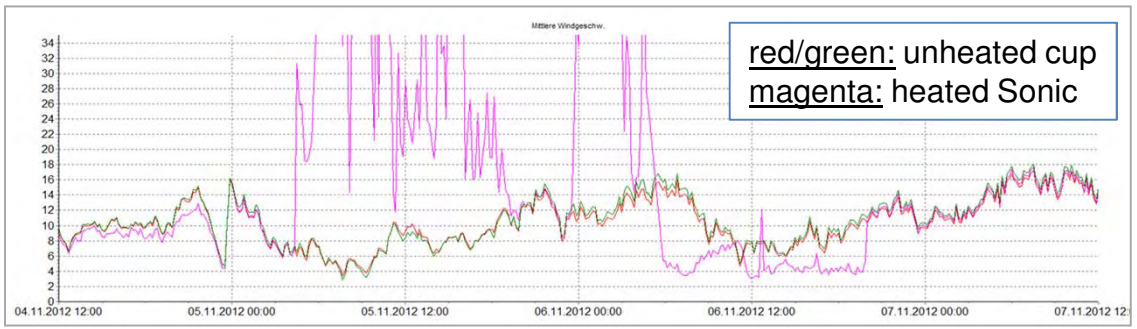

Fig. Source: Energiewerkstatt

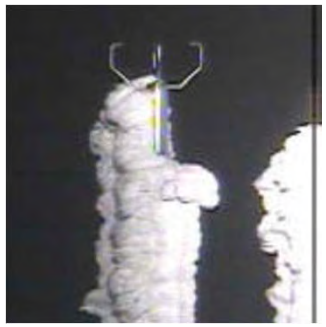

Photo Source: www.lidar.tropos.de

→ 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

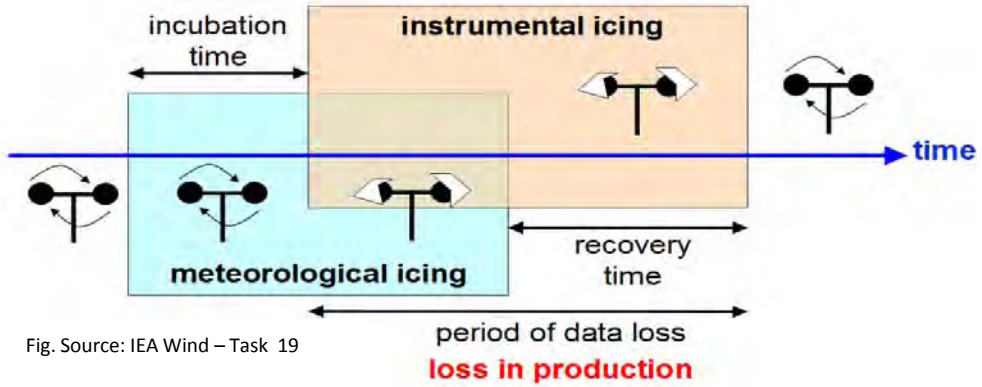

Fig. Source: IEA Wind – Task 19

- 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

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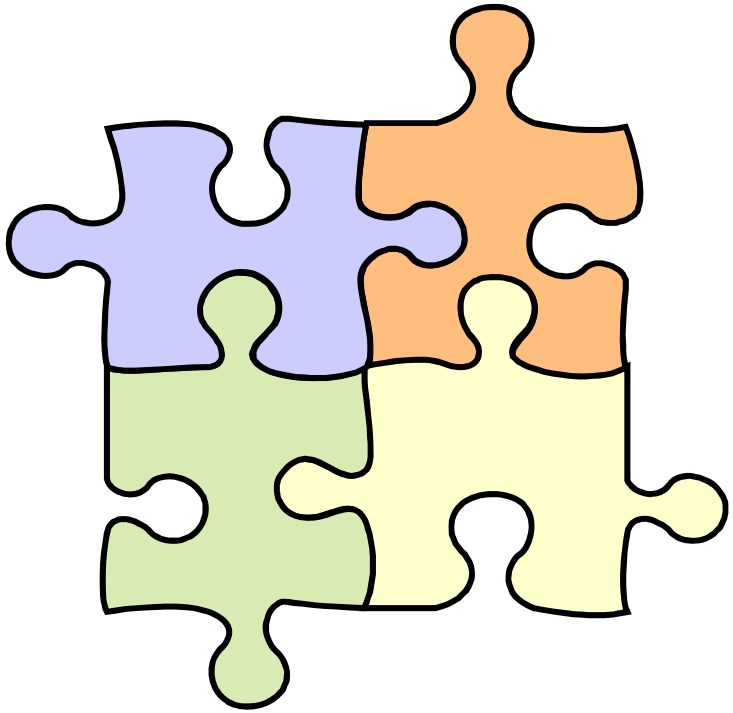
Objectives MORE

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

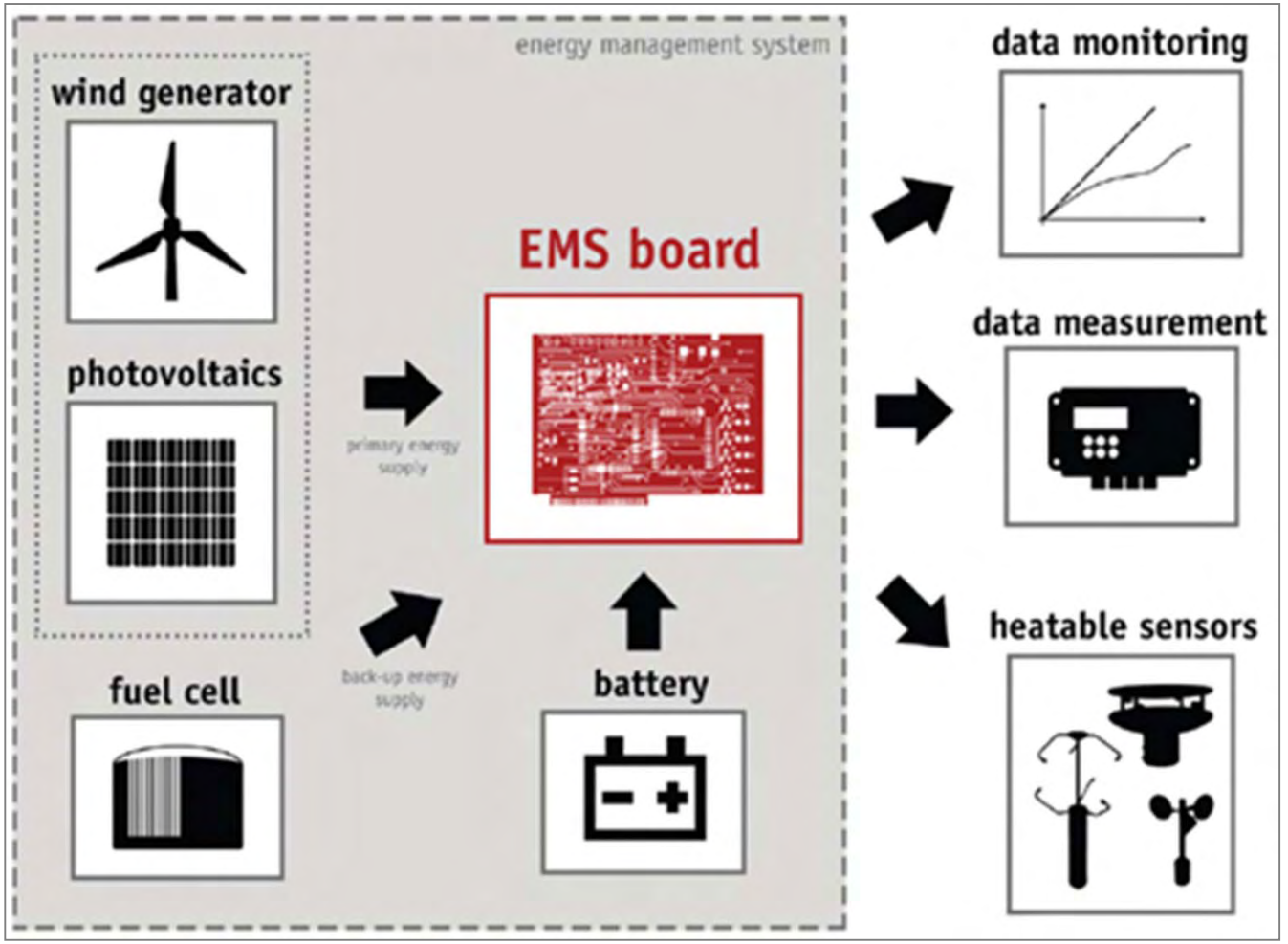


Fig. Source: Energiewerkstatt

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

Photo: Small WT
Source: Energiewerkstatt

Photo: WebCam Pic
Source: Energiewerkstatt

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System components


Photo: MORE
Source: Energiewerkstatt


Photo: MORE
Source: Energiewerkstatt

- 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

Photo: Interfaces
Source: Energiewerkstatt

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

Photo: MORE
Source: Energiewerkstatt

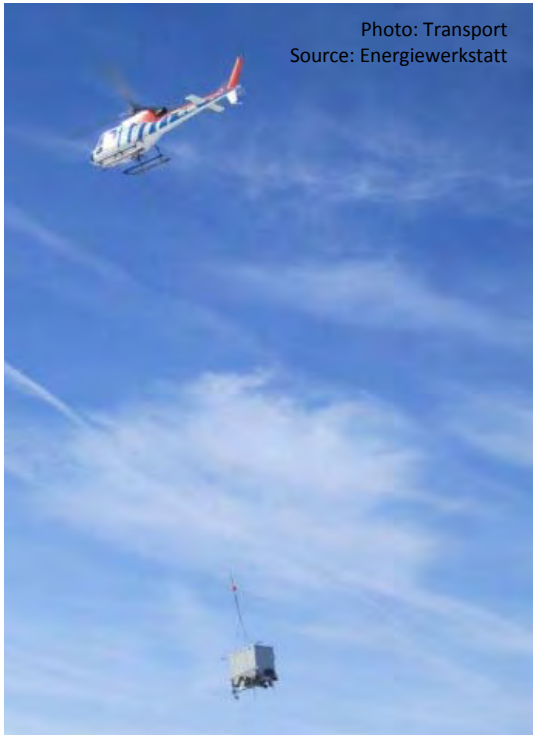

Photo: Transport
Source: Energiewerkstatt

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-Ulrasonic heated
  - Webcam heated
  - Meteorological sensors
- Energy supply system
  - PV generator (1.000 Wp)
  - 2 x small wind turbines (2x 350W)
  - Battery back
  - Fuel cell (90W, backup)
  - EMS-Board


Photo Source: Energiewerkstatt

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)

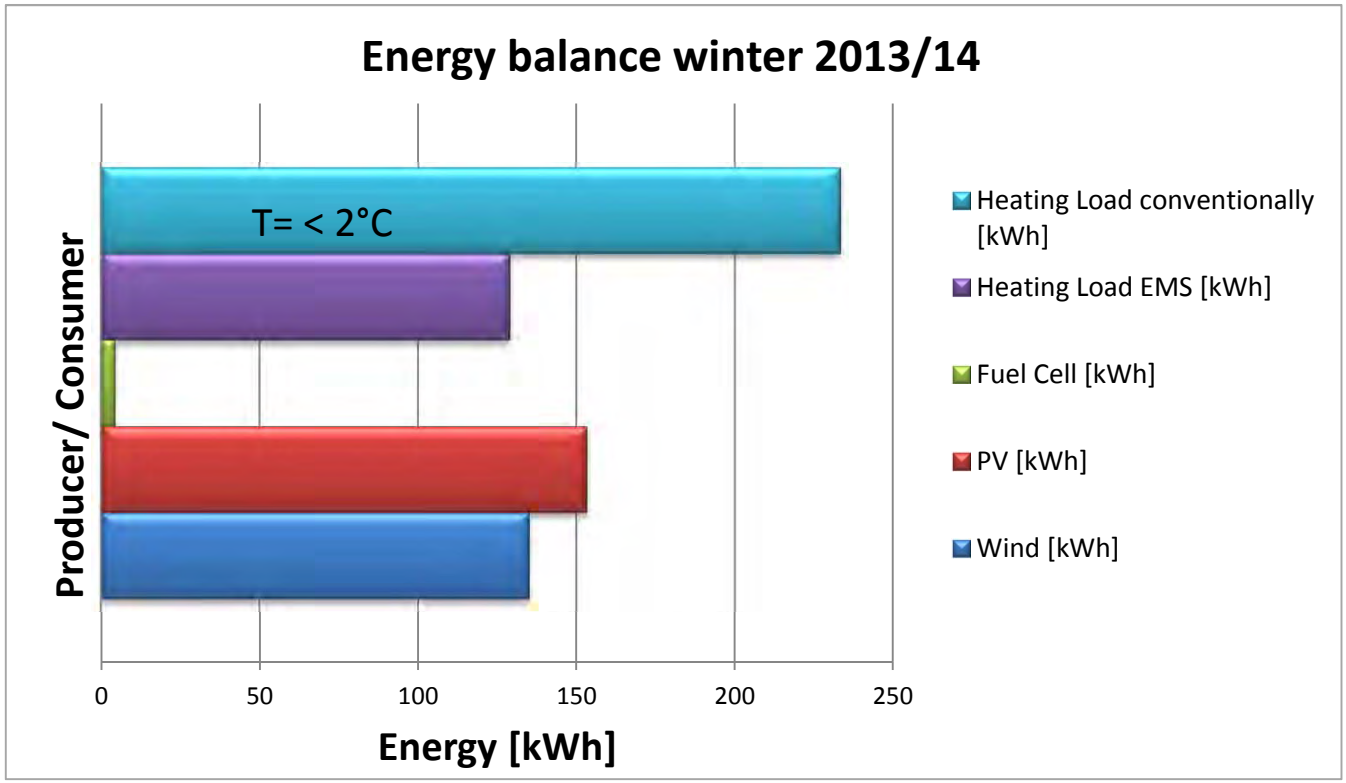

Fig. Source: Energiewerkstatt

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-Ulrasonic heated
  - Webcam heated
  - Meteorological sensors
- Energy supply system
  - PV generator (780 Wp)
  - 1 x small wind turbines (350W)
  - Battery back
  - EMS-Board

Photo: WM Mast
Source: Energiewerkstatt

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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)

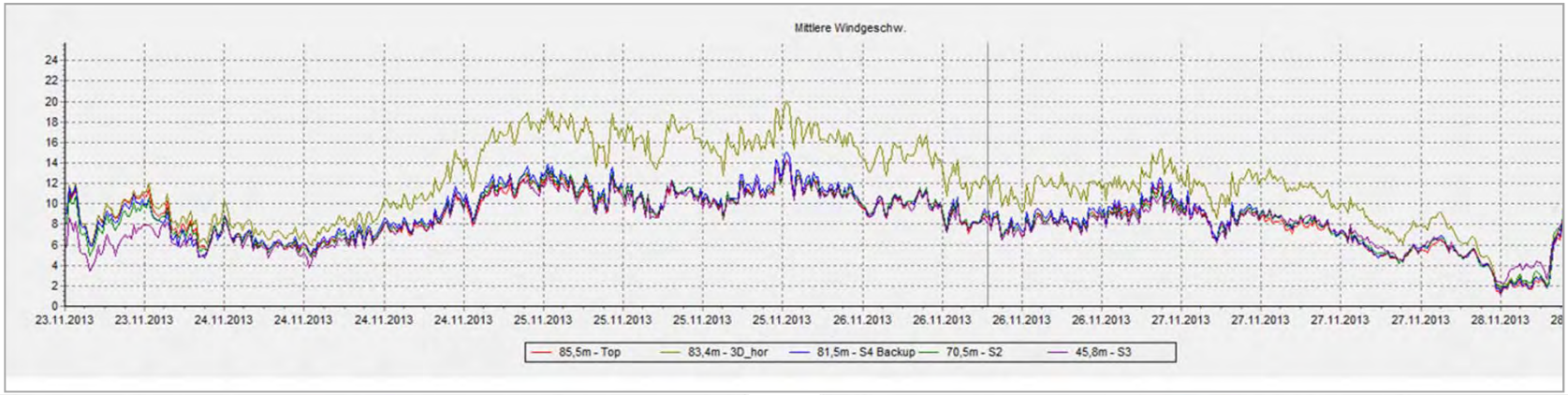

Fig. Source: Energiewerkstatt

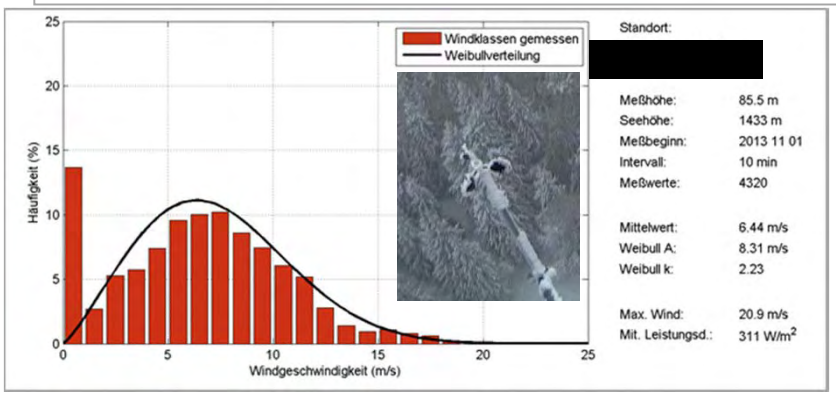

Fig. Source: Energiewerkstatt

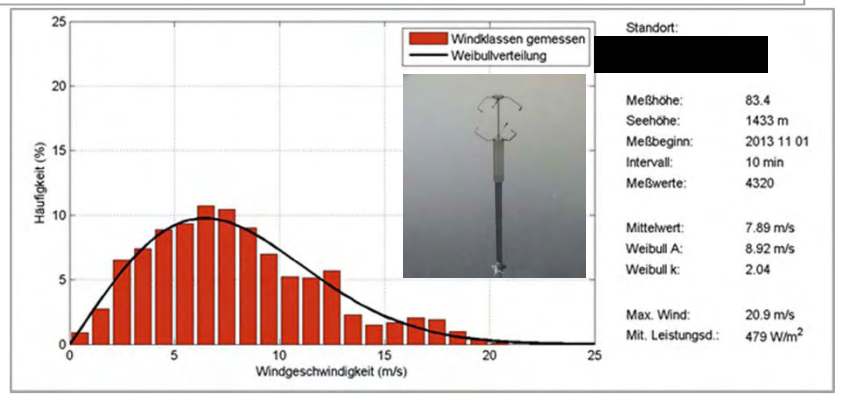

Fig. Source: Energiewerkstatt

Outlook

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

Photo: MORE
Source: Energiewerkstatt

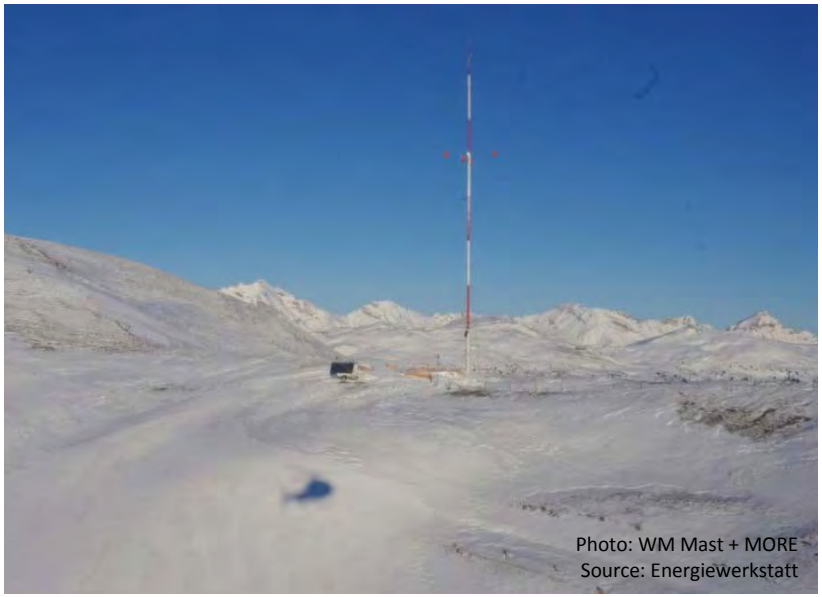

Photo: WM Mast + MORE
Source: Energiewerkstatt

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Photo: Alps
Source: Energiewerkstatt

Thanks for your Attention.

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