Monitoring of PV Village Power Supply Systems in China

G. Bopp, A. Steinhüser, Fraunhofer ISE, Germany

H. Gabler, ZSW, Germany

F. Haugwitz, H. Müller, GTZ, Beijing / China

Liu Hong, Li Zhiming, QNERI, Xining / China

Rural Electrification in China: Background
Electricity for 30 million people

- Chinese Brightness Program: Renewable energy for 23 millions people between 1996 and 2010

- Over the past two years 662 villages have been electrified with PV and PV/Diesel Hybrid systems (10 to 50 kW), total installed capacity 18.5 MW

- Additionally approx. 170 PV/Diesel Hybrid systems will be financed by the German development bank KfW

- Since 2001 the German Agency for Technical Cooperation (GTZ) has been providing technical assistance in the provinces of Yunnan, Qinghai, Gansu and Tibet

History of PV Village Monitoring in Qinghai

- 2002-2004: QBEC installed 112 village PV / PV Hybrid Systems

- Oct. 2004: Selection / Procurement

- March 2005: Training / Installation

- Oct. 2005: Training Statistical Eval.

- Parallel statistical evaluation in Qinghai & Germany until June 2006

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Objectives of Monitoring

- Does the generated electricity meet the demand of the township population?
- Reliability of components?
- Efficiency of components?
- Does system or component failures occur?
- Extension of the regular maintenance period?
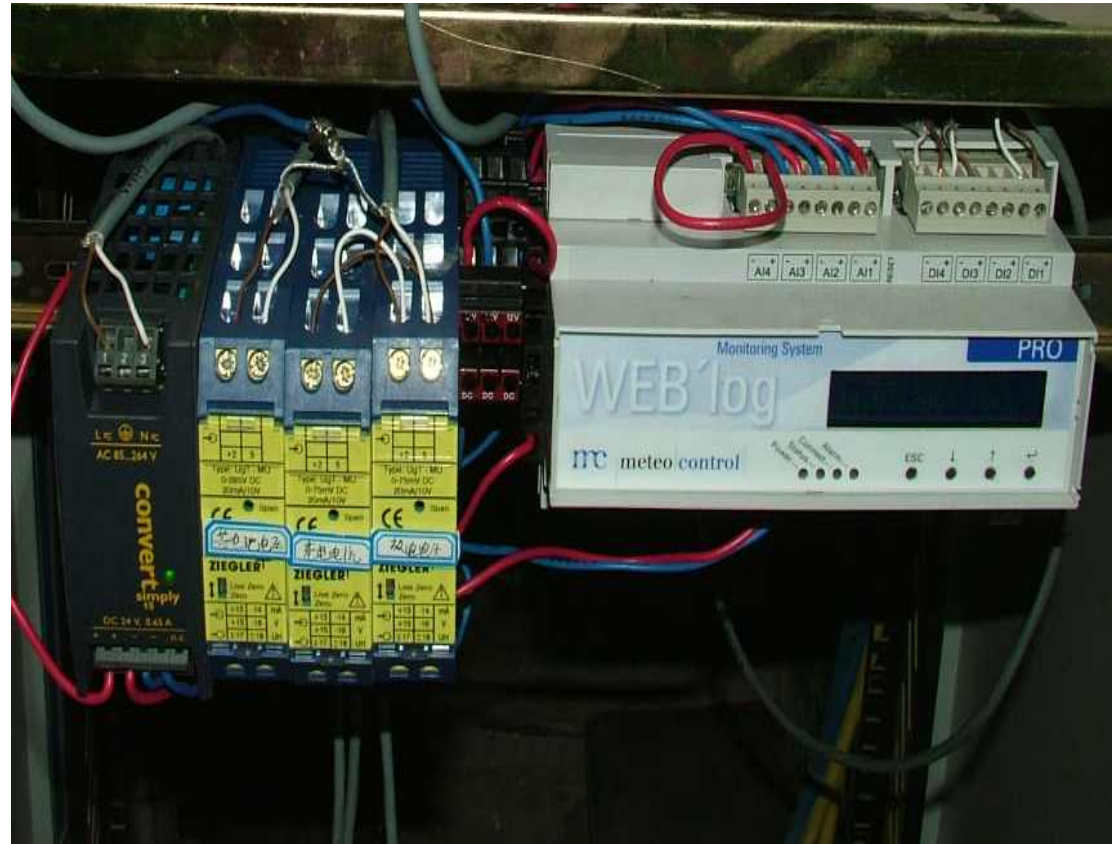- Improvement of the system layout/design?
- Optimisation of components?
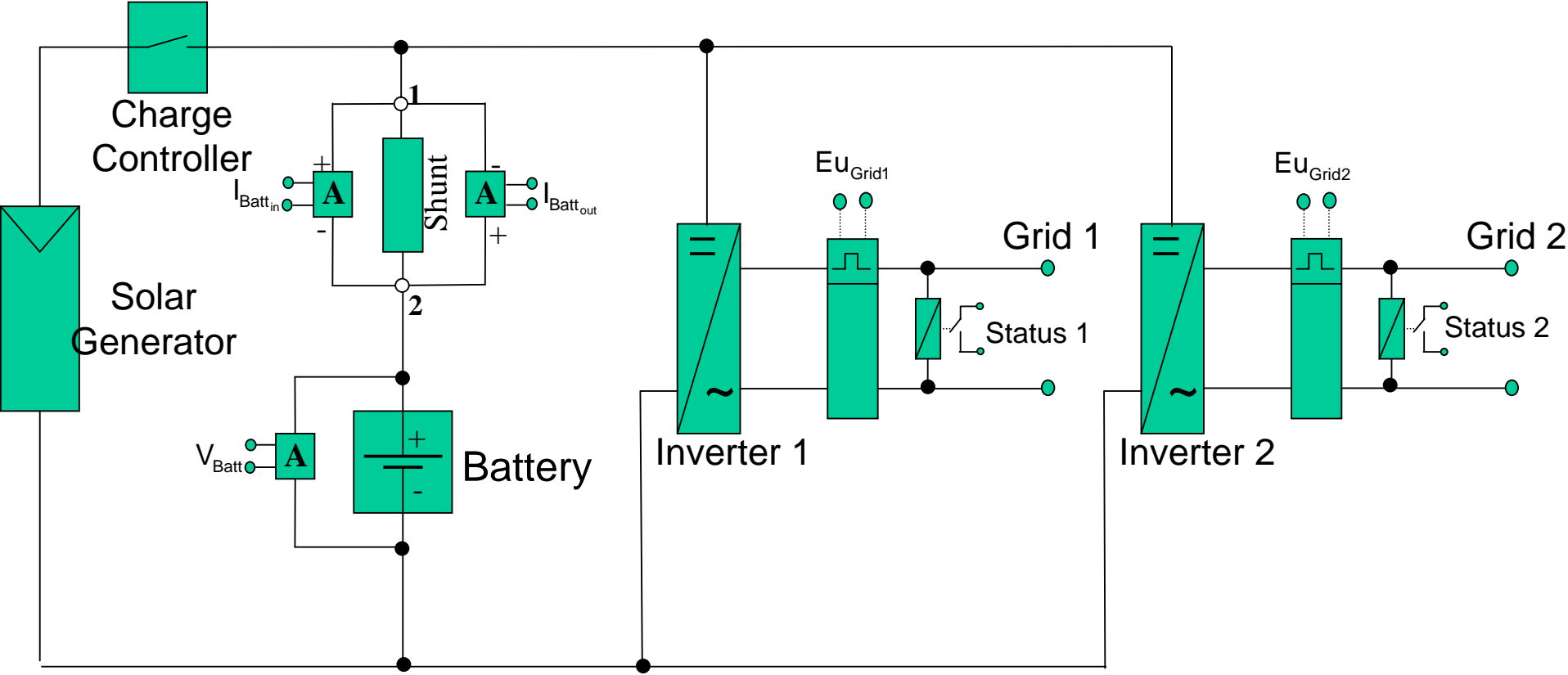
Four different Types of Monitoring

- Written Reports

- Small Data Acquisition System (DAS)

- Full Size Data Acquisition System (DAS)

- Mobile Measurement Equipment

Small Data Acquisition Systems (installed in 7 Townships)

- Automatic data acquisition of 8 signals

- Automatic data transfer by email via analogue telephone line to a data server each night

- Alternatively a memory card will be send by post to QNERI

- With a password the data are available for evaluation and processing
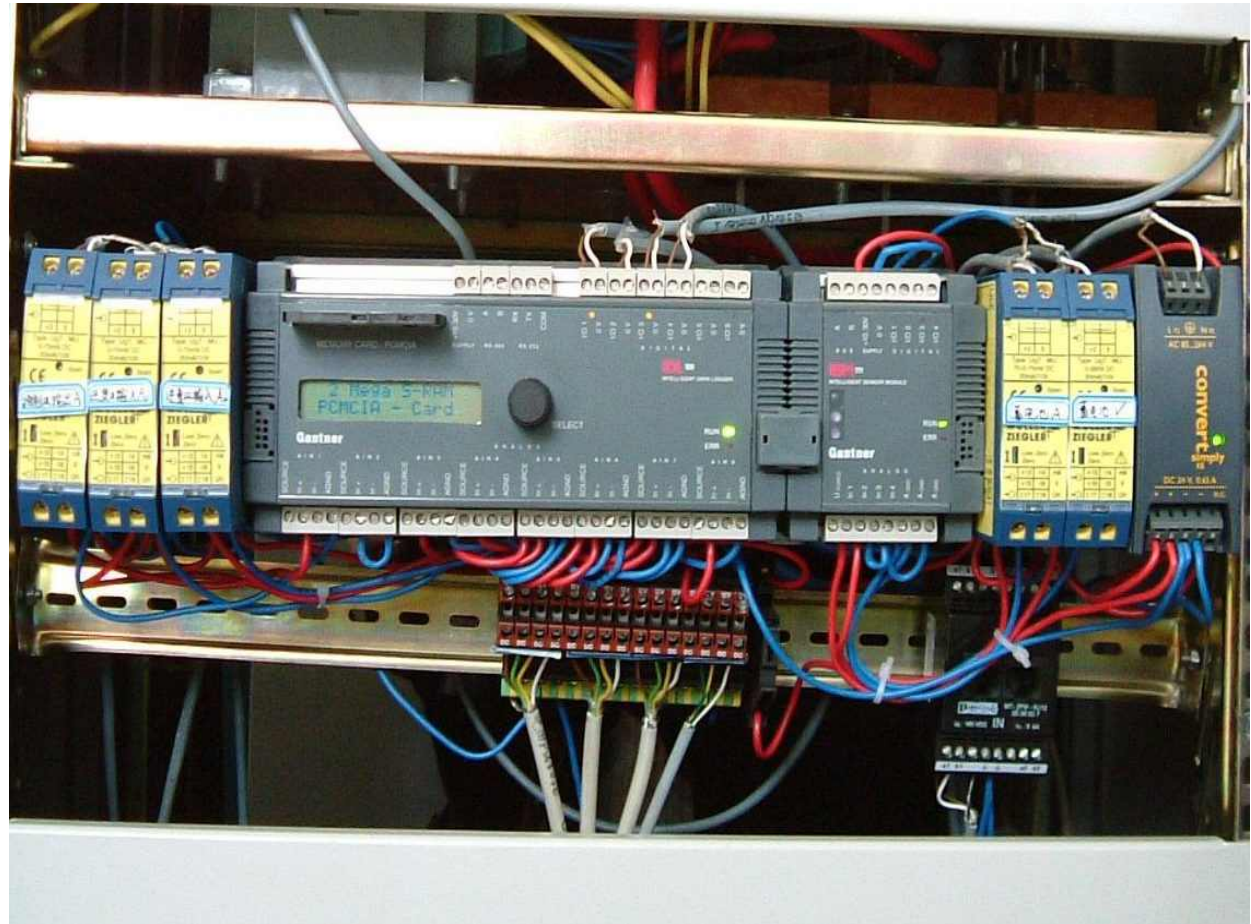
Block Diagram of Measuring Points

Charge Controller

Solar Generator

$I_{Batt_{in}}$

$I_{Batt_{out}}$

Shunt

1

2

V_{Batt}

Battery

Inverter 1

Eu_{Grid1}

Grid 1

Status 1

Inverter 2

Eu_{Grid2}

Grid 2

Status 2

[A] = Isolation Amplifier
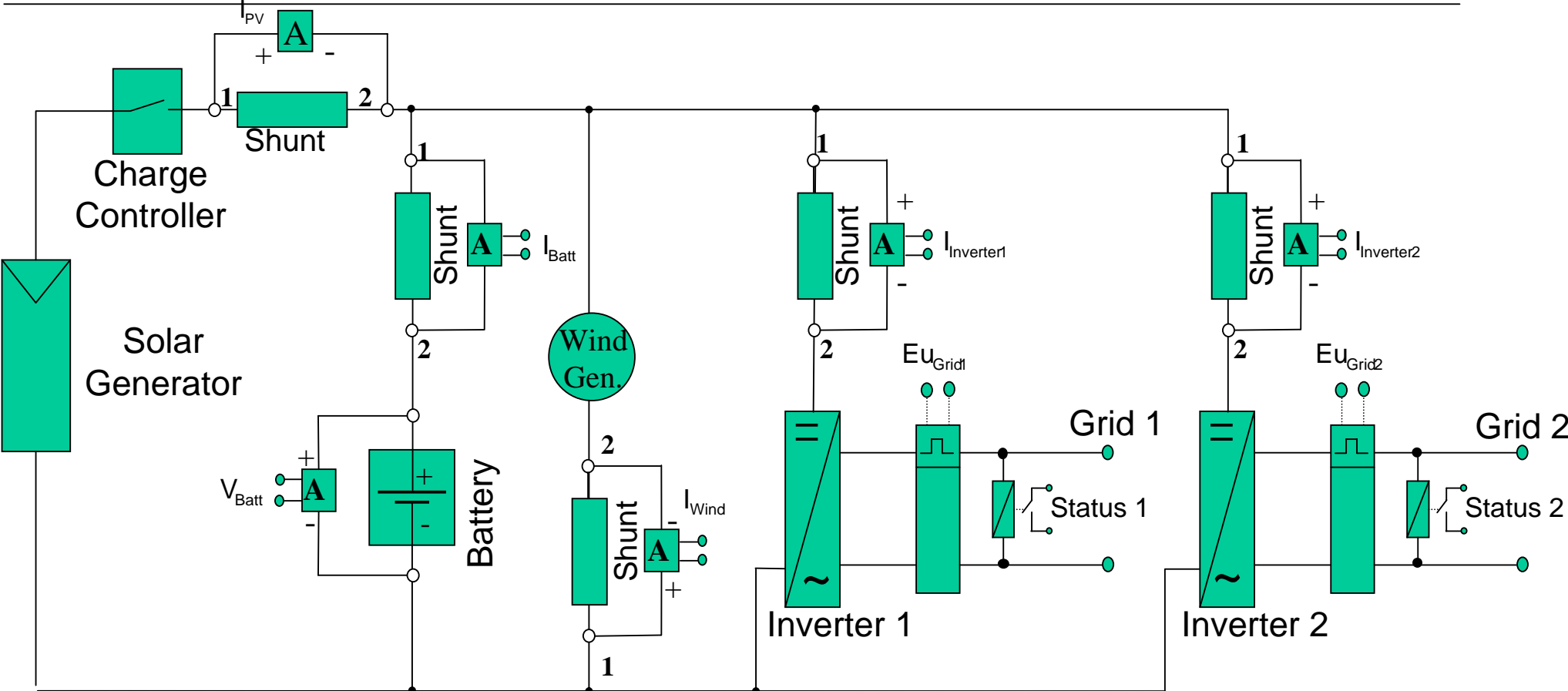
Additional Measurements: Solar Irradiation

# Full Size Data Acquistion Systems (installed in 5 Townships)

- Automatic data acquisition of 15 signals

- Manual data transfer via analogue telephone modem from QNERI every day

- Alternatively a memory card will be send by post to QNERI

- QNERI transfer the data into a database

Block Diagram of Measuring Points

$\boxed{A}$ = Isolation Amplifier

Additional Measurements: Solar Irradiation, Ambient Temperature, PV-Module Temperature, Battery Temperature, Wind Speed

# Main Features of Kesheng Township, Qinghai Province

- 450 km away from the provincial capital, 80 km of this distance is a field path

- 484 households planned, actually only 300

- 40 kW PV generator

- 220 VDC battery voltage, 858 kWh battery capacity

- 2 Inverter 16 kW and 24 kW respectively

- 113 kWh average daily energy consumption

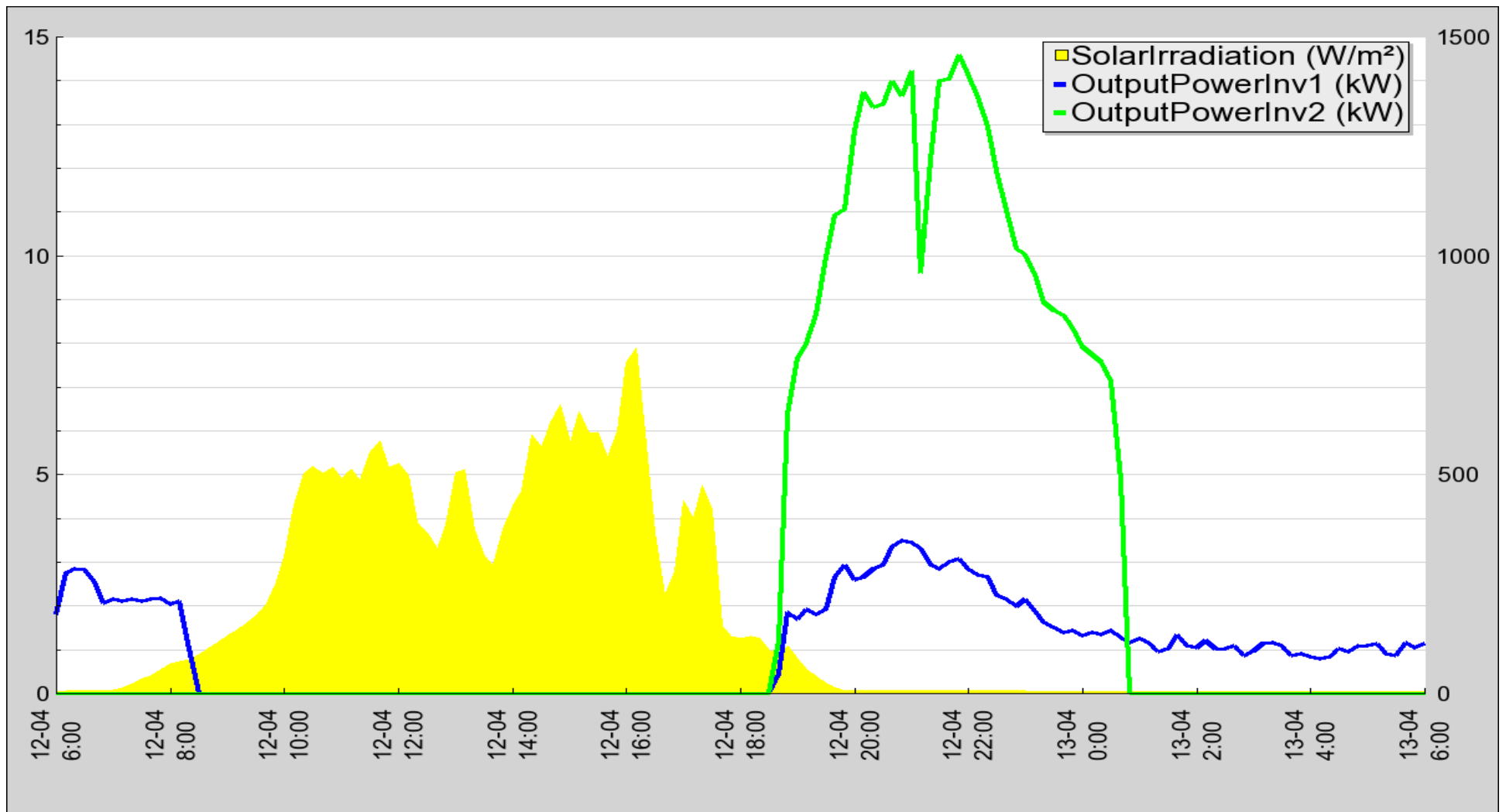# Daily Consumption, Theoretical Energy and Performance Ratio
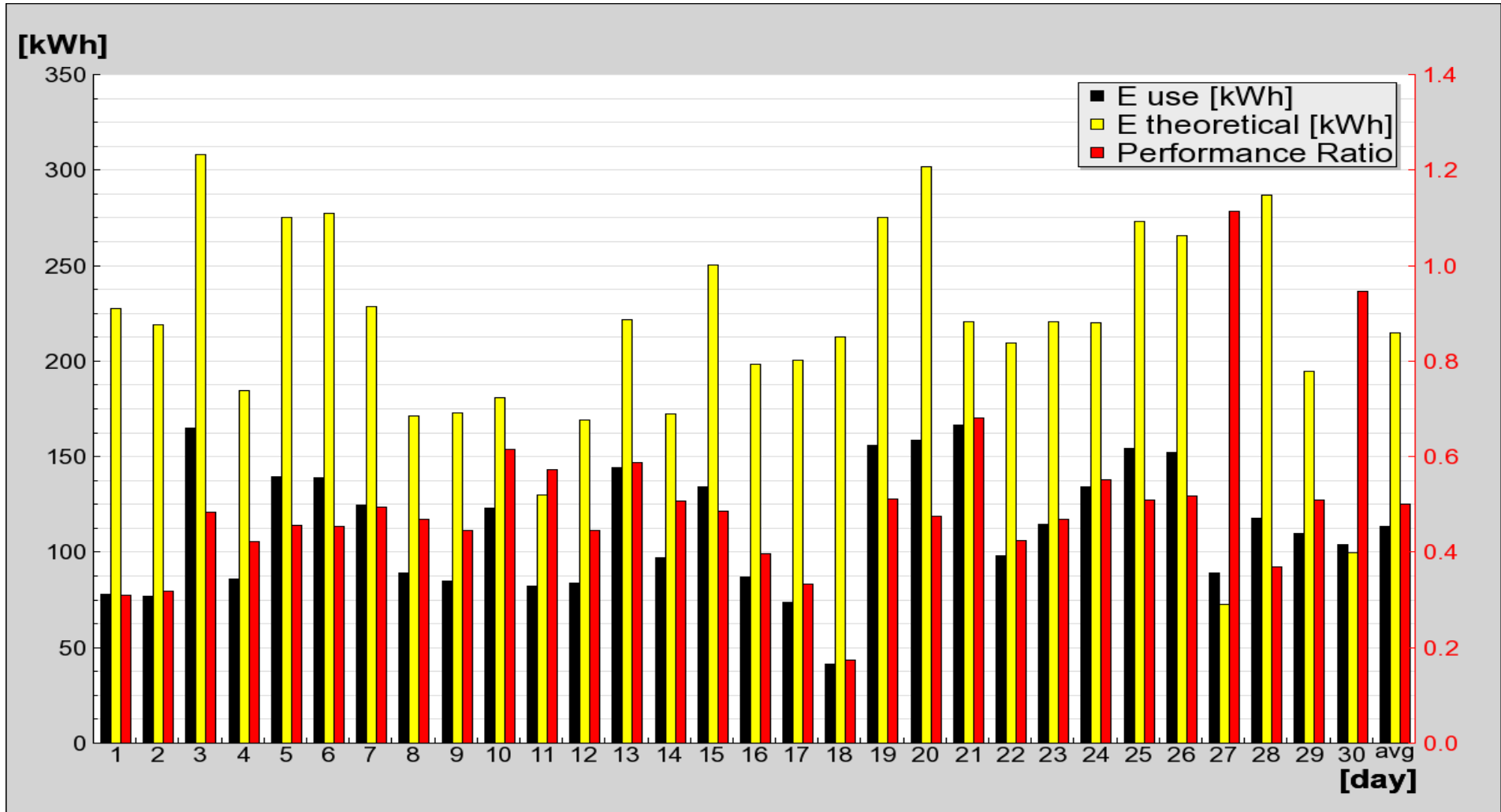
Solar Irradiation and Output Power (sunny day)
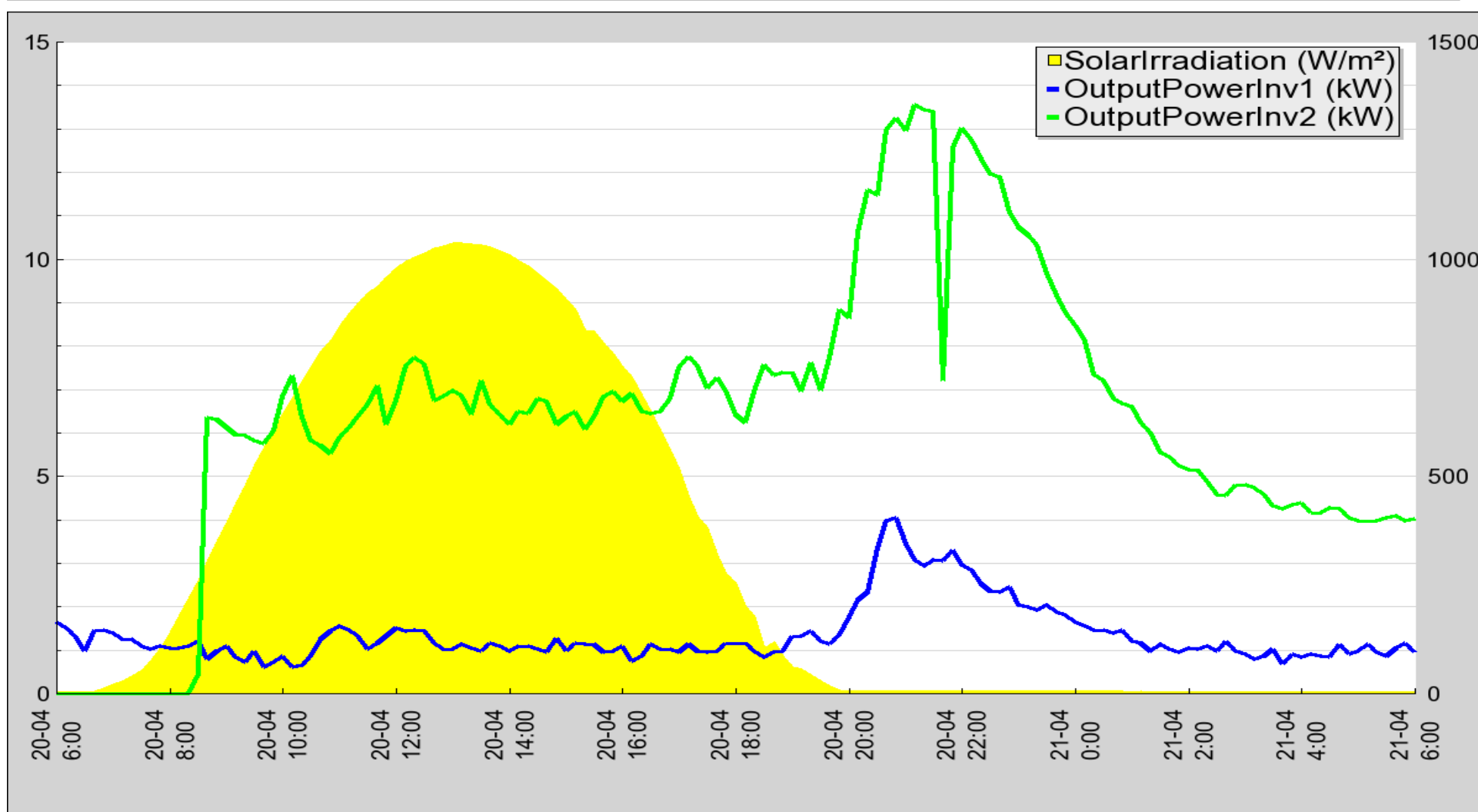
Solar Irradiation and Output Power (cloudy day)

Conclusion

- Energy management is done manually by the operator according to weather conditions

- Average monthly performance ratio (ratio between theoretical available solar energy and actually consumed energy) of 0.5 is acceptable

- A performance ratio of 0,7 can be achieved, e.g. extending of daily operating periods of inverters, to connect more houses, higher efficiencies of components

- To this end further detailed data analysis of Kesheng and other monitored townships are necessary