E2ficcinency

Köthen Workshop 8.+9. October 2013

- BESS Introduction
- General structure
- Operational costs
- Core components

“Autonomous power systems in the Siberian region”

Competence E

Thomas Timke

KIT – Facts and Figures*

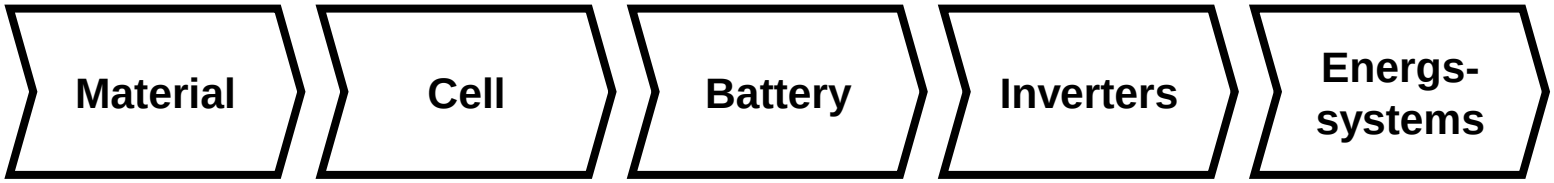
- 9.153 Employees
- 735 Mio € Budget**
- 157 Institutes
- 370 Professors
- 22.500 Students

* 2012
** 2010

Competence E

- Bundling of all electrical energy storage activities
  ➡ mobile and stationary applications

- **Goal:** industrial cost efficient solutions for batteries and drive systems



- **Research**:
  - High energy materials and compact cell designs
  - Modulare battery designs
  - optimized production processes

BESS® at KIT March 2013

Jointly developed by: KIT AccuSol GmbH SIEMENS E-WOLF

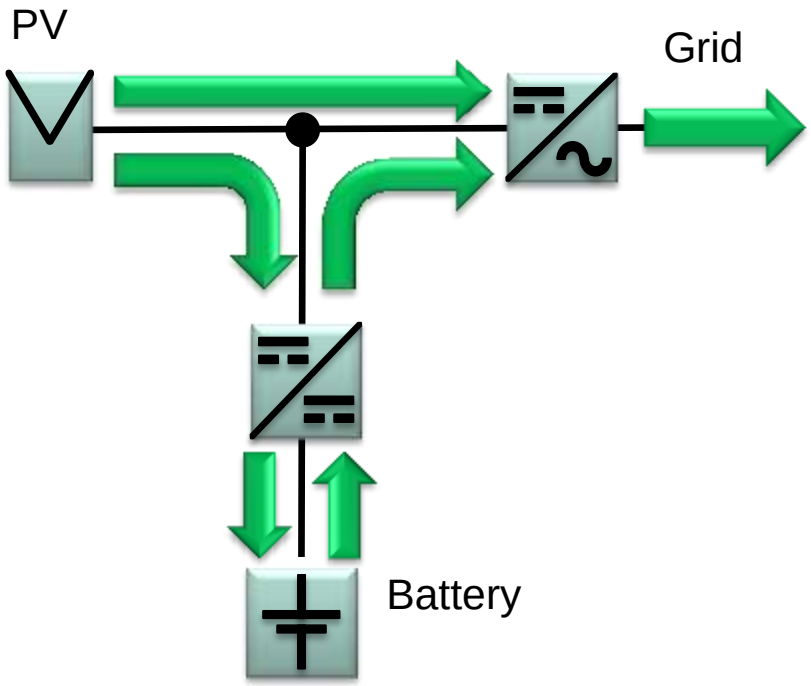
Power-Module 250 kW

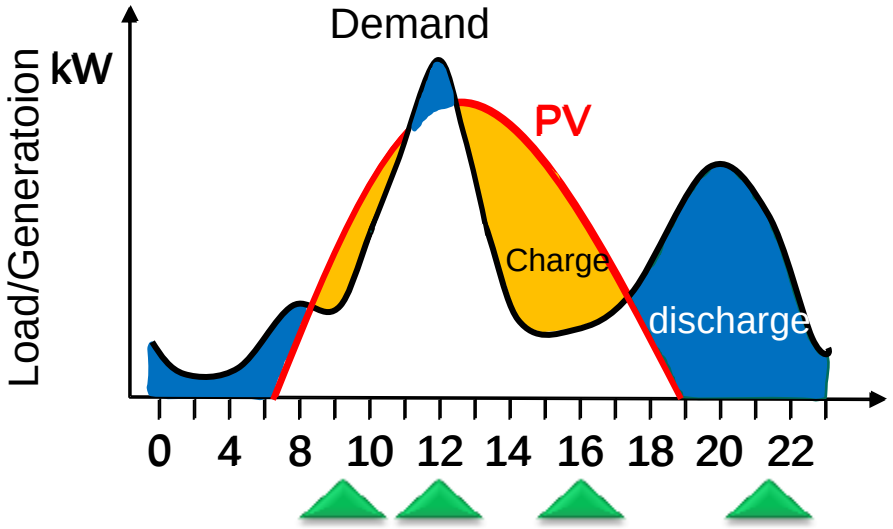
Battery-Module up to 300 kWh

PV 36 kWp installed

PV 1 MWp in installation

Basic Concept of PV and Battery





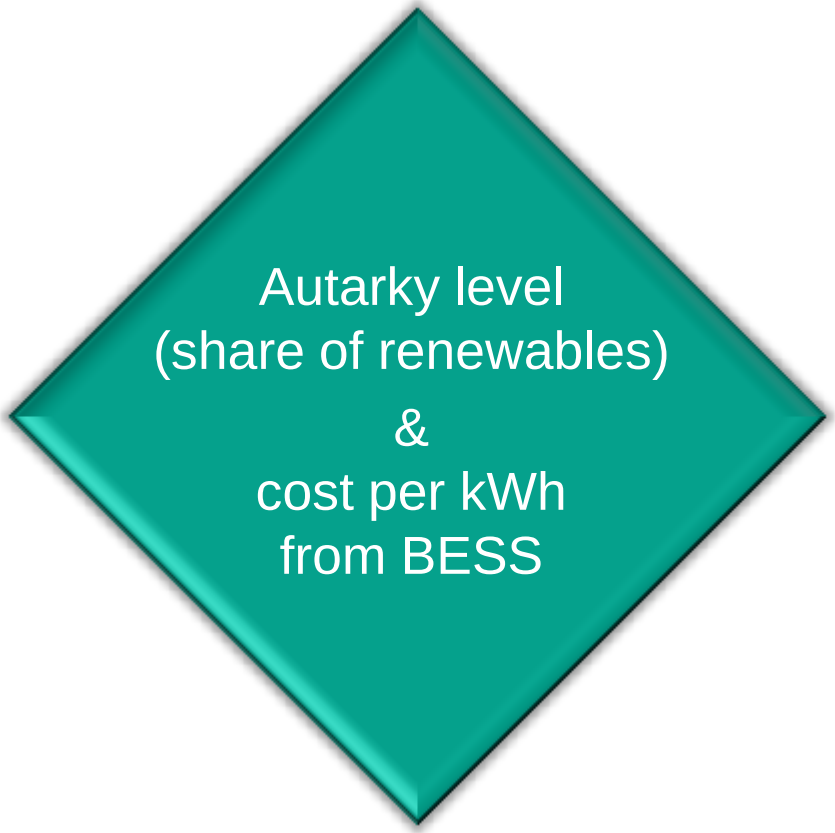
Profitability is determined by:

- System design (AC and/or DC coupling)
- System design (power electronics + battery in relation to PV and load)
- System design (control software, relability, efficiency, maintenance, availability)
- Life time of battery and power electronics

System Dependencies at given loads

Wind and/or PVsize

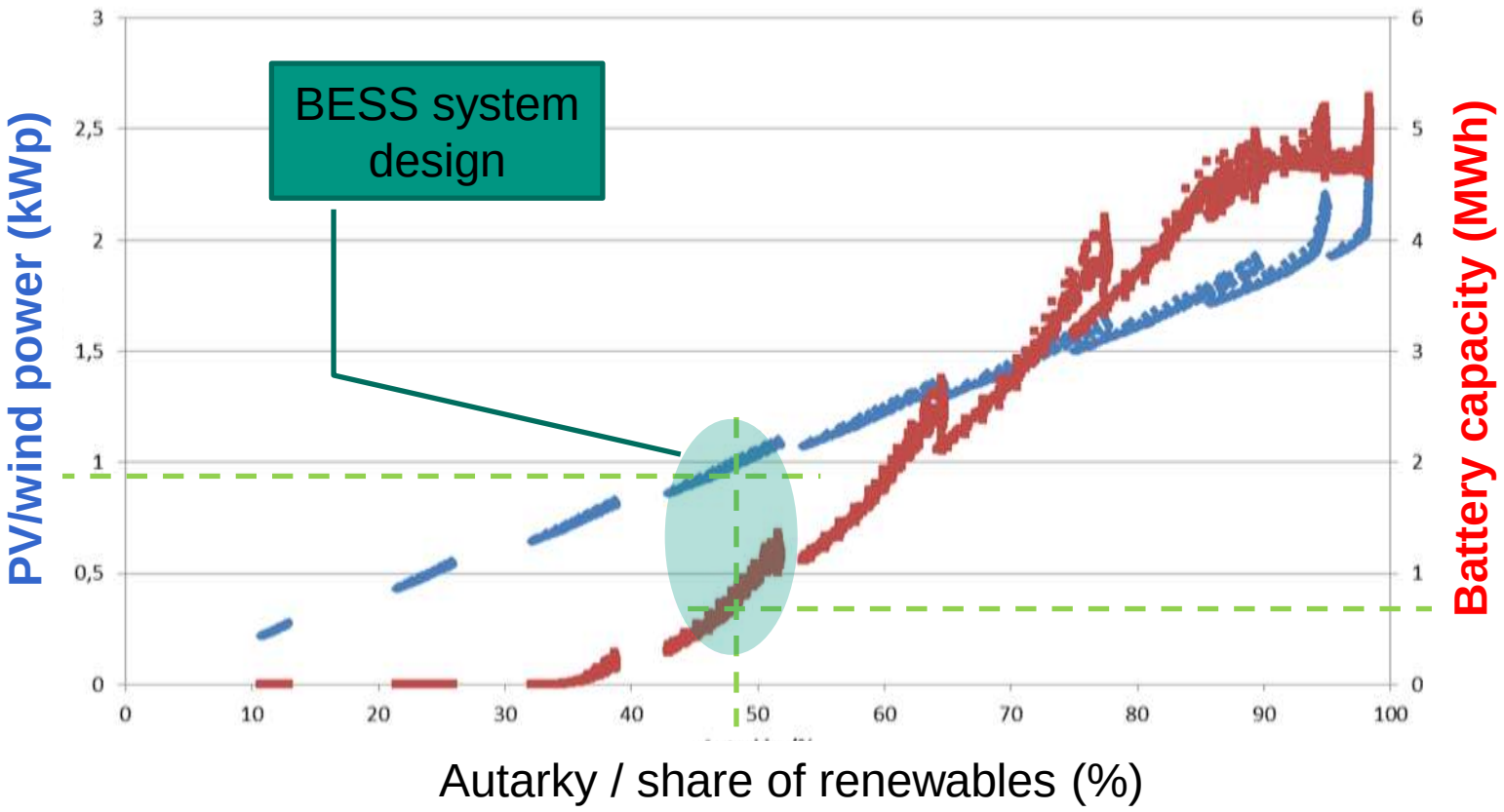
Diesel generator usage



Battery size

Rectifier power

Design & Simulation with provided load and PV data



Electricity Costs for PV+Battery Energy Storage Systems (BESS®)

Total Cost of Ownership (TCO)

$$\text{Costs} = \underbrace{\frac{\text{electricity production costs}}{\text{system efficiency}}}_{\text{production cost}} + \underbrace{\frac{\text{invest + maintenance costs + interest rate}}{\text{full cycle equivalent until end of life}}}_{\text{storage cost}}$$

5-8 cent/kWh

Power Electronics

? cent/kWh

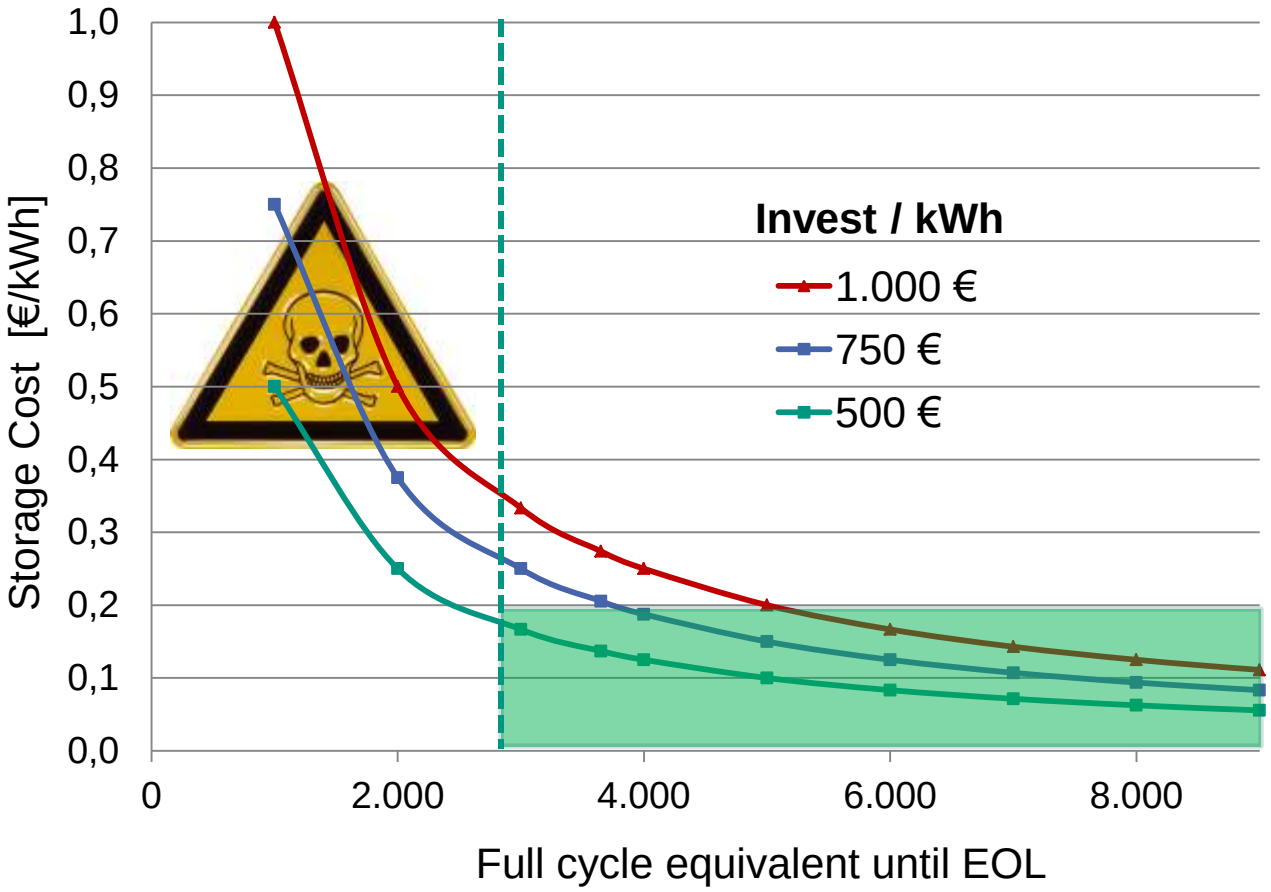
Battery

? cent/kWh

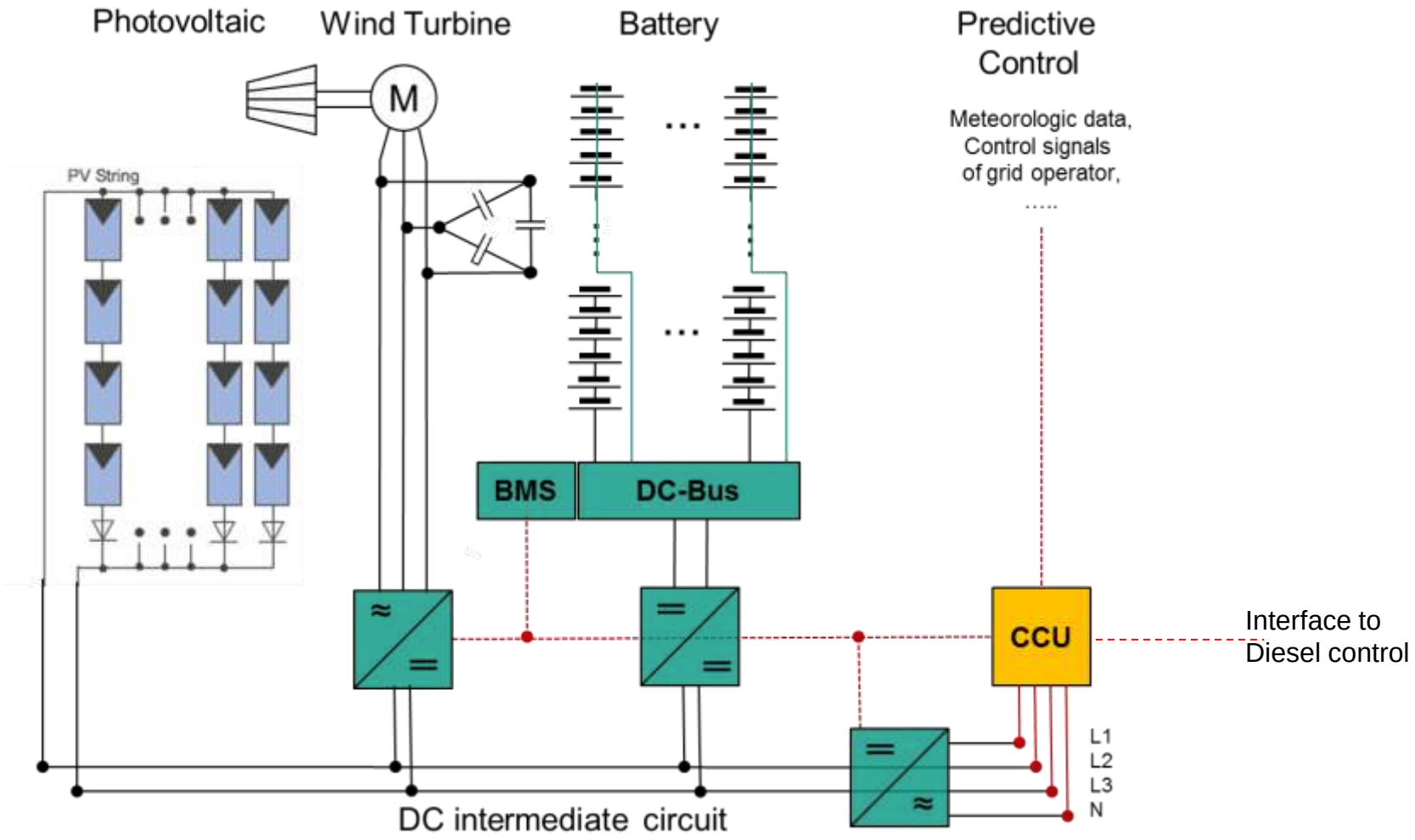
Typical results for well dimensioned renewable/battery-combinations depending on size and profiles:
0.24 – 0.45€/kWh
=> in most cases much cheaper than Diesel generator power

Total Cost of Ownership for Energy Storage

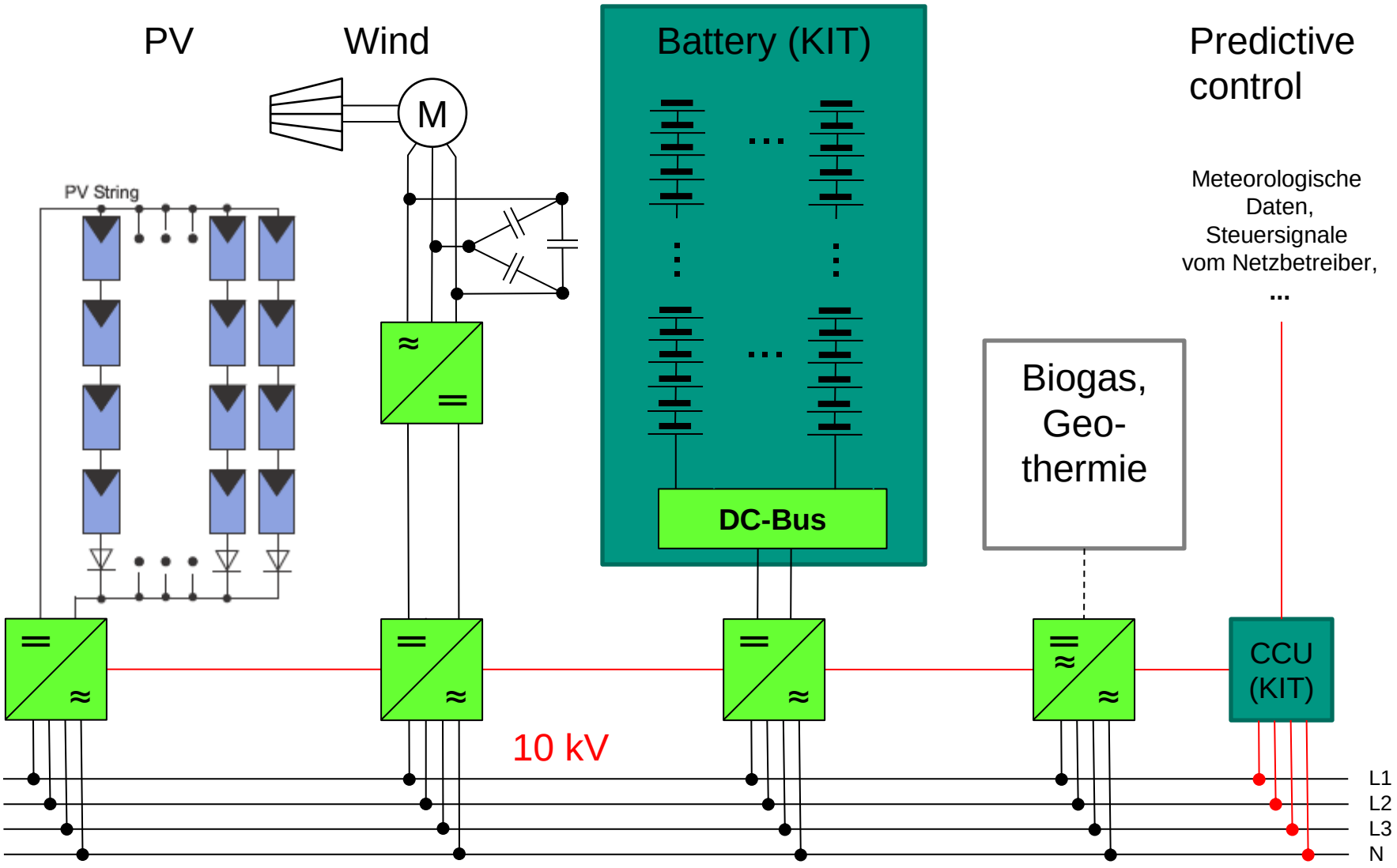
(w/o: PV, interest, maintenance)



System design - DC linked system



System design - AC linked system



AC or DC coupling

Depending on:

- Distance between components
- Grid building or synchronizing to existing grid
- Available components

DC coupling:

- Central DC/AC converter for grid building and grid-services
- Less single DC/AC converters which need to “talk”
- Mainly better efficiency
- Central control at one spot = less data lines

AC coupling:

- More redundant
- Decentral solution
- Communication via frequency
- More components available

Fully modular Ceramic Li-Ion Technology, 100% made in Germany

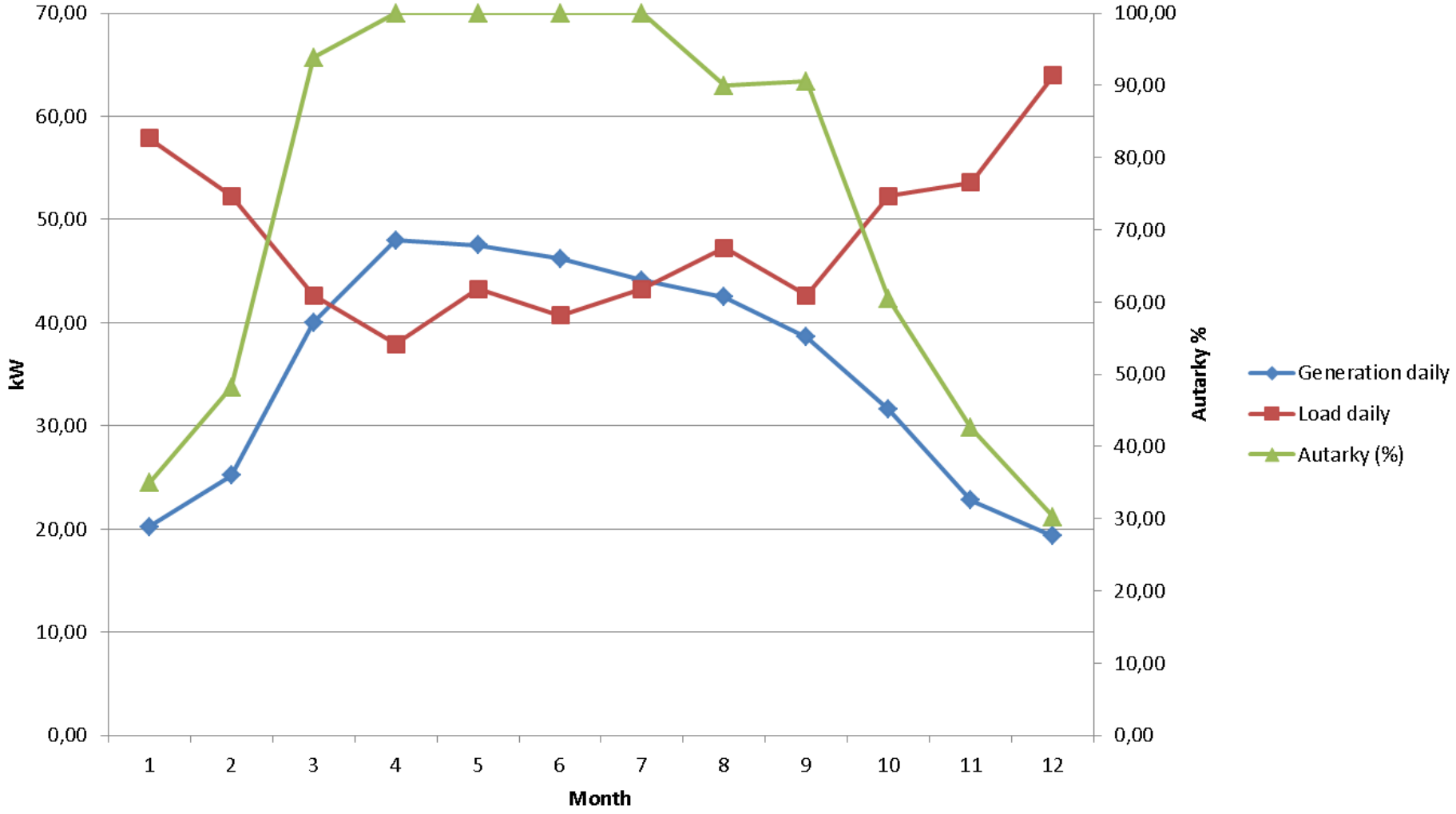
Battery modules

- Automotive proofed in rough environments
- Optimized for stationary usage
- Latest battery management (BMS) features
- Multiple safety levels
- Completly closed, resistand against dust an humidity
- Easy to install and replace, touch- and shortcut protection
- Available with different Li-ion cells and always same dimensions and interface

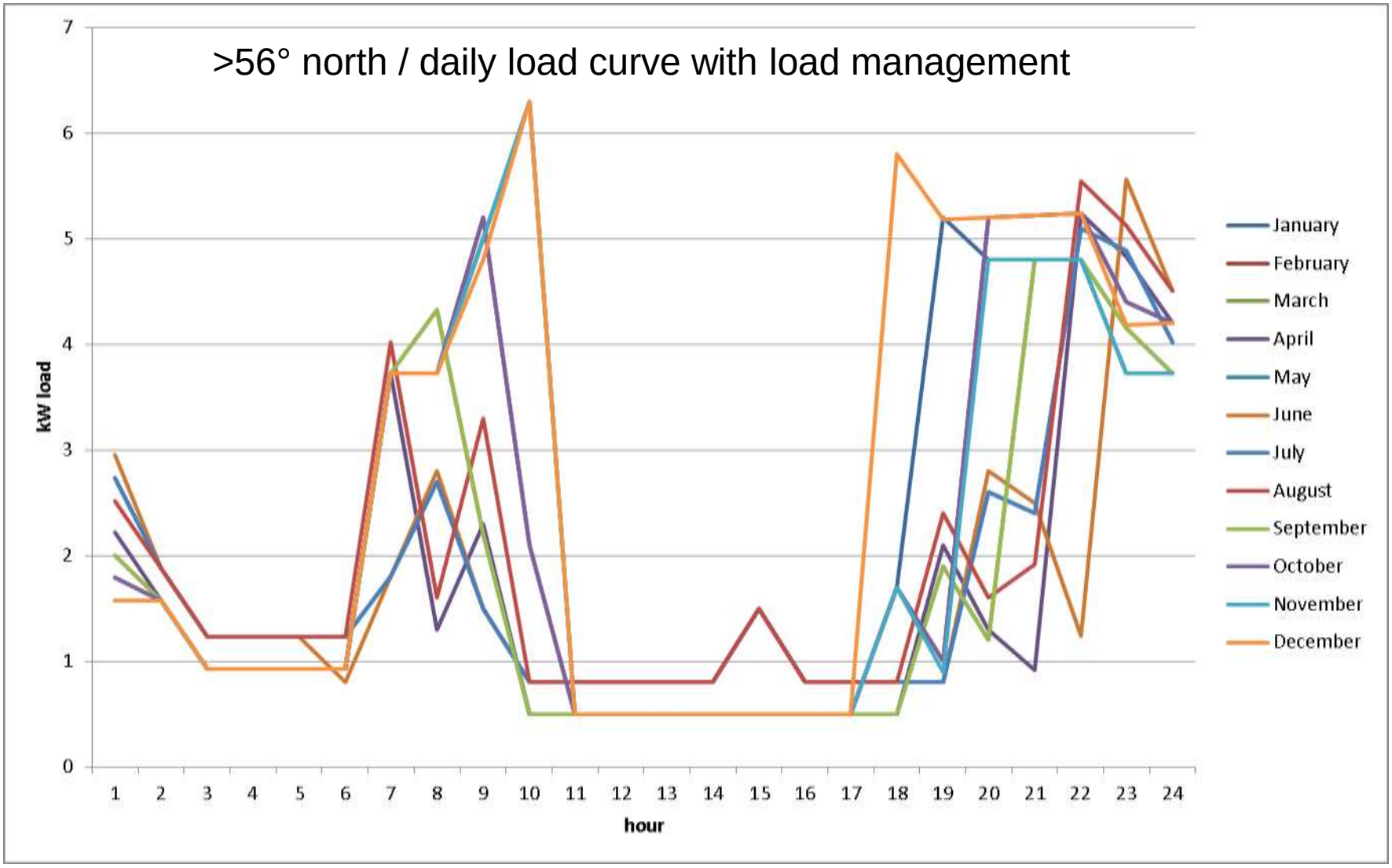
Rough load and generation balance

Generation and load

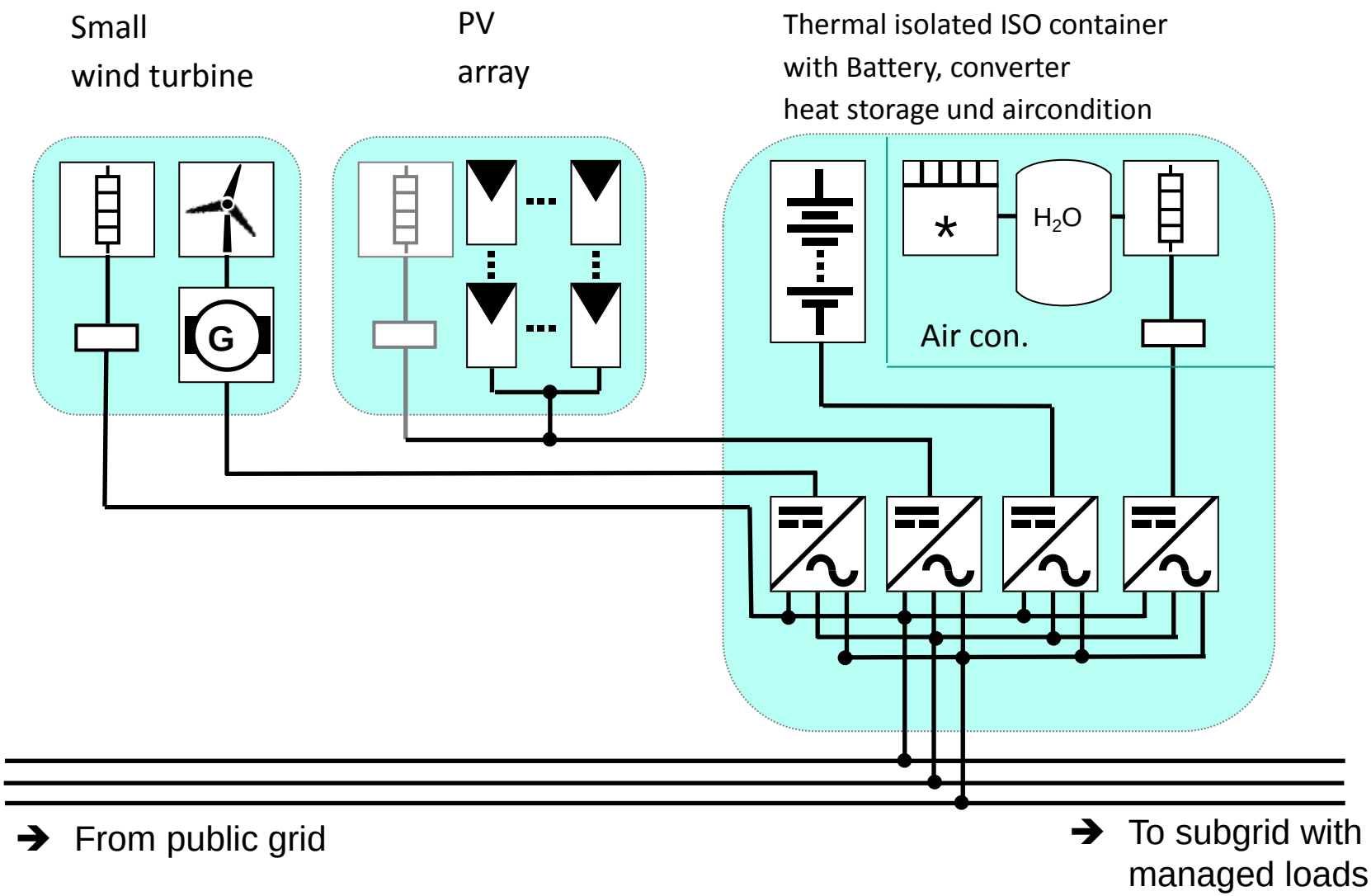
>56° north / PV: 10kWp / 13kW wind / 50kWh / -45…+40°C



Generation and load analysis



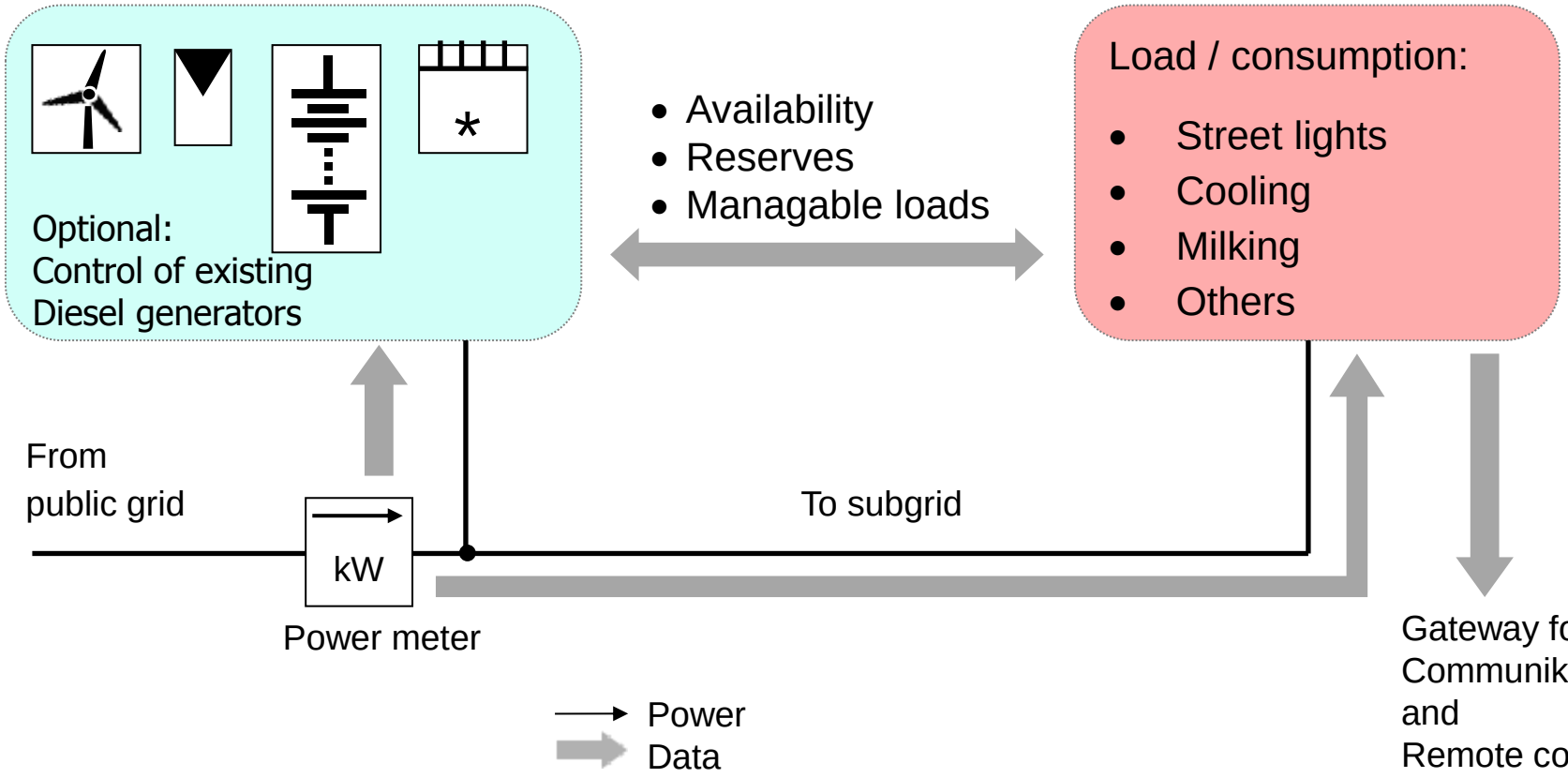
Possible power layout E2ficciency



Possible data and control layout E2ficciency

Control „E“ (KIT):
- Power generation
- Storage
- Thermal management

Control „L“(axxeo):
- Load management
- Communication
- “Utility” decisions



Open points

- System layout
  - AC or DC coupling
  - Central or decentral solution

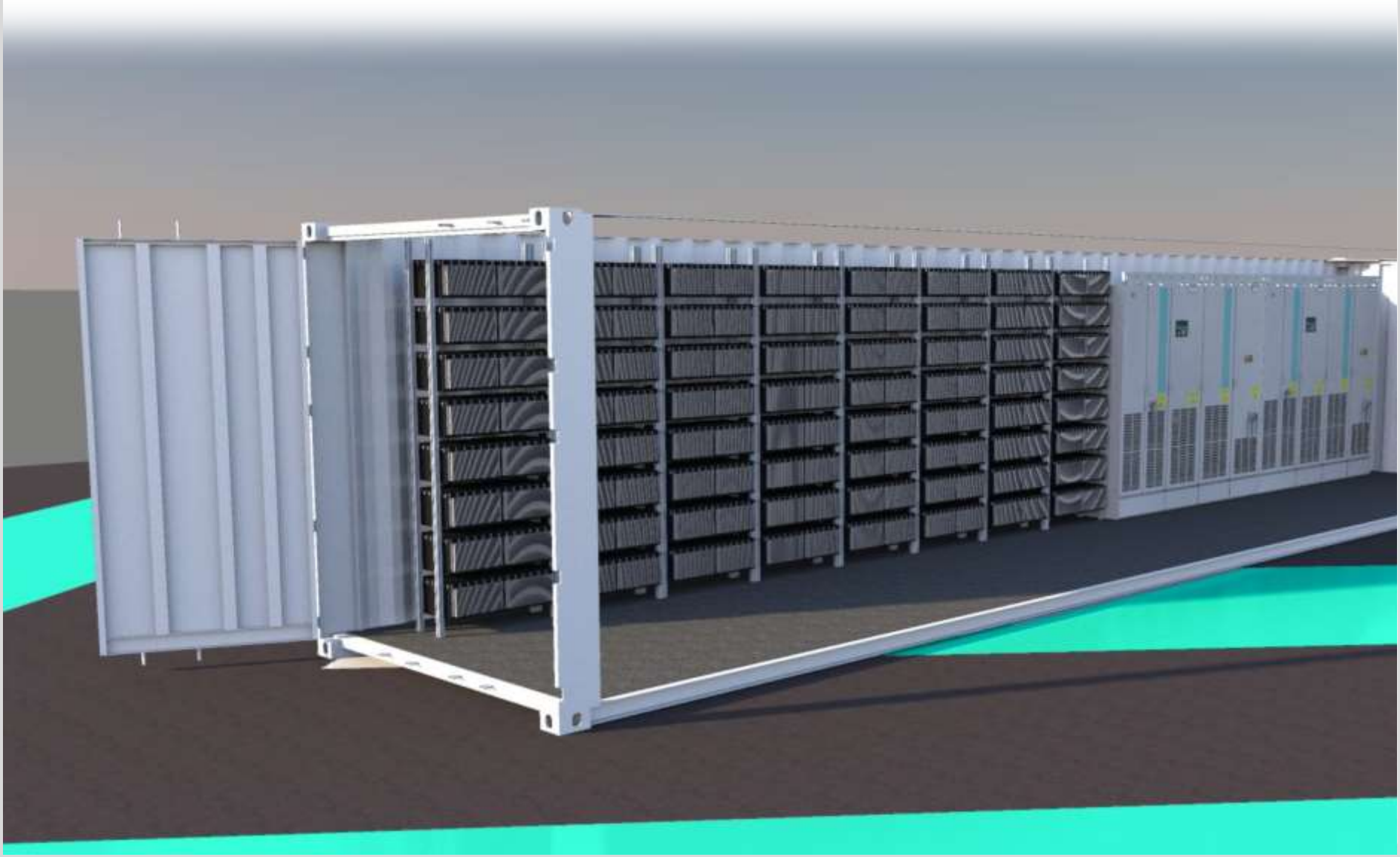
- More exact system dimensioning
  - Detailed wind data
  - Temperature curves
  - Agreed load profiles
  - Agreed autarky level (%)
  - Container / storage options (Outdoor, hall, underground,…)

- Others
  - Local norms/standards and utility regulations
  - Possible gateways
  - Maintenance
  - . . .

Some possible goals

- Modularity and dimensioning process for easy adjustment to other environments with different
  - Load- and generation profiles
  - Temperatures
  - . . .
- Low cycle cost
- Local experts
- Control layers
- Definition of special processes:
  - “Wake up after freezing”
  - Seasonal manual PV panel moving

Container variants



Container variants

Size:
- 10”
- 20”
- 40”
- Special Format

Isolation:
- Rockwool
- Glaswool
- Foam
- PCM

Climate:
- Fan and/or Aircon
- Heat/Cold storage
- Solar thermal
- Sunroof

Mechanics:
- Standard base
- Full double base w/wo cables
- Partial double base for high punctual load
- Standard high
- Special high
- Build in walls / 1-3 doors
- EMV / Lightning

Content:
- Storage and or PCS
- Transformer out/inside

Assembly grade:
- Raw, Basic or complete:
- Raw –from the scratch
- Basic incl. walls, locks,…
- Complete incl. cabling