Hybrid CPV-CSP approach

100 % renewables for ASKAP and SKA

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for Solar Energy Systems

Workshop - Renewable energy concepts for SKA and its pathfinders

Berlin, 7th of April 2011

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Agenda

- High fraction of renewable energies in mini-grids
- Next generation of hybrid PV mini-grids
- Energy management and communication
- Hybrid CPV-CSP approach for ASKAP and SKA
- Discussion points

Mini-grids: Substitution of Diesel generators with renewable energies

Example Brazil

- 21 kWp PV
- 60 kVA Diesel generator
- No storage !!!

→ Only 10 % of annual electricity consumption can be covered by PV

Source R. Rüther

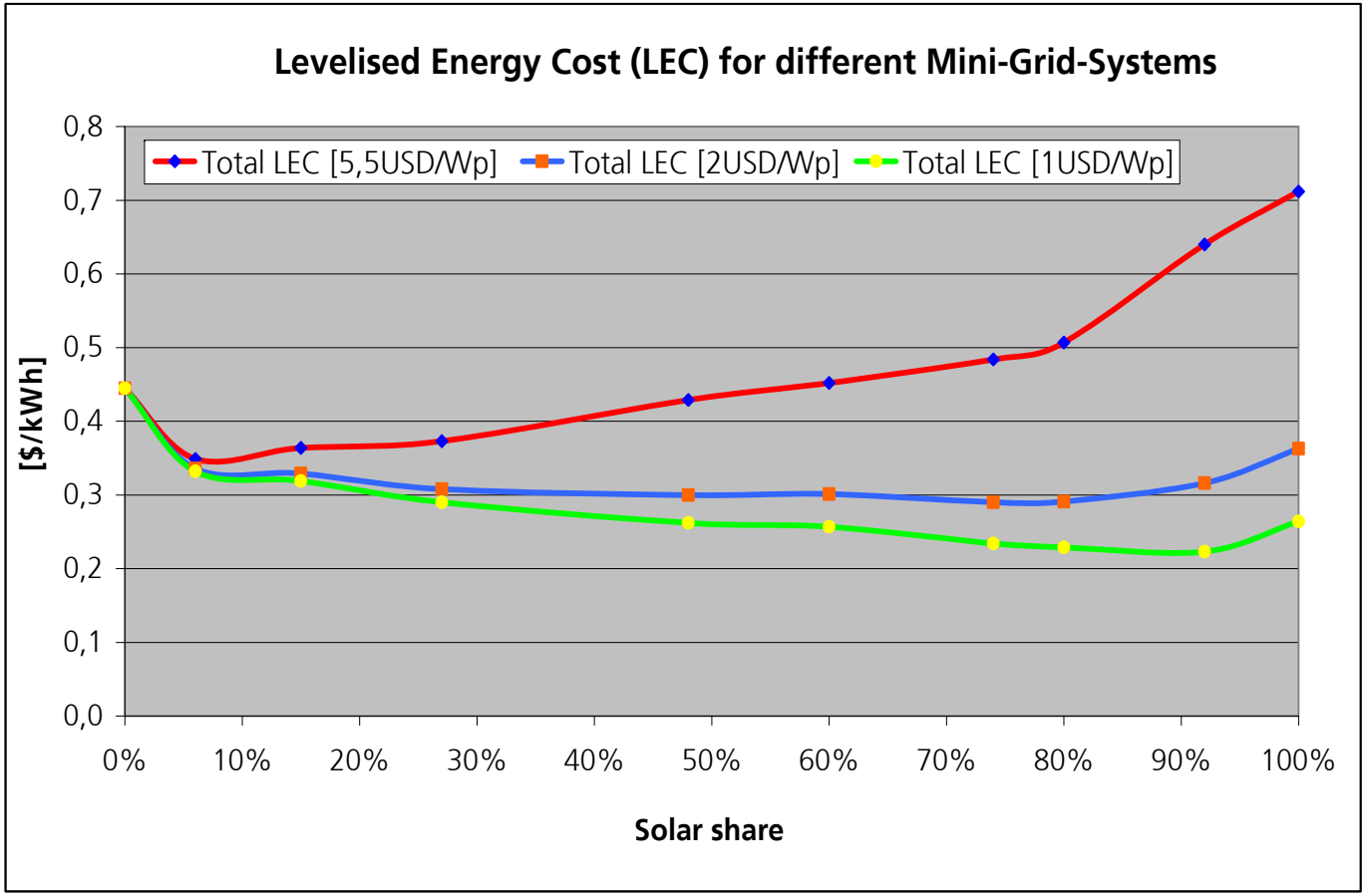
World wide:

Annual new installations of 10 GW Diesel generators !!!

Mini-grids: Substitution of Diesel generators with renewable energies

Life cycle cost analysis – Example Mexico

- 99 households, a rural clinic and a fish factory
- Daily consumption: 2849 kWh
- Peak load: 200 kW
- Variation of PV module prices



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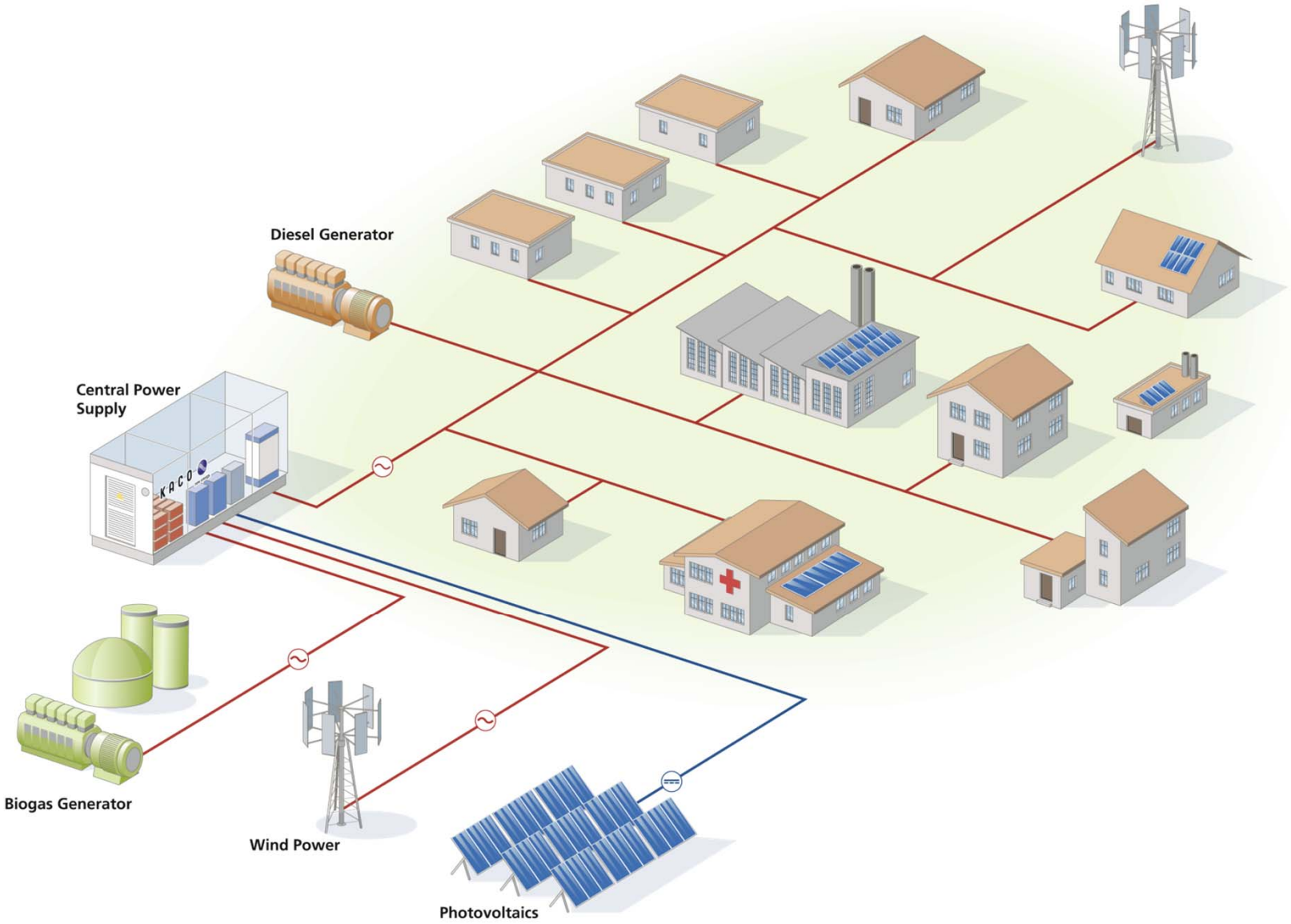
Next generation of hybrid PV mini-grids



KACO new energy.

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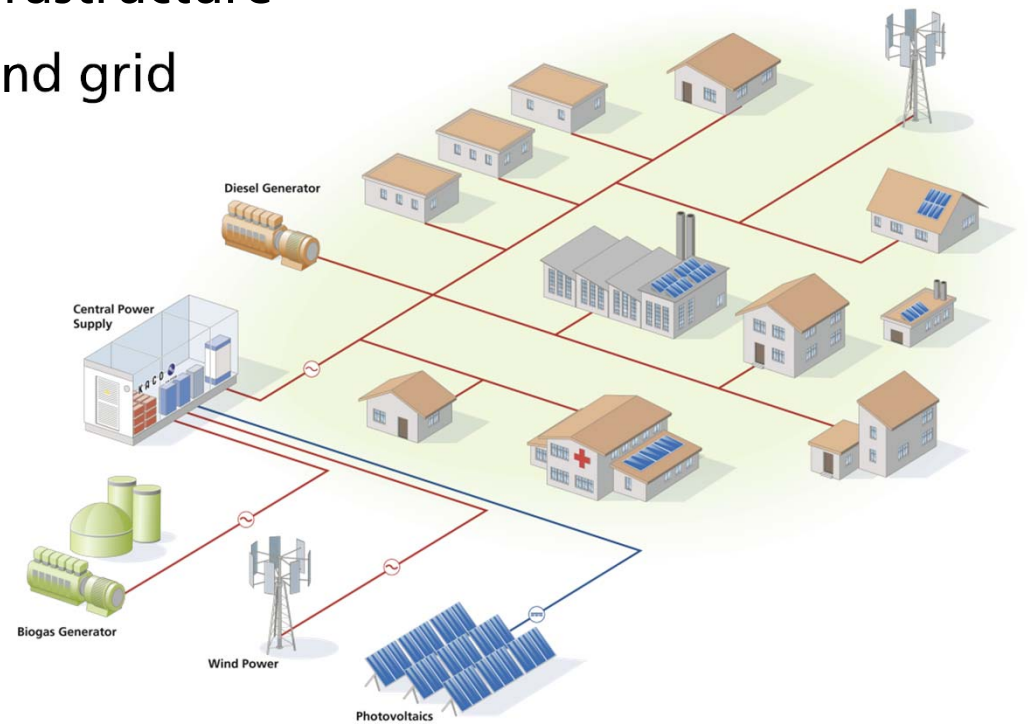
Next generation of hybrid PV mini-grids

- High efficiency power electronics
- Hybrid battery system (lead acid and lithium) with integrated battery management system
- Energy management system
- Standardized communication infrastructure
- Suitable for isolated mini-grids and grid connected applications



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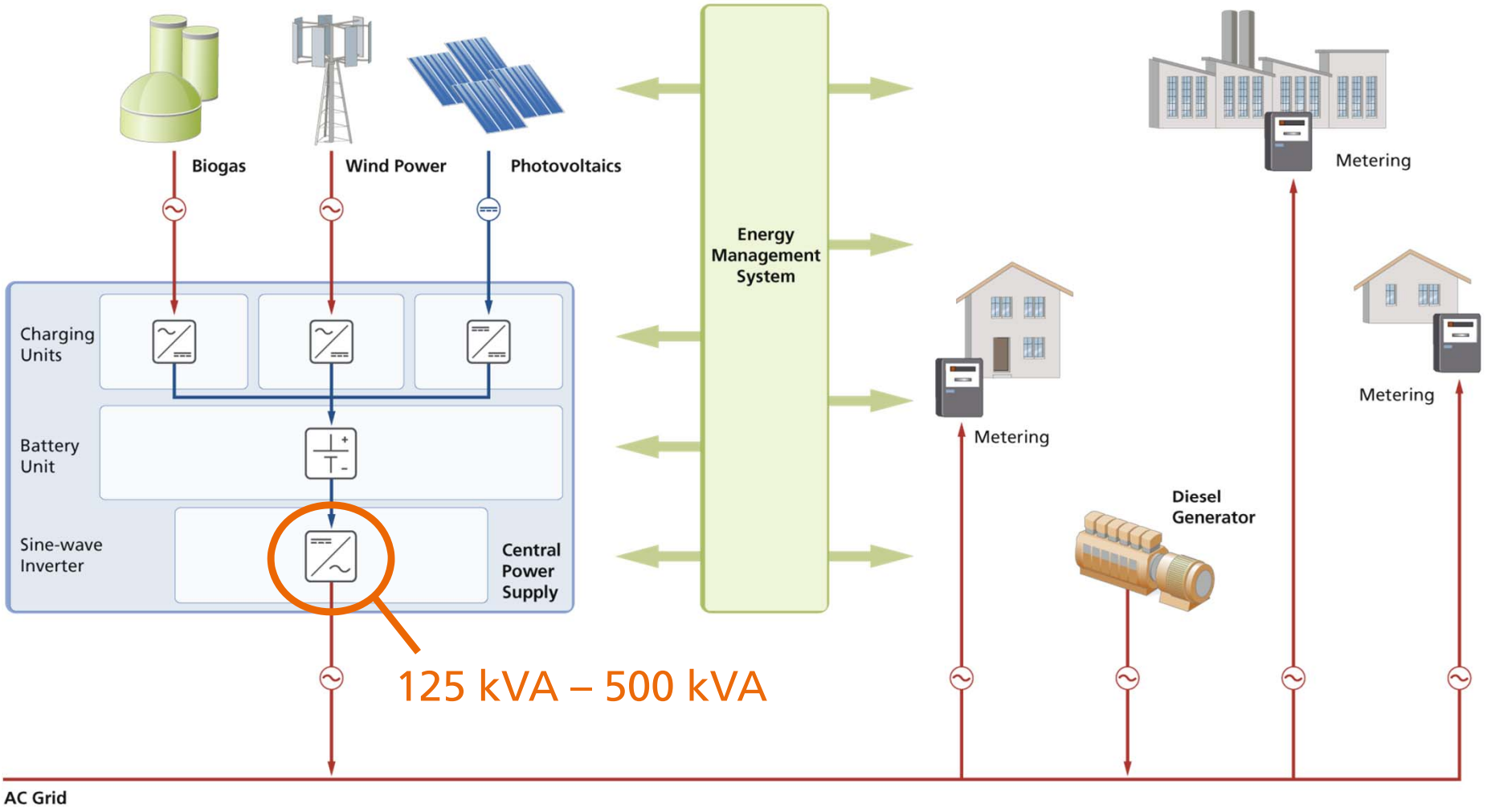
Next generation of hybrid PV mini-grids



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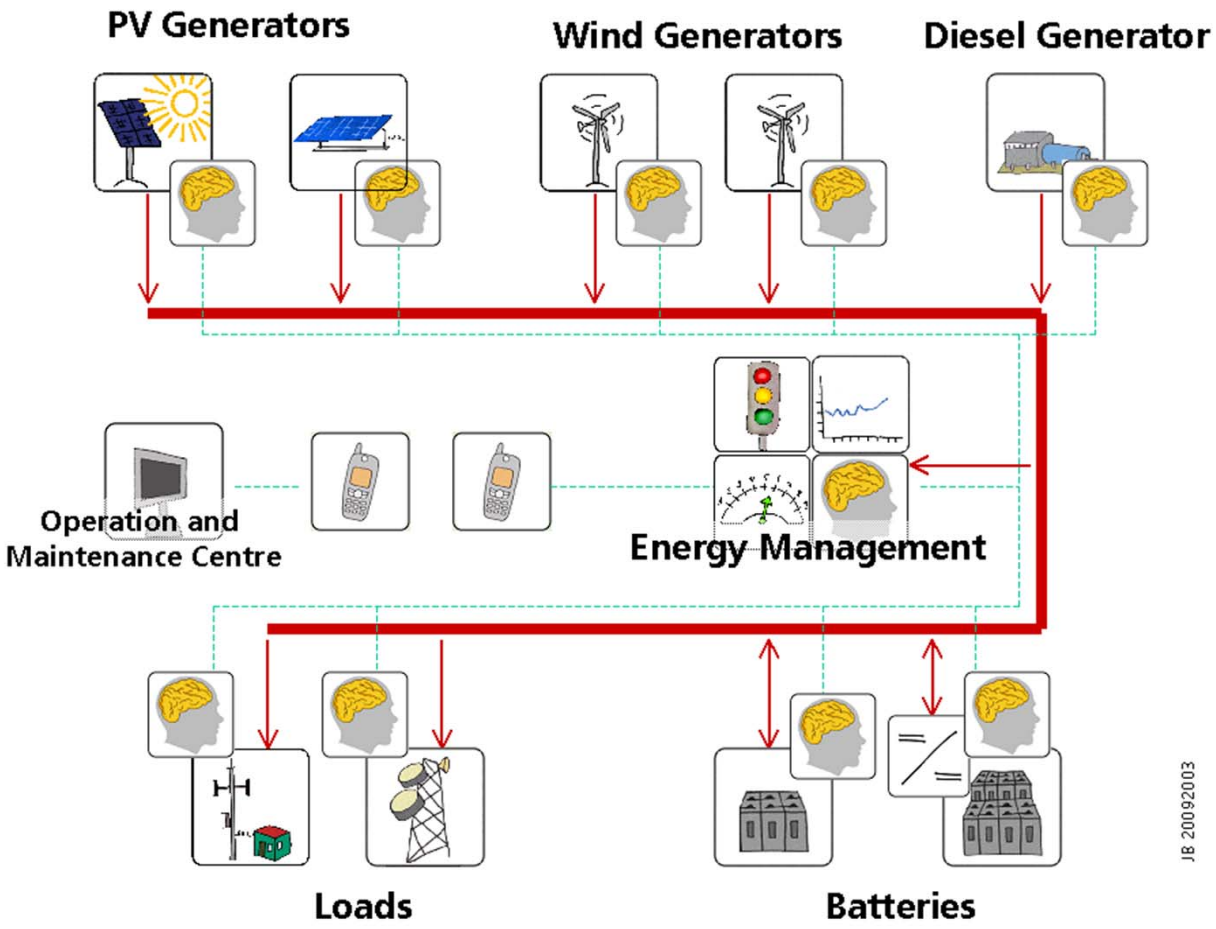
Standardized communication concept

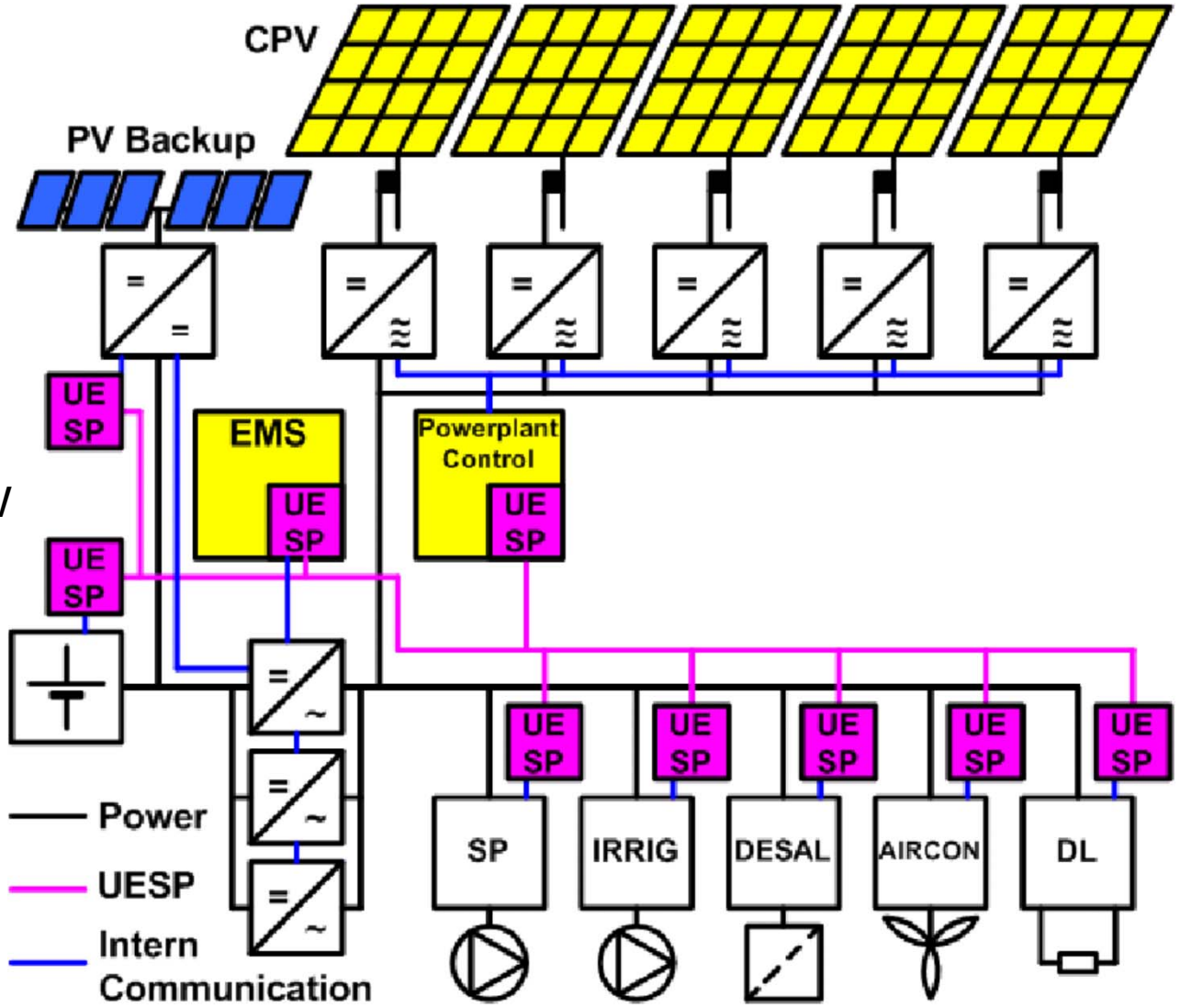
- Superordinate energy management system
- Intelligent components
  - Generators
  - Battery management
  - Loads
- Communication bus
- Standardized “Universal Energy Supply Protocol”

→ Modular, flexible und expandable



CPV off-grid system for water pumping, desalination and irrigation in Egypt

- CPV trackers: 5 x 6 kWp
- CPV inverter: 5 x 6 kW
- Island inverters: 3 x 5 kW
- Flat plate PV with charge controller as backup: 1 kWp
- Submersible Pump: 9 – 15 kW
- Irrigation Pump: 5.5 kW
- Desalination 1.5 kW
- Air conditioning 0.5 kW
- Dump Load 6 kW
- Battery (48 V) 900 Ah (C10)
- 8 – 15 m³/h



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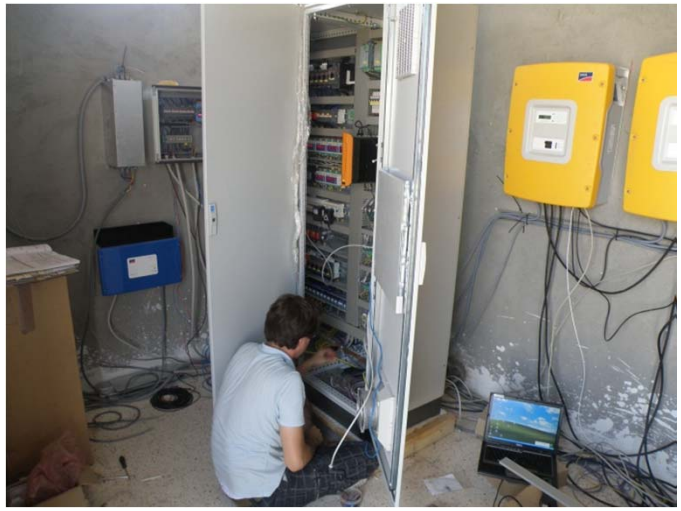
Field installation in Egypt



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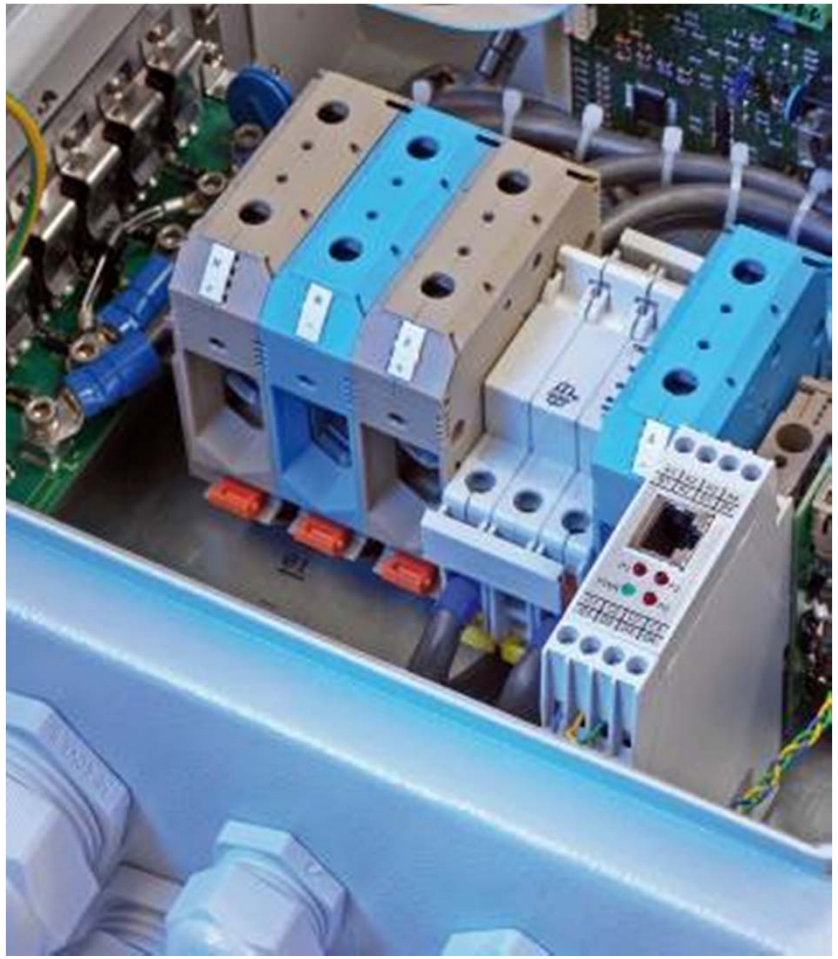
UESP – Universal Energy Supply Protocol

Transfer in CAN in Automation (CiA) specification
→ CiA 454 “energy management systems” as part of the “EnergyBus”

- Standard protocol for communication between components of different manufacturers
- Separation of power- and communication bus (CAN)
- Centralized energy management system in combination with decentralized Intelligence
- High flexibility through plug&play function
- Open protocol as a base for manufacturer
- Simply expandable



EnergyBus e.V.

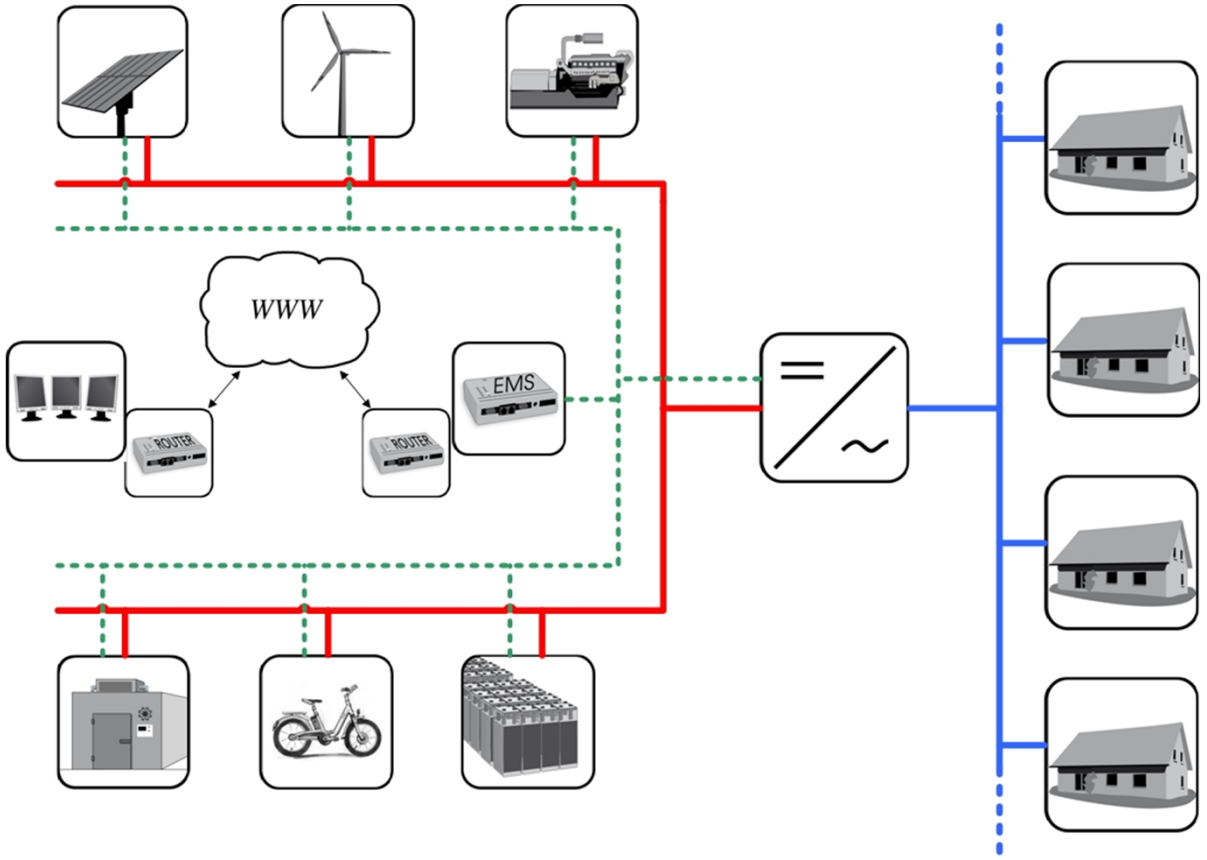
with CANopen specification → CiA 454

- Starting point of EnergyBus e.V.:
  - Interoperability of components of light electric vehicles LEV: Plugs, communication interface, etc.
  - Communication: CANopen specification CiA 454 LEV
  - Significant similarities with stationary PV off-grid and also on-grid (!) applications: batteries, power electronics, loads, user displays, etc.
- Now extended for energy management applications in general

  → New name of CiA 454: „Energy management systems“

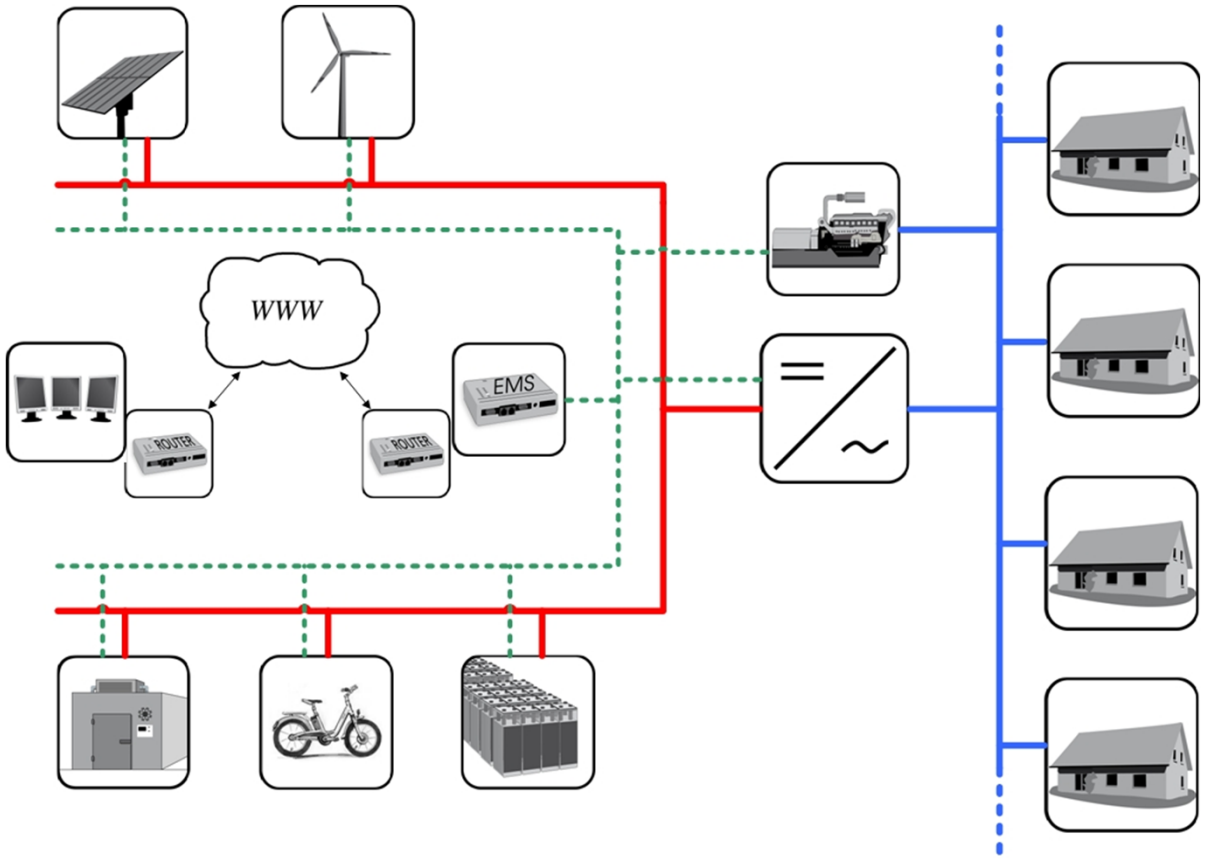
EnergyBus system

Diesel generator
DC coupled



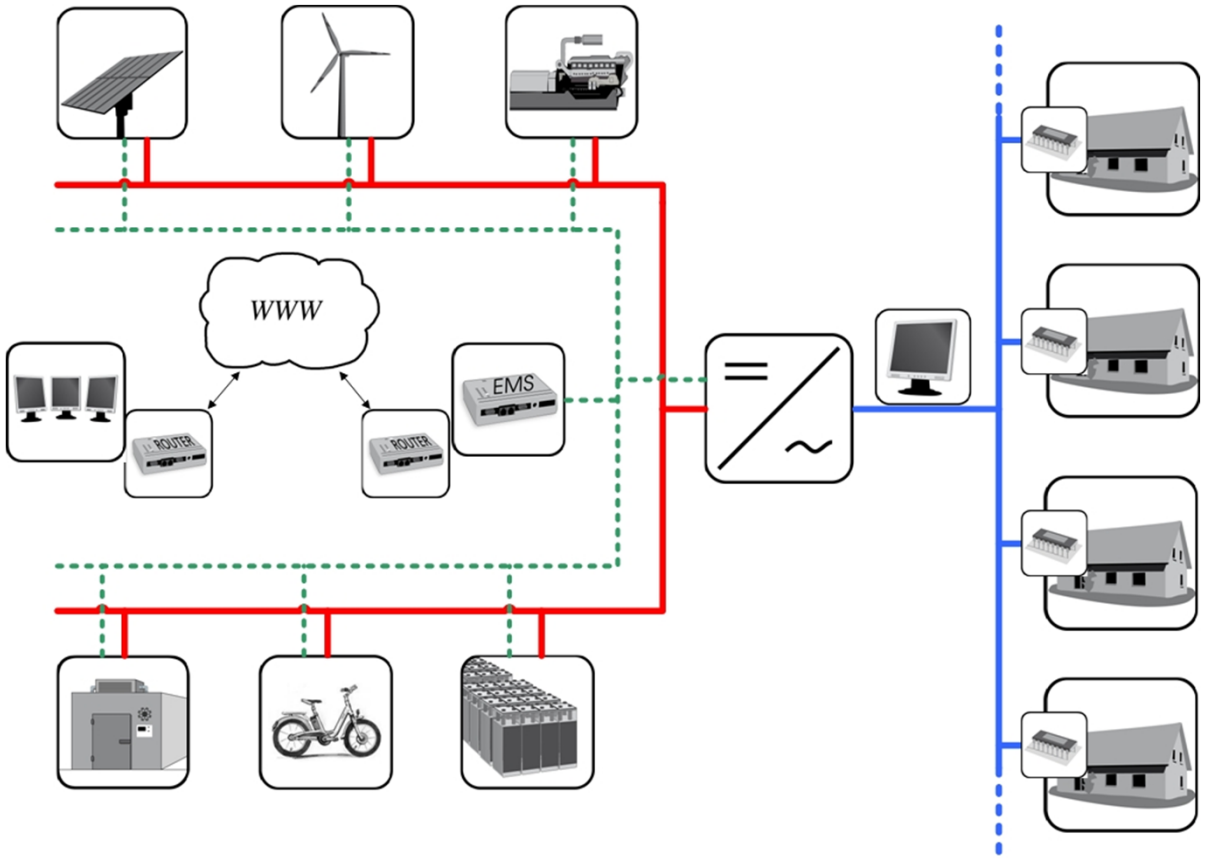
EnergyBus system

Diesel generator
AC coupled

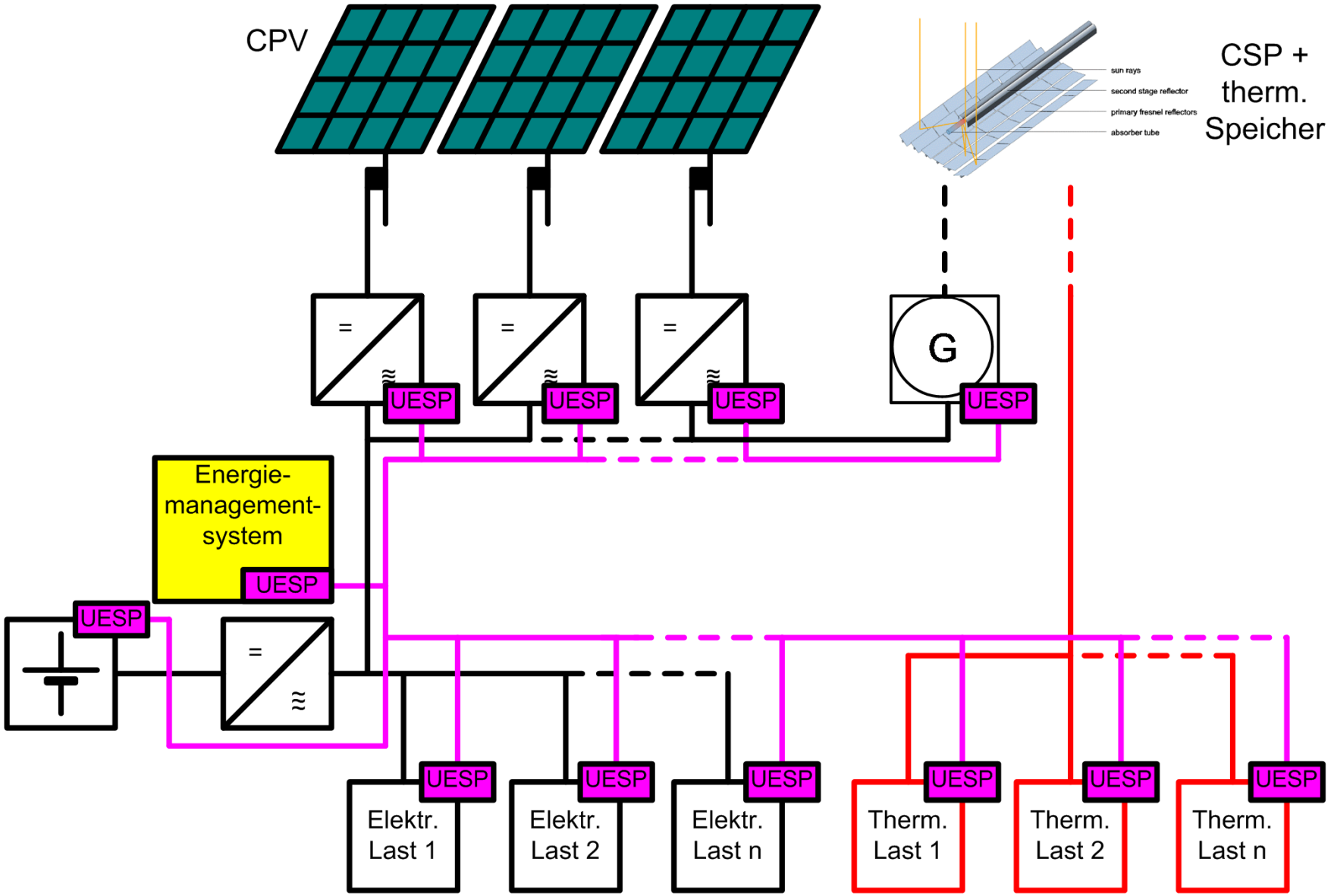


EnergyBus system

Demand side management
e.g. with power line
communication



Hybrid CPV-CSP power plant – System approach



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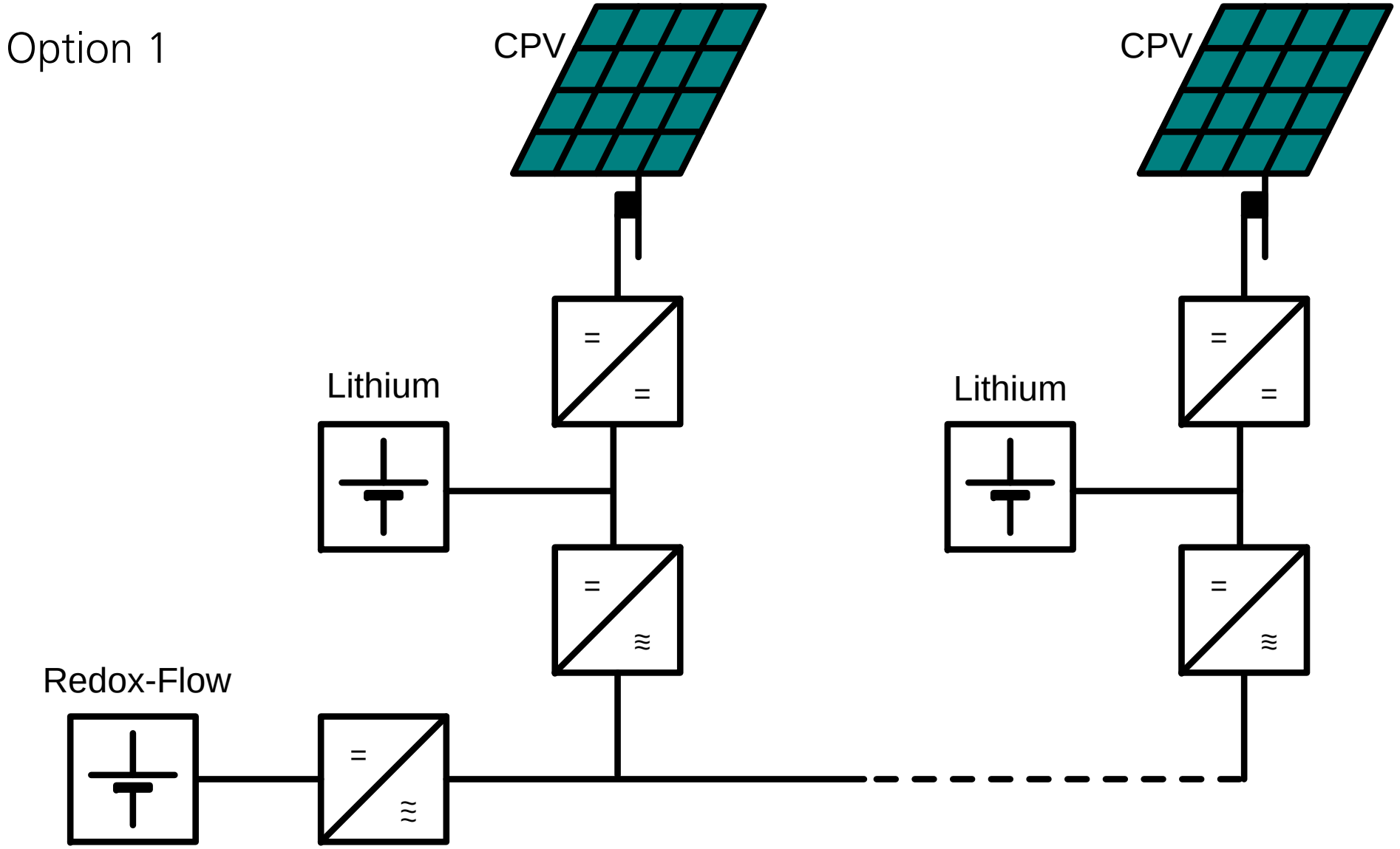
CPV subsystem: Topology

Option 1



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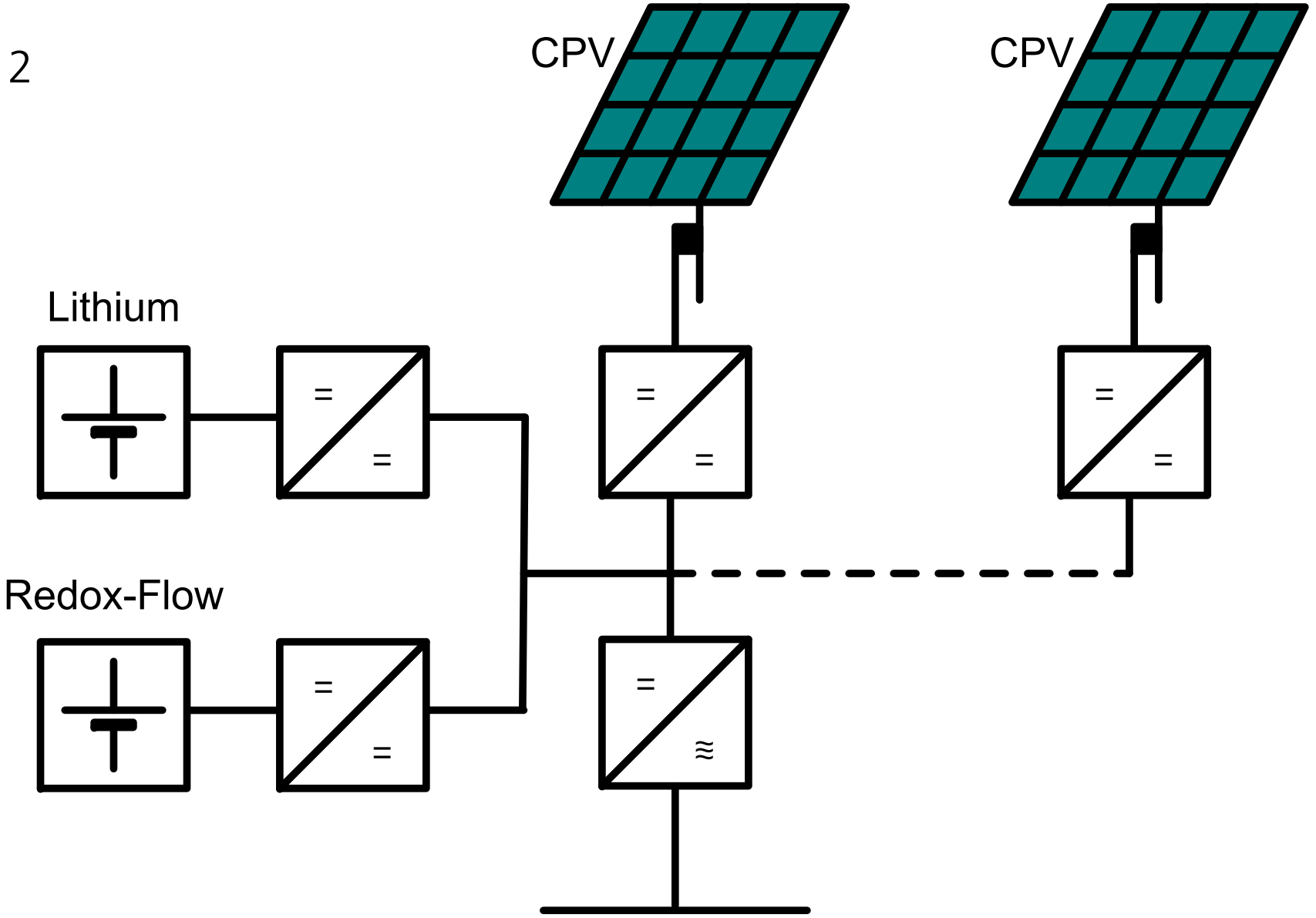
CPV subsystem: Topology

Option 2



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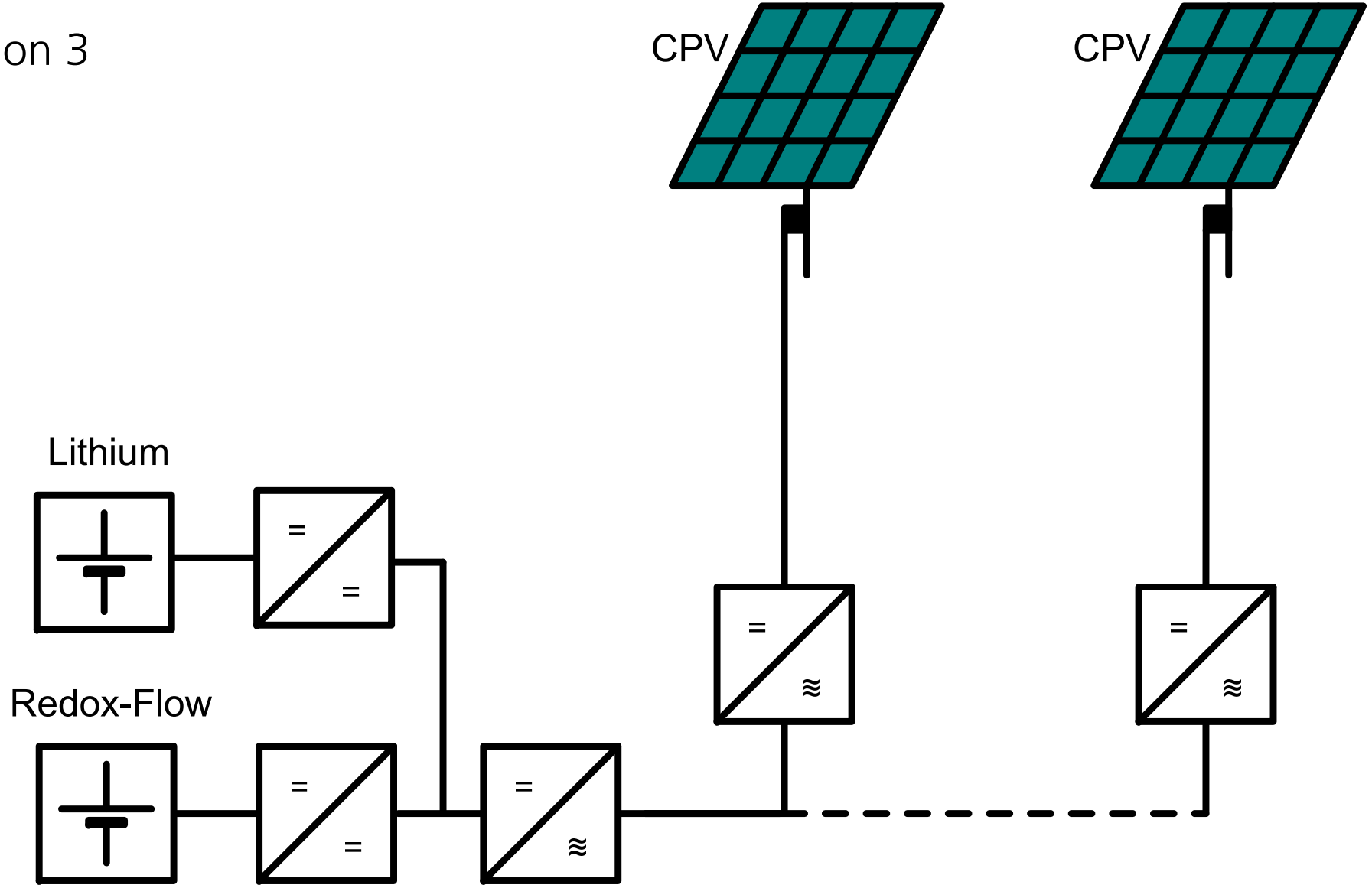
CPV subsystem: Topology

Option 3



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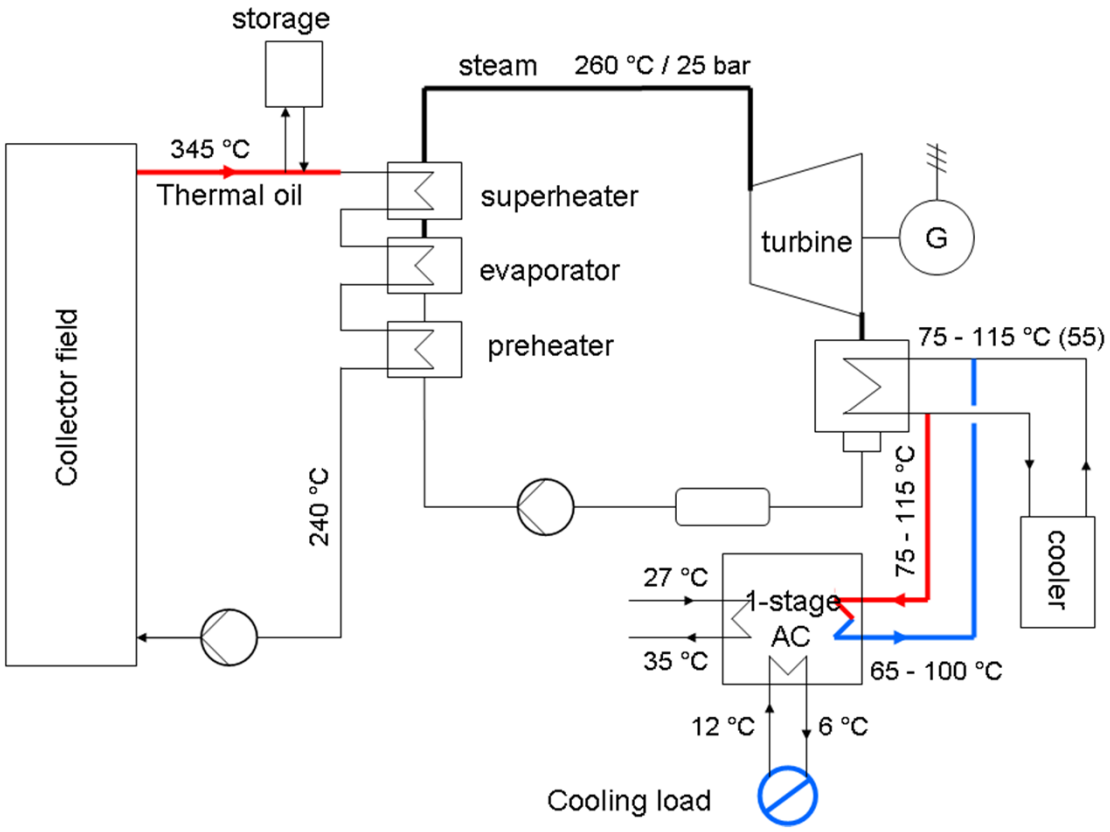
CSP subsystem

Integrated concept of power generation and cooling

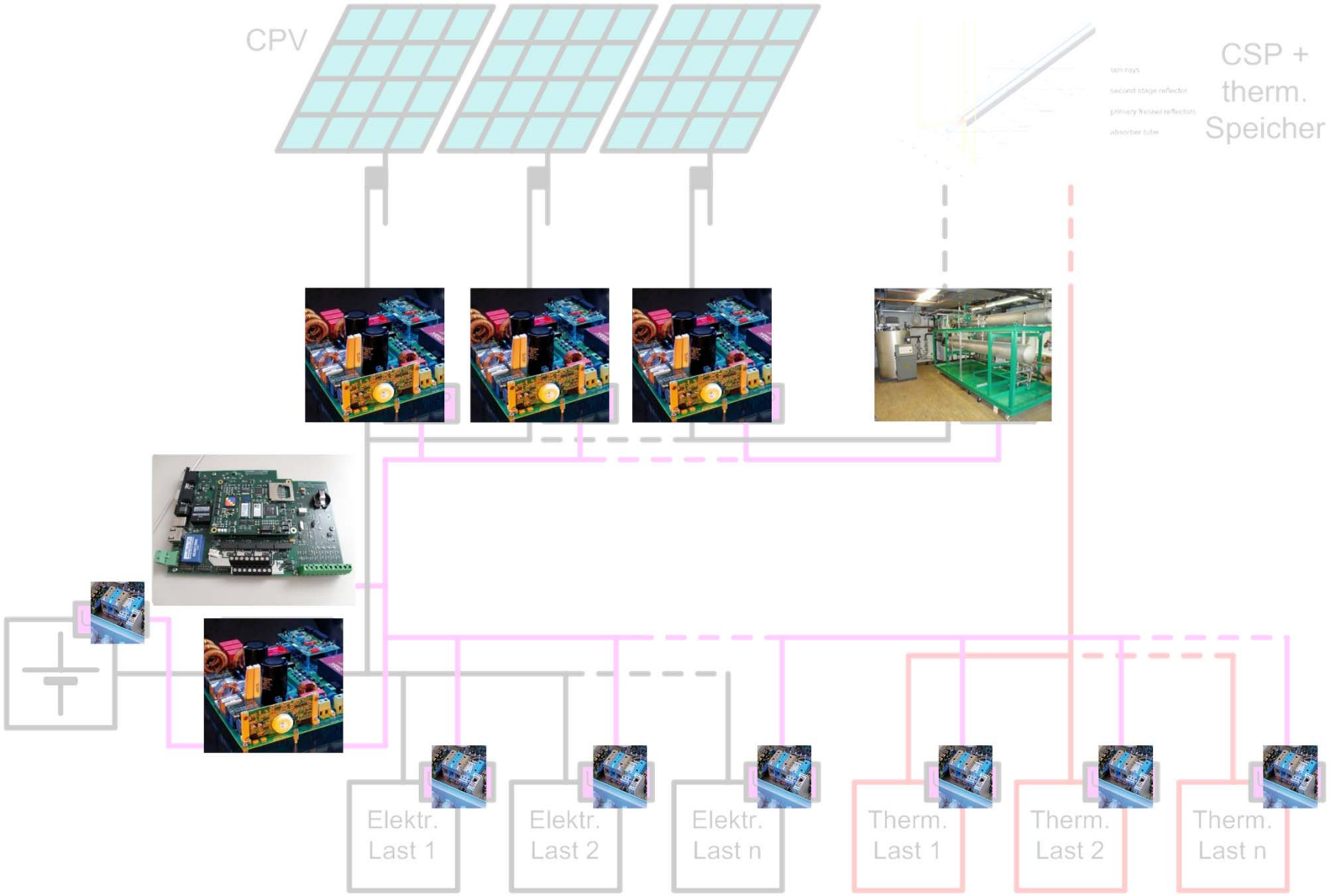
- i.e. 1-stage absorption cooling



Various options:

- Principals
- Integration
- Control

Hybrid CPV-CSP power plant – RFI relevant components



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Discussion

- Hybrid CPV-CSP approach for ASKAP and SKA
  - 100 % renewables !!!
  - Integration of other generation technologies ?
  - Decision on battery systems: Technologies and possible partners
  - EMC issues
  - …
- Time line for ASKAP:
  - EMC issues for stage 1
  - Starting point for stage 2
  - …
- Project partners for stage 2
- Financing for a German-Australian collaboration project ?
- …

Thanks for your attention!

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