Solutions from SMA

for On-GRID, Off-GRID and Hybrid Projects & upcoming new Sunny Island X

Presented by Dipl. Phys. Raden Pelangi Saichu

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Why SMA?

Because …

… more than 125 GW of installed SMA inverter power

in over 190 countries prove SMA's strong market position over many years. . Around 63 million tons of CO2e have been avoided thanks to the PV.

… 1,700 patents and utility models

granted worldwide prove our high innovative strength.

… more than 6 GW of SMA battery inverter power

ensure round-the-clock sustainable electricity supply worldwide and make us a global leader in battery system technology.

… 3,600 SMA employees

are working with our partners and customers to pave the way for the energy supply of tomorrow, today.

Key financials 2022		**Guidance 2023**	
Sales:	MEUR1,066	Sales:	MEUR1,450 to MEUR1,600
EBITDA:	MEUR70	EBITDA:	MEUR135 to MEUR175

TecDax listed since 2008 & MDax in 2023

… ex

40 YEARS POWERFUL PERSPECTIVES

Sunny Island System

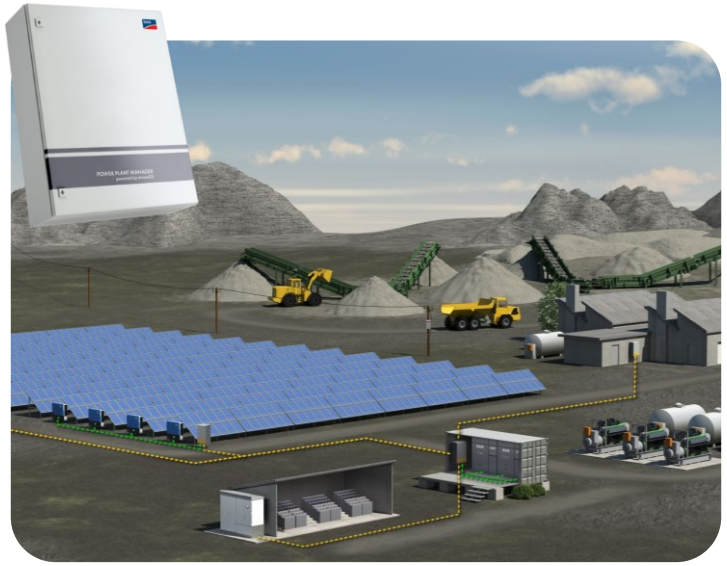
SMA Altenso GmbH, Dipl. Phys. Raden Pelangi Saichu

Power range,
which can be covered

Power range

Sunny Island System

- **0 – 216 kW continuous load**
- **0 - 288 kW load for 30 minutes**
- **Can start/stop Genset as backup**



Hybrid controller Sytem

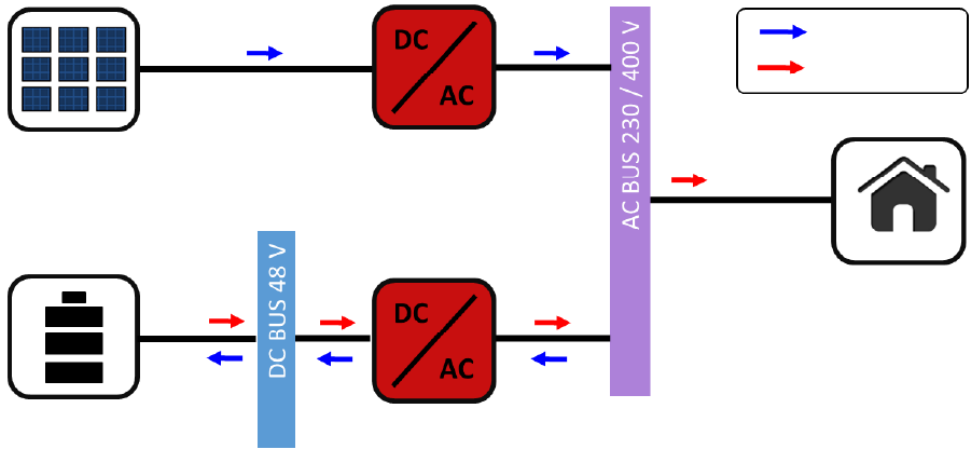
- **150 kW – open end**
- **Reduce powerplant fuel**
- **Flexible for different condition of powerplants**

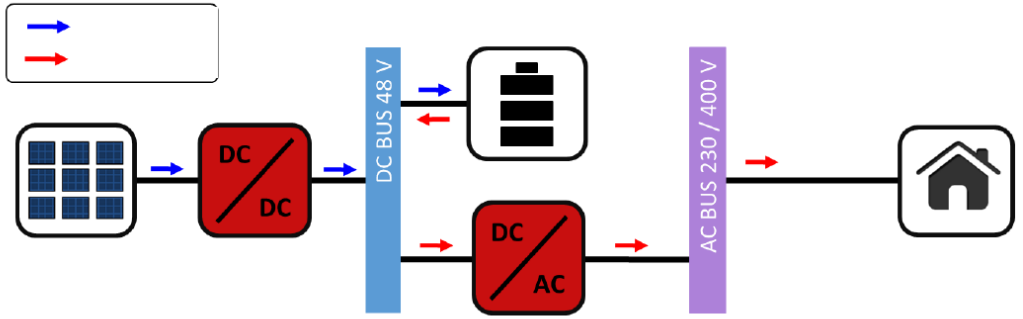
Sunny Central System

- **For On-Grid application 1,9 MW load – open end**
- **For Off-GRID above 1 MW load it make sense – open end**

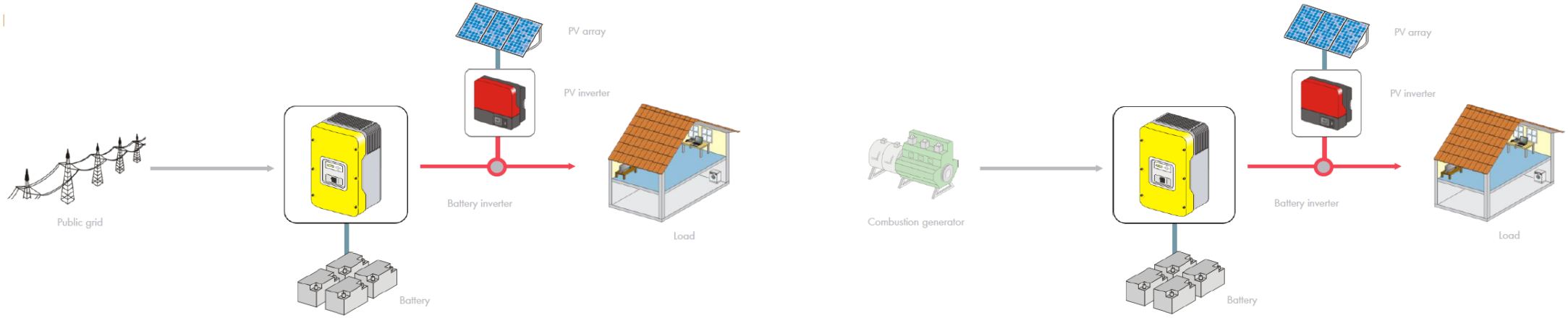
Advantages from Sunny Island against other battery inverters

AC-coupling vs DC-Coupling

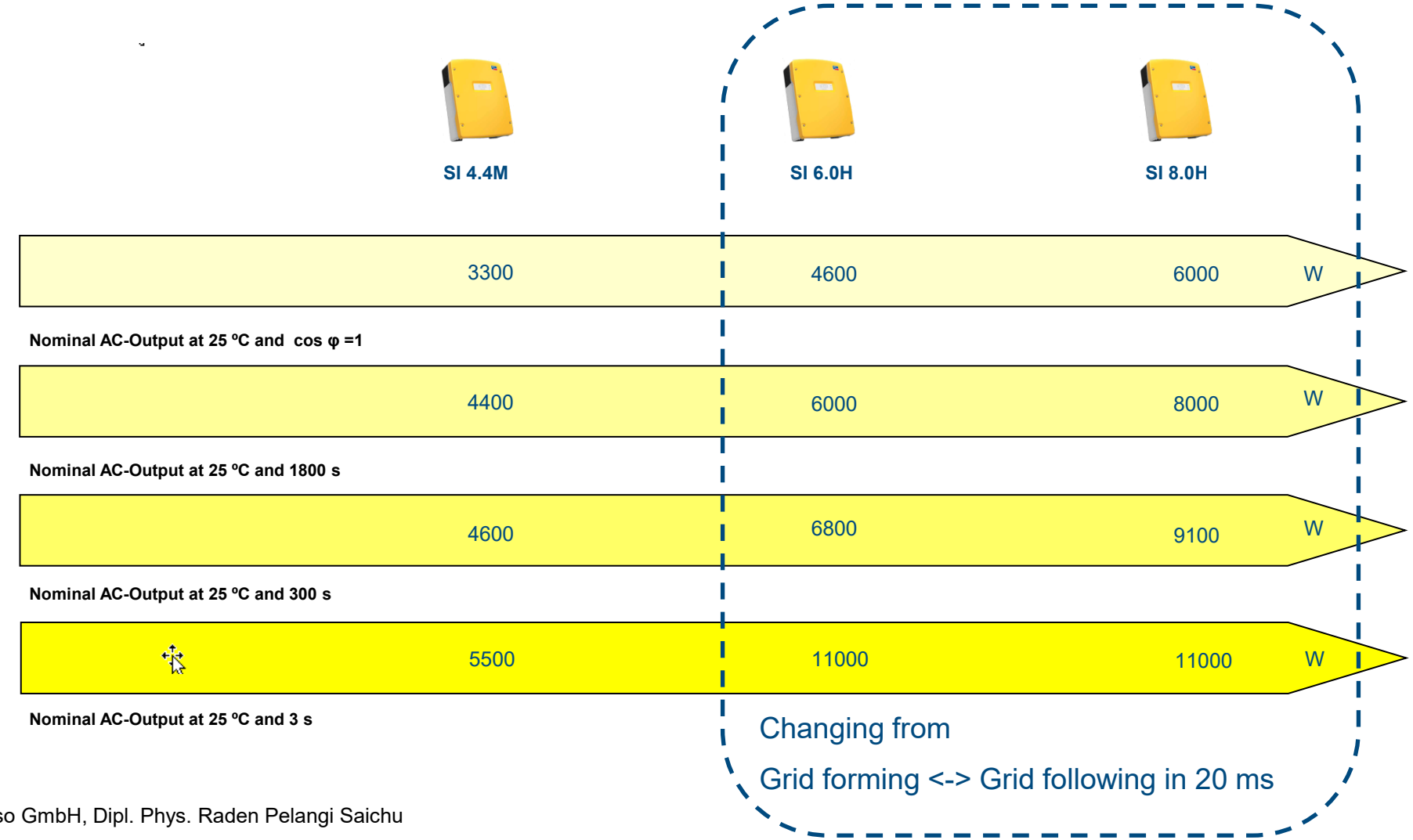




Solution for increase Self-Consumption, Backup and fully Off-GRID



Inrush current capability



Flexibility in batteries

which can be used

Lead Acid

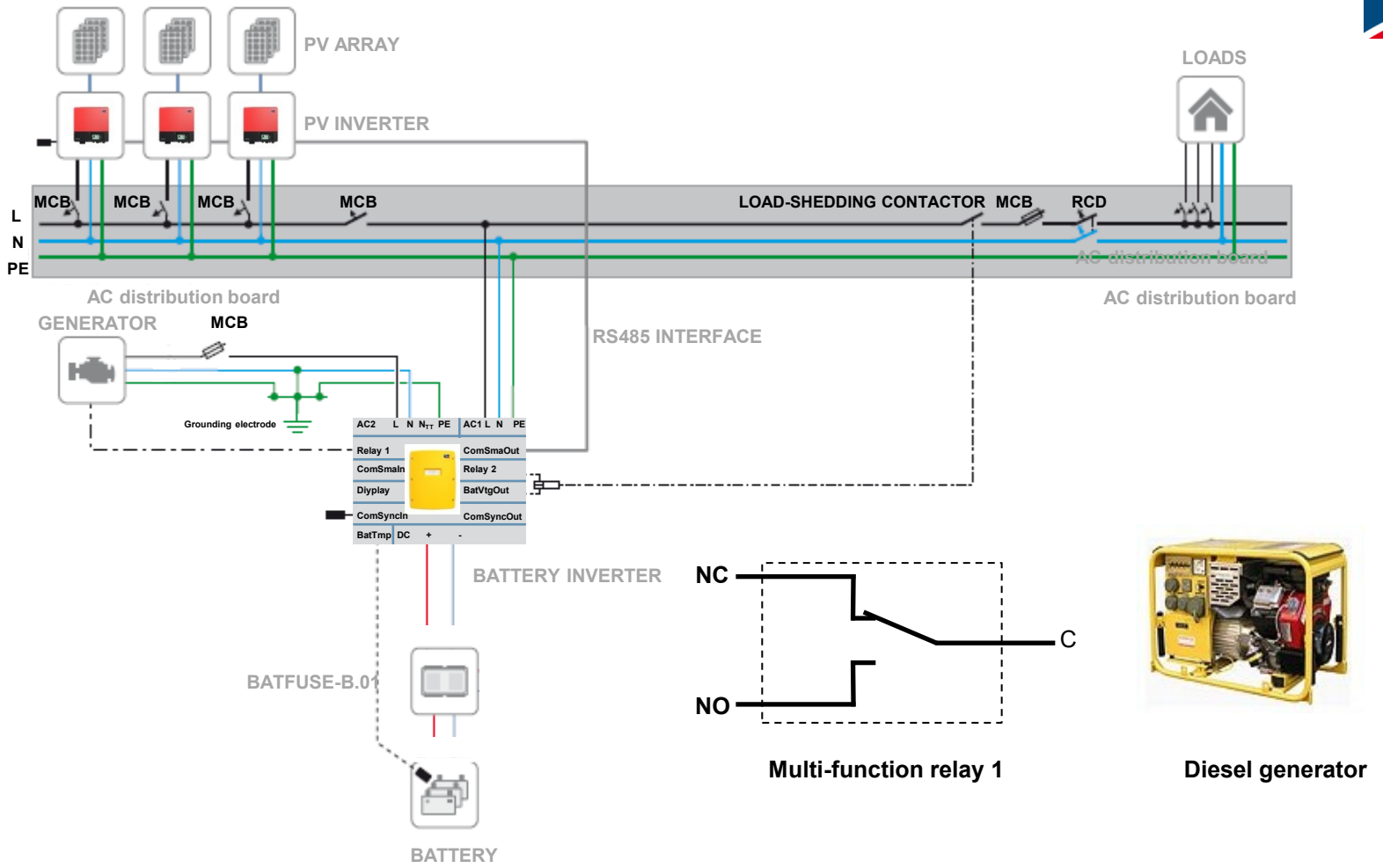
Lead Acid Batteries need **additional settings**, which must be given from the **battery manufacture**!

VRLA and FLA

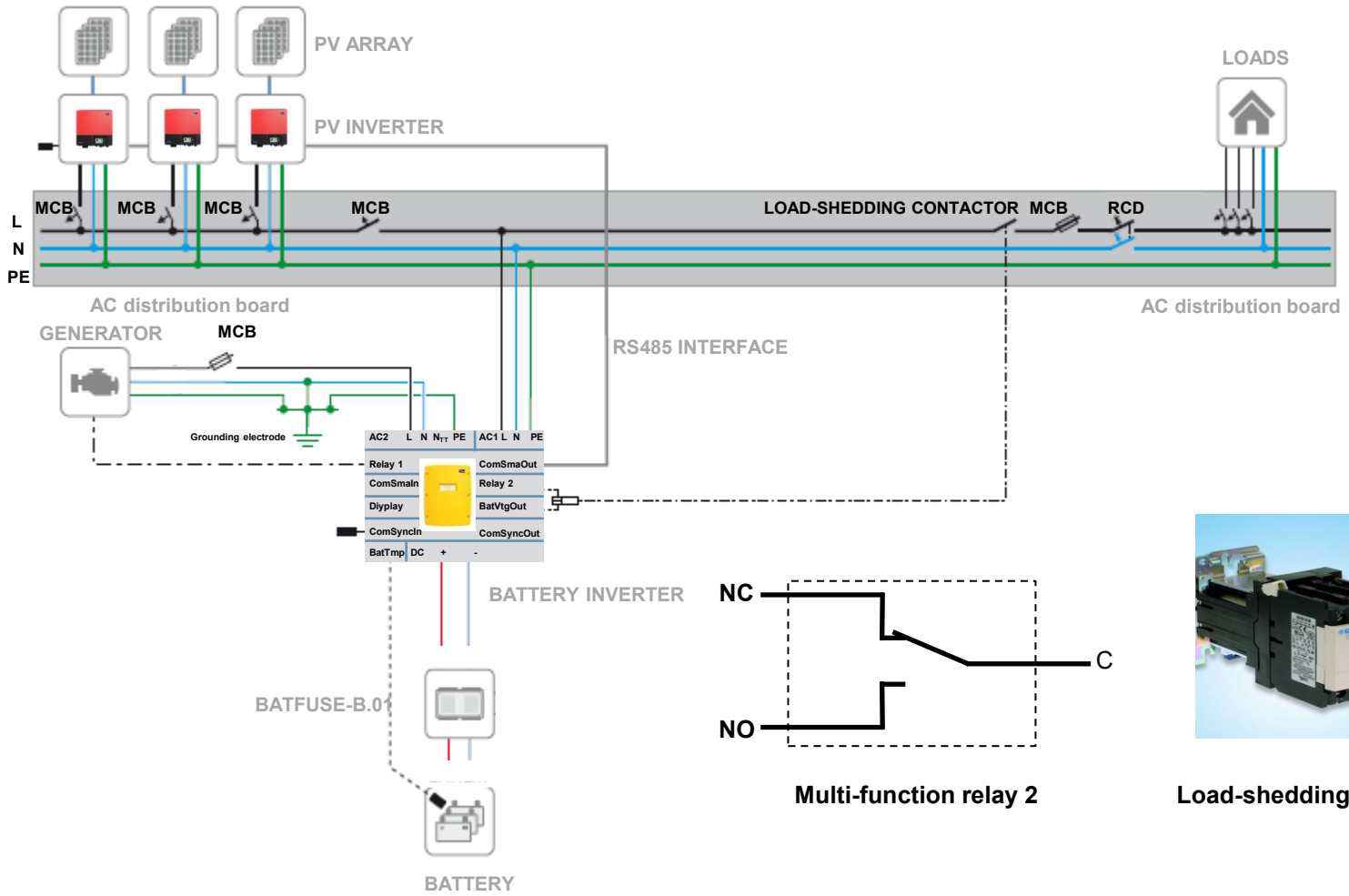
Li-Ion

Safety and operational parameters is handled by the Li-Ion BMS

Automatic Genset



Load shedding can be handled automatically



Scaling up potentials

in case of increasing needs

Multicluster Box

MC-Box-6.3-11

MC-Box-12.3-20

MC-Box-36.3-11

55	138	300	kW

Load @ 25 °C and cos φ =1

36	72	216	kW

Sunny Island @ 25 °C and cos φ =1

55	138	300	kW

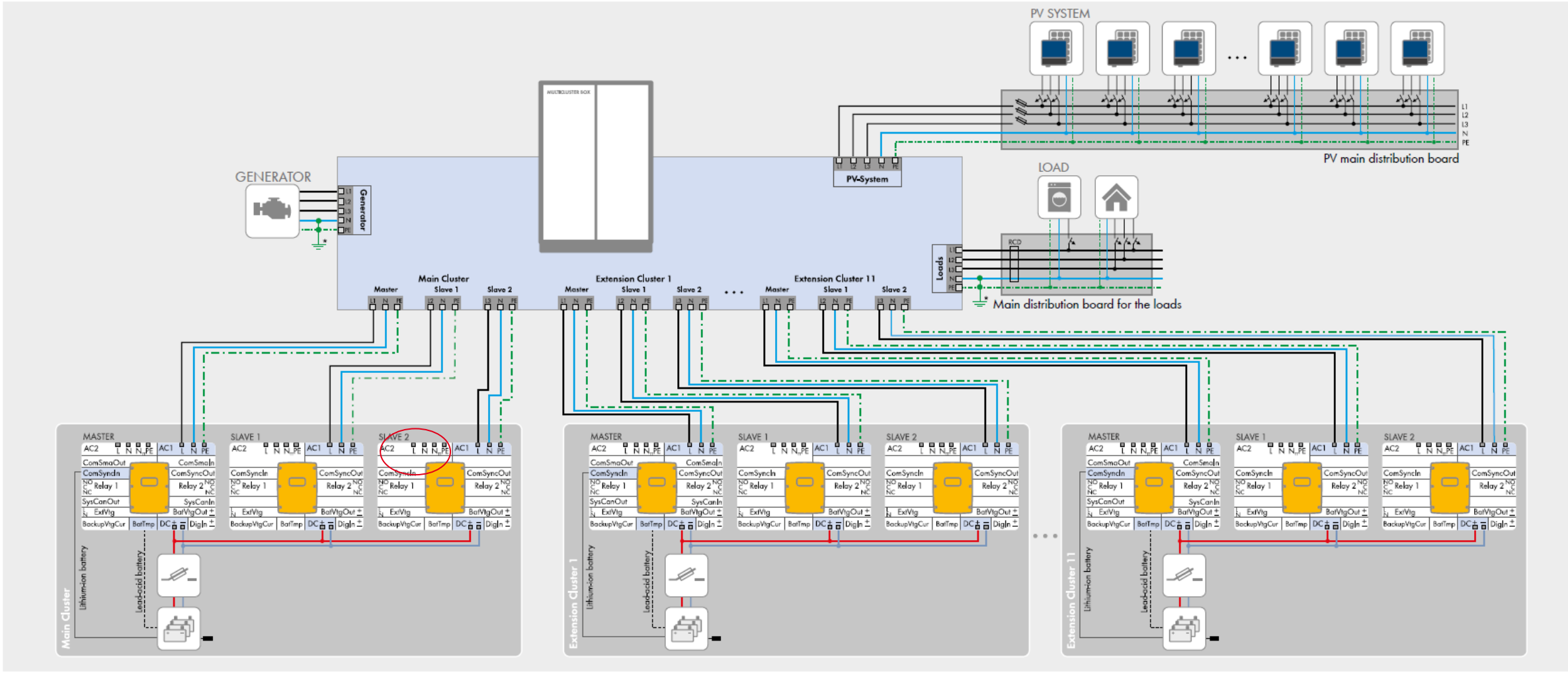
Genset @ 25 °C and cos φ =1

55	138	360	kW

PV Inverter @ 25 °C and cos φ =1

Connect MC-Box 36.3 to AC1

POWER CABLE CIRCUITRY



Hybrid controller

SMA Altenso GmbH, Dipl. Phys. Raden Pelangi Saichu

Power range,

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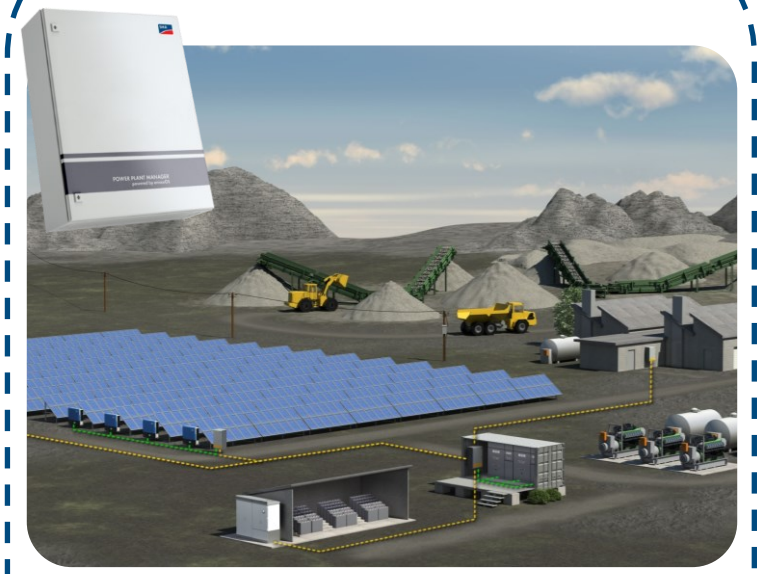


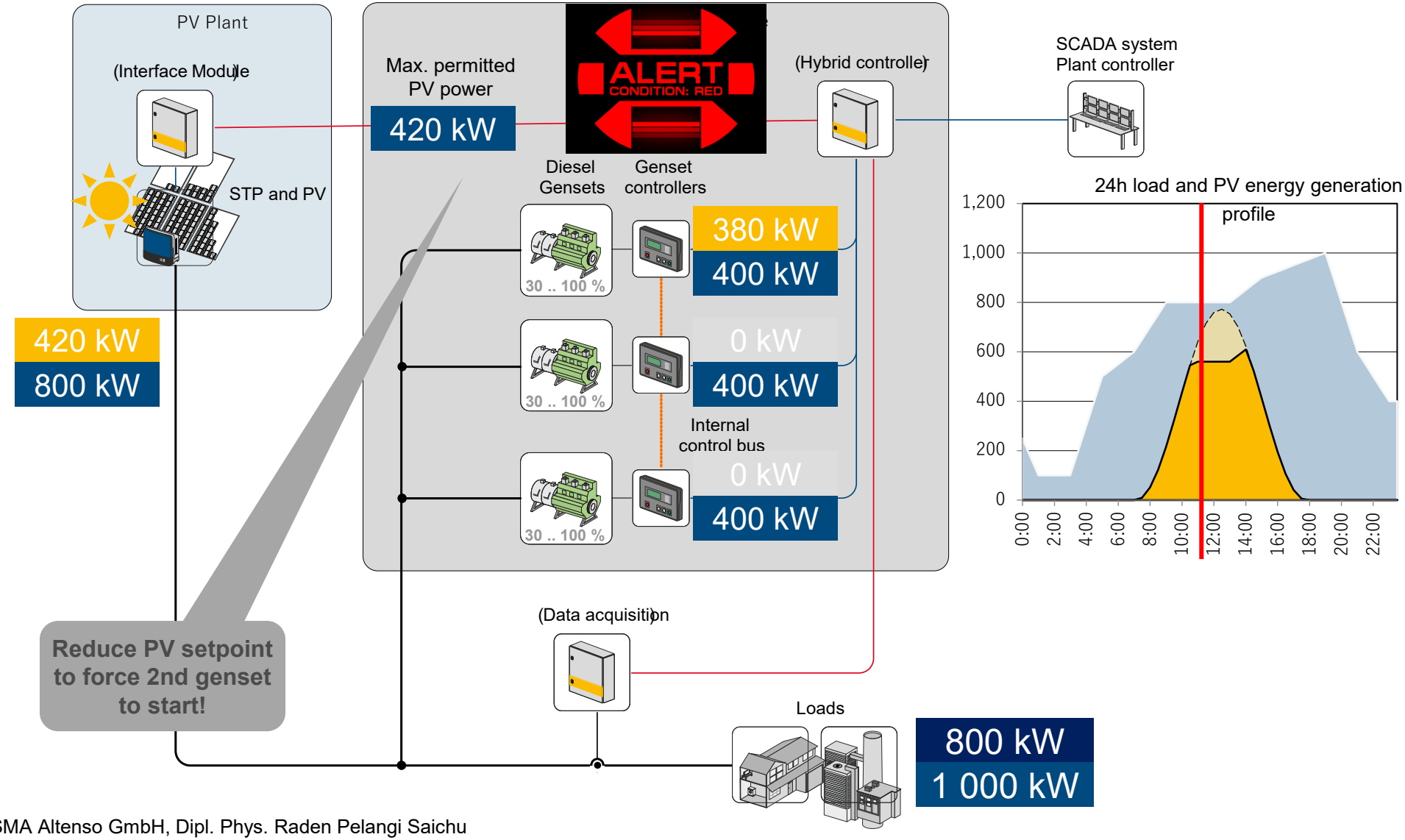
Hybrid controller Sytem

- **150 kW – open end**
- **Reduce powerplant fuel**
- **Flexible for different condition of powerplants**

Sunny Central System

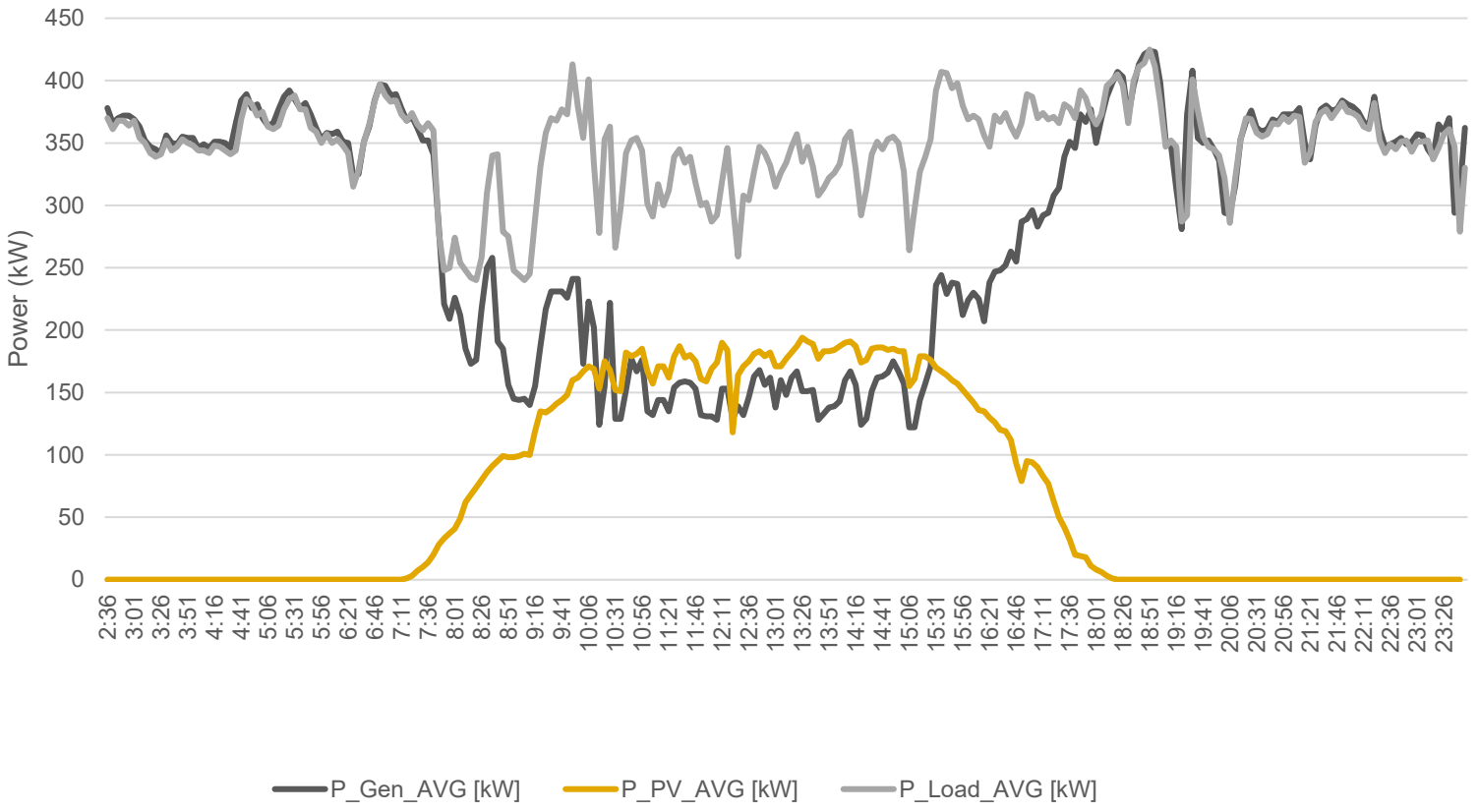
- **For On-Grid application 1,9 MW load – open end**
- **For Off-GRID above 1 MW load it make sense – open end**

How a typical day could look like (5/10)

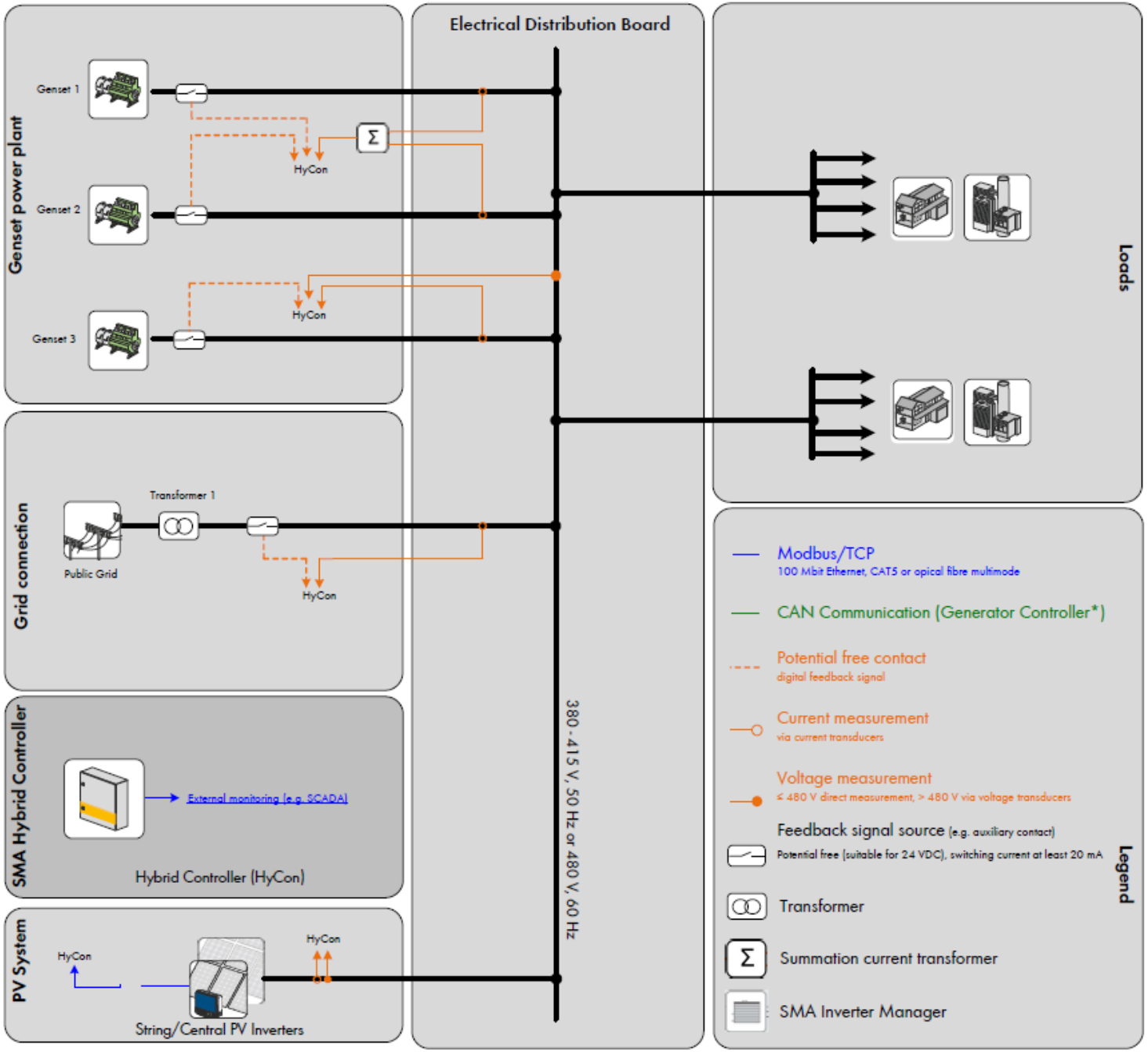


What are the limiting factors for max. PV penetration?

Genset stable minimal load

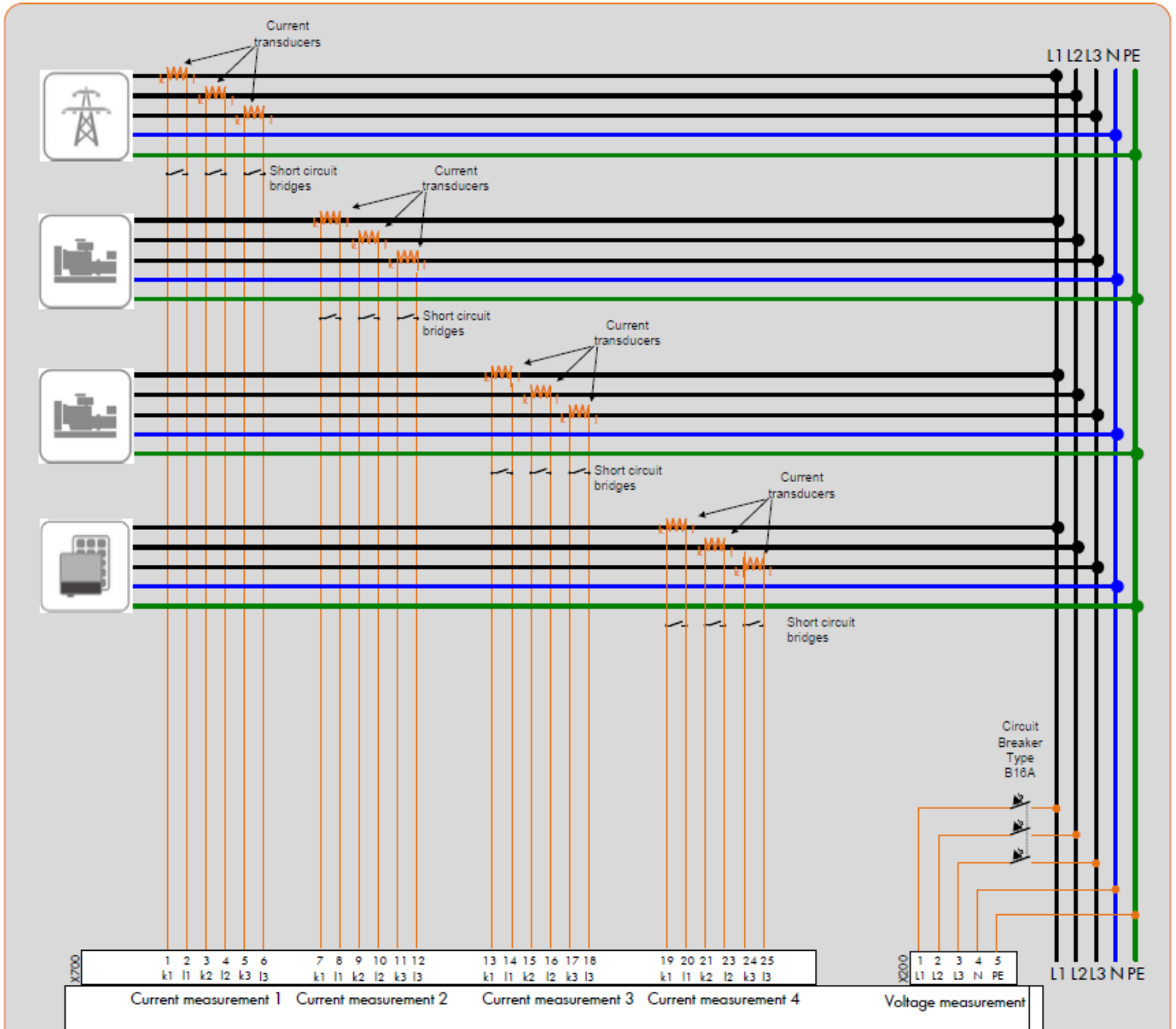


PV-Diesel Hybrid System with SMA Hybrid Controller



The hybrid controller responds based on settings and measurements to ensure that the load is always safely supplied and the diesel generator operates in its intended range.

PV-Diesel Hybrid System with SMA Hybrid Controller



Requires the following additional devices:

- **Current transformers to measure the current from each generator or connections.**
- **Connections to the main busbar to determine the voltages of each phase**
- **A feedback from each generator or connection, if it is connected or not**

Sunny Central Storage

SMA Altenso GmbH, Dipl. Phys. Raden Pelangi Saichu

Power range,

which can be covered or make sense

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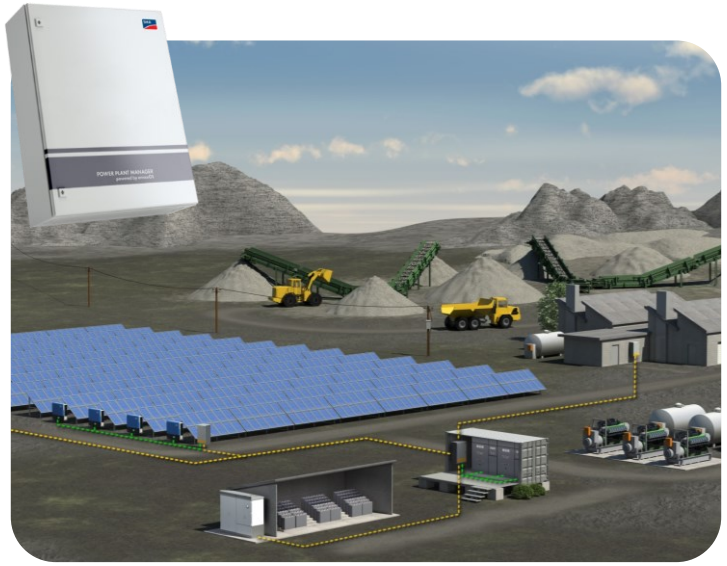

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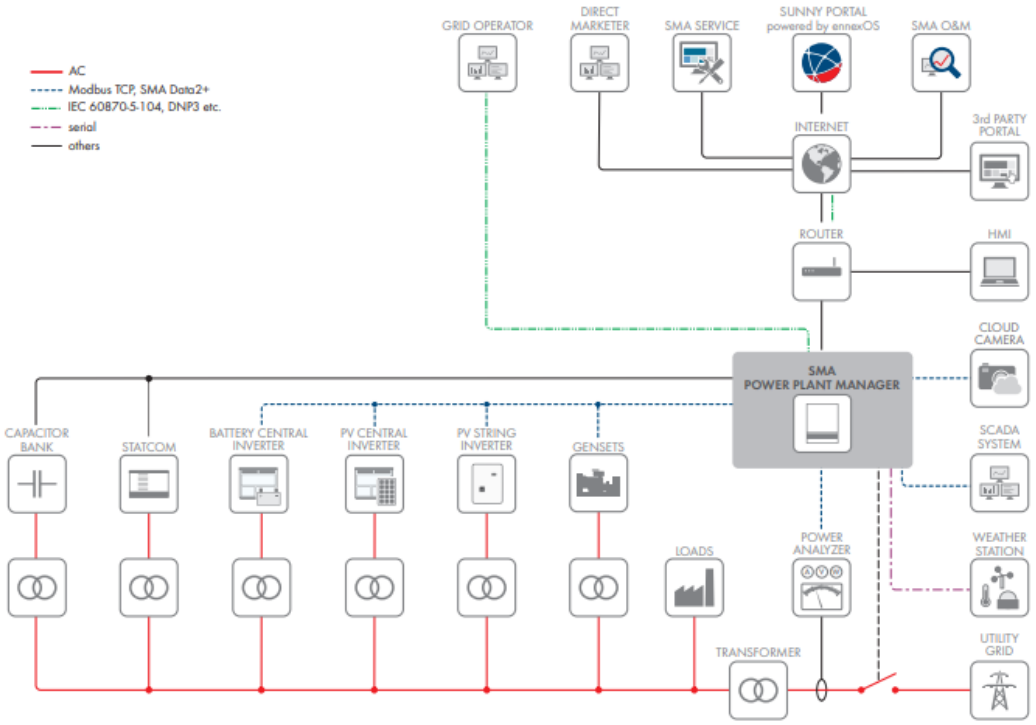
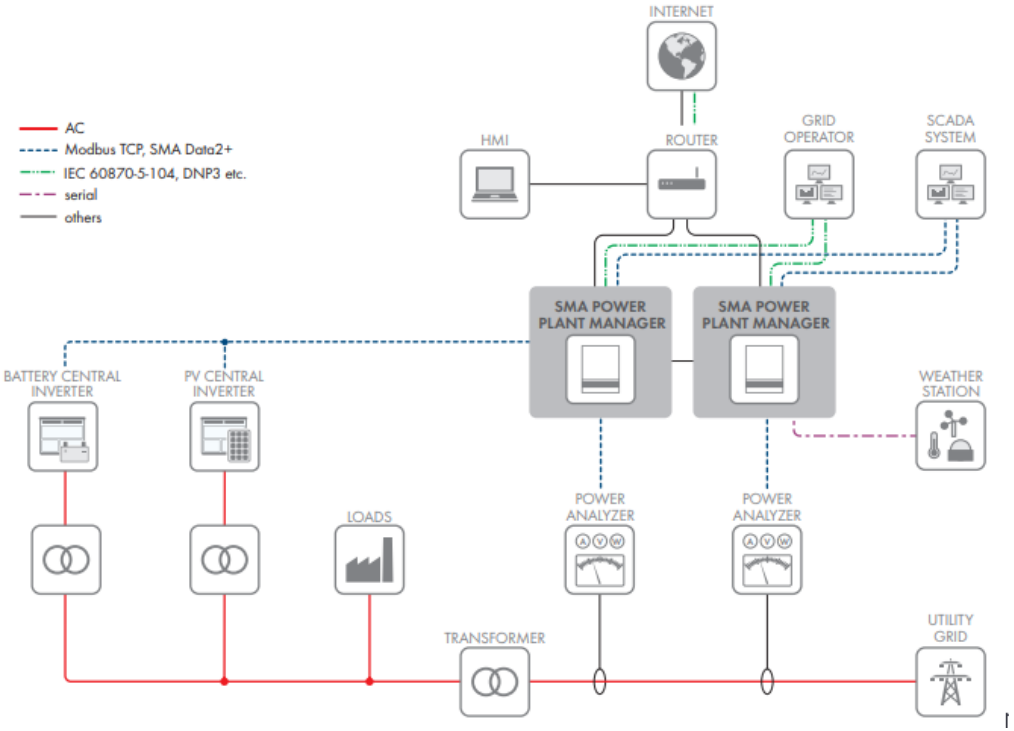
Power Plant Manager

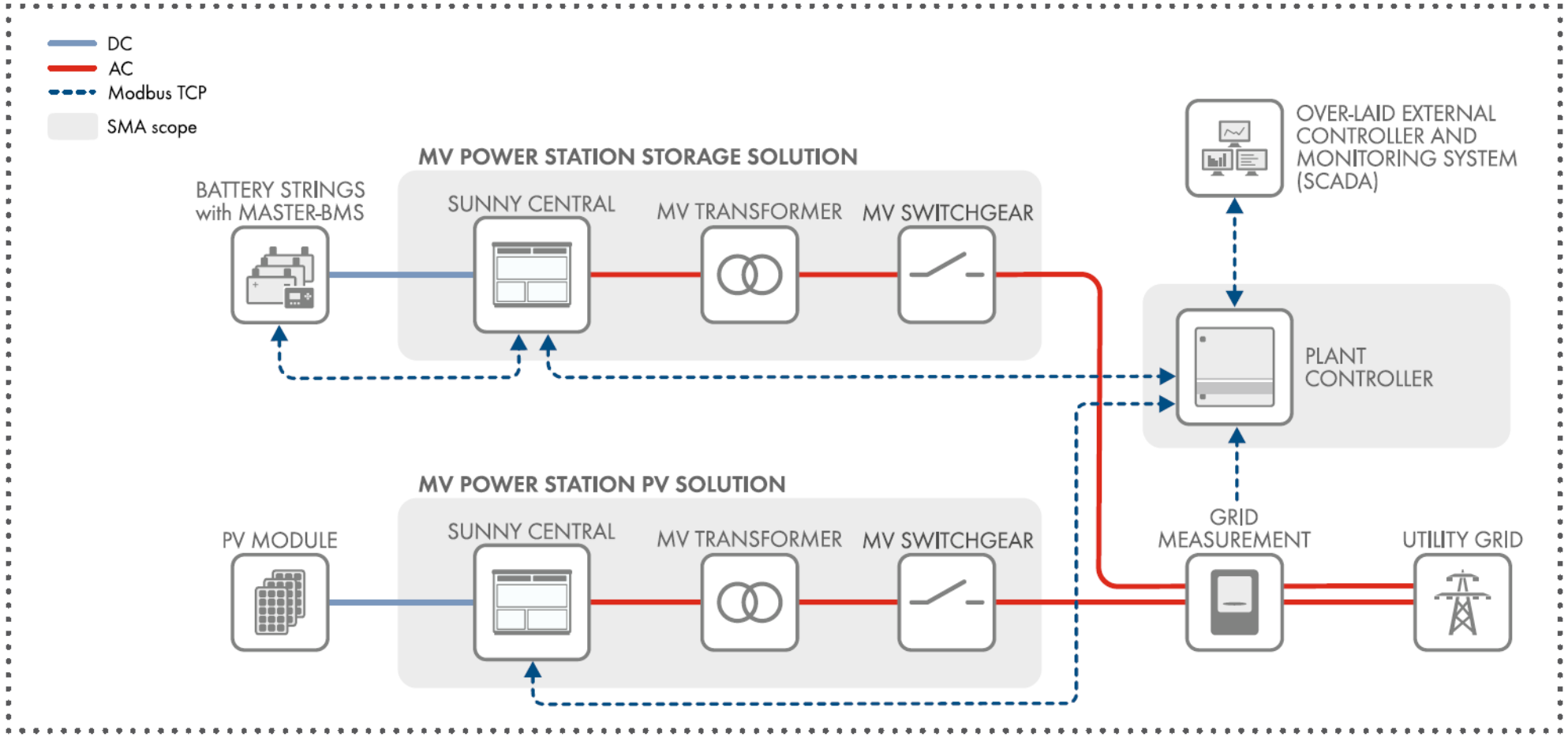
Power Plant Manager





Difference between AC-Coupling and DC-Coupling system in Sunny Central System

AC-Coupling

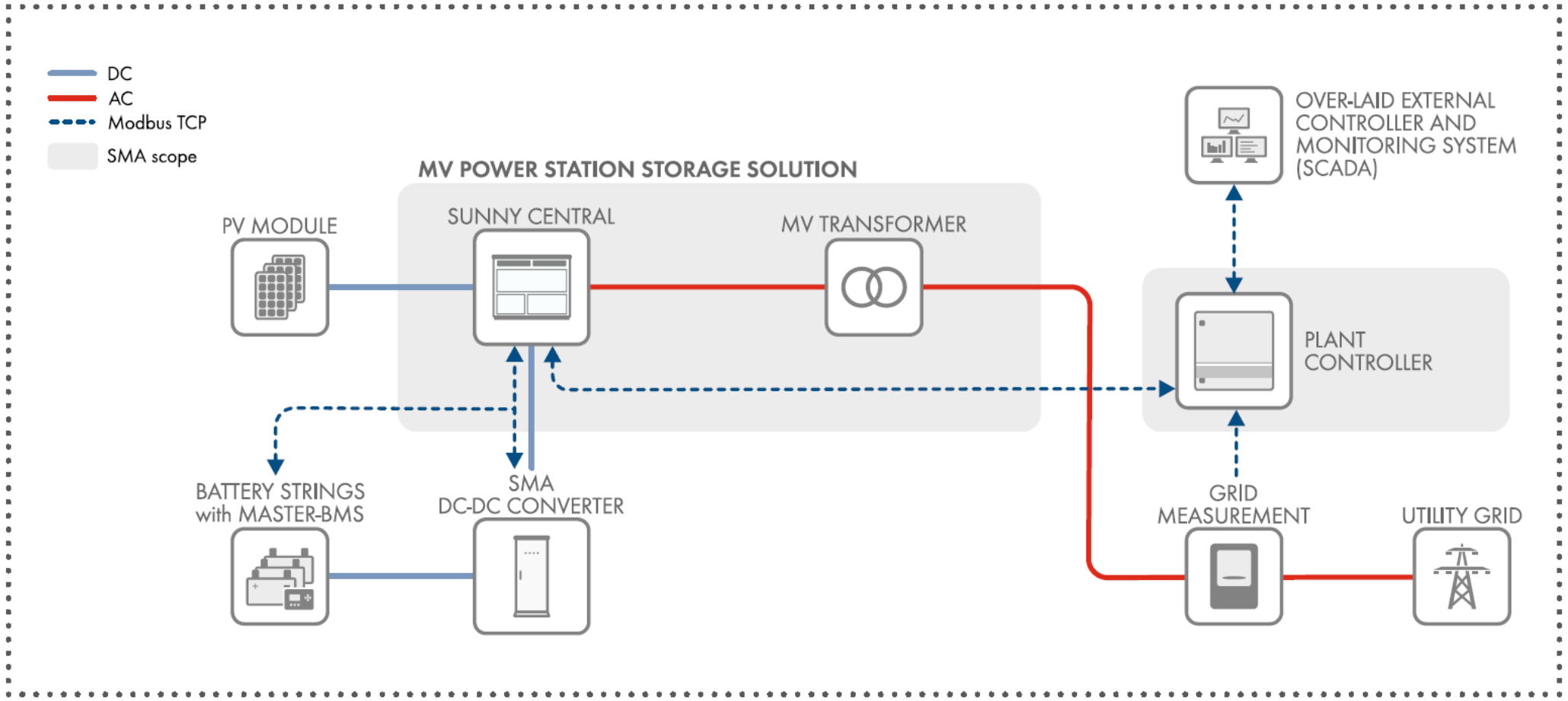


AC-coupled PV + storage system

Sunny Central and Sunny Central Storage

DC-Coupling

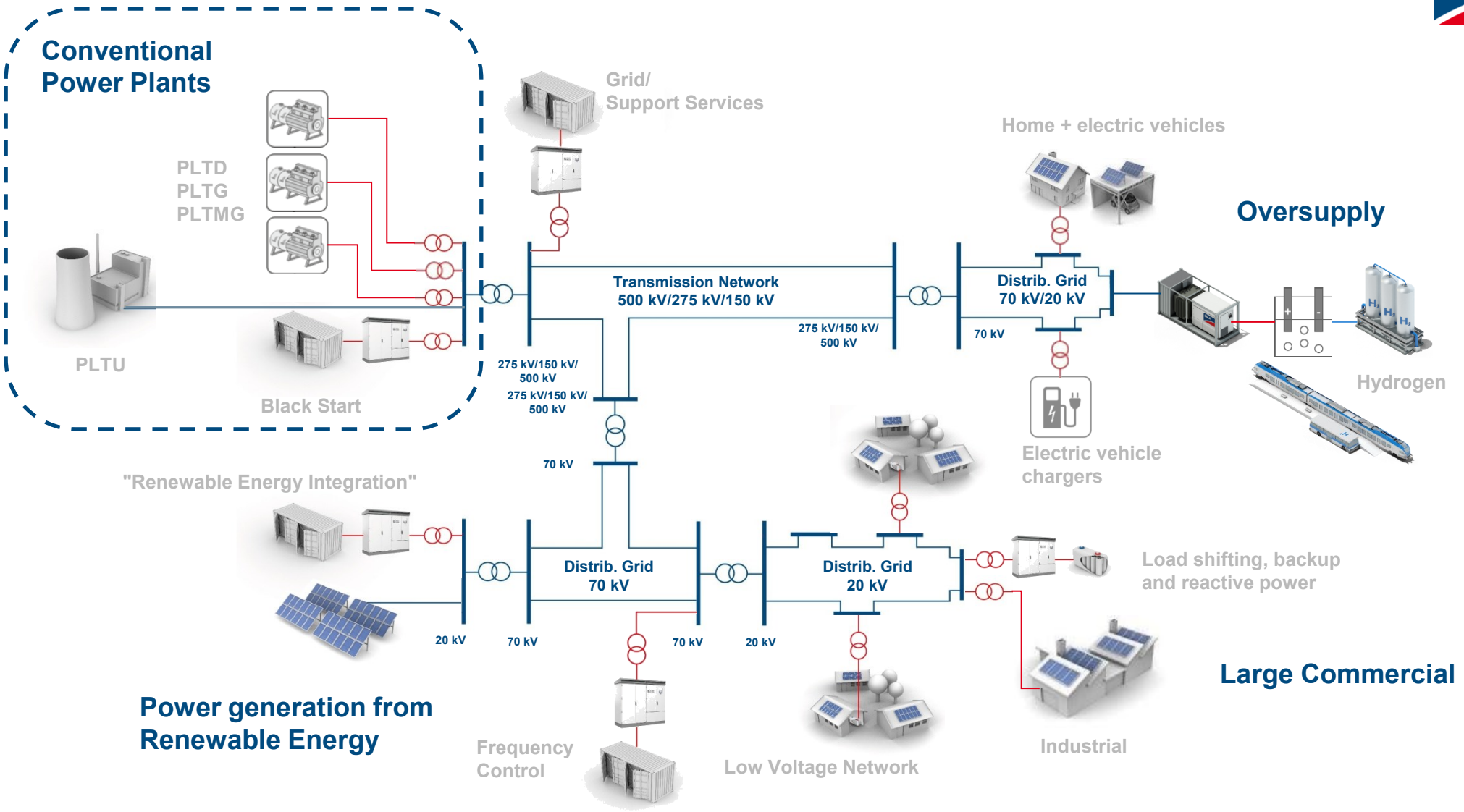
Not suitable for off-GRID or black start



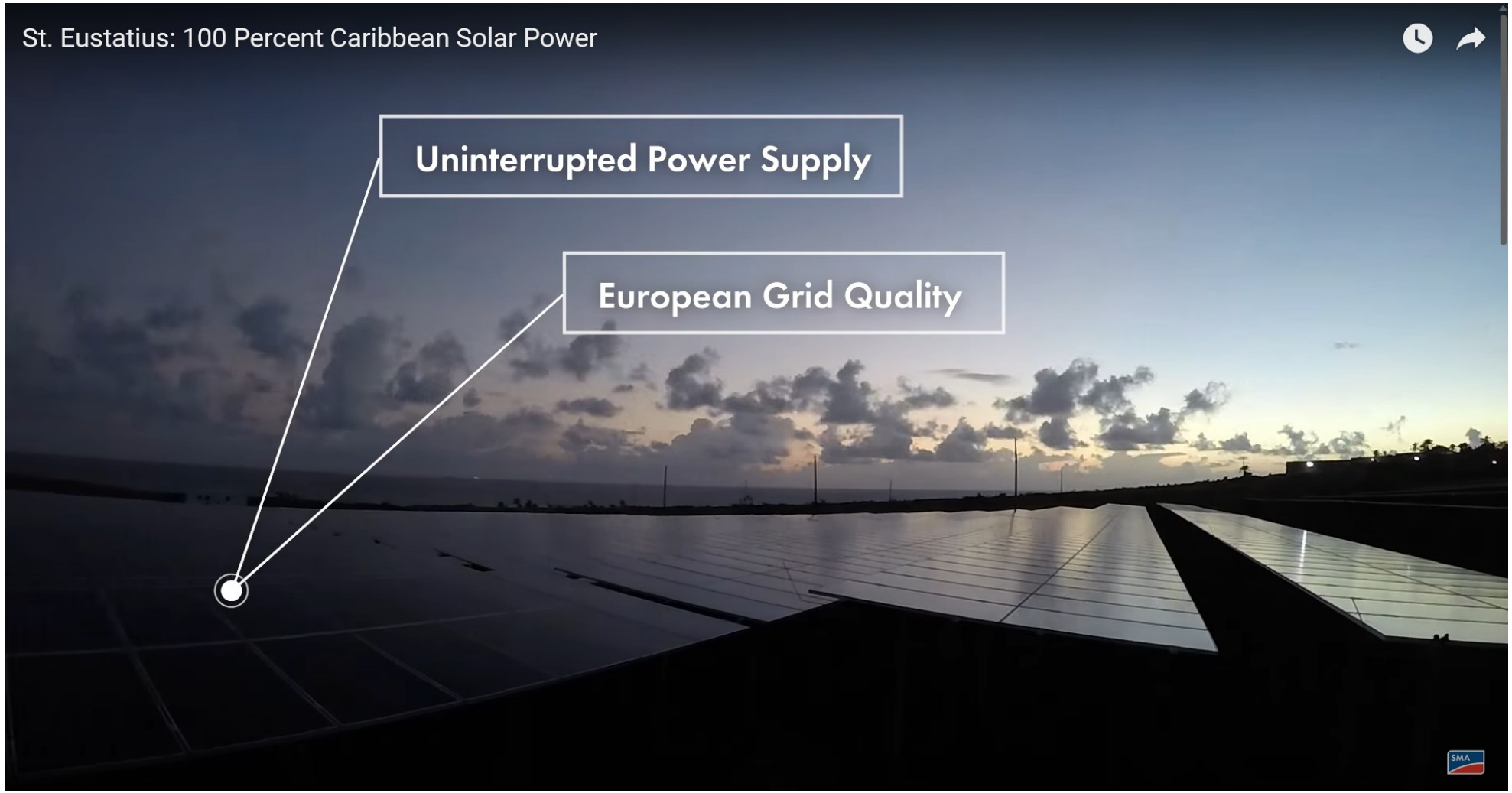
DC-coupled PV + storage system

When Black start capability is needed?

Starting a whole GRID or a conventional power plant



We help the Utility in 2016 to integrate PV inside their Genset in St. Eustatius with European grid standard quality



1.https://www.youtube.com/watch?v=xBM7Rdz5ajA

New Sunny Island X System

SMA Altenso GmbH, Dipl. Phys. Raden Pelangi Saichu

Power range,
which can be covered

Power range

Sunny Island System

- **0 – 216 kW continuous load**
- **0 - 288 kW load for 30 minutes**
- **Can start/stop Genset as backup**

Sunny Island X System

- **30 kW – 800 kW standard**
- **With Altenso more**
- **Can start/stop Genset**
- **Flexible for various power plants**

Sunny Central System

- **For On-GRID applications load from 1.9 MW – no final limit**
- **Reasonable for Off-GRID loads above 1 MW**

Sunny Island Off-Grid Family

Sunny Island **4500**

Sunny Islands **3324** **4248 / 4248U**

Sunny Island **5048 / 5048U**

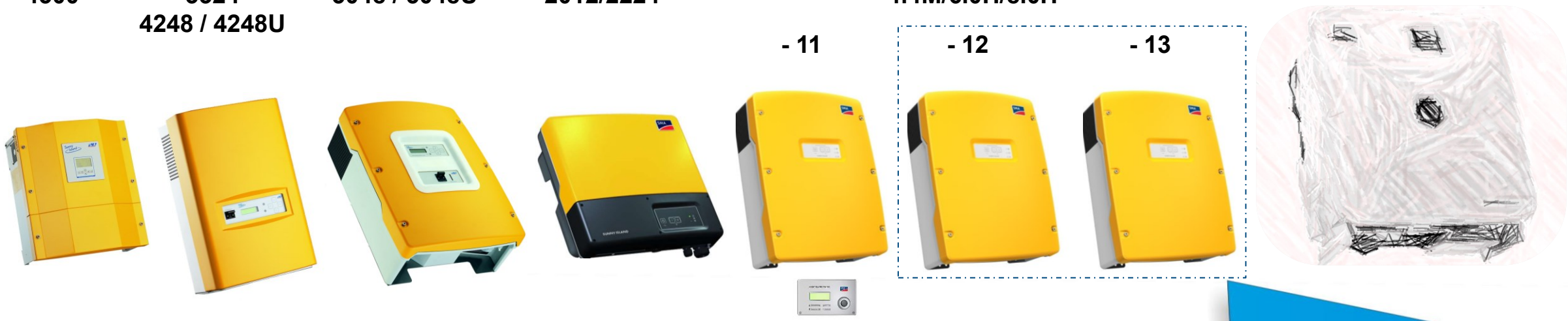
Sunny Island **2012/2224**

- 11

Sunny Island **4.4M/6.0H/8.0H**

- 12

- 13



First Sunny Island, CHP applications, Special applications

Small systems, Single device applications

Multicluster systems for increase of scalability, High overload power

Small systems, 1-phase parallel and three-phase

for Offgrid & Ongrid, Multicluster systems, High Power, Variety of functions & flexibility

What is needed for next generation?

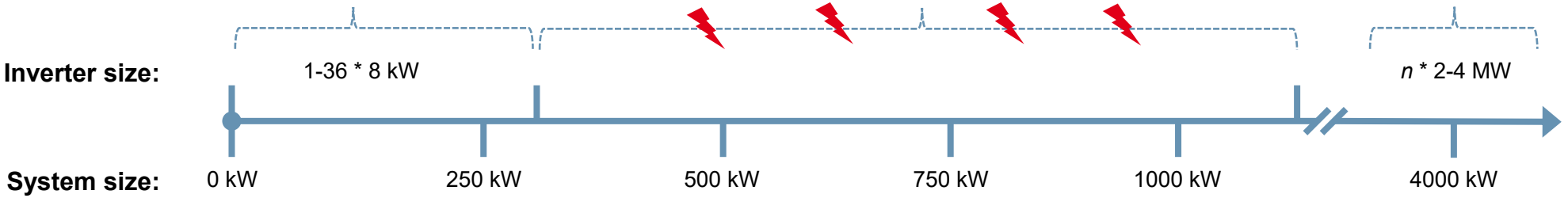
Current Off-Grid portfolio at SMA

- System sizes 4 – 300 kW_{AC} are covered by Sunny Island + MC Box 6 / 12 / 36
- System sizes >1500 kW_{AC} are covered by Sunny Central Storage

Sunny Island 6.0-8.0
+ MC-Boxes 6 - 36

- **There is a gap** in the SMA portfolio for commercial size Off-Grid systems.
- Larger Multicluster-Systems based on single phase Sunny Island require **significant installation efforts.**

Sunny Central Storage
Grid-Forming



New Sunny Island: Target-performance comparison

s

- ✓ Scalable 50kW 3ph @400V inverter units allow an easy handling and will increase redundancy also for larger system sizes
- ✓ Pre-wired Off-Grid Connection Boxes up to 800 kW by SMA
- ✓ Use of grid and / or (multiple) generators in Off-Grid systems
- ✓ Customer specific solution, e.g. up to 2 MW loads, by using the Modbus interfaces

- ✓ The on-Board System Manager powered by ennexOS allows up to 10 devices w/o Data Manager M in (pure) On-Grid Systems
- ✓ Integrated On-Grid Energy Management (e.g. Peak Load Shaving or Self-Consumption Optimization)

- ✓ Wide DC range from 200V upwards allows a better technical fit of the battery to your system needs
- ✓ New list of qualified and approved 3rd party batteries as you well-know from our current 1ph Sunny Island
- ✓ In technical exchange with:

BYD, cecasa, Dyness, TESVOLT, Ampace, UZ, LG, BMZ THE INNOVATION GROUP, PYLONTECH

- ✓ SMA proven inverter technology: Made in Germany with 25 years lifetime design
- ✓ 10 years warranty (5+5)
- ✓ Three-phase transformerless inverter design will reduce costs for acquisition and commissioning significantly

Technical Data & Features

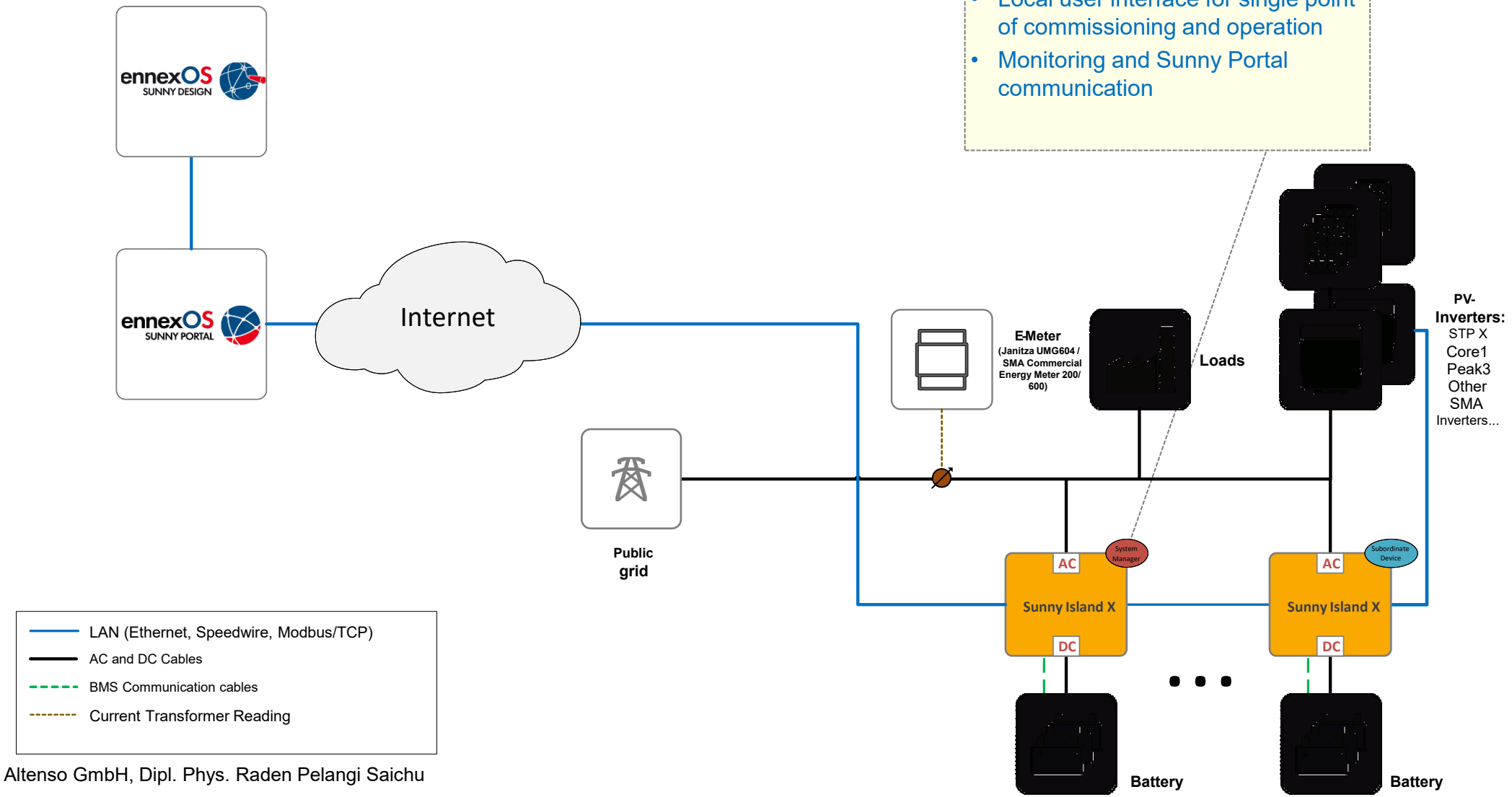
- Inverter with nominal AC-Power of **30 - 50 kW @ 400 V_{AC}**
- **UL-approved** devices for US-grids with 208 or 480V (27 - 60kW)
- **Power derating only above 45°C** ambient temperature allows use in warm equator close areas
- **Real 4 wire inverter technology** for direct supply of single-phase load
- Multiple **AC Parallel operation** by using v/f droops internally
- Internal DC/DC-converter with a variable DC range from **200 to 980 V_{D} ampacity of 150A** allows a most flexible battery design
- **Compatible with different Li-ion battery manufacturers** (BMS communication through **Ethernet** or **CAN**)
- Inverter **start up from AC or DC** improves use and commissioning
- **Weight of 104 kg** and **central lid screwing** allows still a good handling for installation and service
- **IP65** Outdoor installation
- **EMC class B** allows more sensitive loads and devices in Off-Grids
- Modern software and UI/UX design using **ennexOS communication core**

Scenario 1a

Grid tied system **w/o backup** (Sunny Island X as System Manager)

The System Manager provides:

- Up to **11** devices in sum
- Energy and power management (e.g. Self-Consumption, Peak Shaving, Time of Use)
- Local user interface for single point of commissioning and operation
- Monitoring and Sunny Portal communication

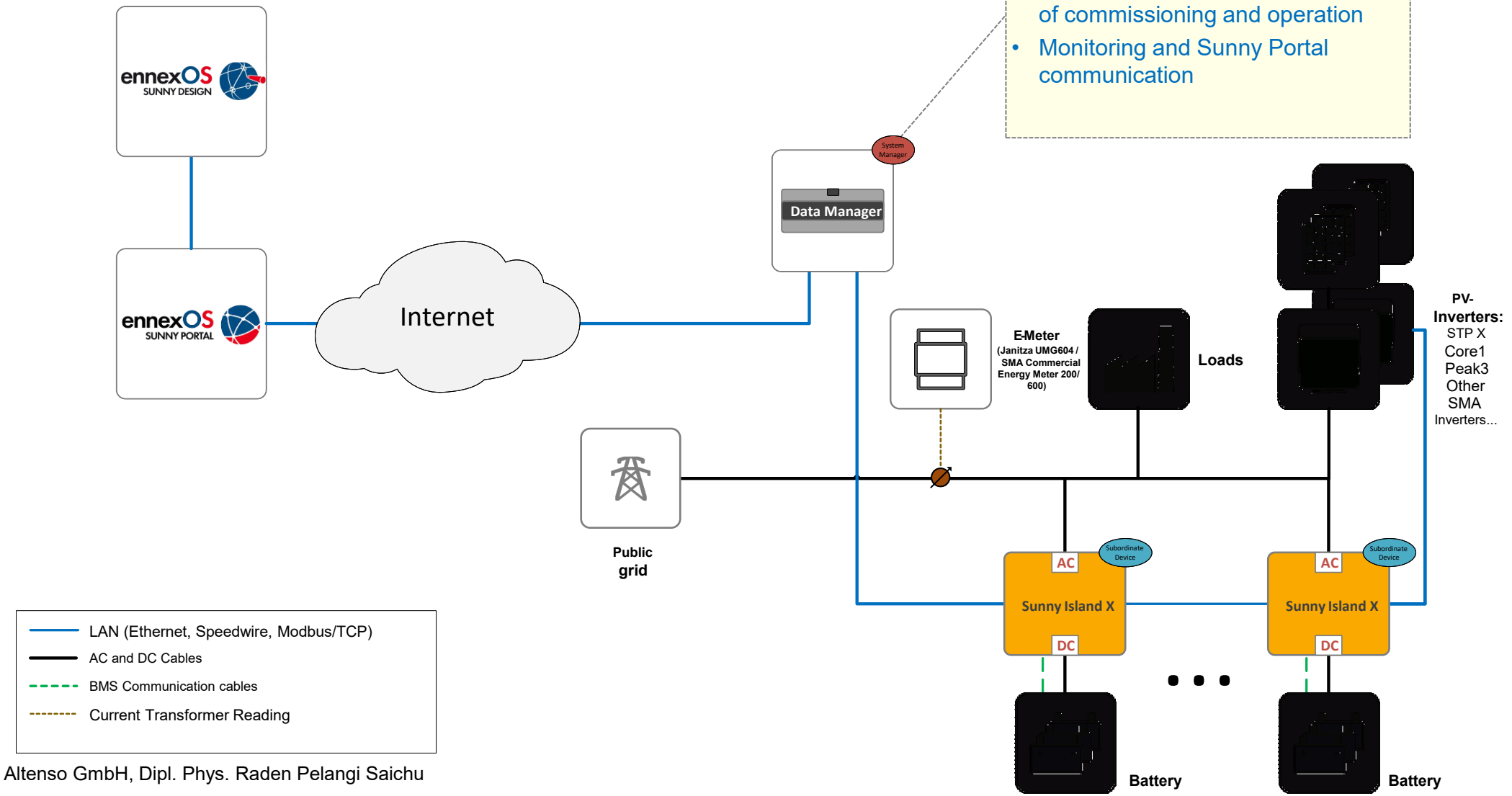


Scenario 1b

Grid tied system **w/o backup** (Data Manager M as System Manager)

The Data Manager provides:

- Up to **50** devices in sum
- Energy and power management (e.g. Self-Consumption, Peak Shaving, Time of Use)
- Local user interface for single point of commissioning and operation
- Monitoring and Sunny Portal communication



Scenario 2

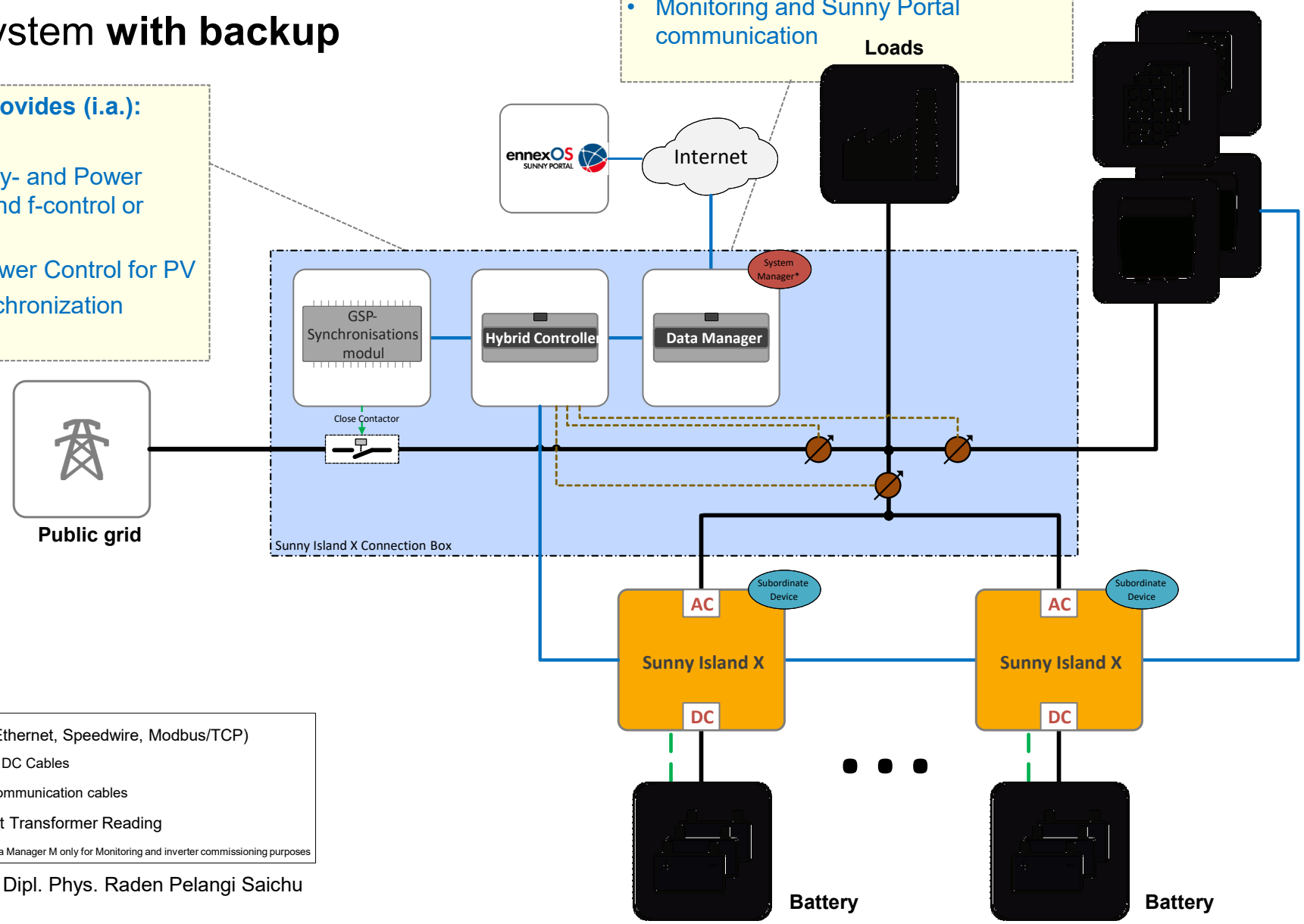
Grid tied system **with backup**

The Hybrid Controller provides (i.a.):

- Blackstart
- On- and Off-Grid Energy- and Power Management (e.g. V- and f-control or Peak Load Shaving)
- Active and Reactive Power Control for PV
- Automatic ext. grid synchronization

The Data Manager provides:

- Local user interface for single point of inverter commissioning
- Monitoring and Sunny Portal communication



Scenario 3

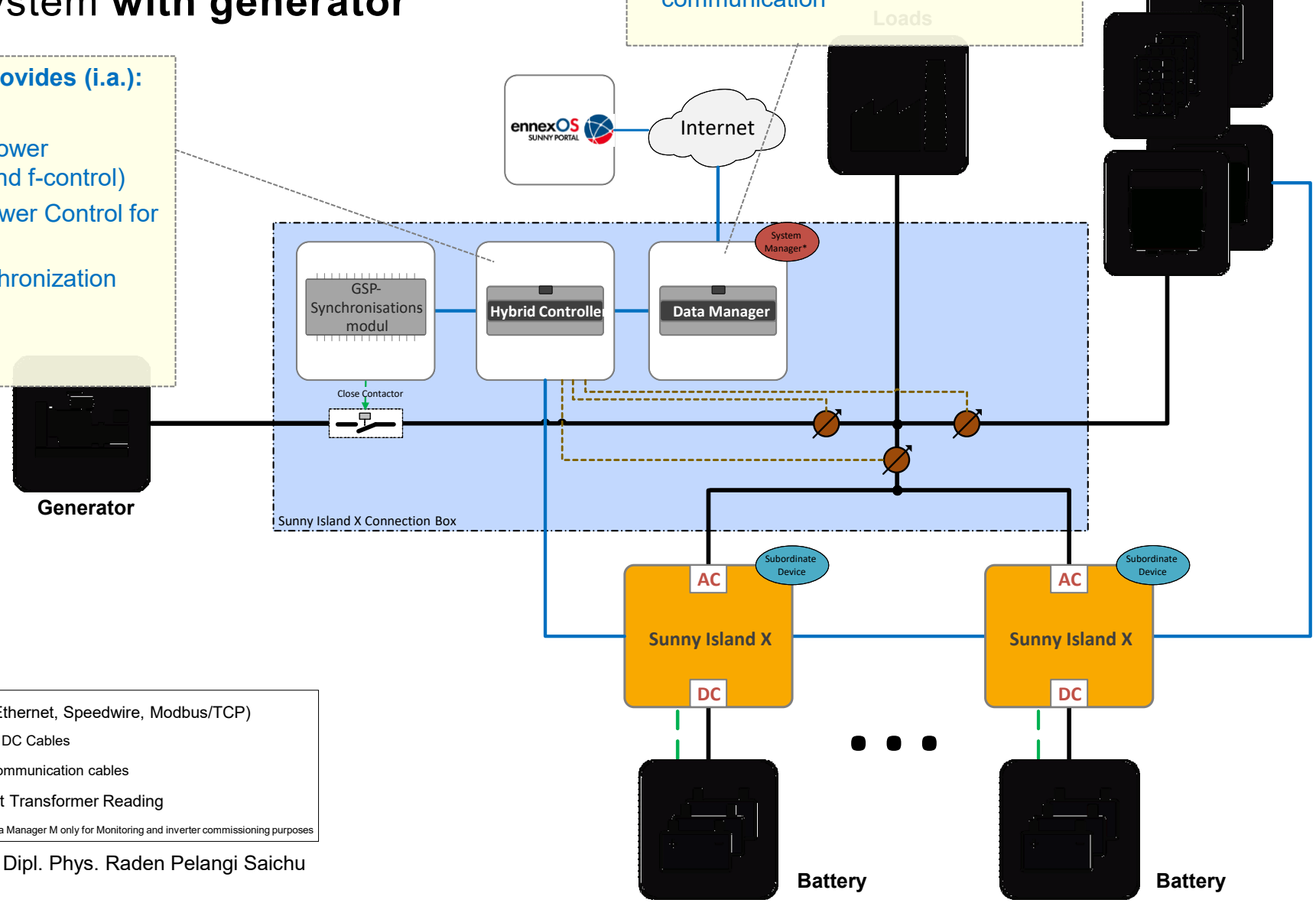
Off-grid System **with generator**

The Hybrid Controller provides (i.a.):

- Blackstart
- Off-Grid Energy- and Power Management (e.g. V- and f-control)
- Active and Reactive Power Control for PV and Genset
- Automatic Genset synchronization
- Diesel-Off-Mode

The Data Manager provides:

- Local user interface for single point of inverter commissioning
- Monitoring and Sunny Portal communication



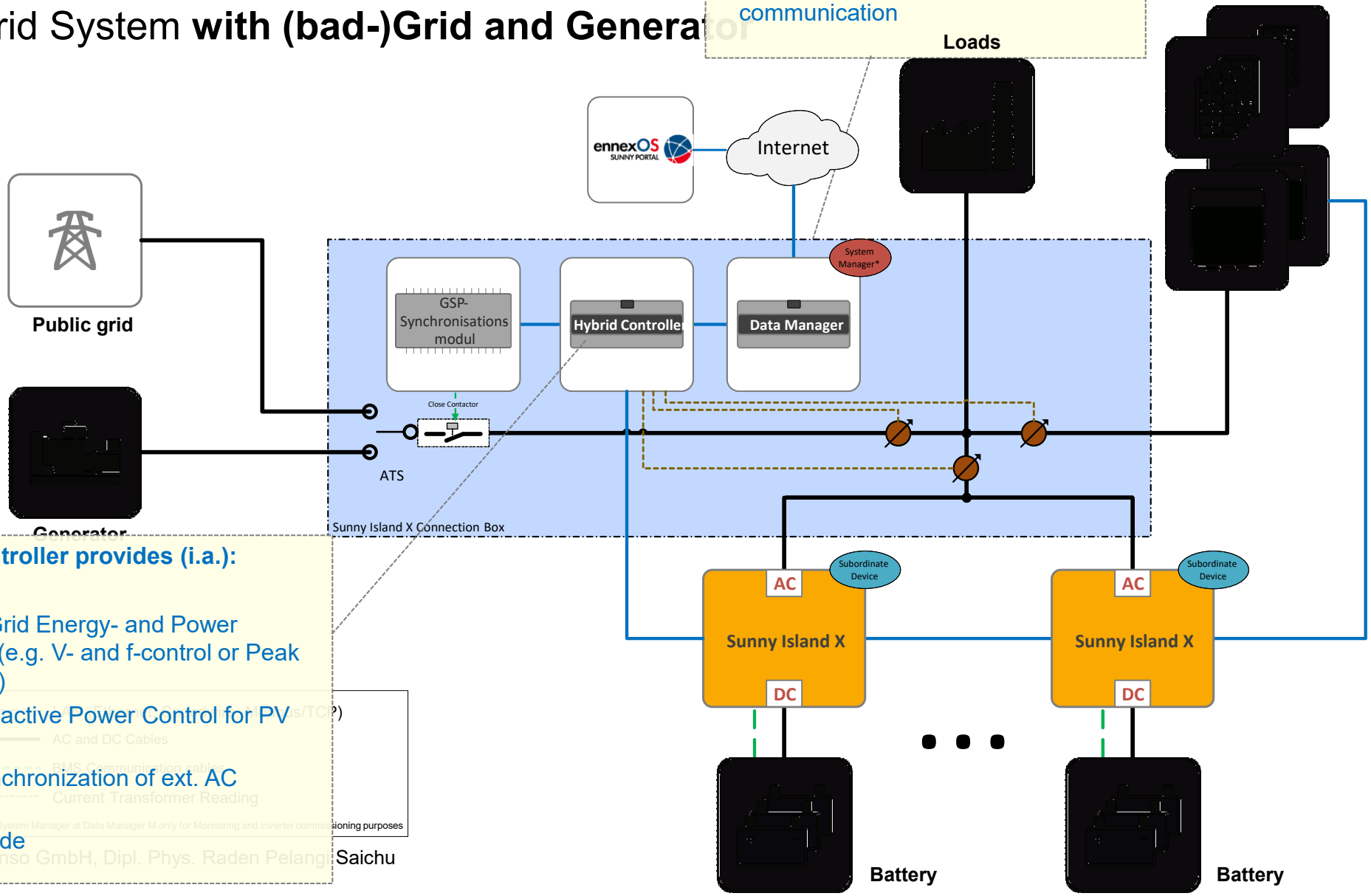
PV-Inverters:
STP X
Core1
Core2
Peak3
Other SMA Inverters...

Scenario 4

Off-grid System **with (bad-)Grid and Generator**

The Data Manager provides:

- Local user interface for single point of inverter commissioning
- Monitoring and Sunny Portal communication



The Hybrid Controller provides (i.a.):

- Blackstart
- On- and Off-Grid Energy- and Power Management (e.g. V- and f-control or Peak Load Shaving)
- Active and Reactive Power Control for PV and Genset
- Automatic synchronization of ext. AC sources
- Diesel-Off-Mode

Scenario 5

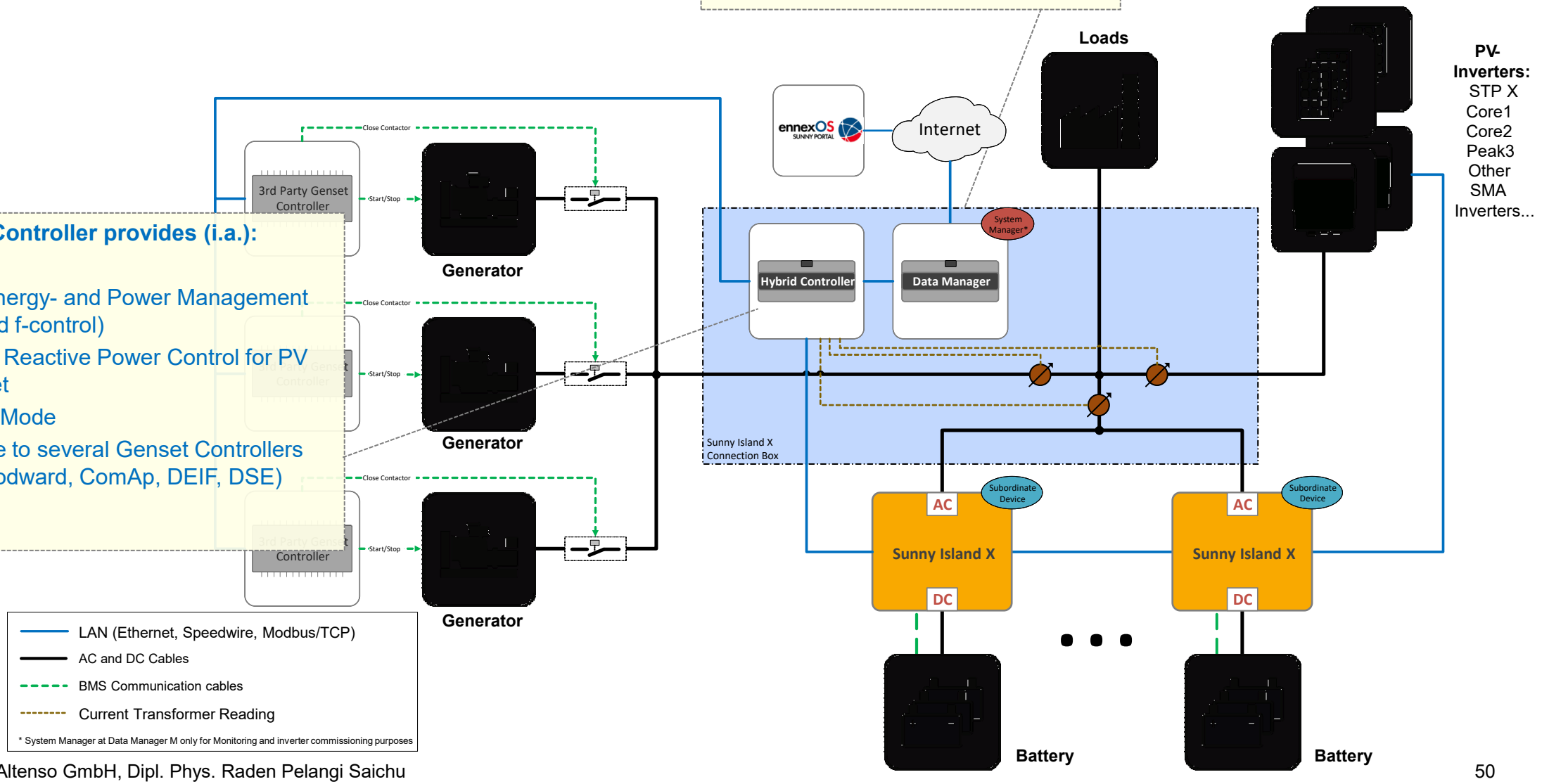
Off-grid System **with multiple generators**

The Data Manager provides:

- Local user interface for single point of inverter commissioning
- Monitoring and Sunny Portal communication

The Hybrid Controller provides (i.a.):

- Blackstart
- Off-Grid Energy- and Power Management (e.g. V- and f-control)
- Active and Reactive Power Control for PV and Genset
- Diesel-Off-Mode
- Compatible to several Genset Controllers (CRE, Woodward, ComAp, DEIF, DSE)



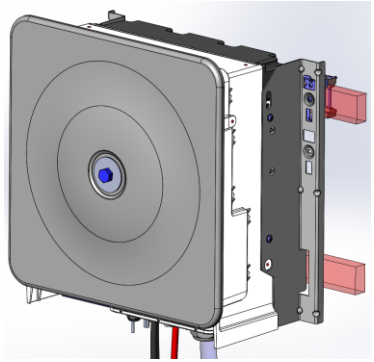
Comparison of former SI Multicluster and New SI System

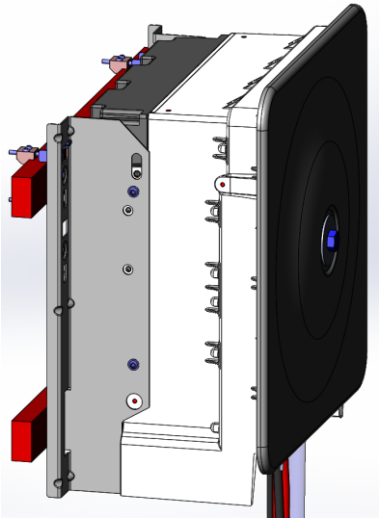
	36x SI 8.0 + MC-Box 36	10x New SI 50 + OffGrid-Box 10	16x New SI 50 + OffGrid-Box 16
Number of inverters	36	10*1	16*1
Grid voltage	400 V	208 / 400 / 480 V	208 / 400 / 480 V
Nominal system power @ 400 V	216 kW	500 kW	800 kW
Peak system power @ 400 V	328 kW (5 minutes)	500 kW (no overload capacity)	800 kW (no overload capacity)
Short circuit power	120 A per Phase (x 12)	140 A*2 per Phase (x 10)	140 A*2 per Phase (x 16)
Maximum PV power @ 400 V	360 kW_{AC} / 430-540 kWp	ca. 500 kW_{AC}*2 / 600-750 kWp	ca. 800 kW_{AC}*2 / 960-1200 kWp
Load shedding (internal/external)	1 / 1	1 / 2	1 / 2
Genset/Grid connection	1x Genset	2x Genset or 1x Genset + 1x Grid or several Gensets with Genset controller	2x Genset or 1x Genset + 1x Grid or several Gensets with Genset controller
Battery connection	CAN, Lead-Acid	CAN, Modbus TCP	CAN, Modbus TCP
DC voltage range	41 V – 63 V	200 V – 980 V	200 V – 980 V

*1 Number of inverters not yet fixed

*2 Maximum allowed PV power and short-circuit power is still under investigation

Mechanical Concept

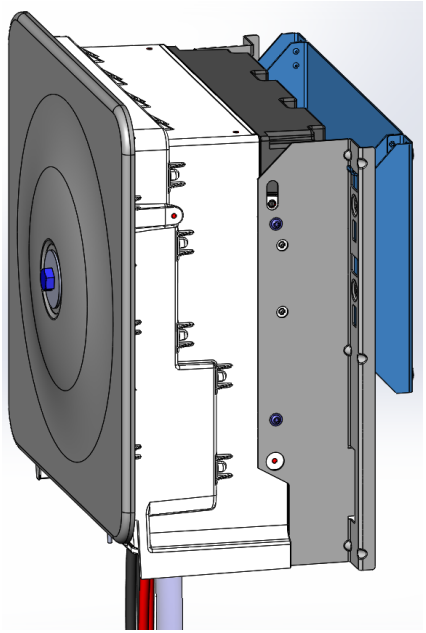




Wall-Mounting

> Left picture: Inverter can be **mounted on rails** like used for PV field installation frames (red part of the left pictures)

> Right picture: Inverter can also be **mounted with a special**
wall-mounting kit which allows a direct installation at the wall (blue part of the right picture)



Lid fixing

> Due to mounting simplification, the housing lid will be **fixed by just one central screw** (blue central screw of the pictures)

Roadmap New Off-Grid Solution

New Genset Connection Boxes for 50-300 kW_{AC} with Sunny Island X

Off-Grid Boxes for 300-800 kW_{AC} with Sunny Island X

New Sunny Island X

Start Fieldtests SI X

2023 | 2024 | 2025

Future Portfolio Off-Grid

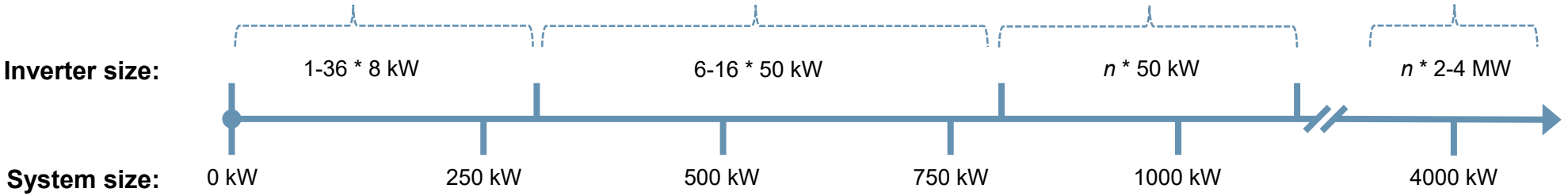
- System sizes 4 – 300 kW_{AC} are covered by Sunny Island + MC 6 / 12 / 36
- **NEW:** System sizes 300 – 800 kW_{AC} and even larger are covered by new Sunny Island X Off-Grid Solution
- System sizes >1500 kW_{AC} are covered by Sunny Central Storage

Sunny Island 6.0-8.0
+ MC-Boxes 6 - 36

Sunny Island X
+ SI X Connection Box

Project specific system design
(e.g. by SMA ALTENSO)

Sunny Central Storage
Grid-Forming



Thank you!

SMA Altenso GmbH

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