



SMA Solar Technology AG  
SMA Sunbelt Energy GmbH

# RMIPPP Solutions

Presented by Timo Relling / Thorsten Ronge / Moutasem Bitar  
South Africa, October 2020

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# SMA & Sunbelt Energy at a glance



## SMA Solar Technology AG

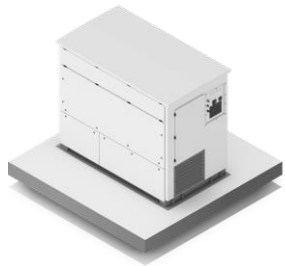
- Founded in 1981
- Installed base: > 95 GW
- Portfolio to serve all PV & storage segments
- 20 subsidiaries with strong service capabilities and access to all channels
- First company to deliver > 3GW of storage PCS

## SMA Sunbelt Energy GmbH

- 100% subsidiary of SMA Solar Technology AG
- Focus on off-grid, hybrid and battery based solar projects in the sunbelt region
- Business model covers component and solution sales, system integration and EPCM of battery projects
- Executed >125 MW of hybrid & storage projects as integrator/EPC
- Currently delivering approx. 100 MW of storage projects
- More than 200 MW of contracted BESS projects for 2020

**SMA has extensive know-how & tailored solutions in the field of battery storage.**

# SMA Products & Services for the RMIPPP

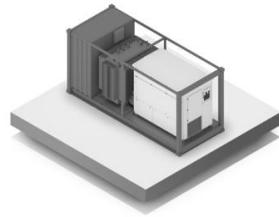


## I. Battery Inverters

2000 – 4600 kW

SMA first company with installed base > 3 GW

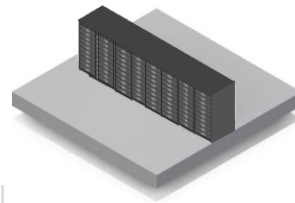
DC Coupling Ready for co-location of renewables



## II. MV Solution MVPS

4000 – 4600 kVA

Plug & Play 20' skidtrailer with transformer, RMU and Sunny Central Storage inverters



## III. Batteries

SMA solution is technology and battery brand agnostic

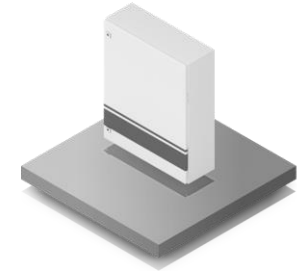
performance warranty up to 20 years and SOH 60%



## IV. Battery Housing

Customised and optimised specific project design

Cost effective, often locally manufactured e-houses or ISO containers



## V. Control & Monitor

Smart energy manager for communication and overall system monitoring

Controller for battery grid code compliance



## VI. Engineering & Project Management

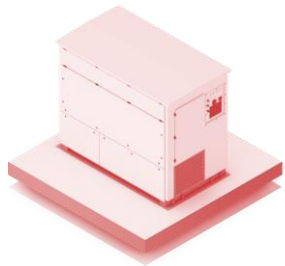
Battery storage design and simulation, grid studies, detail engineering, project management and Know-how transfer



## VII. Service and O&M

Remote and on-site service, warranty extension, spare parts management, 24/7, full or partial O&M service, repowering

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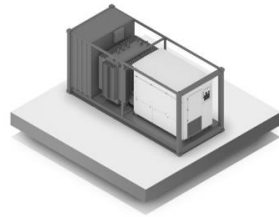


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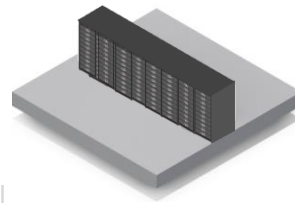
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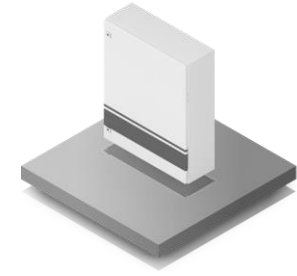
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# DC- and AC-Coupled SMA Solutions



## PV + Storage Solutions



### AC- & DC-Coupled

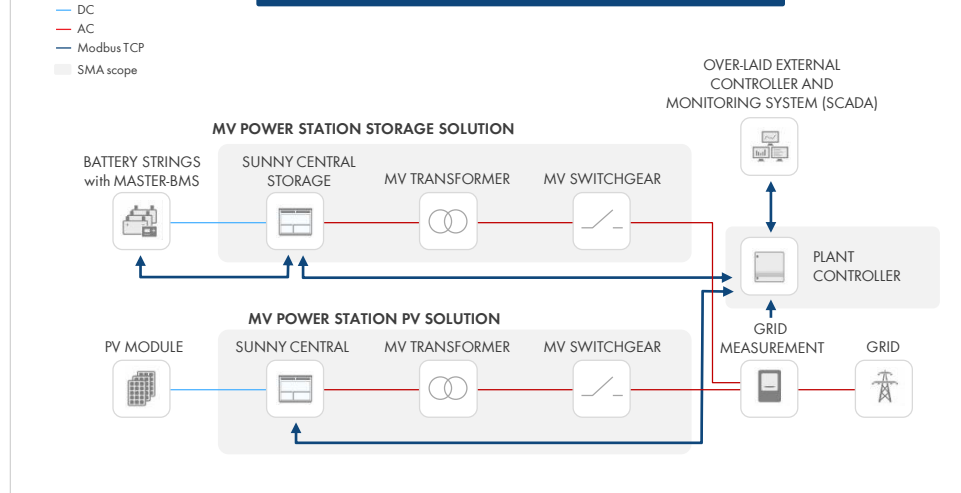
- Depending on project needs, one or even both can be selected



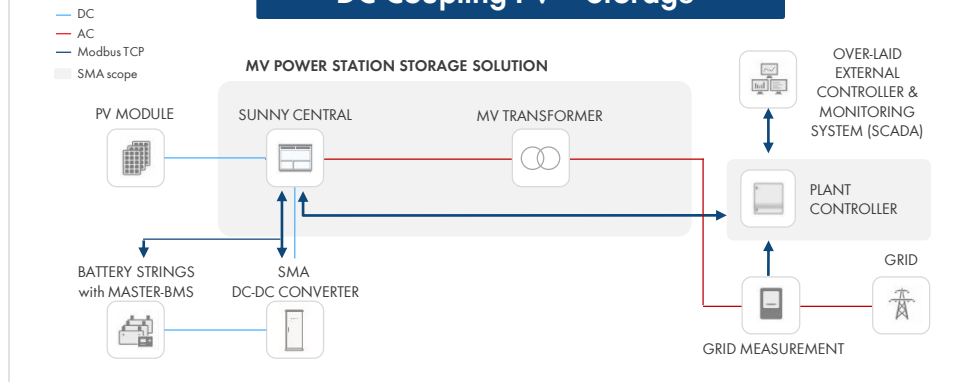
### Add storage today or later

- Add AC-coupled storage at PCC (consider spare MV-feeder today)
- Buy a Sunny Central UP with "DC-Coupling Ready" option today and add storage later

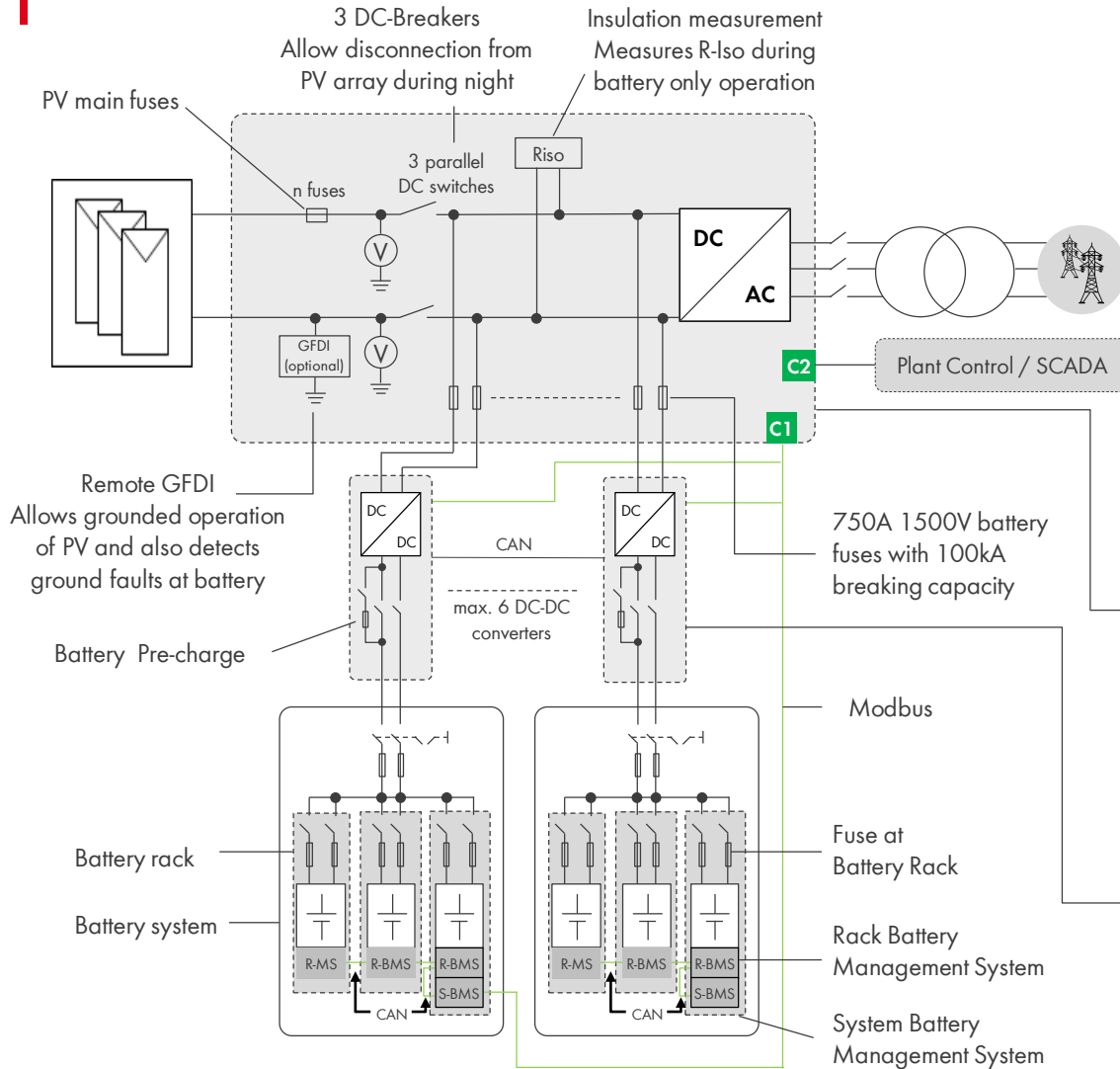
## AC-Coupling PV + Storage



## DC Coupling PV + Storage



# SMA System Architecture



## Plant Control / SCADA

- Talks to Energy Market
- Acts according to Business Case
- Decides to sell / dispatch energy
- Buys energy (charge batteries)
- Provides forecast / dispatch schedules

## Inverter Software

- Still does MPP-Tracking
- Monitors 6 DC/DC converters
- Monitors 6 BMS
- Receives setpoints from Plant Control
- Sets DC-DC Converter current limits
- Sets DC-DC Converter voltage setpoints
- Stores excess energy in batteries
- Can control ramp-rates automatically
- Can charge batteries from AC (future release)
- Under Frequency support in partial load

## IGBT-Topology

- Buck-Boost & Bidirectional (4 Quadrant Operation)
- Allows connection of 1500V batteries (550-1500V)
- Prevents short-circuit currents into inverter and PV array (no tripping of fuses at battery rack required)
- High efficiency for different voltages and loading

# SMA Sunny Central Storage



## PORTFOLIO

- Sunny Central Storage  
1,000/1,100/1,500 V  
1,900 – 3,950 kVA
- Sunny Central Storage UP  
1,500 V  
3,450 – 3,950 kVA
- Sunny Central Storage UP-XT  
1,500 V  
3,450 – 3,950 kVA | 4,000 – 4,600 kVA discharge



# SMA Sunny Central Storage



Power Class <sup>(1)</sup>	1,900 kVA	2,200 kVA	2,475 kVA	2,900 kVA
Power @50°C <sup>(2)</sup>	1,710 kVA	2,000 kVA	2,250 kVA	2,670 kVA
U Battery	500 to 950 V	570 to 950 V	634 to 1000 V	740 to <u>1100</u> V
U DC Min	490 V	545 V	614 V	720 V
U AC	337 V	385 V	434 V	520 V

(1) Output apparent power is function of Temperature / V<sub>pu</sub> / Power Factor / DC Voltage  
 (2) Output @ 50°C / 1.0 V<sub>pu</sub> / 0.8 PF / 950V for SCS1900/2200 & 1000V for SCS2475/2900

# SMA Sunny Central Storage UP



SCS 3450 UP



SCS 3600 UP



SCS 3800 UP



SCS 3950 UP



Power Class <sup>(1)</sup>	3,450 kVA	3,622 kVA	3,795 kVA	3,967 kVA
Power @50°C <sup>(2)</sup>	2,880 kVA	3,020 kVA	3,170 kVA	3,310 kVA
U Battery	880 to 1500 V	921 to 1500 V	962 to 1500 V	1003 to 1500 V
U DC Min	849 V	891 V	934 V	976 V
U AC	600 V	630 V	660 V	690 V

(1) Output apparent power is function of Temperature / V<sub>pu</sub> / Power Factor / DC Voltage

(2) Output @ 50°C / 1.0V<sub>pu</sub> / 0.9 PF / 1,200V

# SMA Sunny Central Storage UP-XT



SCS 3450 UP-XT



SCS 3600 UP-XT



SCS 3800 UP-XT



SCS 3950 UP-XT



Power Class <sup>(1)</sup>	3,450 kVA 4,000 kVA Discharge	3,622 kVA 4,200 kVA Discharge	3,795 kVA 4,400 kVA Discharge	3,967 kVA 4,600 kVA Discharge
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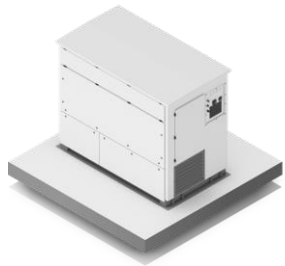
# SMA DC/DC Converter



## SPECIFICATIONS

- Improved thermal behavior
  - 500A @ 30°C
  - 450A @ 40°C
  - 400A @ 50°C
- 500 kW at 1000 Vdc
- 600 kW from 1200 to 1500 Vdc
- 550 to 1500 Vdc input/output range
- Air-cooled
- 98.2% Average efficiency
- Plug & Play integration with Sunny Central PV inverters

# SMA Products & Services for the RMIPPP

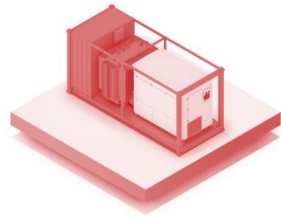


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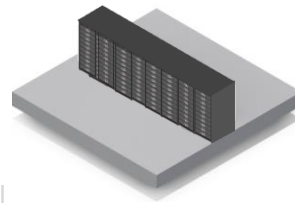
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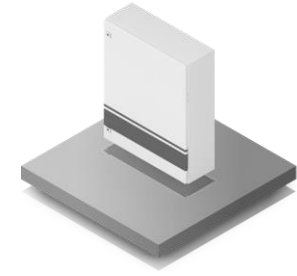
performance warranty up to 20 years and SOH 60%



## IV. Battery Housing

Customised and optimised specific project design

Cost effective, often locally manufactured e-houses or ISO containers



## V. Control & Monitor

Smart energy manager for communication and overall system monitoring

Controller for battery grid code compliance



## VI. Engineering & Project Management

Battery storage design and simulation, grid studies, detail engineering, project management and Know-how transfer



## VII. Service and O&M

Remote and on-site service, warranty extension, spare parts management, 24/7, full or partial O&M service, repowering

# SMA Medium Voltage Power Station (MVPS)



## BENEFITS

- Turnkey solution for lowest cost and shortest installation and commissioning time
- Comprised of Sunny Central or Sunny Central Storage, Solar PV transformer and RMU
- Design according to IEC and IEEE standards
- Modular system for maximum flexibility
- Easy transport

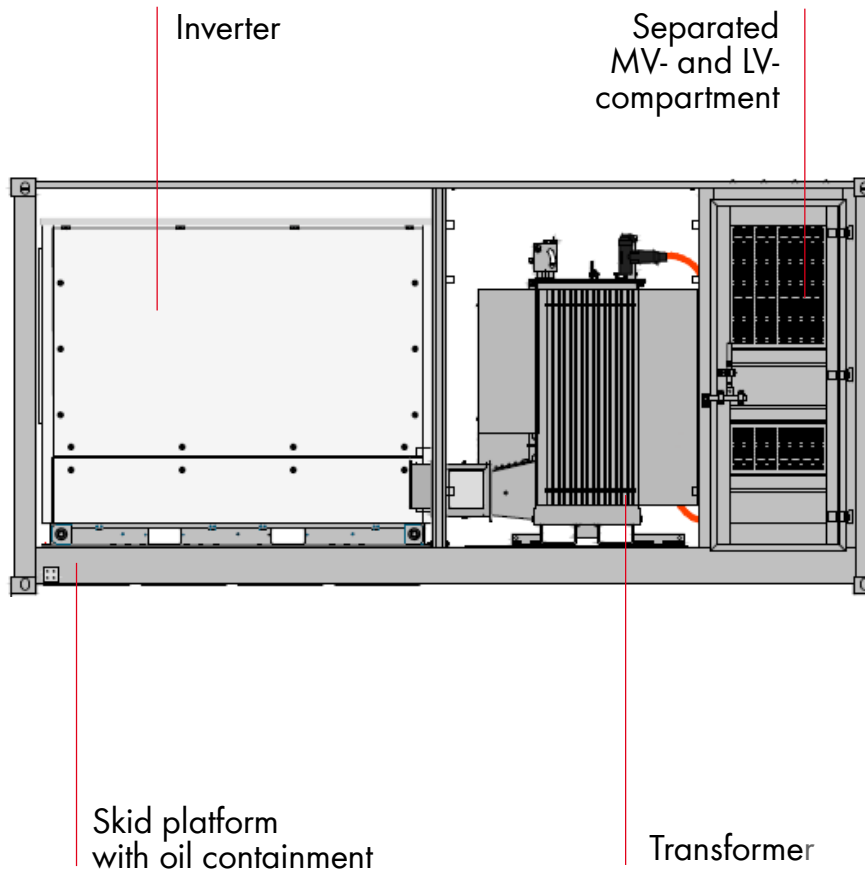
# SMA MVPS Portfolio Overview



MV Power Station (MVPS)	Sunny Central	Sunny Central Storage
MVPS-4600-S2-10	SC 4600 UP	SCS 3950 UP / SCS 3950 UP-XT
MVPS-4400-S2-10	SC 4400 UP	SCS 3800 UP / SCS 3800 UP-XT
MVPS-4200-S2-10	SC 4200 UP	SCS 3600 UP / SCS 3600 UP-XT
MVPS-4000-S2-10	SC 4000 UP	SCS 3450 UP / SCS 3450 UP-XT
MVPS-3060-S2-10	SC 3060 UP	SCS 2630 UP-XT
MVPS-2930-S2-10	SC 2930 UP	SCS 2530 UP-XT
MVPS-2800-S2-10	SC 2800 UP	SCS 2400 UP-XT
MVPS-2660-S2-10	SC 2660 UP	SCS 2300 UP-XT
MVPS-2900-S2-11	SC 2900	SCS 2900
MVPS-2475-S2-11	SC 2475	SCS 2900
MVPS-2200-S2-11	SC 2200	SCS 2200

S2 → S = Skid, 2 = 20 Foot  
10 → Version 1.0

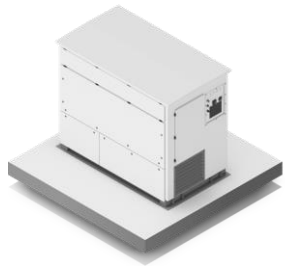
# SMA MVPS Technical Information



- Voltage Levels: 10 kV - 35 kV
- Frequency: 50 / 60 Hz
- Ambient Temperature: -40° to +55°C
- Dimensions (LxWxH):  
6.058m x 2.438m x 2.896m  
(20 foot high cube shipping container)
- Transformer Type: KNAN (biodegradable oil with natural air cooling)
- Switchgear: 1 Feeder / 3 Feeders



# SMA Products & Services for the RMIPPP

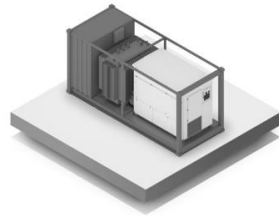


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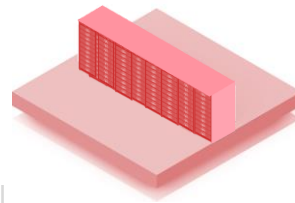
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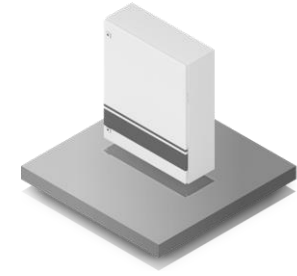
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# SMA: More Than 3 GW Experience in Battery Integration



Narada

EXIDE  
BATTERIES

CATL TOSHIBA

SAMSUNG SDI



SONY



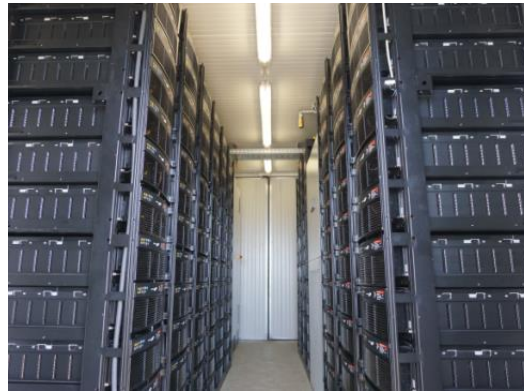
TESVOLT

GILDEMEISTER  
energy solutions

FIAMM

LG Chem

NGK



- SMA is battery technology agnostic as our inverters can be combined with all relevant storage technologies
- SMA has systems in operation with most Tier 1 Battery manufacturers
- Every Battery interface is thoroughly tested in SMA's in-house test center before approval for usage

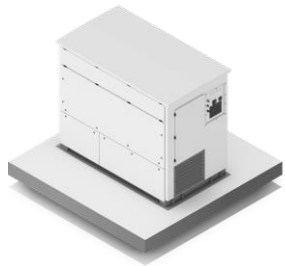
# Optional Scope on Batteries



- Battery selection and supply
- Battery Sizing
- Ensure production capacity before bid submission to avoid deliver delays in uncertain market conditions
- Set-up of augmentation strategy to ensure cost efficient capacity over the lifetime
- Negotiate performance warranty for up to 20years lifetime with battery manufacturer



# SMA Products & Services for the RMIPPP

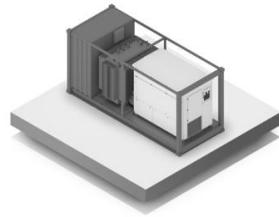


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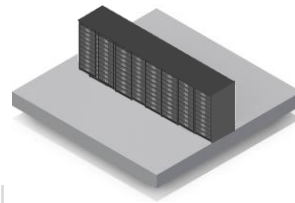
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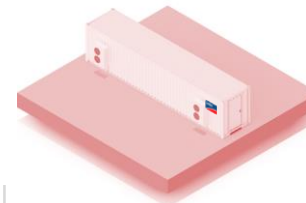
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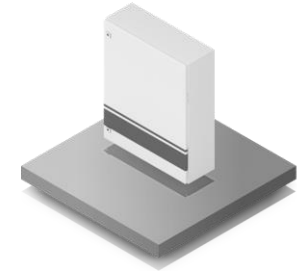
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Battery storage design and simulation, grid studies, detail engineering, project management and Know-how transfer



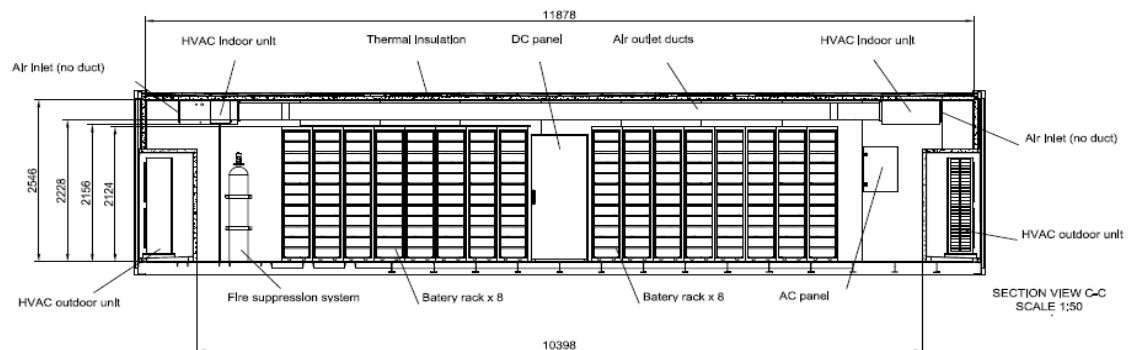
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# Battery Housing Portfolio



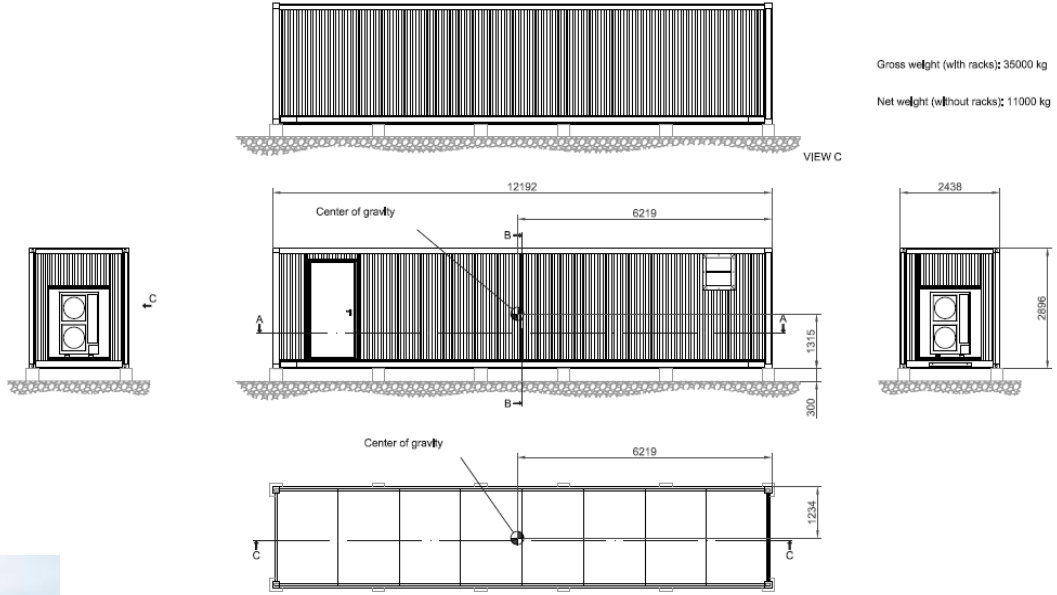
- Several housing options available
  - 20ft, 40ft, 45ft container
  - Prefabricated e-houses
- SMA can offer the following services
  - Supply and commissioning of battery container and e-houses
  - Consult clients during the battery housing supply and design



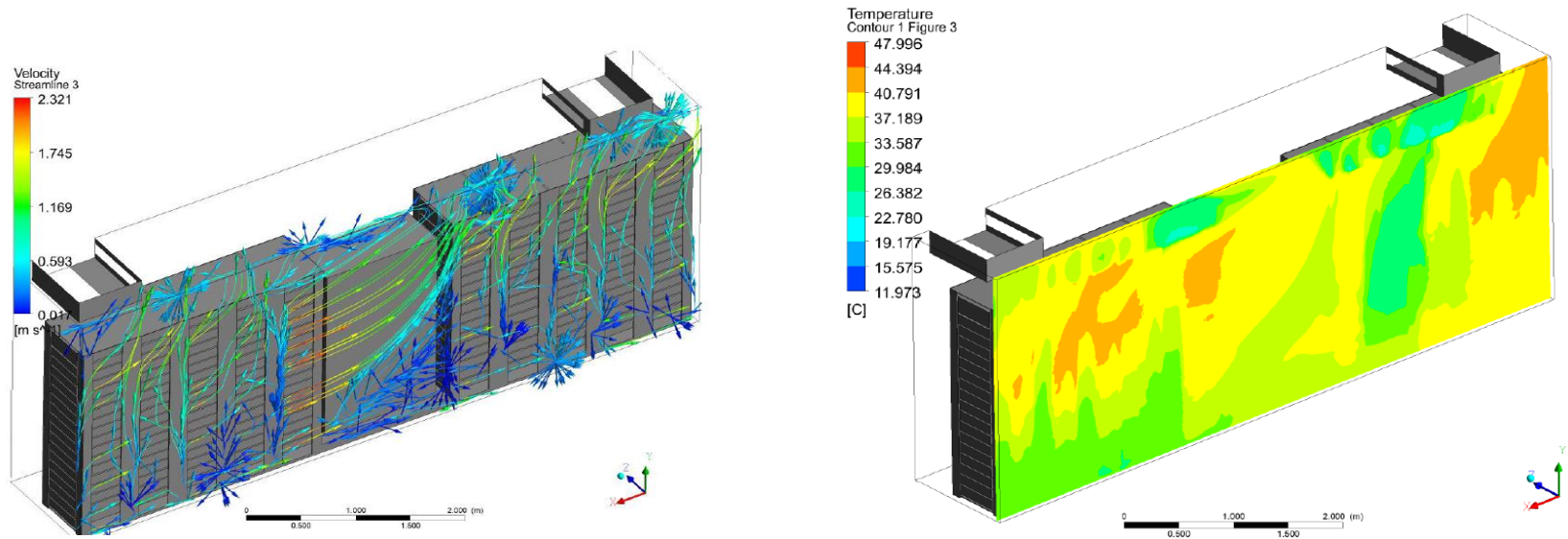
# Battery Housing Portfolio



Gross weight (with racks): 35000 kg  
Net weight (without racks): 11000 kg

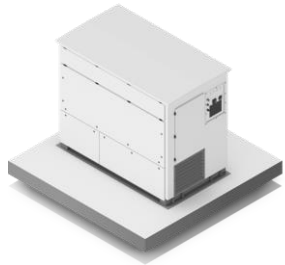


# Benefit from SMA's Experience in Battery Housing



SMA has gained a lot of experience in engineering the battery housing solution such as detailed engineering of air flow and temperature behaviour within the housing to ensure compliance with battery warranty conditions

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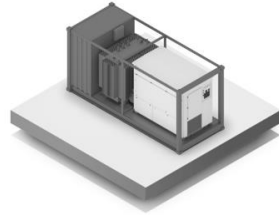


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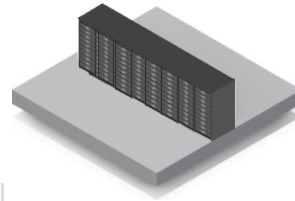
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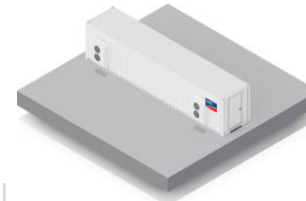
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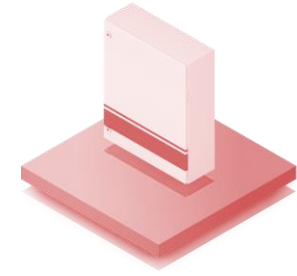
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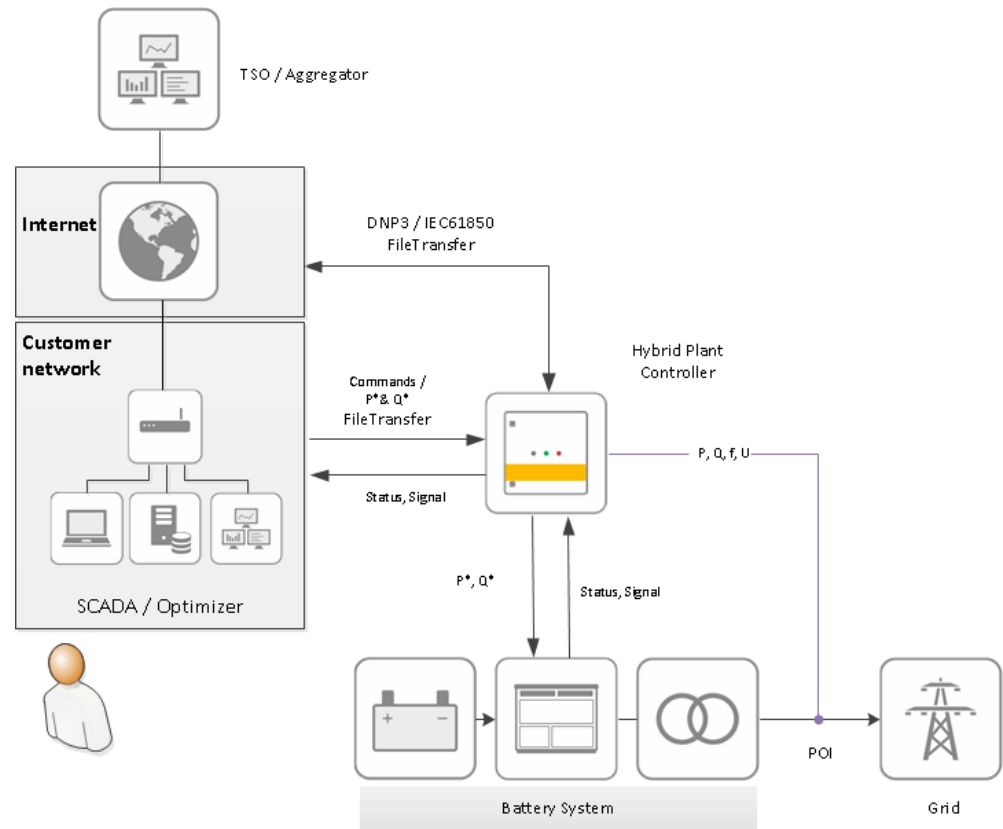


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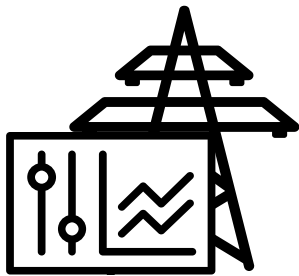
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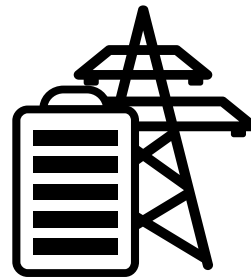
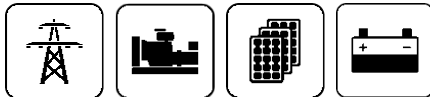
# Typical Communication Scheme



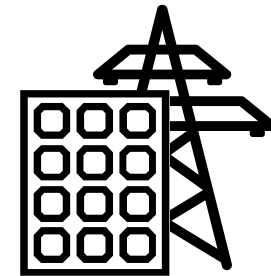
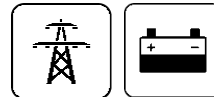
# Power Plant Manager/Hybrid Controller Applications



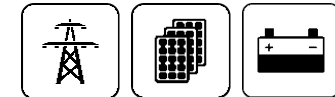
**Microgrid Management**



**BESS Grid Services**



**Renewables Integration**



# Forecasting system required



- The BESF Connection Code draft 5.1 foresees a forecasting system.
- 6 hour forecasts as well as day ahead forecasts are required

## **11.1. BESF owners Availability Values for BESF of Category B and C**

- (1) This section shall apply to *BESF of categories B and C*.
- (2) *BESF owner* shall make available the following signals for individual plants or subset of the signals if aggregated to the *NSP/SO* in the format and method specified by the *NSP/SO*:
  - a) Available discharging MWh, Available charging MWh, State of charge, Min SoC, Max SoC, Instantaneous Reserve Availability, Regulation reserve availability, Ten-minute Reserve availability, Supplemental Reserve availability day-ahead for a week for each hour before 10a.m.
  - b) Available discharging MWh, Available charging MWh, State of charge, Instantaneous Reserve Availability, Regulation reserve availability, Ten-minute Reserve availability, Supplemental Reserve availability for the next 6 hours updated hourly 10 to 20 minutes before the hour,
  - c) Available Mvar for the next 6 hours updated hourly 10 to 20 minutes before the hour.
- (3) The content of each forecast will be structured using XML tags. Examples are available on request. The format is subject to change.

# The World's Largest Energy Data Platform



## REPRESENTATIVE AND GLOBAL

**>1,500,000**  
connected devices

**400,000+**  
registered PV systems

**>180**  
countries



## UP-TO-DATE AND PRECISE

Live values are updated every  
**5 SECONDS**

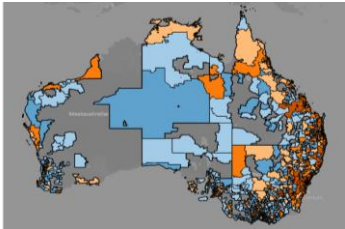
Up to **250**  
different measuring channels

--- 700 GB processed weather data per month --- 1 TB processed satellite data per month --- 20 Million forecasts calculated per month --- 1.117 Virtual servers --- 30 Billion events per month --- 36 TB database volume --- 720 Million incoming files per month --- 10 TB incoming data per month --- 3.8 Million logins per month --- 700 GB processed weather data per month --- 1 TB processed satellite data per month --- 20 Million forecasts calculated per month ---

# Configuration focused on your needs

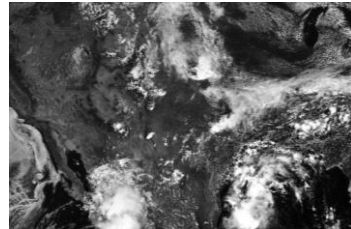


## Intra hour forecasting



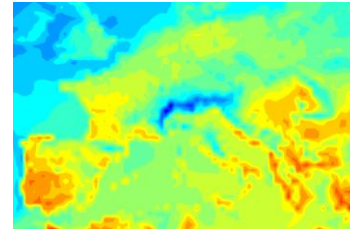
- Based on weather model ensemble, satellite measurements and live metering data
- Updated every 5 minutes

## Intraday



- Based on a weather model ensemble and satellite data
- 24 updates
- Horizon 24 hours

## Day ahead

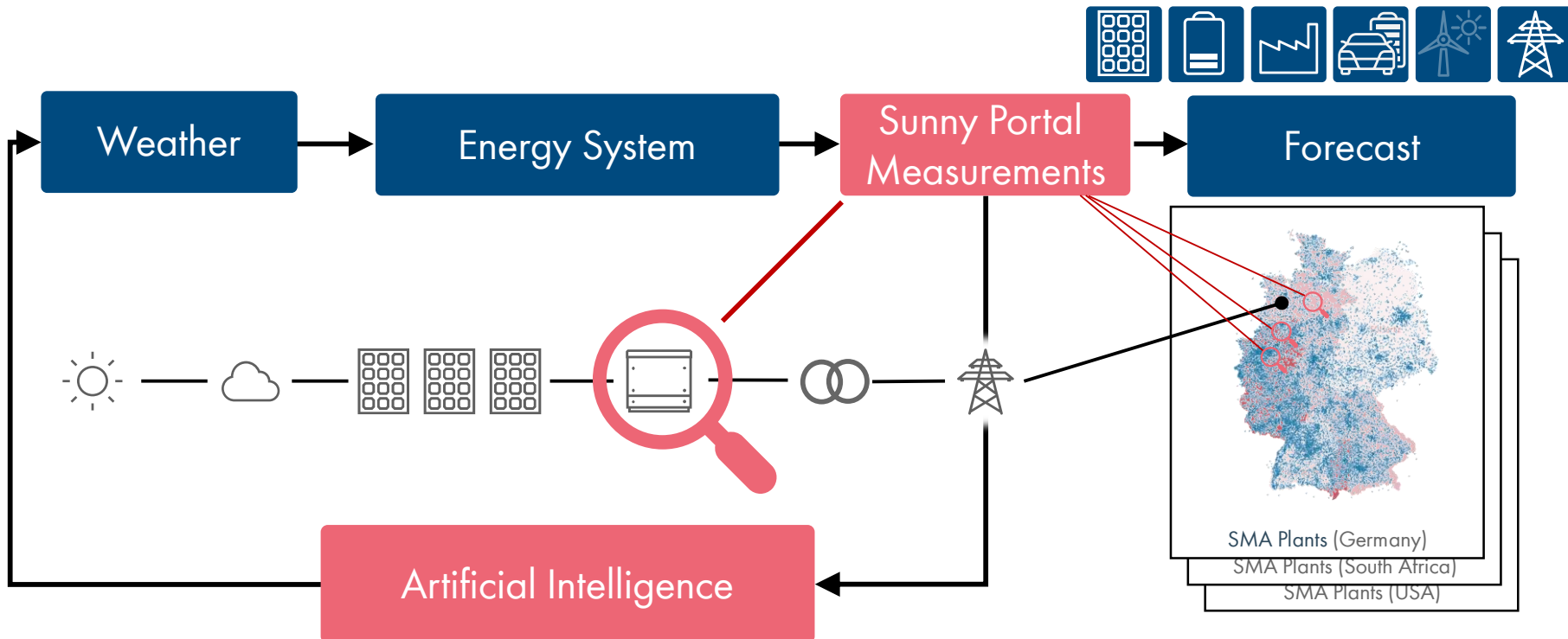


- Based on a weather model ensemble
- Horizon 24 hours of the next day
- Minimum of 4 updates till 12:00 a.m.

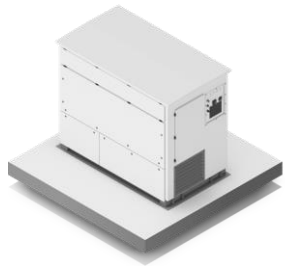
## Data interface

- SMA Datalogger
- API
- email
- FTP
- ...

# AI powered by Sunny Portal measurements drives forecast quality



# SMA Products & Services for the RMIPPP

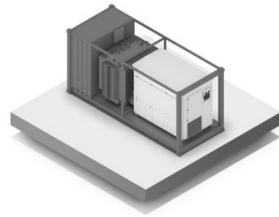


## I. Battery Inverters

2000 – 4600 kW

SMA first company with installed base > 3 GW

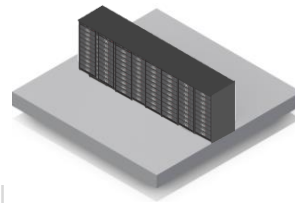
DC Coupling Ready for co-location of renewables



## II. MV Solution MVPS

4000 – 4600 kVA

Plug & Play 20' skidtainer with transformer, RMU and Sunny Central Storage inverters



## III. Batteries

SMA solution is technology and battery brand agnostic

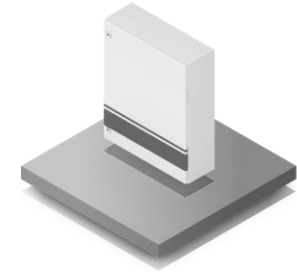
performance warranty up to 20 years and SOH 60%



## IV. Battery Housing

Customised and optimised specific project design

Cost effective, often locally manufactured e-houses or ISO containers



## V. Control & Monitor

Smart energy manager for communication and overall system monitoring

Controller for battery grid code compliance



## VI. Engineering & Project Management

Battery storage design and simulation, grid studies, detail engineering, project management and Know-how transfer



## VII. Service and O&M

Remote and on-site service, warranty extension, spare parts management, 24/7, full or partial O&M service, repowering

# Simulation Results for 50MW contracted capacity

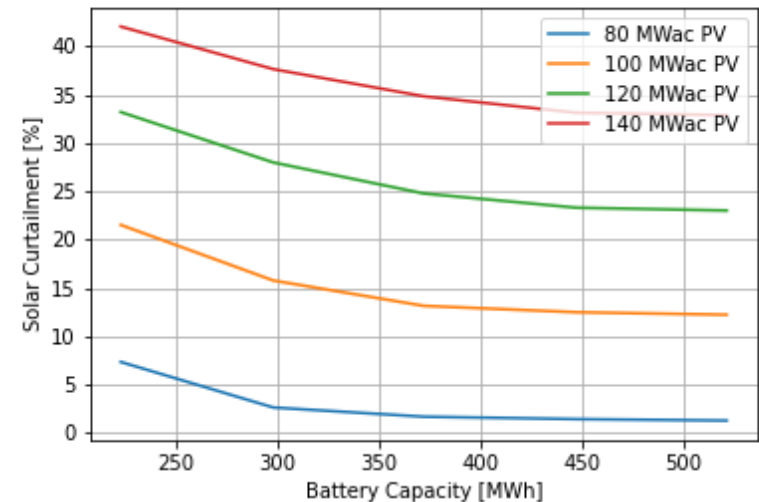
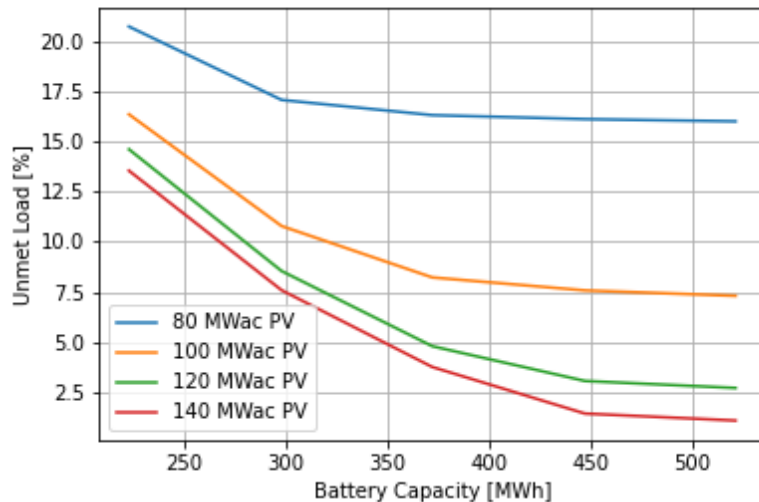


## Assumptions:

- Single Axis tracker in Uppington area
- DC/AC ratio 1,43
- AC coupled system
- Curtailment and unmet load for year 1

## Results:

- Only significant oversizing lead to unmet load of <2%
  - E.g. PV 140MWac, BESS >400MWh
  - Competitive?

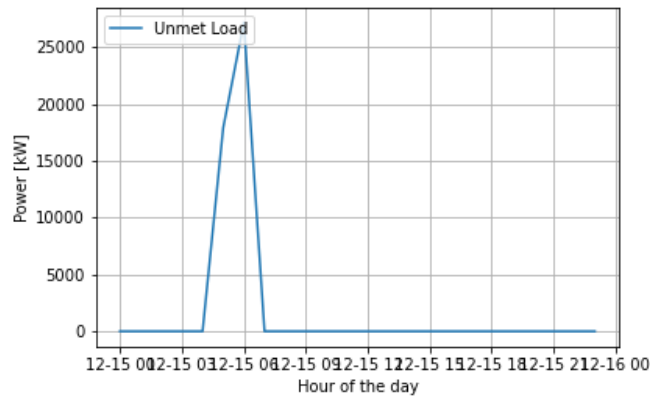




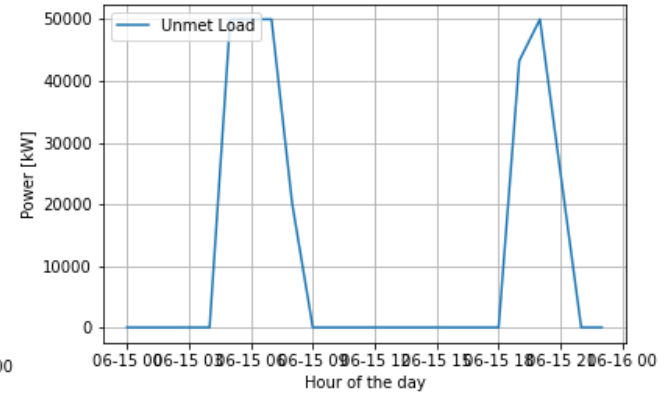
# Simulation Results for 50MW contracted capacity



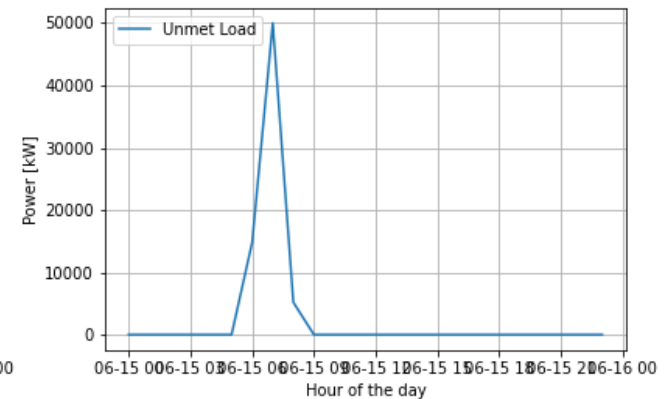
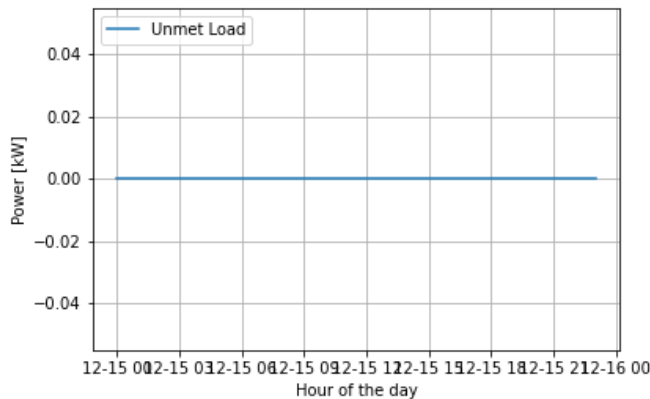
## Summer



## Winter



PV: 80MWac  
BESS: 223MWh  
Unmet load: ~20%



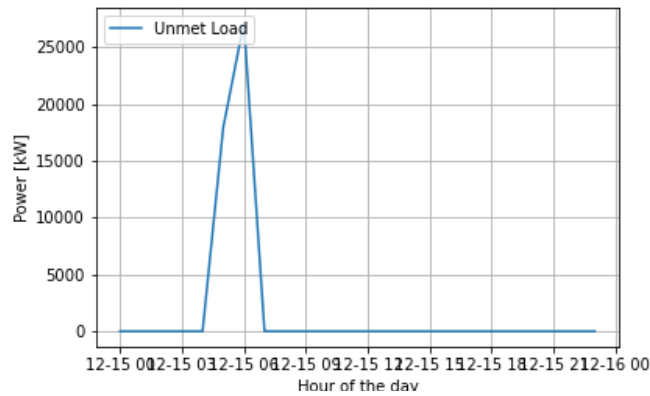
PV: 120MWac  
BESS: 372MWh  
Unmet load: ~5%

# Simulation Results for 50MW contracted capacity

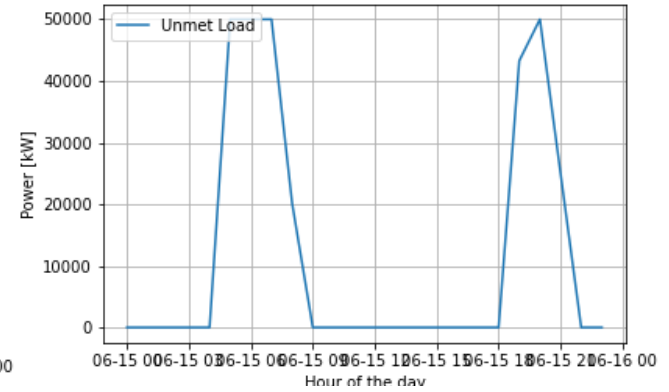


PV: 80MW<sub>ac</sub>  
BESS: 223MWh  
Unmet load: ~20%

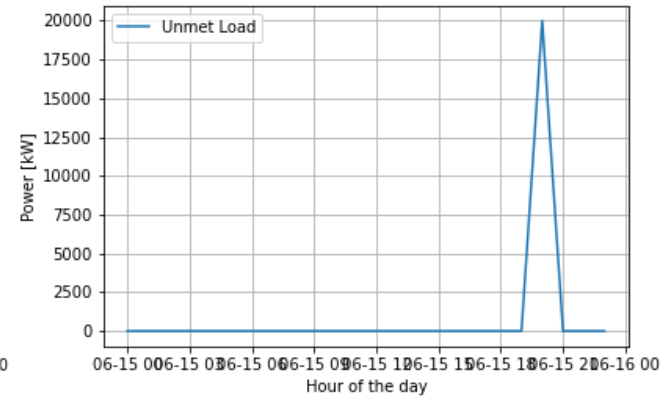
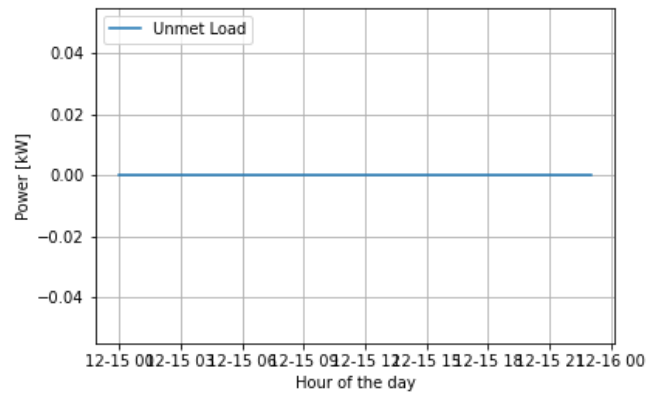
### Summer



### Winter



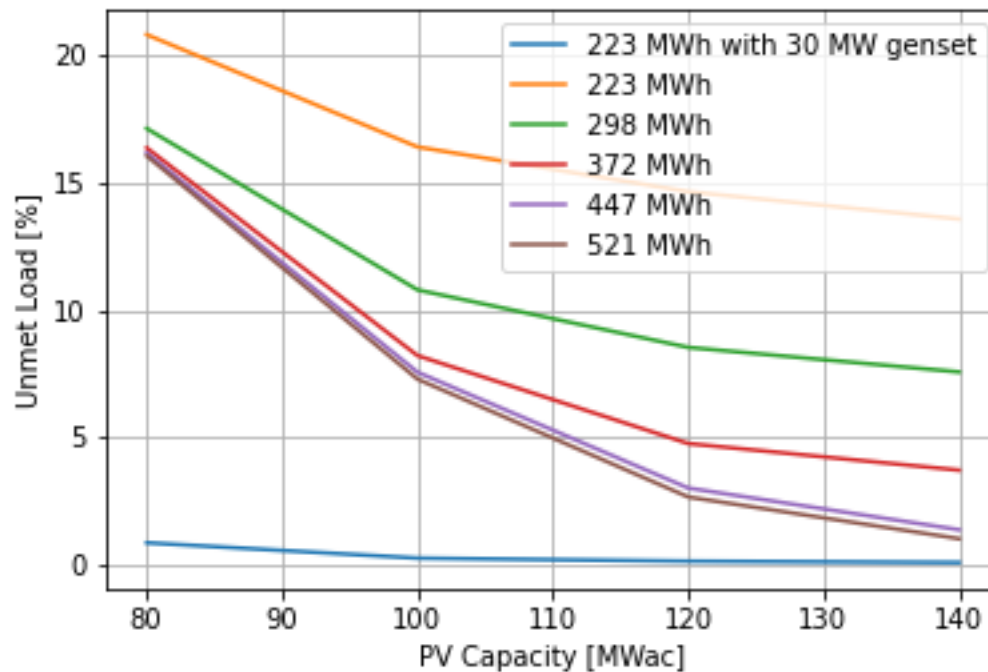
PV: 80MW<sub>ac</sub>  
BESS: 223MWh  
Genset: 30MW  
Unmet load: ~1%



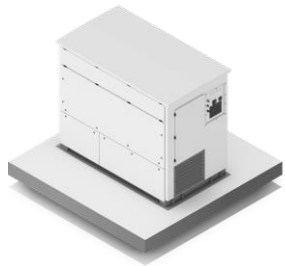
# Simulation Results for 50MW contracted capacity



Comparison of unmet load per year for different sizing options



# SMA Products & Services for the RMIPPP

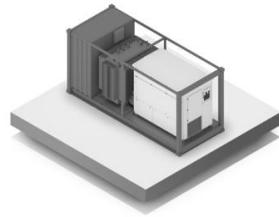


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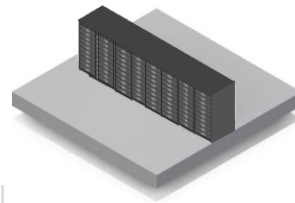
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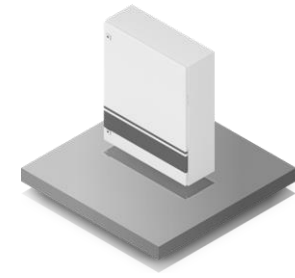
performance warranty up to 20 years and SOH 60%



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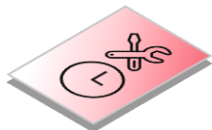
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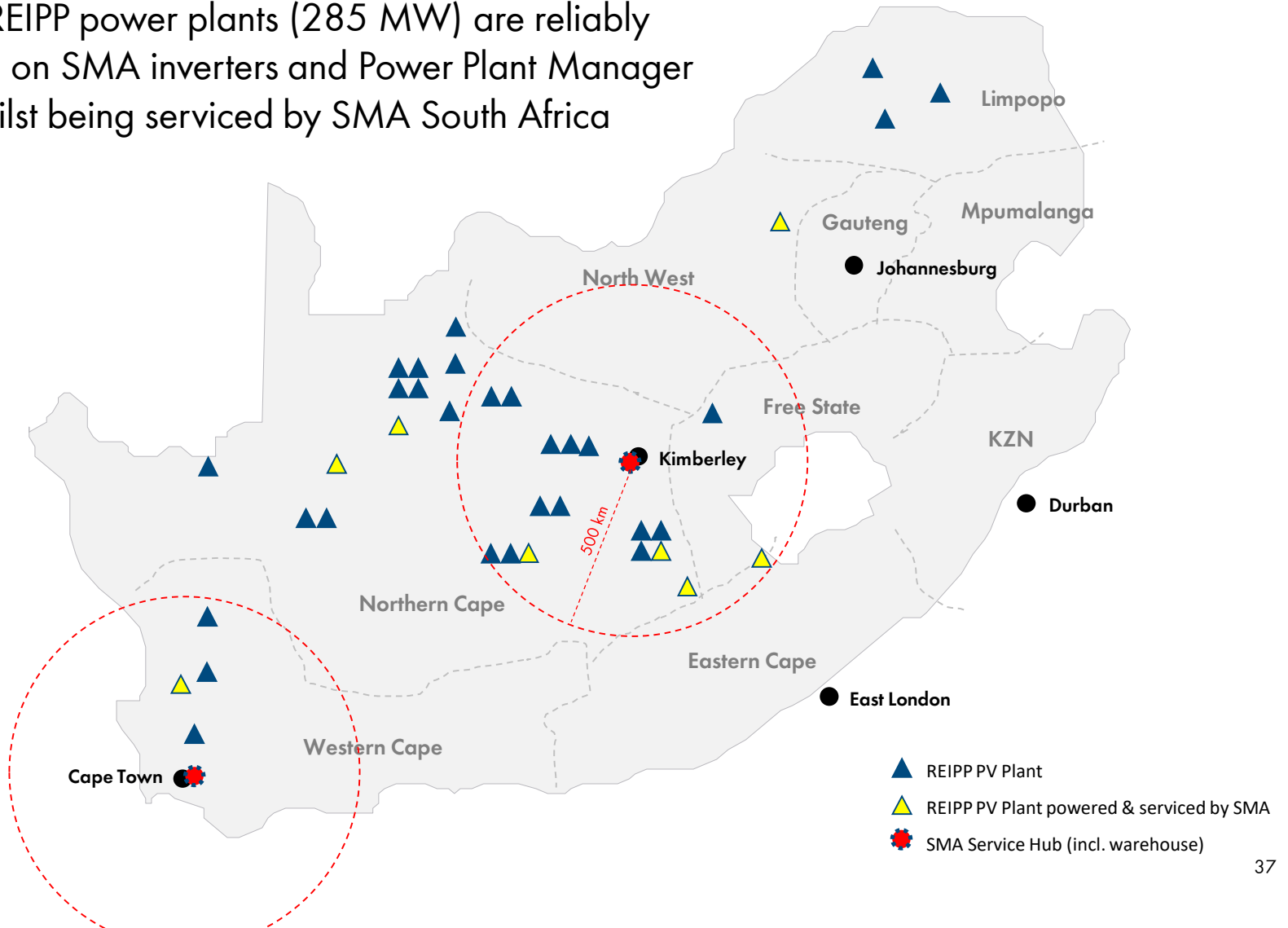
## VII. Service and O&M

Remote and on-site service, warranty extension, spare parts management, 24/7, full or partial O&M service, repowering

# SMA's unique and proven Service Team in South Africa



8 REIPP power plants (285 MW) are reliably run on SMA inverters and Power Plant Manager whilst being serviced by SMA South Africa



# Choose SMA in South Africa because ...



... we have **a local subsidiary** in Cape Town and Kimberley that features a team with **knowledge about the local market** conditions like B-BBEE and Local Content

... we have **long-lasting relationships with all major IPP's in South Africa** and our **equipment runs reliably** in local large-scale plants since 2013

... we **maintain service hubs with trusted staff and parts** in South Africa to **ensure highest availability** during power plant operation

... we run renowned **SMA Solar Academy courses** to train customers and their employees on SMA technology as well as **O&M of PV (+storage) plants**

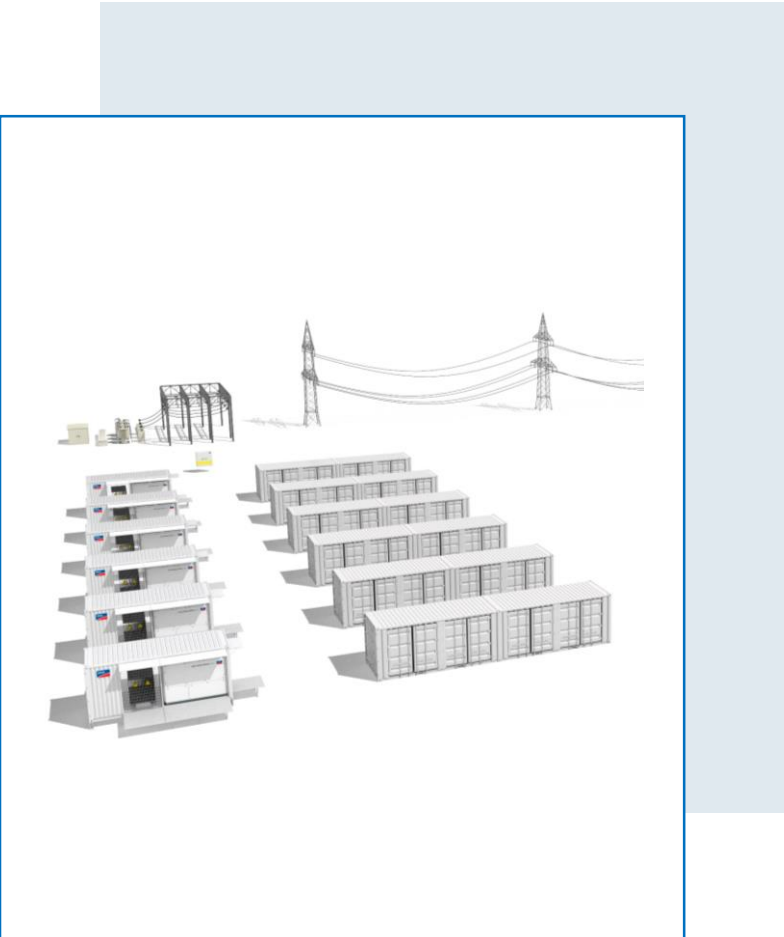
... we keep pumping power into the South African grid by utilizing our **Power Plant Manager/Controller** on local utility-scale plants, a device **fully compliant to the newest South African Grid Code**

The background of the slide is a wide-angle, high-angle photograph of a large-scale solar farm. The solar panels are arranged in long, parallel rows that stretch far into the distance, creating a strong sense of perspective. The sun is high in the sky, creating a bright lens flare effect that illuminates the scene. The sky is a clear, pale blue, and the horizon shows a line of trees and a flat landscape.

## SMA Lighthouse Projects

Large Scale Storage

# 1 GW SMA Battery Inverters shipped in 2019 alone



Location / Project	Power	Application
South Korea	24 MW	Freq Control
St. Eustatius, Caribbean	1 MW	Hybrid PV-Diesel integration
UK	100 MW	Freq Control
UK	60 MW	Capacity Market and Freq Control
UK	60 MW	Capacity Market and Freq Control
UK	33 MW	Capacity Market and Freq Control
USA	35 MW	Reactive Power + Freq Control
USA, Texas	22 MW	Freq Control
Canada	12 MW	Grid Peak Load Shaving
Germany	3 MW	Freq Control
Germany	6 MW	Freq Control
Cobija, Bolivia	2.2 MW	Hybrid PV-Diesel integration
Germany	6.3 MW	Freq Control
Australia	0.5 MW	Renewable smoothing & energy shift
Caribbean Island	4.4 MW	Offgrid Electrification - Grid forming
Caribbean Island	4 MW	Offgrid Electrification - Grid forming

## Selected References



# Pelham (UK)



The main application of the project is the capacity market and frequency response services but also features other applications like Triads management and reactive power provision.

This project is the largest battery project in the European Union in a single location till date.

The complete project timeline from contract signature till commissioning was reached within 5,5 months.

## Project

- Location: **Pelham, UK**
- Commissioning: **November 2017**

## Plant information

- Installed battery power: **64 MVA**
- Installed battery storage: **50 MWh of Li-Ion NMC batteries for frequency regulation**
- Batteries installed in customized containers
- Connected at 132 kV

## SMA System Technology

- 26 SMA Sunny Central Storage 2475 with noise reduction packages
- 26 Medium Voltage Block 2475
- 7 Customized SMA E-houses
- SMA Power Plant Controller
- EMS

# Langenreichenbach (Germany)



SMA's large scale on-grid project is a 16 MW prequalified PRL (Primärregelleistung – Frequency response) system.

The system is installed within a substation and connected at 33 kV to provide grid stability.

The project uses 25 MWh of batteries and is the second of a series of project of the same type.

## Project

- Location: **Langenreichenbach, Germany**
- Commissioning: **June 2018**

## Plant information

- 16 MW/25 MWh frequency response battery system in Germany
- Serves for frequency regulation at the grid via demand power/storage supply and provision of reactive power

## SMA System Technology

- 9 x SCS 1900 and 9 x MVPS 1900
- Plant Control and SCADA System
- Engineering, Technical Design, Consulting, Simulation and Sizing

# St. Eustatius (NL Antilles)



Today the solar plant covers 23% of the island's total energy requirement. The main challenge was the grid stability due to fast power fluctuations related to cloud movement.

SMA Sunbelt integrated a Li-Ion storage facility to absorb such fluctuations, provide energy shifting and frequency stability functionalities also at nighttime.

The observed solar fraction reaches 88% at midday.

## Project

- Location: Dutch Caribbean Island of St. Eustatius
- Commissioning: 2016
- Specific requirements: Exposure to salty air and hurricanes, fast cloud movement

## Plant information

- Installed PV power: 1,89 MWp
- Installed Storage: 1 MW, 570kWh
- Diesel Capacity: 4 MVA
- Annual energy yield: 3.200 MWh
- Reduction in CO2: 2.240 to
- Annual diesel savings: > 850.000 liters

## SMA Sunbelt Energy GmbH

- System design, simulation and engineering
- Procurement and delivery of entire control and storage system
- Training
- Commissioning and consulting during operation

# St. Eustatius (NL Antilles), Phase 2



An expansion of the first phase has been commissioned in 2017. The feature of the project is the diesel-off operation, which allows the island to switch off the generators during the day and run completely on the solar energy.

The system also included additional 2,15 MWp and 4,4 MW of grid forming battery inverters with 5,35 MWh of batteries

## Project

- Location: Dutch Caribbean  
Island of St. Eustatius
- Commissioning: October 2017

## Plant information

- Installed PV power: 2,15 MWp (in Phase 2)
- Installed battery power: 4 MW/ 5357 kWh
- Diesel generator rating: 4 MVA
- Renewable penetration: 47%

## SMA System Technology

- SMA Fuel Save Controller
- 2 SMA Sunny Central Storage 2200 (grid forming)
- 2 SMA Sunny Central CP 1000 XT

# French Polynesia



SMA Sunbelt has been contracted to provide a PV-Diesel-Battery plant on an Island in the French Polynesia.

The plant features the grid forming SMA battery inverters to allow diesel-off operation during the daytime. The project aims to achieve a renewable fraction of over 60% on a 24h basis.

The control and battery inverter system allows for grid forming and blackstart of diesel generators in the island.

## Project

- Location: **French Polynesia**
- Commissioning: **August 2018**

## Plant information

- Installed PV power: **1,3 MW**
- Installed battery power: **2 MW**
- Installed battery storage: **2,7 MWh**
- Diesel Generator: **6X 160 kW**
- Renewable Fraction: **62%**

## SMA System Technology

- 1 SMA Sunny Central Storage 2200
- 16 Sunny Tripower 60
- 6 Sunny Tripower 25000TL-30
- 1 SMA designed battery container
- SMA Fuel Save Controller

A vibrant, sunlit scene at a water park. In the foreground, two people are standing on a wooden platform, splashing water. In the background, a person is captured mid-air, performing a backflip. The scene is filled with lush green trees and bright sunlight, creating a warm and energetic atmosphere.

# Thank you!

**SMA Solar Technology AG**  
**SMA Sunbelt Energy GmbH**

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34266 Niestetal, Germany

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info@SMA.de