

Flagship Project in the Caribbean – PV Hybrid System on the Island of St. Eustatius

Allowing High Penetration of Renewable Energy



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Panel Experience Exchange: Best Practice of Solar Projects Worldwide
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1 Introduction: PV Hybrid System Technology

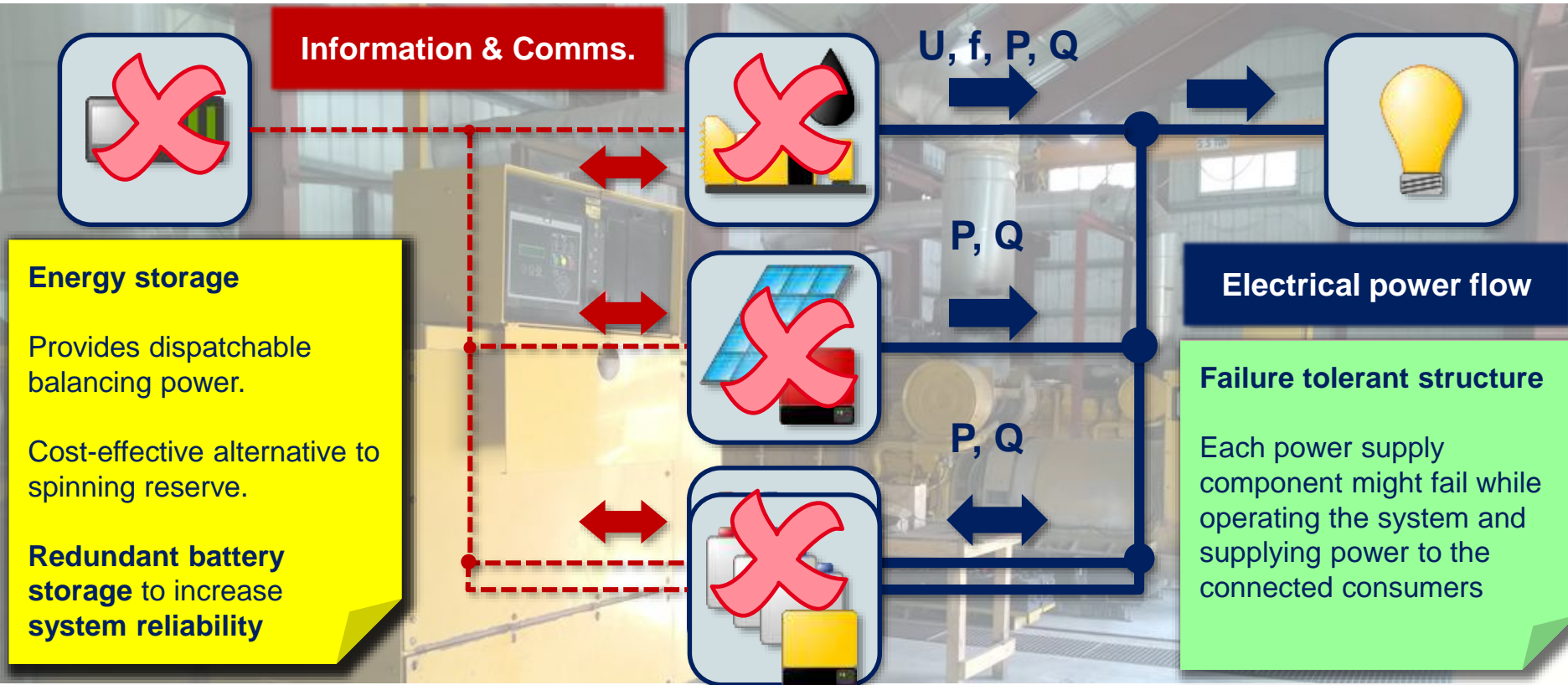
2 St. Eustatius – Flagship Project in the Caribbean

3 Second Phase – Finally Switching the Diesel off

4 Summary and Conclusion



Hybrid Systems Provide Security of Supply



At a Glance



1

Introduction: PV Hybrid System Technology

2

St. Eustatius – Flagship Project in the Caribbean

3

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Showcase: MW-Scale Hybrid Power plant in St. Eustatius



Up to 88 % of the island's
power demand by PV!

4 MW installed genset
capacity in 6 units

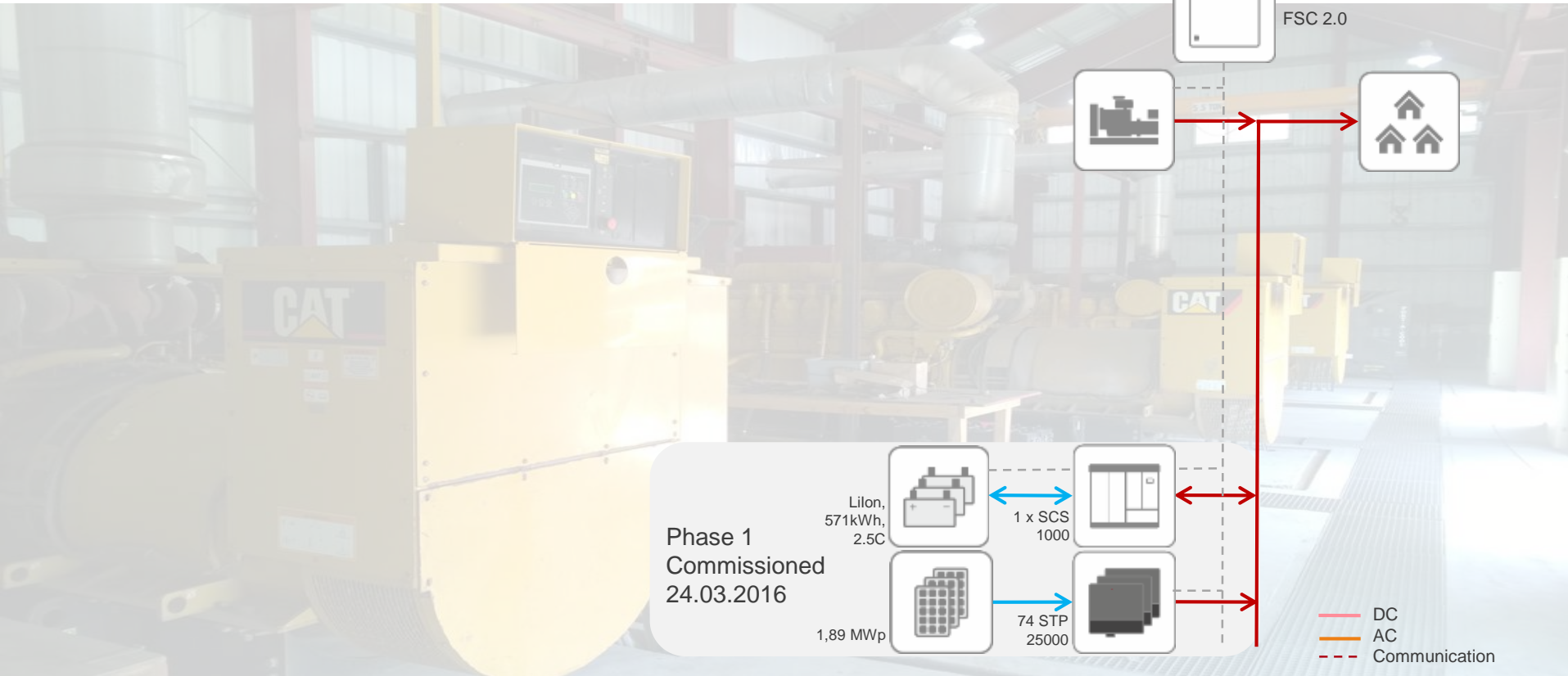
4,15 MWp Photovoltaics

5.4 MW (5,9 MWh) Li-Ion
energy storage



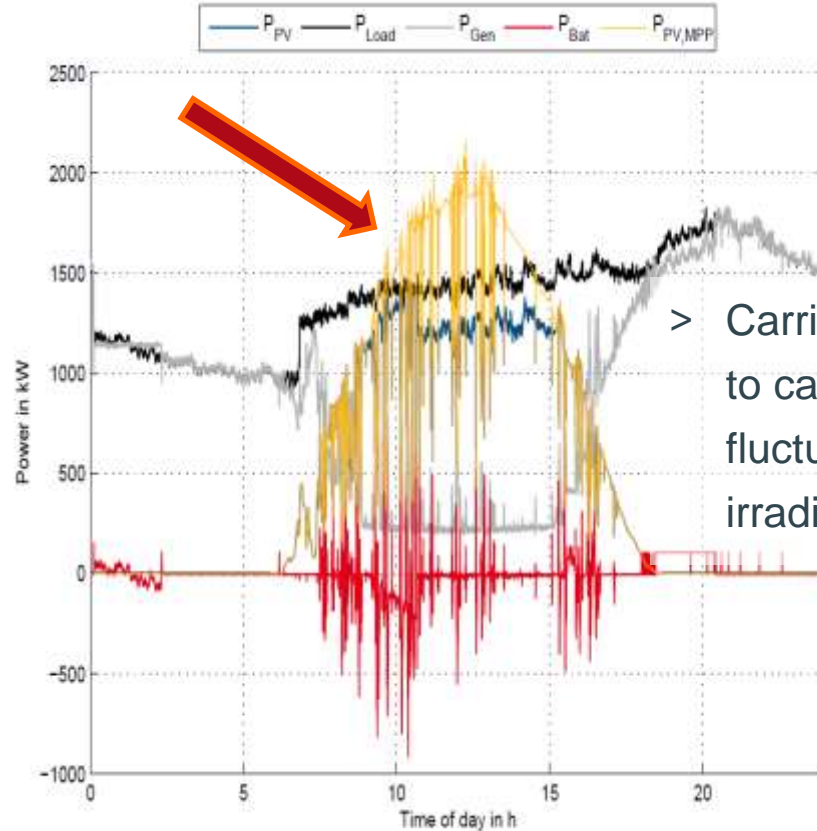
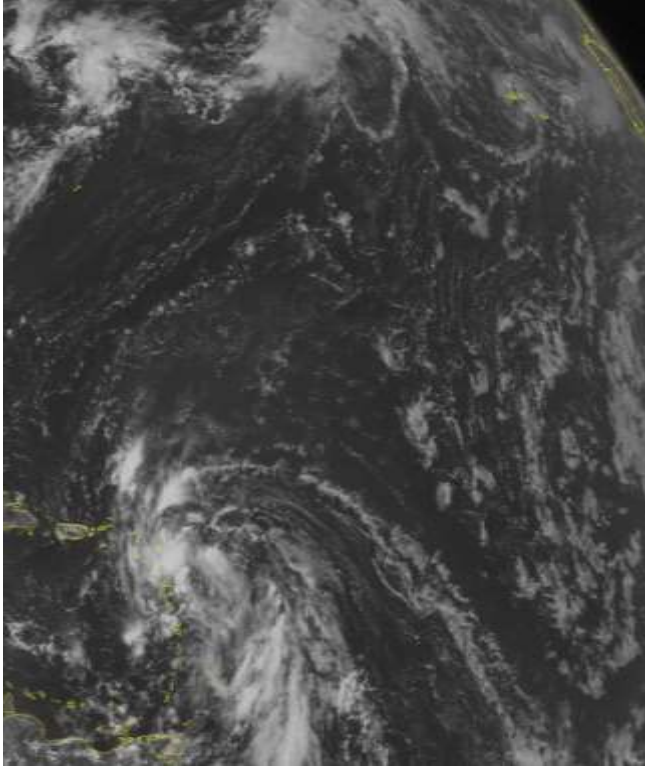
Solar and Storage in Statia

Technical Overview Phase 1



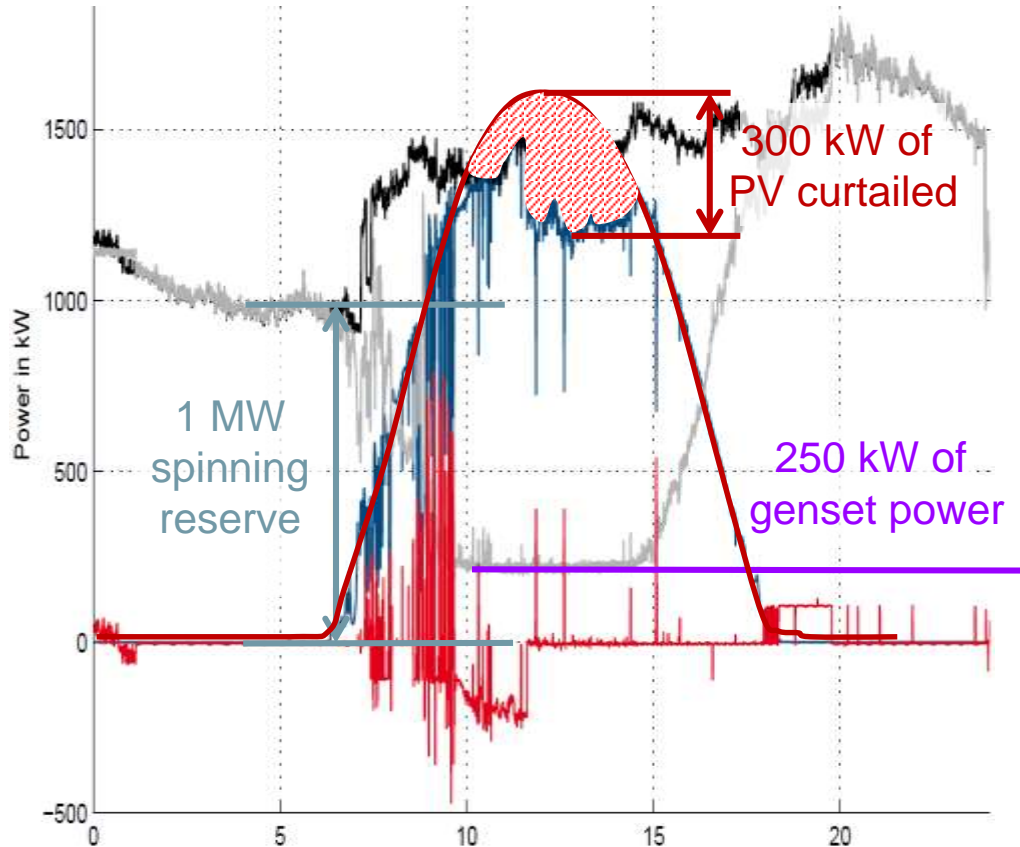
Typical Day in the Caribbean: Rapidly Moving Clouds

Origin: <https://www.yahoo.com/news/airlines-cruise-ships-monitoring-caribbean-system-192404430.html>



System Operation **With Battery**

Real Data From April 3rd, 2016



- > Required average genset capacity reduced to approx. **250 kW** during PV generation hours
- > Spinning reserve requirements mostly covered by the battery!
 - ⇒ Diesel gensets only to cover the gap between load and current generation plus battery capacity
- > PV generation curtailment reduced to the minimum

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3

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4

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Visual Comparison Phase 1 vs Phase 2



Solar and Storage in Statia: Technical Overview Phase 2



GRID FORMING BATTERY INVERTERS

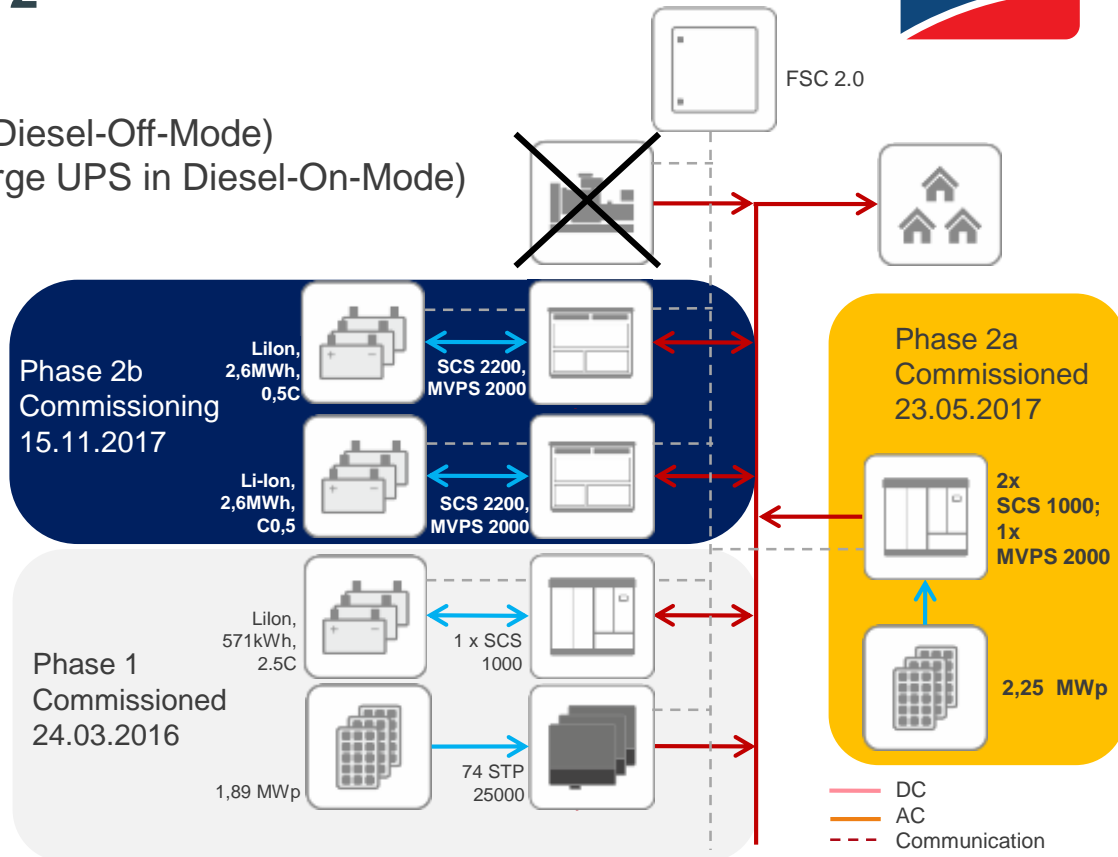
Day operation without Diesel Generators (Diesel-Off-Mode)

Full redundancy for generator operation (large UPS in Diesel-On-Mode)

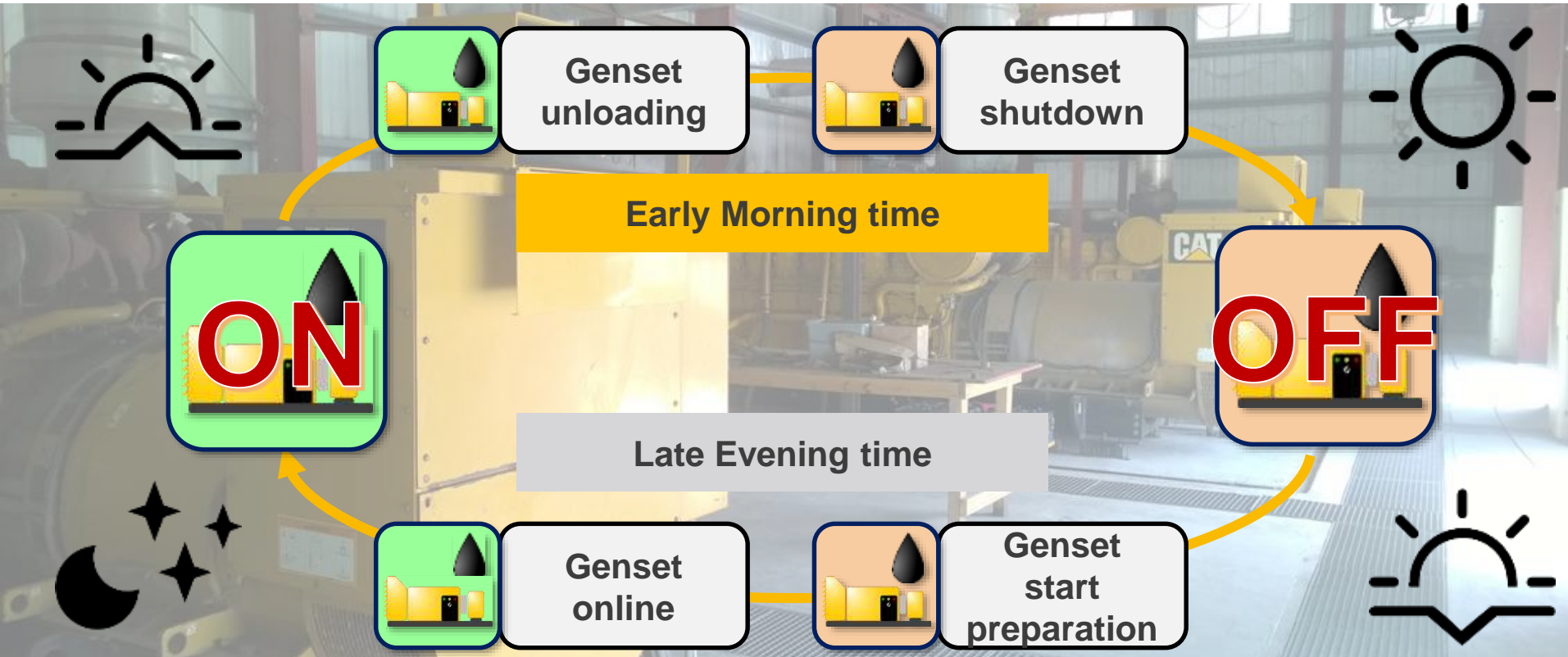
- **Voltage source**
- Frequency regulation
- Spinning Reserve Provision
- Synchronisation Diesel On-Mode/
Diesel Off-Mode

St. Eustatius II

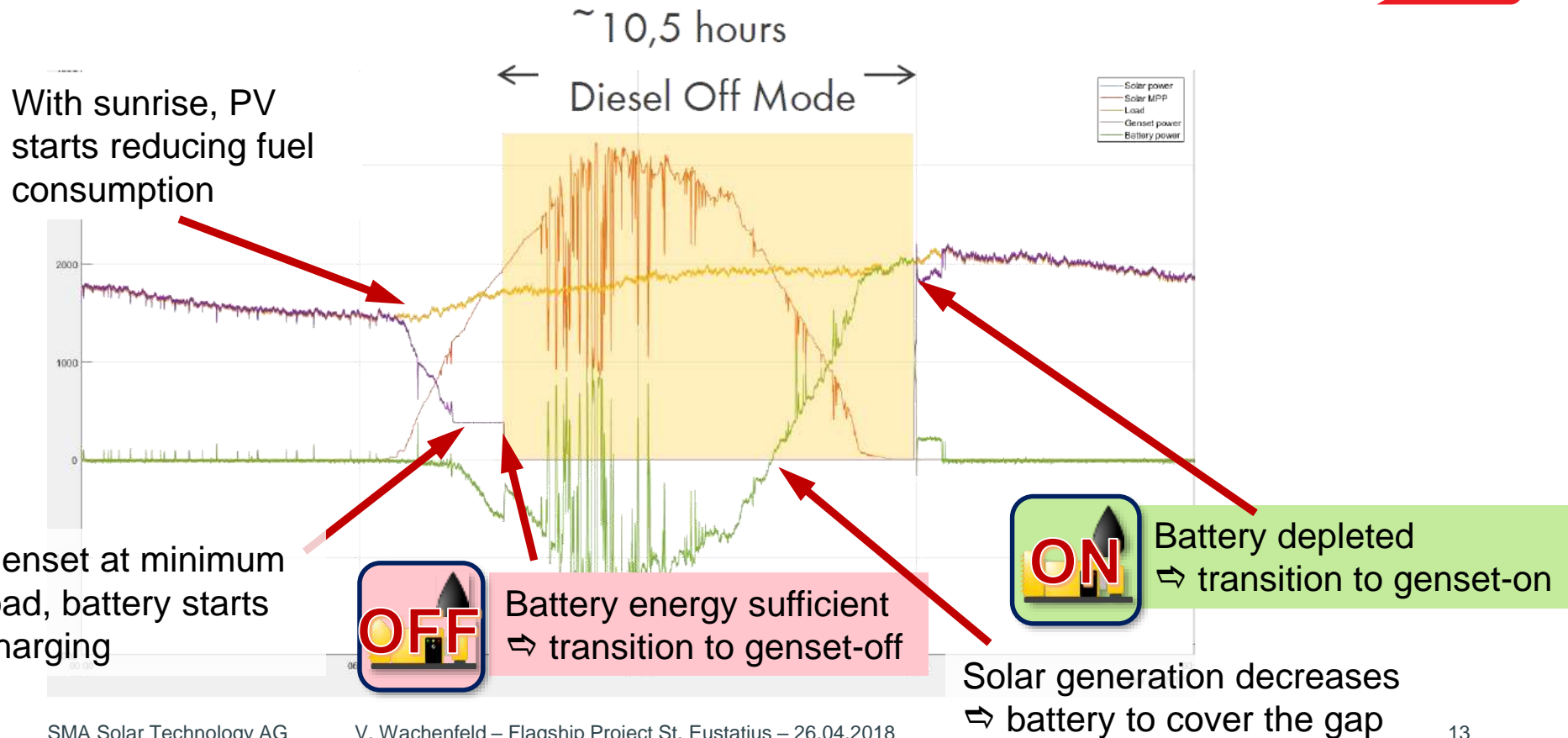
Estimated fuel savings	1 728 000 liters/a
Solar Energy Produced (net)	6,4 GWh /a
CO2 savings	4,561 to CO ₂ /a
Used PV energy	6 494 547 kWh
Solar energy fraction	46%



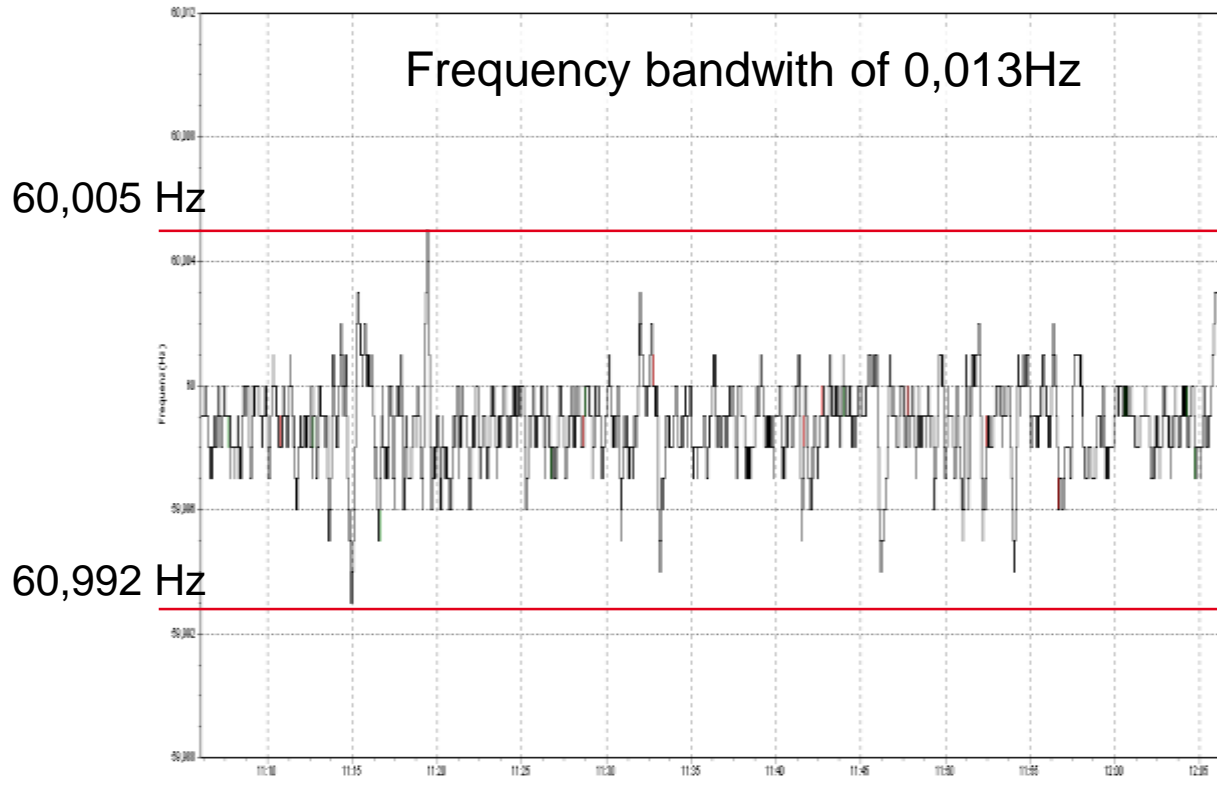
Operational Concept: Dynamic Genset Shutdown by Fuel Save Control



Solar and Storage in Statia – Typical Day “Diesel Off Mode”



Frequency Stability in Diesel Off Mode



- > Recording on 31.10.2017 from 11.00 am to 12.05pm during step load tests
- > **Result:** Frequency deviation during load steps less than 10 mHz!!

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Increased PV Penetration

Achievements on ST. EUSTATIUS

- > **Automatic** Genset Control and **transition to Diesel Off-Mode** and Diesel On-Mode
- > **Integration** of all components and **existing genset infrastructure** into control scheme
- > **Co-generation** with Diesel in Diesel-On Mode
- > Voltage and frequency source in **hot-standby for uninterrupted power supply** also at night (UPS function)
- > 3 layer built-in **redundancy concept**
- > **Short circuit clearance in 120ms**
- > **European grid quality** ($\pm 0.005\text{Hz}$ deviation)



Award Winning Project

SMA

