

The background of the slide features a photograph of two men standing in a field of tall grass. The man on the left is wearing a white hard hat and a red long-sleeved shirt. The man on the right is wearing a dark blue polo shirt and is holding a laptop, pointing at the screen. The scene is set against a bright, hazy sky. Overlaid on the image are several large, semi-transparent blue diagonal stripes.

PV Magazine Webinar Reasons for Repowering

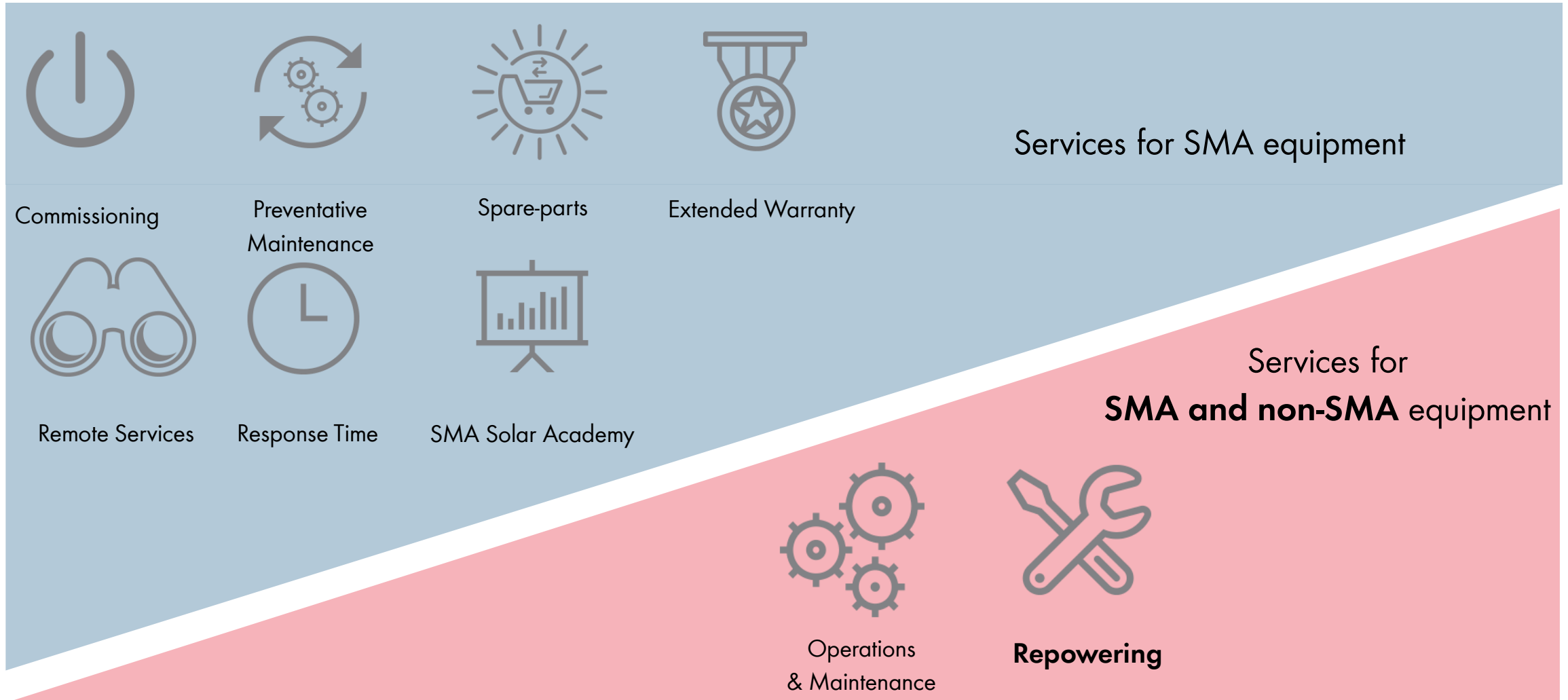
Presented by Behnam Rassekh Afshar
& Thorsten Höfer

We Listen To You

- Constant exchange with our customers for more than 40 years
- Accompanying our customers throughout the entire lifecycle of the plant
- Listening to customer's needs and pains and developing our services accordingly



Never Walk Alone – SMA Services



What Is Repowering?



- Partially or complete change of the existing installation
- Important to maintain the performance
- Higher yields - module degradation plus wear and tear of hardware impact the yield of the installation



Reasons For Repowering?

1. Real inverter performances differ from the expected performance (Efficiency, Availability)
2. Decrease in components reliability and availability
3. Low performance of service and support
4. OEM of original inverter went out of business



Assessing What's In It For You



- Helping asset owners **understand repowering project** implications in **financial terms**
- Financial model for **solid investment decision**
- **Individual development** of future business model according to **customer's commercial expectations**
- **Individual cost-benefit analysis** of repowering investment costs
- Possibility to conduct **sensitivity analysis**

Repowering Business Model – KPIs At A Glance



For your assessment or further internal decision making, we analyze three markers:

- Internal Rate of Return (IRR)
- Net Present Value (NPV)
- Break Even Period

Repowering Business Model – Sensitivity Analysis



IRR Sensitivity		Merchant Tariff			
Tariff Duration	2,3%	0,04€	0,05€	0,06 €	0,07 €
	1	- 1,98 %	- 1,98 %	- 1,98 %	- 1,98 %
	2	- 0,41 %	- 0,33 %	- 0,25 %	- 0,17 %
	3	0,26%	0,37 %	0,47 %	0,57 %
	4	0,86 %	0,98 %	1,10 %	1,21 %
	5	1,40 %	1,53 %	1,66 %	1,78 %
	6	1,88 %	2,02 %	2,15 %	2,28 %
	7	2,31 %	2,45 %	2,59 %	2,72 %
	8	2,69 %	2,84 %	2,98 %	3,11 %

First analysis is impact of merchant tariff and project lifetime on IRR

IRR Sensitivity		
CAPEX	€ 1.834.989	2,31 %
	€ 1.822.489	2,41 %
	€ 1.809.989	2,60 %
	€ 1.797.489	2,91 %
	€ 1.784.989	3,33 %
	€ 1.772.489	3,89 %
	€ 1.772.489	4,62 %
	€ 1.759.989	5,55 %

Second analysis is impact of total repowering project cost (estimate) on IRR



Where does repowering engineering start?
At www.SunnyDesignWeb.com



Cancel

Change the manufacturer and type of PV module

OK

You can select the manufacturer and type of PV module here. The magnifying glass symbol can be used to open the PV module search.

Change all PV arrays

Only take current PV module into account


Module selection

 Detailed search


 Favorites

 Add new PV module

Manufacturer

Sharp 

PV module

NU-185 (E1) (06/2007) 

Type	PV array 1 26780/26780	Displacement power factor $\cos \varphi$	Limitation of AC active power																																													
2 x SC 2200-10 PV system section 1 PV/Inverter compatible	A: 515 x 26	1.00	2200.00 kW																																													
Peak power: 4.95 MWp Nominal power ratio: 91 % Energy usability factor: 97.8 %																																																
Performance		PV/Inverter compatible																																														
Nominal power ratio: 91 % 		<table border="1"> <thead> <tr> <th>Parameter</th> <th>Inverter</th> <th>Input A</th> <th>Input B</th> <th>Input C</th> </tr> </thead> <tbody> <tr> <td>Max. DC power</td> <td>2.25 MW</td> <td>2.48 MWp</td> <td></td> <td></td> </tr> <tr> <td>Min. DC voltage</td> <td>570 V</td> <td>535 V</td> <td></td> <td></td> </tr> <tr> <td>PV typical voltage</td> <td></td> <td> 583 V</td> <td></td> <td></td> </tr> <tr> <td>Max. DC voltage (PV module)</td> <td>1000 V</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Max. PV voltage</td> <td></td> <td> 872 V</td> <td></td> <td></td> </tr> <tr> <td>Max. operating input current per MPPT</td> <td>3960 A</td> <td> 3970.7 A</td> <td></td> <td></td> </tr> <tr> <td>Max. input short-circuit current per MPPT</td> <td>6400 A</td> <td></td> <td></td> <td></td> </tr> <tr> <td>PV max. circuit current</td> <td></td> <td> 4398.1 A</td> <td></td> <td></td> </tr> </tbody> </table>		Parameter	Inverter	Input A	Input B	Input C	Max. DC power	2.25 MW	2.48 MWp			Min. DC voltage	570 V	535 V			PV typical voltage		583 V			Max. DC voltage (PV module)	1000 V				Max. PV voltage		872 V			Max. operating input current per MPPT	3960 A	3970.7 A			Max. input short-circuit current per MPPT	6400 A				PV max. circuit current		4398.1 A		
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Inverter efficiency: 98 % 																																																
Annual energy yield: 4,690.12 MWh Spec. energy yield: 947 kWh/kWp Performance ratio: 82.5 % Full load hours: 1065.9 h Line losses (in % of PV energy): --- %																																																



PV array 1
26780/26780

Displacement power factor $\cos \varphi$

Limitation of AC active power
2200.00 kW

Cancel **Configure strings** OK

Here, the connected PV array with the number and length of the strings can be configured for each DC input of the inverter. The possible values are shown in the entry fields.

Nominal power ratio: 91 % Peak power: 4.95 MWp

135 % 81 % Number of PV modules: 26780

Input	PV array	Strings	PV modules	Total
A	PV array 1	< 515 > (1...749)	X < 26 > (26...29)	13390

+ Connect an additional PV array to the input (Polystring) i

Full load hours: 1065.9 h PV max. circuit current ✓ 4398.1 A

Line losses (in % of PV energy): --- %

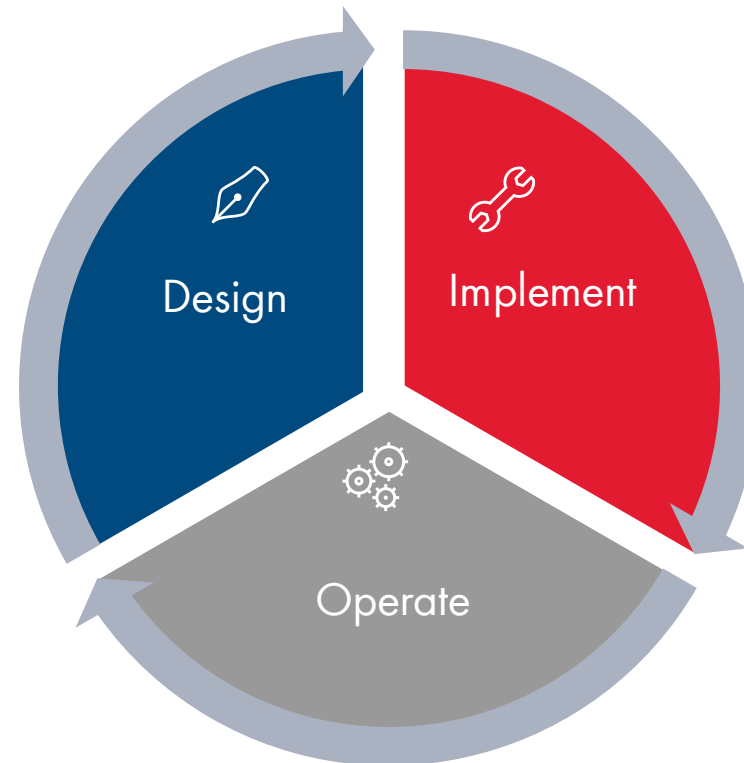
More Than Just Hardware Replacement



Engineering Services

You can trust our expertise and experience to analyze your plant thoroughly. SMA has 40+ years of technical development excellence and outstanding ability to customize solutions.

- Engineering Services
- Performance and potential analysis
- Technical feasibility
- Planning recommendation



Technical implementation

Customization of hardware exchange and technical implementation by expert technicians.

Service & Support

Attain peace of mind with our regional service team presence and chose your ideal warranty and O&M package.



SMA Repowering: simply MORE

Repowering Compatibility Guide



Finding Your Perfect Match Repowering Compatibility Guide



- Repowering possibilities at a glance
- Straight forward solution guide
- Most common inverters for repowering

Repowering Made Easy



Technical Data	Power Electronics Freesun FS 1001H	14 x SHP Peak3 100-20	Eaton Power Xpert Solar 1670	Sunny Central 2200-US
Input (DC)				
MPP voltage range V_{DC} (@25°C)	467 - 900 V	512 - 1000 V	550 - 800 V	522 - 950 V
Max. input voltage $V_{DC,max}$	1000 V	1000 V	1000 V	1000 V
Max. input current I $I_{DC,max}$	2000 A	2520 A	3100 A	4100 A
Output (AC)				
AC voltage	330 V	347 V	357 V	357 V
Nominal AC power @ $\cos \Phi = 1$	1000 kW	1000 kW	1667 kW	1667 kW
Nominal apparent AC power	1000 kW	1000 kW	1850 kW	1850 kW
Replace existing nameplate power	Yes		Yes	
Reuse existing transformer	Yes		Yes	



Repowering of Kaco central inverter



Repowering of Bonfiglioli central inverter



Repowering of Schneider
central inverter with low
MPP start voltage

Everything At A Glance



- The global **repowering demand increases**
- Due to **innovative portfolio** we cover **all types** of existing **installations**
- **SMA** holds a huge opportunity on **additional services** to **safeguard the future of your installation and investment** e.g.:
 - **Spare parts** availability
 - **Remote services** and monitoring
 - **Warranty extensions**
 - Availability **guarantees**

Everything At A Glance



- Updating the hardware does also allow to provide grid support, like reactive power, where monetarized
- **Globally** available dedicated **project and engineering team**
- Unprecedented technical expertise offered via **Engineering Services**

Interested in repowering your plant?



There is a dedicated team to assist you with all your questions

- It starts with your dedicated account manager
- Your local service sales manager

or contact us via repowering@sma.de