

Photon Energy Operations Smart Operations & Maintenance

- Oradea, Romania, 14.11.2018

Lauru Bădiță – Country Manager O&M

PHOTON ENERGY GROUP

A global solar power solutions and services company

- **Wide ranging expertise** covering the entire lifecycle of solar power systems:

- Project Development
- EPC solutions
- PV module & inverter distribution
- Project finance & insurance
- Power Production with 26 MWp
- Operations & Maintenance
- Inverter Cardio
- Photon Energy Control
- Investment protection

- Active in **15 countries** across **2 continents**

- Available in **Romania** near **Oradea** with **15 MWp**

- **50 MWp** of PV solar power plants commissioned in **6 countries**

- O&M services provided for **220 MWp** across **two continents**



- Technology supplied for **several hundred MWp** of projects

- Headquartered in the **Netherlands** and **75+ professionals in 6 offices** worldwide

- Founded in Prague in **2008**

- **Publicly listed company** on the Warsaw and Prague Stock Exchanges

GLOBAL PRESENCE

Photon Energy at a glance

~50 MWh
of PV plants installed



Plant portfolio
26.1 MWp



27.3 GWh
produced in 2017



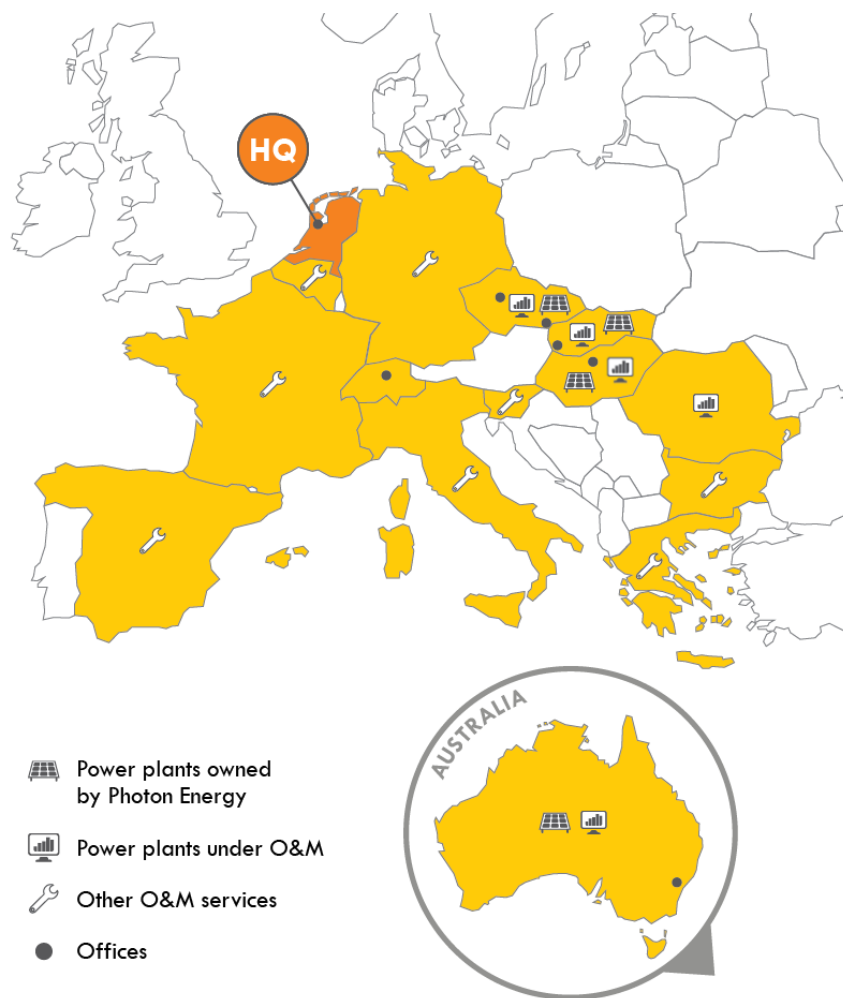
Active in
15 countries



O&M services for
220+ MWp



Energy supplied for
10 000+
households



PHOTON ENERGY GROUP

Life-cycle expertise

SOLAR SOLUTIONS

Energy solutions and project development from concept to completion, for both utility scale solar and on-site power production.

WATER TECHNOLOGY

Comprehensive solutions for water management, treatment and remediation.

SOLAR O&M

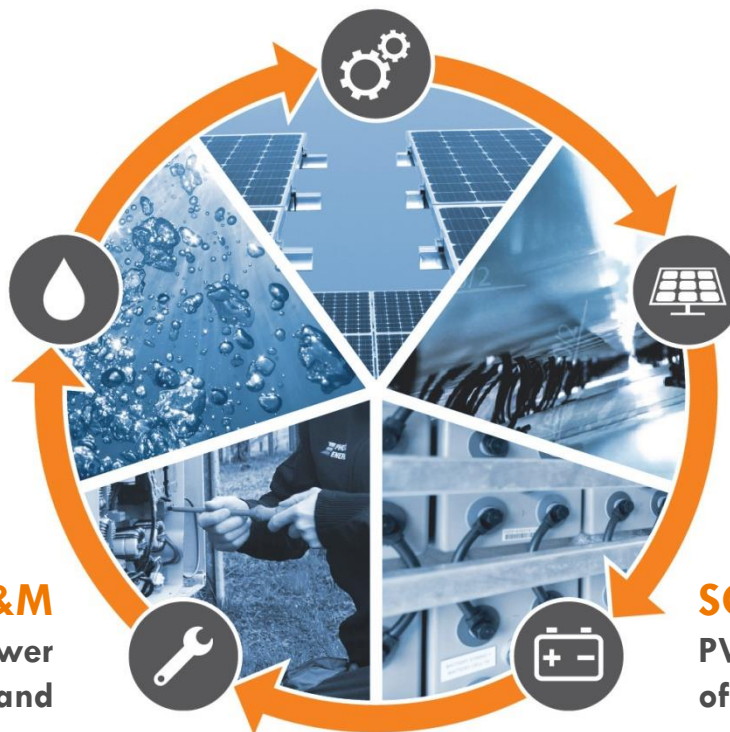
Fully integrated power plant monitoring and O&M services.

TECHNOLOGY

Solar power system packages and top quality components.

SOLAR STORAGE

PV battery systems for a level of performance, power quality and reliability beyond the grid.



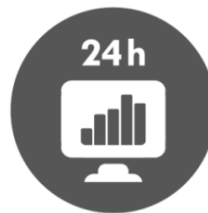
PV OPERATIONS AND MAINTENANCE

Complete O&M solutions

Preventive maintenance



Smart monitoring



Repair work



Reporting



Security support



Guarantees



Inverter Cardio



Revenue enhancement



Consultancy



Accounting services



PV OPERATIONS AND MAINTENANCE

SMART O&M

Looks like a small issue. Costs a lot of money.

With smart O&M you minimize the risk of financially painful consequences:

- Small technical issues escalating into big problems
- Loss of revenue / cash flow
- Repairing extensive damage can lead to downtime over several days!
- Paperwork (insurance, banks, health and safety)
- Risk of injury to staff (insurance claims, healthcare expenses...)



PV OPERATIONS AND MAINTENANCE

OUR FULL-SERVICE SCOPE INCLUDES

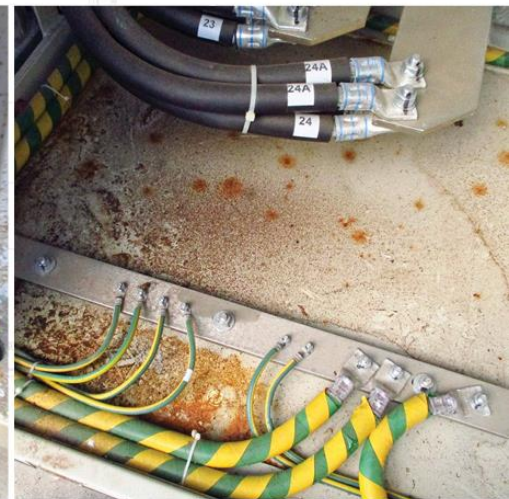
- ▶ Preventive maintenance
- ▶ Reporting and smart monitoring
- ▶ Repair work
- ▶ Administrative services
- ▶ Security support
- ▶ Stock and spare parts management





INVERTER CARDIO PREVENTIVE MAINTENANCE

BEFORE



DC SECTION

AFTER



STANDARD IN PREVENTIVE MAINTENANCE

BEFORE



AFTER



INVERTER CARDIO

FIX MY PV INVERTER

Cost effective:

we repair inverters cheaper than original manufacturers.

Time effective:

typically we fix and ship inverters in a matter of days.

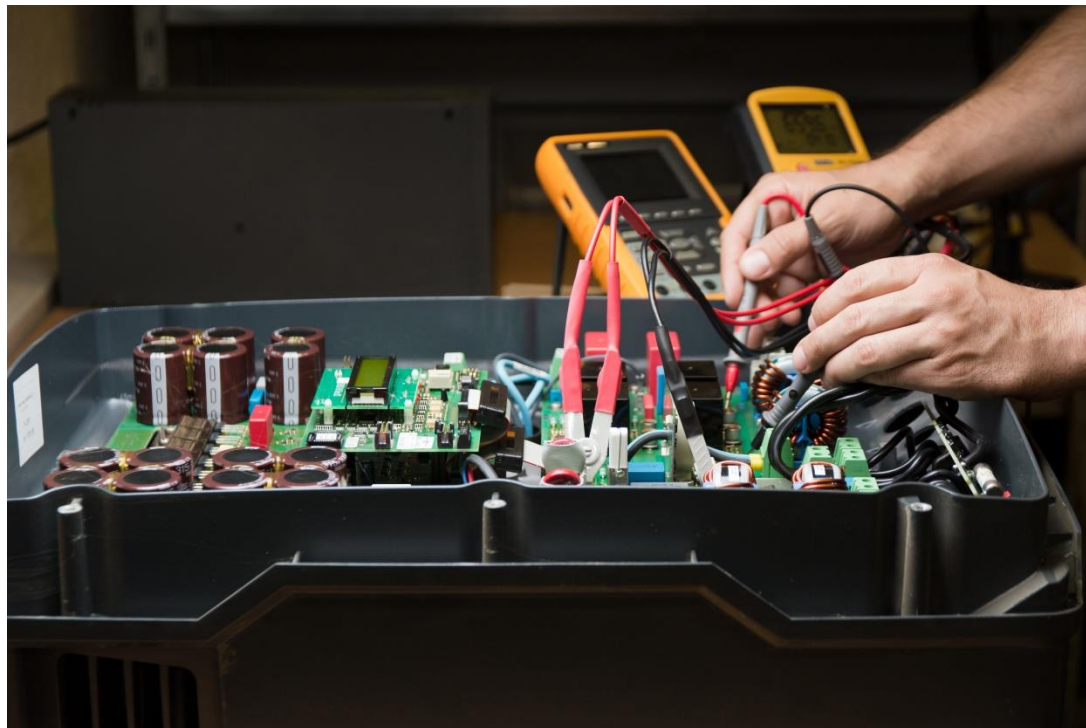
Costs under control:

upfront repair cost estimate.

Experts at work:


our repair shop repaired over 4000 string inverters to date.

www.fixmyinverters.com



CONTROL AND MONITORING

PECOM: PHOTON ENERGY COMMAND

- PECOM is an ideal **monitoring, planning and supervision software platform** for managing portfolios of PV power plants.
 - The **web-based solution** is suited for all types of PV projects.
 - PECOM is designed and developed for **operations, control room and dispatch centres** for **PV, storage and hybrid** power plants.
 - PECOM is an **easy-to-use, intuitive and highly customisable** software platform with a wide range of tools for your control room.
- 
- The ideal solution for service providers, who want to **save time and costs** and pass the savings on to their customers.
 - For PV power plants, hybrid power plants and other RE projects.

Thank you

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EXPERTS FOR
THE SOLAR AGE.

Photon Energy Control New Energy Efficiency Tools

- ORADEA, Romania, 14 November 2018
- Jan Černý, Sales Representative

WHY MONITORING IS THE MOST IMPORTANT TOOL

BASIC FACTS

- Avoid yield losses
- Extend lifespan of PV plant
- Increase efficiency of PV plant
- Save time
- Production reports
- Management and stock
- User-free - service, investors, owners
- Cloud-based hosting
- Smart monitoring (365 days a year)
- Developed in-house
- PECOM 2.0 coming soon



MONITORING

LEVELS OF MONITORING

**Inverters
(All Manufacturers)**



Zone-monitoring



String-monitoring



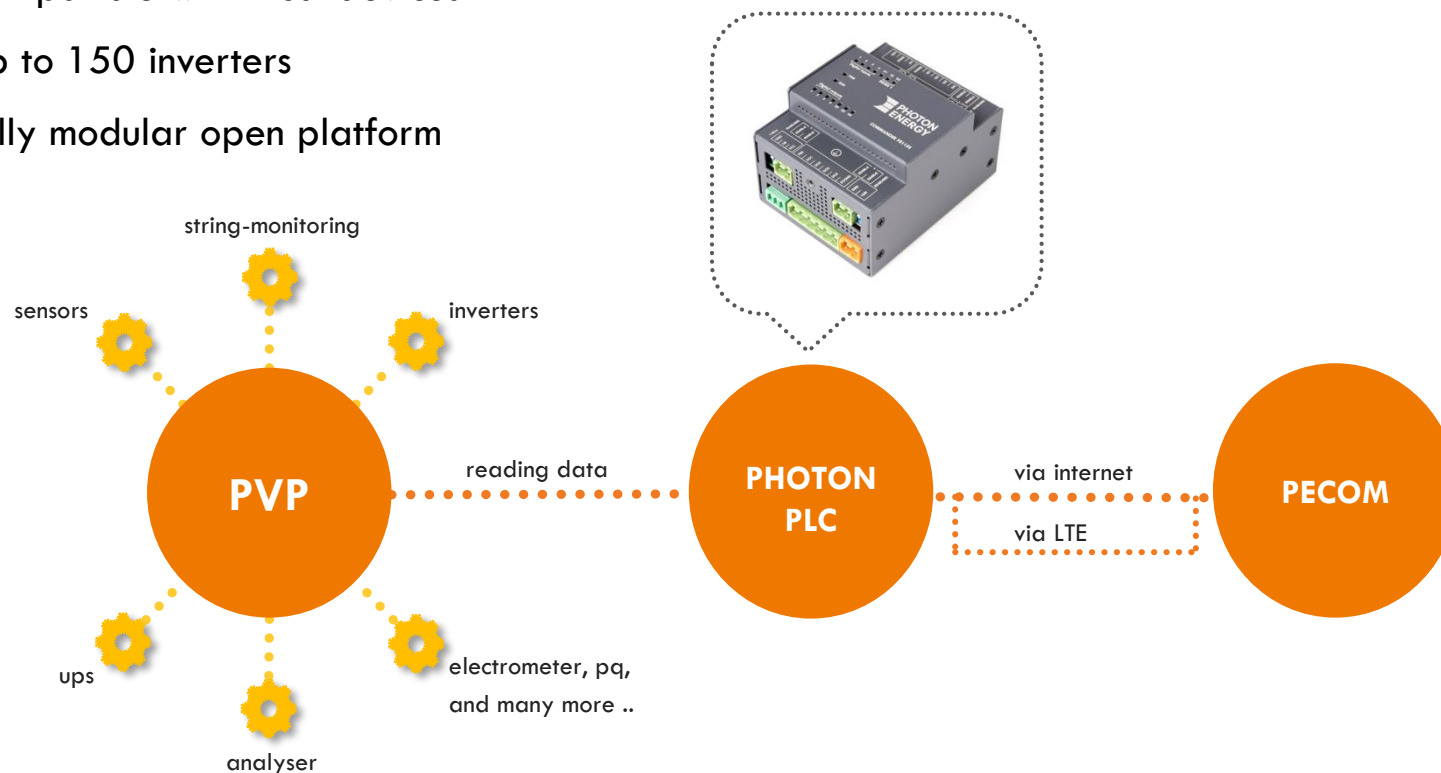
PLC

MONITORING

MONITORING

PVP COMMUNICATION & PLC

- Developed by Photon Energy
- Programmable for PV plants incl. all sectors of industry
- Compatible with most devices
- Up to 150 inverters
- Fully modular open platform



MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

TYPE OF TECHNOLOGY AND MODULES

- We monitor the arrays of PV panels in your plant based on panel technology
- Our monitoring system adapts to all types of invertors, including the combination of central, decentral invertors and master slave system
- Eliminate the area of permanent shadows

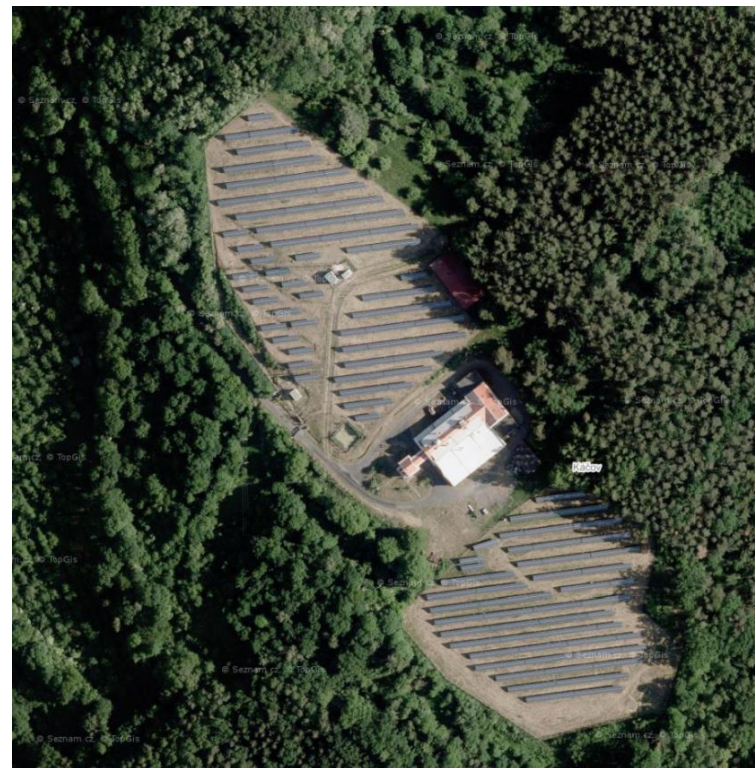


MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

LOCAL OVERSHADOWING OF THE AREA

- Detect local shadows
- Active period settings
- Proposals to improve efficiency

DEVICE	POWER AC kW	DAILY ENERGY DEVIATION %
✖ WR 64 PLC 1	0.505	-71.000
✖ WR 53 PLC 1	0.979	-48.000
✖ WR 50 PLC 2	1.466	-24.000
✖ WR 60 PLC 2	1.461	-17.000
✖ WR 56 PLC 1	1.485	-15.000



MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

SNOW COVERING OF THE PANELS







- Detect snow cover
- Evaluate and solve the situation
- Informing client
- Control via CCTV and forecast



MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

OVERHEATING OF THE INVERTERS

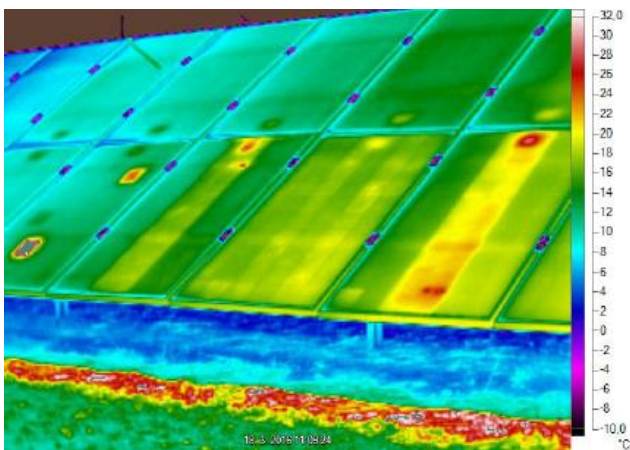
- Different types of inverters have different maximum overheating temperatures guaranteed by manufacturer
- Overheating has the biggest impact on the lifetime of the fan, condenser, display and back-up battery

DEVICE		TEMPERATURE 1 °C	TEMPERATURE 2 °C
✓ Inverter 1a Blok 1		64.000	43.000
✓ Inverter 1b Blok 1		65.000	43.000
✓ Inverter 2a Blok 1		62.000	43.000
✓ Inverter 2b Blok 1		58.000	43.000
✓ Inverter 3a Blok 1		64.000	44.000
✓ Inverter 3b Blok 1		66.000	44.000

MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

OVERHEATING OF INVERTERS

- Inverter and transformer temperature monitoring
- Periodic thermovision of PV panels, PVP control
- Prevention of losses due to burning or overheating of cables, inverters or transformer station



MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

CASE STUDY OF OVERHEATING – PVP 1 MW_p

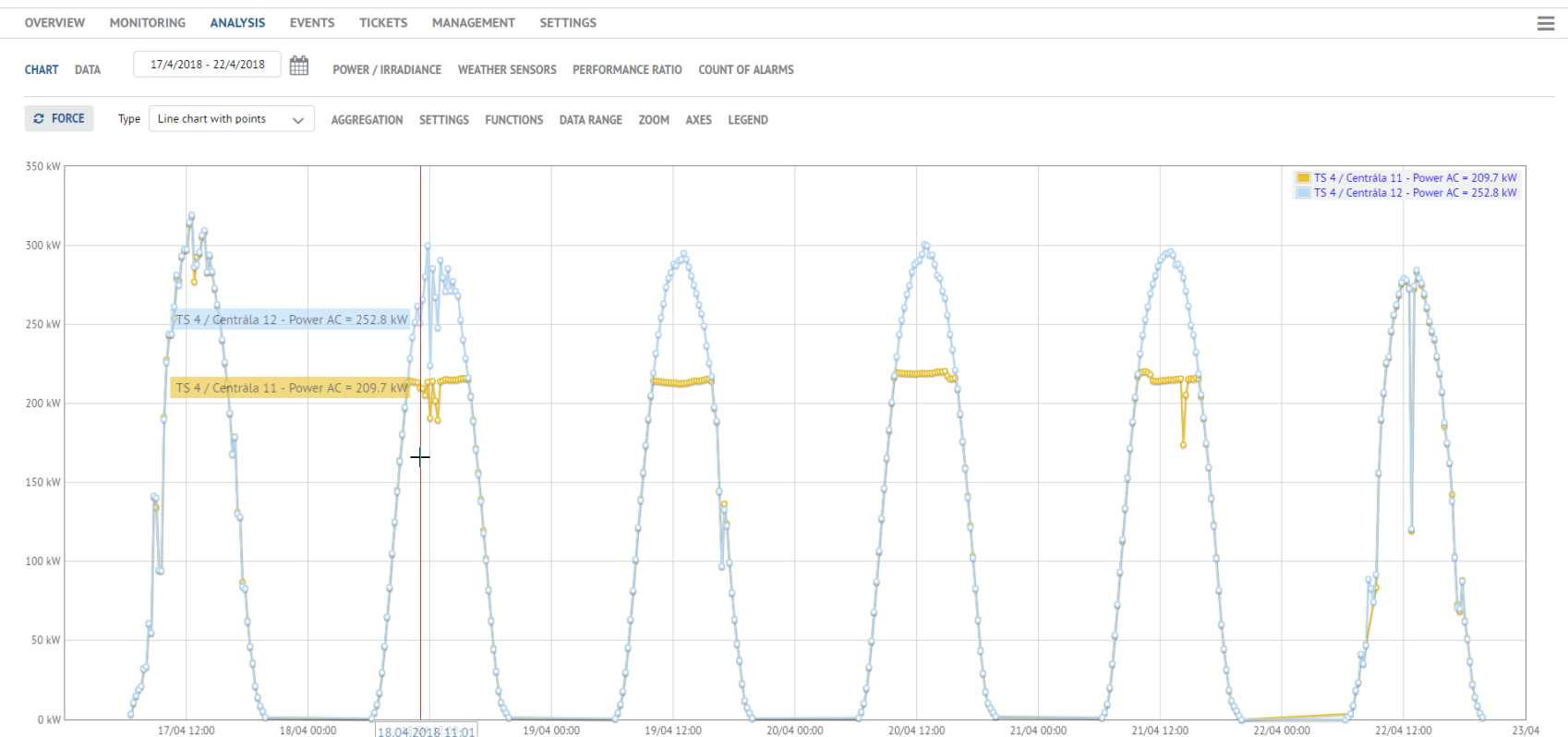
- Short-term faults are caused by the limitation of the device's performance due to temperature

DATE	GOOD INV	BAD INV	PURCHASE PRICE*	LOSS OF PROFIT
19. 4. 2018	122 kWh	113 kWh	0,55 EUR	4,47 EUR
20. 4. 2018	120 kWh	100 kWh	0,55 EUR	11,01 EUR
21. 4. 2018	112 kWh	92 kWh	0,55 EUR	11,25 EUR
22. 4. 2018	116 kWh	83 kWh	0,55 EUR	18,11 EUR
* Purchase price 0.55 EUR				44,84 EUR

- Losing profit exceeding **4000,- EUR** per 1 MW_p PVP

MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

SPECIFIC EXAMPLE – CENTRAL INVERTER



MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

SPECIFIC EXAMPLE – CENTRAL INVERTER

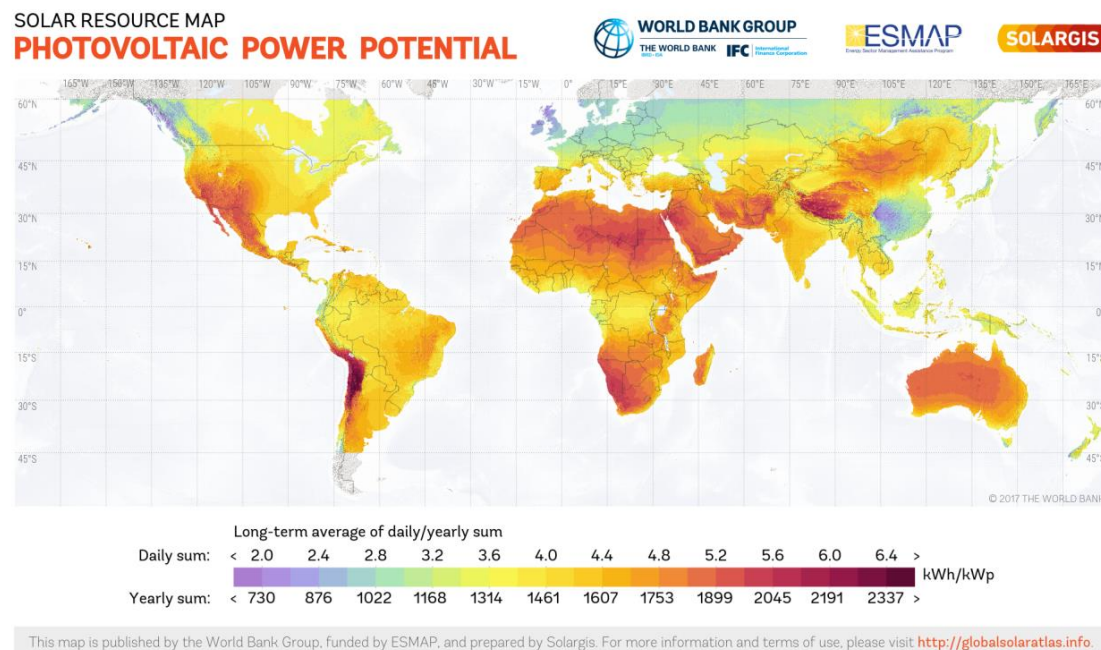
- Comparison of the impact of a poorly conditioned inverter to the loss of profit

DATE	GOOD INV	BAD INV	PURCHASE PRICE*	LOSS OF PROFIT
18. 4. 2018	2 225 kWh	1 927 kWh	0,55 EUR	163 EUR
19. 4. 2018	2 225 kWh	1 927 kWh	0,55 EUR	163 EUR
20. 4. 2018	2 211 kWh	1 911 kWh	0,55 EUR	164 EUR
21. 4. 2018	2 299 kWh	1 989 kWh	0,55 EUR	170 EUR
22. 4. 2018	2 306 kWh	1 953 kWh	0,55 EUR	193 EUR
* Purchase price 0.55 EUR				853 EUR

MAIN FACTORS INFLUENCING PRODUCTION EFFICIENCY

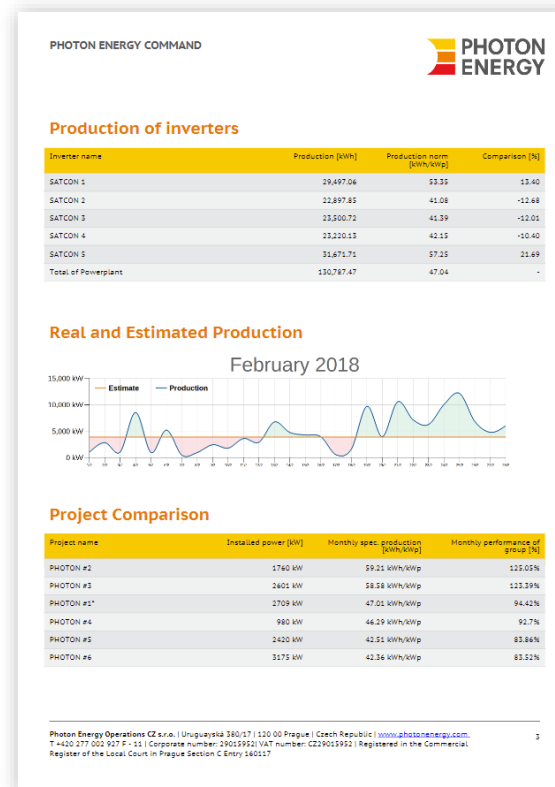
FORECASTING

- Intraday trading
- Maximise the value of the solar power you own to operate
- Control and forecast energy production in hourly or 15 minute increments
- Improve certainty of load forecasts



REGULAR REVIEW REPORTING

- Regular reports for the given period
- Possibility of individual report generation
- Detailed overview, not only for banks
- Statement and status of the faults at PVP during a pre-defined period of time
- Financial overview



KEY TOOLS OF PHOTON ENERGY MONITORING

TICKETING

TICKETS TICKET ACTIONS PROJECT ACTIONS HELPDESK STATISTICS

+ New ticket

Sync. tickets

TICKET ID	STATUS	BEGINNING	TITLE	DEVICE	VARIABLES	
#0014317	5. Validation	21/4/2018 17:04	Inverter fault	WR 50	Power AC	Edit Delete
#0013922	8. Finished ticket	27/3/2018 12:57	Preventive maintenance			Edit Delete
#0013348	8. Finished ticket	18/2/2018 12:02	VN outage/ PV out of order	WR 03, WR 04, WR 06, WR 07, WR 39, WR 42, WR 44, WR 45, WR 46, WR 47, WR 49, WR 51, WR 65, WR 68	Power AC	Edit Delete
#0013120	8. Finished ticket	2/2/2018 10:12	VN outage/ PV out of order	PVP	Communication alarm, Power Alarm	Edit Delete
#0013033	8. Finished ticket	22/1/2018 14:45	Inspection			Edit Delete
#0012965	8. Finished ticket	19/1/2018 10:30	VN outage/ PV out of order	PVP	Communication alarm, Power Alarm	Edit Delete
#0012779	8. Finished ticket	4/1/2018 11:24	VN outage/ PV out of order	PVP	Communication alarm, Power Alarm	Edit Delete
#0012770	8. Finished ticket	3/1/2018 15:45	VN outage/ PV out of order	PVP	Communication alarm, Power Alarm	Edit Delete
#0012640	8. Finished ticket	21/12/2017 11:47	Preventive maintenance			Edit Delete
#0012627	8. Finished ticket	20/12/2017 13:24	String fault	WR 57, WR 64, WR 68	Daily Energy deviation	Edit Delete
#0012560	8. Finished ticket	14/12/2017 08:06	Preventive maintenance			Edit Delete

KEY TOOLS OF PHOTON ENERGY MONITORING

TICKETING

ACTIVE
VARIABLES

DETAILS

LIMITS

MAIN
ADVANCED
ACTIONS
HISTORY
ATTACHMENTS

Ticket #014317
Close

☒ WR 50 - Power AC

Other variables: 6
CSV

+

display selected variables

View graph
Find variables
View data

*Title

Inverter fault

Subtitle

Other alarms

*Technician

Kadleček Jan

Detection

0h

0h

*SLA

SLA2

Arrive

0h

0h

Starting

21/4/2018

17:04

Reaction

72h

0h

Deadline

24/4/2018

17:04

Production

Affected

Status

5. Validation

100%

Availability

Contact
Description

B
I
U
S

Fall of inverter 50 with broken fuse on current 3.
Power of inverter has been renewed.

KEY TOOLS OF PHOTON ENERGY MONITORING MANAGEMENT

CONTACTS

SECTION	NAME	PHONE	EMAIL	NOTES	CONFIDENTIAL LEVEL
Schvalování	-	-	-	bez nutnosti schvalování	↕
Oznamování	-	-	-	bez nutnosti oznámování	↕
Majitel (SPV 4.s.r.o.)	Jan Vážný (RLRE)				↕
Subdodavatel	Kuboušek	602 144 564		Sečení trávy / úprava poze	↕
VN service	SEKV - Musil	603 254 912		příjemce reportů	↕
Distribuce	E.ON dispečer	545 141 217		TS 702 32	↕
Distribuce	E.ON - správce SCADA funi	724 056 140		Lubor Podrazil	↕
Internet Provider	Mirovka.net	775 559 495	lubos_hutar@mirovka.net		↕
Security - PCO	SIDA	582 345 463			↕
EZS Camridge Company	Michal Boček	777 242 232			↕
Správce okolních pozemků	Kachyňa	604 270 770			↕
Hlavní technik	Kamil Koneček	+420775855604	kamil.konecek@photonen		↕
Manažer FVE	Vladimír Hochman	+420775862872	vladimir.hochman@photo		↕
Provozní manager	Miroslav Simek		miroslav.simek@photoner		↕

DATASHEETS

NAME	FILE
Solar Module AIDE	11 AIDE Solar AD250M6-Ab.pdf 205.84KB
Inverter SMA	13 SMA SMC8000TL.pdf 458.25KB

PROTOCOLS

NAME	FILE
Energy Yield	PVSYST Fyshwick.pdf 9.08KB 20/6/2016 19:46
IMS Plan	PEA-1209-001 Site Specific O&M IMS plan Fyshwick.docx 613.56KB 20/6/2016 19:46
Site Layout	03 DC string layout.pdf 355.40KB 28/2/2017 09:48
Preventive Maintenance Report	20170502_Fyshwick_Preventive_maintenance_report.pdf 49.45KB 3/5/2017 11:56

ENTRIES

ID	NAME OF TECHNICIAN	ENTRY TIME	EXIT TIME	TIME	TICKET ID
2286	Kamil Koneček	13/2/2018 11:04	13/2/2018 14:30	3h 26min	#0013100
2325	Kamil Koneček	20/2/2018 09:18	20/2/2018 13:33	4h 15min	#0013369



















KEY TOOLS OF PHOTON ENERGY MONITORING

STOCK MANAGEMENT

STOCK

GROUP	NAME	EAN	DATE	COUNT	STATUS	USER	TICKET
Fuses	Fuse 160A		12/3/2018	1	New	Ferdinand Stefancsik	#0013433
Fuses	Fuse 16A		16/3/2018	1	New	Ferdinand Stefancsik	#0013557
Fuses	Fuse 160A		24/3/2018	1	New	Ferdinand Stefancsik	#0013888
Fuses	Fuse 16A		24/3/2018	1	New	Ferdinand Stefancsik	#0013888
Fuses	Fuse 16A		24/3/2018	1	New	Ferdinand Stefancsik	#0013859

MOVEMENT IN STOCK

PROJECT NAME	GROUP	NAME	EAN	NEW	REFURBISHED	DAMAGED	COUNT	
PHOTON #1	Panels ver1	BSC40Wp	Solar 1	0			6760 min: 0 (0)	  Edit  Delete
PHOTON #1	Panels ver1	CEEG 185 Wp Module	Solferino	10			10 min: 20 (20)	  Edit  Delete
PHOTON #1	Panels ver1	KANEKA 100W Module	Solar 3	40			40 min: 0 (0)	  Edit  Delete
PHOTON #1	Panels ver1	KANEKA 105 W Module	Solar 3	16			16 min: 0 (0)	  Edit  Delete
PHOTON #1	Panels ver1	Sunwell WDACC0870	Solar 2	0			880 min: 0 (0)	  Edit  Delete
PHOTON #1	Panels ver1	Sunwell WDACC0871	Solar 2	0			393 min: 0 (0)	  Edit  Delete

KEY TOOLS OF PHOTON ENERGY MONITORING

INTERACTIVE MAPS



CONTACT

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