PVTECH TECHTalk Product Series

20 OCTOBER 2021

FIMER

WEBINAR

An inverter's role in delivering high availability and low LCOE for a new era of utility-scale solar

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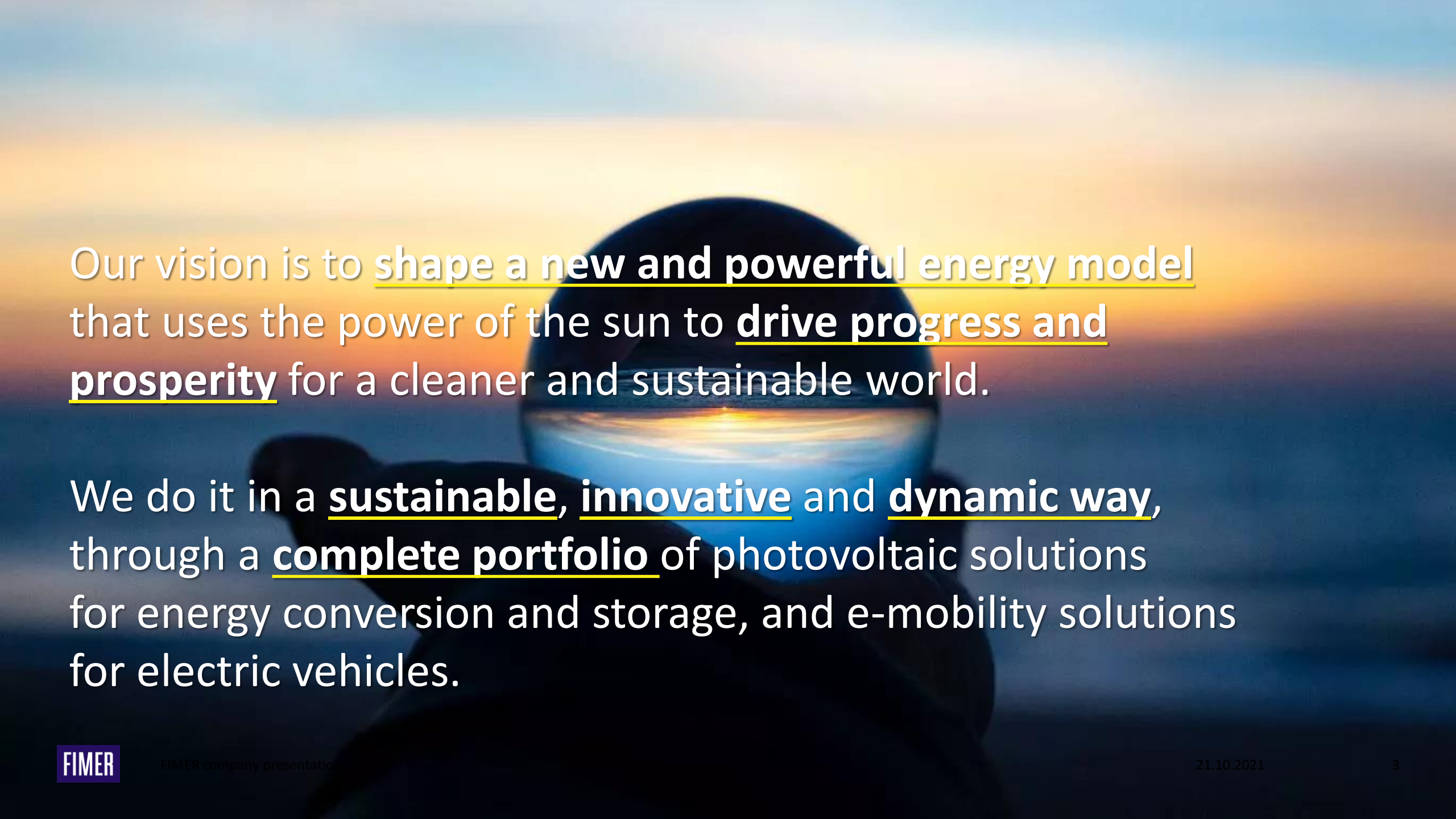
A New Era


Our vision is to shape a new and powerful energy model that uses the power of the sun to drive progress and prosperity for a cleaner and sustainable world.
We do it in a sustainable, innovative and dynamic way, through a complete portfolio of photovoltaic solutions for energy conversion and storage, and e-mobility solutions for electric vehicles.

RESPONSIBILITY

Every day we strive to offer our customers **reliable and highly technological** solutions and to build a world where energy is used in a sustainable manner for future generations.

FIMER

PASSION

We never stop. We are a company that has growth in its DNA, able to **evolve and improve, perfecting our know-how and our expertise**. This is reflected in the passion we put into our work, into the solutions we create and into the technologies we design every day.

FIMER

PROFESSIONALISM

We are **close to our customers** in all challenges with expertise, **to ensure the quality and distinctive excellence** of our solutions.

FIMER

FLEXIBILITY

We are quick **to interpret changes and fast at adapting to market** developments.
We are able to **constantly improve** and work hard to be number one when it counts, where it counts.

ETHICAL SOURCING

Sustainability goes beyond **carbon footprint** and emissions, it begins with base raw materials.

We're **sourcing raw materials in accordance with international standards and practices**, as well as introducing some of our own standards to secure a supply chain free from corruption of people or planet.

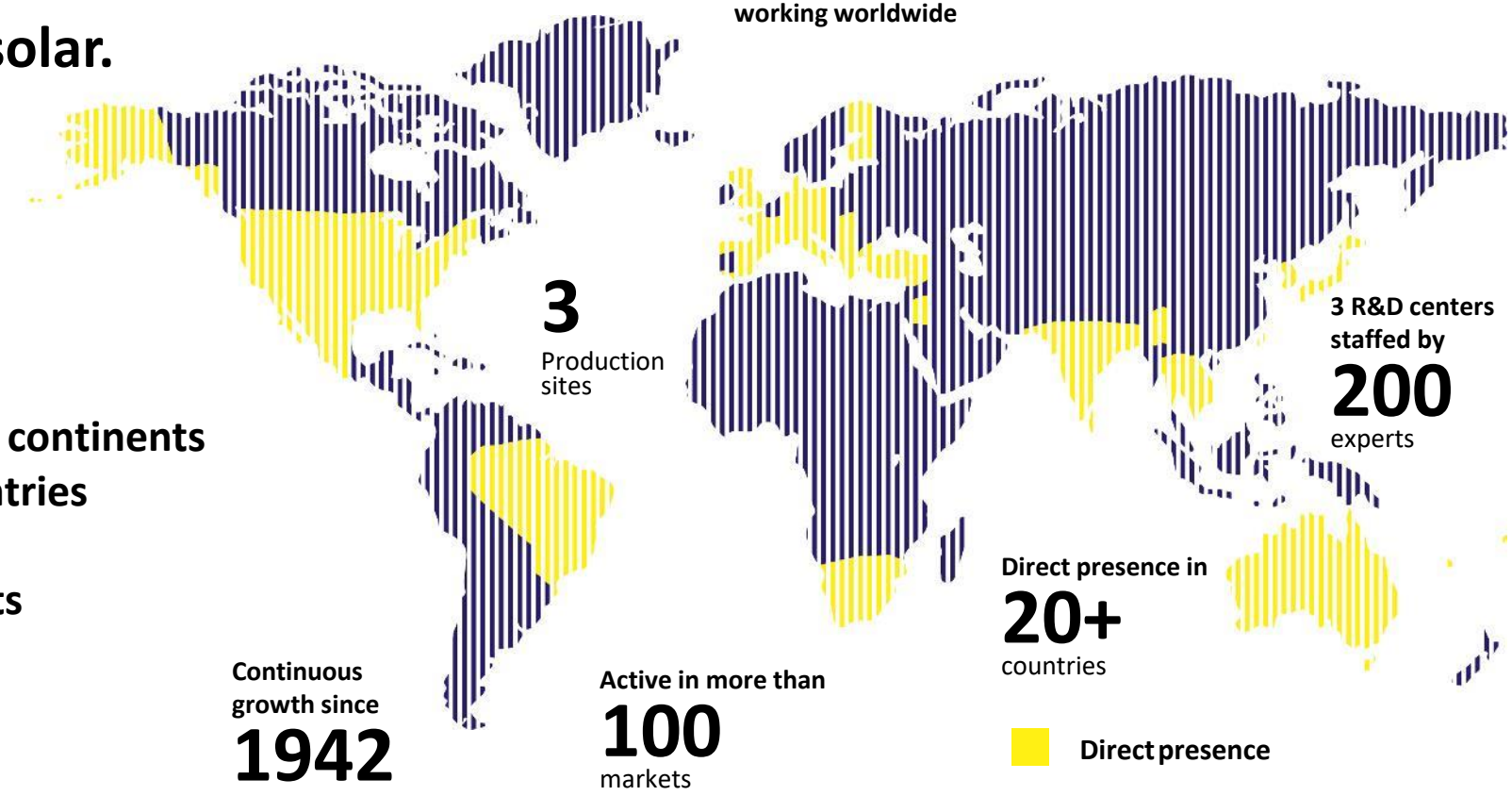
FIMER

International footprint

Over 90% of our business is solar.

Operating in over 100 countries,
we are close to our customers,
taking care of understanding
and of satisfying their needs.

Direct presence: **over 20 countries in 5 continents**
Geographic distribution: **over 100 countries**
Employees: **over 1100**
Global repair centers: **12 in 5 continents**
Production sites: **3**
Research centers: **3**



Solar

Providing complete solutions for the solar market, we address the challenge of energy transition.
Today, inverter development and manufacturing is our main vocation, and we can provide support to customers all over the world and at every stage of a solar project.

12+
GW
Capacity/year (String Inverter, Central Inv, Storage PCS)

55+
GW
Installed base

5
Continents

FIMER - Streamlined Utility Market Approach

Transition to an Efficient Utility Portfolio – Bringing Modular Conversion Concept to the Next Level

The drivers

Thanks to innovative power electronics the large string inverters are reaching the economical benefits of central inverters.

XX MIN

Reduced project development time and cost requires flexible solution with multiple MPPT and wider voltage range.

Higher risk and cost associated to components or functional parts obsolescence is a long-term threat to system owners.

FIMER's objectives

Address the central inverter market with a fully scalable solution for the remaining 39% still using central inverter.

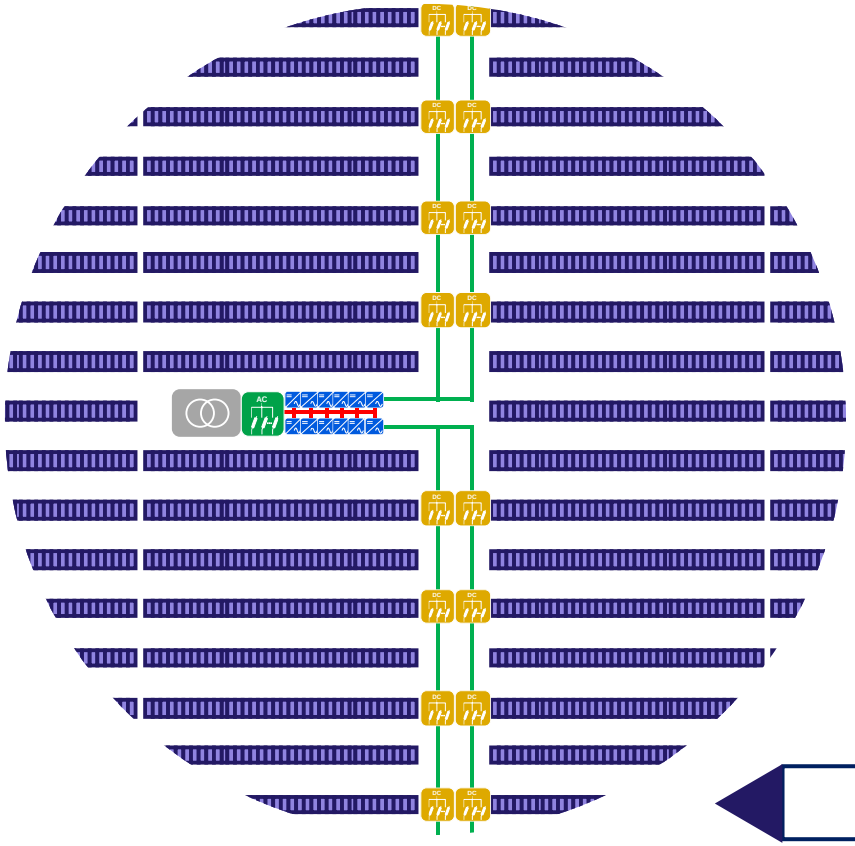
Focus utility developments and operations on a modular power building block, reducing time-to-market and management costs.

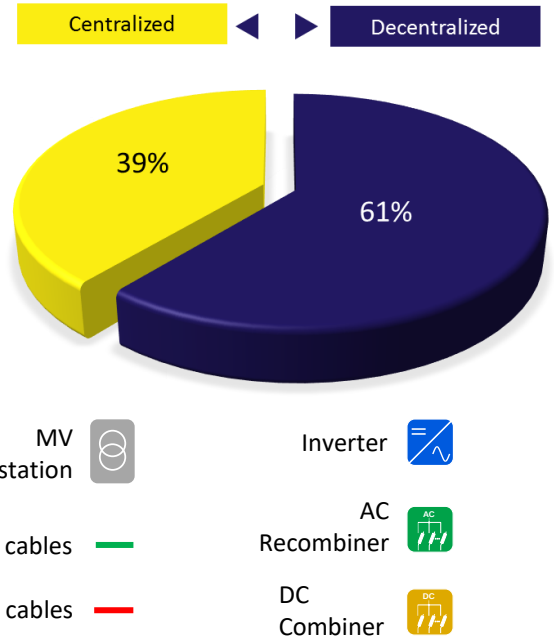
Unmatched flexibility and scalability: adapt to systems of any kind and any size.

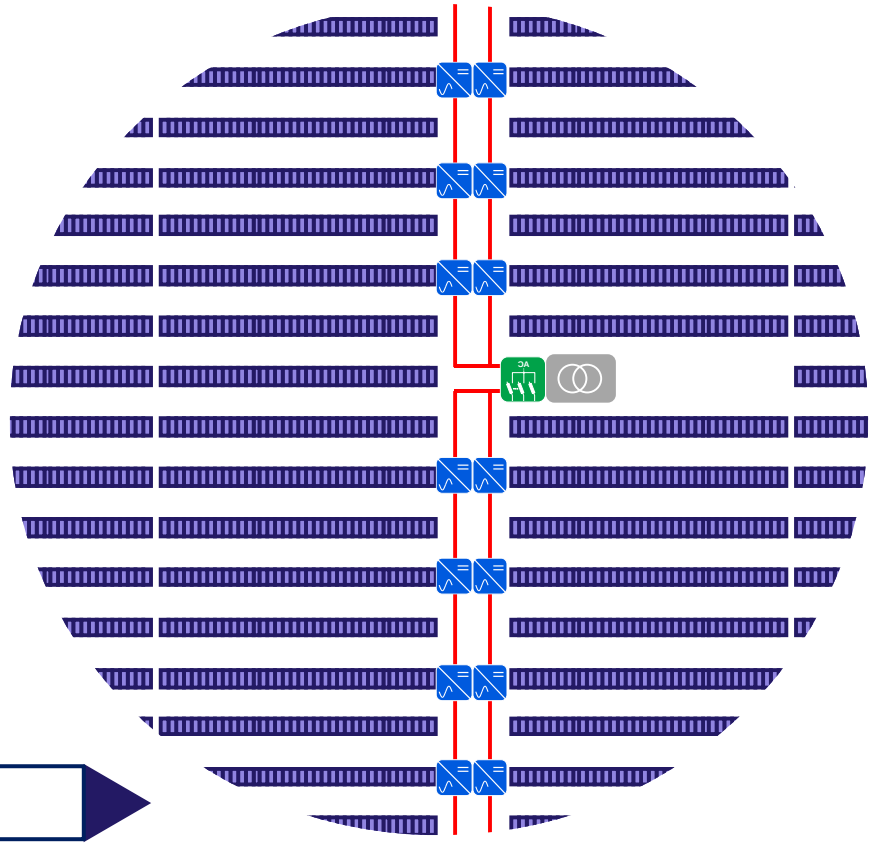
Drastically **reduce downtime costs – System availability 99.9%**

FIMER answer to a clear market need

FIMER MODULAR CONVERSION SOLUTIONS to support 100% of Utility Inverter Market Demand







MODULAR INVERTER CONCEPT

CENTRALIZED SYSTEM LAYOUT

DECENTRALIZED SYSTEM LAYOUT

NEW PVS-350 and NEW PVS-260/300-MVMCS

Designed for 100% of Utility-Scale applications; satisfying the needs for both centralized and decentralized applications.

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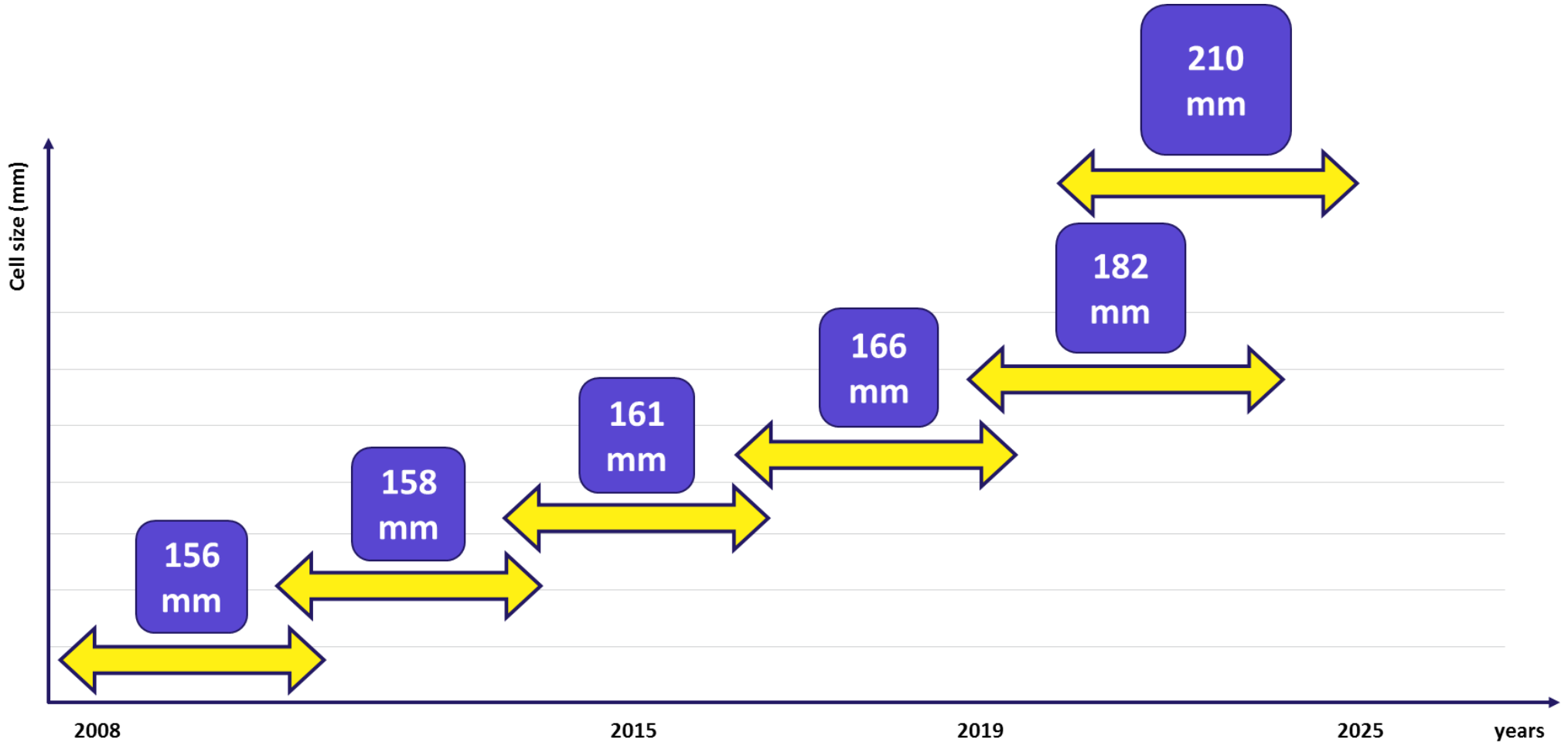
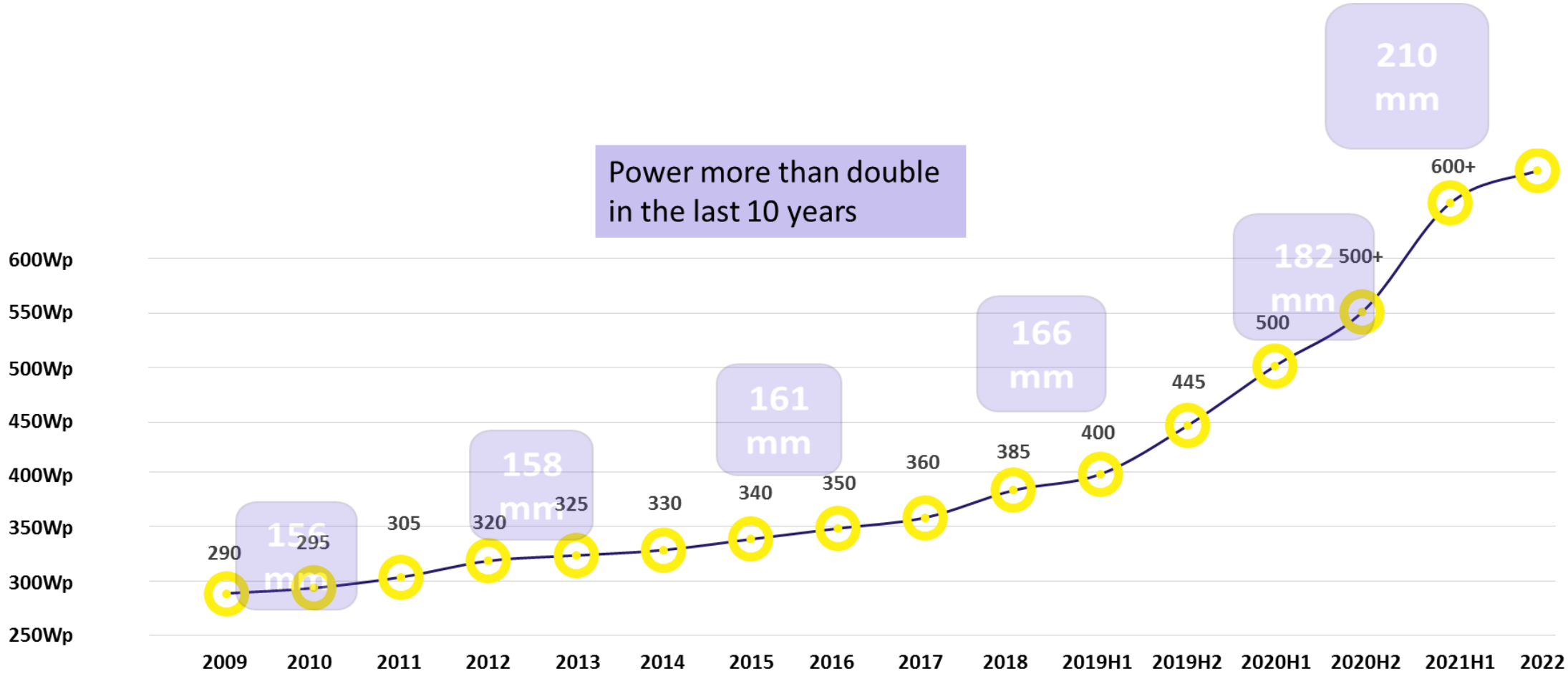
NEW PVS-350 solution for Decentralized Architecture

PVTECH TECHTalk Product Series

Modules cells Size trend

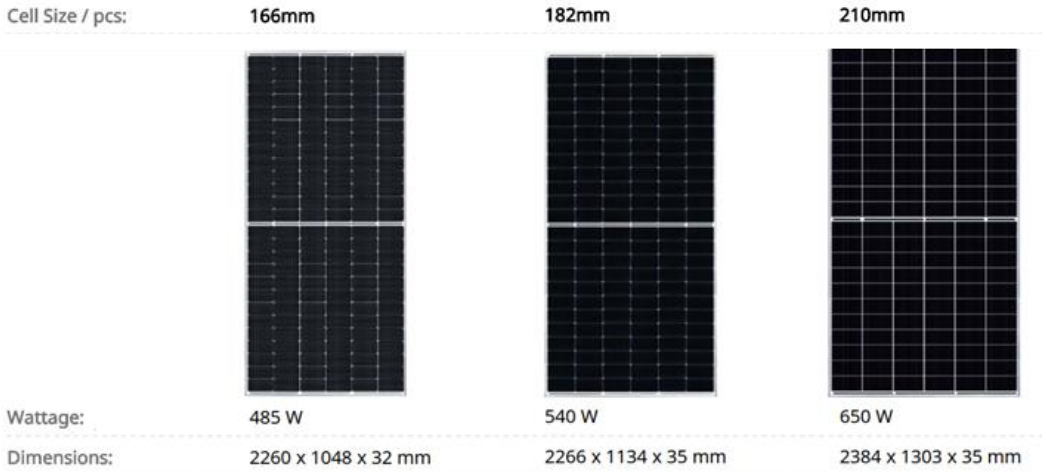


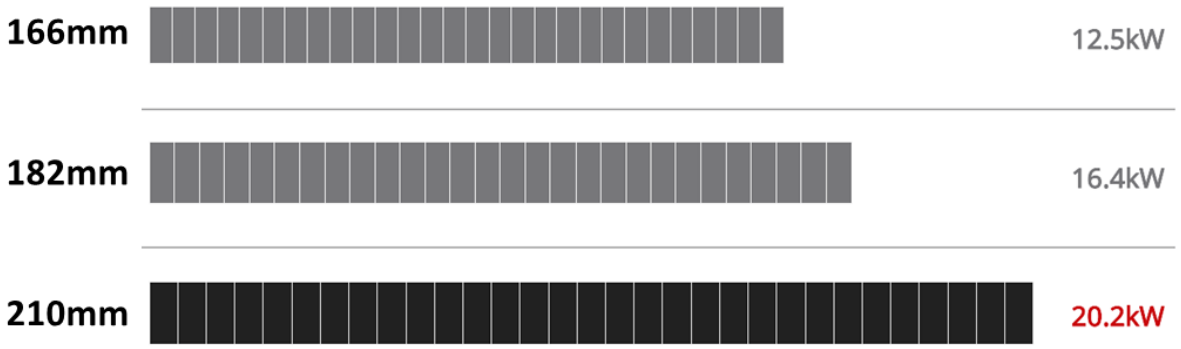
PV modules Power trend



PV modules Power trend

System Benefits





- Per Module unit power increase
- Power per string increase

- Reduced number of installed modules per MW
- Reduced number of string and cables per MW
- Reduced steel/aluminium per MW

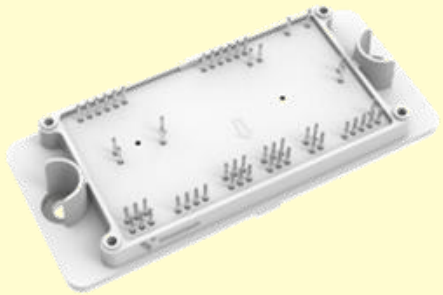
- Logistics cost decrease → up to 0.09 €c/Wp
- Tracker and installation cost decrease → 0.35 ÷ 0.66 €c/Wp
- eBOS decrease → 0.1 ÷ 0.15 €c/Wp

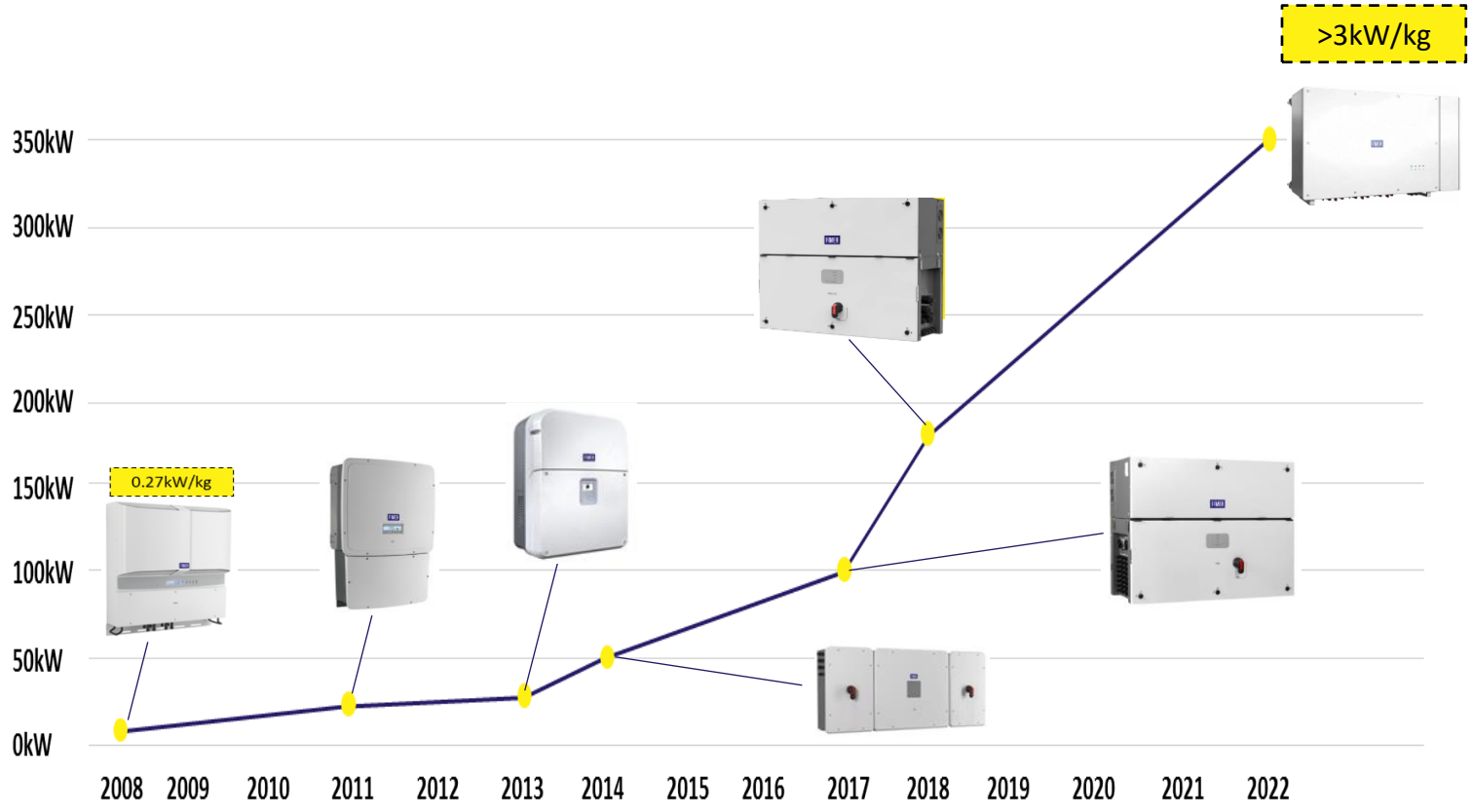
- **Total Saving → 0.5 ÷ 0.9 €c/Wp**

String Inverter Power trend

Thanks to innovative power electronics String inverter power trend follow the rush of the modules

Fully exploit the latest innovations in power switch technology.





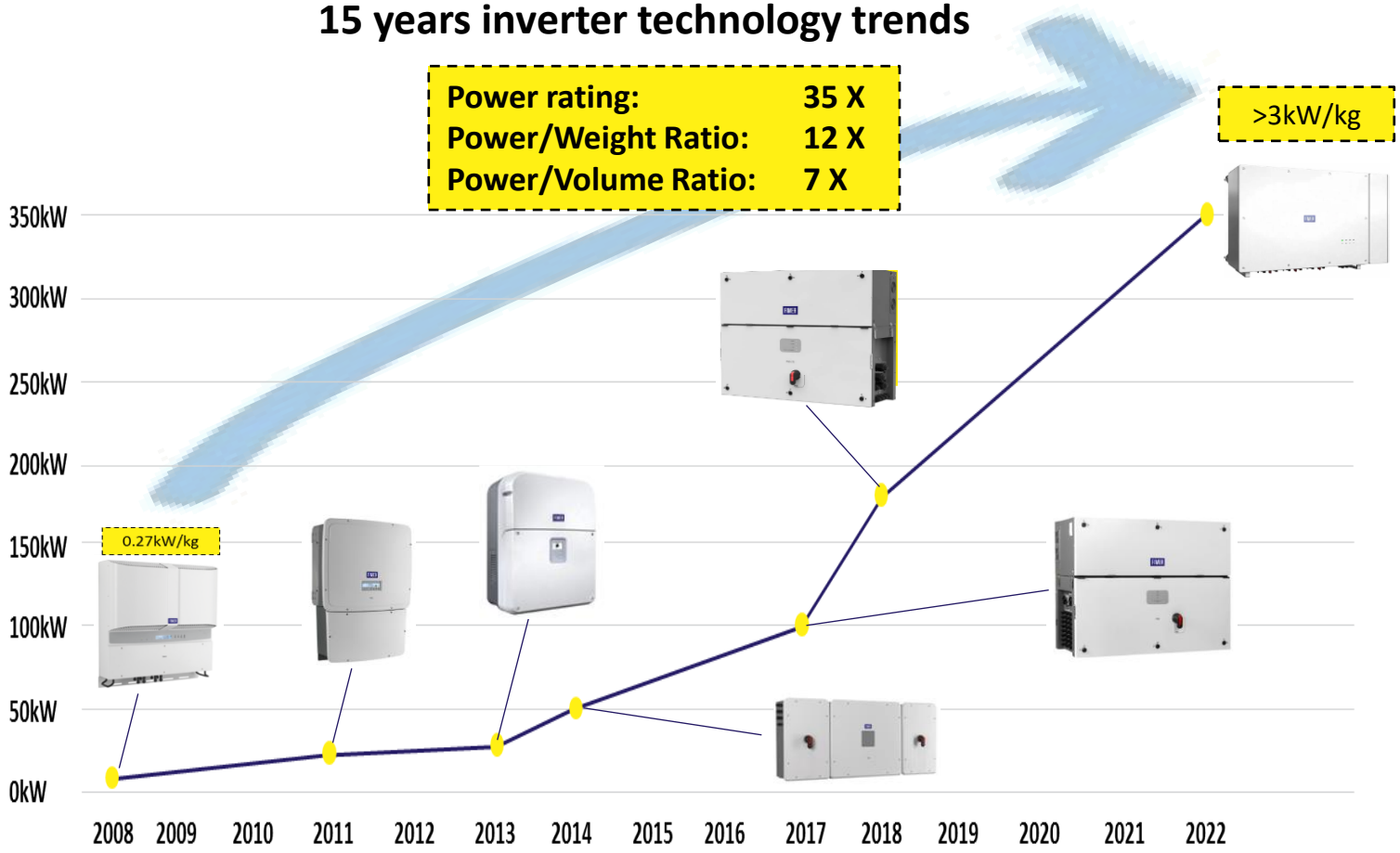
String Inverter Power trend

PVS-350: why 350kW?
The rationale

- **YIELD**
- **CAPEX**
- **LOGISTIC**

15 years inverter technology trends

Power rating:	**35 X**
Power/Weight Ratio:	**12 X**
Power/Volume Ratio:	**7 X**



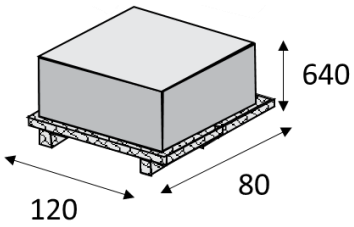
String Inverter Power trend

PVS-350: why 350kW?
The rationale

350kW **253A** **800Vac**

YIELD — Optimal balance of the DC and AC cable losses to preserve the maximum Yield and reduce CAPEX

CAPEX — Maximum exploitation of the electrical BoS to minimize the cost per W of the system



EU pallet

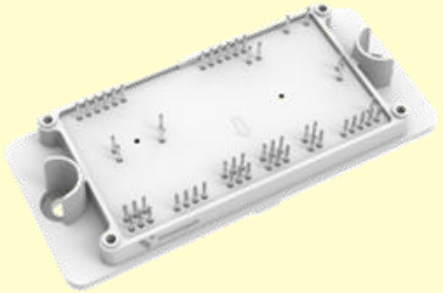
LOGISTIC — Keep the form factor to be able to ship in a standard pallet to minimize the Logistic cost

String Inverter Power trend

PVS-350: 350kW – 3 Technical Innovations enabling the record-high power capacity

Availability of new High Current/Low Losses Power IGBT modules

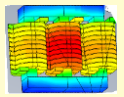
Optimization of the 3-level topology

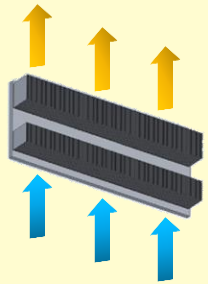


Efficient cooling system

+30% cooling efficiency with skived heatsing technology

Thermal loads moved outside of the IP66 enclosure

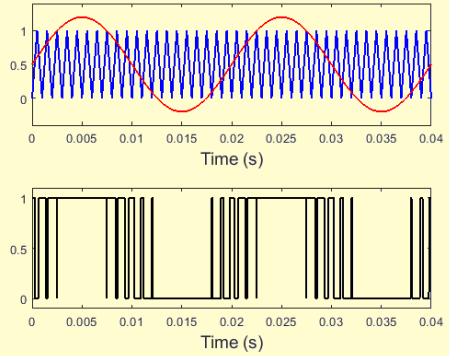




>99% Ultra-high efficiency through advanced IGBT modulation techniques

-30% switching losses

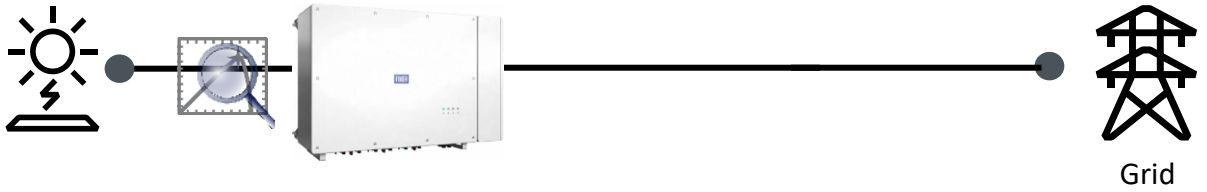
Discontinuous Modulation (DPWM)



PVS-350

Multi-MPPT Inverter for Decentralized Systems

PVS-350	IEC
AC Power	**350kW**@30°C 333kW @40°C
MPPT # / Ratings	**12** / **45A Impp**, 60A Isc
DC Voltage	500 – 1500 Vdc Max Input Voltage 1500Vdc
AC Voltage	800 V



- **Wireless** access to the **embedded Web User Interface**
- **Easy commissioning** capability
- **Remote** firmware upgrade
- **String diagnosis** through online IV curve analysis
- **Fuse-free design**
- **Arc Fault Detection** device included (also in IEC version)

PVS-350

Multi-MPPT Inverter for Decentralized Systems

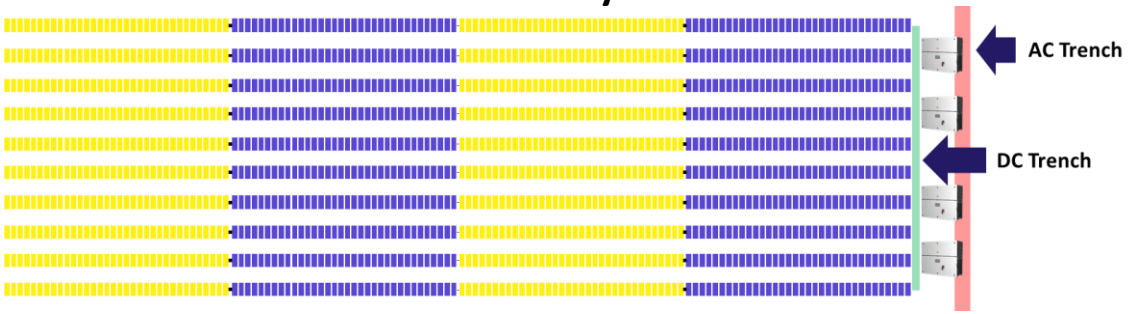
- The most powerful string inverter in Utility
- The highest Power to Weight Ratio in the category (> 3kW/kg)
- Compatibility with ULTRA-high power modules with a single model
- String diagnosis through online IV curve analysis
- DC Series Arc Fault Circuit Interrupter

PVS-350

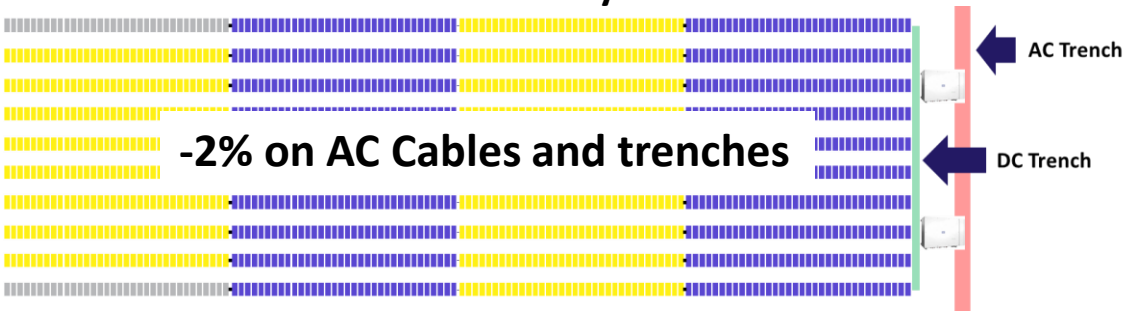
Main Benefits Vs Existing Multi MPPT Platform

YIELD — Optimal balance of the DC and AC cable losses to preserve the maximum Yield and reduce CAPEX — **CAPEX**

PVS-175 Layout



PVS-350 Layout



100MW Project	FIMER PVS-350	FIMER PVS-175
N° of inverter	286	540
Inverter x MV station	22 (7.7MVA)	36 (6.66MVA)
Benefits	-47% Inverter	
	-2% AC cables	
	-5% AC trenches	

> - 0,01 €c/W

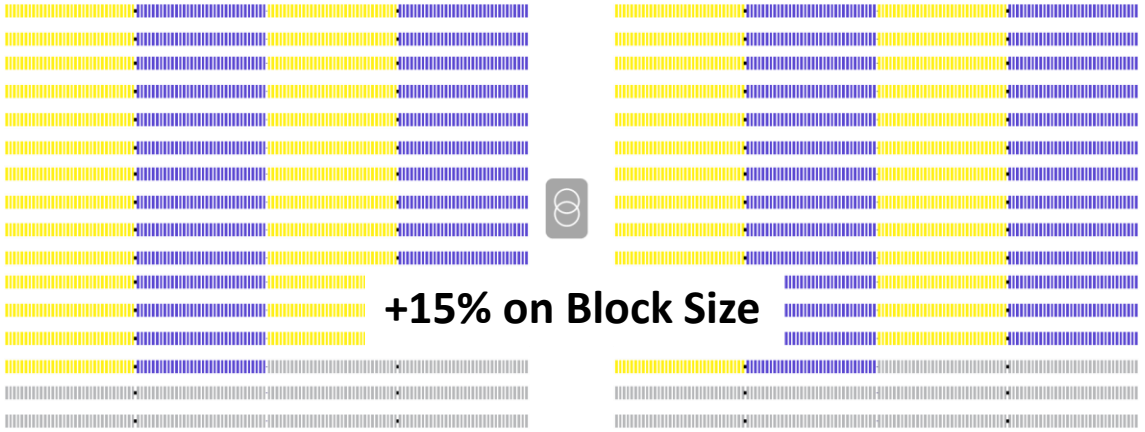
PVS-350

Main Benefits Vs Existing Multi MPPT Platform

CAPEX

Maximum exploitation of the electrical BoS to minimize the cost per W of the system

From 6.66MVA Block to 7.7MVA block



100MW Project		
	FIMER PVS-350	**FIMER PVS-175**
Inverter x MV station	22 (7.7MVA)	36 (6.66MVA)
N° of station	13	15
Benefit	**-13.3% MV Station**	

> - 0,26 €c/W

PVS-350

Main Benefits Vs Existing Multi MPPT Platform

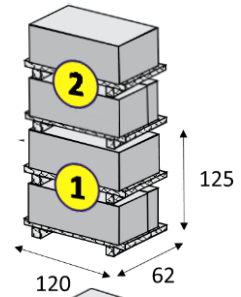
LOGISTIC

Keep the form factor to be able to ship in a standard pallet to minimize the Logistic cost

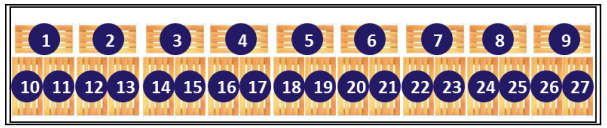
	FIMER PVS-350	FIMER PVS-175
Dimensions (WxHxD) [mm]	*1100x740x490*	*1100x890x360*
AC Power Max/Nominal [kW]	*350/333*	*185/175*

- Power-to-Weight Ratio: 3027 W/kg
- Power density: 835 W/dm^3
- Inverter Box is compatible with standard EU pallet to optimize the shipment cost

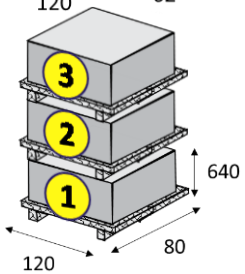
Thanks to its weight and dimensions, PVS-350 represents the higher power density inverter on the market!



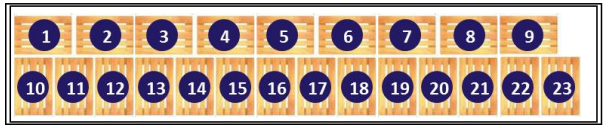
Maximum 2 Layers



PVS-175



3Layers



PVS-350

	FIMER PVS-350	FIMER PVS-175
N° of Layers	3	2
Inverters x Container	69	54
Power x Container	24,15MVA	9,99MVA
Benefit	**+140% Power x Container**	

- 0,02 €c/W

PVS-350

Main Benefits Vs Existing Multi MPPT Platform

MAIN BENEFITS	>> KEY ADVANTAGES << VS EXISTING MULTI-MPPT PLATFORMS & CONVENTIONAL MODULES	
Logistic & Installation	**-30% overall costs**	thanks to the record-high capacity and power-to-weight ratio. Saving may exceed **0.03 €c/watt**
AC eBOS	**Up to 15% higher AC capacity for the MV station**	means less stations per MWac installed power. In a 100MW system the saving may exceed **0.26 €c/watt**
182/210mm Ready	**Optimized for the latest Ultra-High Power modules**	enabling additional cost savings compared to 166mm modules on Trackers, eBOS, and Logistics up to **0.5 – 0.9 €c/W**
Total savings	**0.8 to 1.2 €c/W lower than other solutions**	saving on a 50/100MW plant, depending: • the PV module technology and • thanks to the FIMER's new Multi-MPPT solution that is the enabler to be able to use this modules

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NEW PVS-260/300-MVMCS solution for centralized architecture

PVTECH TECHTalk Product Series

PVS-260/300-MVMCS

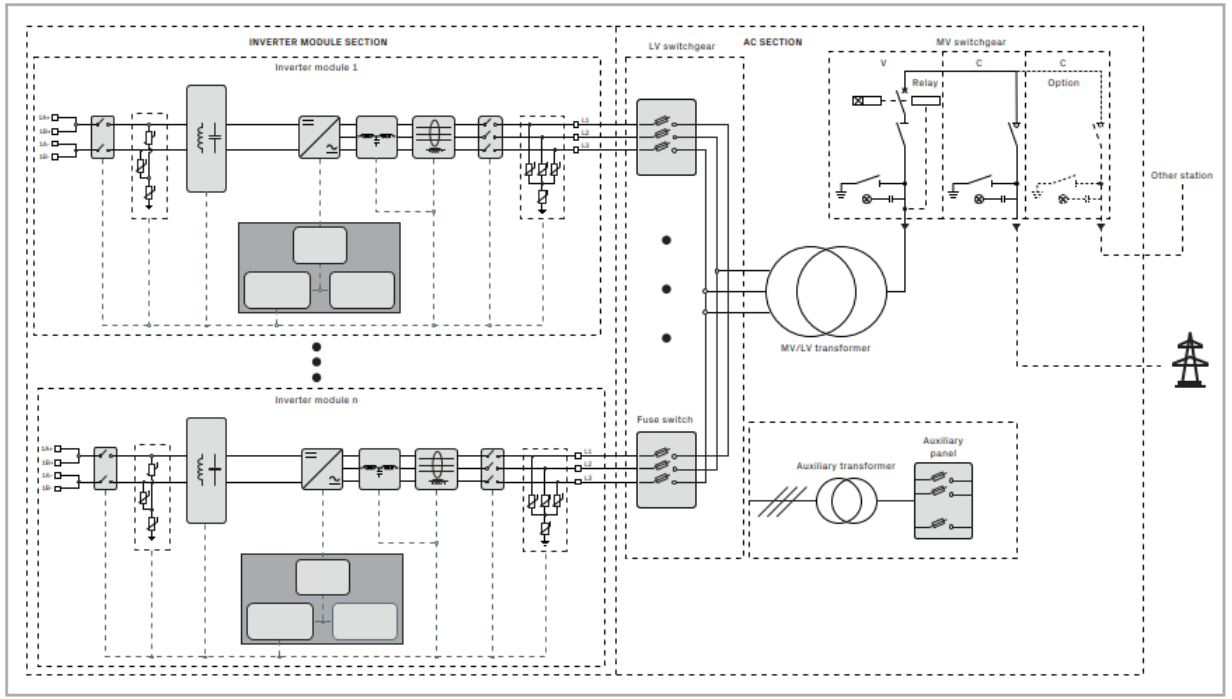
Modular Solution for Centralized Systems

- The most powerful single stage modular inverter in Utility
- 1:1 Replace any conventional central inverter solution in the same footprint
- Reduced O&M costs, compared to a central inverter solution
- Minimum system downtime, availability > 99.9%
- 100% scalable to all power sizes needed

PVS-260/300-MVMCS

100% scalable to all power sizes needed

- 100% fully integrated solution
- True plug&play solution
- Fully controlled the supply chain.



Highest modularity, perfect fit with any DC/AC ratio

Solution based on:

- PVS-260: 262,5kW – 600V, or
- PVS-300: 300kW – 690V

Up to 24 inverter on the same Skid:

- PVS-260: 6300 kVA
- PVS-300: 7200 kVA

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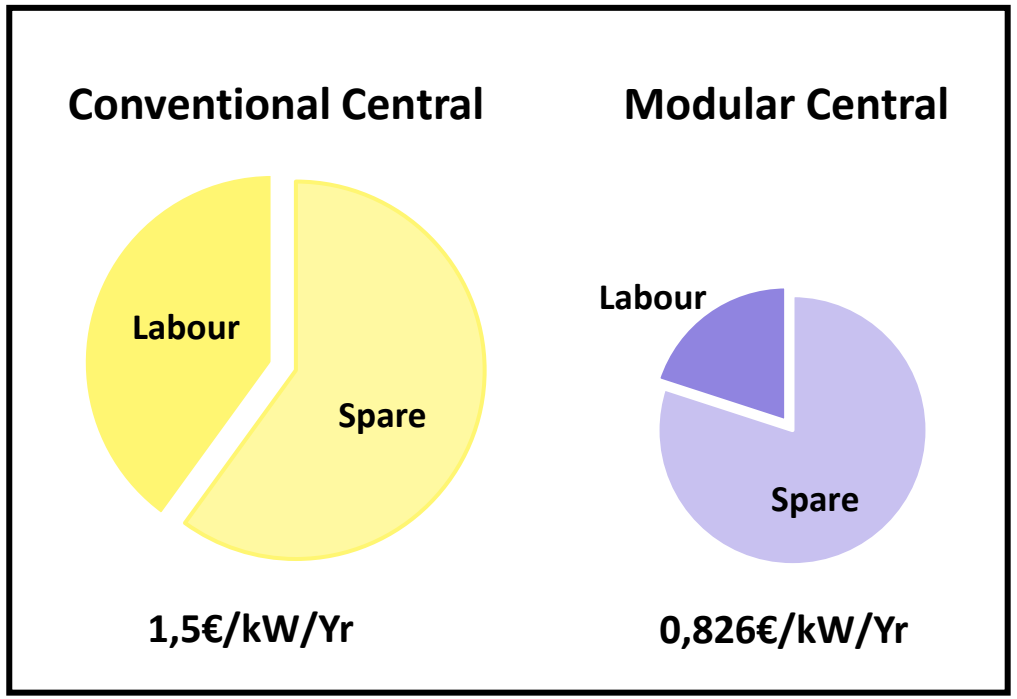
PVS-260/300-MVMCS

Main Benefits Vs Conventional Central solution

OPEX

Replace on fail concept and swappable power blocks reduce the number of spare parts and the O&M activity on site



Typical O&M activity cost

100MW Project		
	Central Inverter	**Modular Inverter**
Inverter Spare	• Fuses • Fan • Capacitor • Modules • …..	Typically 1% of total units installed available onsite
Inverter repair & replacement	• Manufacturer expertise or • specialized trained technician	Customer technician

Provide more than 1.3 €c/Watt saving in 25Yrs(*)

(*) Initial 5 years are covered by the standard warranty

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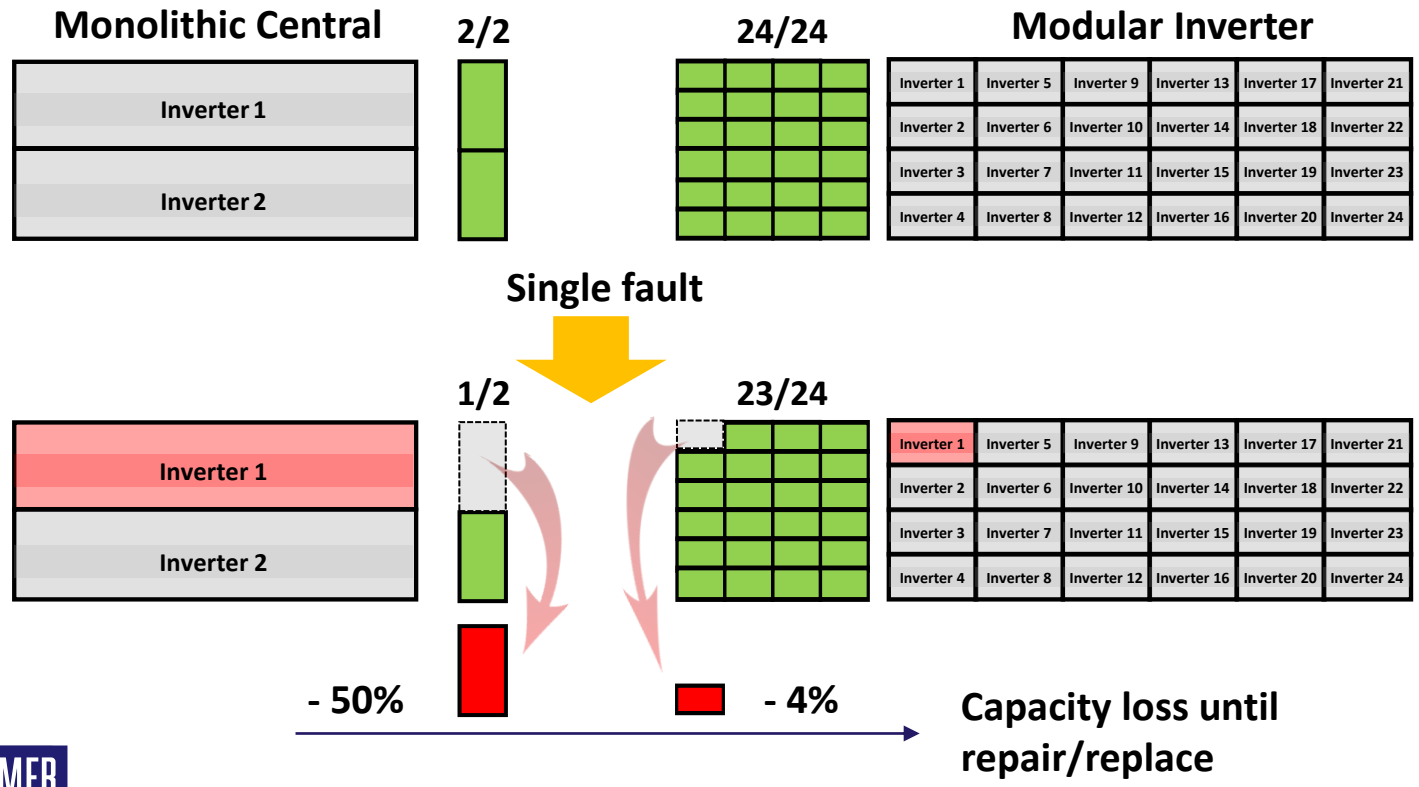
PVS-260/300-MVMCS

Main Benefits Vs Conventional Central solution

AVAILABILITY

The embedded fault tolerance is the key to maximize the system availability



- **Low sensitivity to a Single fault**

→ System availability > 99,9%

- **Easy and fast replacement**

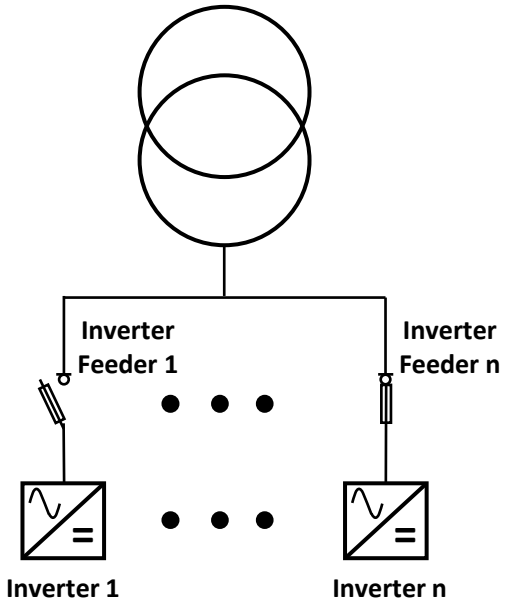
→ Module weight ≤100kg, easy to manage even from Customer personnel (No need Manufacturer's technicians)

PVS-260/300-MVMCS

Main Benefits Vs Conventional Central solution

AVAILABILITY

The embedded fault tolerance is the key to maximize the system availability



- Up to 24 Independent MPPTs **to preserve the Yeld in case of single fault**
- Complete segregation of each single unit, each inverter feeder is protected with a dedicated fuse switch disconnector in order **to safely operate on each single unit while not penalizing the Energy production**

	Central Inverter	Modular Inverter
System Availability	Maximum 99,5%	> 99,9%

99.9% compared to 99.5% maximum from central solutions, thanks to the inherent fault tolerance, reduced MTTR and labor cost guaranteed by modular conversion

+0,4%

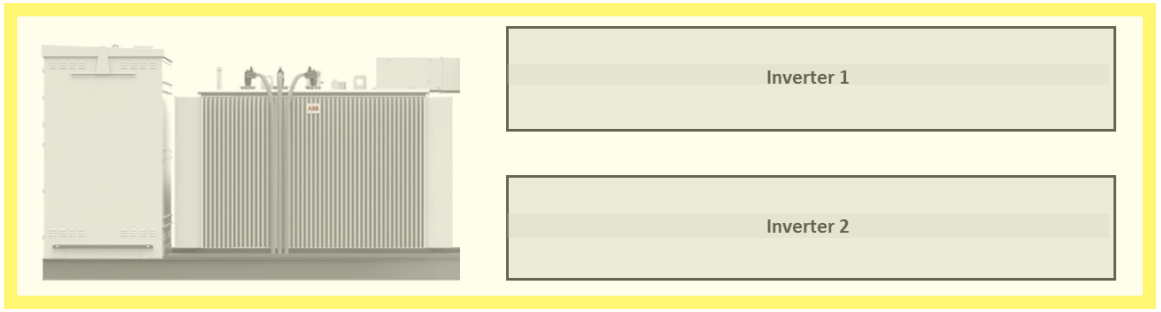
PVS-260/300-MVMCS

Main Benefits Vs Conventional Central solution

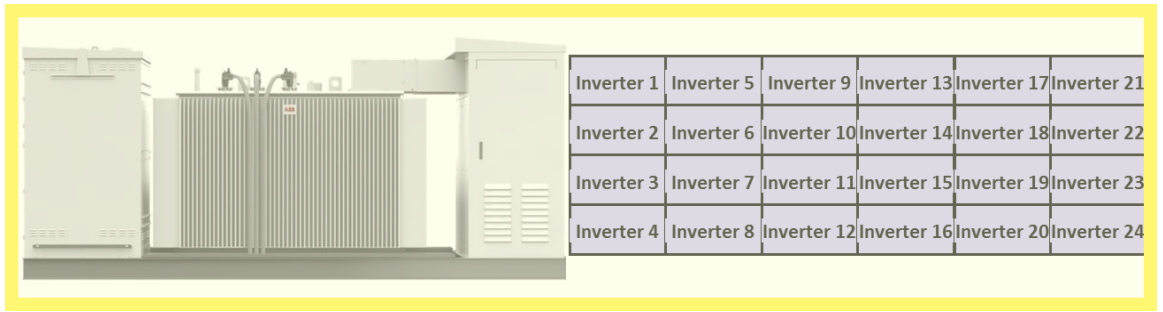
PWR Density

Replace any conventional central inverter solution in the same footprint
Based on 24 x 260/300 kVA ultra-high power density swappable power modules

Monolithic Central Inverter solution footprint



Modular String Inverters



MODULAR CENTRAL INVERTERS – POWER RATINGS / 600Vac & 690Vac								
PVS-260-MVMCS		3.675MVA@30°C (14)	3.82MVA@40°C (16)	3.94MVA@30°C (15)	5MVA@50°C (21)	5.5MVA@50°C (23)	6.3MVA@30°C (24)	
PVS-300-MVMCS	3.3MVA@30°C (11)	3.6MVA@30°C (12)	3.82MVA@40°C (14)	3.9MVA@30°C (13)			6.3MVA@30°C (21)	7.2MVA@30°C (24)
MONOLITHIC CENTRAL	**3.2MVA@30°C**	**3.6MVA@30°C**	**3.8MVA@40°C**	**4MVA@30°C**	**5MVA@45°C**	**5.5MVA@45°C**	**6.4MVA@30°C**	**7.2MVA@30°C**

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PVS-260/300-MVMCS

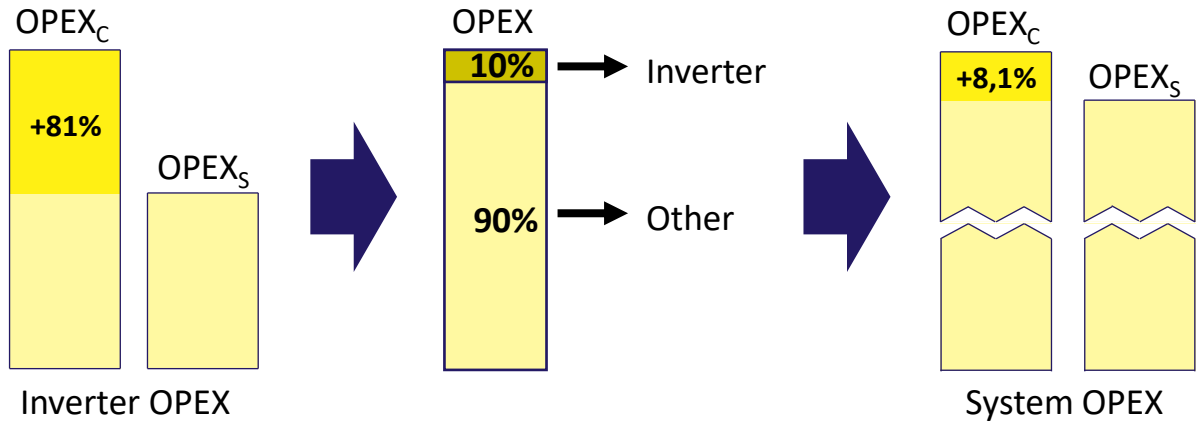
Main Benefits Vs Conventional Central solution

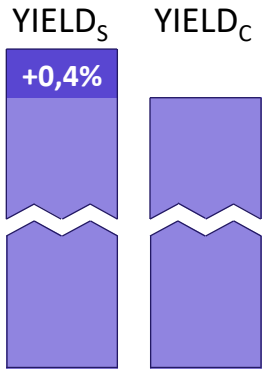
LCOE

Lower LCOE is the result of the equation of the Centralized architecture and modular core

- $OPEX_S = 0{,}55 \times OPEX_C$
- $YIELD_S = 1{,}004 \times YIELD_C$

$$LCOE = \frac{CAPEX + OPEX}{YIELD}$$





$LCOE_S = 0{,}985 \div 0{,}975 \times LCOE_C$

It is possible to reduce LCOE by -1.5% ÷ -2.5% compared with conventional solution

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PVS-260/300-MVMCS

Main Benefits Vs Conventional Central solution

MAIN BENEFITS	>> KEY ADVANTAGES << VS CONVENTIONAL CENTRAL SOLUTIONS	
O&M	**- 1.3 €c/Watt**	Typical saving over 25 years, thanks to the granularity of power conversion accomplished with smaller and swappable power blocks
Availability	**+ 0.4%**	99.9% compared to 99.5% maximum from central solutions, thanks to the inherent fault tolerance, reduced MTTR and labor cost guaranteed by modular conversion
PWR Density	**=**	The AC capacity of a fully equipped plug & play 40 feet Medium Voltage Compact Skid can reach 7200kVA, same as the largest conventional central solutions
LCOE	**-1.5% ÷ -2.5%**	Depending on site-specific conditions the LCOE of a 50/100MW plant designed with FIMER's new modular solution is 1.5% to 2.5% lower than conventional solutions

Thank you

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