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10 AM – 11 AM | BST, London

pv magazine webinars

Central vs. String Inverters: Myth & Reality

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Act today for a tomorrow without the mistakes of yesterday.
A clean future for us and all who follow.

SUNGROW

POWER HOUR

NEXT GENERATION UTILITY SOLUTIONS

YOUR SPEAKERS
FOR TODAY

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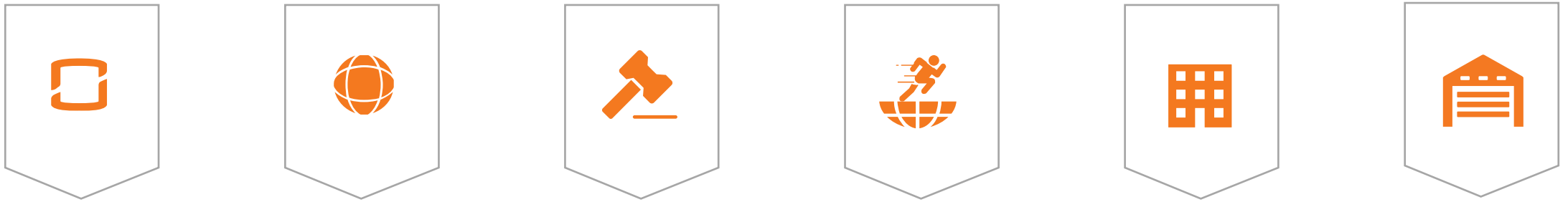
A focused leader in inverter technology



1997

Founded by Professor Cao

2006

Expanded to the Global Market

2011

Listed on SZSE

2015

No.1 of Global Market Share

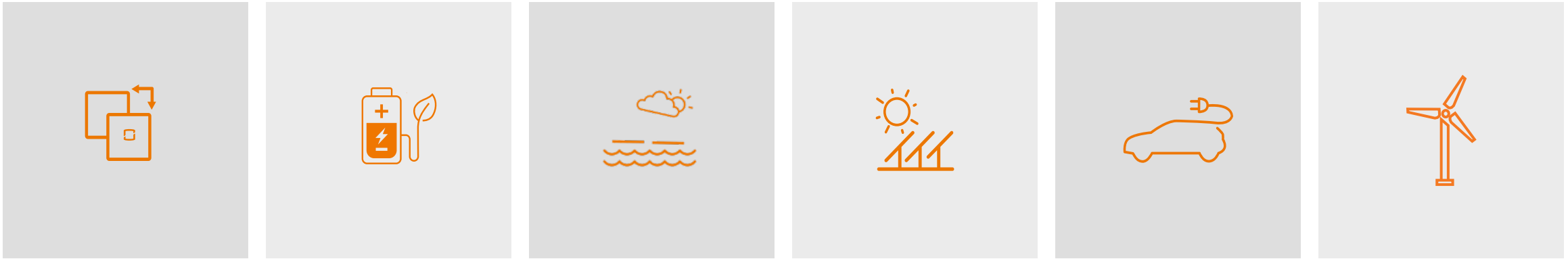
2018

India Factory in Operation

2019

Hit 100GW Installation

Committed to providing world-leading clean power solutions



PV Inverters

ESS

Floating PV Systems

Project Development

Power Electronics

Wind Energy Converters

Core technology is the permanent power of Sungrow

$90 M

Invested in R&D in 2019

40%+

Proportion of technical R&D personnel

2000+

Patent applications accumulated

The world’s largest inverter factory

50 GW / Year
Global Production Capacity

China Factory
47 GW / Year
ESS 6 GW / 6GWh

India Factory
3 GW / Year

An extensive footprint across the globe

EUROPE
6 Service offices
16 Local warehouses

AMERICAS
3 Service offices
11 Local warehouses

MIDDLE EAST
1 Service office
1 Local warehouses

APAC
7 Service offices
10 Local warehouses

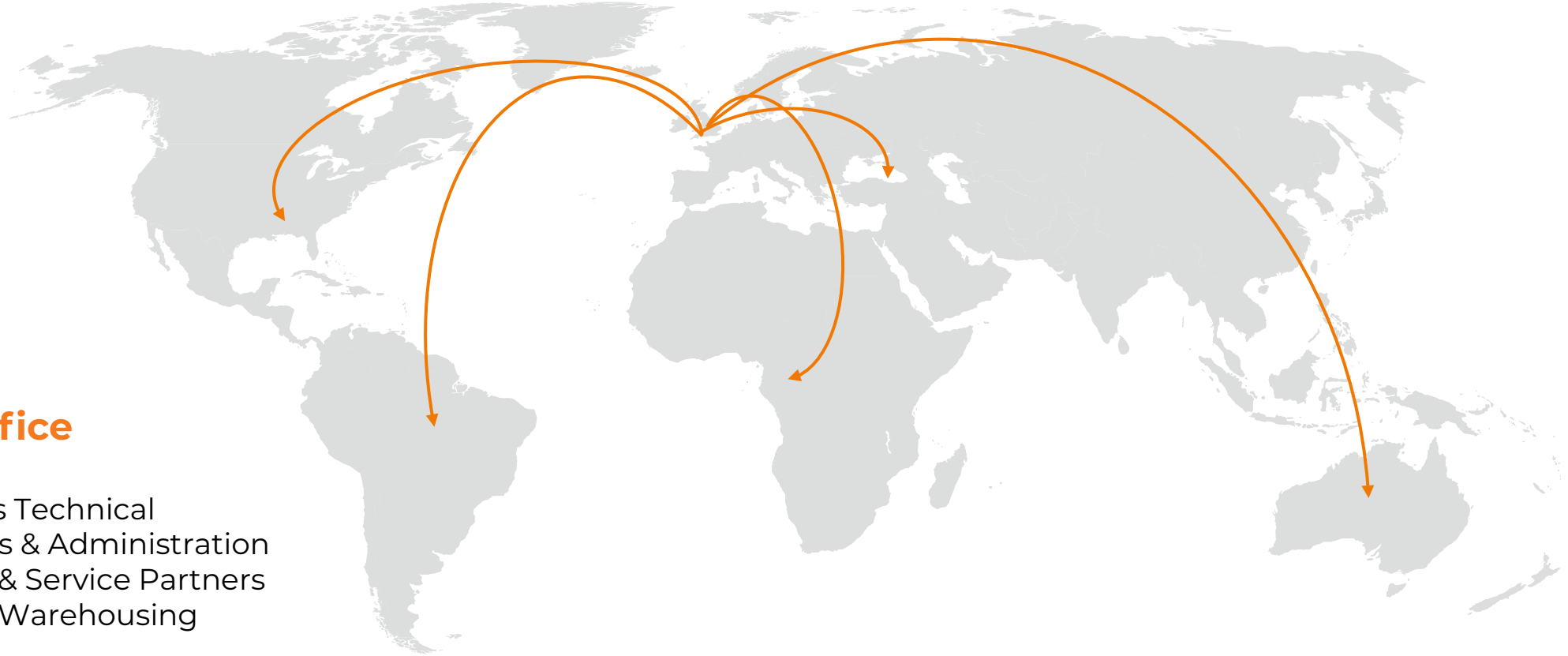
SOUTHERN AFRICA
1 Service office
1 Local warehouses

60+
Countries

50+
Service Outlets

20+
International Subsidiaries

UK Office – Milton Keynes

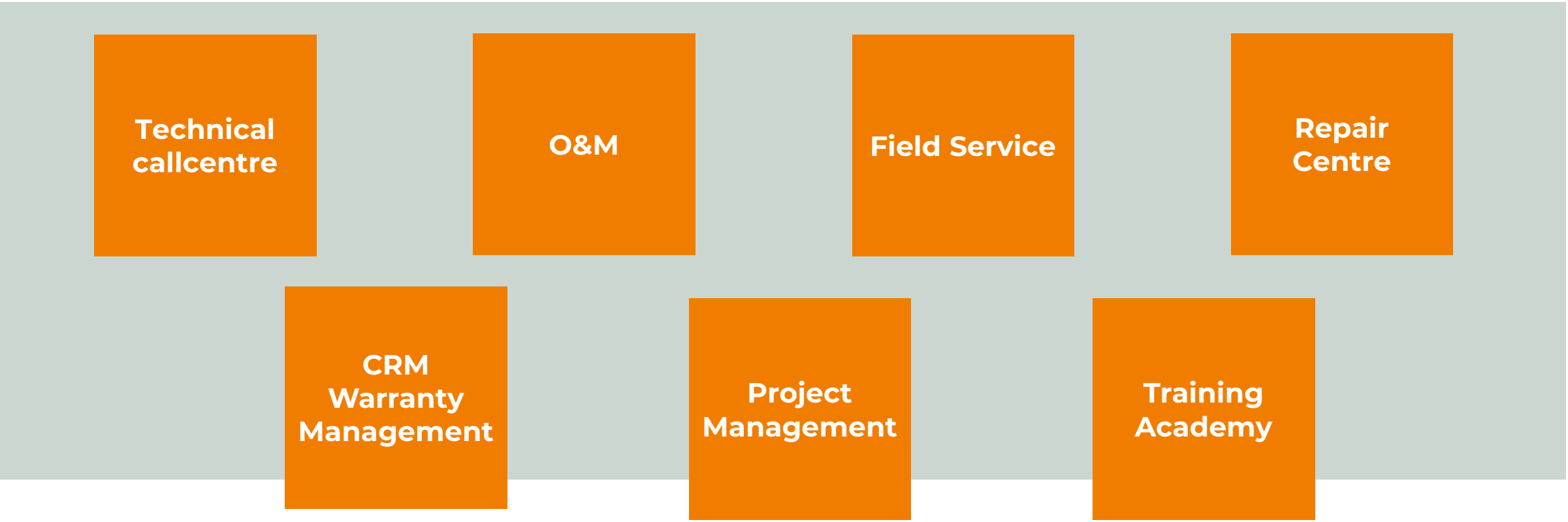


UK Office

Sales
Presales Technical
Logistics & Administration
Service & Service Partners
Service Warehousing

Focus on utility scale EPC's & Investors
Global project reach

Added value service for you

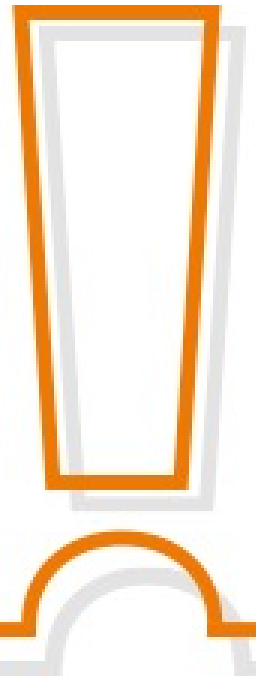


Central vs String Inverters: Myth & Reality

The $1mil question

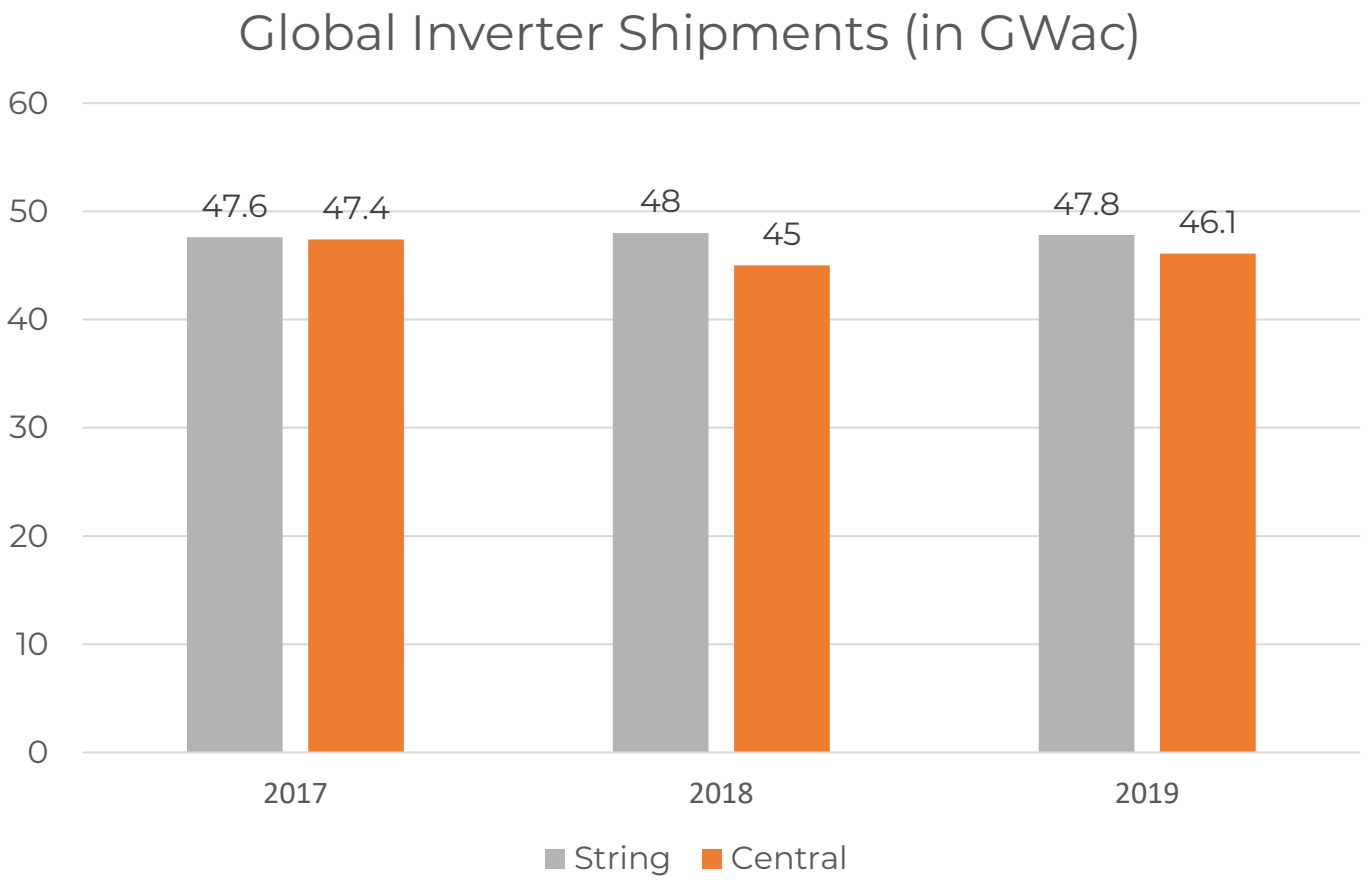
Are strings or centrals a better option, overall, for my project?

The $1mil question



Let’s explore!

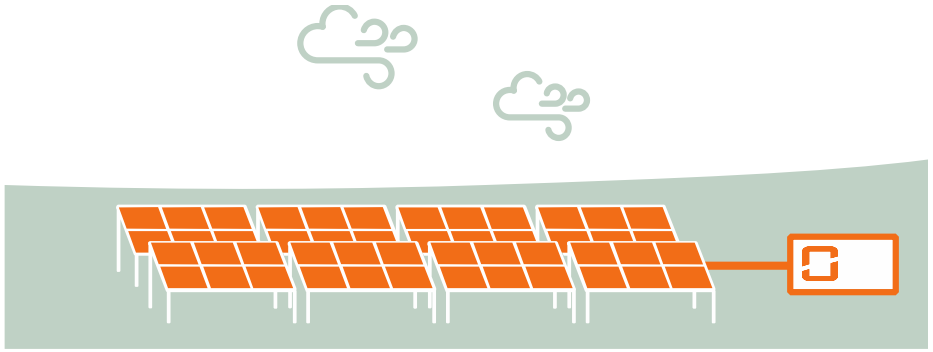
What is the industry doing

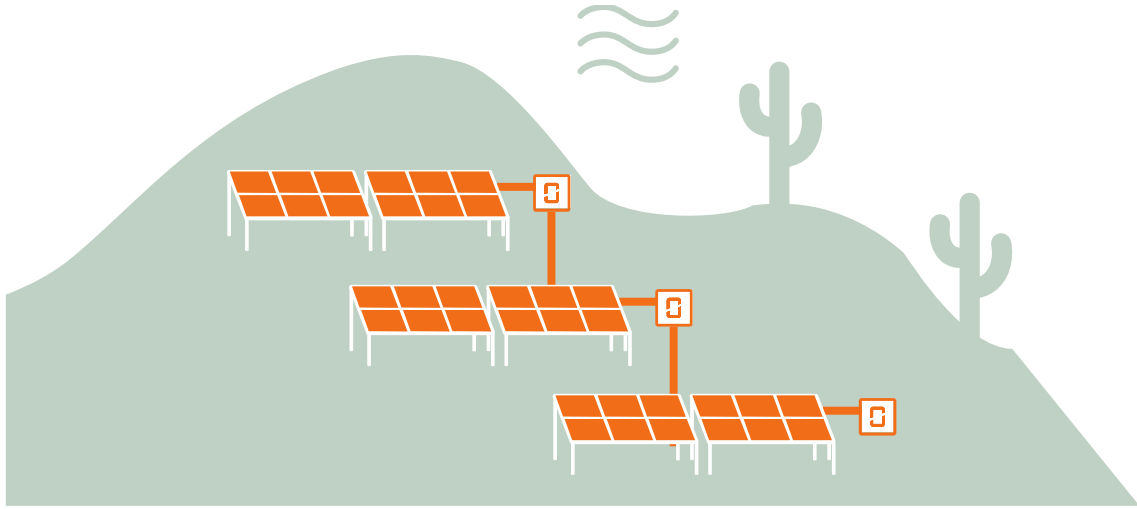


- Both technologies are relevant in the global PV arena
- Both concepts have a strong following in the developer/EPC community
- Both financial models equally viable, not necessarily for the same projects though

Source: IHS Markit

Head-to-head: centrals vs strings





CASE STUDY 1

Size: 50MWac @40°C

Location: United Kingdom

Mounting type: Fixed mount

Terrain: Flat

DC/AC ratio: 150%

Inverter model: SG3125HV-30 (central)

CASE STUDY 2

Size: 10MWac @45°C

Location: Spain

Mounting type: Single-axis tracker

Terrain: Fairly hilly

DC/AC ratio: 110%

Inverter model: SG250HX (string)

Analysis assumptions

- The project lifetime is 20 years.
- No repowering is considered in either case study. All inverters covered by a warranty extension from Y6 to Y20.
- Annual module degradation rate taken as 0.5% / year.
- The analysis ignores time-value-of-money effects.
- Simple relative-performance metric:

$$\textbf{TPI = Technology Performance Index} = \frac{\Delta CAPEX + \Delta \text{REVENUE}_{YEAR1\text{-}20} + \Delta OPEX_{YEAR1\text{-}20}}{MW_{AC}}$$

Case Study 1: CAPEX

CENTRALS

Item	*Quantity*
6.25MVA stations	7 units
3.15MVA stations	1 units
24-input combiners	246 units
300mm^2 1-core AL/XLPE/AWA/PVC cable	93,480m

STRINGS

Item	*Quantity*
SG250HX inverter	223 units
6.3MVA TX station	8 units
240mm^2 3-core + 120mm^2 1-core AL/XLPE/SWA/PVC cable (TN earthing)	42,370m

Total
€ 2,522,988

+

ΔCAPEX = **€ 305,140**

Total
€ 2,828,128

−

Case Study 1: REVENUE$_{YEAR1-20}$

CENTRALS

	MWhs
Y1-Y20 Yield	1,474,071

REVENUE$_{Y1-20 @ €60/MWh}$
€ 88,444,260

−

STRINGS

	MWhs
Y1-Y20 Yield	1,477,914

REVENUE$_{Y1-20 @ €60/MWh}$
€ 88,674,840

+

ΔREVENUE$_{YEAR1-20}$ = - € 230,580

Notes:
[1] Cable loss profiles: 1.5% DC / 0.1% AC (centrals)
0.6% DC / 1.1% AC (strings)
[2] Mismatch loss profiles: 0.6% (centrals)
0.4% (strings)

Case Study 1: $OPEX_{YEAR1-20}$

CENTRALS

Maintenance type	*Euro*
Preventive	135,046
Corrective	369,167

Total
€ 504,213

+

STRINGS

Maintenance type	*Euro*
Preventive	168,807
Corrective	595,721

Total
€ 764,528

−

$\Delta OPEX_{YEAR1-20}$ =
€ 260,315

Notes:
[1] OPEX covers warranty extensions up to Y20 and labour cost for all inverter maintenance works.
[2] All O&M work is subcontracted to 3d parties (no in-house personnel available).
[3] A 2-man crew assumed for all works, except for centrals' corrective maintenance (1-man crew).
[4] Corrective maintenance is carried out on an annual basis for both centrals and strings.

Case Study 2: CAPEX

CENTRALS

Item	*Quantity*
6.25MVA stations	1 units
3.15MVA stations	1 units
24-input combiners	35 units
300mm^2 1-core AL/XLPE/AWA/PVC cable	9,100m

STRINGS

Item	*Quantity*
SG250HX inverter	48 units
6.3MVA TX station	2 units
240mm^2 3-core AL/XLPE/SWA/PVC cable (IT earthing)	6,240m

Total
€ 452,210
+

ΔCAPEX = **€ 133,478**

Total
€ 585,688
−

Case Study 2: REVENUE$_{YEAR1-20}$

CENTRALS

	MWhs
Y1-Y20 Yield	455,065

STRINGS

	MWhs
Y1-Y20 Yield	460,293

REVENUE$_{Y1-20 @ €60/MWh}$
€ 27,303,900

−

ΔREVENUE$_{YEAR1-20}$ =
- € 313,680

REVENUE$_{Y1-20 @ €60/MWh}$
€ 27,617,580

+

Notes:
[1] Cable loss profiles: 1.37% DC / 0.1% AC (centrals)
0.38% DC / 0.76% AC (strings)
[2] Mismatch loss profiles: 1.0% (centrals)
0.4% (strings)

Case Study 2: $OPEX_{YEAR1-20}$

CENTRALS

Maintenance type	*Euro*
Preventive	33,761
Corrective	76,861

Total
€ 110,622

+

STRINGS

Maintenance type	*Euro*
Preventive	0
Corrective	114,506

Total
€ 114,506

−

$\Delta OPEX_{YEAR1-20}$ =
€ 3,884

Notes:
[1] OPEX covers warranty extensions up to Y20 and labour cost for all centrals' maintenance works.
[2] Central's O&M work is subcontracted to 3d parties. Strings' O&M handled by in-house personnel (zero labour).
[3] A 2-man crew assumed for all works, except for centrals' corrective maintenance (1-man crew).
[4] Corrective maintenance is carried out on an annual basis for both centrals and strings.

Head-to-head: outcome

Case study: 1
UK 50MW

Centrals' TPI = € 6,697 / MW_{AC}

or

Strings' TPI = - € 6,697 / MW_{AC}

Case study: 2
Spain 10MW

Strings' TPI = € 17,631 / MW_{AC}

or

Centrals' TPI = - € 17,631 / MW_{AC}

i.e. the savings' potential of both technologies can be positive, and hence make more financial sense over their counterpart, **under specific circumstances**.

Conclusions

Technology decision strongly dependent on factors such as:

- Business strategy & key project drivers (min CAPEX, max PR etc.)
- In-house expertise and supply-chain optimisation (EPC / owner)
- Geography & solar resource
- O&M arrangements

Though the cut-off is far from clear, there is strong evidence that centrals' financial advantage scales with project size, a trend that has not been reversed in the last 10-15 years.

A one-size-fits-all approach seems to lead to sub-optimal decisions.

Thorough investigation of all options is advised at all times.

SG3215HV-MV

Complete medium voltage solution
for a **400 MW**
solar PV installation

Meets electricity needs
of **150,000 residents**

Completion date
January 2019

Capacity
400 MWp

SG2500HV-MV-20

Largest solar plant in Egypt

The solar park produces
1.8 GWh of electricity
annually

Completion date
March 2018

Capacity
150 MWp

Egypt
Solarpark Benban

SG125HV

Inverter **status** accessible
from **iSolarCloud app**

Provides energy for
2,100 homes

Completion date
2018

Capacity
10 MWp

Netherlands

Dordrecht solarpark

SG60KTL

Supplying the **growing demand** for clean energy

Completion date
2018

Capacity
7.5 MWp

Germany
Mindorf PV plant

Sungrow string & central portfolio

Utility

SG6250 / 6800HV-MV

SG250HX

C&I

SG110CX

SG33/40/50CX

Residential

2kW~20kW
PV Inverters

SH5.0/6.0/8.0/10R
T Hybrid Inverters

SBP4K8 Battery

Monitoring

iSolarCloud

APP

Logger1000

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