



## Central VS

### **Distributed Architecture**

in utility PV plants



93%

## Main Figures

Domestic

Export







"Zero"

36.000 m2

128.000 m2

3,560 MW \*

3.800 m2

150.000

420.000

15.800

6.200

\* 4,120 MW

CO\_emitted

Production area

Offices and facilities

Welding machines/year

**Conversion Units/year** 

Air conditioners/year

by the end of the year

Solar division production capacity/year (String Inv. –Central Inv. - Storage Inv.)

PC Board dpt. production capacity/year

Combiner Boxes production/year

Total land area















# Central Modular Inverter FIMER architecture VS Standard Central solutions









## EFFICIENCY DIAGRAM MONOLITHIC INVERTER



## EFFICIENCY DIAGRAM 4 MODULE INVERTER



## EFFICIENCY DIAGRAM **10 MODULE INVERTER**







#### The most reliable, competitive and advanced technology available



MPS system (Modular Power System) is a particular architecture for power modules of FIMER inverters which GUARANTEES HIGHER EFFICIENCY & Energy Production compared to conventional centralized inverters. <u>This Technology maximize all the advantages of the Central and Distributed configuration.</u>

Thanks to this system our inverters' power modules switch on gradually PRODUCING ENERGY AT ONLY **< 700W** generated by the PV plant.

This means that a FIMER inverter SWITCHES ON EARLIER AND SWITCHES OFF LATER!

The result is that FIMER inverters produce on average **11% MORE** than conventional PV inverters.

This highst efficiency means HIGHER GAIN already in the first working years of the machine and warranty period.



# Modular Central solutions VS String Distributed architecture

## RESA MED General PV plant configuration



THE GROUP







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## DC cable connection/ Combiner box

VS





- Direct connection between PV string and Inverter.
- Energy transport on AC side and AC losses are <u>150% higher</u> than DC losses.



#### MODULAR CENTRAL ARCHITECTURE

- Energy transport on DC voltage.
- Simple external combiner box.
- Flexibility of configuration.









- Bigger number of inverters/components (MTBF)
- In case of inverter fault the PV subplant doesn't produce energy.



#### MODULAR CENTRAL ARCHITECTURE

- Limited nr. of inverters (4 or 6 per conversion unit).
- In case of fault PV generator the power to inverter is the same (only a clamp of one stack).

In case of maximum indication and only in the first years of life of the PV moduls.





VS





- External expensive Panel with two or three level of AC parallel Circuit Breaker. (up to 3,200 A) \*very expensive and difficult to be procured
- Losses of these AC boxes are not considered with the inside inverter efficiency.
- Difficult to create a switching syncronism for a big number of inverter paralleled on AC side.



#### MODULAR CENTRAL ARCHITECTURE

- Direct connection from Inverter to MV-LV Transformer.
- All AC power connection are verified during factory test.





## Distributed solution critical points in utility PV scale







- Grid code compliance
- Costs
  - Commissioning time
  - False mithos and O&M Advantages







#### AC PARALLEL PANEL:

this panel connects all the inverter together on AC side. AC panel could be splitted in two different types; one (see picture) close to MV/LV transformer and other panels for first parallel level distributed on field. For central solution there is only a point to point connection between the inverter and MV/LV transformer.

#### AC LOSSES:

this panel has switches and Circuit Breaker in series to power flow and this reduce the BOS efficiency.

#### • FAULT PROBABILITY (MTBF):

Higher number of AC connection increases the probability of fault of PV plant.



# Grid Code Compliance



**PREMISE:** Connection rules and grid compliances impose much more restrictive constraints to the system every day. And evry day we are subject to updated of the PPCs.

Very fast response times from external commands (disconnection, power limitation) or digital frequency control loop (voltage frequency regulation).



#### Centralized Inverter:

They're checked by a PLC conversion unit that directly controls them with digital and analog signals (very fast).

#### • String Inverter:

They can only be checked via modbus or wifi (slow and unsafe bus because of the adjustment loop).





| ITEM  | MODULAR CENTRAL<br>SOLUTION   | DISTRIBUTD SOLUTIONS          | ITEM                       |
|---|-------------------------------|-------------------------------|----------------------------|
| INVERTER                                      | 28,500                        | 29,000                        | INVERTER                   |
| CONVERSION UNIT OR<br>SKIN<br>(TRAFO + MW SG) | 30,700                        | 29,500                        | LV – MV – TRAFO<br>+ MV SG |
| COMBINER BOX                                  | 4,500                         | 12,000                        | LV AC<br>PARALLEL BOX      |
| BOS   | 29,740                        | 37,600                        | BOS                        |
| COMMISSIONING                                 | 3,700                         | 5,200                         | COMMISSIONIG               |
| TOTAL SOLUTION                                | <u><b>67,400</b></u> + 29,740 | <u><b>75,700</b></u> + 37,600 | TOTAL SOLUTION             |





# Commissioning time



- Centralized Inverter: PPC and Scada systems are wired and tested at the factory, reducing commissioning time due to Inverter / PPC communication.
  - String Inverter: Reduced number of DC connections but increased number of AC side connections.







## String Inverter

Weight 70 kg (minimum 2 technician)

**Outdoor** (any intervention is subject to weather conditions)

Interaction of more than one vendor for commissioning, O&M & warranties

Longer Commissioning Time

Total setting on plant

### Standard Central Inverter

1 module stack (heaviest component) 18 kg (1 technician)

Indoor (any intervention is possible in all weather conditions)

One vendor for all the issues

Shorter commissioning Time

Pre-setting on factory



# **O&M** Advantages



- Modular stacks are indipendently managed from Supervisor Control Unit.
- When a fault happens in one stack, the other can work fine.
- Power from PV field is managed from the other nr. 9 power stacks.
- The only case of convertion power loss is when PV field gives more than 9/10 of nominal power.





# Local Content possibilities



#### **STRING SOLUTION**

- Production line of string inverters only
- Difficulties on implementing, locally, a reliable production line for advanced electronic
- All the main components are out of the SoW of the inverter manufacturer
- No local people involved in the plant construction phase

#### **CENTRAL SOLUTION**

- Local production of the main electromechanical components
- Assembly lines for Conversion units or skid
- Local production of MV power transformers
- Local production of combiner boxes
- Local production of MV switch gears
- Many people involved during construction phase.





Thank you for your attention.

## Fimer, Inverter for Life