

**GREENPOWER
TOTHEPEOPLE**



rem **TEC**

**AGROVOLTAICO®
10 years design
and operation
experience**



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Presented at



AgriVoltaics2020
Conference & Exhibition
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Perpignan, 16th October 2020

AGROVOLTAICO®?

AGRO = Agriculture
+
VOLTAIC = PV Power

Shadow
management

TARGET

More crops
+
Power



AGROVOLTAICO®

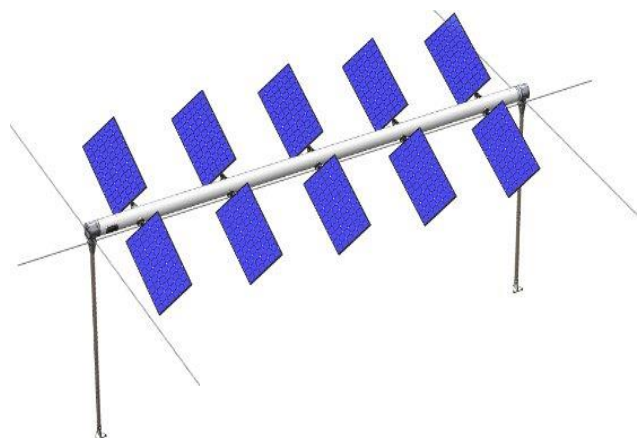


Agrovoltaico® is a modular system, based on the main unit, called **tracker**. Each tracker is composed by:

- ✓ A support structure made by 2 vertical poles;
- ✓ An horizontal steel profile able to rotate around its axis;
- ✓ Smaller profile mounted perpendicular to the horizontal axis, able to rotate around their axes;
- ✓ Rotating PV modules to follow the sun path during the day;
- ✓ A dynamic shadow to reduce hydric stress of the plantation underneath

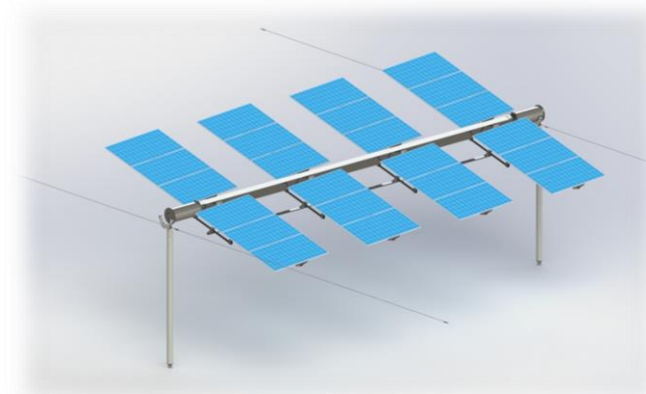
AGROVOLTAICO® TRACKER

- ✓ Tracker technology single (2D) or double (3D) axis
- ✓ Tensile structure
- ✓ Tracker placed at 4.5- 5.5 m height from ground
- ✓ Tracker 12 m long – 12 -18 m distance between rows
- ✓ Algorithms for tracking, backtracking, shadow management, growth of crops



RELEASE 1.0

- ✓ Tracker 12 m long – 12 m distance between rows
- ✓ Up to 24 kWp power capacity

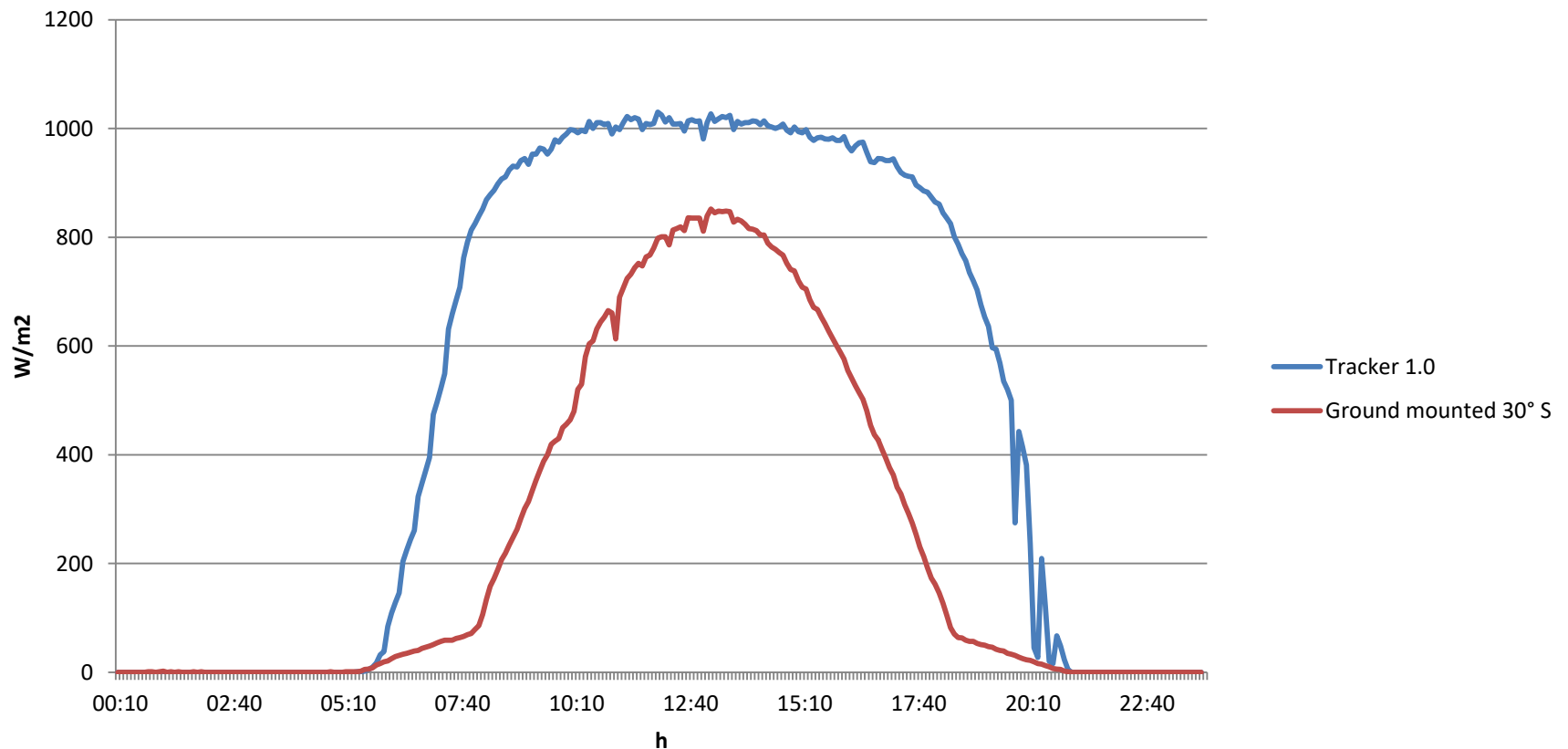


RELEASE 2.0

- ✓ Tracker 12 m long – 12-18 m distance between rows
- ✓ Up to 60 kWp power capacity

RESULTS RELEASE 1.0

Irradiation 20/06/2020 in Virgilio (MN)



Average annual power production increase = +37%

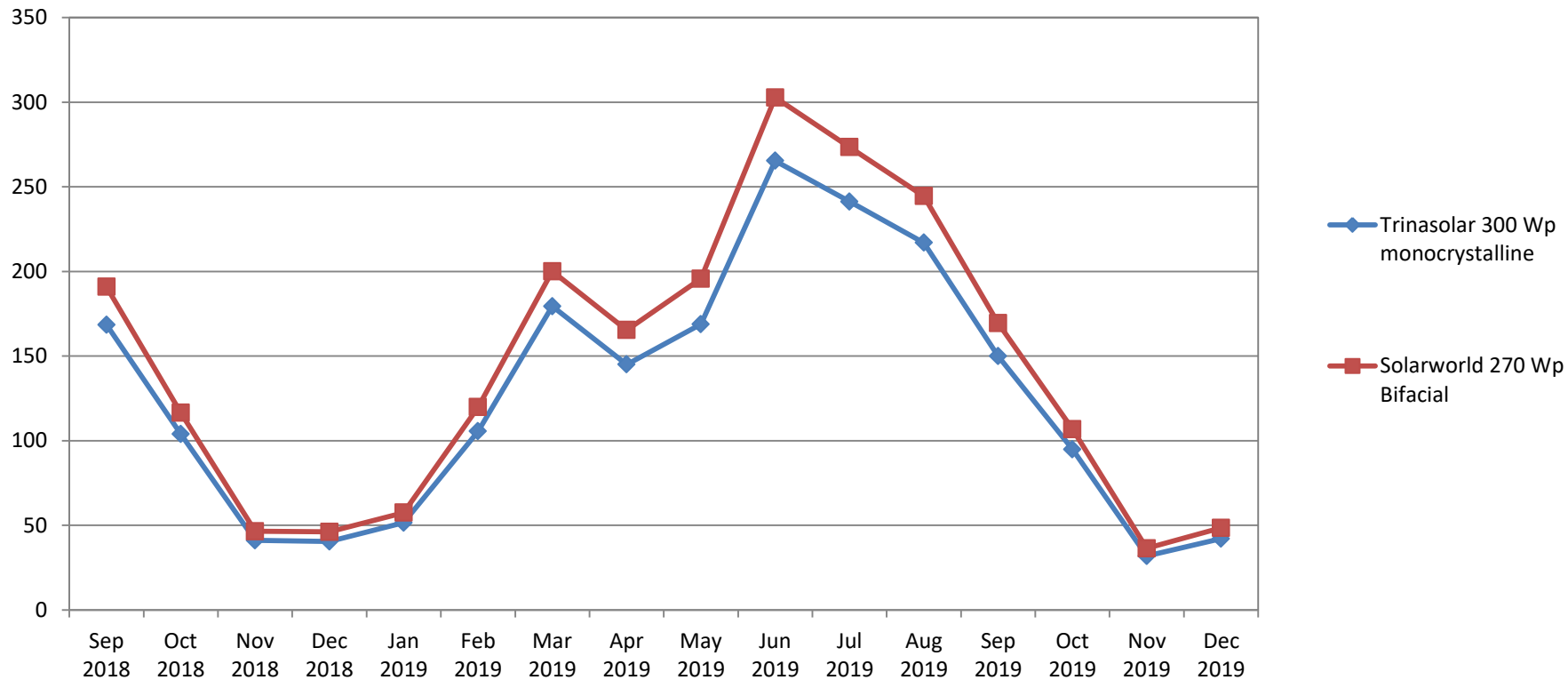


RESULTS RELEASE 2.0:

Bifacial Modules

[kWh/kWp]

Bifacial and mono-facial modules comparison



Average annual power production increase = +13%

REFERENCES

- ✓ 7 plants in operation since 2011 (Italy, China, Japan, France)
- ✓ 12 plants ordered for operation 2020/2021 (Italy, France, Japan)



EDF Renouvelables, Les Renardières (France): 117 kWp – Tracker 3D-2.0

ADVANTAGES OF AGROVOLTAICO®

- ✓ HIGH EFFICIENCY IN AGRICULTURE & POWER PRODUCTION
- ✓ INTELLIGENT MANAGEMENT OF SHADOW, CROP & POWER PRODUCTION
- ✓ NOT INVASIVE BY WORLDWIDE LOWEST GROUND FOOTPRINT
- ✓ HIGH RESISTENT STRUCTURE



Monticelli (Italy) 3,23 MWp



PLANT PROCESS

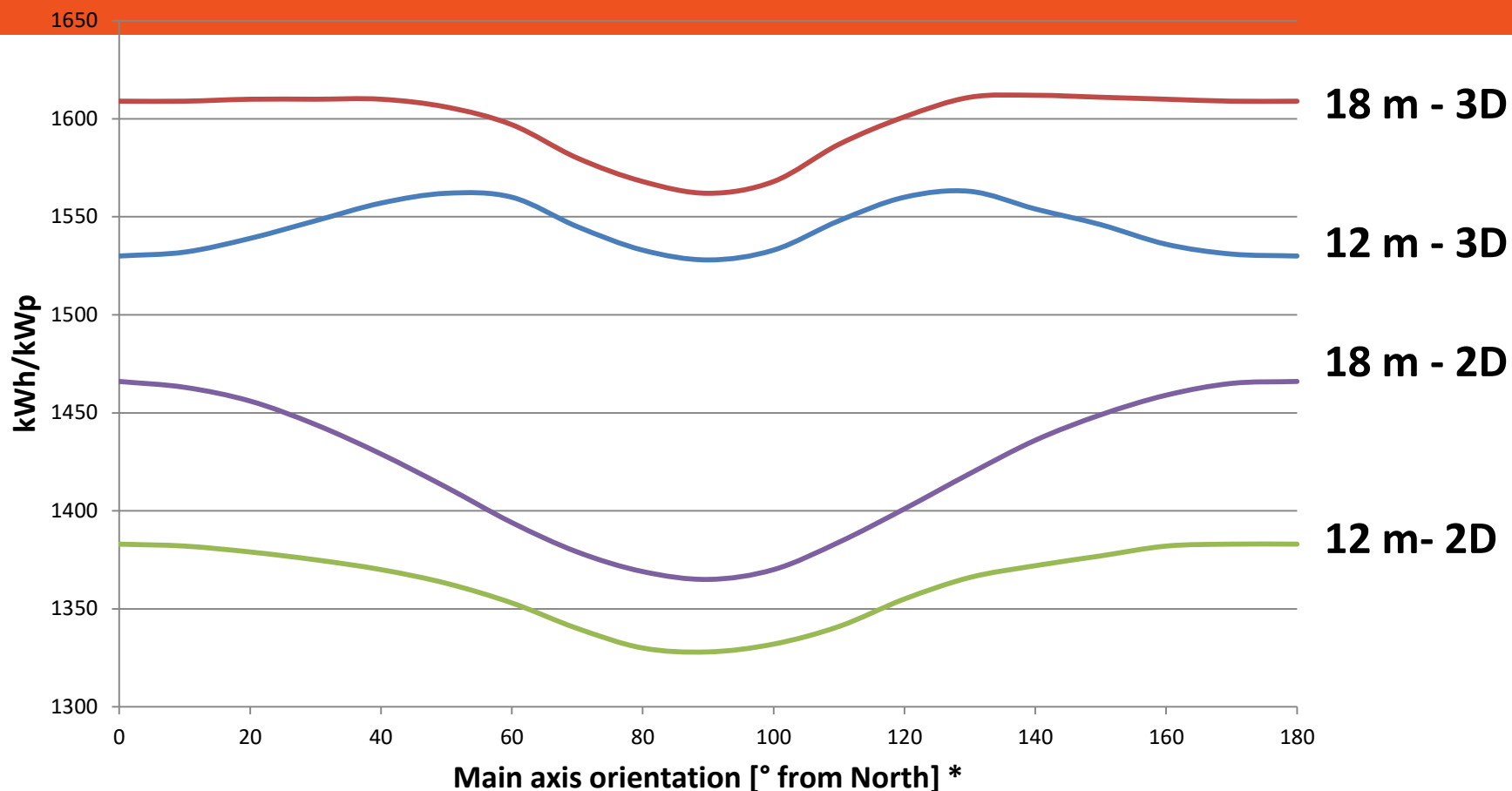
DESIGN PARAMETERS

- ✓ **Location** → Weather data, choice of system configuration (2D/3D)
- ✓ **Orientation of tracker rows** → Optimal 3D: 45° N – 2D: 0° N
- ✓ **Row distance** → Higher row distance = higher power production but lower shadow
- ✓ **System configuration (2D/3D)** → Depending from crop, location and orientation
- ✓ **Crop agriculture** → Special crop requirement for shadow management

Examples of theoretical energy production vs location

		PARIS (FR) Lat. 48.9° N		BRINDISI (IT) Lat. 40.7° N		BELEM (BR) Lat. -1.5° N	
	Row distance (m)	(kWh/m ² /y)	Difference to fixed configuration	(kWh/m ² /y)	Difference to fixed configuration	(kWh/m ² /y)	Difference to fixed configuration
3D-T1.0	12	1517	+ 36.7%	2614	+ 37.6%	2380	+ 28.9%
3D-T2.0	12	1416	+ 27.6%	2412	+ 27.0%	2290	+ 24.1%
3D-T2.0	15	1444	+ 30.1%	2469	+ 30.0%	2320	+ 25.7%
3D-T2.0	18	1461	+ 31.6%	2497	+ 31.4%	2335	+ 26.5%
2D-T2.0	12	1260	+ 13.5%	2085	+ 9.7%	2107	+ 14.1%
2D-T2.0	15	1292	+ 16.5%	2147	+ 13.0%	2139	+ 15.9%
2D-T2.0	18	1311	+ 18.1%	2179	+ 14.7%	2155	+ 16.7%
Fixed plant (optimal tilt)		1110		1900		1846	

ENERGY PRODUCTION & ORIENTATION



*Angle that main axis forms with North direction. 0° means North-South direction

AGROVOLTAICO® & AGRICULTURE

Shadow management on the ground:

- ✓ Possibility to **adapt shading** percentage
- ✓ Creation of an algorithm that automates the choice
- ✓ Shadowing or hail nets can be integrated in the structure to protect the crops

Cumulated more than 30 crop harvesting experience on large agriculture surfaces





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CROPS EXEMPLES



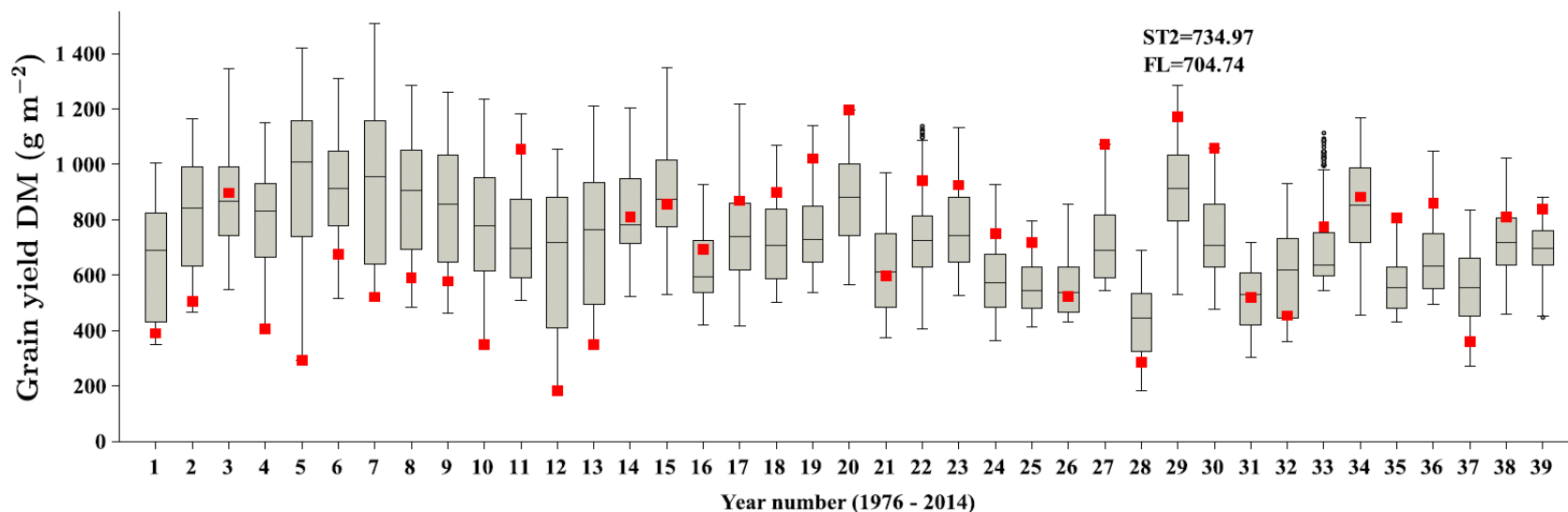
- Corn
- Wheat
- Rice
- Medical herb
- Rape
- Protein pea
- Soy
- Coffee
- Tea
- Berries
- Grapes
- Hemp
- Tomato
- Melon
- Pumpkin

CROP YIELD SIMULATION

- ✓ REM Tec has carried out various growth simulations on **different crops** (maize, Goji berry, hemp, grapes, etc....)
- ✓ **Few differences** about the biomass production, possible increase for some crops

Agrovoltaico 2.0: **734,97 g/m²**
 Open field: **704,74 g/m²**

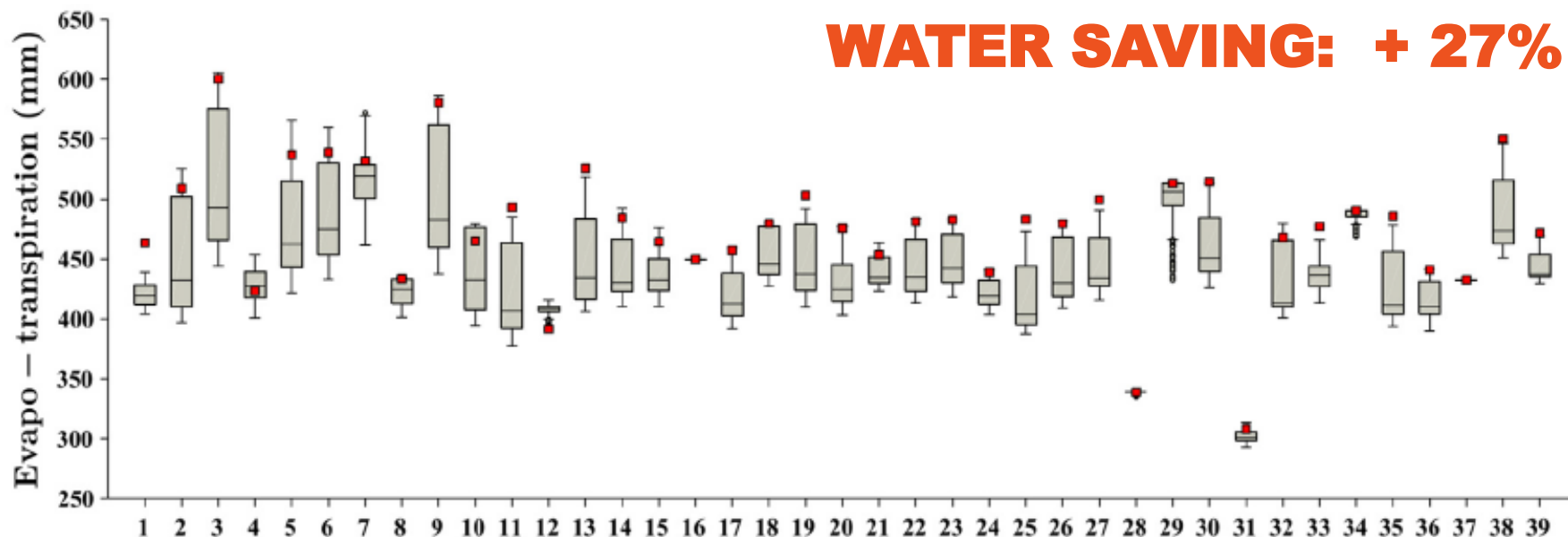
Maize yield average: + 4.3%



Grain production under Agrovoltaico and Full light condition (1974 - 2014)

CROP YIELD SIMULATION

- ✓ REM Tec has carried out various growth simulations on **different crops** (maize, Goji berry, hemp, grapes, etc....)
- ✓ **Few differences** about the biomass production
- ✓ **Water saving** due to the decrease of solar radiation



Evapotranspiration for maize in Monticelli (1975-2004)

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**Agrovoltaico is
High energy
production for
high quality
agriculture**



THANK YOU FOR YOUR ATTENTION

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