

Advanced Solar Data Analytics on over 16GW PV assets worldwide

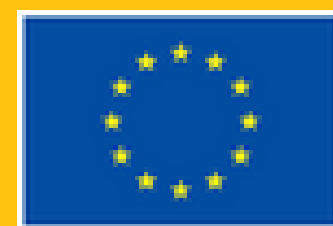
SOPHIA PV-Module Reliability 2021

Julián Ascencio-Vásquez
Solar R&D Project Manager

09/06/2021
Virtual Event



TRUSTPV
SOLAR PV, PERFORMANCE & RELIABILITY



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Research and Innovation Programme.**



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What is next?

1

About 3E nv

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1999

3E foundation
as a spin-off
of IMEC

2010

Launch of our
digital journey

2014

Launch of
Solar Data
Services

2020

Surpassing
10 GW of
connected
assets

2021

Launch of
Wind Analytics
LivLiner
Inside



1999 - 2007

Organic
growth,
international
presence

2012

Launch of our
digital twin
performance
model

2017

Launch of
Solar Analytics
& Sensor
Check

2021

Launch of
3E's digital
platform
SynaptiQ

100
experts

- Engineers
- Energy economists
- Market strategists
- Data scientists
- Meteorologists

90+
Gigawatt

- Solar PV
- Wind onshore
- Wind offshore
- Storage
- Grids & mini-grids

5
spin-offs

- FLIDAR
- XANT
- Wattson
- DUSS
- DeltaQ

108
countries

- Local knowledge
- Onsite experience
- Grid code expertise
- Language spoken
- Track record



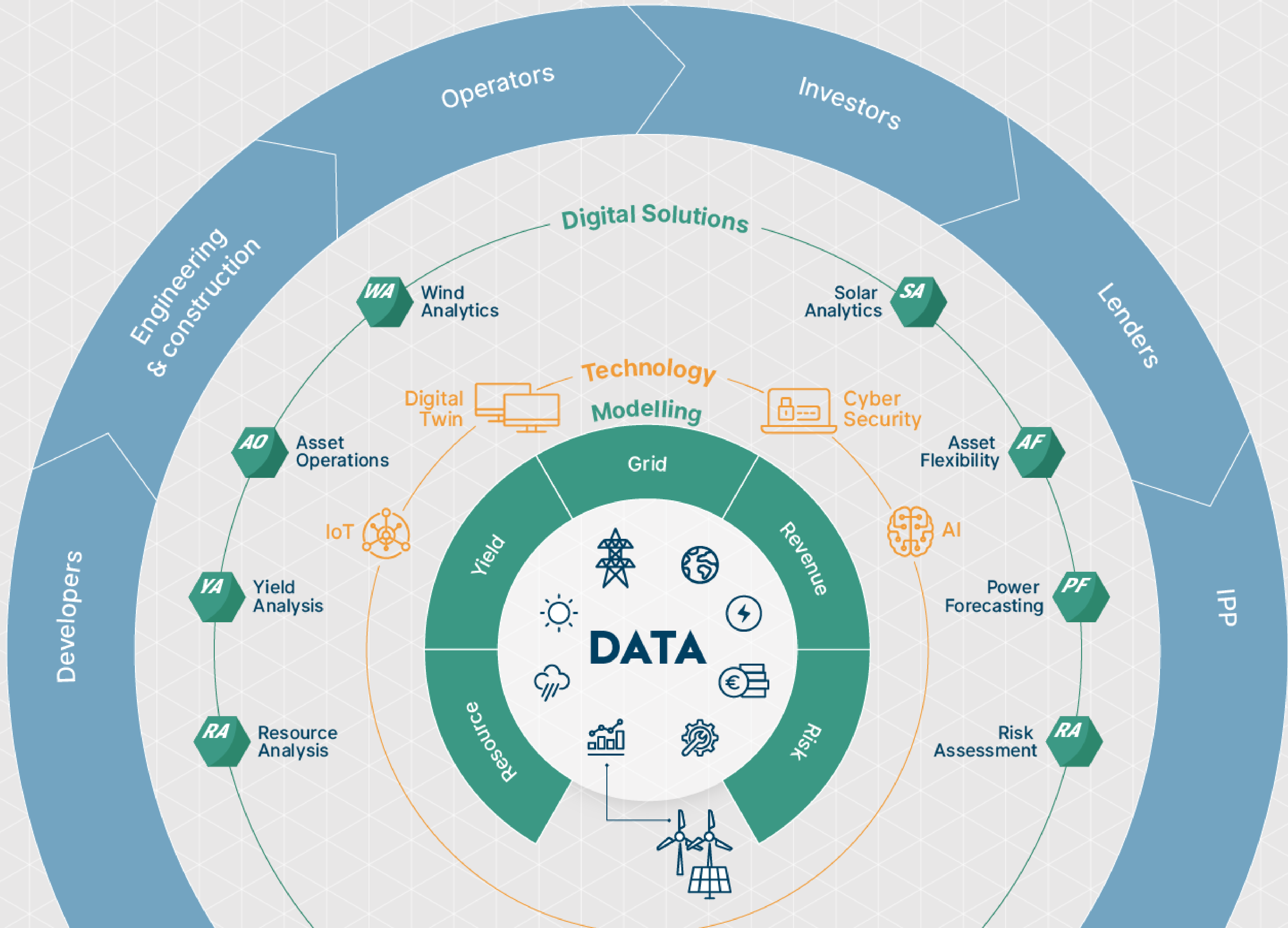
Digitize Your Renewable Energy and Maximize Your Asset Value

Digital Solutions

SynaptiQ is the go-to digital platform for development, operational asset management and analytics. The platform combines all our leading SaaS products into a one-stop solution for each phase of your renewable energy project.

Expert Services

Our experienced team delivers bankable expert services for engineering, technical and strategic decision support and is ready to fast-track your next renewable energy project.



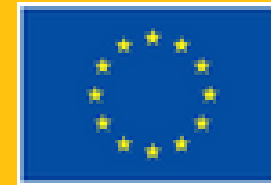
2

About TRUST-PV project

Advanced Solar Data Analytics on over 16GW PV assets worldwide



TRUST-PV PROJECT

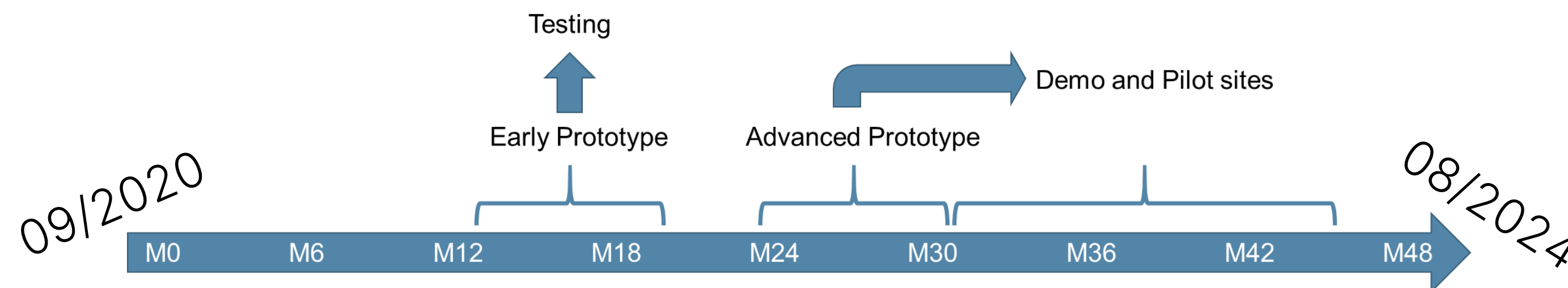
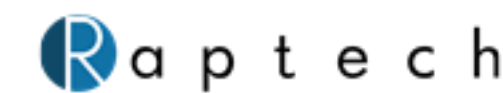


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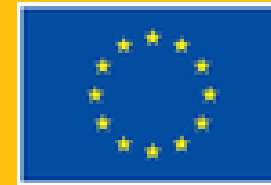
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Project Coordinator

eurac
research

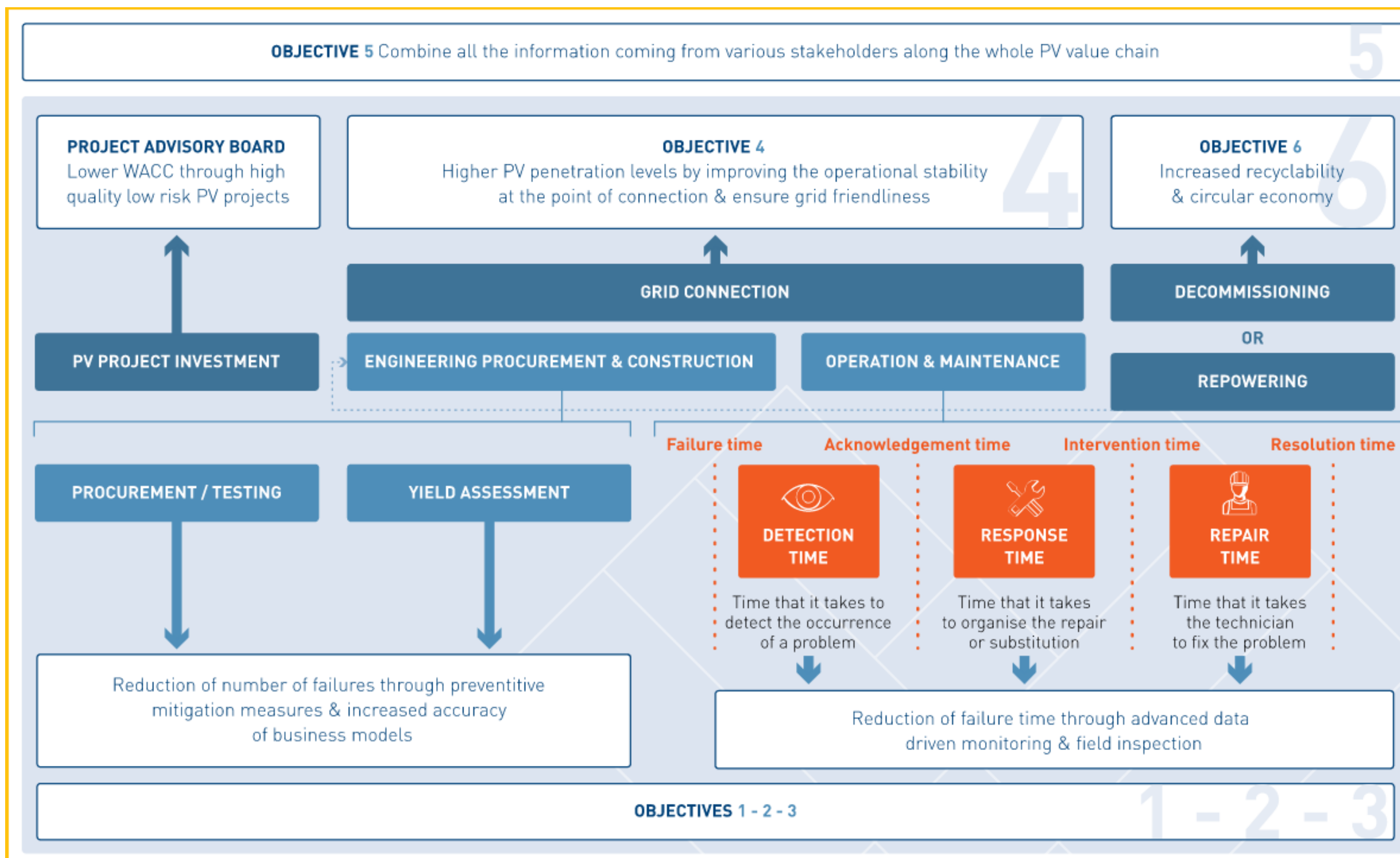


TRUST-PV PROJECT



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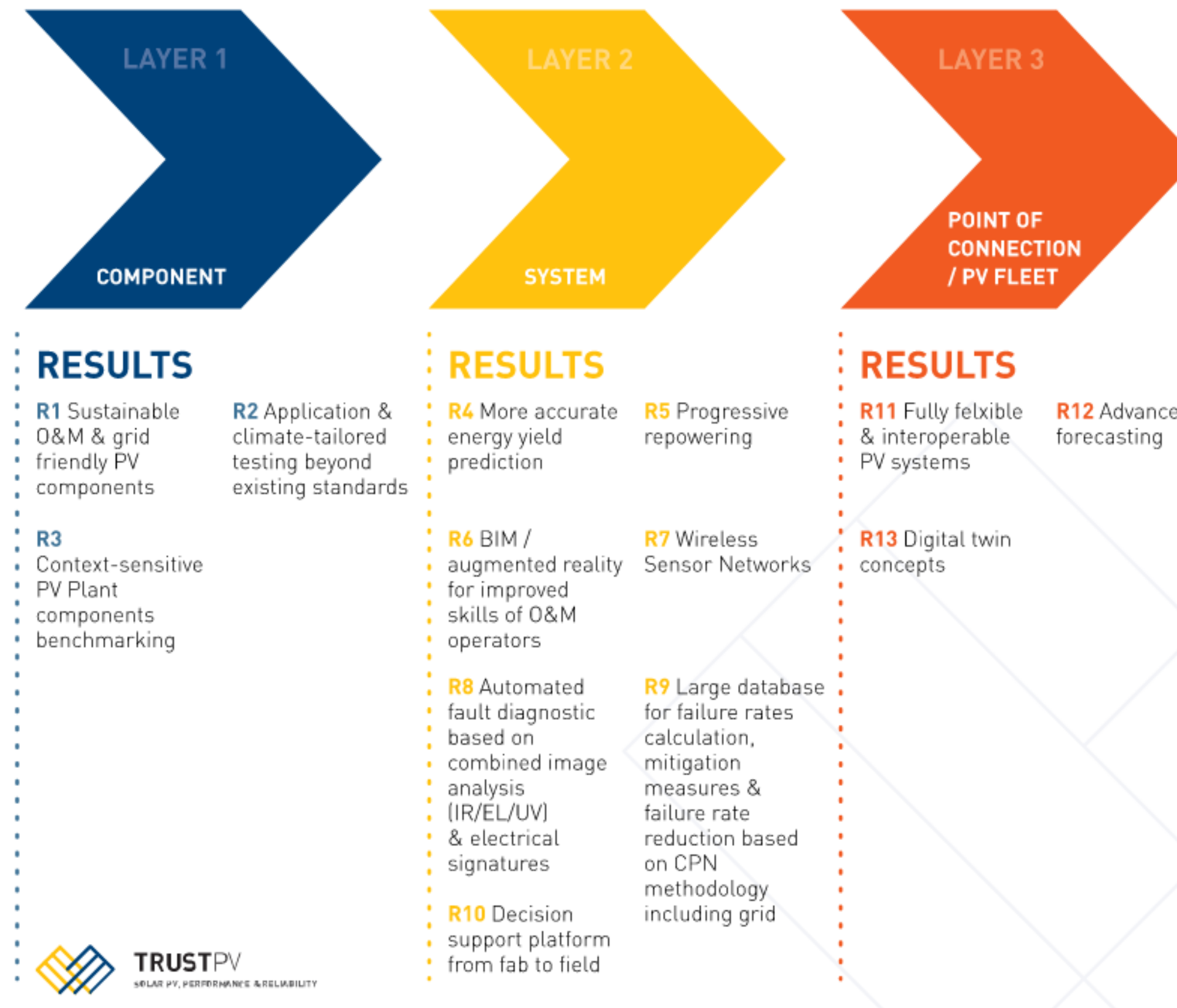
- ➔ Solar regulation
- ➔ Advanced modelling
- ➔ Advanced diagnostics
- ➔ Financing / Derisking
- ➔ Circular Economy
- ➔ Digitalisation

TRUST-PV PROJECT



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MAPPING OF EXPECTED RESULTS



More than 20 Exploitable Results already identified

time to market 2023 onwards

OBJECTIVES

TRUSTPV's RESULTS ENABLE THE ACHIEVEMENT OF OBJECTIVES

- 1 Increase P&R & lifetime of system components.
- 2 Increase the knowledge on the performance & establish cost effective fault diagnostic models of medium size commercial-residential systems.
- 3 To increase the design accuracy & the reliability & performance of utility – large commercial systems.
- 4 To combine all the information coming from various stakeholders along the whole PV value chain into a platform for enhanced decision-making.
- 5 To allow higher PV penetration levels by improving the operational stability at the point of connection and ensure grid friendliness.
- 6 To increase the sustainability of utility – large commercial systems through progressive repowering interventions.

3

PV Plant Components Benchmarking

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Introduction

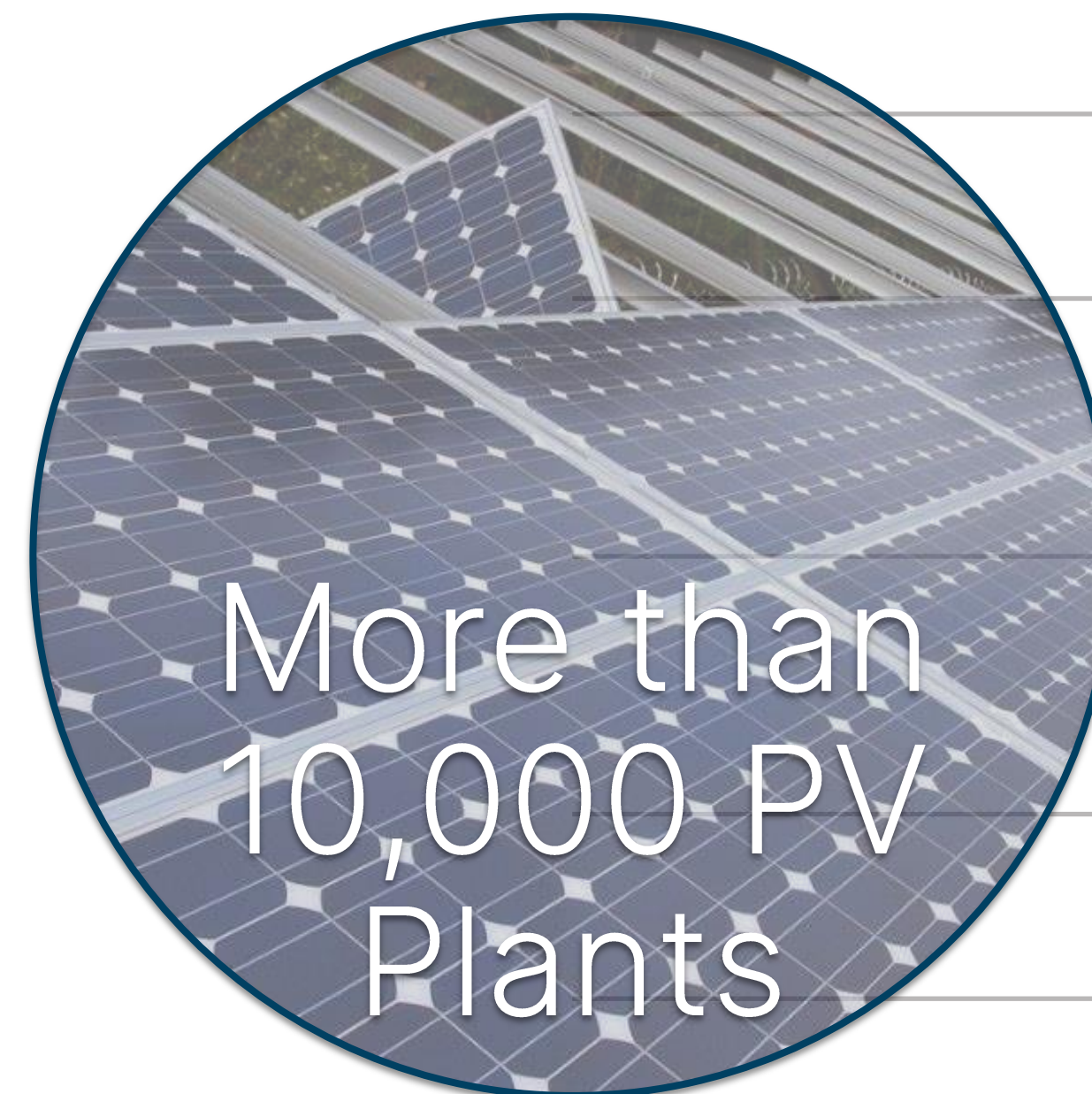
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- ✓ **Value proposition:** The PV system community has been looking for reliable statistics and reference data sets from practical experience and under real life operating conditions for many years. However, up to now, the lack of context sensitivity made that available statistics can serve for benchmarking only to a limited extent. The partners will disseminate their project results to the relevant stakeholder groups.
- ✓ **Main customers:** PV device manufacturers, investors, developers, asset managers, owners and operators.
- ✓ **Time-to-market:** 1.5 years for a Minimum Viable Product (MVP) and 2 to 3 years for a full-scale service on the market.

Introduction

Advanced Solar Data Analytics on over 16GW PV assets worldwide

- Learn about/from/with our own data
- Easy access to real insights
- Data-driven Benchmark
 - Manufacturers
 - Models
 - Configurations
 - Technologies
- Compare to your peers
- Make qualitative AND quantitative decisions



Partners involved and contributions

3E nv

- Over +10k PV Systems
- Over +10GW installed Capacity
- Approx, 3/4 Rooftop, 1/4 Ground



BayWa r.e. Italy

- Over +190 PV Systems
- Over +0.2GW installed Capacity
- Approx, 3/4 Ground, 1/4 Rooftop



Enel Green Power

- Over +100 PV Systems
- Over +4GW installed Capacity
- Approx, Half Fixed, Half Tracker



Innosea

- Identification of Floating PV Systems
- Engagement of clients
- Target +5 Floating Systems



Huawei

- Theoretical information
- Insights from laboratories









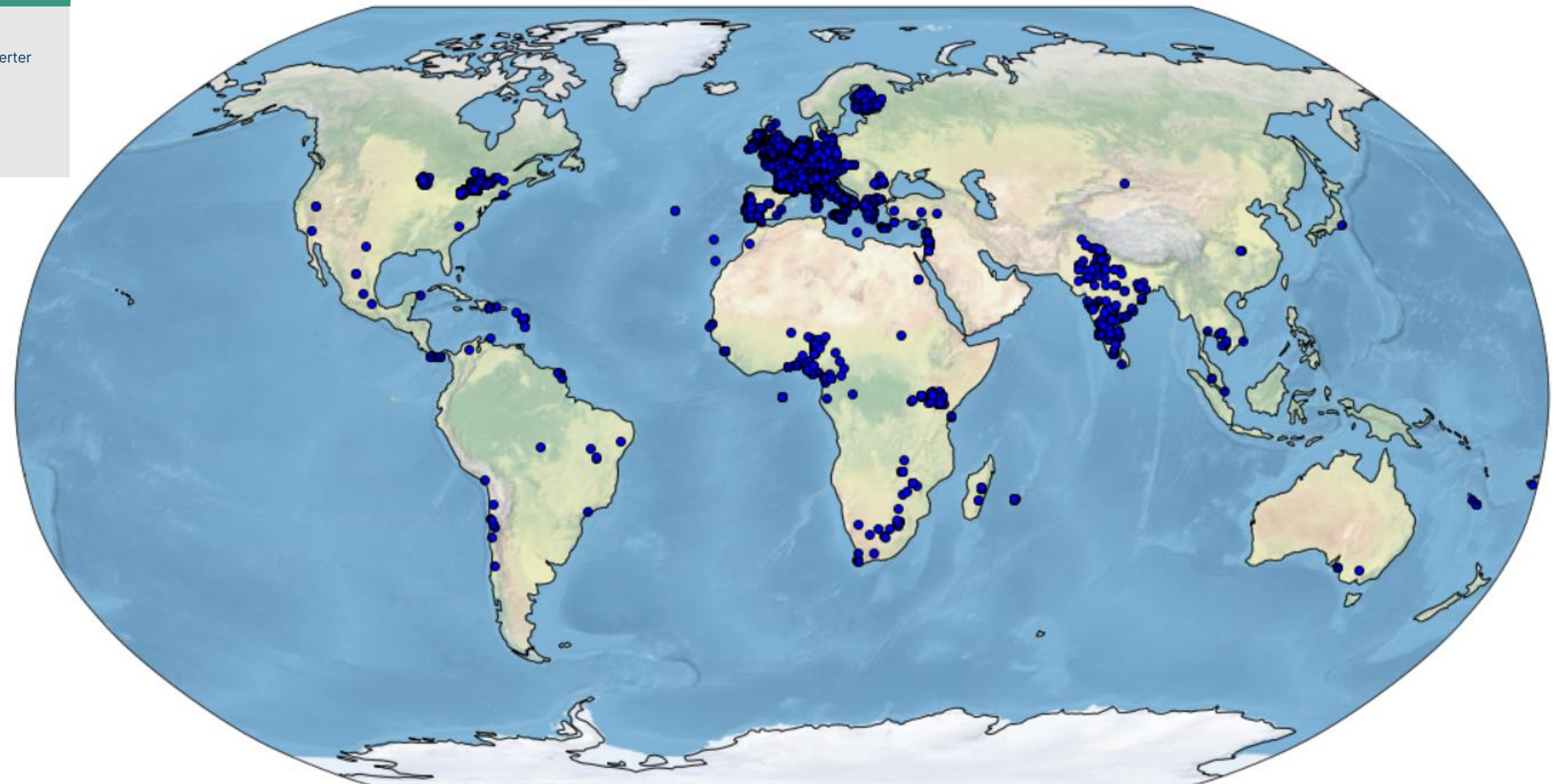
Solarcentury (now Statkraft)

- Over +90 PV Systems
- Over +0.9GW installed Capacity
- Approx, 2/3 String, 1/3 Central Inverter



Partners involved and contributions

<p>3E nv</p> <ul style="list-style-type: none"> Over +10k PV Systems Over +10GW installed Capacity Approx, 3/4 Rooftop, 1/4 Ground 	<p>BayWa r.e. Italy</p> <ul style="list-style-type: none"> Over +190 PV Systems Over +0.2GW installed Capacity Approx, 3/4 Ground, 1/4 Rooftop 	<p>Enel Green Power</p> <ul style="list-style-type: none"> Over +100 PV Systems Over +4GW installed Capacity Approx, Half Fixed, Half Tracker 
<p>Innosea</p> <ul style="list-style-type: none"> Identification of Floating PV Systems Engagement of clients Target +5 Floating Systems 	<p>Huawei</p> <ul style="list-style-type: none"> Theoretical information Insights from laboratories 	<p>Solarcentury</p> <ul style="list-style-type: none"> Over +90 PV Systems Over +0.9GW installed Capacity Approx, 2/3 String, 1/3 Central Inverter 



- Over +10.6k PV Systems
- Over +16GW installed Capacity

Main Concept

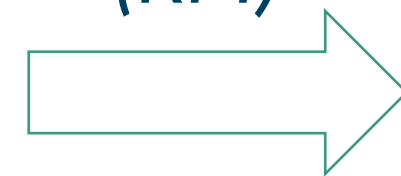
Advanced Solar Data Analytics on over 16GW PV assets worldwide

- OPERATIONAL KPIs

- Performance Ratio
- Performance Index
- Availability
- Degradation Rates
- Soiling Rates
- More...



Performance Metric (KPI)



Show :
KPI 1

Versus :
Feature 1

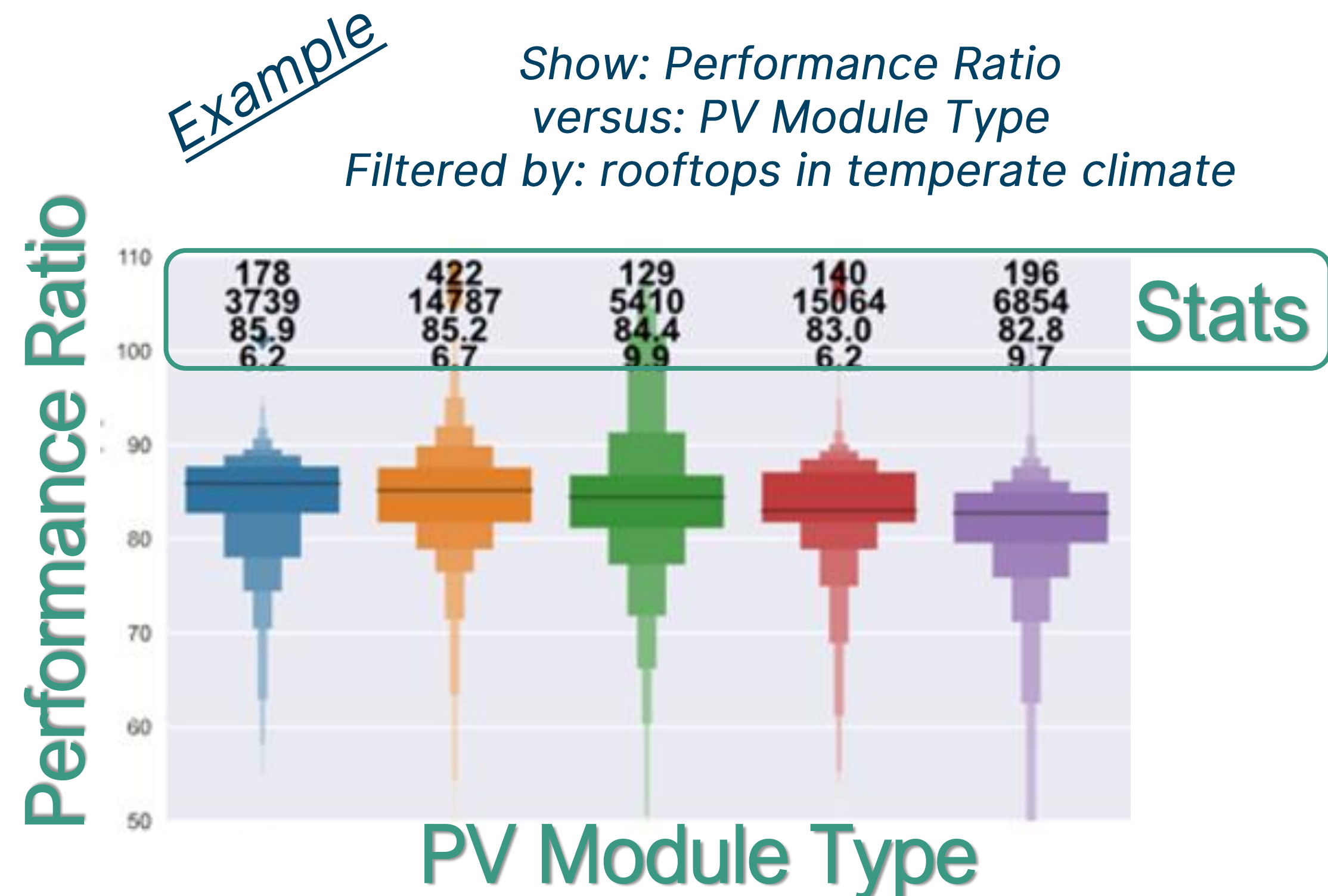
Filtered by :
Feature 2/3/4/...

- FEATURES

- PV Module (Type, etc.)
- Inverter (Type, etc.)
- Climate Zone
- Country
- Weather conditions
- More...

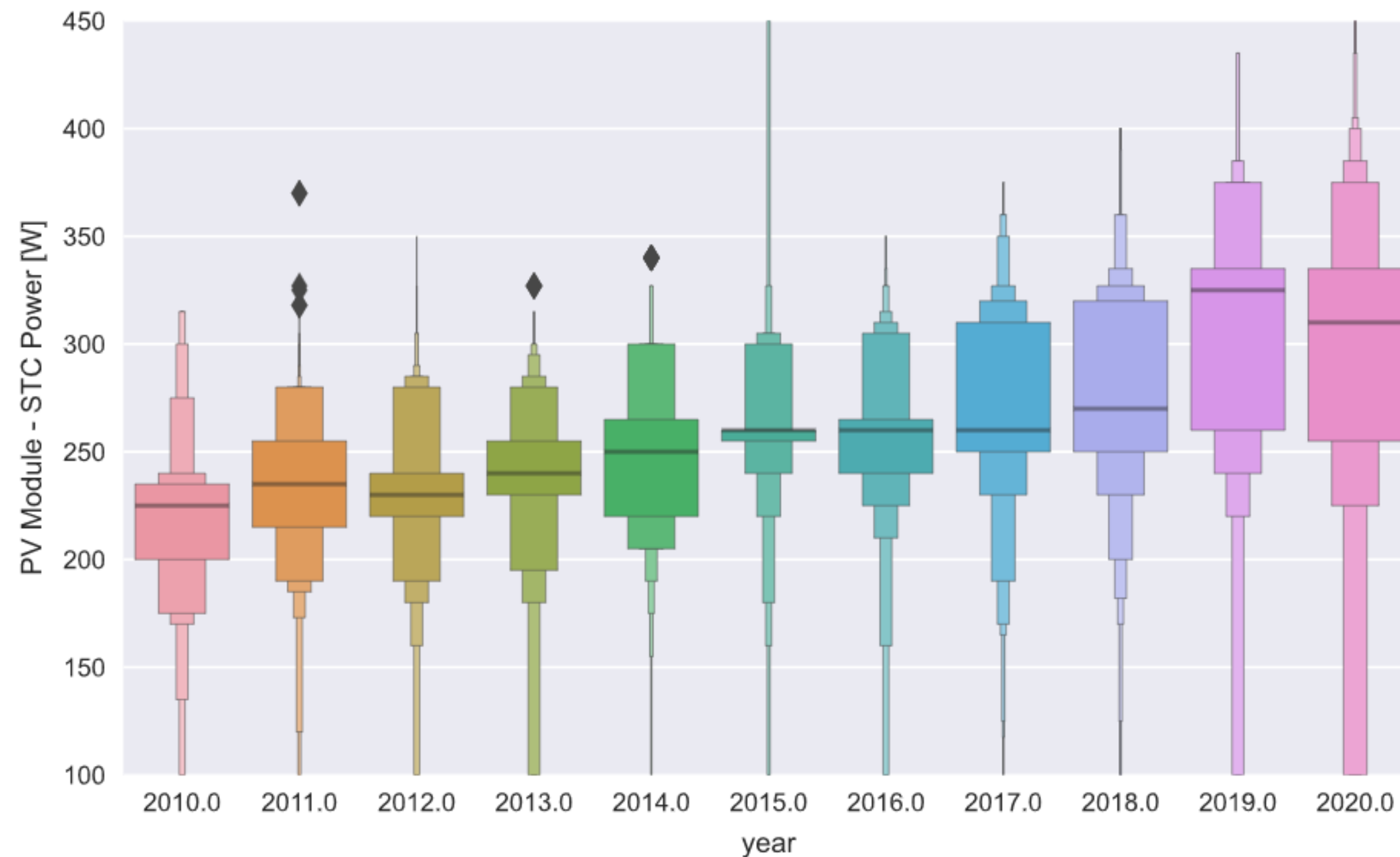


Comparison + Filters

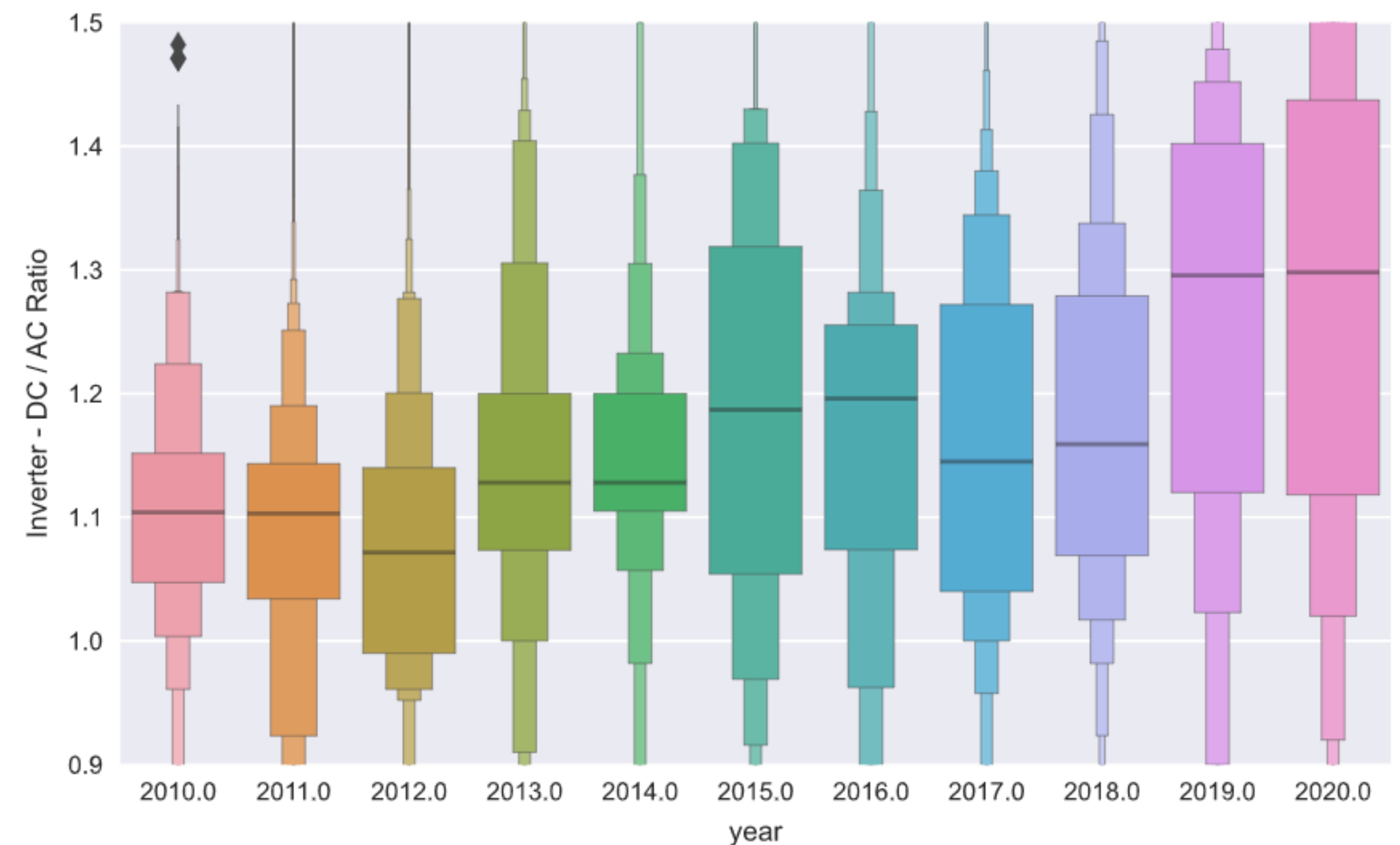


Trend indicators based on monitoring data

- PV Module Design Trends (Powerful modules)

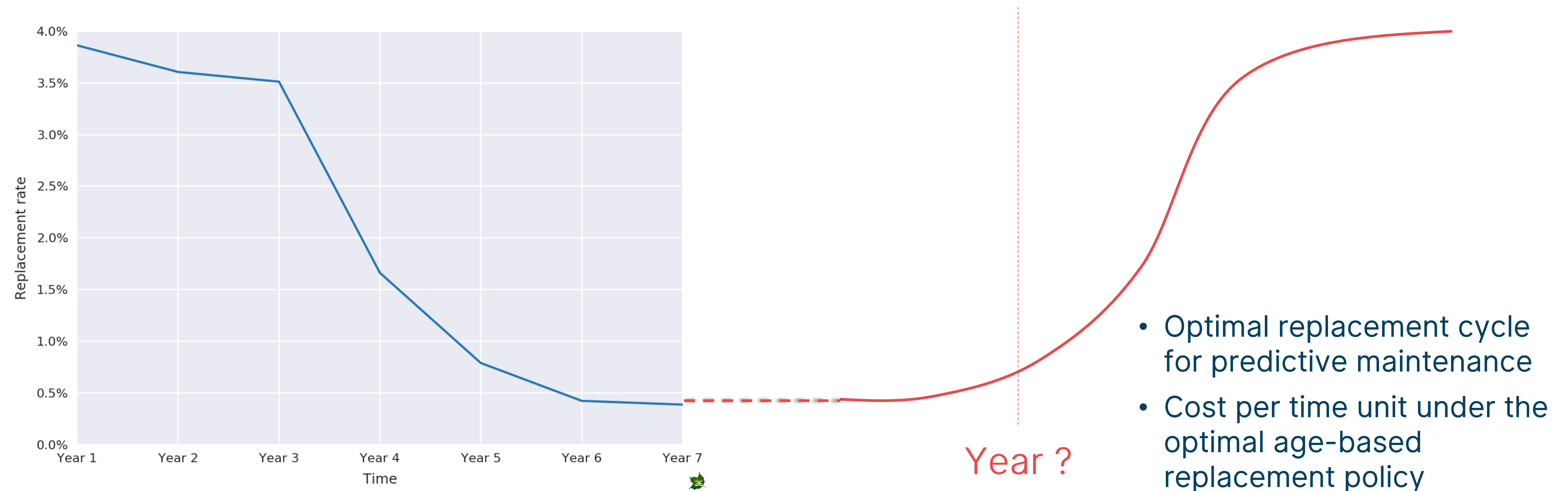


- Inverter Design Trends (Oversizing trend)



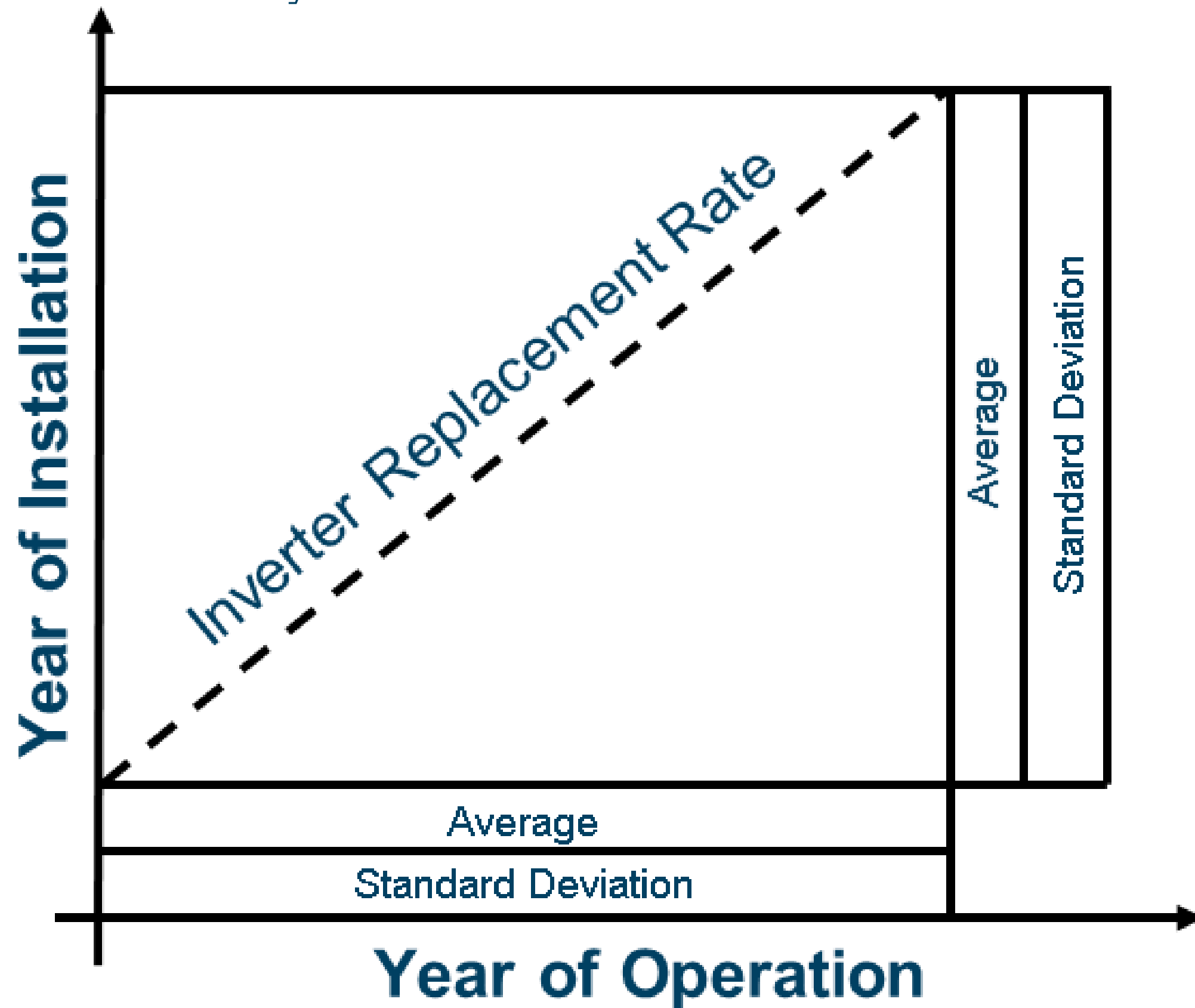
Background – Solar Bankability (2017)

When is the right time to replace an inverter?



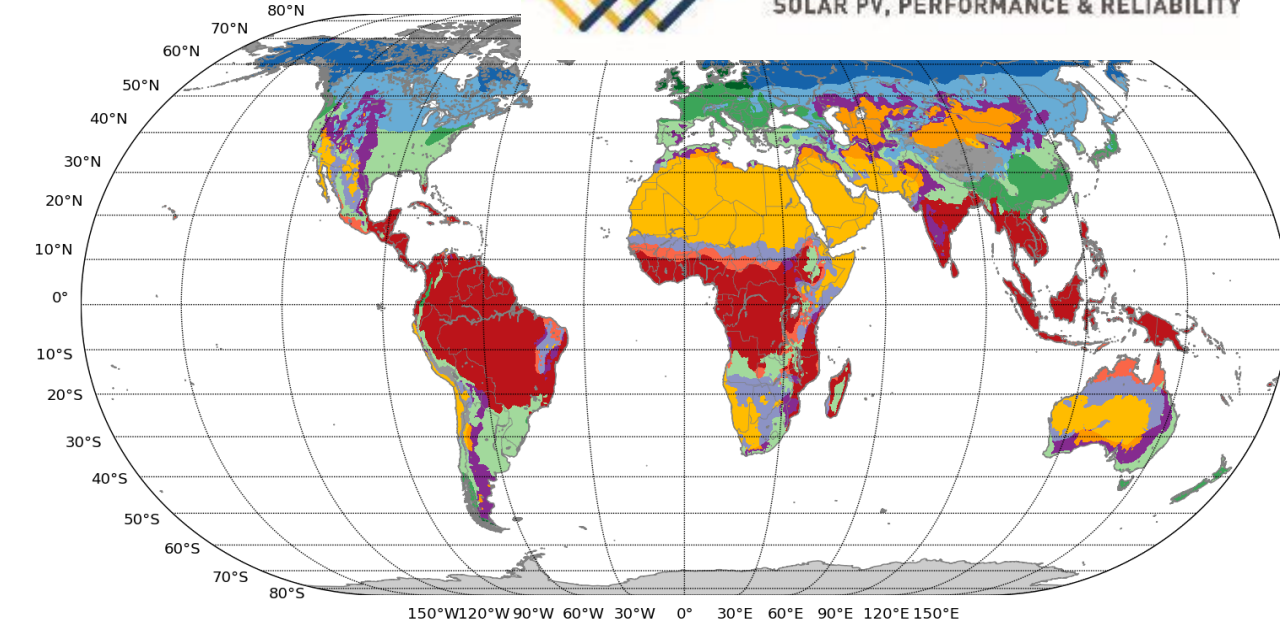
Inverter Replacement Rate Matrix

Preliminary Results

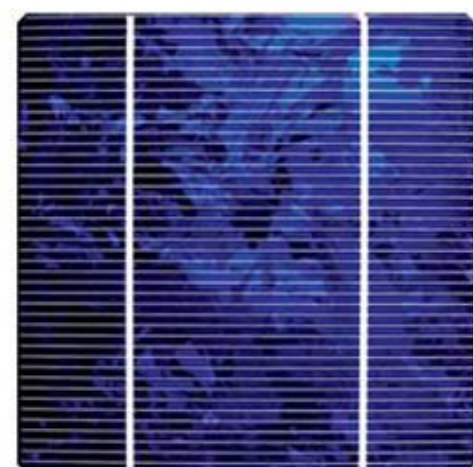


Year of Installation	Year of Operation 0	Year of Operation 1	Year of Operation 2	Year of Operation 3	Year of Operation 4	Year of Operation 5	Year of Operation 6	Year of Operation 7	Year of Operation 8	Year of Operation 9	Year of Operation 10	Average	STD
2010	0.38	1.36	2.97	0.91	1.24	0.38	0.26	2.35	1.28	0.85	1.48	1.22	0.84
2011	2.65	4.89	7.00	1.81	1.00	0.63	1.62	1.82	3.13	1.75	0.09	2.40	2.00
2012	1.20	2.34	2.83	1.34	1.21	2.50	2.35	4.97	1.52	0.23		2.05	1.29
2013	3.92	6.38	2.34	1.52	1.37	2.63	1.15	0.79	0.75			2.32	1.83
2014	2.74	2.39	1.35	1.40	1.32	2.92	1.70	0.24				1.76	0.89
2015	1.78	1.55	1.63	4.73	2.70	1.80	0.12					2.04	1.41
2016	1.03	2.32	1.90	3.29	4.10	0.09						2.12	1.46
2017	1.10	6.15	1.65	2.79	0.26							2.39	2.29
2018	2.23	3.37	3.69	0.44								2.43	1.47
2019	2.08	1.79	0.61									1.49	0.77
2020	2.22	0.23										1.22	1.41
Average	1.94	2.98	2.60	2.03	1.65	1.56	1.20	2.03	1.67	0.94	0.79		
STD	0.99	2.01	1.79	1.34	1.19	1.18	0.87	1.84	1.02	0.76	0.99		

Context Clustering Availability



MonoCrystalline



MultiCrystalline



Versus

Rooftop



Ground-Mounted



Versus

Central Inverter



String Inverter



Versus

Tracking



Fixed



Versus

Utility Scale

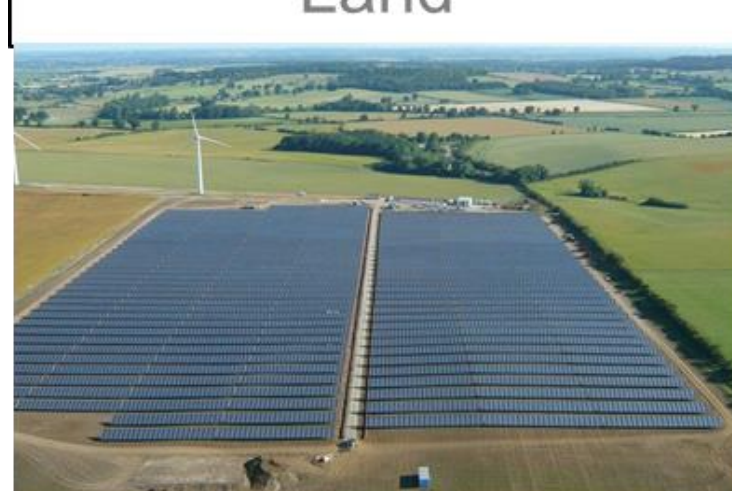


Residential

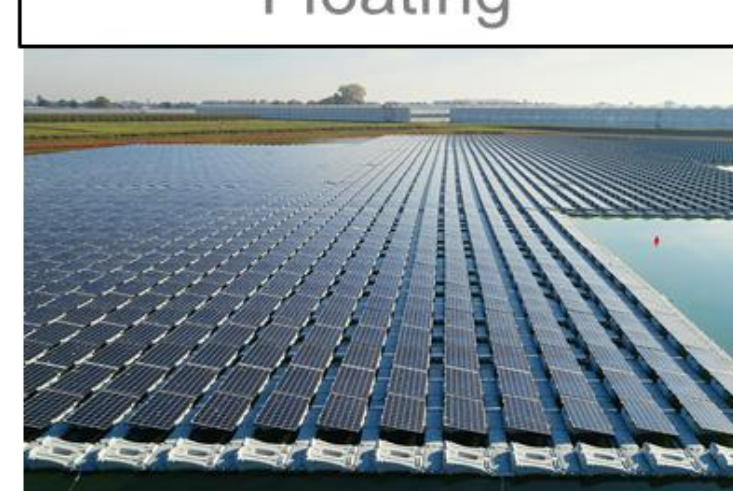


Versus

Land

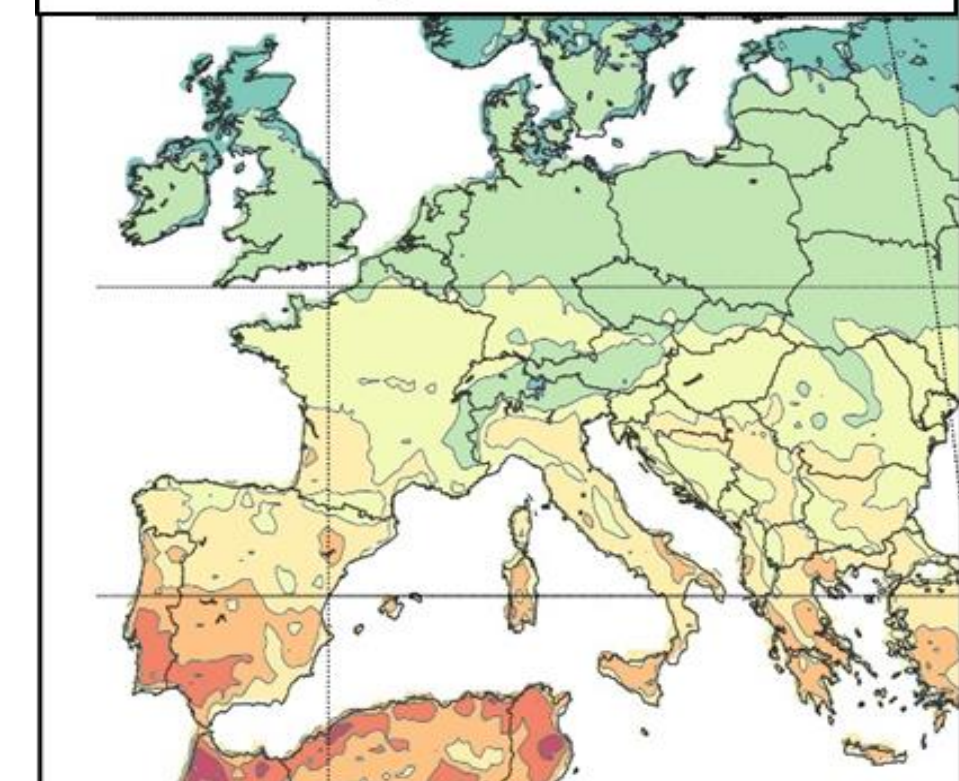


Floating

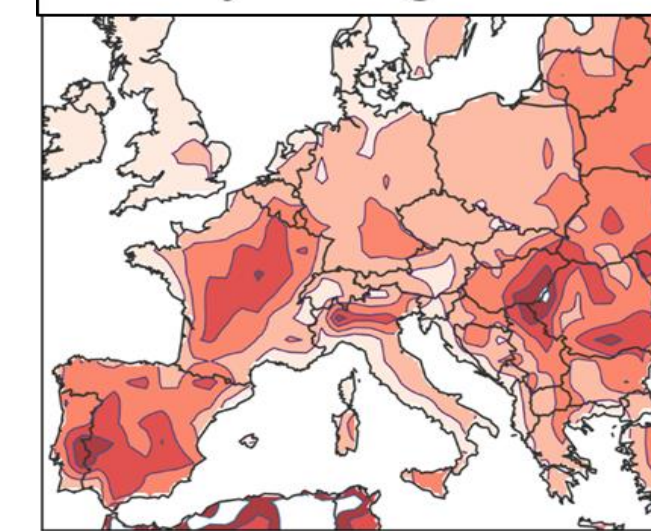


Versus

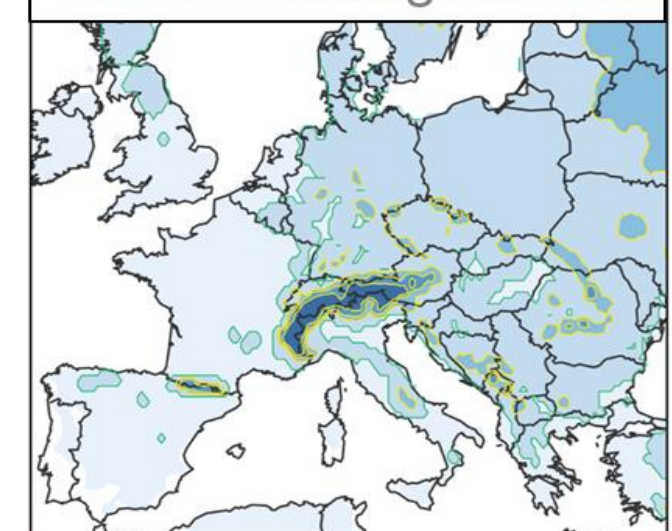
PVM Degradation Rates



Daily Soiling Rates



Snow Shading Losses



4

What is next?

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What is next?

- **Extraction of geographical parameters**
 - Climate zones and Weather risks
 - Horizon profiles
 - Terrain complexity
- **Assessments using advanced solar data analytics**
 - Module-level and System-level degradation rates
 - Soiling rates and soiling losses
 - Inverter Failure Rates and Replacement Rate

Title: Advanced Solar Data Analytics on over 16GW
PV assets worldwide
SOPHIA PV-Module Reliability WEBINAR 2021
9-10 June 2021

Title: Context-Sensitive PV Plant Components
Benchmarking Based on Monitoring Data
EUPVSEC 2021
Session Reference: 4CO.3.6
Wednesday, 08th September 2021, 15:15

Thank you

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