

Regional PV Power Modelling and Forecasting

Task 16 Parallel session

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Rotterdam, 15th September 2026



PVPS: Photovoltaic Power System Programme

- established in **1993** within the International Energy Agency (IEA)
 - global network of expertise, acting as reference for policy and industry
-  400 international participants, over 200 reports published since 1998

TASK 16 I Solar Resource for High Penetration

Lowering yield uncertainty, planning and investment costs for PV by enhancing the quality of forecasts and resources assessments.

Task Managers



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Initiated in 2017

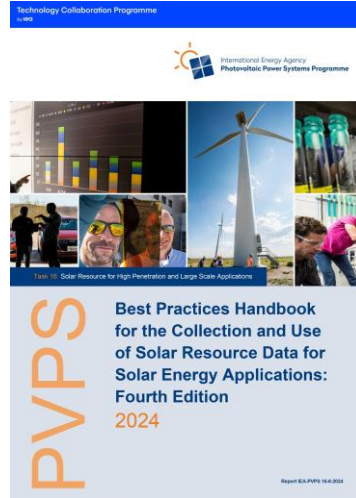
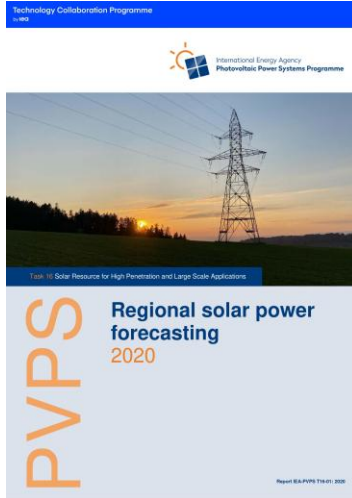
75 members (19 countries, 51 institutions)

Solar resource monitoring and modelling

Solar forecasting

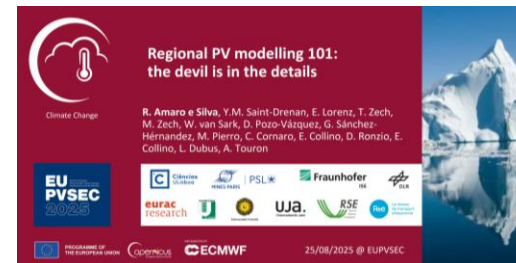
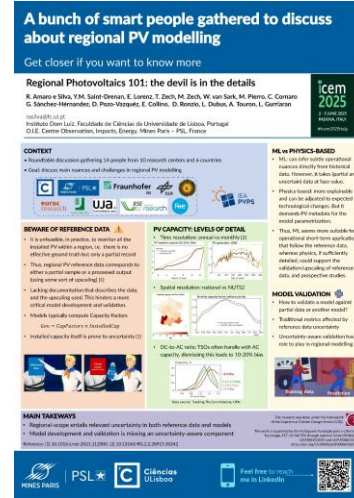
Benchmarks, Firm power, Climate change

Task 16 and Regional PV



9.6.2 Regional PV Estimation and Forecasting

Regional PV power estimates or forecasts aim to represent the aggregated PV output that is fed into the grid over regions that can range from a few streets feeding into a single, low-voltage substation, to a municipality, to a control zone of a distribution system operator or a transmission system operator, or even an entire country. A region could be geometrically defined, for which the allocation of which plants are in which region is clear, or it could be defined by a shared grid node, in which case detailed grid data might be needed or the selection of plants in the region might be uncertain or dynamic. A regional forecast represents an ensemble of contiguous plants in an area of interest, either geographically or within a branch of the electric grid. Thus, it tends to differ from a portfolio forecast that is used (e.g., in direct marketing).



Why organize this session



Current situation:

It's difficult to find "regional people" @ EUPVSEC
(despite it's practical relevance)

Short-term strategy:

Execute a targeted outreach workshop (totally not a cult)

Reason for organizing this



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Mid-term goal:

Increase critical mass and find "regionals" as easily as
the needle on the left

Agenda for today



- **Regional PV 101**
- **The importance of national PV capacity estimates**
- **Challenges in regional PV (a TSO perspective)**
- **Impact of self-consumption on regional PV power feed-in**
- **Mentimer moment + closing words**

Rodrigo Amaro e Silva (ULisbon)

A. Buckley (USheffield)

Laurens Stoop (TenneT NL)

Elke Lorenz (Fraunhofer ISE)



Stay tuned!



with the support of

SOLREV-2 „Solar Resources and
Predictions for Grid and
Market Integration of Solar Energy“

Supported by:



on the basis of a decision
by the German Bundestag





Regional PV 101

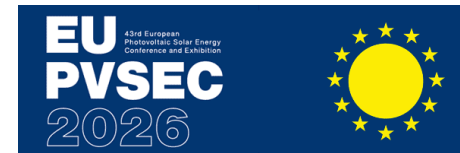
Rodrigo Amaro e Silva



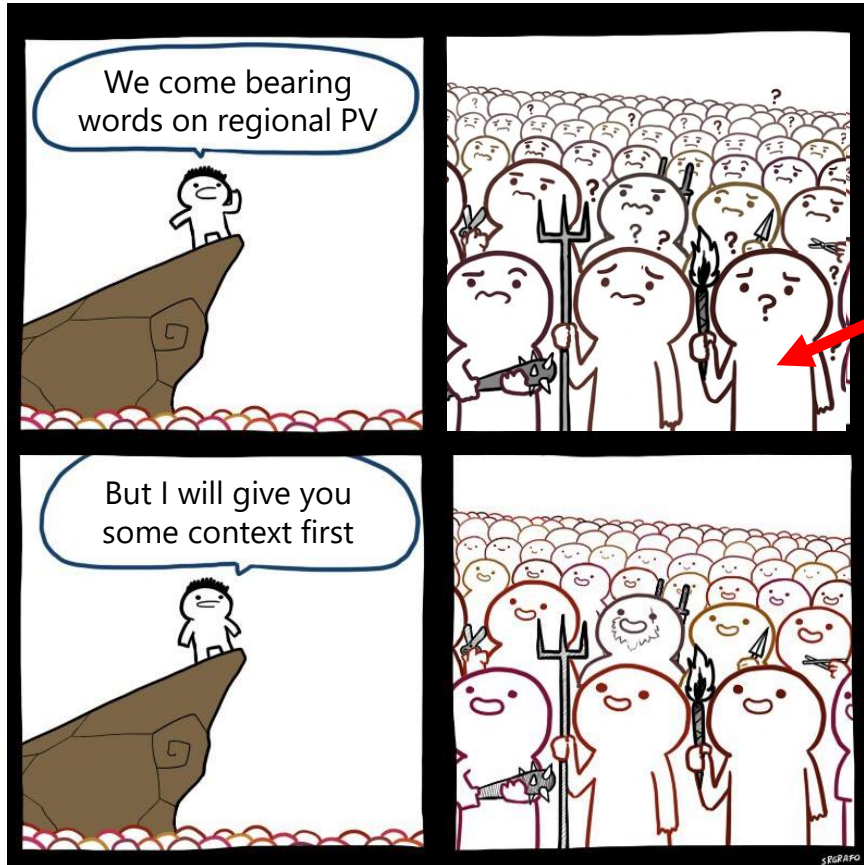
Rotterdam, 15th September 2026

Technology Collaboration Programme
by **iea**

Regional PV Power Modelling and Forecasting



The goal for this talk



How I imagine
the audience

Me 4 years ago, when I
started my regional work

Hopefully, all of you by
the end of the session

Typical single-site approach



Local weather data

JASOLAR

JPM60S20 365-360W/1500V

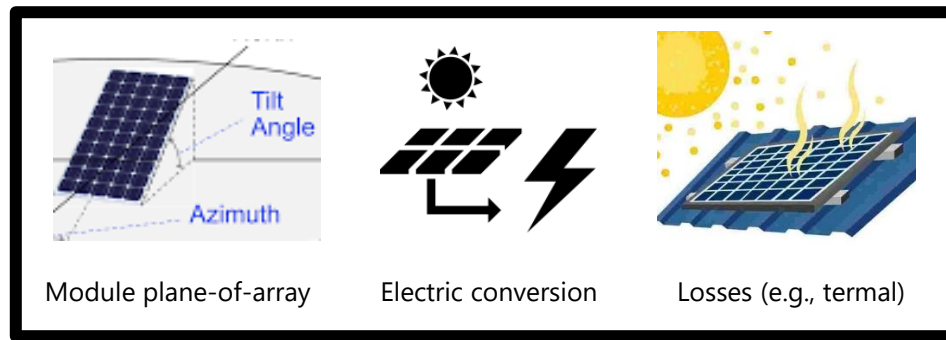
MECHANICAL DIAGRAMS

ELECTRICAL PARAMETERS AT STC

Parameter	Value	Unit	Parameter	Value	Unit
Open Circuit Voltage (V _{oc})	47.12	V	Short Circuit Current (I _{sc})	15.82	A
Maximum Power (P _{max})	365	W	Maximum Power Voltage (V _{mp})	41.12	V
Maximum Power Current (I _{mp})	8.88	A	Temperature Coefficient (P _{max})	-0.45	W/W/°C
Temperature Coefficient (V _{oc})	2.10	V/V/°C	Temperature Coefficient (I _{sc})	0.06	A/A/°C
Temperature Coefficient (V _{mp})	-0.45	V/V/°C	Temperature Coefficient (I _{mp})	0.06	A/A/°C
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Temperature Coefficient (P _{max})	-0.45	W/W/°C	Temperature Coefficient (P _{max})	-0.45	W/W/°C

STC: Standard Test Conditions: 1000W/m² irradiance, 25°C cell temperature, AM1.5 spectrum, 1.5 air mass, 1

Equipment datasheet



**PV generation estimate
(model output)**



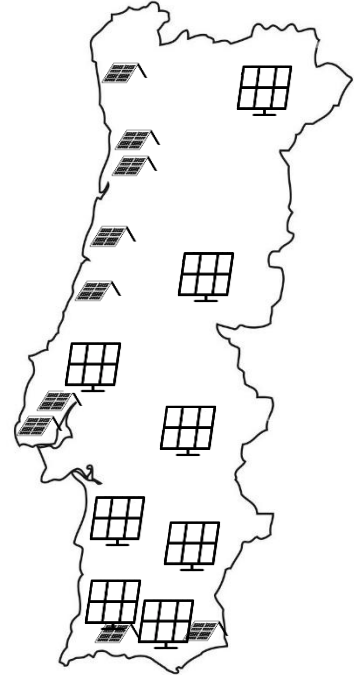
Contrasting with regional PV



Goal: aggregated PV generation over a given region
(possibly normalized by installed capacity, i.e., capacity factor)

Having to handle with

- Widespread PV locations, varying radiation and temperature
- Different technical and implementation differences
- Space-time dynamics
- Very limited public (and overall) data!



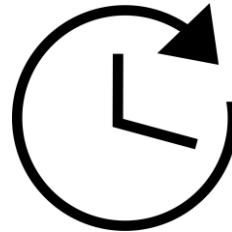
What for? Regional applications



In Portugal, there are > 280.000 PV installations. And it's a small country!

- Monitoring and processing all this in real-time: costly and logistically challenging

So, first and foremost, regional PV models are meant to estimate (and forecast) generation which is “invisible” to the grid



What for? Regional applications



Establish a “ground truth” estimate

Grid
balancing

Reserve
sizing

Transmission
scheduling

Energy
marketing

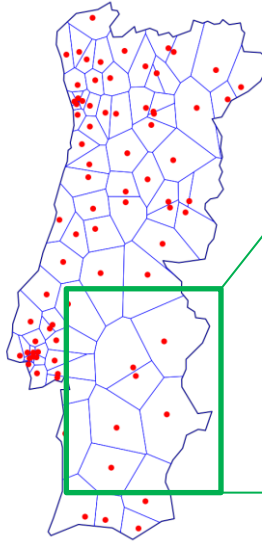
Long-term
studies*

(covered in more detail by Laurens and Alistair)

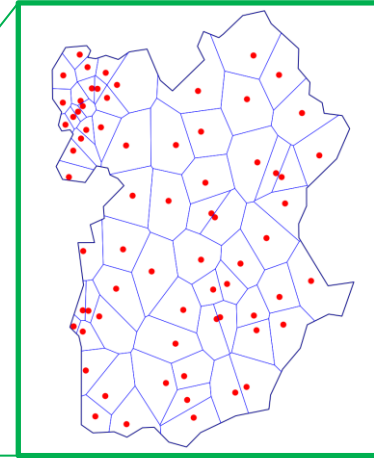
Regional scales



National
(or other NUTS)

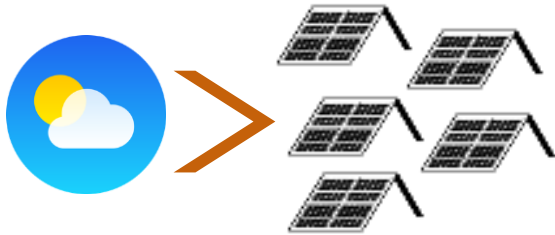


Transmission
substation

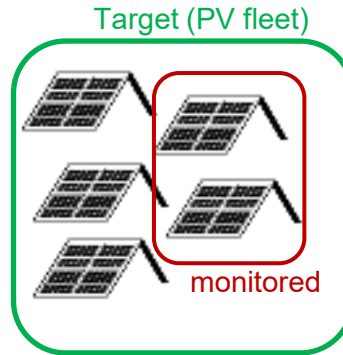


Distribution
substation

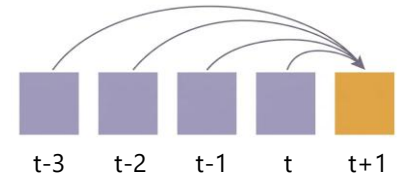
Regional approaches



Weather-to-energy conversion



Upscaling



Autoregressive
(forecasting-only)

Or a hybrid combination of the above.



Regional PV nuances



Data needs: many times more



TSOs often provide national-level generation and installed capacity.
(maybe sub-national)

Which is useful for autoregressive modelling. But where to find:

- ? system-level generation for testing upscaling
- ? PV metadata for parameterizing physical model

And even resolution of the available aggregated data could be improved.

Estimates as “reference” data



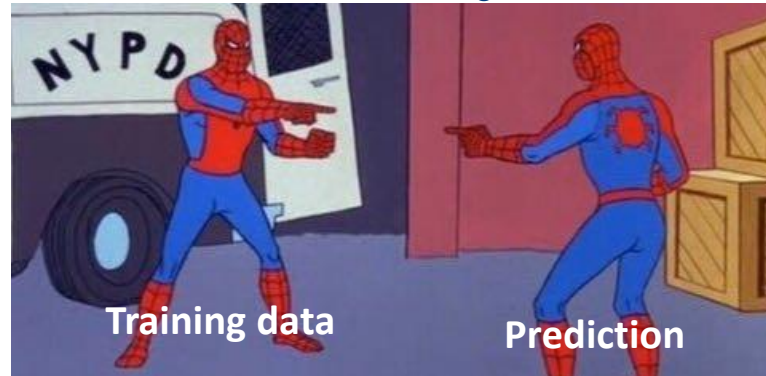
If regional PV is most often a model output, it has uncertainties & assumptions
(covered by Alastair Buckley next)

This impacts...

Model validation



Model training

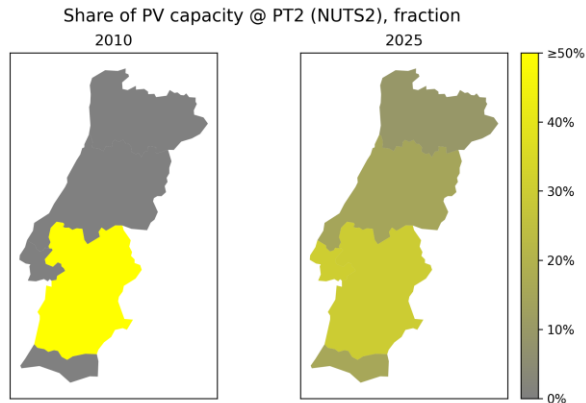


Aggregate PV: a dynamic concept

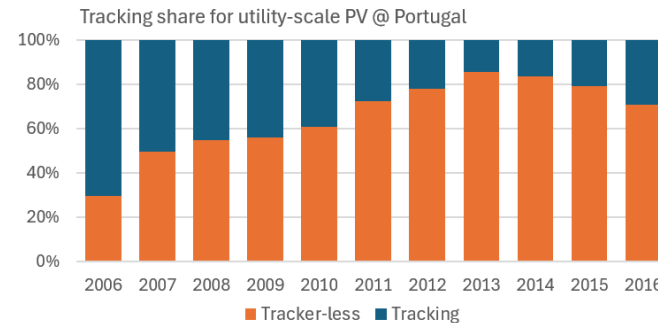
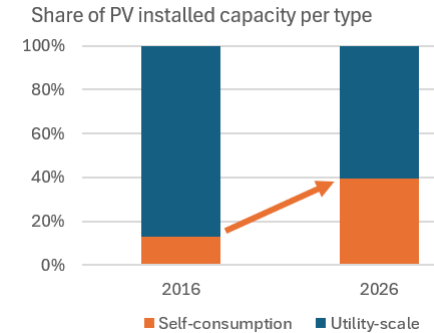


The Portuguese example:

Spatial distribution



Installed configurations



Aggregate PV: a dynamic concept



New configurations popping up:



Floating PV



Agrovoltaics

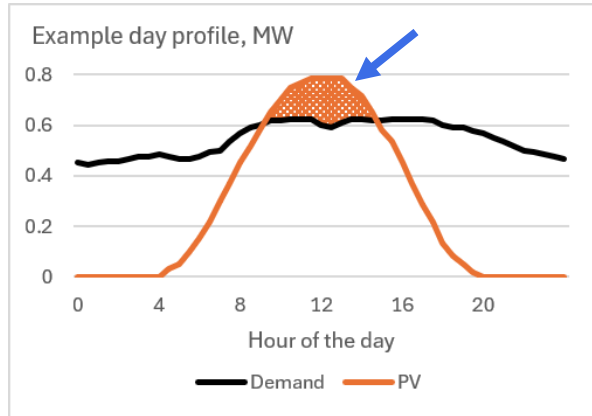


Balcony PV

Generation $\neq$ Feed-in



Grid operators tend to monitor feed-in, which can differ from generation for PV (covered by Elke Lorenz later)



Becomes more complex with storage and curtailment

Although TSOs are interested in feed-in, PV models need to be validated against generation



Storage



Curtailment



- Regional PV covers various applications and geographical scales
- Clear links with single-site modelling, but also very specific nuances
- “Limited data” is most often the case
 - Parameterizations in physical models are often oversimplified
 - Typically means “room for ML to thrive”
- Food 4 thought: what room is left for physical modelling?

Introduction

Enough of me, great talks coming next.

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