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Online Workshop COST Action PEARL PV, 2 December 2021

# PV Data Management and the PEARL PV Data Challenge

Chair:

Dr. Atse Louwen, Eurac Research, Institute for Renewable Energy, Italy

Co-Chairs:

Dr. Carolin Ulbrich, Helmholtz-Zentrum Berlin, Germany

Dr. Eli Shirazi, University of Twente, Netherlands

Prof. Angèle Reinders, University of Twente/Eindhoven University of Technology, Netherlands

# Introducing myself

- ❖ Main research topics
  - ❖ PV performance and reliability
  - ❖ Modelling + machine learning in PV and solar irradiance
  - ❖ PV sustainability and circularity
  - ❖ Experience Curves / Learning Curves for energy technologies
- ❖ Short resume
  - ❖ Senior Researcher, PV performance and Reliability, Eurac Research, Institute of Renewable Energy, Oct. 2019 - present
  - ❖ Postdoctoral Researcher, Experience Curves of Renewable Technologies Copernicus Institute of Sustainable Development, Utrecht University 2017-2019
  - ❖ PhD thesis: "Assessment of the energy performance, economics and environmental footprint of silicon heterojunction photovoltaic technology". Copernicus Institute of Sustainable Development, Utrecht University, Jan. 2017



Dr. Atse Louwen

≡ Can we record this session?

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# Data analysis of big data of PV systems using the CKAN database of PEARL PV

Prof. Dr. Ralph Gottschalg, Fraunhofer CSP,  
Germany

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# The importance of shared and synthetic datasets

Prof. Dr. Angèle Reinders  
University of Twente/Eindhoven University of Technology, Netherlands

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# Use of PEARL PV platform to Share Spectral data

Basant Raj Paudyal, University of Agder, Norway

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# Performance Analysis and Degradation of a Large Fleet of PV Systems

Dr. Sascha Lindig, Eurac Research, Italy

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# Pearl PV CKAN database Demo

Dr. Atse Louwen, Eurac Research, Italy



# ❖ PEARL PV CKAN Database DEMO

- ❖ CKAN = Comprehensive Knowledge Archive Network
- ❖ Open source Open Data storage + distribution
- ❖ PEARL PV CKAN is a customized version
- ❖ Dedicated to PV system + meteo-data
- ❖ Hosted by University of Twente, Enschede, NL
- ❖ <https://ckan.pearl-pv-cost.eu/>

# PEARL PV CKAN

- ≡ Datasets
- ≡ Organizations
- ≡ Groups

4 completely public datasets  
(more inside when you log in!)

The screenshot shows the Pearl PV CKAN website interface. At the top, there is a navigation bar with the logo 'PEARL PV' and links for 'Datasets', 'Organizations', 'Groups', and 'About'. A search bar is located in the top right corner. Below the navigation bar, there is a 'Search data' section with a search input field containing 'E.g. environment' and a search button. Below the search bar, there are 'Popular tags' for 'APE', 'Meteorological data', and 'rooftop'. A 'Pearl PV CKAN Repository statistics' box displays '4 datasets', '5 organizations', and '1 group'. A blue arrow points from the text box on the left to the '4 datasets' statistic. Below the statistics, there is a 'Quicklinks to help:' section with links for 'Add a dataset' and 'Edit a dataset'. A 'Global normal spectral irradiance in Albuquerque' dataset is also visible. The footer contains information about the CKAN API and the CKAN Association, along with a language dropdown menu set to 'English'.

# ≡ Datasets

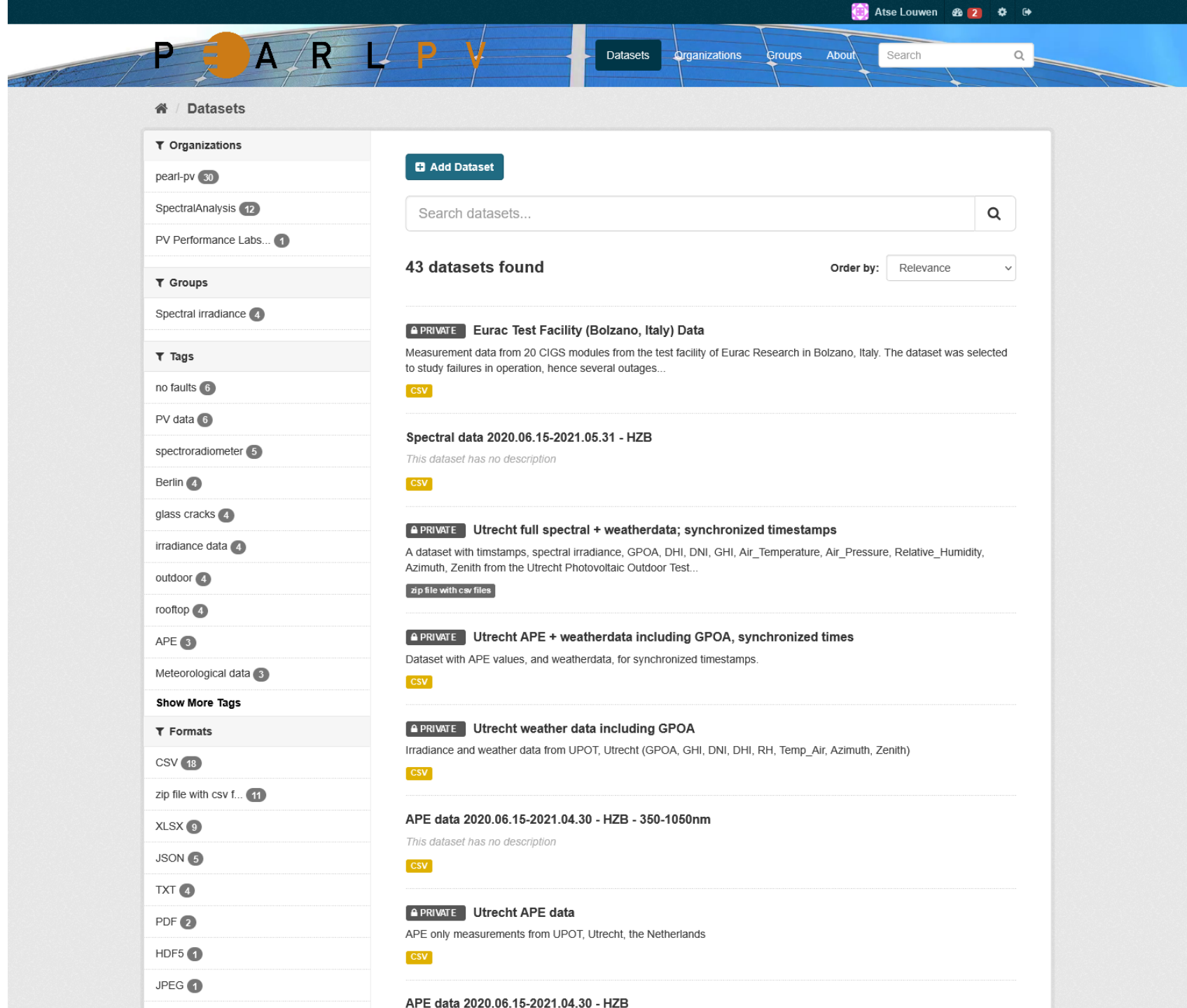
View all dataset and filter by:

≡ Organizations

≡ Tags

≡ Formats

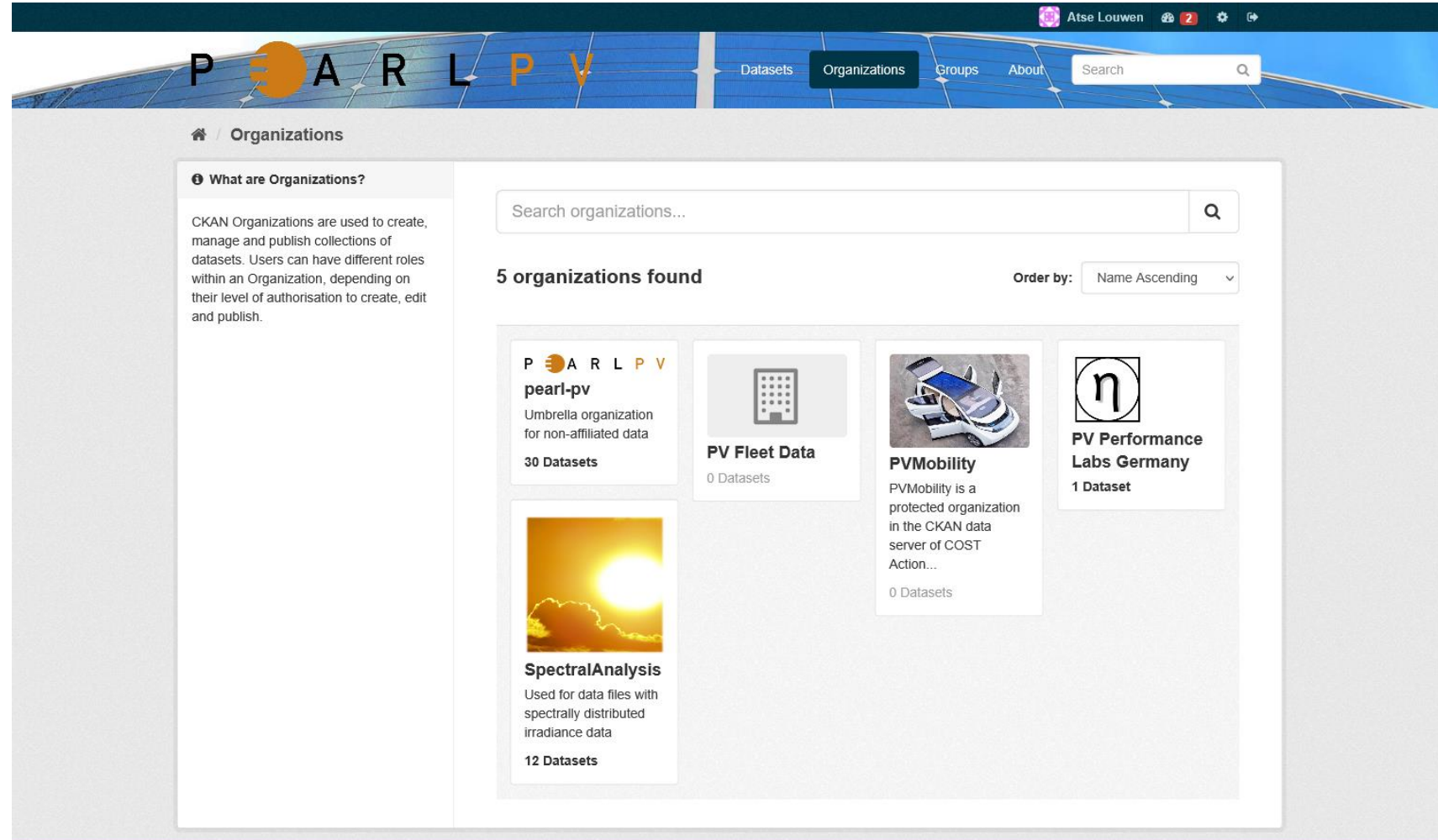
≡ Licenses



The screenshot shows the PEARLPV Datasets page. The header includes the PEARLPV logo, navigation links for Datasets, Organizations, Groups, and About, and a search bar. The main content area is divided into two columns. The left column contains filters for Organizations (pearl-pv: 30, SpectralAnalysis: 12, PV Performance Labs...: 1), Groups (Spectral irradiance: 4), Tags (no faults: 6, PV data: 6, spectroradiometer: 5, Berlin: 4, glass cracks: 4, irradiance data: 4, outdoor: 4, rooftop: 4, APE: 3, Meteorological data: 3), and Formats (CSV: 18, zip file with csv f...: 11, XLSX: 9, JSON: 5, TXT: 4, PDF: 2, HDF5: 1, JPEG: 1). The right column displays a list of datasets, starting with 'Eurac Test Facility (Bolzano, Italy) Data' (PRIVATE, CSV), 'Spectral data 2020.06.15-2021.05.31 - HZB' (CSV), 'Utrecht full spectral + weatherdata; synchronized timestamps' (PRIVATE, CSV), 'Utrecht APE + weatherdata including GPOA, synchronized times' (PRIVATE, CSV), 'Utrecht weather data including GPOA' (PRIVATE, CSV), 'APE data 2020.06.15-2021.04.30 - HZB - 350-1050nm' (PRIVATE, CSV), and 'Utrecht APE data' (PRIVATE, CSV). Each dataset entry includes a brief description and a 'zip file with csv files' button.

# Organizations

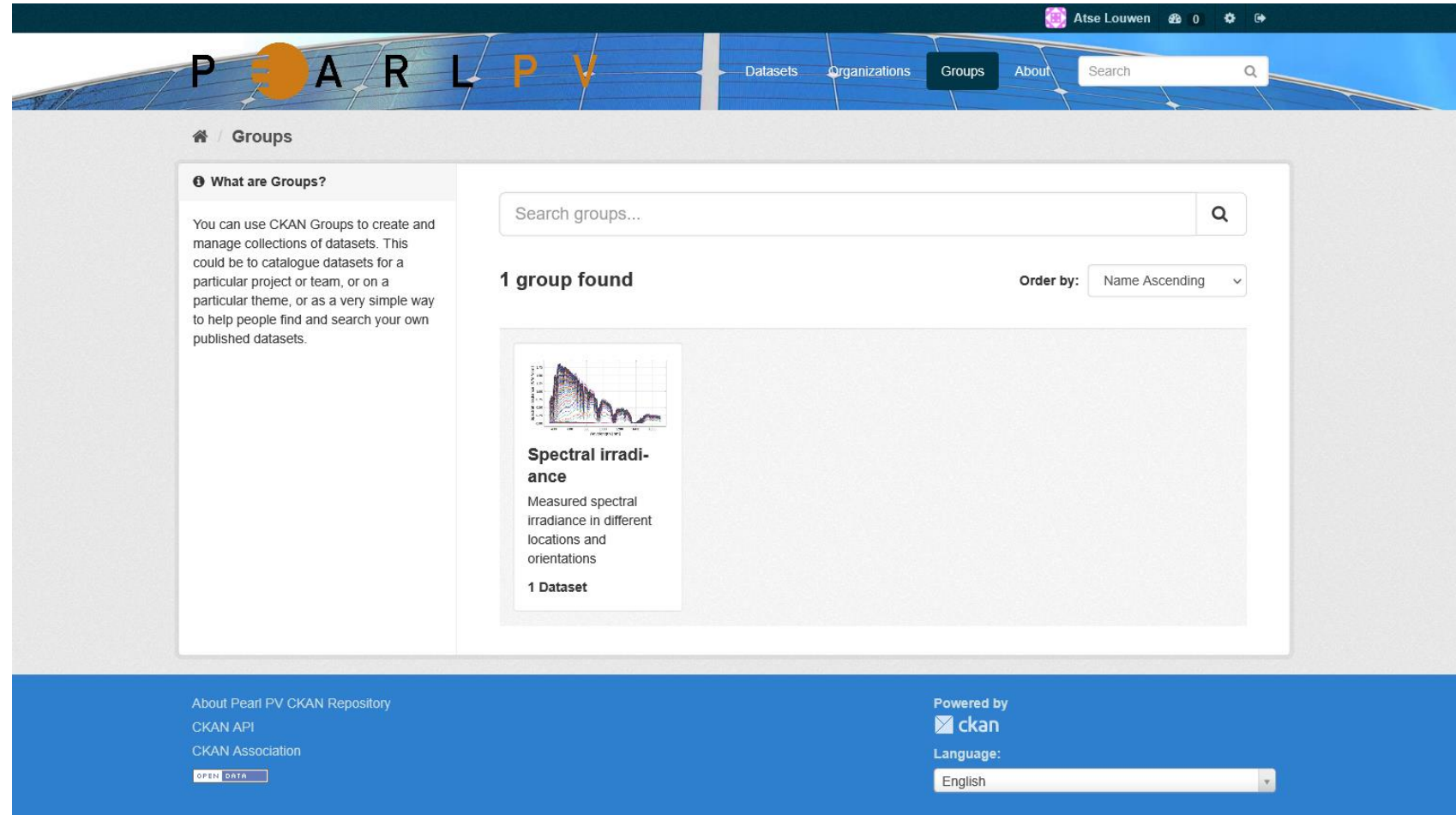
- Collection of datasets and users
- Users can have different roles in the organization
  - Member
  - Editor
  - Admin



The screenshot shows the 'Organizations' page on the Pearl PV CKAN repository. The page features a navigation bar with 'Datasets', 'Organizations', 'Groups', and 'About' links, along with a search bar. The main content area includes a sidebar with a 'What are Organizations?' section explaining CKAN Organizations. The main area displays a search bar for organizations, a dropdown for '5 organizations found' sorted by 'Name Ascending', and a grid of organization cards. The cards shown are: 'pearl-pv' (Umbrella organization for non-affiliated data, 30 Datasets), 'PV Fleet Data' (0 Datasets), 'PVMobility' (Protected organization in the CKAN data server of COST Action..., 0 Datasets), 'PV Performance Labs Germany' (1 Dataset), and 'SpectralAnalysis' (Used for data files with spectrally distributed irradiance data, 12 Datasets).

# Groups

- Are mainly used for collections of datasets
- Not users



The screenshot shows the 'Groups' page on the Pearl PV CKAN repository. The header includes the 'PEARL PV' logo, navigation links for 'Datasets', 'Organizations', 'Groups', and 'About', and a search bar. The main content area features a 'What are Groups?' section explaining that groups are used to create and manage collections of datasets. Below this is a search bar for groups, which has returned one result: 'Spectral irradiance'. The result includes a thumbnail image of a spectral irradiance graph and a description: 'Measured spectral irradiance in different locations and orientations'. A '1 Dataset' link is also visible. The footer contains links for 'About Pearl PV CKAN Repository', 'CKAN API', 'CKAN Association', and 'OPEN DATA', along with 'Powered by ckan' and a language dropdown menu set to 'English'.

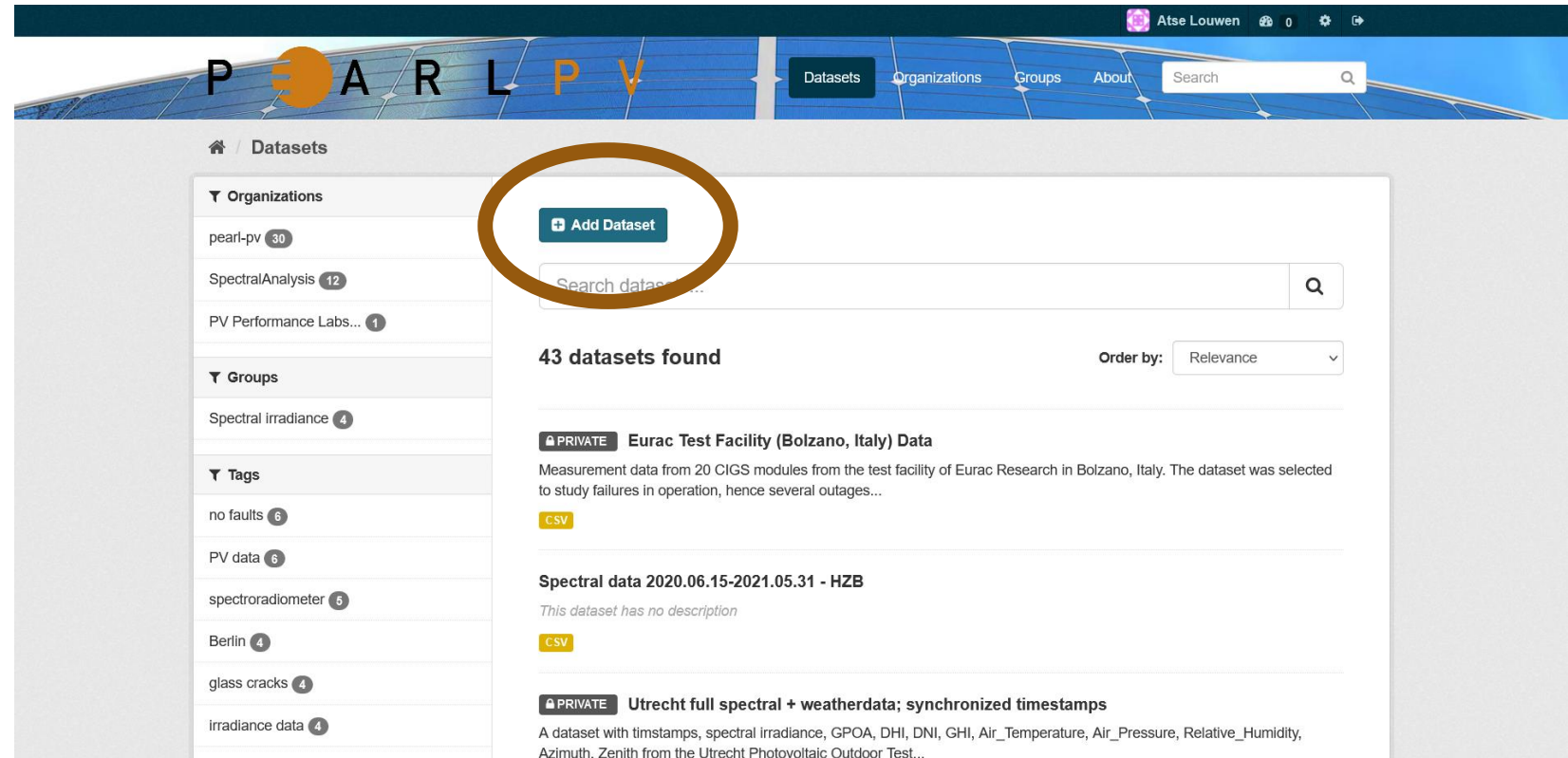
# Registering

- ≡ Straightforward
- ≡ NDA has been created to ensure users know how to use the database
- ≡ E.g.: don't share or publish data without consent of owner
- ≡ When registering, you automatically accept his NDA

The screenshot shows the registration page for the Pearl PV CKAN Repository. The page has a dark blue header with the 'PEARL PV' logo and navigation links for 'Datasets', 'Organizations', 'Groups', and 'About'. A search bar is also present. The main content area is titled 'Registration' and contains a 'Why Sign Up?' section and a 'Register for an Account' form. The form includes fields for Username, Full Name, Email, Password, and Confirm, along with a checkbox for accepting the NDA and a 'Create Account' button. The footer contains links for 'About Pearl PV CKAN Repository', 'CKAN API', 'CKAN Association', and 'OPEN DATA', along with 'Powered by ckan' and a language dropdown menu.

# ≡ Uploading Data

- ≡ Upload forms customized to allow for detailed description of PV system data



The screenshot shows the PEARL PV website interface. The top navigation bar includes 'PEARL PV' and 'Atse Louwen'. The main content area is titled 'Datasets' and features a sidebar with filters for Organizations, Groups, and Tags. A prominent orange circle highlights the '+ Add Dataset' button. The main content area displays a search bar, a list of 43 datasets found, and a dropdown menu for 'Order by: Relevance'. The first dataset listed is 'Eurac Test Facility (Bolzano, Italy) Data', which is marked as 'PRIVATE' and includes a 'CSV' download option. The second dataset is 'Spectral data 2020.06.15-2021.05.31 - HZB', also marked as 'PRIVATE' and with a 'CSV' download option. The third dataset is 'Utrecht full spectral + weatherdata; synchronized timestamps', marked as 'PRIVATE' and with a 'CSV' download option.

# ≡ Uploading Data

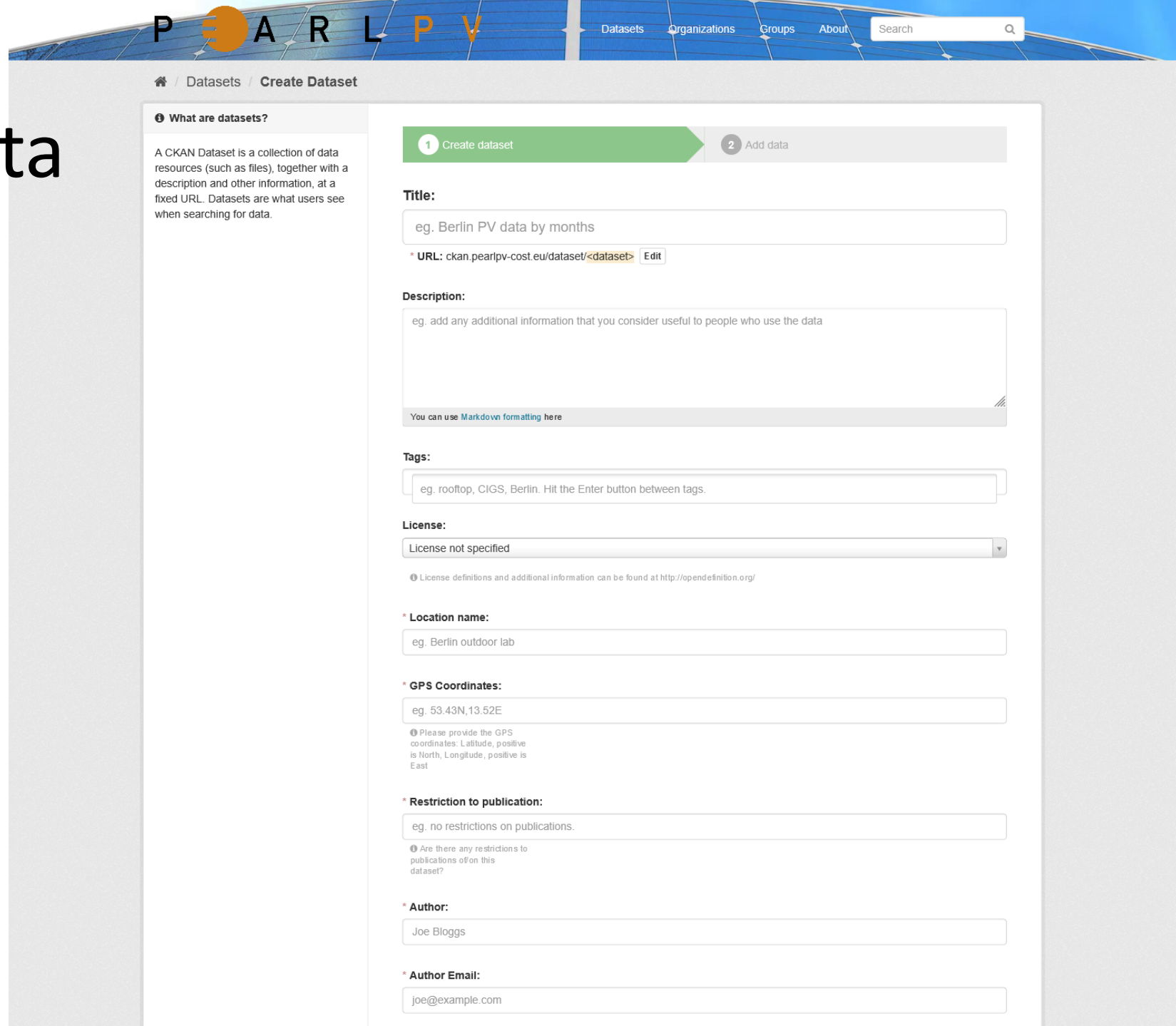
Many fields that aid in exchange:

≡ **Tags**

≡ **License**

≡ **Location**

≡ **Author (owner) and maintainer (contact) of data**



**What are datasets?**

A CKAN Dataset is a collection of data resources (such as files), together with a description and other information, at a fixed URL. Datasets are what users see when searching for data.

**1 Create dataset** **2 Add data**

**Title:**

eg. Berlin PV data by months

\* URL: ckan.pearlpv-cost.eu/dataset/<dataset> [Edit](#)

**Description:**

eg. add any additional information that you consider useful to people who use the data

You can use [Markdown formatting here](#)

**Tags:**

eg. rooftop, CIGS, Berlin. Hit the Enter button between tags.

**License:**

License not specified

[License definitions and additional information can be found at http://opendefinition.org/](http://opendefinition.org/)

\* **Location name:**

eg. Berlin outdoor lab

\* **GPS Coordinates:**

eg. 53.43N,13.52E

[Please provide the GPS coordinates: Latitude, positive is North, Longitude, positive is East](#)

\* **Restriction to publication:**

eg. no restrictions on publications.

[Are there any restrictions to publications of/on this dataset?](#)

\* **Author:**

Joe Bloggs

\* **Author Email:**

joe@example.com



# ≡ Uploading Data

Many fields that aid in exchange:

≡ Tags

≡ License

≡ Location

≡ Author/owner and maintainer

≡ **System metadata**

**\* Author Email:**

**Maintainer:**

**Maintainer Email:**

**Keywords:**

**\* Fixed installation, tilt:**  
  
ⓘ Ground to module, if installation is fixed, else put 'n.a.'

**\* Fixed installation, azimuth in °:**  
  
ⓘ 180(° = South), 90(° = East), 0(° = North) and 270(° = West), if installation is fixed, else put 'n.a.'

**Tracking Mode:**

**Type of installation:**

**\* PV module technology:**

**Total number of PV modules in the system:**  
  
ⓘ Provide a total number of PV modules in the system

**Number of modules connected in one string:**  
  
ⓘ Provide a number of modules connected in one string

**Number of strings connected to each inverter:**  
  
ⓘ Provide a number of strings connected to each inverter

**Total number of PV strings in the system:**

# ≡ Uploading Data

Many fields that aid in exchange:

- ≡ Tags
- ≡ License + Visibility
- ≡ Location
- ≡ Author/owner and maintainer
- ≡ System metadata
- ≡ **Description of dataset**
- ≡ **Dataset visibility!**

You can use [Markdown formatting here](#)

Shading:

First date of measurements:

dd / mm / yyyy

Last date of measurements:

dd / mm / yyyy

Additional information on soiling:

brown coal mining nearby, regular sandstorm

Degradation or failure indicators:

hail event on 13.4.2018, there after drop in pmpp, inverter failure on 17.5.2019, degradation notable after summer 2016

You can use [Markdown formatting here](#)

\* Organization:

SpectralAnalysis

Visibility:

Private

Source:

http://example.com/dataset.json

Version:

1.0

Miscellaneous:

Here you can leave general comments e.g. on the web interface

You can use [Markdown formatting here](#)

The *data license* you select above only applies to the contents of any resource files that you add to this dataset. By submitting this form, you agree to release the *metadata* values that you enter into the form under the [Open Database License](#).

\* Required field

[Next: Add Data](#)

# Uploading Data

- Many file formats supported
- Multiple files per dataset possible
- Additional field to describe the file structure, data formats etc.

Atse Louwen

Atse Louwen

PearL PV

Datasets Organizations Groups About Search

Home / Datasets / Create Dataset

**What's a resource?**

A resource can be any file or link to a file containing useful data.

**Additional information**

It would be very much appreciated if you could add a filled-in template file to the dataset containing as much information as possible. The template can be downloaded [DOWNLOAD HERE](#) and upload it as an (new) resource here on the right.

**1 Create dataset** **2 Add data**

**File:**

**Name:**

eg. Berlin PV data outdoor 2017 - part 1 optimal angle installation

**Description:**

Please consider to provide detailed information, see 'Additional Information' on the left

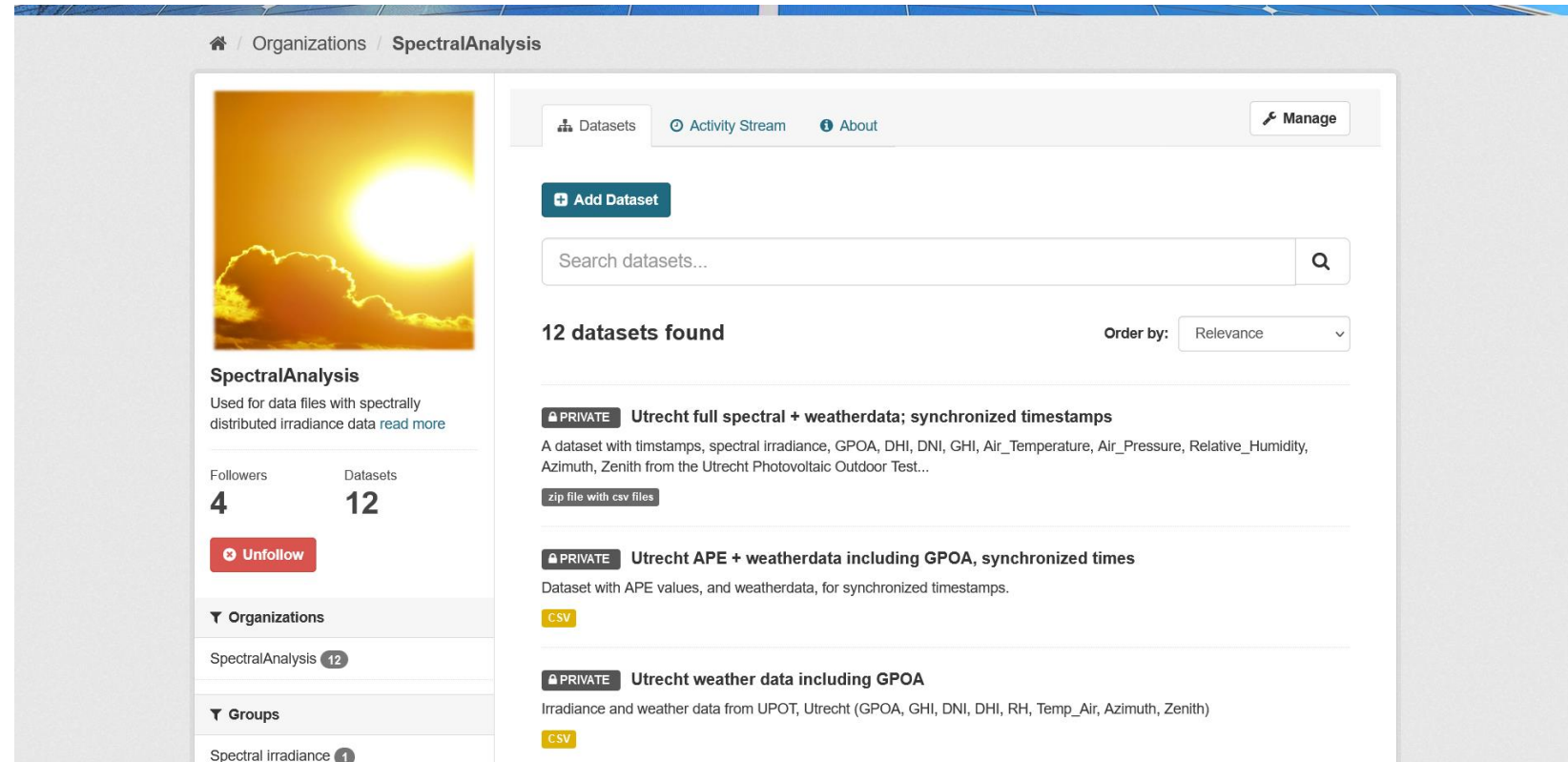
You can use [Markdown formatting](#) here

**Format:**

eg. CSV, XML or JSON

# Viewing and Downloading Data

As easy as finding and selecting a dataset



The screenshot displays the user interface for the 'SpectralAnalysis' organization. The page is titled 'Organizations / SpectralAnalysis' and features a navigation bar with 'Datasets', 'Activity Stream', and 'About' tabs, along with a 'Manage' button. A prominent 'Add Dataset' button is visible. Below this is a search bar labeled 'Search datasets...' and a dropdown menu showing '12 datasets found' with an 'Order by: Relevance' selector. The main content area lists three datasets, each with a 'PRIVATE' label and a 'CSV' download option:

- Utrecht full spectral + weatherdata; synchronized timestamps**: A dataset with timestamps, spectral irradiance, GPOA, DHI, DNI, GHI, Air\_Temperature, Air\_Pressure, Relative\_Humidity, Azimuth, Zenith from the Utrecht Photovoltaic Outdoor Test... (zip file with csv files)
- Utrecht APE + weatherdata including GPOA, synchronized times**: Dataset with APE values, and weatherdata, for synchronized timestamps. (CSV)
- Utrecht weather data including GPOA**: Irradiance and weather data from UPOT, Utrecht (GPOA, GHI, DNI, DHI, RH, Temp\_Air, Azimuth, Zenith) (CSV)

On the left side of the page, there is a profile card for 'SpectralAnalysis' with a sun and clouds image, a description 'Used for data files with spectrally distributed irradiance data', 4 followers, 12 datasets, and an 'Unfollow' button. Below the profile card are sections for 'Organizations' (listing SpectralAnalysis with 12 datasets) and 'Groups' (listing Spectral Irradiance with 1 dataset).

# Viewing and Downloading Data

- As easy as finding and selecting a dataset
- Data can be previewed online if format supports it

The screenshot displays a dataset page for 'Eurac Test Facility (Bolzano, Italy) Data'. The left sidebar includes a 'Follow' button, organization information for 'pearl-pv', social media links for Twitter and Facebook, and a license section for 'Open Data Commons Open Database License (ODbL)'. The main content area shows the dataset title, a description, and a 'Data and Resources' section with a table of tags (CIGS, free-standing, italy, mountains, shading, test facility). Below this is an 'Additional Info' table with fields like Location name, GPS Coordinates, and Author. A 'Manage' button is in the top right, and a circled 'Explore' dropdown menu is visible on the right side of the page.

**Eurac Test Facility (Bolzano, Italy) Data**

Followers: 0

[Follow](#)

**Organization**

**P A R L P V**  
**pearl-pv**  
Umbrella organization for non-affiliated data [read more](#)

**Social**

[Twitter](#)

[Facebook](#)

**License**

Open Data Commons Open Database License (ODbL) [OPEN DATA](#)

Dataset [Groups](#) [Activity Stream](#) [Manage](#)

**Eurac Test Facility (Bolzano, Italy) Data** PRIVATE

Measurement data from 20 CIGS modules from the test facility of Eurac Research in Bolzano, Italy. The dataset was selected to study failures in operation, hence several outages are in the data. Measurements from 01.01.2012 to 31.08.2012

This data is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

**Data and Resources**

[CSV](#) **Bolzano Airport CIGS data 2012 until 31.08**  
Following measurement variables: T\_ambient (ambient temperature)...

[CIGS](#) [free-standing](#) [italy](#) [mountains](#) [shading](#) [test facility](#)

**Additional Info**

Field	Value
Location name	Bolzano Airport, Italy
GPS Coordinates	46.46N, 11.33E
Restriction to publication	only after informing data owner
Author	Atse Louwen
Author Email	Atse Louwen

[Explore](#)

- [Preview](#)
- [Download](#)
- [Edit](#)

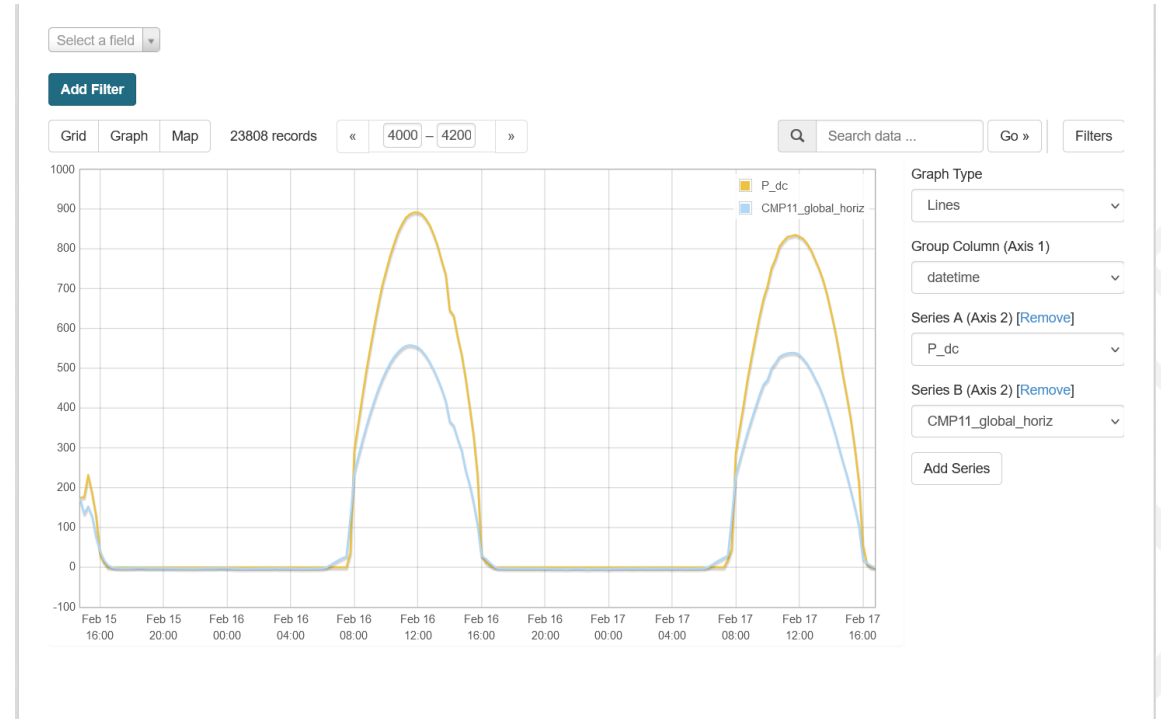
# Previewing Data

Select a field

Add Filter

Grid Graph Map 23808 records « 4000 - 4200 » Search data ... Go » Filters

_id	datetime	T_ambient	CMP11_...	CMP11_...	CMP11_...	Gill_win...	Gill_win...	T_coeff...	L_(mm)	W_(mm)	area_(m2)	Number	Pn_tot_...
4384	2012-02-...	8.87650...	125.953...	171.252...	242.497...	279.6	2.30066...	-0.3	1258	658	16.55528	20	1100
4385	2012-02-...	9.598151...	96.8473...	135.199...	194.969...	262.866...	4.02933...	-0.3	1258	658	16.55528	20	1100
4386	2012-02-...	10.8651...	71.9838...	153.219...	279.583...	146.133...	4.33533...	-0.3	1258	658	16.55528	20	1100
4387	2012-02-...	11.06419...	64.6092...	129.068...	243.179...	127.533...	4.238	-0.3	1258	658	16.55528	20	1100
4388	2012-02-...	11.03983...	56.5566...	77.7166...	123.394...	168.266...	4.916	-0.3	1258	658	16.55528	20	1100
4389	2012-02-...	10.788295	41.4974...	41.4574...	45.6933...	46.4666...	4.7	-0.3	1258	658	16.55528	20	1100
4390	2012-02-...	10.46115...	18.4685...	18.3087...	19.2660...	68.2666...	3.58066...	-0.3	1258	658	16.55528	20	1100
4391	2012-02-...	10.2386...	5.38976...	5.209174	5.735311...	51.5333...	2.544	-0.3	1258	658	16.55528	20	1100
4392	2012-02-...	10.2083...	0.10352...	0.00221...	0.43762...	58.6666...	4.03933...	-0.3	1258	658	16.55528	20	1100
4393	2012-02-...	10.4205...	-1.69061...	-1.713228	-1.2116938	73.0666...	3.94733...	-0.3	1258	658	16.55528	20	1100
4394	2012-02-...	10.4345...	-2.066338	-2.07278...	-1.61362...	52.8666...	3.168	-0.3	1258	658	16.55528	20	1100
4395	2012-02-...	10.1445...	-2.38029...	-2.42869...	-1.8302762	83.8666...	2.36333...	-0.3	1258	658	16.55528	20	1100
4396	2012-02-...	10.0710...	-2.16928...	-2.16880...	-1.68698...	72.2	2.952	-0.3	1258	658	16.55528	20	1100
4397	2012-02-...	10.1806...	-2.06421...	-2.01675...	-1.783563	71.2	4.674	-0.3	1258	658	16.55528	20	1100
4398	2012-02-...	10.2520...	-1.5475844	-1.52522...	-1.24985...	81.2	3.632	-0.3	1258	658	16.55528	20	1100
4399	2012-02-...	10.1239...	-1.41706...	-1.40403...	-1.1852392	86.8666...	2.98666...	-0.3	1258	658	16.55528	20	1100



# Viewing and Downloading Data

- ❖ Datasets can be labelled **private**
- ❖ **Restricted** to specific organization members
- ❖ Organization admins can add you!

The screenshot shows a dataset page with the following elements:

- Dataset Title:** Utrecht full spectral + weatherdata; synchronized timestamps
- Privacy:** A 'PRIVATE' label is circled in orange.
- Followers:** 0
- Follow Button:** A green 'Follow' button.
- Organization:** A section titled 'Organization' with a photo of a sunset and the text 'SpectralAnalysis' and 'Used for data files with spectrally distributed irradiance data [read more](#)'. This section is also circled in orange.
- Data and Resources:** A section titled 'Data and Resources' with a 'csv' icon and the text 'All data in zip archive' and 'Data is in csv format, for each month from 2014-07 to 2018-01'. There are also buttons for 'Meteorological data', 'irradiance data', and 'spectral data'.
- Additional Info:** A table with the following data:

Field	Value
Location name	UPOT, Utrecht, the Netherlands
GPS Coordinates	52.0877N, 5.1675E
Restriction to publication	for internal use only, publish results after contact with author and maintainer
Author	Atse Louwen
Author Email	<a href="mailto:Atse.Louwen@uu.nl">Atse Louwen</a>

Additional UI elements include a 'Manage' button, an 'Explore' button, and a dropdown menu with options: 'More information', 'Download', and 'Edit'.

## Useful links

- Main page: <https://ckan.pearlpv-cost.eu/>
- PEARLPV CKAN guide: <https://ckan.pearlpv-cost.eu/usermanual.pdf>
- General CKAN guide: <https://docs.ckan.org/en/2.8/user-guide.html>
- CKAN API guide: <https://docs.ckan.org/en/2.8/api/index.html>



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# Pearl PV data challenges



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# Pearl PV Data Challenge 1

comparison of PV performance across Europe

Dr. Eli Shirazi, University of Twente,  
Netherlands

# Introducing myself

- ❖ Main research topics
  - ❖ PV generation forecast
  - ❖ Digitalization of the energy system
  - ❖ Energy management
  - ❖ Grid integration of PV generation
- ❖ Short resume
  - ❖ Assistant Professor, Sustainable Energy Technology Systems Group, Dept. of Design Production and Management, Fac. of Engineering Technology, University of Twente, 2021 - present
  - ❖ Postdoctoral Researcher, Dept. of Electrical and Electronic Engineering, Fac. of Engineering Science, KU Leuven. 2019-2021
  - ❖ PhD thesis: "Self-healing in Smart Distribution Networks with PV penetration by Distributed Control". 2019



Dr. Dipl.-Ing. Eli (Elham) Shirazi

# Research Questions

The analysis of submitted data sets will be related to PEARL PV's main research questions which are as follows:

1. What is the relationship between weather data, PV system metadata and the power output?
2. The average annual yield of PV systems?
3. The performance ratio of PV systems across EU?

# ≡ Data Challenge

## comparison of PV performance across Europe

- ≡ Dataset should allow to investigate degradation, performance loss based on location, climate and PV technology
- ≡ The goal is to have a harmonized, high-coverage, open dataset of solar photovoltaic installations across EU
- ≡ There are both module measurements and system data available

# ≡ The Required Data

PV system metadata
GPS Coordinates
Fixed installation, tilt and azimuth
Tracking Mode
PV module technology
Total number of PV modules in the system
Number of modules connected in one string
Number of strings connected to each inverter
Total number of PV strings in the system
Soiling
Shading

Variables
Resolution: < 1 hour
Horizon: > 1 year
global horizontal irradiance (GHI)
plane-of-array (POA) irradiance
module temperature
DC output power
AC output power

# Preparing Datasets

## Data Cleaning

- Outliers, missing datapoints and data gaps

## Data Filtering

Filtering serves to identify and remove data within the time series that are influenced by factors that cannot be modeled

- Irradiance threshold filtering
- Power threshold filtering
- Inverter saturation and curtailment
- Clear-sky filters
- Shading, soiling, and snow corrections

# KPI

Participants are kindly asked to use the following key performance indicators (KPI's) in their analysis:

- ❖ The final yield  $Y_f$ , is defined as the energy output ( $E_{AC}$ , the total AC power produced by the solar PV system over a defined period) per the system's rated capacity ( $P_{rated}$ ).

$$Y_f = \frac{E_{AC}}{P_{rated}}$$

- ❖ The reference yield, is defined as the solar radiation at the plane of array ( $H_{POA}$ ) divided by the irradiance at the standard test conditions ( $G_{STC} = 1 \text{ kW/m}^2$ ).

$$Y_{ref} = \frac{H_{POA}}{G_{STC}}$$

- ❖ The Average annual final yield and performance ratio (PR):

$$PR = \frac{Y_f}{Y_{ref}} = \frac{E_{AC}/P_{rated}}{H_{POA}/G_{STC}}$$



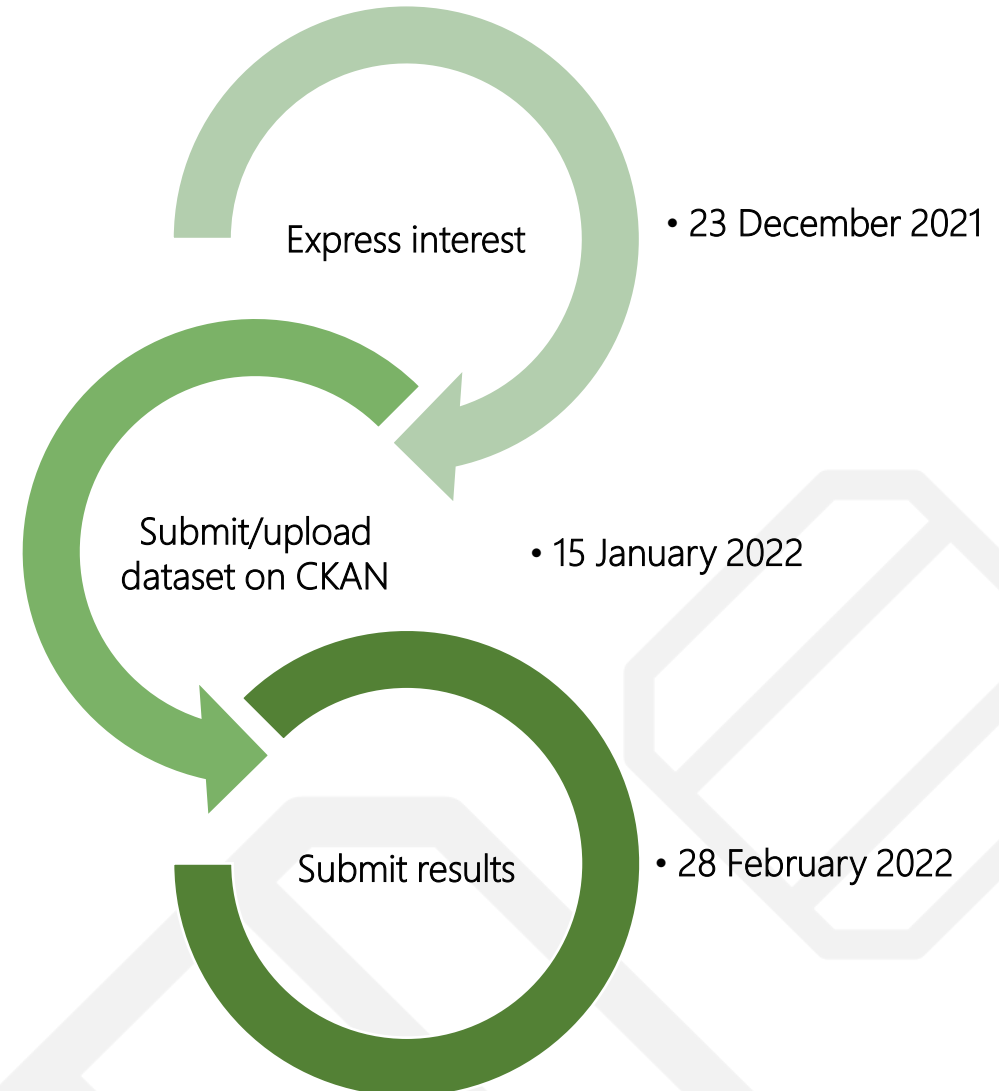
## Access to the data

- There will be repository dedicated to the data of this data challenge on CKAN data server.
- By contributing datasets, participants gain access to the datasets of other participants, and can join in a Europe wide intercomparison of performance and degradation of PV systems.



# Timeline

If you are interested to participate in the challenge and/or to use the CKAN database for other purposes, contact me: [e.shirazi@utwente.nl](mailto:e.shirazi@utwente.nl)



P  A R L P V

# Pearl PV Data Challenge 2: Fault Detection

Dr. Atse Louwen, Eurac Research, Bolzano, Italy

# ❖ PEARL PV data challenge: Fault Detection

- ❖ Fault detection very active field in PV research
- ❖ Comprehensive datasets needed for proper development, training, testing and validation
- ❖ Labelled datasets important
- ❖ Chicken/egg situation?
- ❖ With this challenge, we aim to invite researchers to
  - ❖ Get to know the PEARL PV CKAN database
  - ❖ Use the database to upload and exchange data
  - ❖ Collaborate on research topics within the PEARL PV community

# ❖ PEARL PV data challenge: Fault Detection

- ❖ Challenge: **to develop, train, test and validate fault detection algorithms** in the Pearl PV framework
- ❖ We summarize and present results in the Pearl PV conference (March 2022)
- ❖ Compare and rank fault detection algorithms
- ❖ Joint publication on overall results
- ❖ Participants submit a dataset and gain access to all other datasets

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## Requirements:

- ❖ At least **one full year** of PV monitoring dataset
- ❖ At least **hourly** resolution
- ❖ Datasets contain 2.5%-7.5% of artificially introduced faults:
  - ❖ Module level: soiling, improperly installed, glass breakage
  - ❖ Inverter level: not operating, error message, fan failure + overheating
- ❖ All faults labelled including type of fault
- ❖ Metadata of PV plant to allow e.g. to determine propagation of module faults at string level
- ❖ Description of the dataset and approach to introduce faults

## ❖ Access to the data

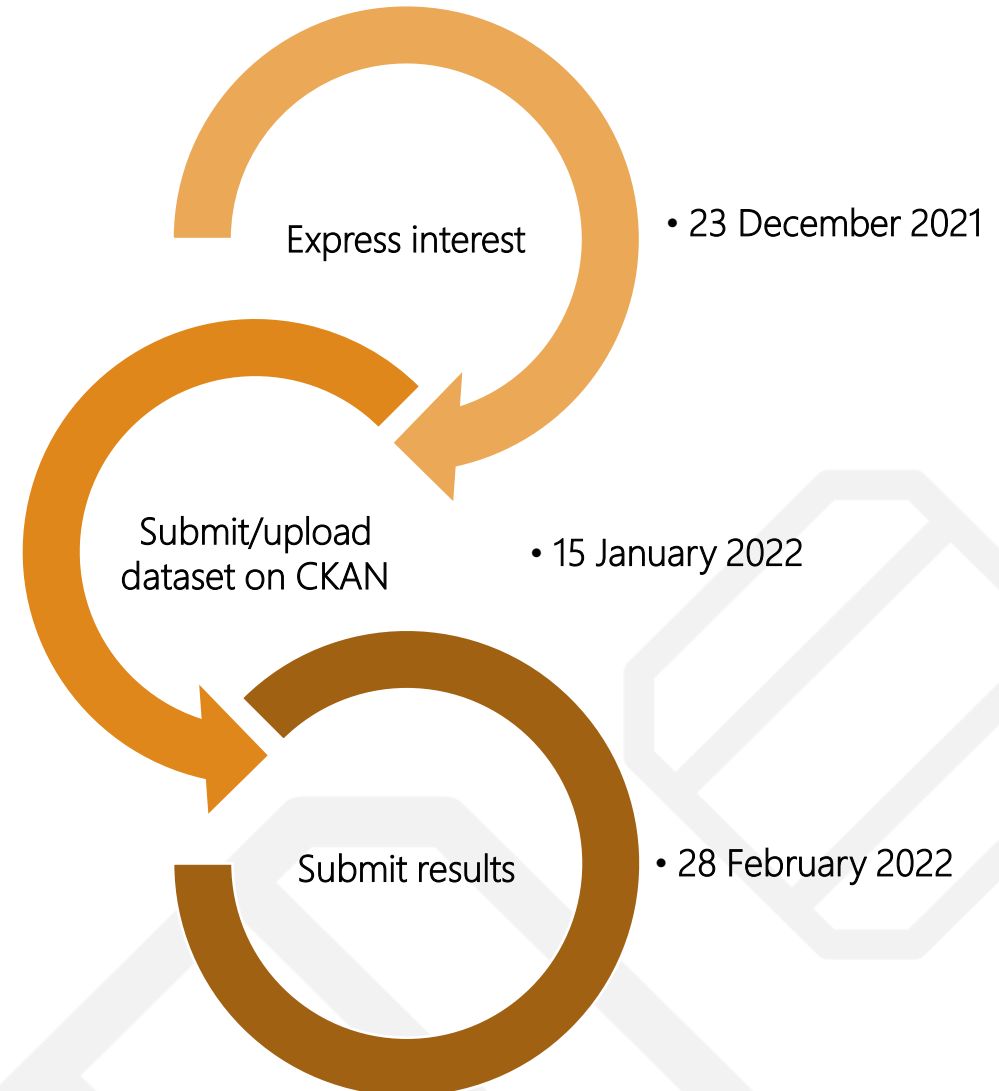
- There will be repository dedicated to the data of this data challenge on CKAN data server.
- By contributing datasets, participants gain access to the datasets of other participants, and can join in a Europe wide intercomparison of fault detection algorithms



# Timeline

If you are interested to participate in the challenge  
Contact me: [atse.louwen@eurac.edu](mailto:atse.louwen@eurac.edu)

To use the CKAN database for other purposes, contact  
Eli: [e.shirazi@utwente.nl](mailto:e.shirazi@utwente.nl)





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## Timeline:

- ❖ Express interest (deadline: **24 dec 2021**)
- ❖ Submit/upload dataset on CKAN (**15 jan 2022**)
- ❖ Develop, train/test and validate algorithms
- ❖ Submit results (**28 Feb 2022**)

If you are interested to participate in the challenge and/or to use the CKAN database for other purposes, contact me [atse.louwen@eurac.edu](mailto:atse.louwen@eurac.edu)

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# Closing of the Workshop



## ❖ Wrap-Up

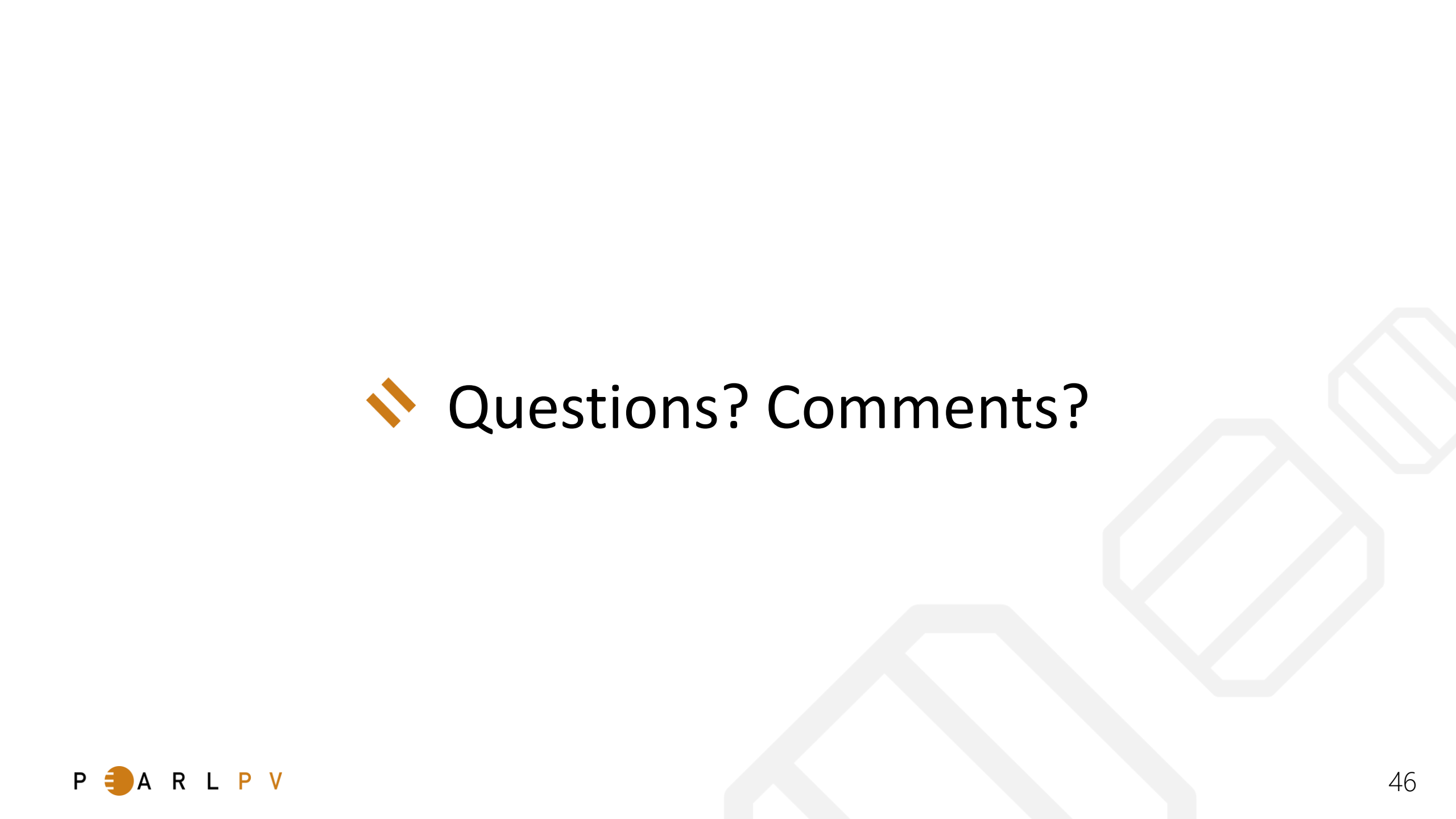
- ❖ As presented and discussed here, PV research becomes ever more data-centric
- ❖ A convergence of computational power, high-quality open-source tools and increasing data availability offers great possibilities
- ❖ Pearl PV is hosting a CKAN database server to enable exchange of data and research collaboration in the Pearl PV framework  
<https://ckan.pearl-pv-cost.eu/>
- ❖ We are inviting the audience to contribute to the CKAN database by means of two data-challenges

## ❖ Wrap-up: data challenges

- ❖ We presented here two data-challenges to enable research collaboration and foster data exchange using the PEARL PV CKAN
  - ❖ Comparison of PV performance across Europe
  - ❖ Comparison of Fault Detection Algorithms
- ❖ There will be dedicated repositories for these data challenges on CKAN data server (Organizations, in CKAN terminology)
- ❖ By contributing datasets, participants gain access to the datasets of other participants, and can join in a Europe wide intercomparison of **PV performance degradation** and **fault detection algorithms**

## ❖ Wrap-up: previous data challenge

- ❖ At the EUPVSEC we presented the first data challenge
- ❖ Regarding spectral data exchange
- ❖ To find a way to implement spectral data in our favorite PV modelling tools
- ❖ There is a be dedicated repository for this data challenges on CKAN data server as well
- ❖ Although not presented here, we still would like to work on it
- ❖ **Details will be shared with you online**



Questions? Comments?

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# Thank you for your attention!

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Prof. Angèle Reinders, University of Twente/Eindhoven University of Technology, Netherlands