SunPeek

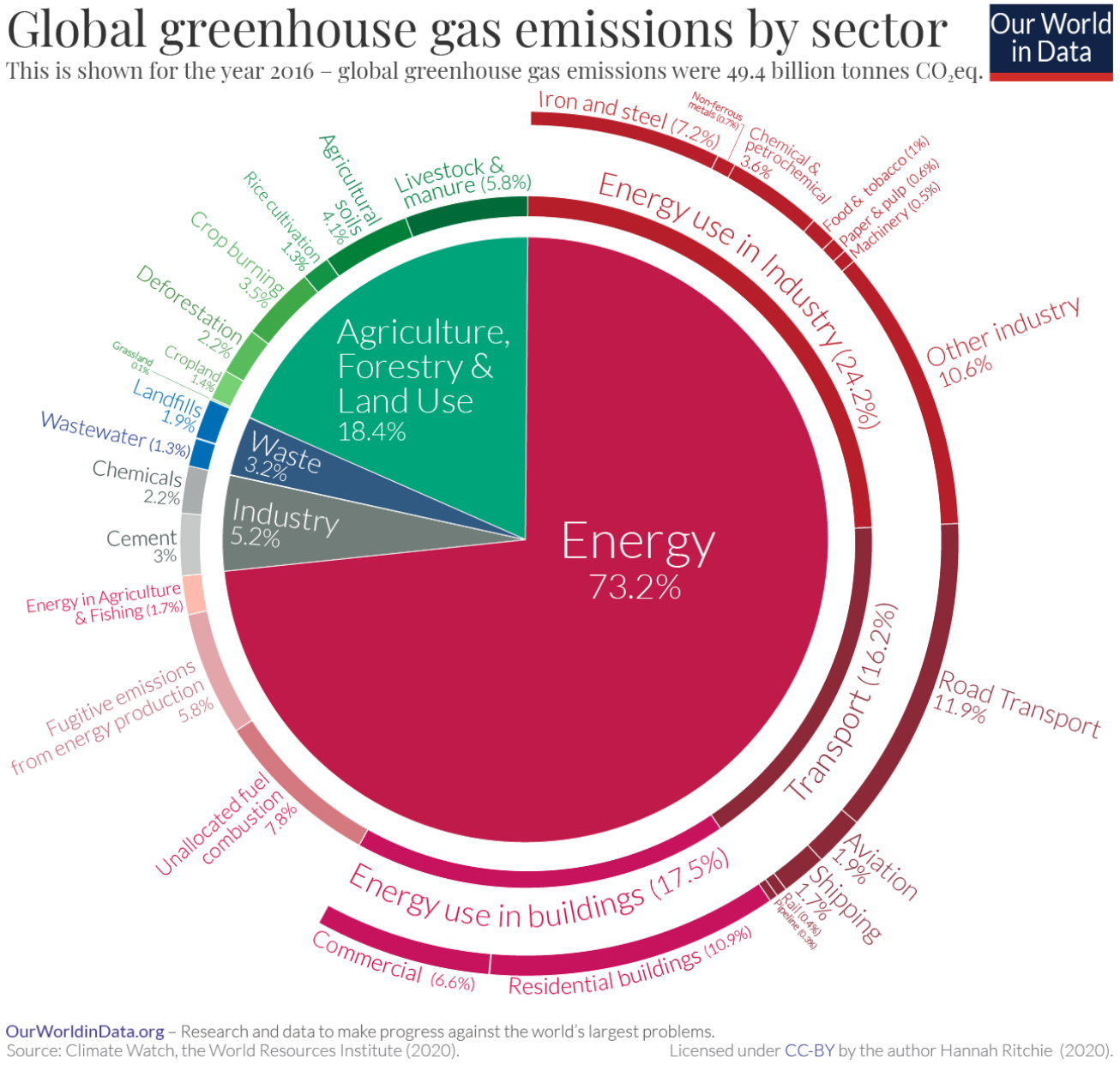
Open-Source Software for Performance Assessment and Monitoring of Large Solar Thermal Plants

Philip Ohnewein, Marnoch Hamilton-Jones,
Daniel Tschopp, Lukas Feierl, Maria Moser

FOSDEM

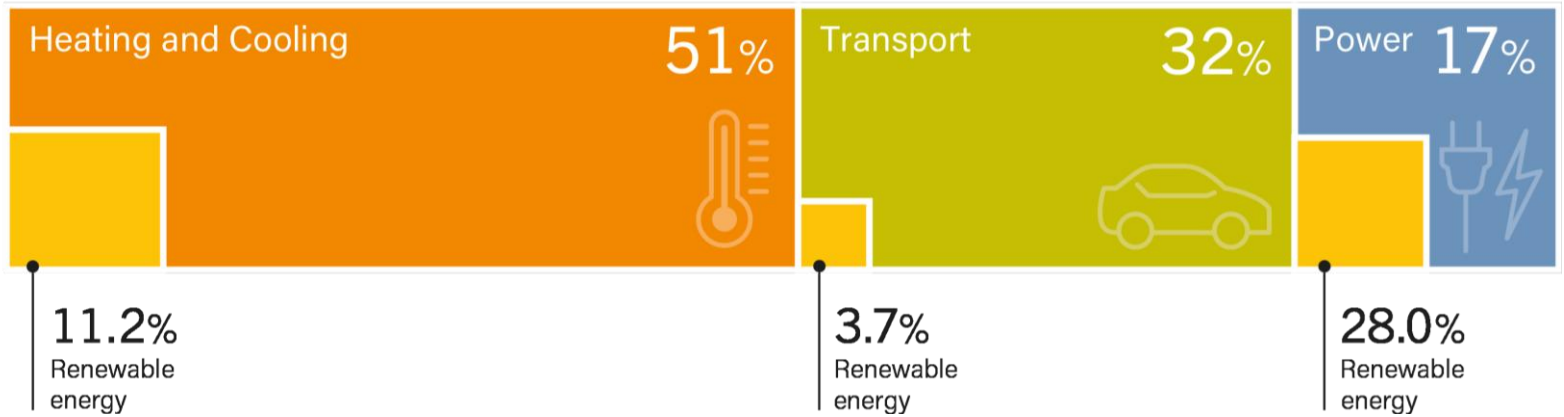
 2025-02-01, FOSDEM 2025

Energy & CO_2

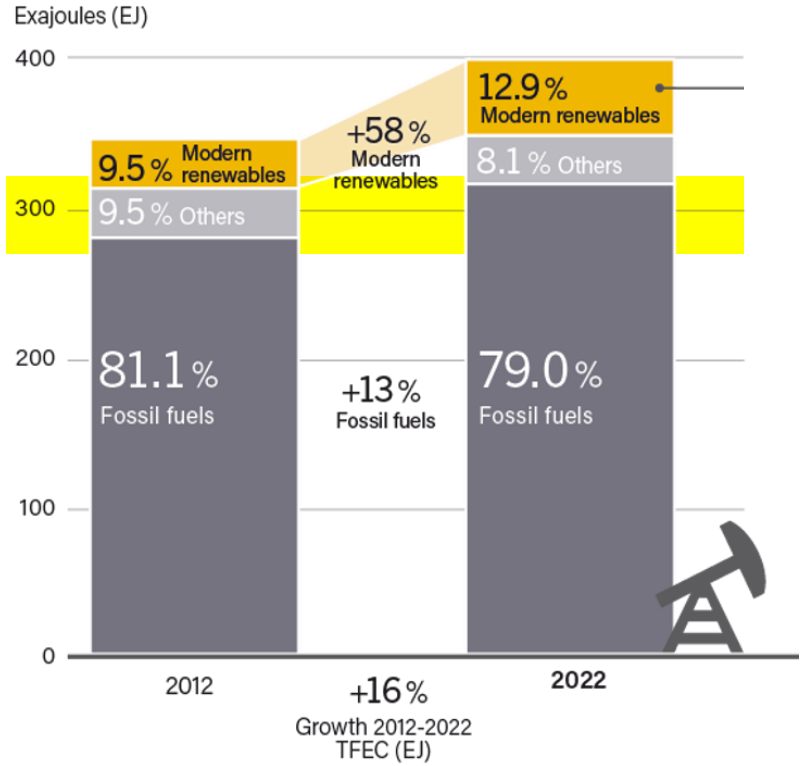


Energy Overview

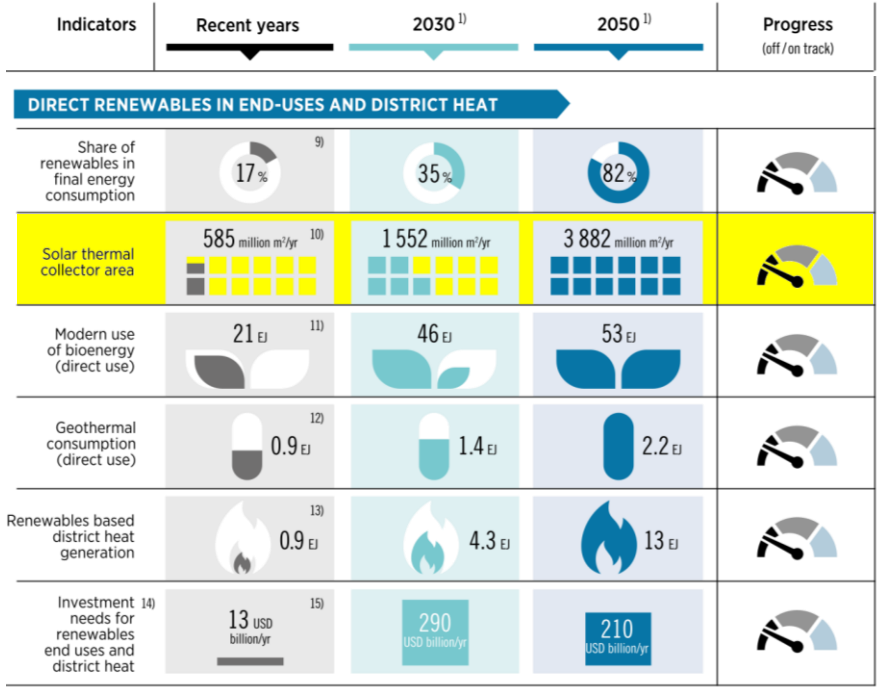
Source: REN21 Renewables 2023 GSR



Source: REN21 Renewables 2024 GSR

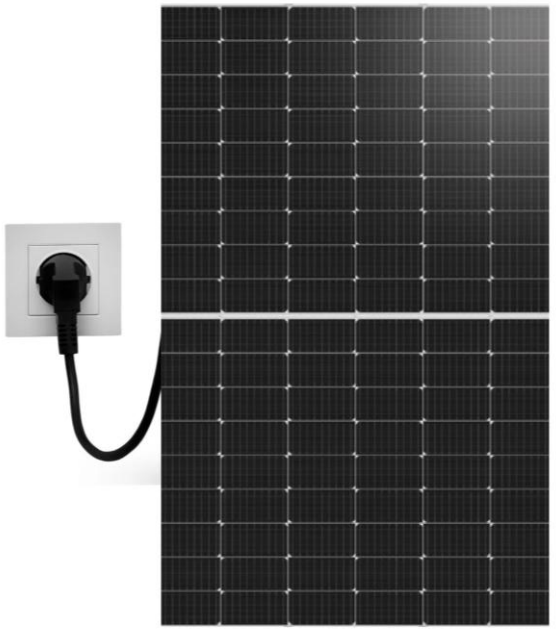


Source: IRENA World Energy Transitions Outlook 2022

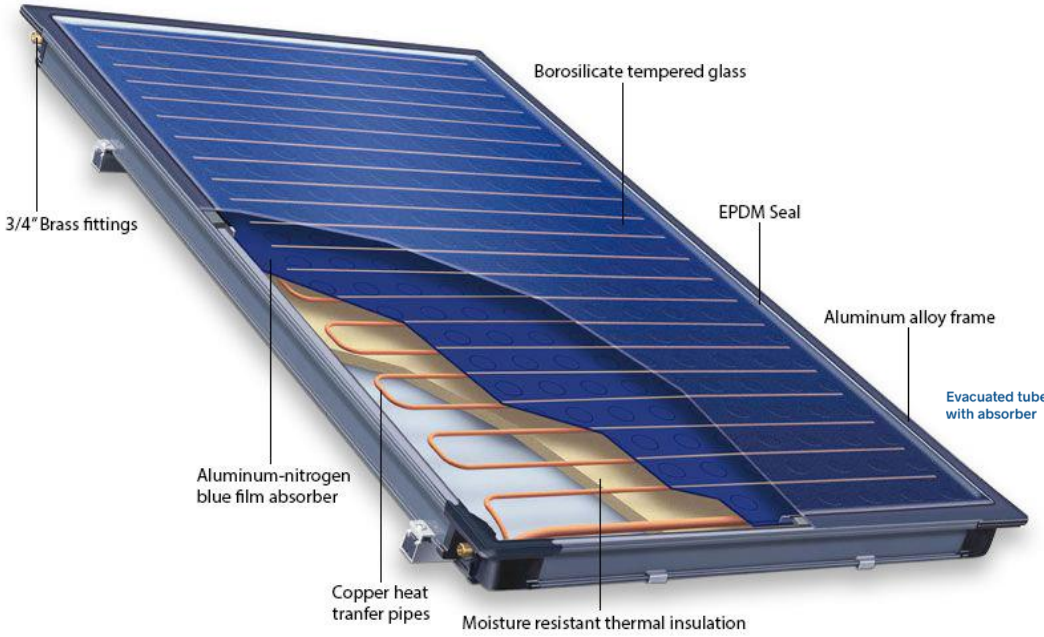


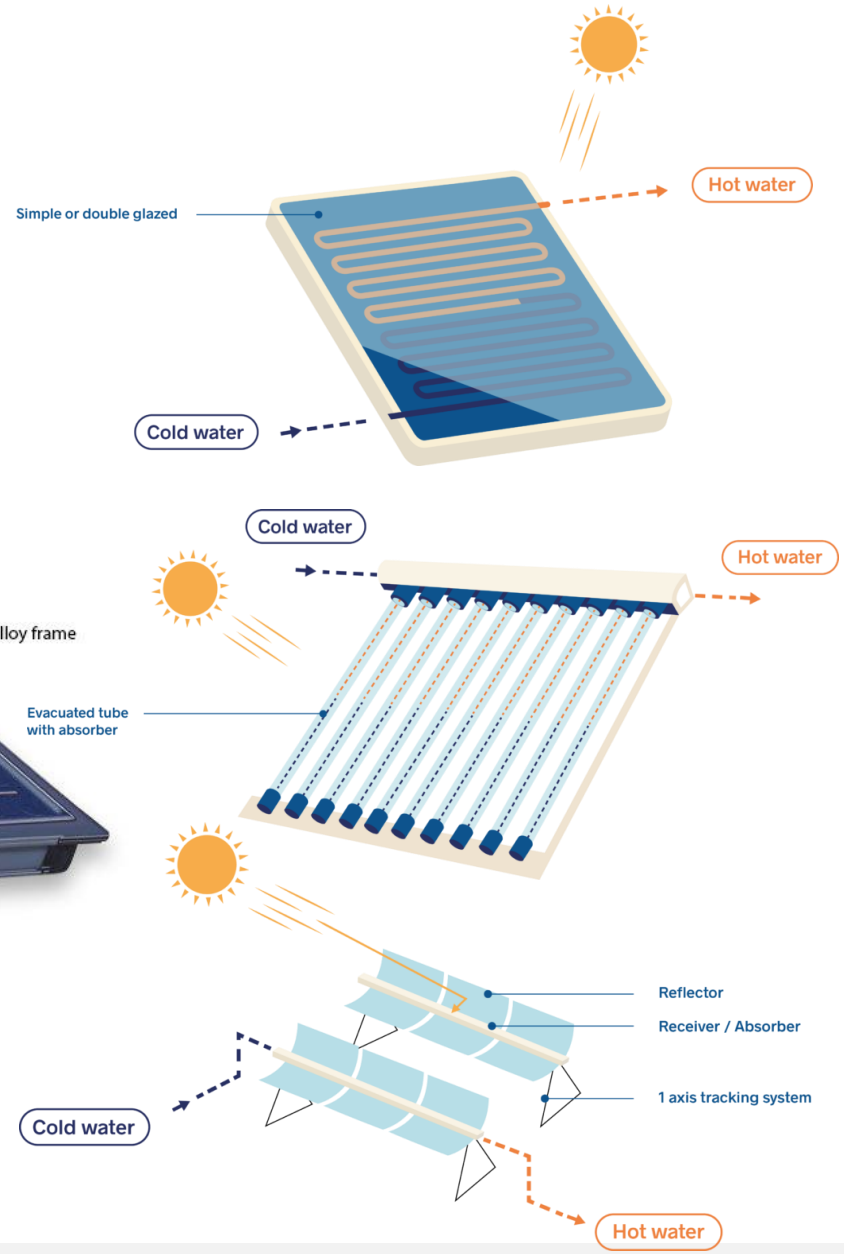
PV / Solar Thermal

PV module



Solar thermal collector





Large-scale solar thermal systems

Friesach,
Source: Solar Engineering Guggenberger

Högslätten Härnösand
Source: Absolicon

Fernheizwerk Graz (FHW)
Source: Picfly.at Thomas Eberhard

St. Ruprecht an der Raab,
Source: Gasokol GmbH

Fernwärme Ettenheim
Source: Peter Blaser

Stadtwerke Greifswald
Source: Ritter XL Solar

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Performance Verification

„Does the solar plant perform as expected?“

Performance Monitoring

„Does performance change over time?“

SunPeek Philosophy

Performance Verification

„Does the solar plant perform as expected?“

Performance Monitoring

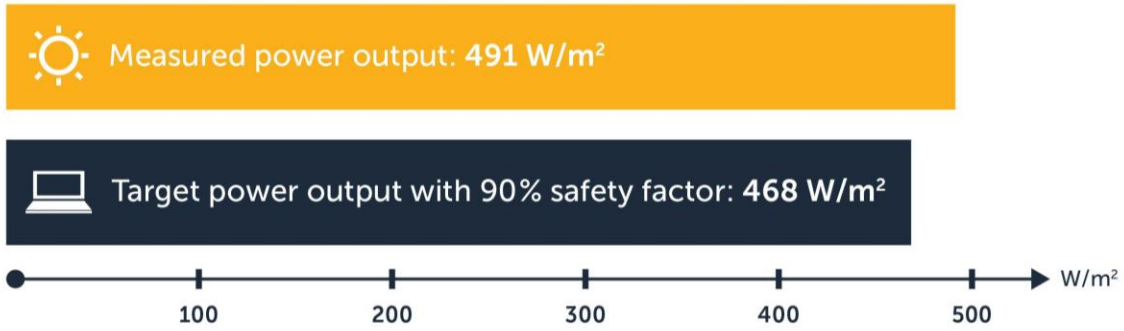
„Does performance change over time?“

How does it work?

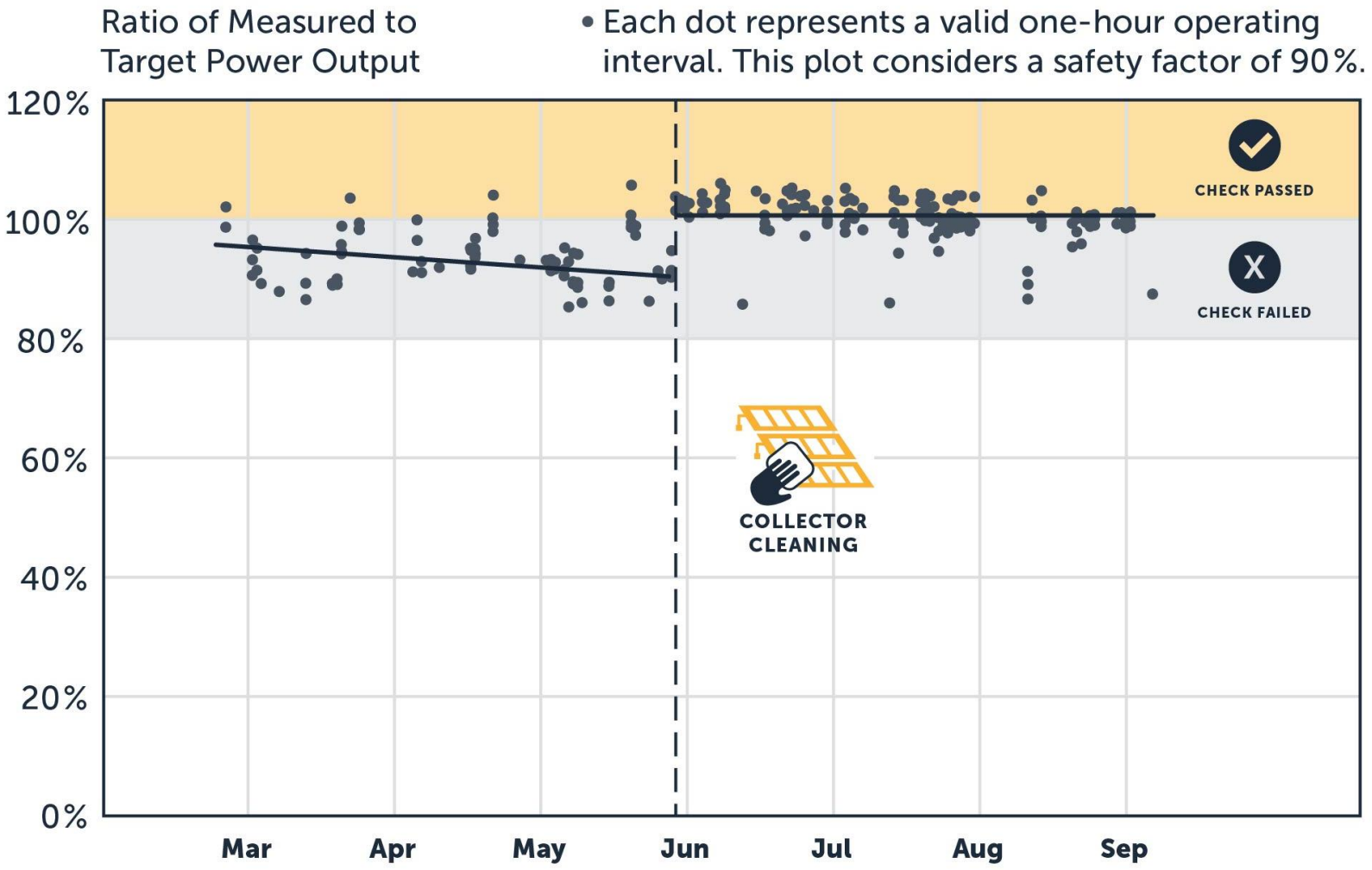
- Each dot represents a valid one-hour operating interval. This plot considers a safety factor of 90%.

Power Check is fulfilled if measured power output during valid operating intervals is greater than target power output including safety margin.

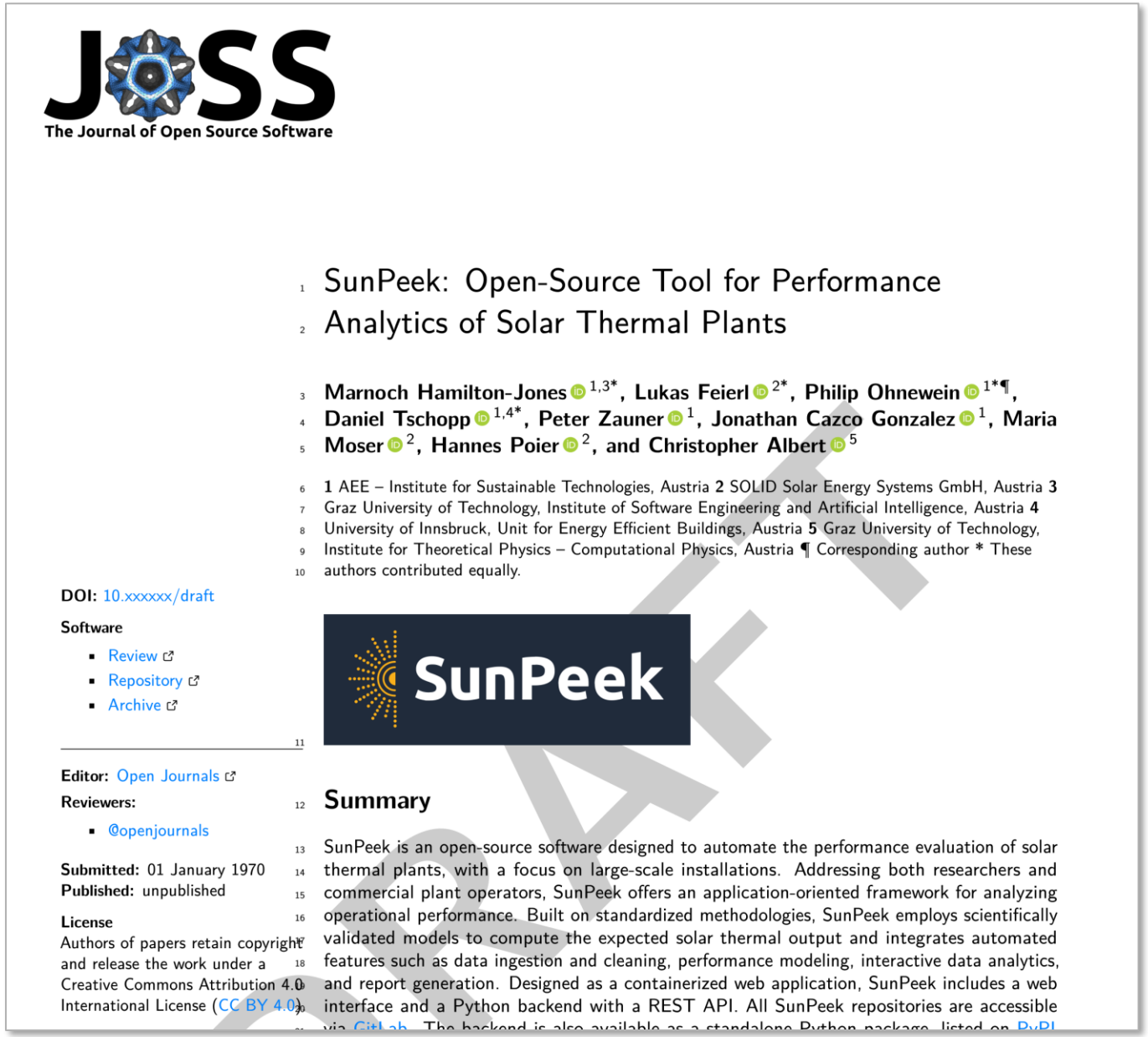
A check requires at least 20 hours with stable plant operation.



SunPeek for ongoing Monitoring



SunPeek JOSS Paper!



JOSS
The Journal of Open Source Software

SunPeek: Open-Source Tool for Performance Analytics of Solar Thermal Plants

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1 AEE – Institute for Sustainable Technologies, Austria **2** SOLID Solar Energy Systems GmbH, Austria **3** Graz University of Technology, Institute of Software Engineering and Artificial Intelligence, Austria **4** University of Innsbruck, Unit for Energy Efficient Buildings, Austria **5** Graz University of Technology, Institute for Theoretical Physics – Computational Physics, Austria ¶ Corresponding author * These authors contributed equally.

DOI: 10.xxxxxx/draft

Software

- Review
- Repository
- Archive

Editor: Open Journals
Reviewers:

- @openjournals

Submitted: 01 January 1970
Published: unpublished

SunPeek

Summary

SunPeek is an open-source software designed to automate the performance evaluation of solar thermal plants, with a focus on large-scale installations. Addressing both researchers and commercial plant operators, SunPeek offers an application-oriented framework for analyzing operational performance. Built on standardized methodologies, SunPeek employs scientifically validated models to compute the expected solar thermal output and integrates automated features such as data ingestion and cleaning, performance modeling, interactive data analytics, and report generation. Designed as a containerized web application, SunPeek includes a web interface and a Python backend with a REST API. All SunPeek repositories are accessible via GitLab. The backend is also available as a standalone Python package, listed on PyPI

Fresh off the press ☺ Pre-Print:

https://zenodo.org/communities/sunpeek/

SunPeek

SunPeek Community

Funding

Community, Users & Enablers

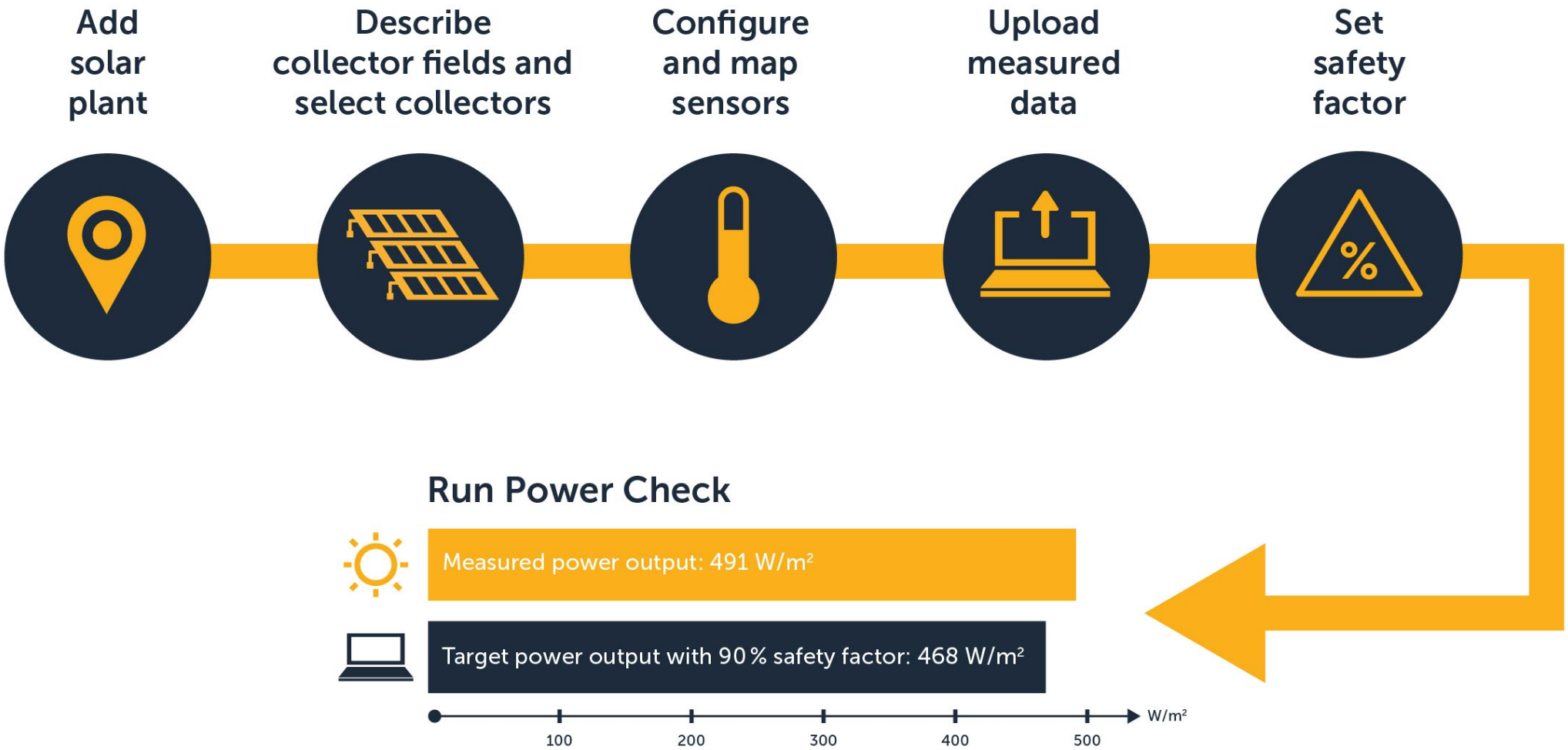
Steering Committee & Maintainers





Initiators

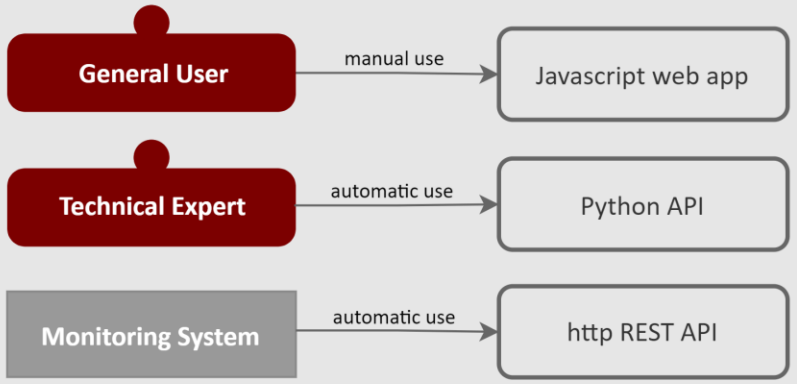
Steps to SunPeek Power Check



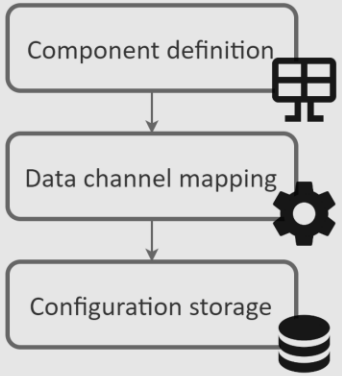
Analysis Process

SunPeek

Triggering SunPeek Data Ingestion and Analysis



Plant Configuration *[manual, one-off]*

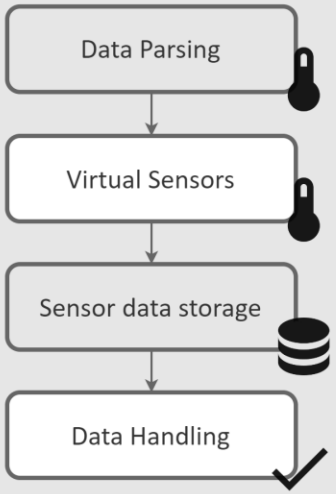


Define location and main components: collectors, collector fields, etc.
Define settings like collector area, tilt and azimuth angles, row spacing.

Map data channel names to components.
Define sensor settings and physical units.

Plant configuration stored in SQL database.

Data Ingestion *[automatic]*



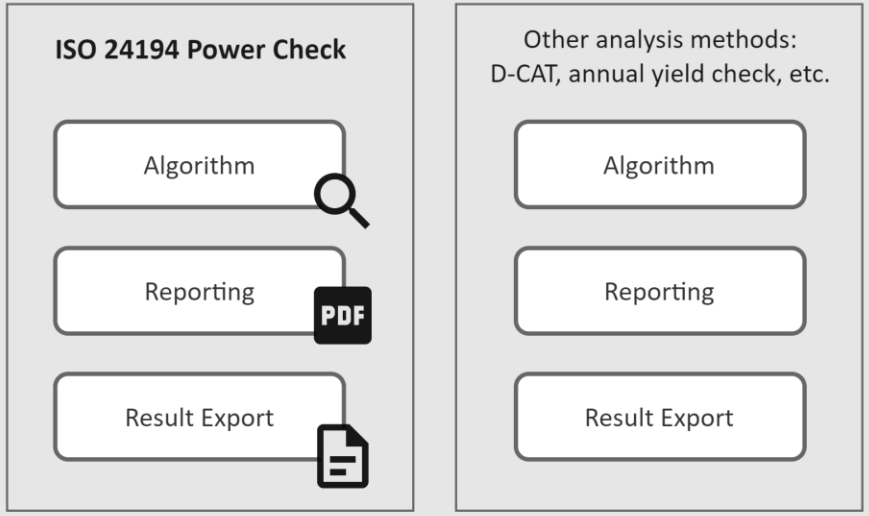
Parse raw input data to time series.
Attach configuration info: Physical units, type of error checks

Calculated time series data.
Allows introducing custom data models.

Time series sensor data stored in Parquet storage.
Includes both measured and virtual sensors.

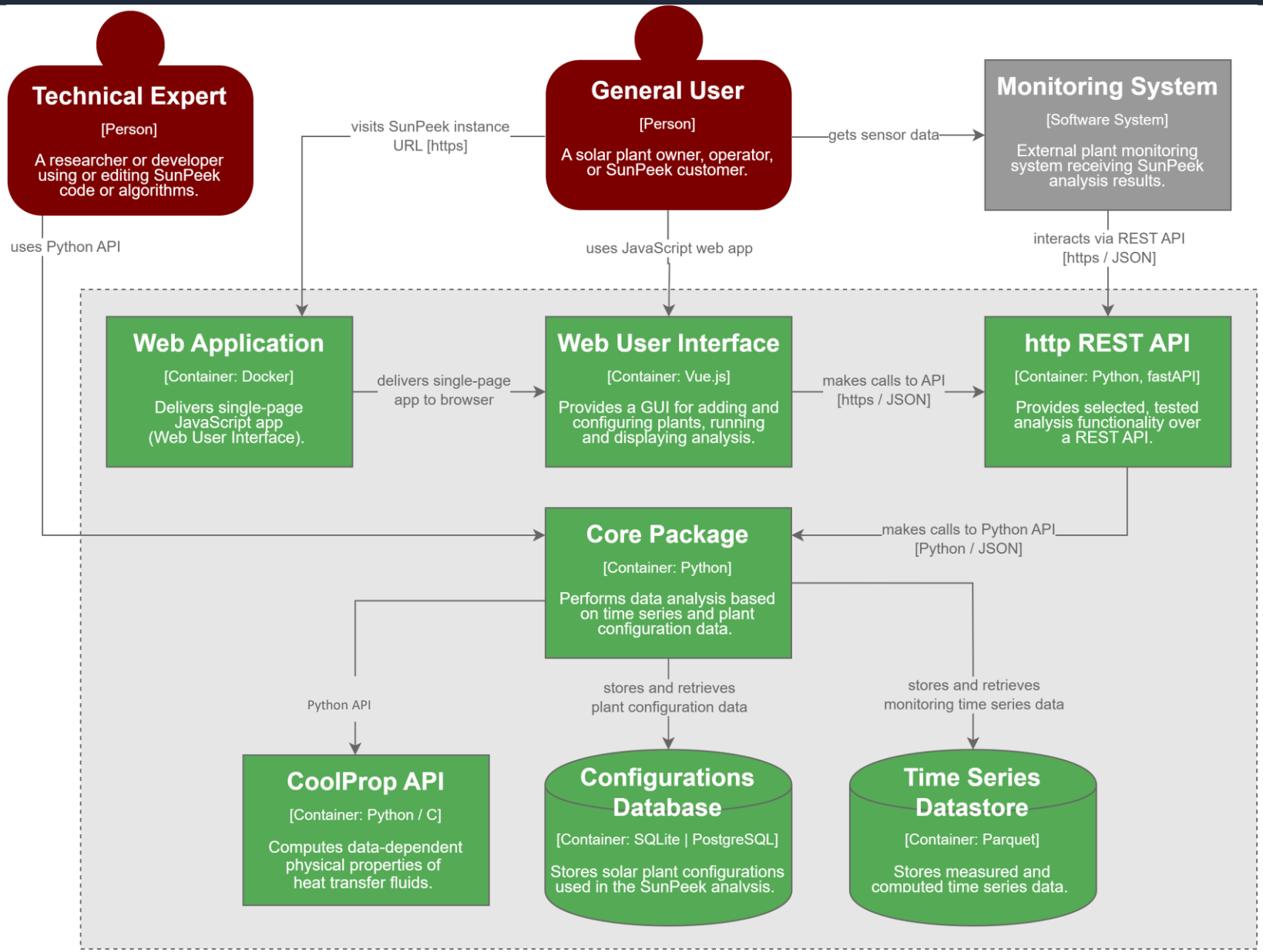
Run on-the-fly gross error checks on time series data.
Provide quality-checked data as pandas Series.

Data Analysis *[automatic]*



Architecture

SunPeek

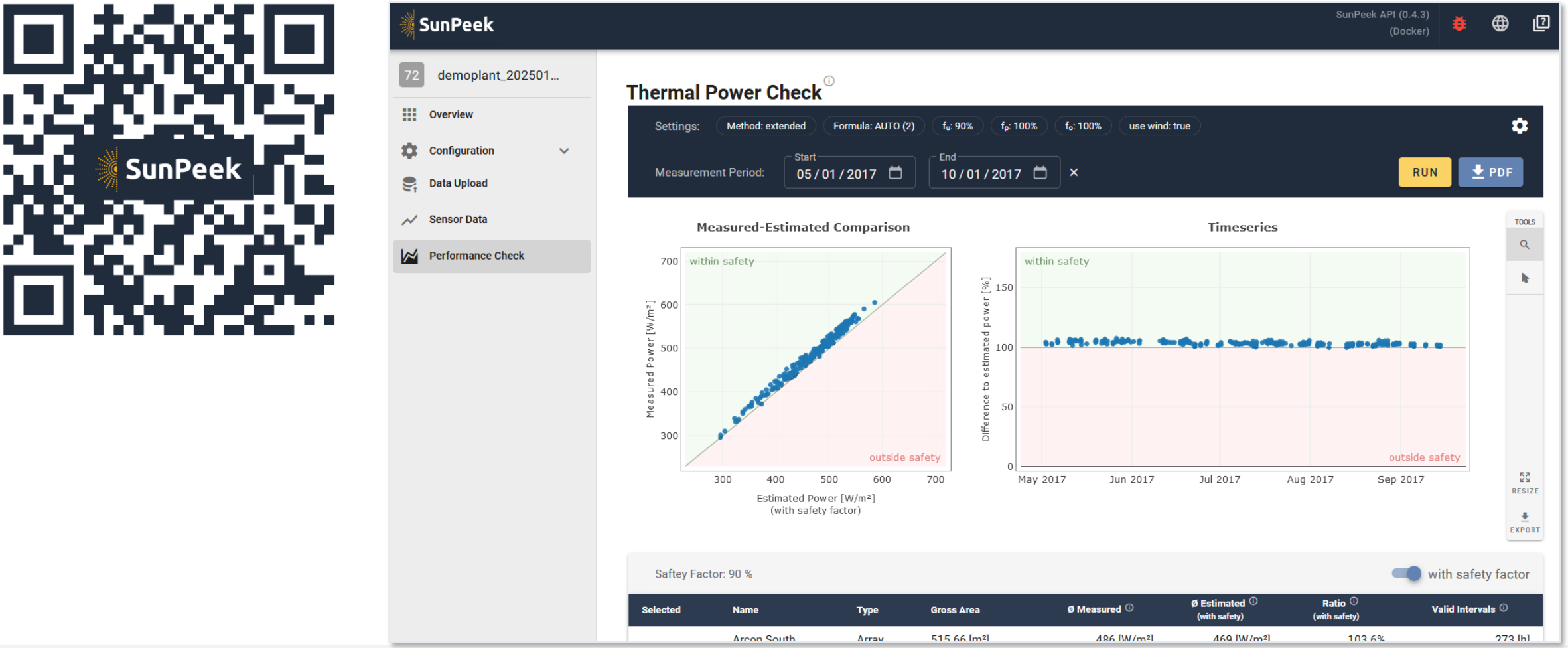


Installation Options

- For long term installation or use with the UI, docker images are provided, along with a docker compose file.
  - See https://docs.sunpeek.org/quick_start/installation/index.html
- Main application can run as a stand-alone container if only the REST API is needed.
- For researchers, or integrating directly into other software: Python package, `pip install sunpeek` (optional install extras: `demo`, `db`, `api`). https://pypi.org/project/sunpeek/

SunPeek Demo Server

https://demo.sunpeek.org/



SunPeek Information

✓	**Software Repository**	https://gitlab.com/sunpeek/
✓	**Support**	support@sunpeek.org
✓	**Zenodo Community**	https://zenodo.org/communities/sunpeek
✓	**Public Demo**	https://demo.sunpeek.org/

SunPeek

Join us!

Join SunPeek! Whether you're a researcher, developer, solar professional, or enthusiast, your participation is welcome. Let's create a brighter solar thermal future together!

www.sunpeek.org

AEE INTEC

SOLID solar energy systems

GASOKOL Solar. Seit 1981.

SCHNEID