LOD-GEOSS

FAIR Data in Energy Systems Analysis

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Open Energy Family

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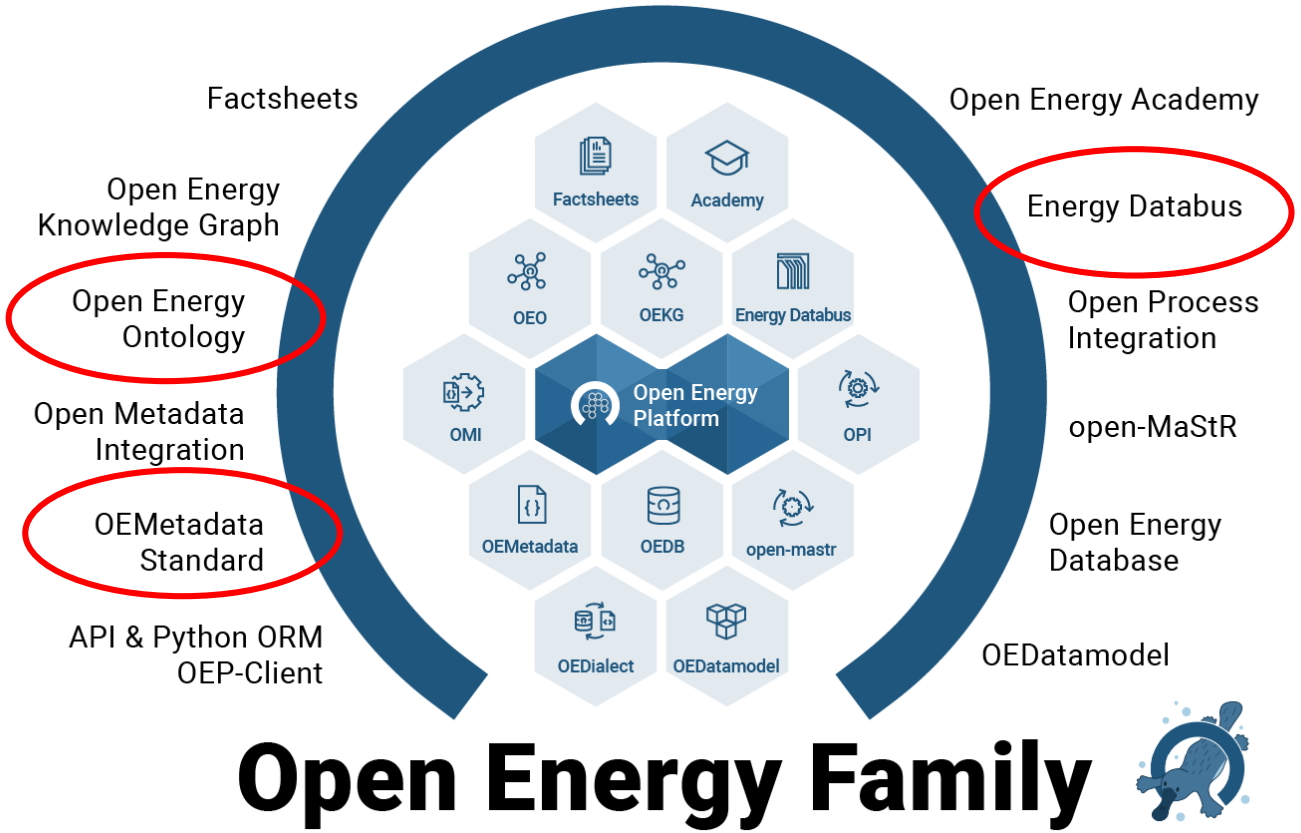
- The **Open Energy Family** is an initiative for open and FAIR data in the domain of energy systems research
- Development of a FAIR infrastructure within the Open Energy Family



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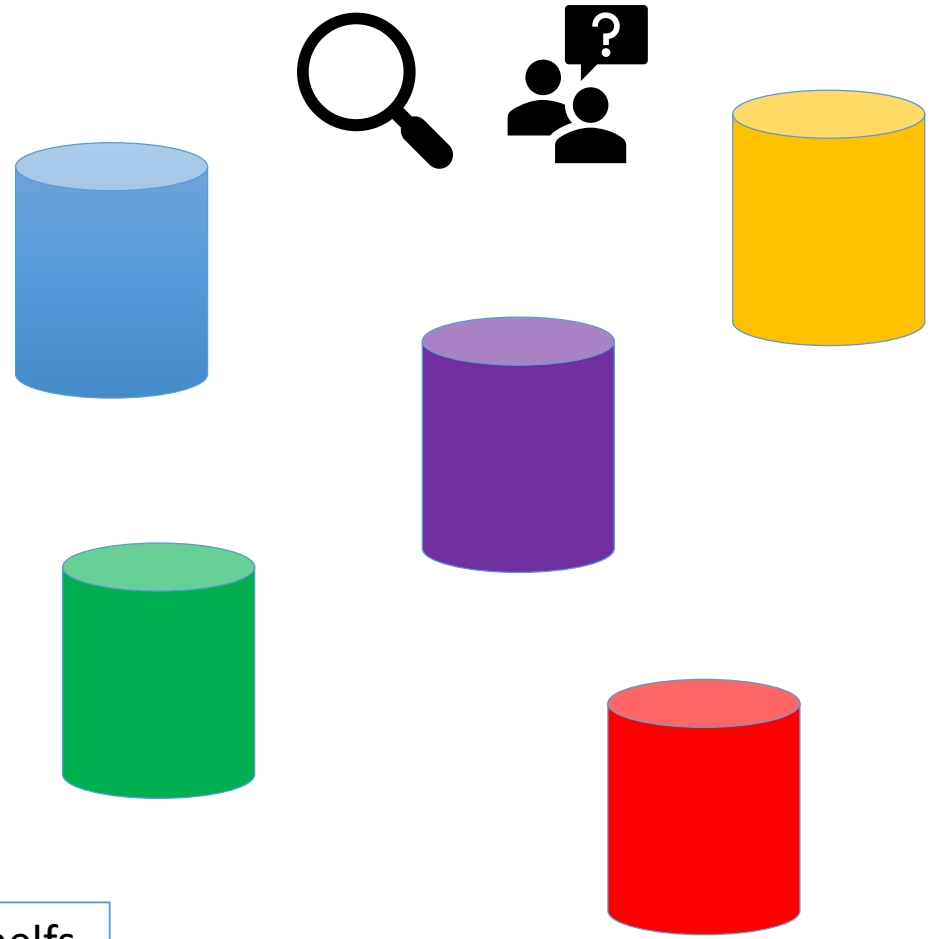
Challenges I: Finding and Accessing Data

- Many data bases exist, each in its own flavor
  - Data access
  - Data format
  - Data licenses (if at all)
  - Sometimes hard to find

- Data collection is a labor intensive task
- Data cleaning, aggregation, etc.
  is repeated by many researchers with different results
- Data quality is often unknown



Imagine a library without a catalog and systematic numbers on the shelfs

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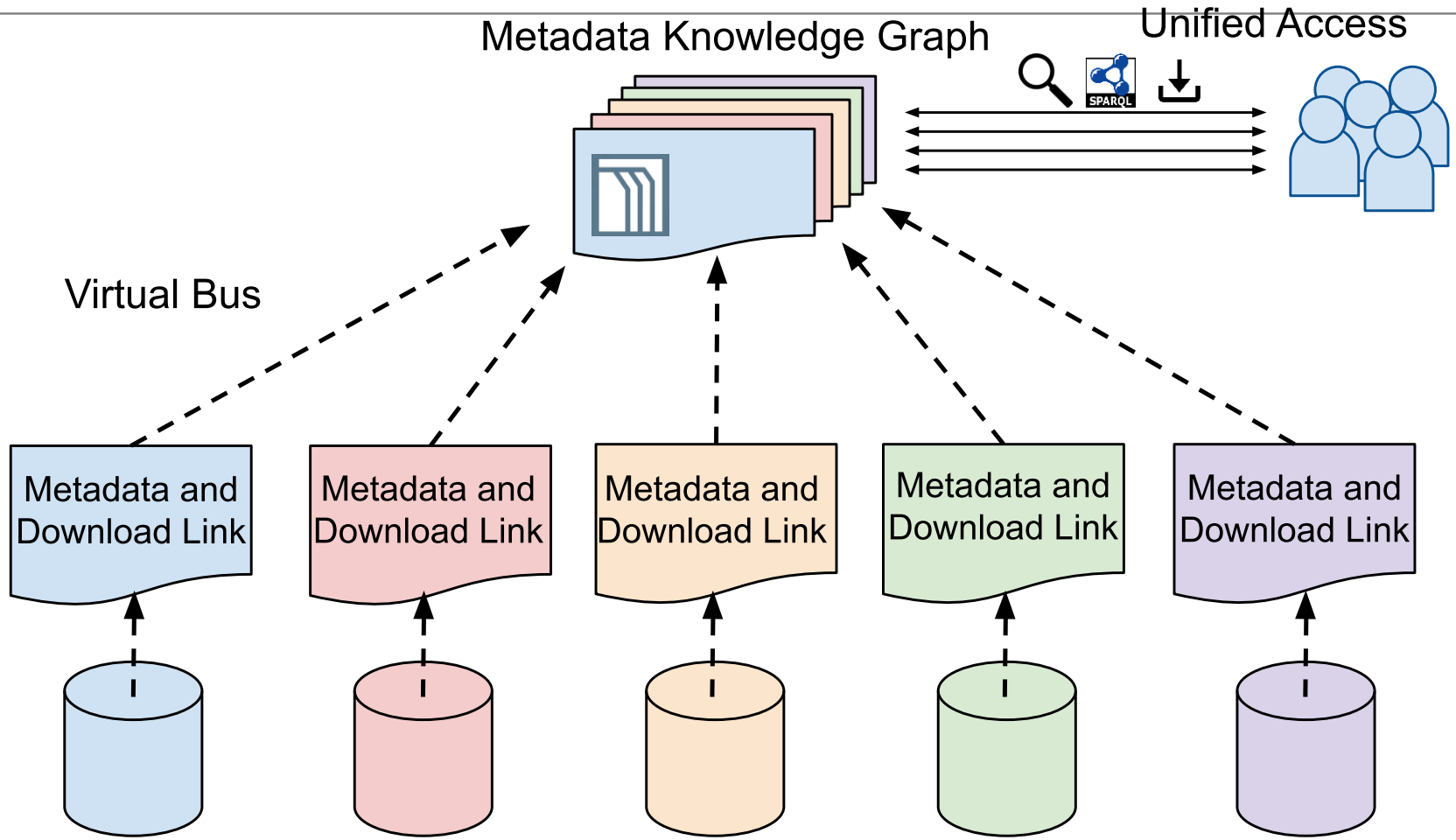
Solution I: A Metadata Catalog

- A metadata catalog harvests the (rich) metadata from the available data sources
- The catalog can be used to discover data
- The metadata contains a URI to the actual data
- In case of data bases possibly also an API/Interface description



The domain uses the OEP Metadata string: https://openenergy-platform.org/tutorials/jupyter/OEMetadata/

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Findable: OEMetadata

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- A metadata standard for „energy related data“
- Based on existing technologies and standards as “Frictionless Data” and “DataCite”
- Implemented as JSON-LD to be human and machine readable
- Latest release (v1.5.1) is “ontology ready”
- Target: 5-star Linked Open Data

Categories

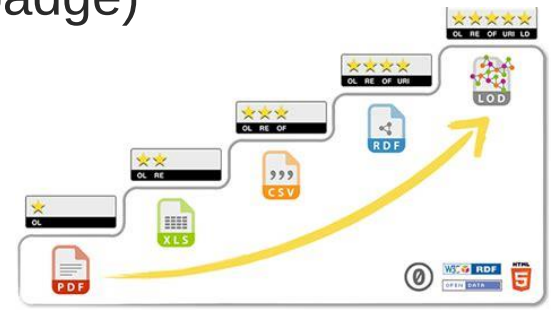
- **General** (name, title, description)
- **Context** (homepage, funding, contact)
- **Spatial** (location, extent, resolution)
- **Temporal** (referenceDate, timeseries)
- **Source** (origin, licenses)
- **Provenience** (contributors)
- **Resource** (schema, fields, type, description)
- **Review** (context and badge)

OEMetadata

FRICTIONLESS DATA

DataCite

Findable Accessible Interoperable Reusable



https://github.com/OpenEnergyPlatform/oemetadata

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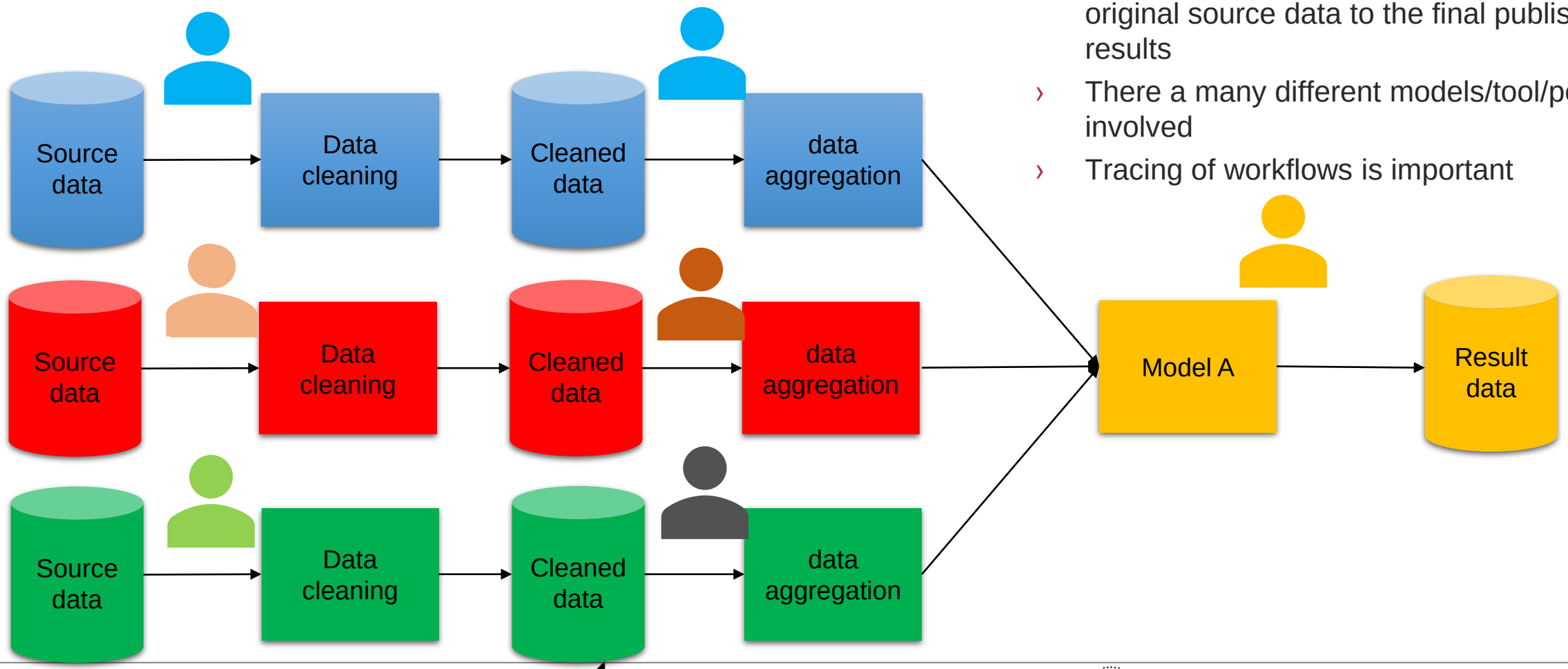
Challenge II: Who has done what to the data?



- There are many processing steps from the original source data to the final published results
- There a many different models/tool/persons involved
- Tracing of workflows is important

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PROV-O as a W3 Standard

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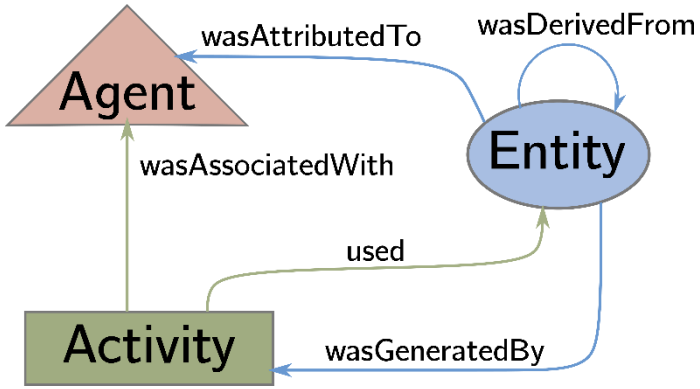
Entities	Digital, physical or conceptional (.e.g. data sets or files)
Activities	Use or generate entities, e.g. algorithms or workflows
Agents	Have control over activities or own entities, e.g. persons, organizations, software

Entities, **Activities** and **Agents** are related through **relations** with each other.

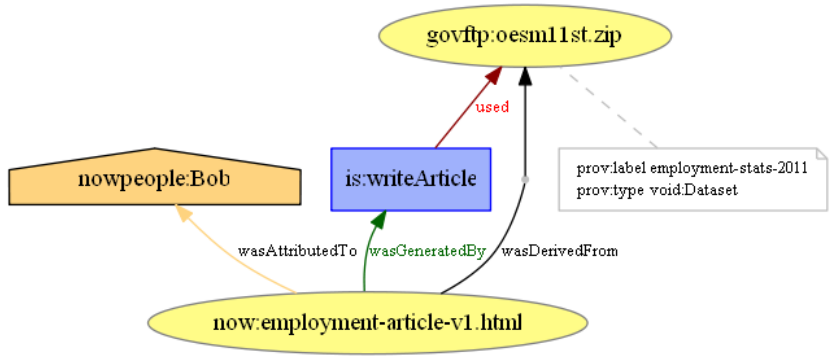
Provenance Information can be collected automatically and visualized in graphs, e.g. with ProvStore

A record **of who (Agent)** processed with which **Tools (Activity)** which **data (Entities, input and output)**

Schematic:



Example:



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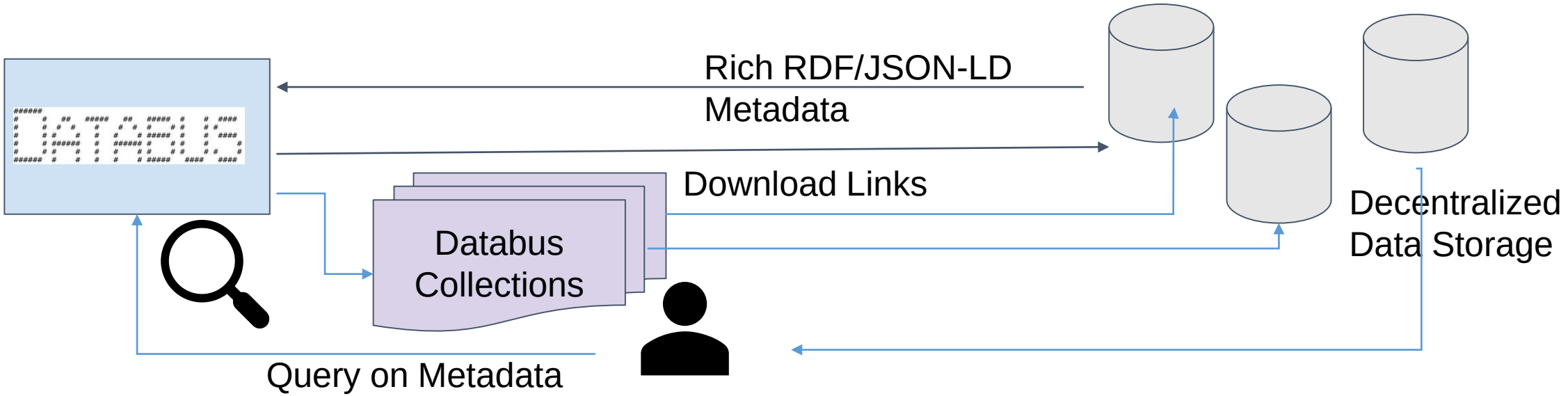
Findable & Accessible: The Open Energy Databus

Databus is a virtual bus. It can address files on the web and coordinate dataflows based on DataID metadata. No actual data is uploaded to the bus.



- Unique and persistent data identifiers (PID) are created by the Databus https://databus.openenergyplatform.org/account_name/group/artifact/version/
- Data sets are linked to their source data through the data ids
- Incremental modifications to data (e.g. people can reuse cleanings or aggregations someone else has done before)

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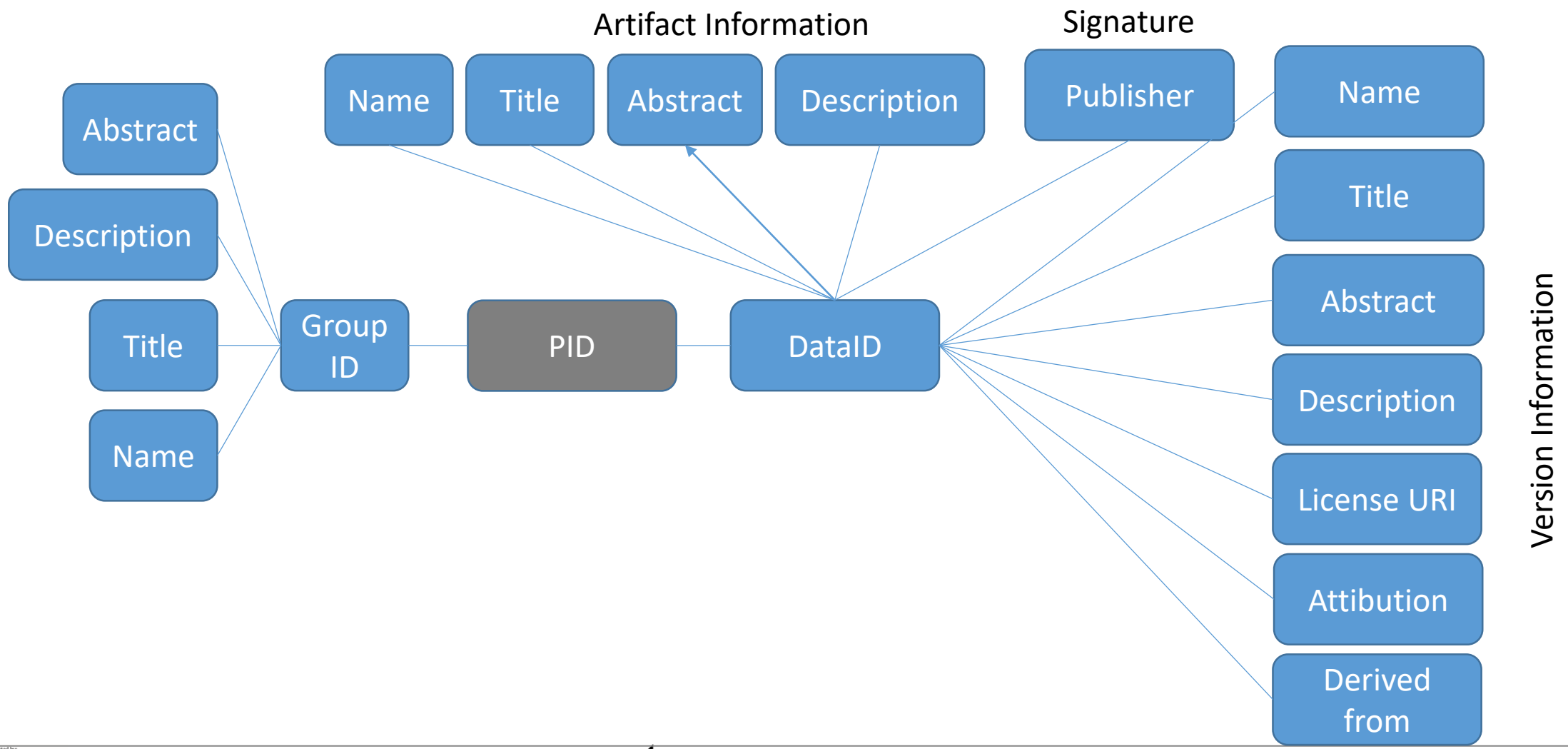
Databus Metadata



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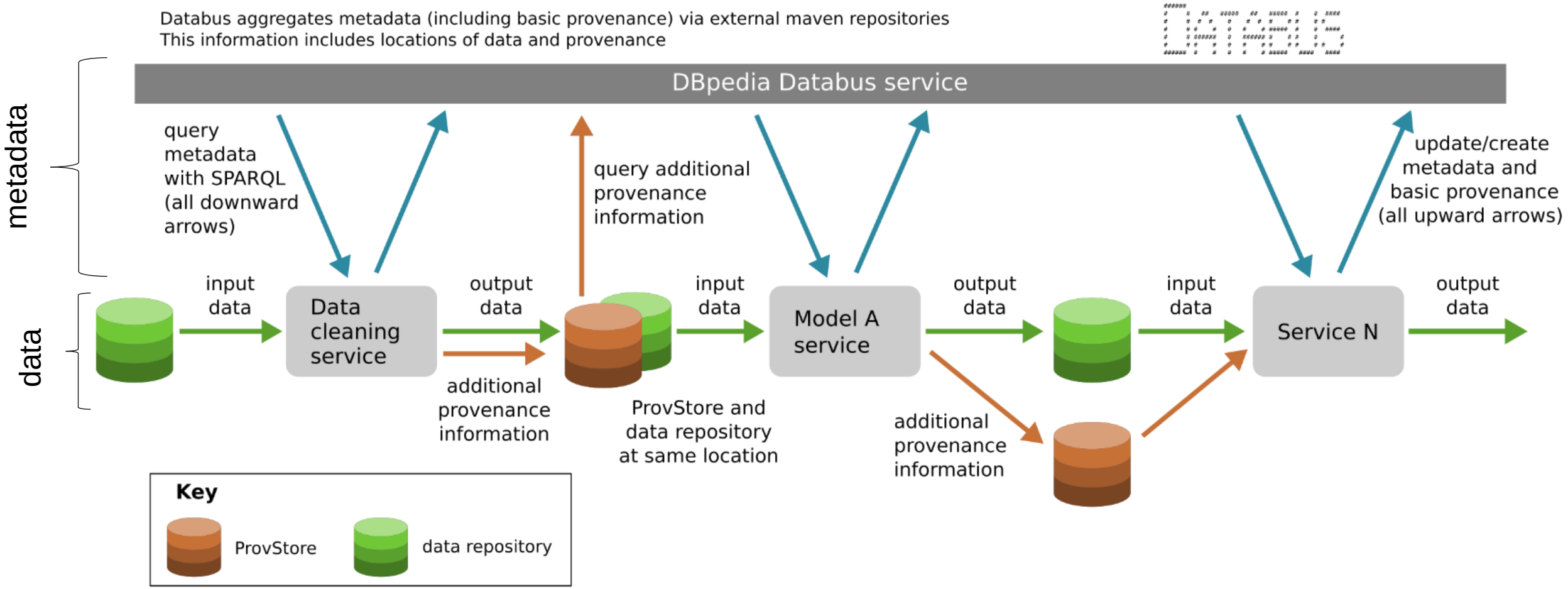
Findable & Accessible: Architecture Concept



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Databus as PID / Fair Digital Object (FDO) provider

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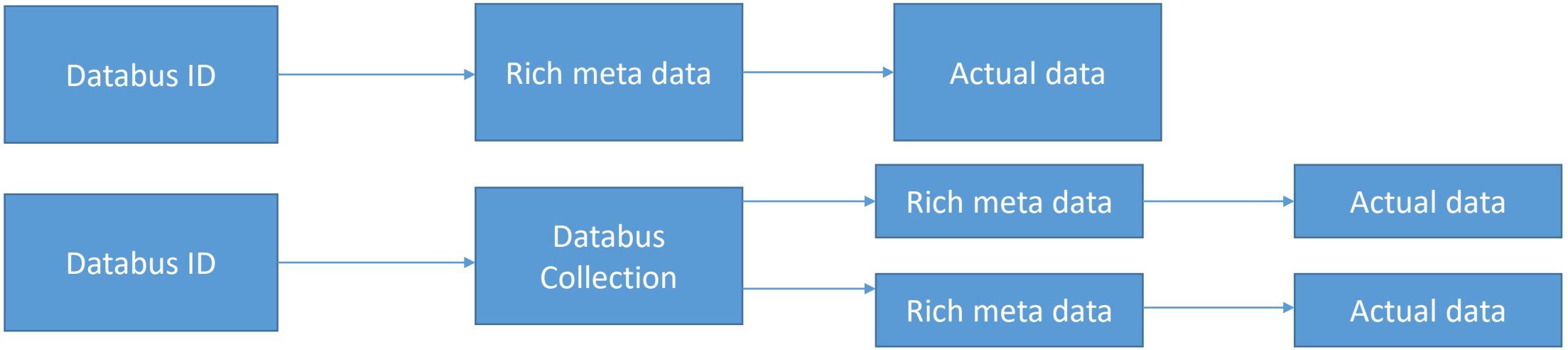
- Uploading meta data to the Databus creates a unique ID for the data set which can be used as a persistent data identifier (PID) to cite and share the data
- Databus URI (PID): https://databus.openenergyplatform.org/account_name/group/artifact/version/
  - Databus collections can be used to group data
  - The actual data is linked within the meta data
- Databus ID can be used to access all necessary information
- Databus ID is a pointer to a (FAIR) digital object
- **Persistent ID to make data citable**



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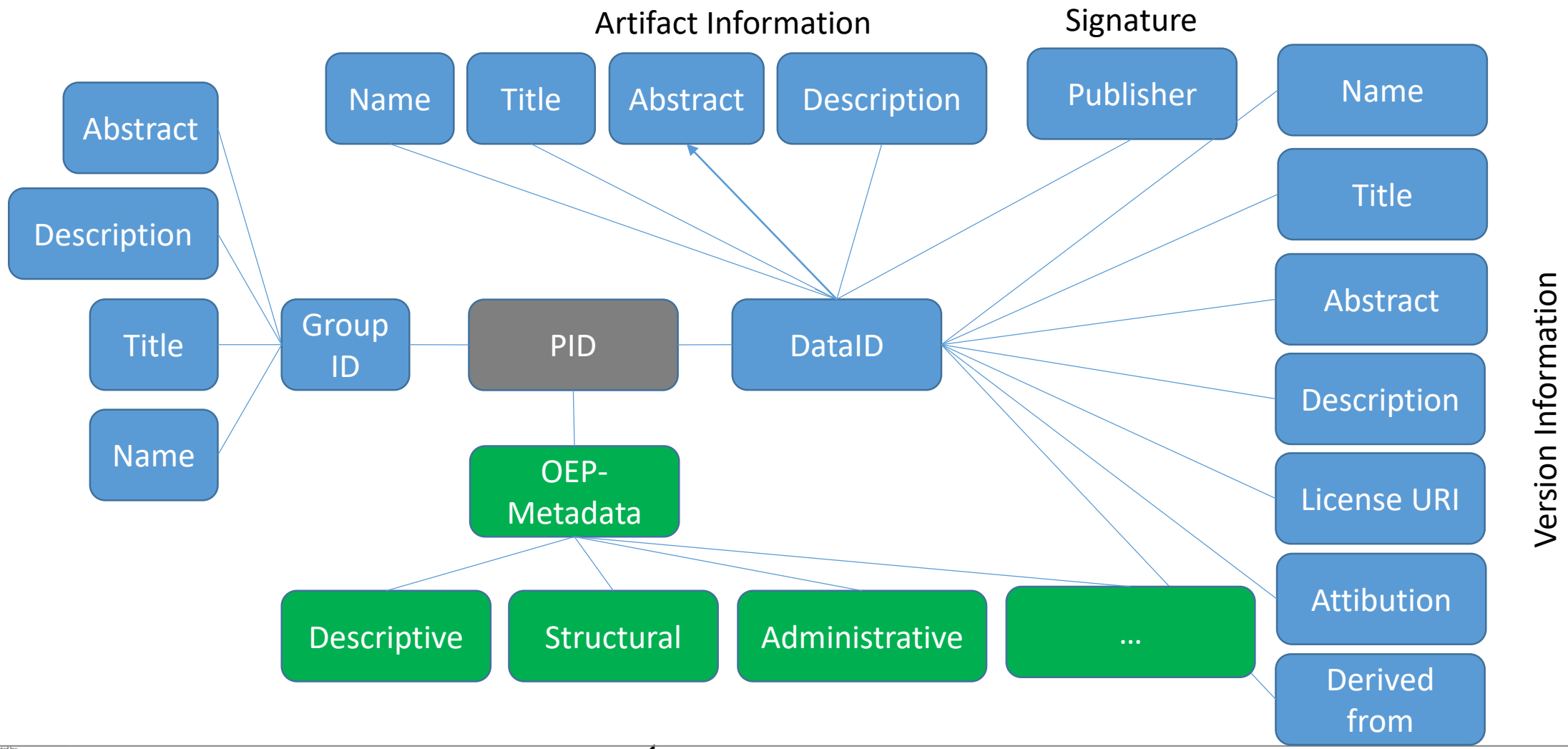
Enhancing the databus graph with OEMetadata



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Interoperable: The Open Energy Ontology

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- Each data source comes with its own annotation

- Example from solar meteorology:
  - **GHI:** Global Horizontal Irradiation (Energy) or Irradiance (Power)
  - **Global:** Could also be Global Horizontal Irradiation or Irradiance
  - **Surface downward irradiation:** The usual term in climate science for what we usually call GHI

- **Taxonomies** or **ontologies** create a **data language** to annotate data
- Ontologies can describe relations: *direct radiation* **is a part** of the *global irradiation reaching the surface*
- Ontologies make data interpretable, also by machines and algorithms

- **Good ontologies are created on a consensus building and open development process within the community.**
  - We use the 'Open Energy Ontology', https://openenergy-platform.org/ontology/, https://doi.org/10.1016/j.egyai.2021.100074

- Data sets can be annotated with the "**Subject"** tag, individual columns in the resource section with "**Is about"** within the JASON-LD metadata

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Demonstrator: Publication of a Data Set Using the databus

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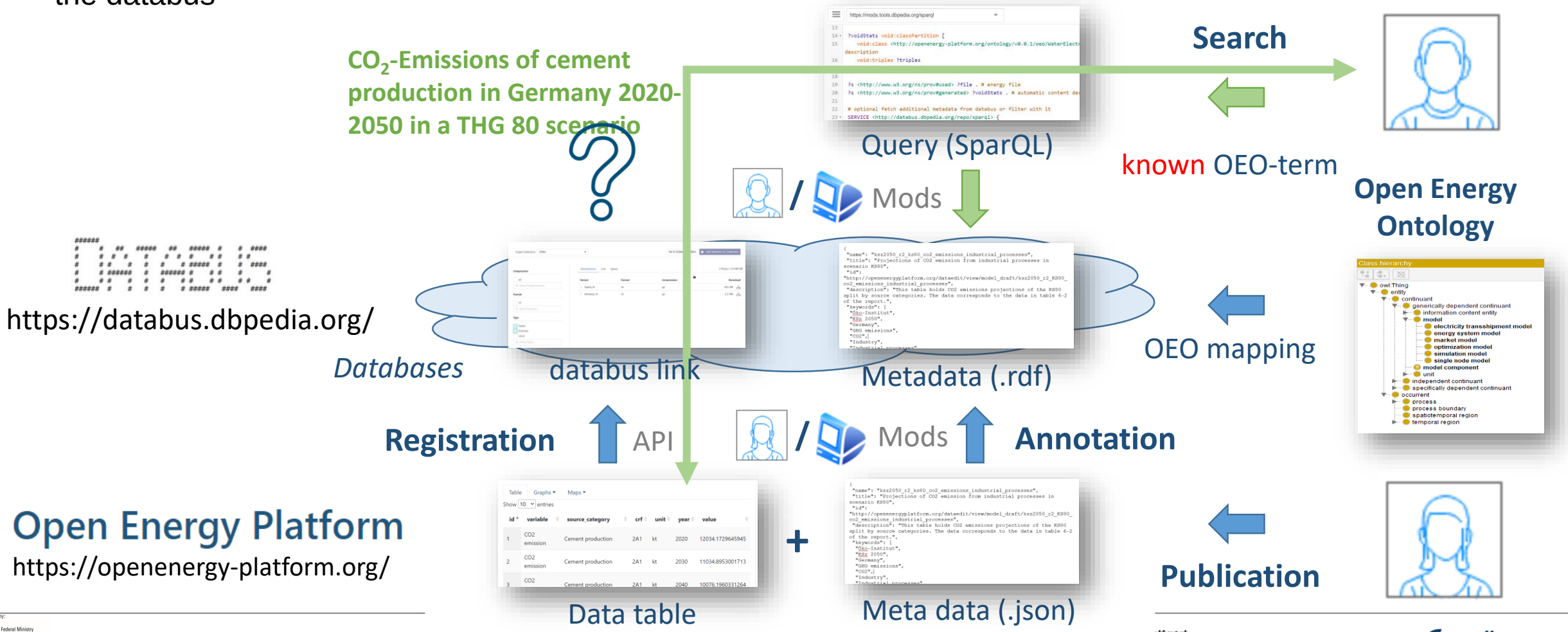
› **Goal**: Demonstration of the improved visibility and improved discovery of a data set through the registration in the databus



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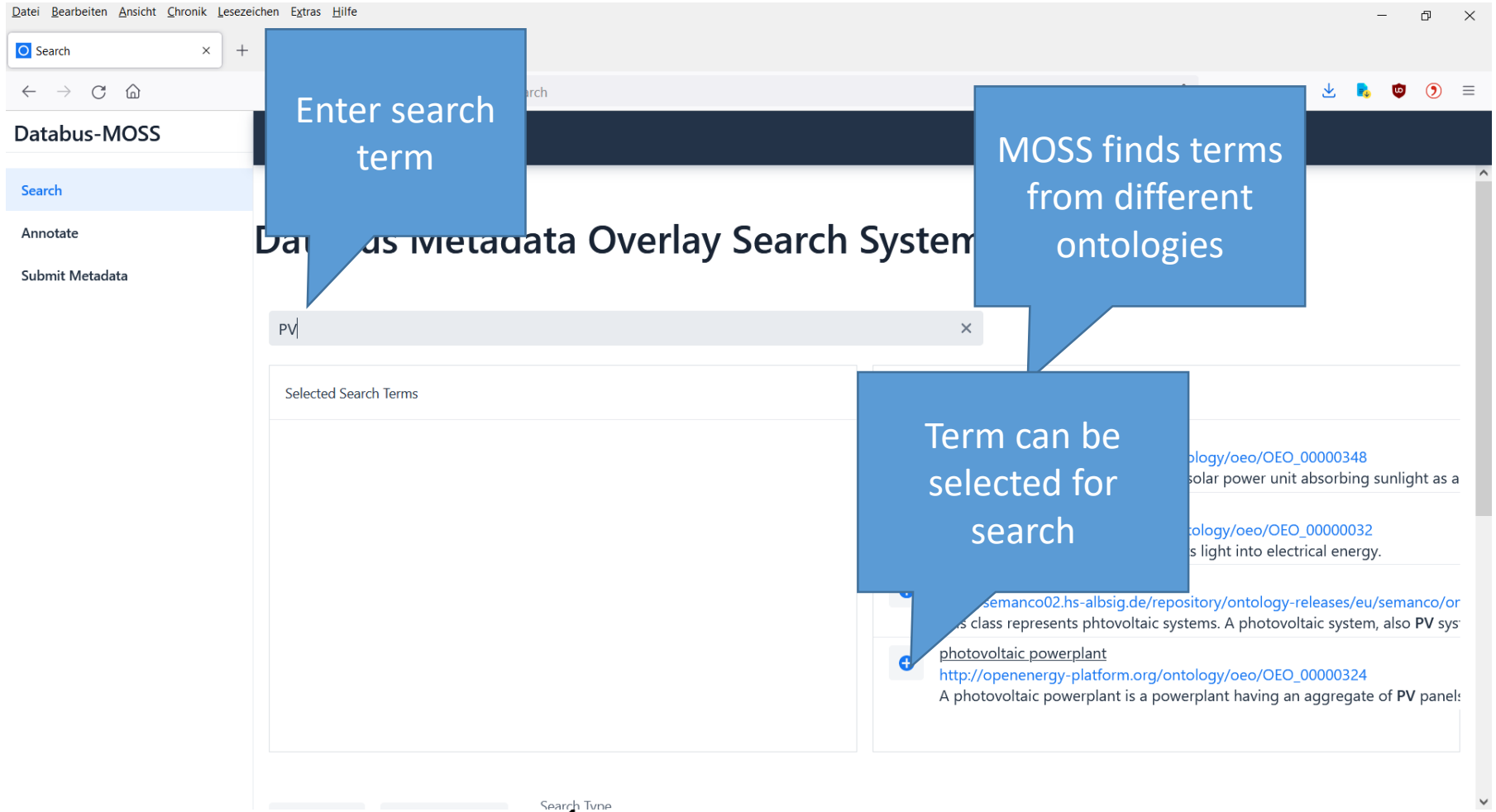
Searching data with the MOSS (Metadata Overlay Search System)



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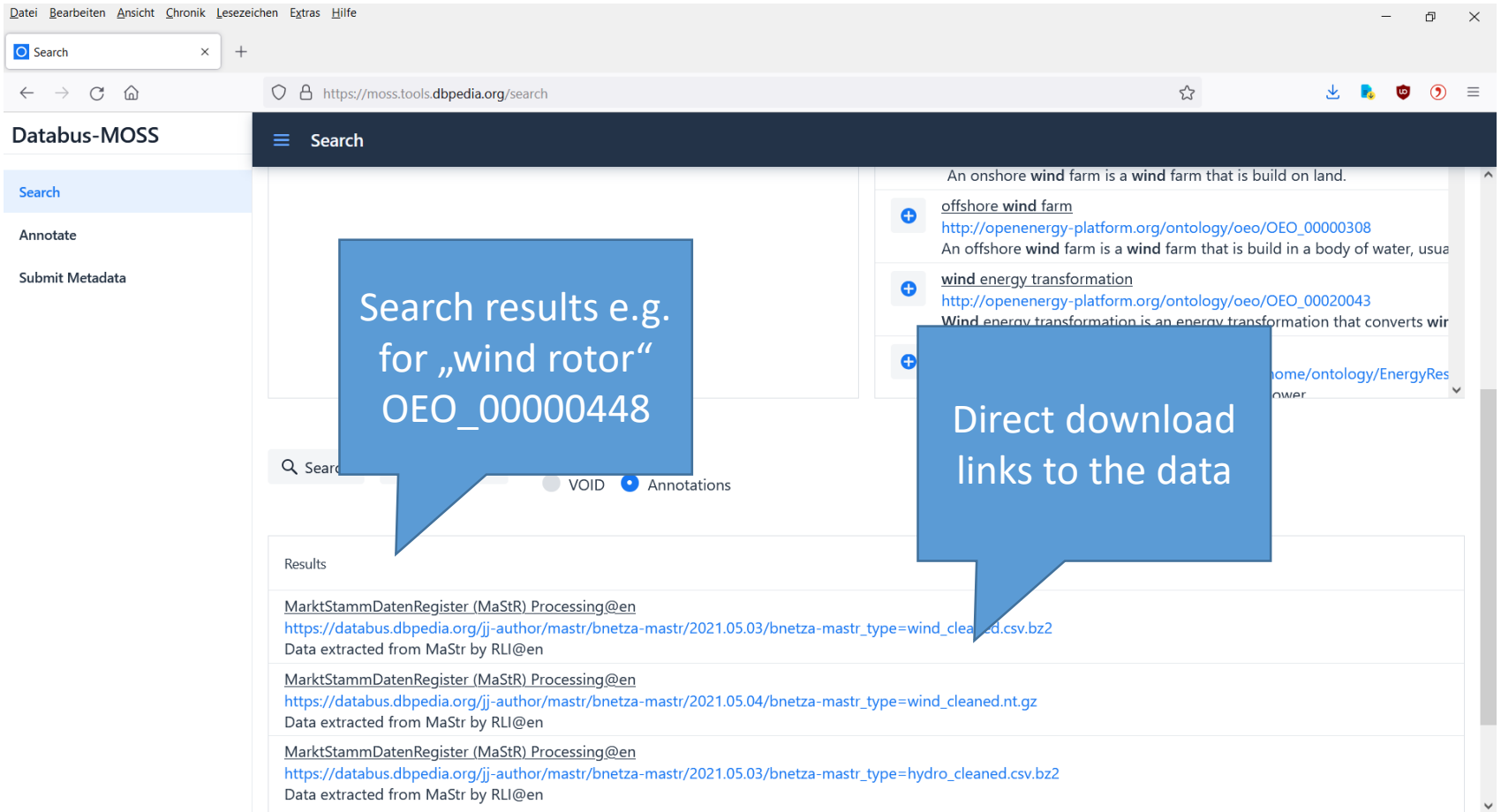
Searching with MOSS



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Conclusion

- The databus offers
  - a service to manage and search registered metadata
  - Persistent identifies for tracing data processing and citing data
  - Databus as pointers to digital objects
- **Reusable:** Data licenses are an obligatory part of the DataID and OEMetadata and are linked to dalicc.net to be machine actionable.
- The databus supports the implementation of FAIR principles in the Domain of Energy Systems Analysis
- The developed architecture in conjunction with the use of the Open Energy Ontology enables semantic searches for data in the domain of energy systems analysis
- **The developed architecture with distributed repositories, common metadata and schema descriptions, an ontology and a data catalog already forms some kind of open data cloud with the domain of energy systems analysis.**

- Further resources:
  - https://zenodo.org/communities/lod-geoss
    - Recommendations on Data Licensing
    - Demonstration and Best Practices
  - https://databus.openenergyplatform.org/
  - hhttps://github.com/OpenEnergyPlatform/oemetadata
  - https://openenergy-platform.org/ontology/
  - https://doi.org/10.1016/j.egyai.2021.100074
  - https://moss.tools.dbpedia.org/search
  - https://github.com/LOD-GEOSS/databus-snippets

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