

METADATA-ANNOTATED MODELLING WITH FAME

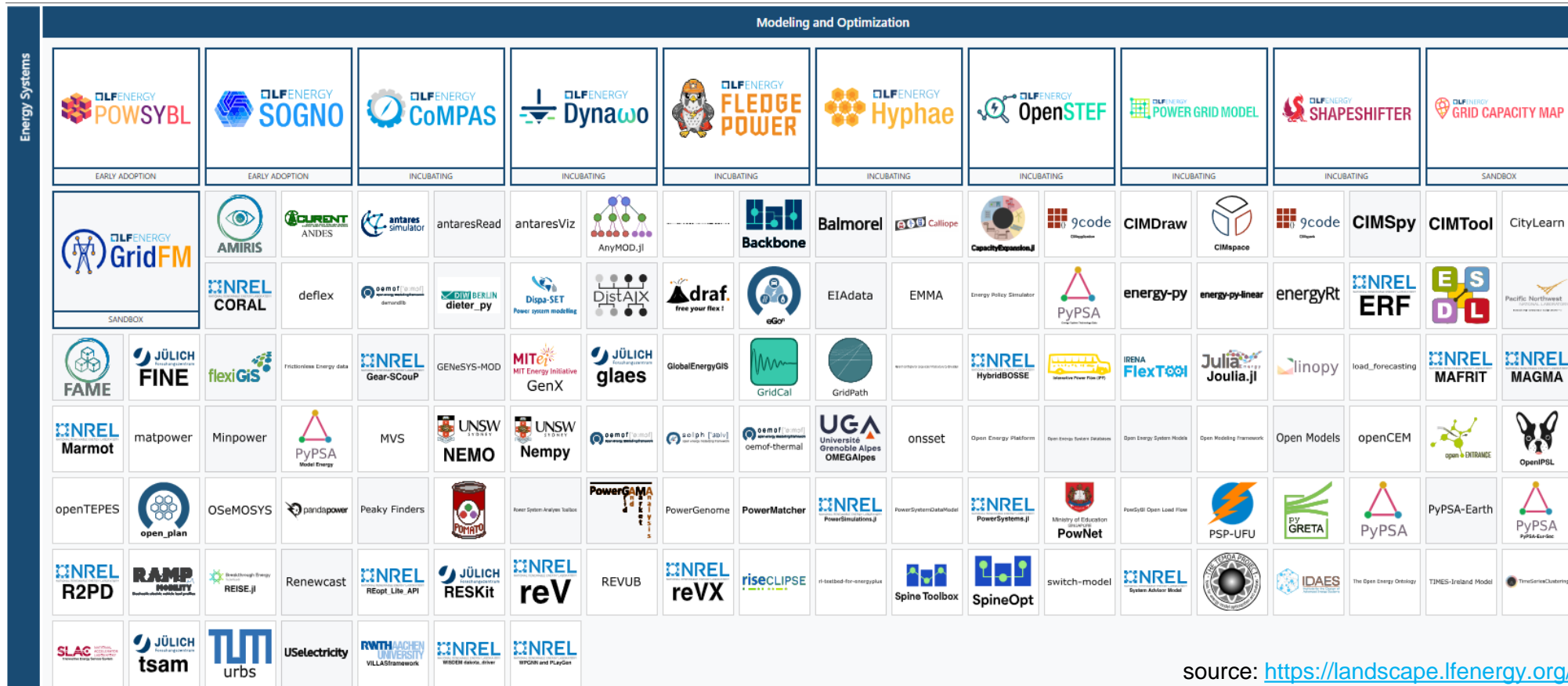
An Open Electricity Market Model Example

Christoph Schimeczek*, Ulrich Frey, Felix Nitsch



Why annotate Models with Metadata?

Landscape of Open Energy System Models



source: <https://landscape.lfenergy.org/>



Build Trust
→ Research Results

Reduce Duplication
→ Reuse Models

Extend Applications
→ e.g. Couplings

Why annotate Models with Metadata?

Deepen Model Understanding



What to Understand

- Scope, Assumptions, Restrictions
- Inputs
- Outputs

Sources of Information

- README
- User Documentation
 - Examples
 - Tutorials
- Support Measures
 - Q&A Forum
 - Emails / Calls

Standardized Metadata

- Components
- Input Interface
- Output Interface

- ➔ Even Further Help to Model Users
- ➔ Unlock *Automation* of Model Reuse & Coupling

Modelling Framework: FAME

What is FAME?

open Framework for distributed Agent-based Modelling of Energy systems



Create an agent-based model...



What is FAME?

open Framework for distributed Agent-based Modelling of Energy systems



Create an agent-based model...



What is FAME?

open Framework for distributed Agent-based Modelling of Energy systems

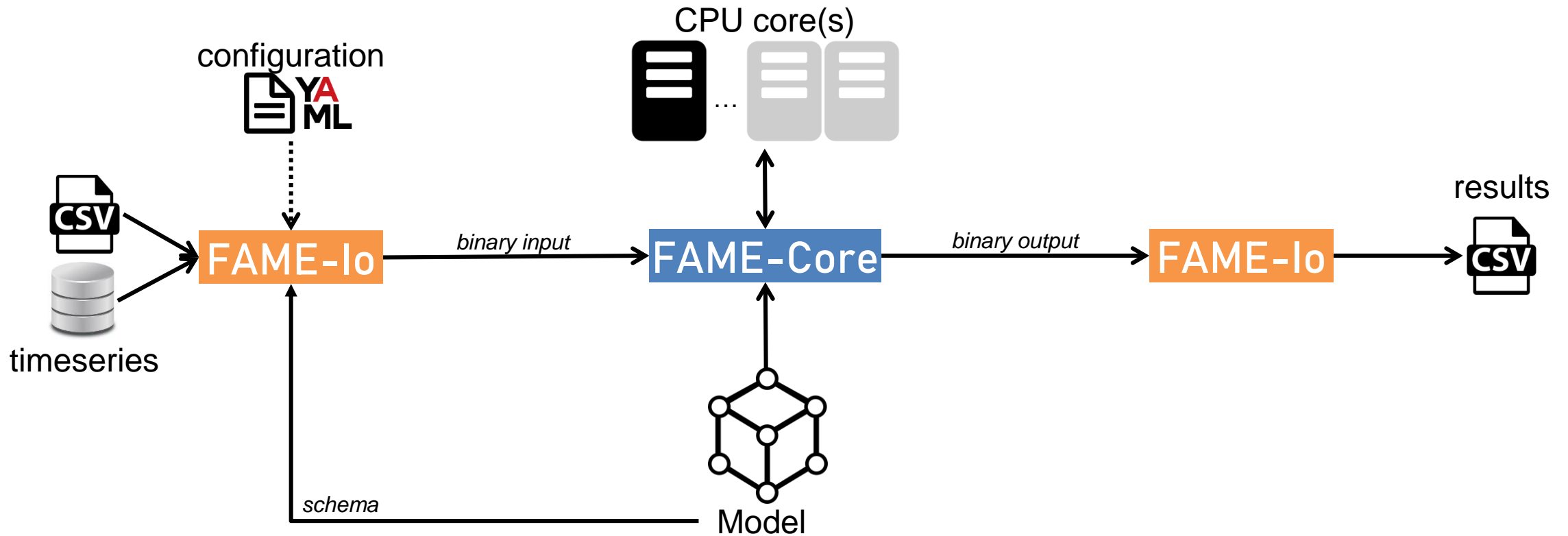


Reduce overhead!

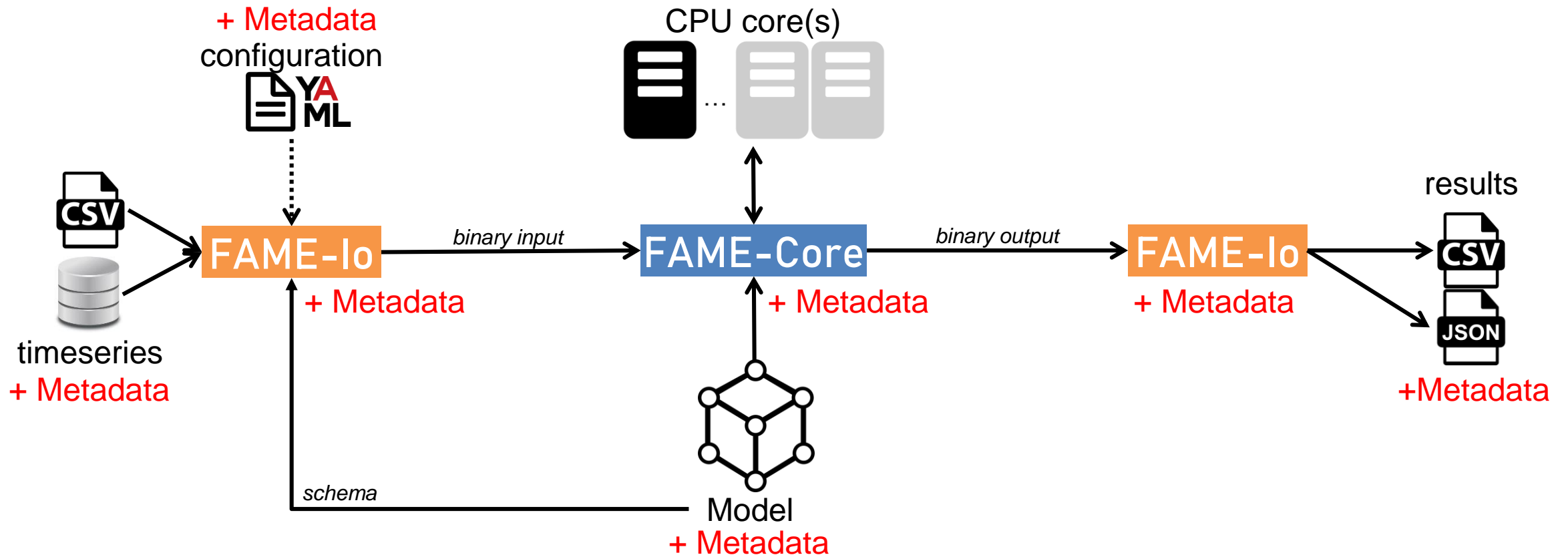
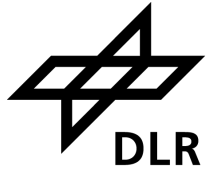


<https://gitlab.com/fame-framework>

How does FAME work?

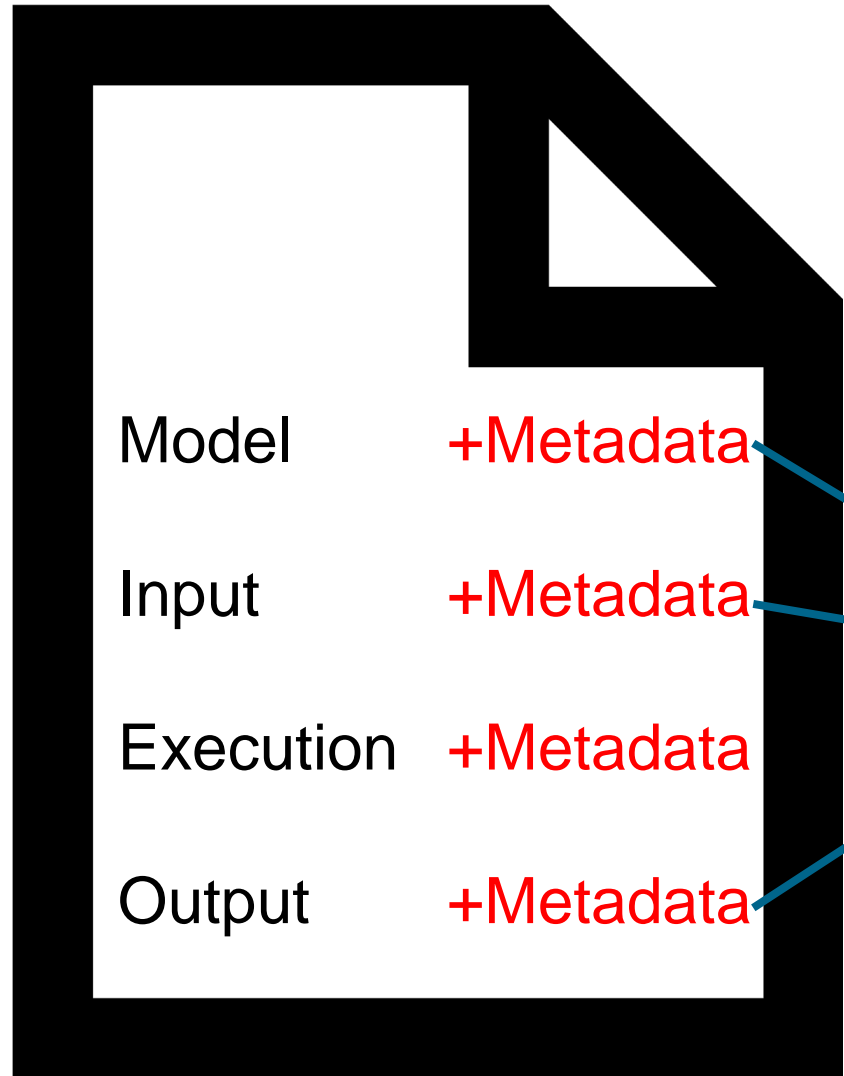


What about the Metadata?



(Meta)Data Storage

Binary Result File



Standardisation



source:

<https://openenergy-platform.org/ontology/>

Fully-fledged example



AMIRIS

<https://dlr-ve.gitlab.io/esy/amiris/home/>

Application Example: AMIRIS

Image source: DLR e.V.

What is AMIRIS?

*The open **A**gent-based **M**arket model for the **I**vestigation of **R**enewable and **I**ntegrated energy **S**ystems*



AMIRIS

- an **agent-based** power market model
- **business-oriented** dispatch decision
- focus: **renewable** energy sources and **flexibility** options
- available **open source** at <https://gitlab.com/dlr-ve/esy/amiris>



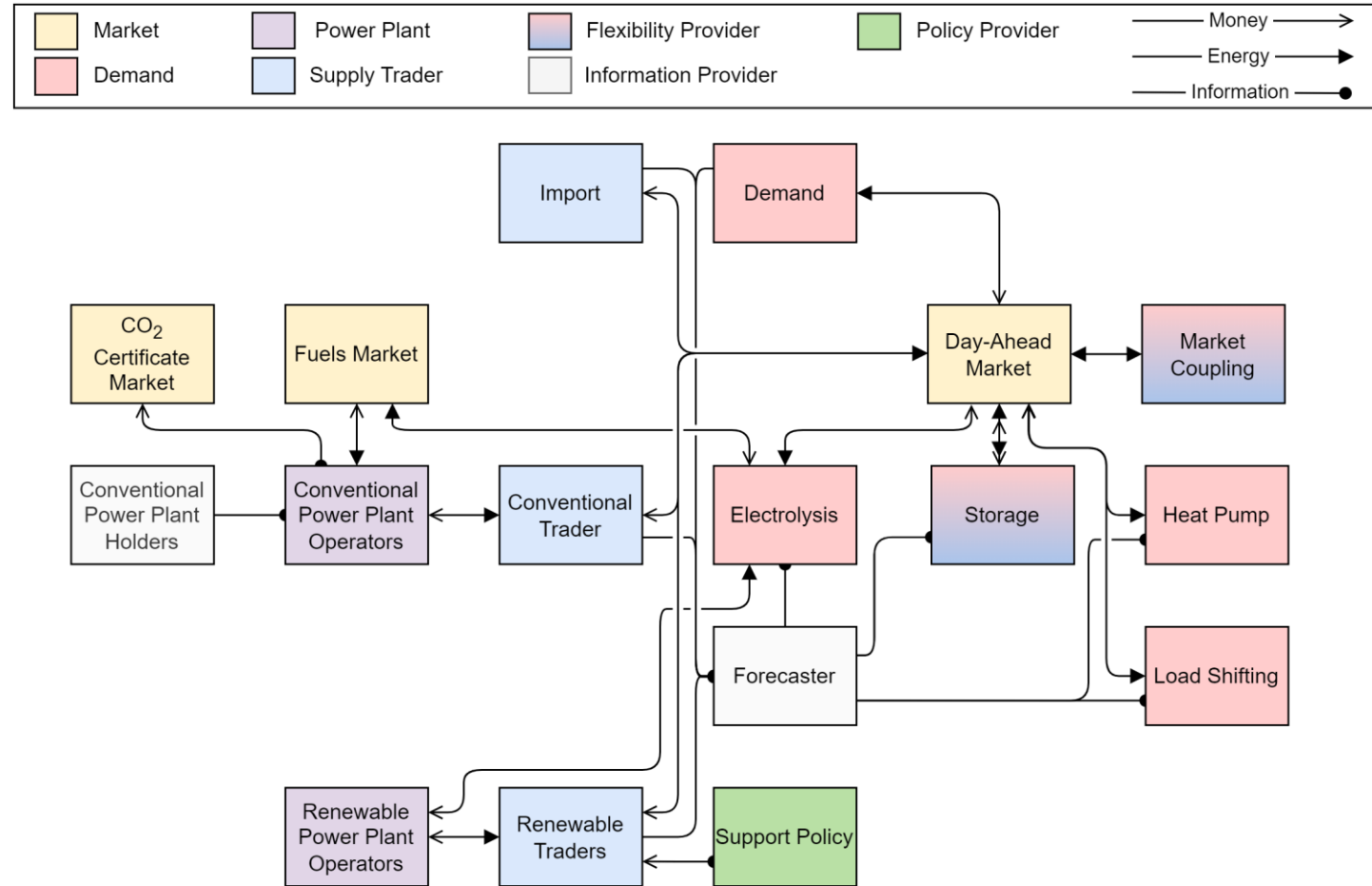
Model Complexity

- ~25 Agent Types
- ~75 Logic Modules
- ~20 Message Types

Simulation Complexity

- ~50 Agents, 375 connections
- ~400 scalar inputs, 15 time series
- ~30 output types

➔ Provide Metadata for all Elements



© German Aerospace Center (DLR) 

Metadata

Model Annotation



schema.yaml

- Agent Types
 - Inputs
 - Outputs
- } Independent of Simulation Data

CarbonMarket:

MetaData:

Description: "The CarbonMarket sells CO2 emission allowances, determines their prices and accounts for total quantity of sold CO2 allowances."

OEONearestConcept: OE0 00020075

Attributes:

Co2Prices:

MetaData:

Description: "The CO2 price. It is an exogenously defined price time series."

OEONearestConcept: OE0 00010269

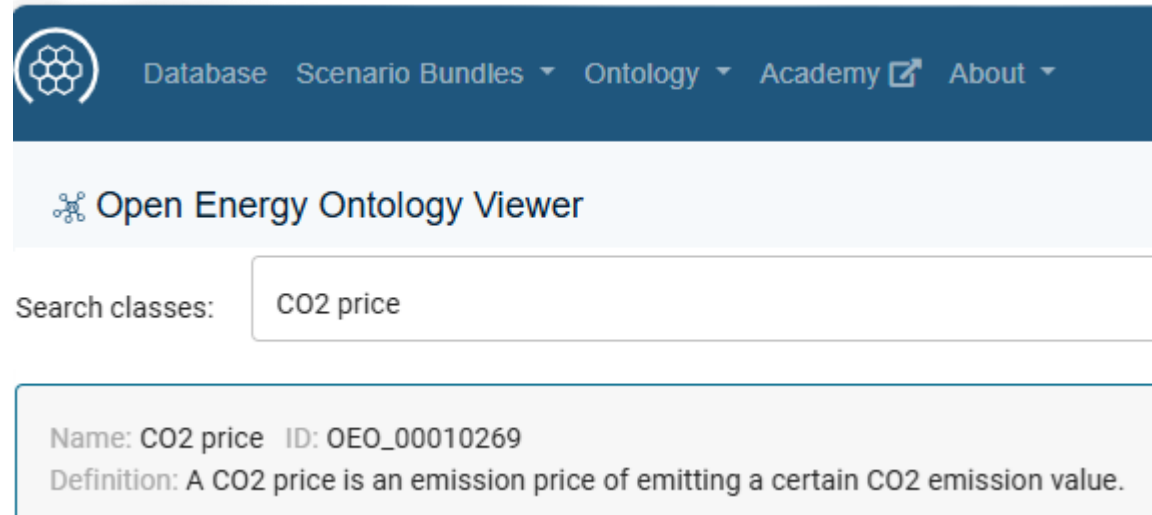
Outputs:

Co2EmissionsInTons:

MetaData:

Description: "Registered CO2 emissions in tons"

OEONearestConcept: OE0 00260007



Attributes:

Co2Prices:

MetaData:

Description: "The CO2 price. It is an exogenously defined price time series."

OEOnearestConcept: OEO 00010269

source: <https://openenergy-platform.org/ontology/>

➔ Standardisation & Automated Linking of Data & Models

Metadata

Simulation Data Annotation



configuration.yaml

- Definitions
- Scalars & Timeseries

```
FuelType:  
  Values:  
    OIL:  
      MetaData:  
        Description: "Fuel type oil"  
        OEONearestConcept: OE0 00010316
```

```
- Type: FuelsMarket
```

```
  Id: 4
```

```
  Attributes:
```

```
    FuelPrices:
```

```
      - FuelType: NUCLEAR
```

```
        Price:
```

```
          Value: 2.00
```

```
          MetaData:
```

```
            Description: "Own estimate, price in EUR per MWh"
```

→ Specify, e.g., Provenance

Conclusion & Outlook

Achieved

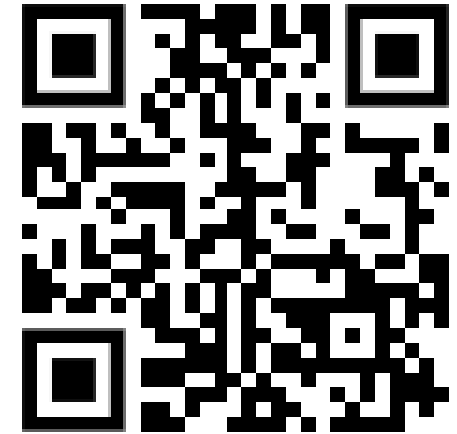
- Metadata support for every element:
 - models, inputs, outputs
- All (meta)data conserved in binary file
- Fully fledged example: AMIRIS

Ongoing work

- Add missing metadata, e.g.
 - input data provenance
 - units
- Define output metadata JSON structure
- Generalise concept linking
 - other concept sources
 - match qualifiers

Outlook

- Automate coupling of models & data



Topic: Metadata-Annotated Modelling with FAME: An Open Electricity Market Model Example

Date: 2025-02-25

Author: Christoph Schimeczek, Ulrich Frey, Felix Nitsch

Institute: German Aerospace Center (DLR)
Institute of Networked Energy Systems

Image sources: All images “DLR (CC BY-NC-ND 3.0)” unless otherwise stated