

Real-Time Emissions Calculation Using the Notifications Protocol in Solid Towards dynamic LCA



Presenters



LUKA



LUKAS

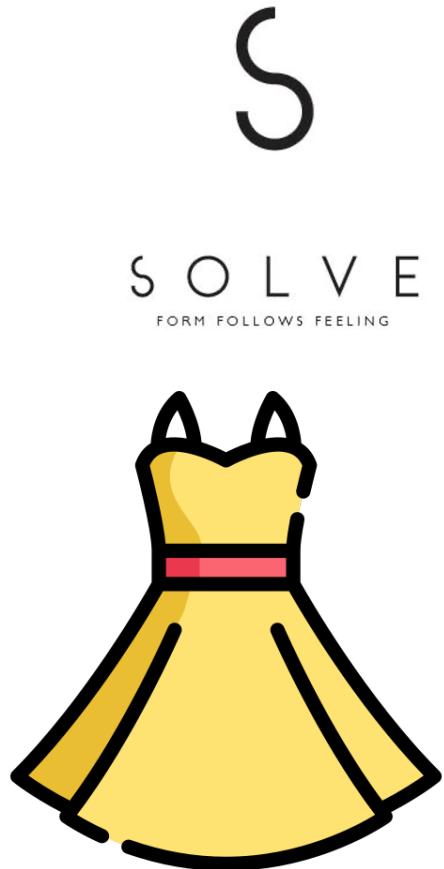


JAN

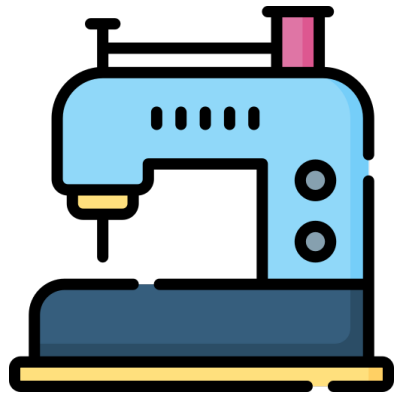
**Master of Computer Science,
University of St. Gallen,
Switzerland**



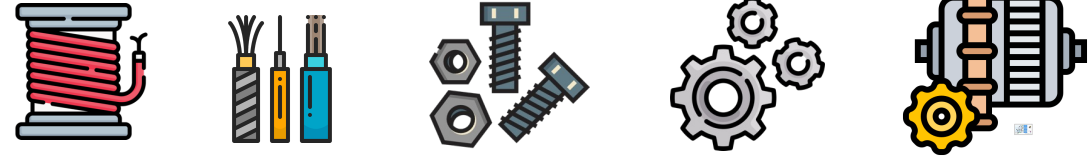
Solve - Life Cycle Assessment



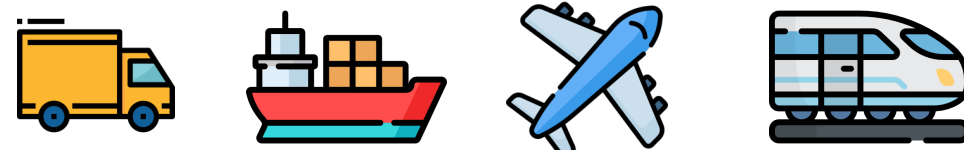
Bernina - Life Cycle Assessment



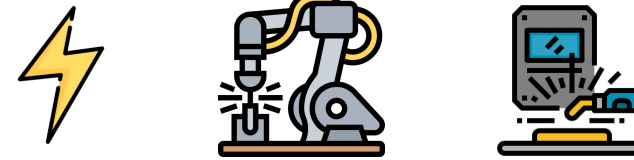
Raw Material



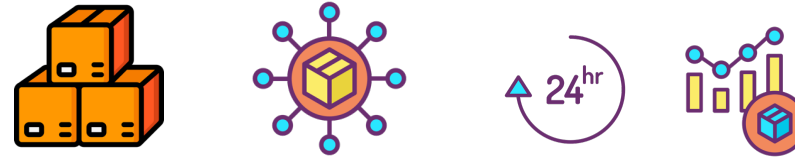
Transport



Production



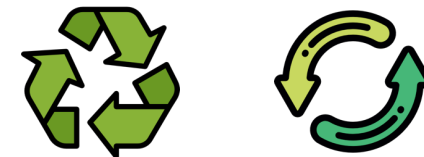
Packaging/Distribution



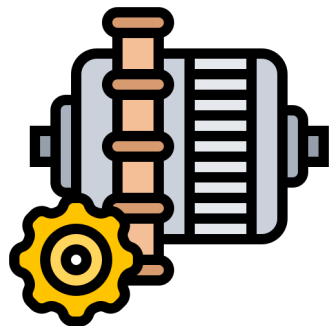
Use



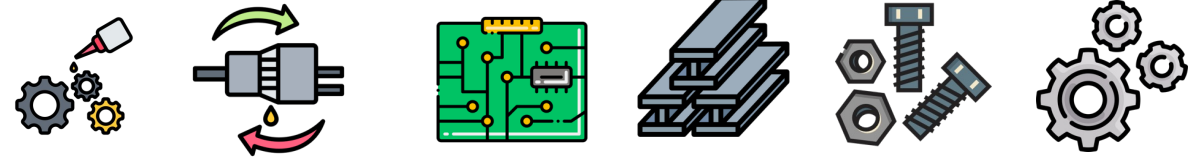
Recycle



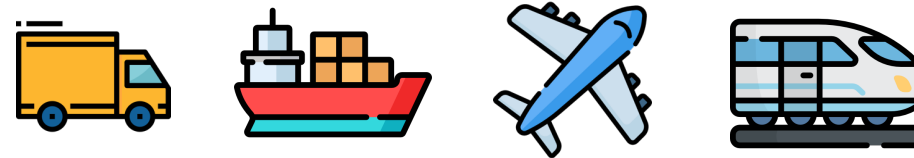
Li Yuan - Life Cycle Assessment



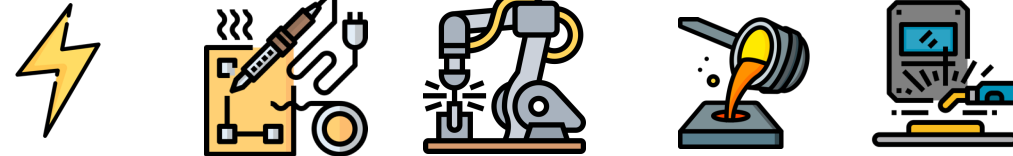
Raw Material



Transport



Production



Packaging/Distribution



Use



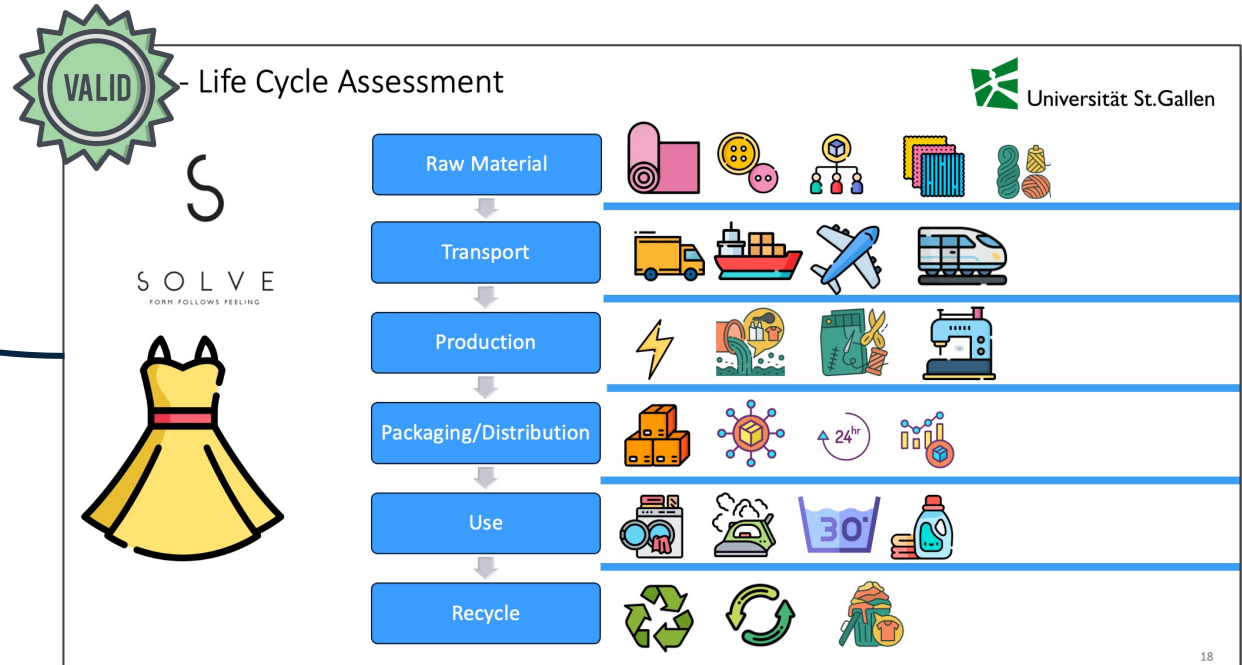
Recycle



Static LCA is outdated very fast

Only **valid** under following criteria

- Exact product decomposition
 - No changes in the supply chain
 - Only for a certain point in time
- > Not feasible in today's world, especially with Multiple stakeholders involved



Solution: **dynamic LCA**

- Recalculate emissions as soon as one node/pod in the supply chain changes

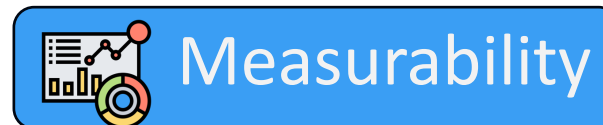
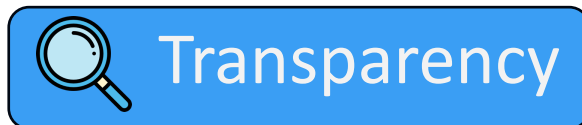


Enablement of GHG-Bond trading

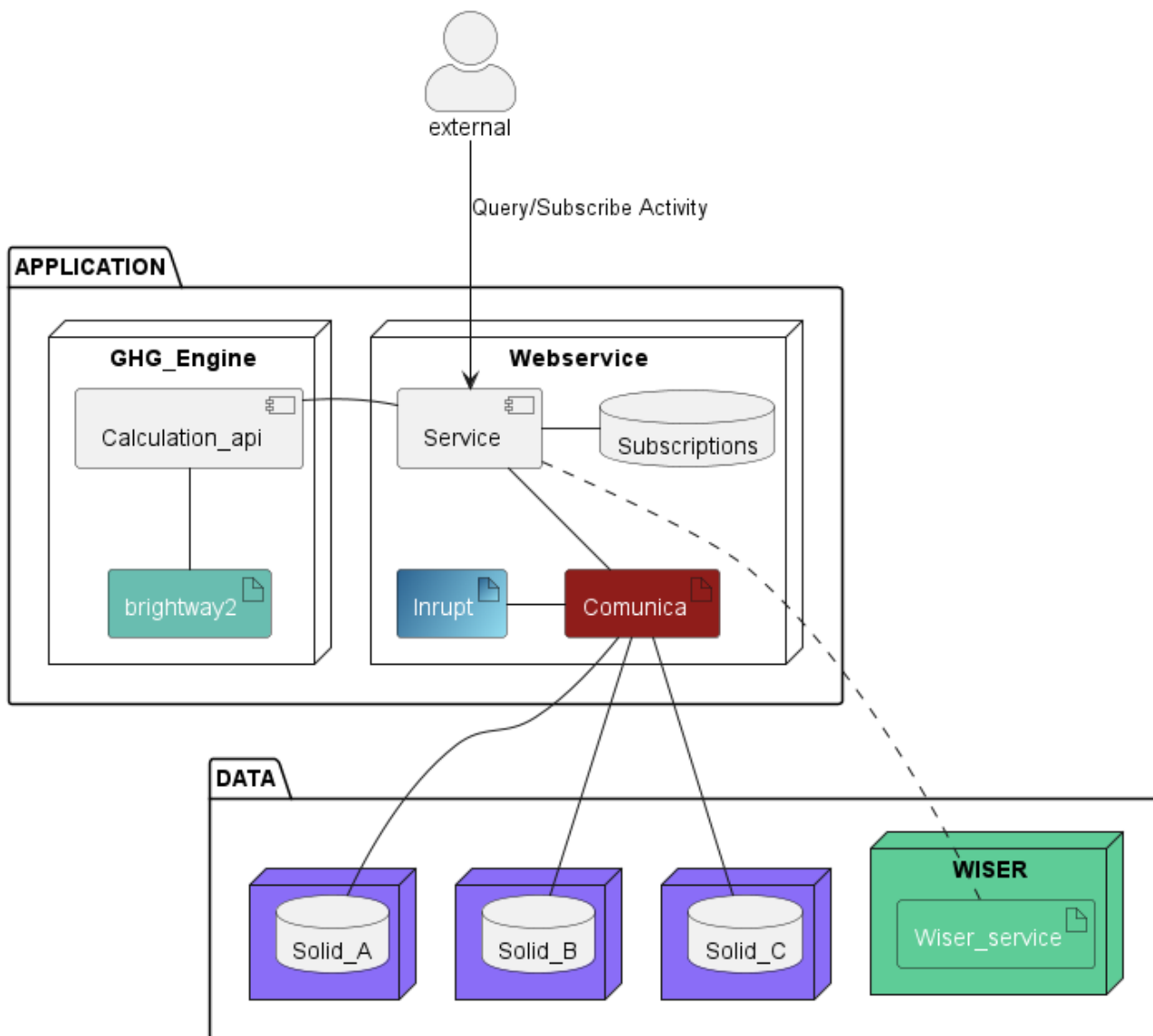
Real time emission changes could be mapped to bonds and ESG-Fonds for dynamic pricing



Timeline



Architecture Overview



Application

- Calculation api built with Flask
- Webservice built with Express

Solid

- Pods on their own Solid providers

Comunica

- As federated Sparql Query Engine

Inrupt

- As Comunica auth session provider

WISER

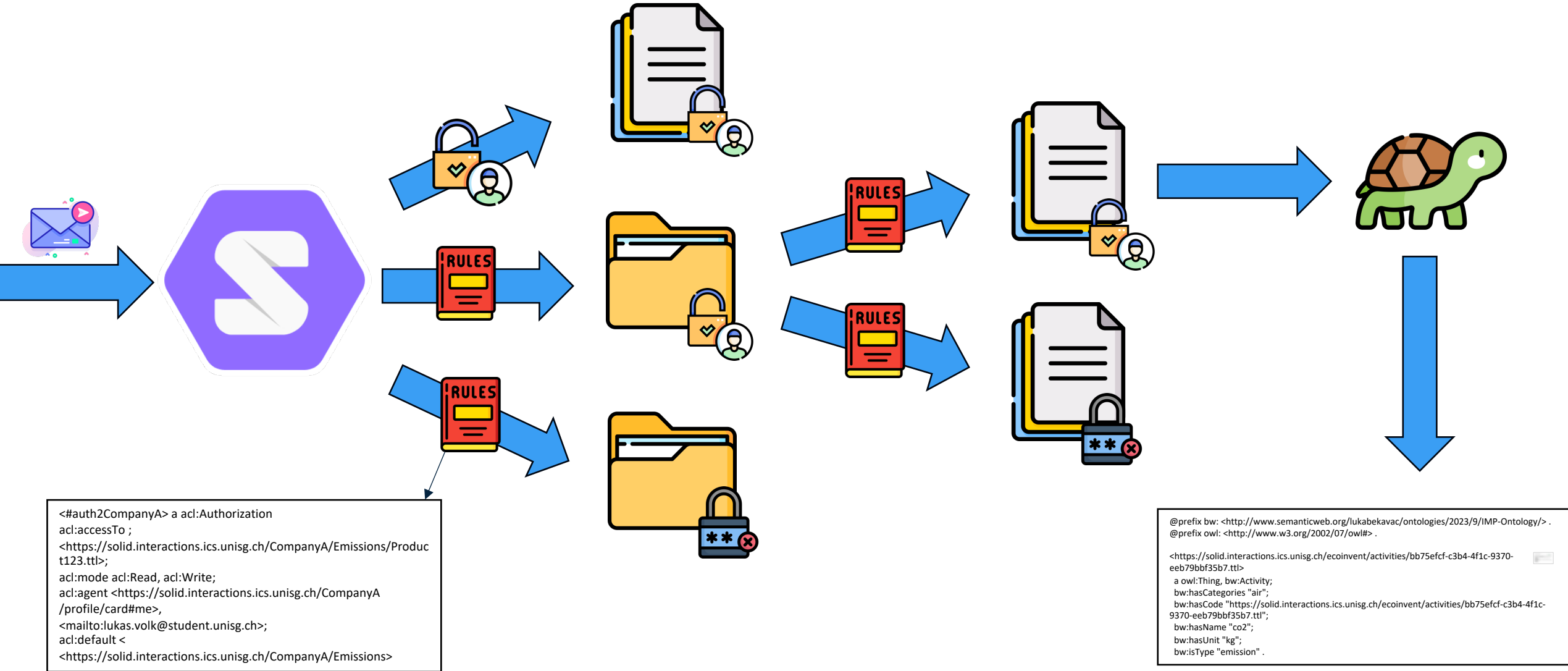
- For fallback GHG estimates

Brightway2

- As GHG calculation engine

Solid Pods

Authentication & Authorization



Data on the Solid Pods



```
@prefix bw: <http://www.semanticweb.org/lukabekavac/ontologies/2023/9/IMP-Ontology/> .
```

```
@prefix owl: <http://www.w3.org/2002/07/owl#> .
```

```
<https://solid.interactions.ics.unisg.ch/ecoinvent/activities/bb75efcf-c3b4-4f1c-9370-  
eeb79bbf35b7.ttl>
```

```
  a owl:Thing, bw:Activity;
```

```
  bw:hasCategories "air";
```

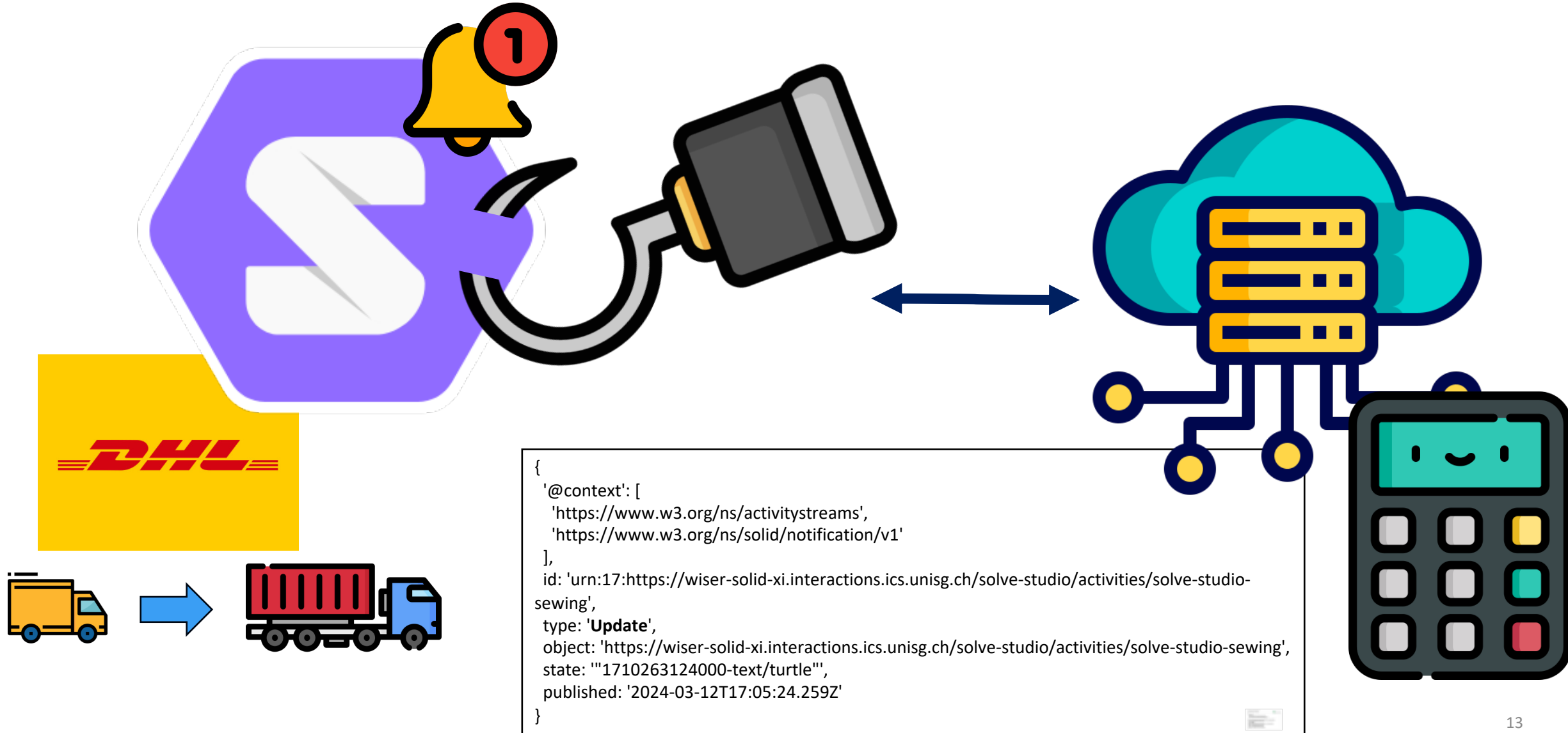
```
  bw:hasCode "https://solid.interactions.ics.unisg.ch/ecoinvent/activities/bb75efcf-c3b4-4f1c-  
9370-eeb79bbf35b7.ttl";
```

```
  bw:hasName "co2";
```

```
  bw:hasUnit "kg";
```

```
  bw:isType "emission" .
```

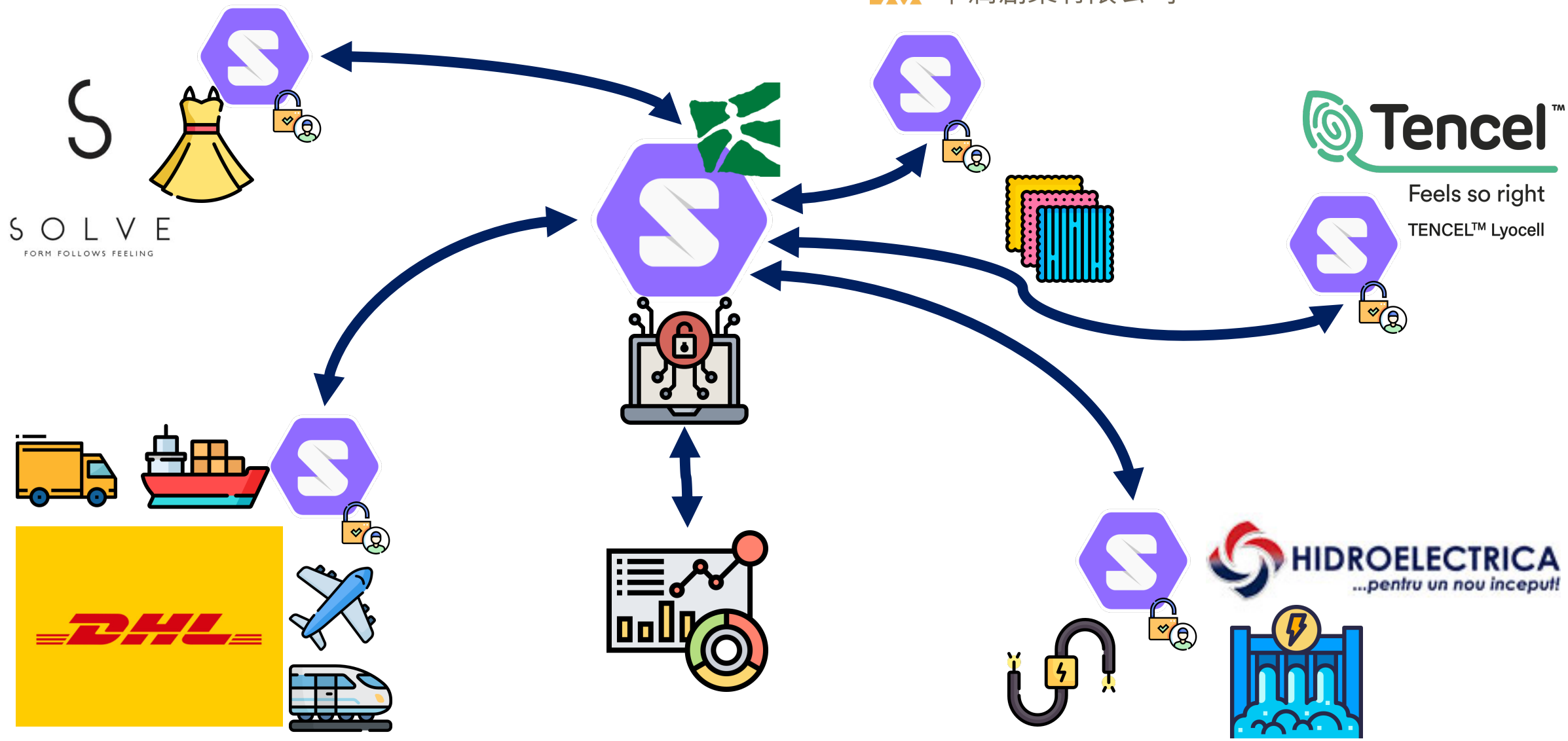
Solid Notification Protocol



Solid Notification Message

```
{
  '@context': [
    'https://www.w3.org/ns/activitystreams',
    'https://www.w3.org/ns/solid/notification/v1'
  ],
  id: 'urn:17:https://wiser-solid-xi.interactions.ics.unisg.ch/solve-
studio/activities/solve-studio-sewing',
  type: 'Update',
  object: 'https://wiser-solid-xi.interactions.ics.unisg.ch/solve-
studio/activities/solve-studio-sewing',
  state: '"1710263124000-text/turtle"',
  published: '2024-03-12T17:05:24.259Z'
}
```

Pods landscape



Learnings Developer experience – Solid Community Server



- **First implementation took less than a day for webhook channel**
- **Webhook trigger management needs better handling**



- **No structural data changes needed from local GraphDB to federated Solid pods**
- **Strong base architecture regarding scalability and security**

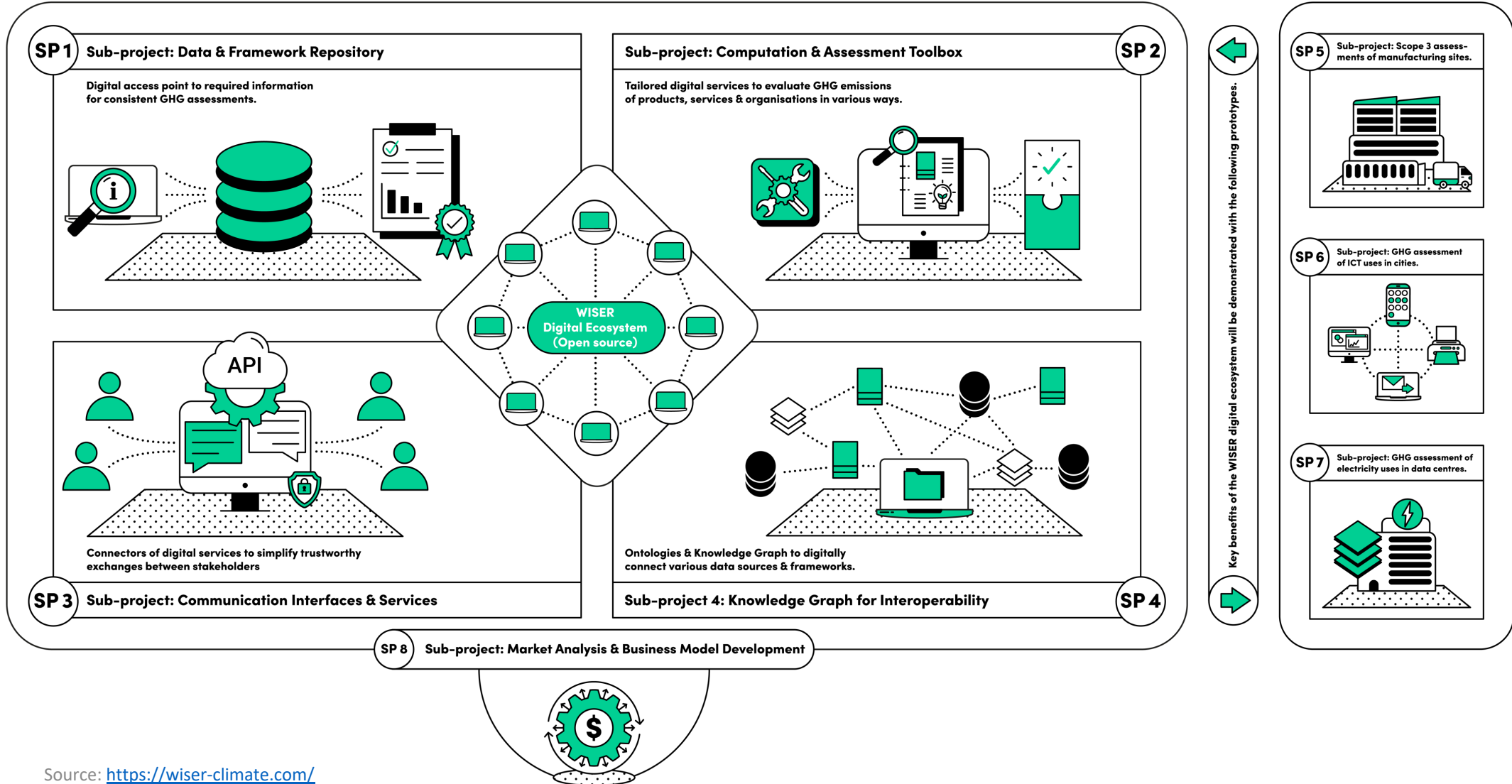


- **Powerful Query Engine**
- **Performance can struggle on large federated queries**
- **Not the most convenient API**
- **Internal caching caused problems with dynamic updates**



- **Easy compatibility with Comunica**
- **Strong authentication and notifications API**

Wiser Flagship





Real-Time Emissions Calculation Using the Notifications Protocol in Solid Questions?