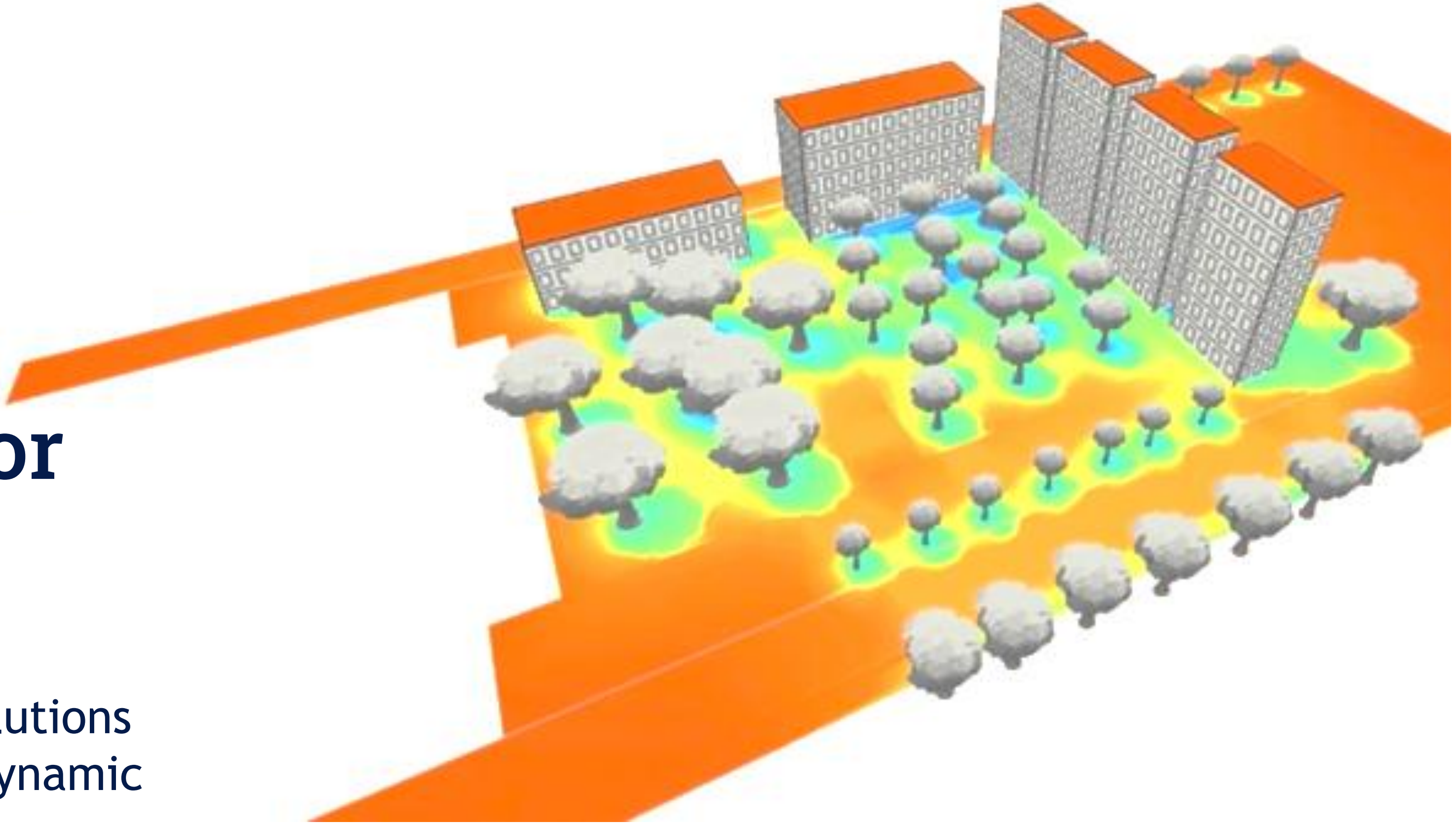


Digital twins for outdoor thermal comfort simulations

Quantifying the Impact of Nature Based Solutions (NbS) on Outdoor Thermal Comfort using Dynamic Simulation Tools

Dr. Koldo Urrutia Azcona koldo.Azcona@iesve.com
Dr. Niall Buckley niall.buckley@iesve.com

24/09/2024

About IES

Home to the largest building physics analytics team in the world

27
Years of building analysis

Apache
World renowned simulation engine

75,000+
Projects per year

>1,000,000
Buildings

37
Power stations prevented

IES

The Best of Physics, Data and AI/ML

Physics Enabled Simulation

- Based on fundamental physics principles
- Simulates the physics of energy & heat flow

Real & Virtual Sensor Data

- IoT & BMS Data from the Real Building
- Virtual Sensor Data from the Simulation

AI & Machine Learning

- Enables data driven prediction
- Fills data gaps & checks for anomalies

Digital Twin

Leverages the best of both Building Simulation, Sensor Data, AI & Machine Learning

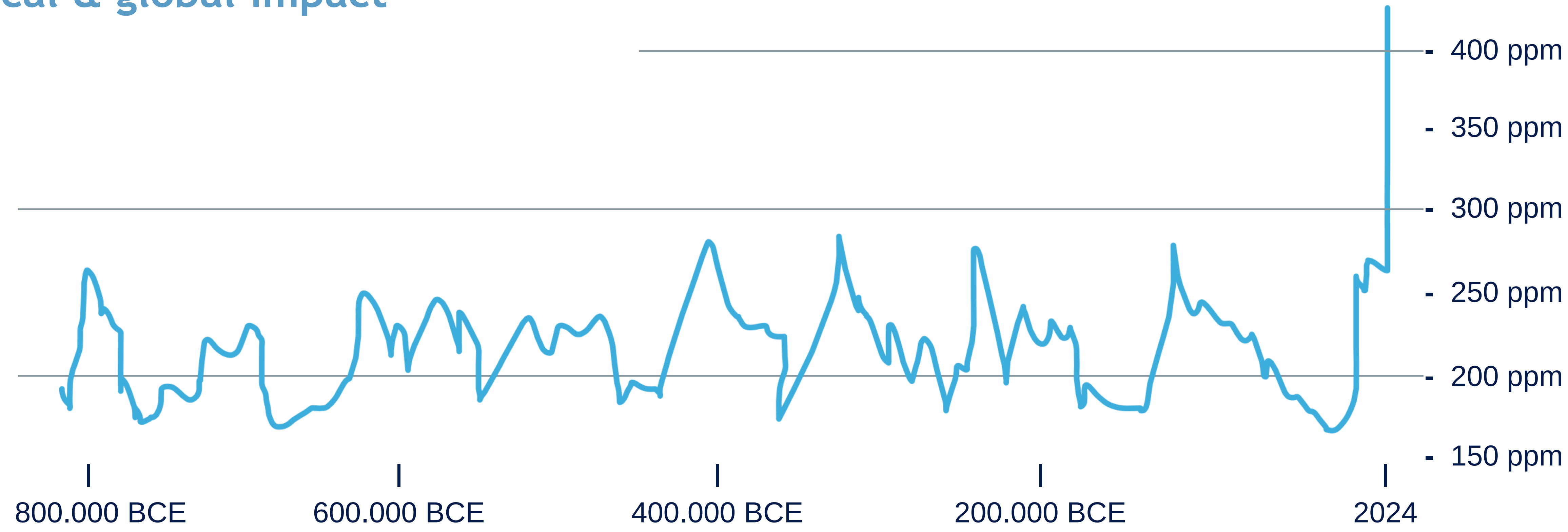
IES

Global problem / local impact

Climate change, cities and heat exposure

Human progress attached to GHG emissions

Local & global impact



Source
US National Oceanic & Atmospheric Administration (2024)

Cities, in the spotlight

Problem & partial solution to the crisis

2% 56% 70% 70% 70%

Source
UN Habitat III (2016), *The New Urban Agenda*

Cities currently gathering 4.2 billion people

Cities expected to host 6.7 billion people by 2050

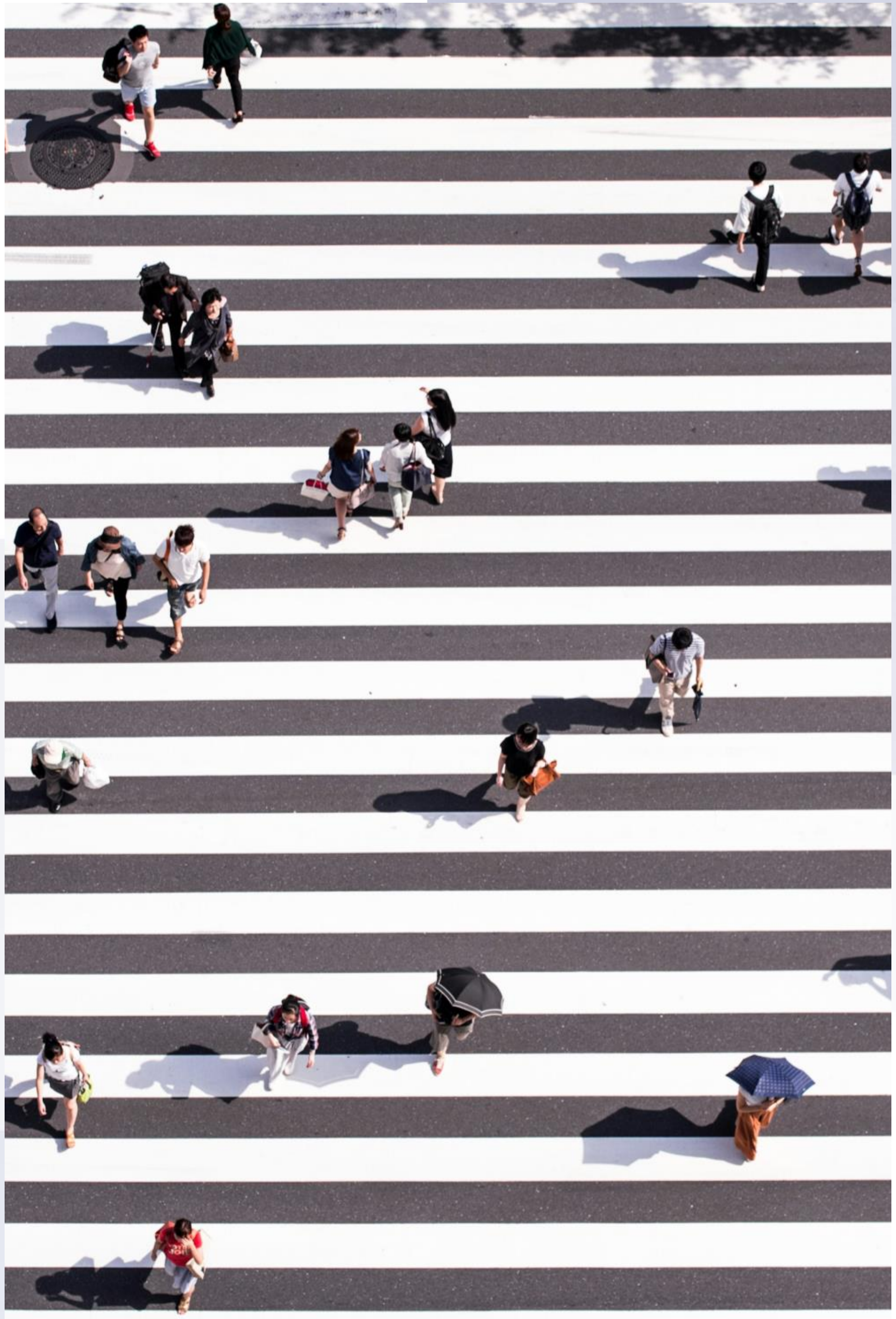
Unforeseen climate change consequences

New patterns altering life conditions in cities

- i.e.: due to global GHG effect + urban heat island effects

  >>mortality rates in New York expected to increase by 47% to 95% (2007/2050)

Source
Knowlton et al, *Projecting Heat-Related Mortality Impacts Under a Changing Climate in New York City*



Improving outdoor thermal comfort

Best way of addressing heat exposure in cities

How addressing outdoor thermal comfort?

Shadowing and albedo's surfaces

Sun exposure

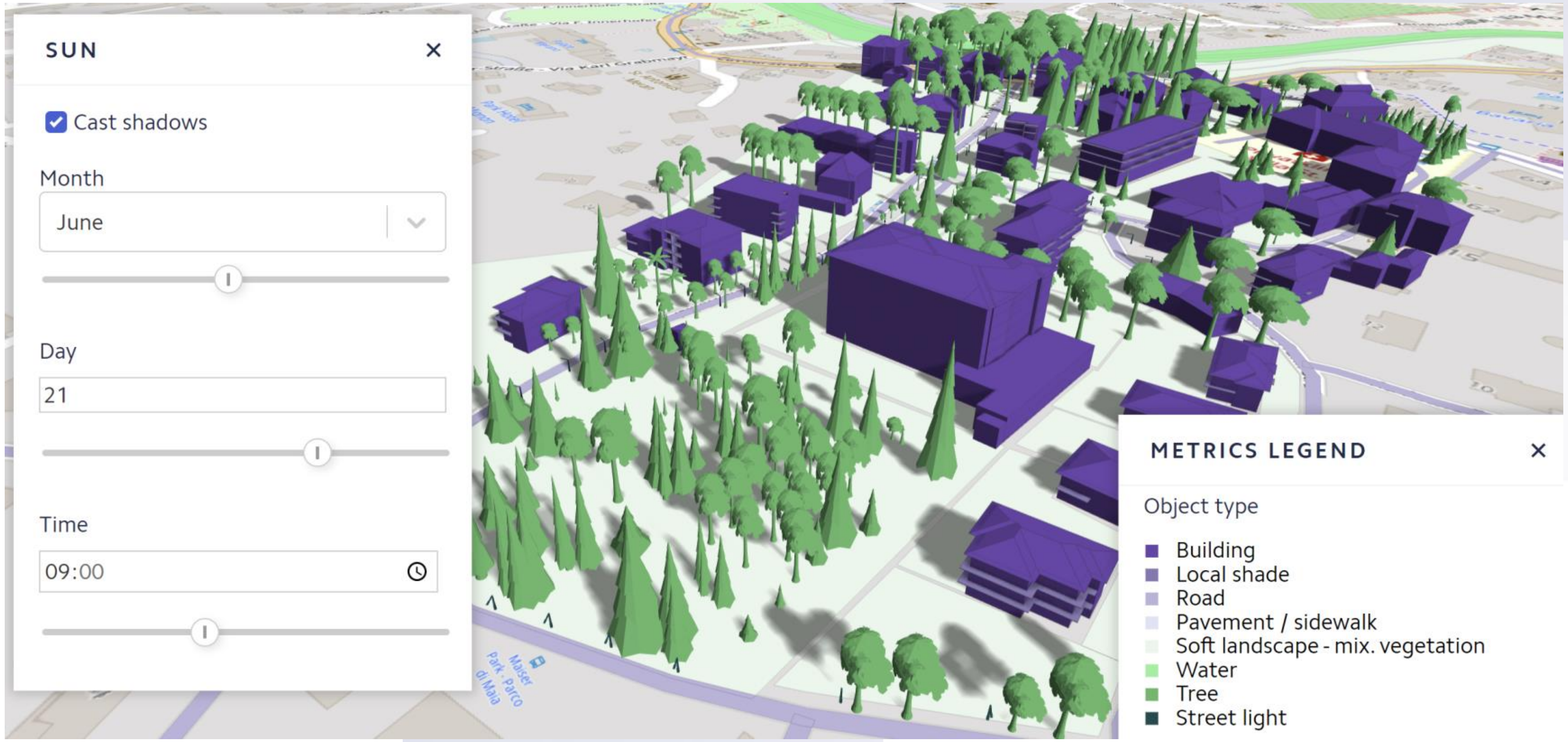
Surfaces’ albedo

Surfaces’ albedo

Outdoor thermal comfort metrics

The impact of physics based simulations

Transitioning from the real world… (reality)
… to the virtual environment… (baseline/ physics-based simulations)
… and back to reality (time to implement with simulated impacts!)



We need numbers before implementing…

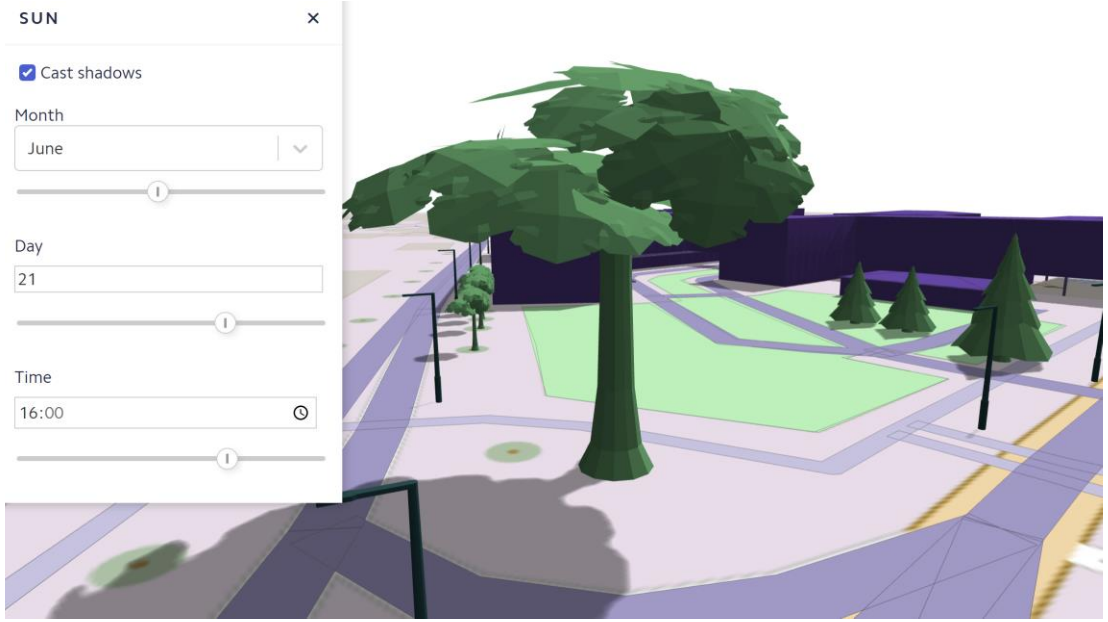
Let’s simulate the impact on outdoor thermal comfort

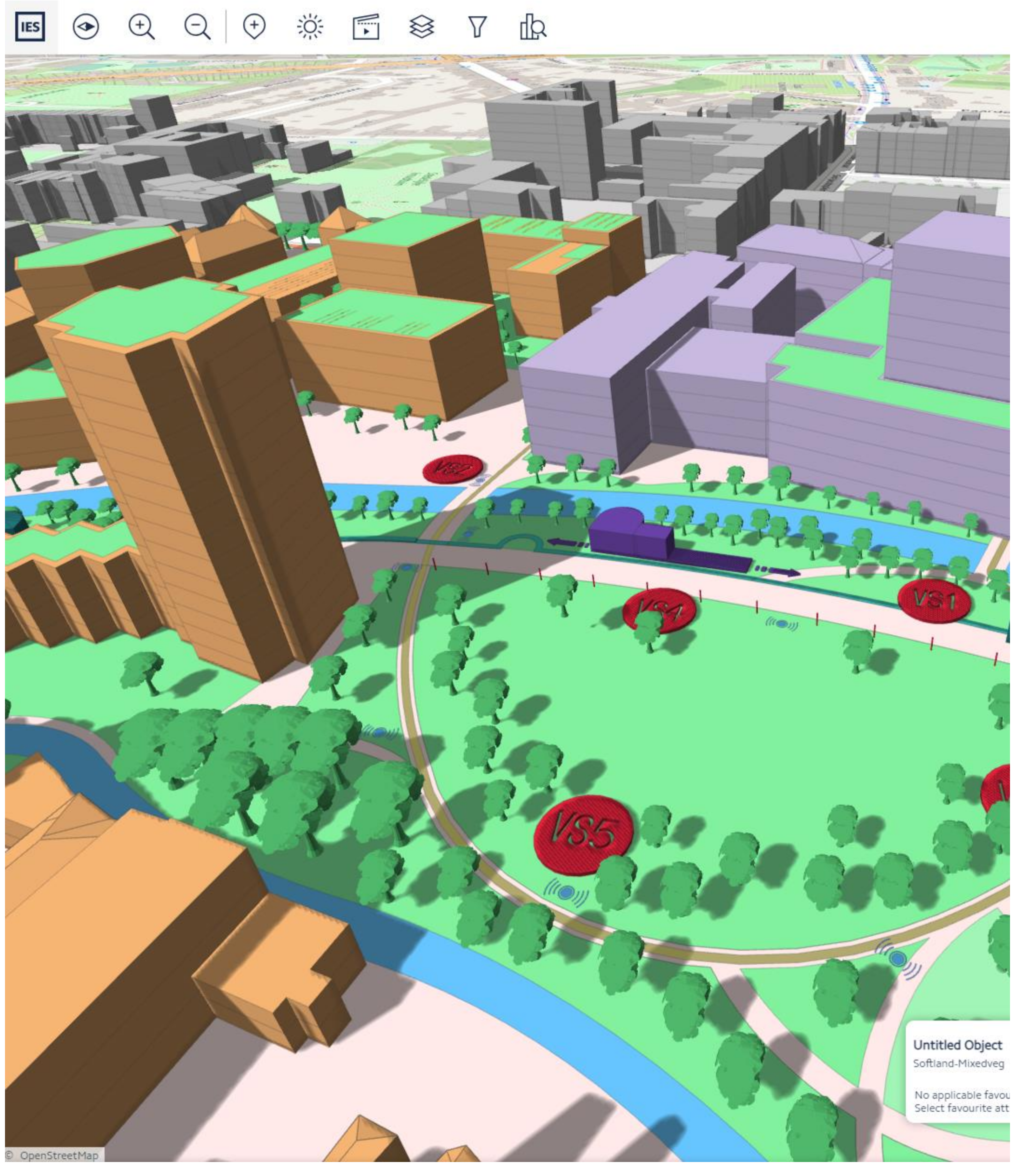
The user has a model in IES suit of tools

- Introduce **weather files** in the model
- Introduce **new objects** (i.e.: trees and inherent shades, surfaces)
- Set relevant **characteristics** (i.e.: albedo/ emissivity) **on objects** (soft landscape, parking, buildings, etc.)
- **Run the simulation, getting thermal comfort metrics** on the model

Simulation: introduce new objects in the model

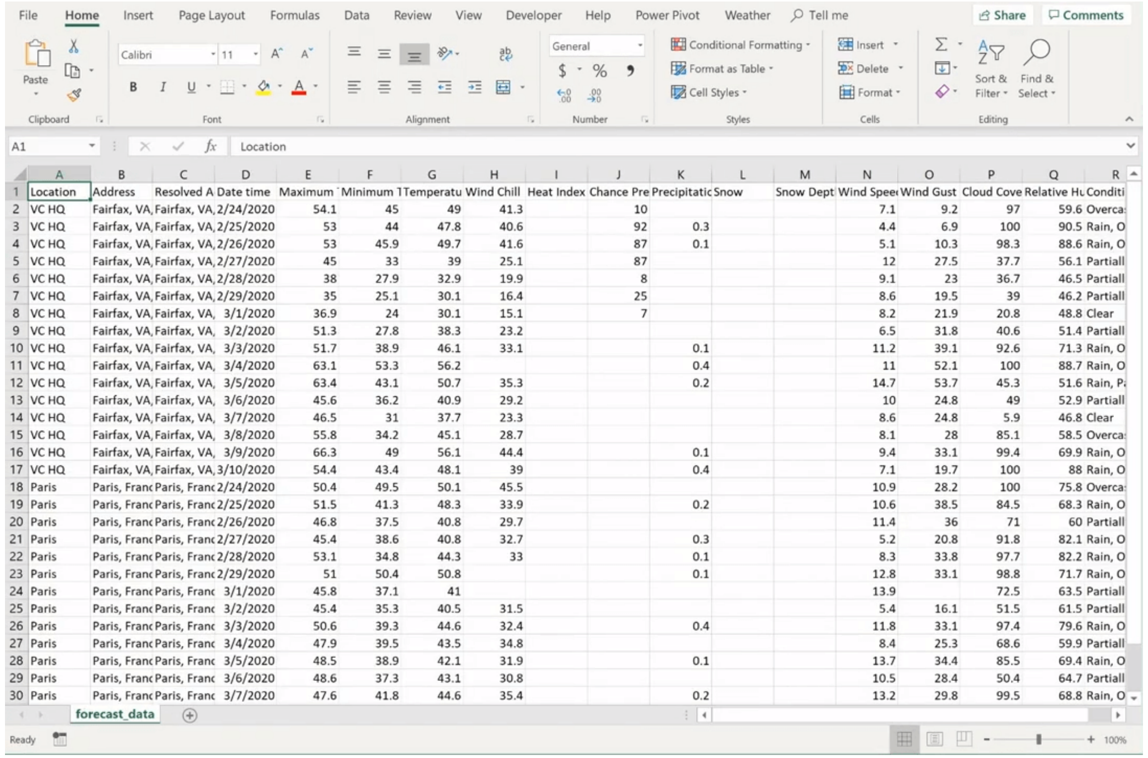
Vegetation, less emissive surfaces





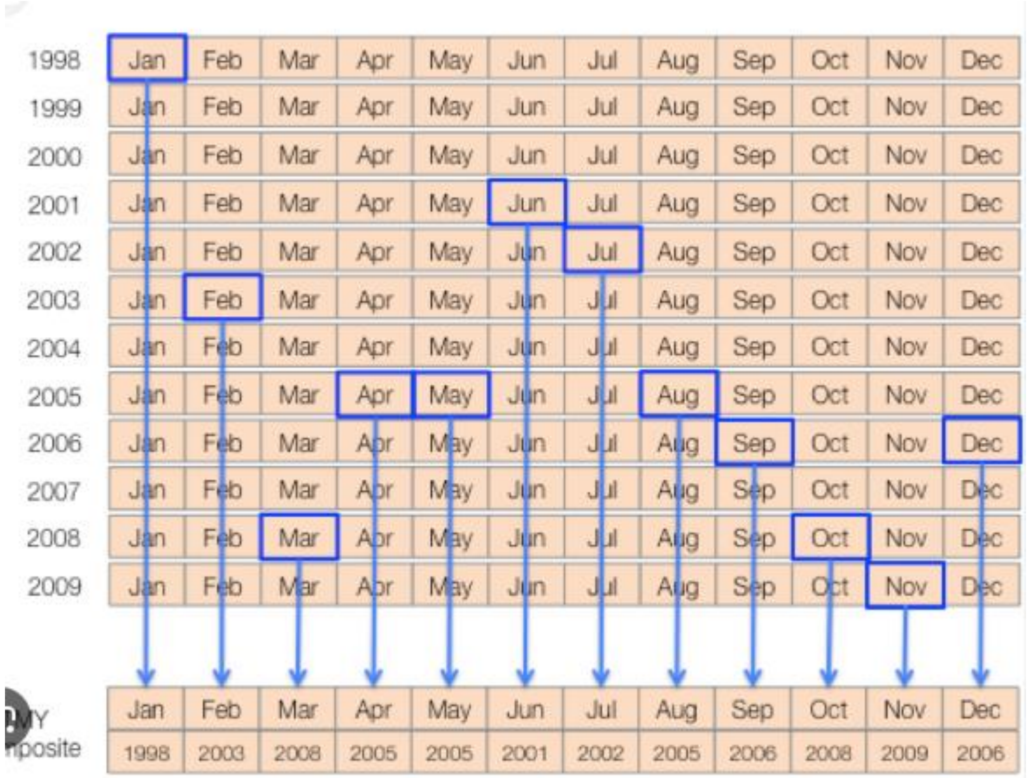
Simulation: weather files

UTCI, air temperature, humidity, etc.



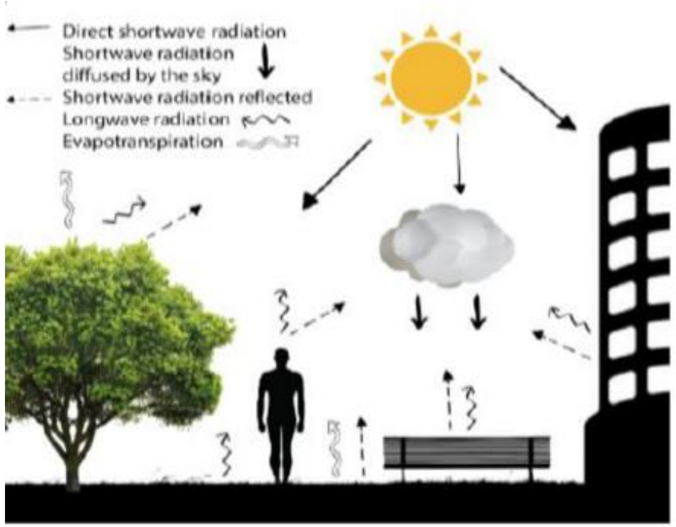
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Location	Address	Resolved A	Date time	Maximum	Minimum T	Temperatu	Wind Chill	Heat Index	Chance Pre	Precipitatic	Snow	Snow Dept	Wind Speed	Wind Gust	Cloud Cove	Relative Hu	Conditi
2	VC HQ	Fairfax, VA,	Fairfax, VA,	2/24/2020	54.1	45	49	41.3		10				7.1	9.2	97	59.6	Overca
3	VC HQ	Fairfax, VA,	Fairfax, VA,	2/25/2020	53	44	47.8	40.6		92	0.3			4.4	6.9	100	90.5	Rain, O
4	VC HQ	Fairfax, VA,	Fairfax, VA,	2/26/2020	53	45.9	49.7	41.6		87	0.1			5.1	10.3	98.3	88.6	Rain, O
5	VC HQ	Fairfax, VA,	Fairfax, VA,	2/27/2020	45	33	39	25.1		87				12	27.5	37.7	56.1	Partiall
6	VC HQ	Fairfax, VA,	Fairfax, VA,	2/28/2020	38	27.9	32.9	19.9		8				9.1	23	36.7	46.5	Partiall
7	VC HQ	Fairfax, VA,	Fairfax, VA,	2/29/2020	35	25.1	30.1	16.4		25				8.6	19.5	39	46.2	Partiall
8	VC HQ	Fairfax, VA,	Fairfax, VA,	3/1/2020	36.9	24	30.1	15.1		7				8.2	21.9	20.8	48.8	Clear
9	VC HQ	Fairfax, VA,	Fairfax, VA,	3/2/2020	51.3	27.8	38.3	23.2						6.5	31.8	40.6	51.4	Partiall
10	VC HQ	Fairfax, VA,	Fairfax, VA,	3/3/2020	51.7	38.9	46.1	33.1			0.1			11.2	39.1	92.6	71.3	Rain, O
11	VC HQ	Fairfax, VA,	Fairfax, VA,	3/4/2020	63.1	53.3	56.2				0.4			11	52.1	100	88.7	Rain, O
12	VC HQ	Fairfax, VA,	Fairfax, VA,	3/5/2020	63.4	43.1	50.7	35.3			0.2			14.7	53.7	45.3	51.6	Rain, Pa
13	VC HQ	Fairfax, VA,	Fairfax, VA,	3/6/2020	45.6	36.2	40.9	29.2						10	24.8	49	52.9	Partiall
14	VC HQ	Fairfax, VA,	Fairfax, VA,	3/7/2020	46.5	31	37.7	23.3						8.6	24.8	5.9	46.8	Clear
15	VC HQ	Fairfax, VA,	Fairfax, VA,	3/8/2020	55.8	34.2	45.1	28.7						8.1	28	85.1	58.5	Overca
16	VC HQ	Fairfax, VA,	Fairfax, VA,	3/9/2020	66.3	49	56.1	44.4			0.1			9.4	33.1	99.4	69.9	Rain, O
17	VC HQ	Fairfax, VA,	Fairfax, VA,	3/10/2020	54.4	43.4	48.1	39			0.4			7.1	19.7	100	88	Rain, O
18	Paris	Paris, Franc	Paris, Franc	2/24/2020	50.4	49.5	50.1	45.5						10.9	28.2	100	75.8	Overca
19	Paris	Paris, Franc	Paris, Franc	2/25/2020	51.5	41.3	48.3	33.9			0.2			10.6	38.5	84.5	68.3	Rain, O
20	Paris	Paris, Franc	Paris, Franc	2/26/2020	46.8	37.5	40.8	29.7						11.4	36	71	60	Partiall
21	Paris	Paris, Franc	Paris, Franc	2/27/2020	45.4	38.6	40.8	32.7			0.3			5.2	20.8	91.8	82.1	Rain, O
22	Paris	Paris, Franc	Paris, Franc	2/28/2020	53.1	34.8	44.3	33			0.1			8.3	33.8	97.7	82.2	Rain, O
23	Paris	Paris, Franc	Paris, Franc	2/29/2020	51	50.4	50.8				0.1			12.8	33.1	98.8	71.7	Rain, O
24	Paris	Paris, Franc	Paris, Franc	3/1/2020	45.8	37.1	41							13.9		72.5	63.5	Partiall
25	Paris	Paris, Franc	Paris, Franc	3/2/2020	45.4	35.3	40.5	31.5						5.4	16.1	51.5	61.5	Partiall
26	Paris	Paris, Franc	Paris, Franc	3/3/2020	50.6	39.3	44.6	32.4			0.4			11.8	33.1	97.4	79.6	Rain, O
27	Paris	Paris, Franc	Paris, Franc	3/4/2020	47.9	39.5	43.5	34.8						8.4	25.3	68.6	59.9	Partiall
28	Paris	Paris, Franc	Paris, Franc	3/5/2020	48.5	38.9	42.1	31.9			0.1			13.7	34.4	85.5	69.4	Rain, O
29	Paris	Paris, Franc	Paris, Franc	3/6/2020	48.6	37.3	43.1	30.8						10.5	28.4	50.4	64.7	Partiall
30	Paris	Paris, Franc	Paris, Franc	3/7/2020	47.6	41.8	44.6	35.4			0.2			13.2	29.8	99.5	68.8	Rain, O

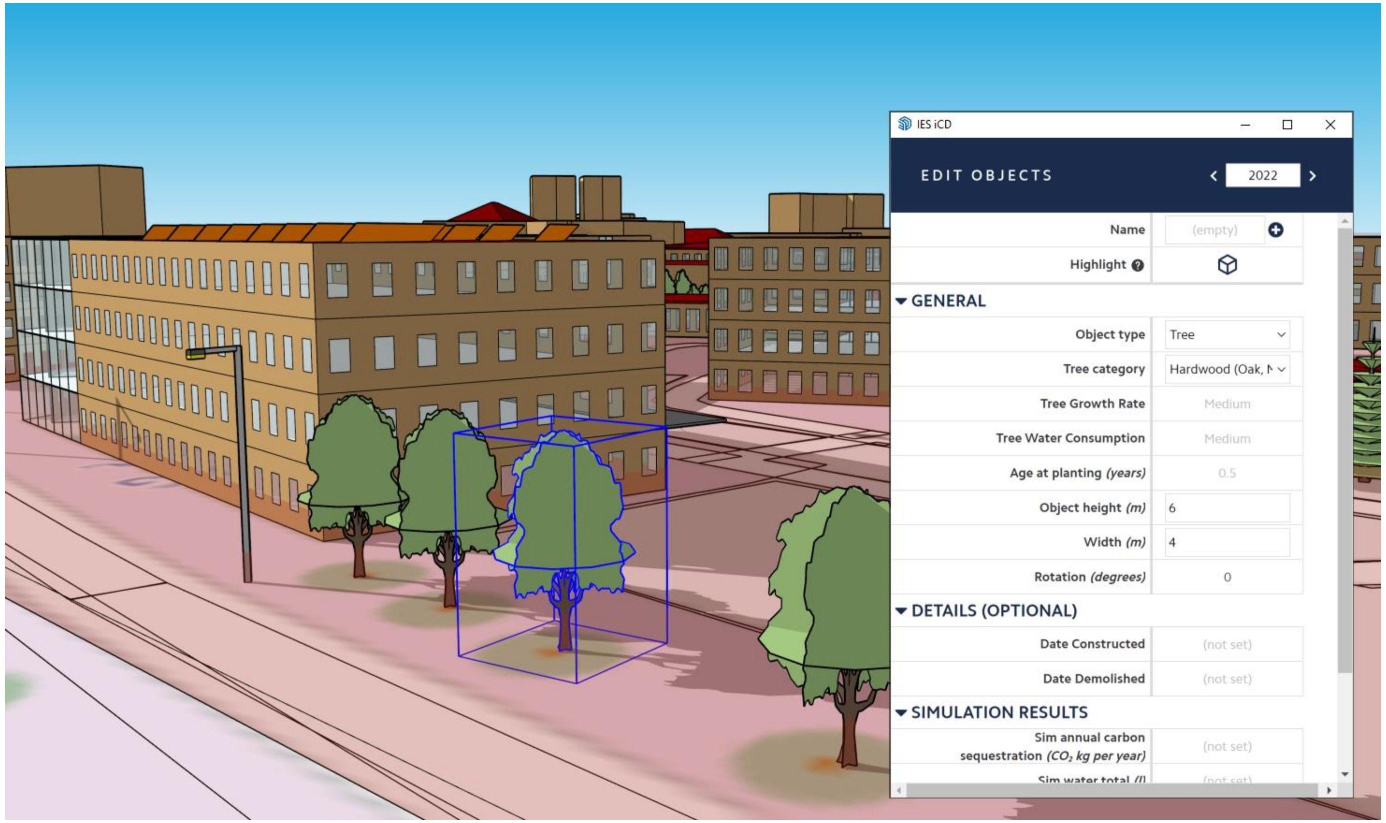
forecast_data



Simulation: set relevant characteristics on objects

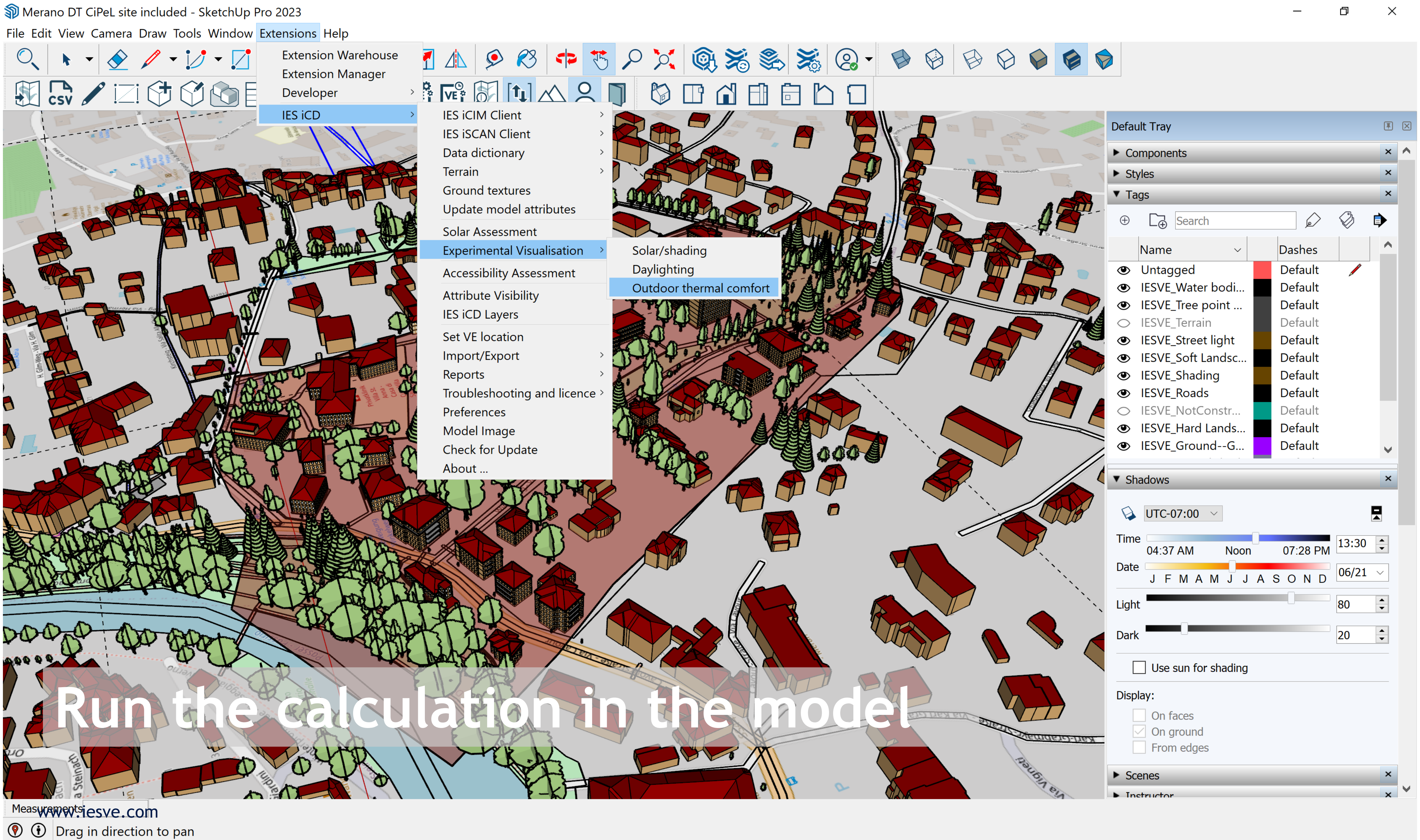
Key elements for radiation/ thermal analysis





Simulation: run the calculation

We get specific thermal comfort metrics for a specific time/time-frame


Merano DT CiPeL site included - SketchUp Pro 2023
File Edit View Camera Draw Tools Window Extensions Help
Extension Warehouse
Extension Manager
Developer
IES iCD
IES iCIM Client
IES iSCAN Client
Data dictionary
Terrain
Ground textures
Update model attributes
Solar Assessment
Experimental Visualisation
Accessibility Assessment
Attribute Visibility
IES iCD Layers
Set VE location
Import/Export
Reports
Troubleshooting and licence
Preferences
Model Image
Check for Update
About ...
Solar/shading
Daylighting
Outdoor thermal comfort
Default Tray
Components
Styles
Tags
Search
Name
Dashes
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Default
IESVE_Terrain
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IESVE_Street light
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IESVE_Soft Landsc...
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IESVE_Hard Lands...
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IESVE_Ground--G...
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Shadows
UTC-07:00
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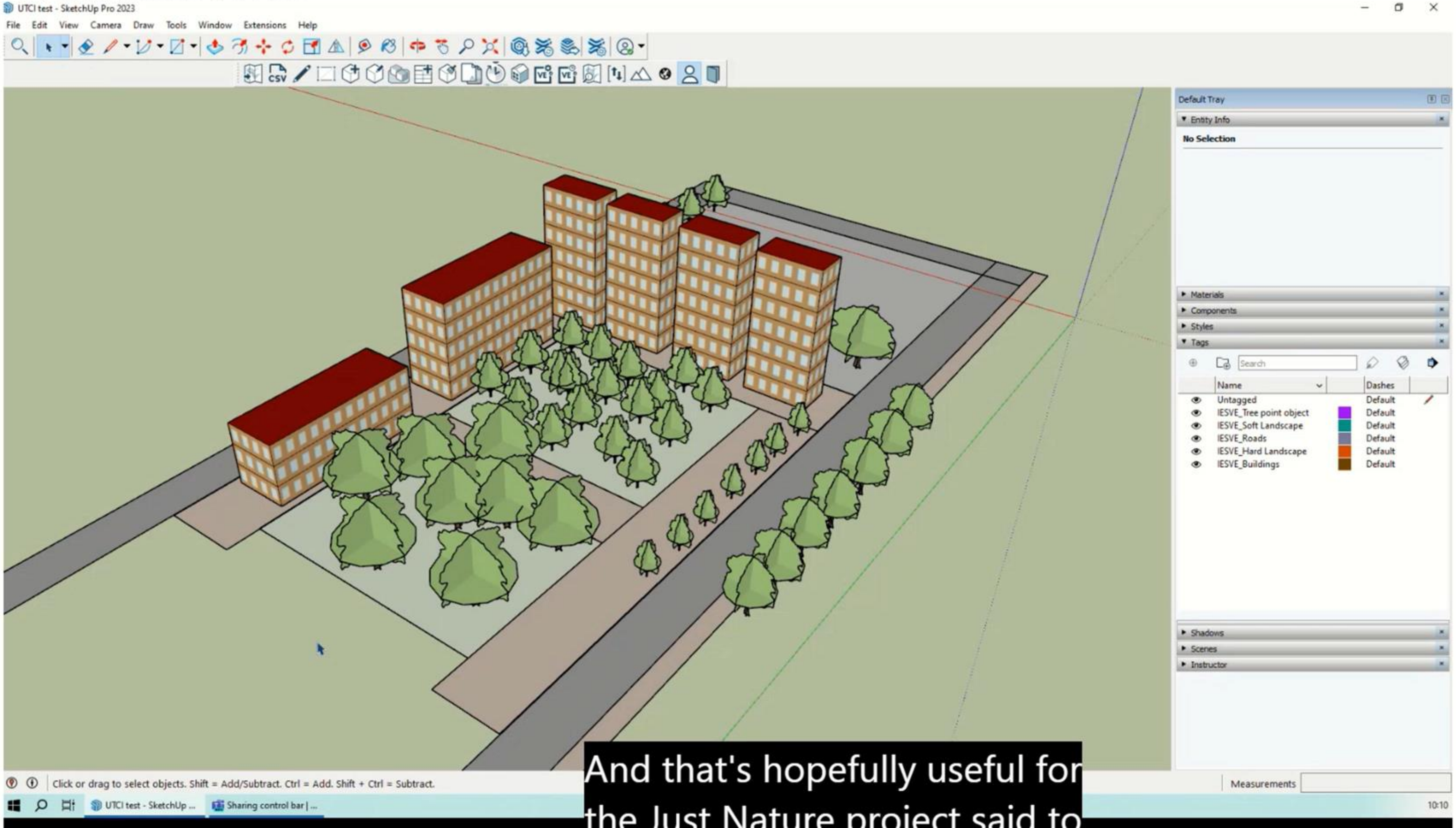
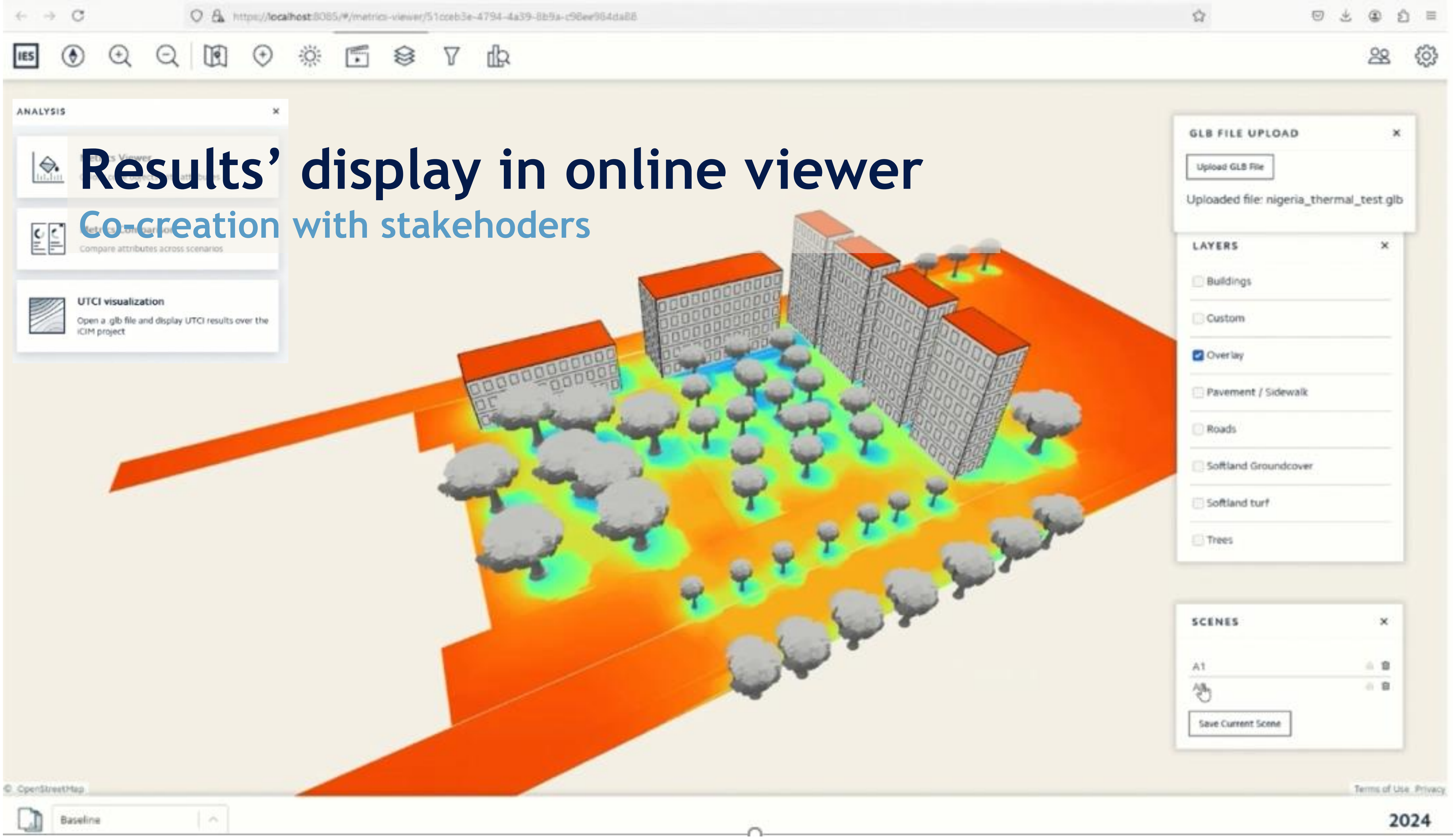
07:28 PM
13:30
Date
J F M A M J J A S O N D
06/21
Light
80
Dark
20
Use sun for shading
Display:
On faces
On ground
From edges
Scenes
Instructor
Measurements
Drag in direction to pan
Run the calculation in the model
www.iesve.com

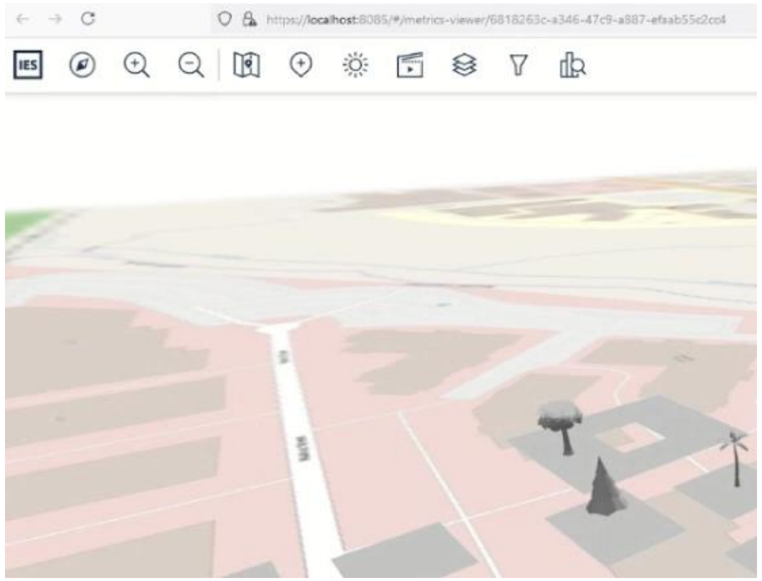
UTCI simulation in iCD

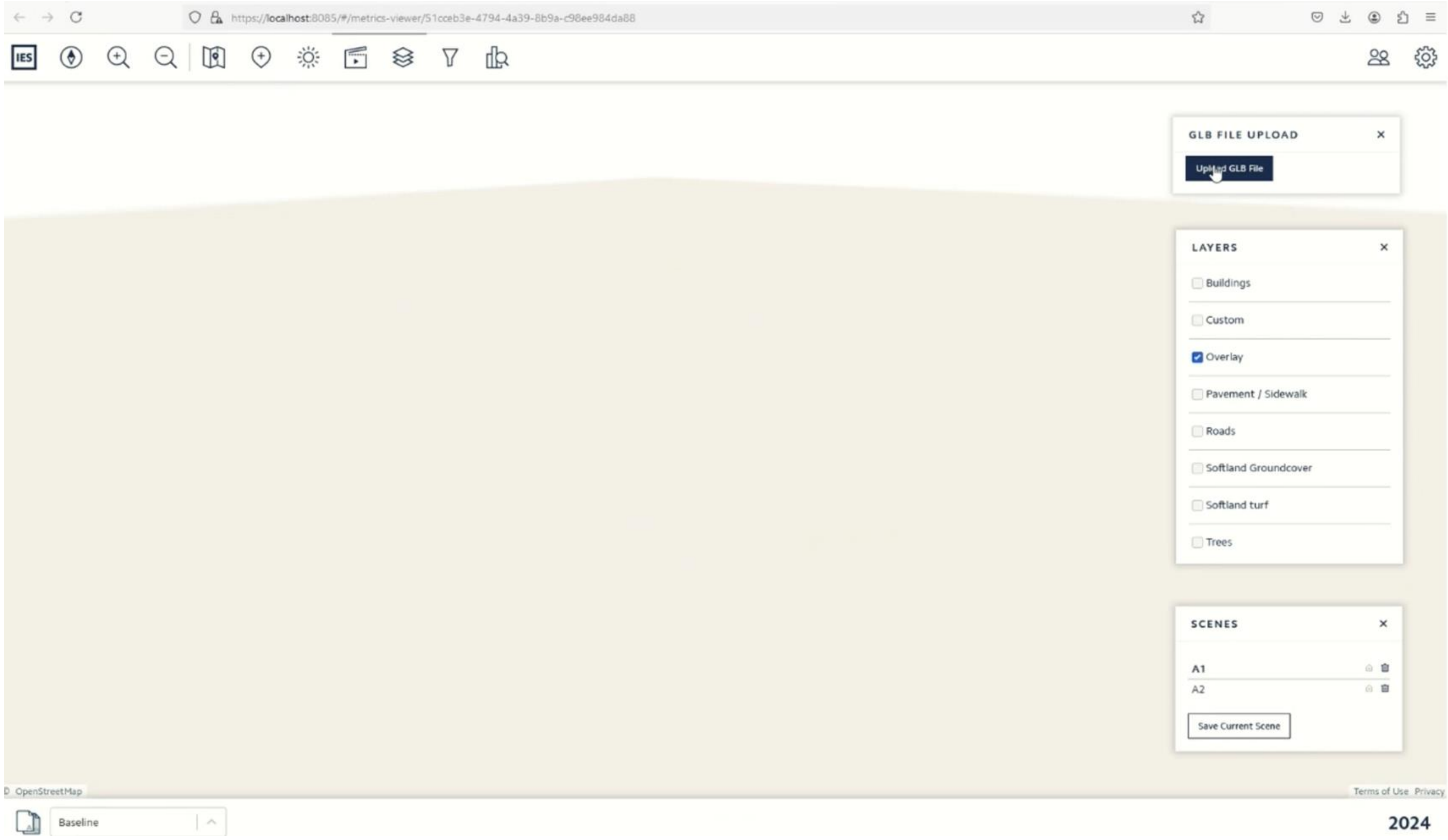


Results’ display in online viewer

Co-creation with stakehoders






GLB FILE UPLOAD
Upload GLB File
LAYERS
Buildings
Custom
Overlay
Pavement / Sidewalk
Roads
Softland Groundcover
Softland turf
Trees
SCENES
A1
A2
Save Current Scene
OpenStreetMap
Terms of Use
Privacy
Baseline

2024

Final remarks

- Final stages of product development
  - i.e.: UTCI legend, timeframe simulations
- Next steps
  - **simulations influenced by real-time data** from local sensors
- IES as a company
  - solid steps towards climate adaptation functionalities
- Looking forward to apply and further develop our tools
  - Industry / EU project opportunities to impact climate action

Thank you

Any Questions?

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Dr. Niall Buckley niall.buckley@iesve.com

MANOEUVRE

Energy System Modelling for Transition to a net-Zero 2050 for EU via REPowerEU

European Energy Vision 2060 (EU EnVis 2060) Scenarios

Mostafa Barani

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Norwegian University of Science and Technology (NTNU)
Trondheim, Norway

NTNU

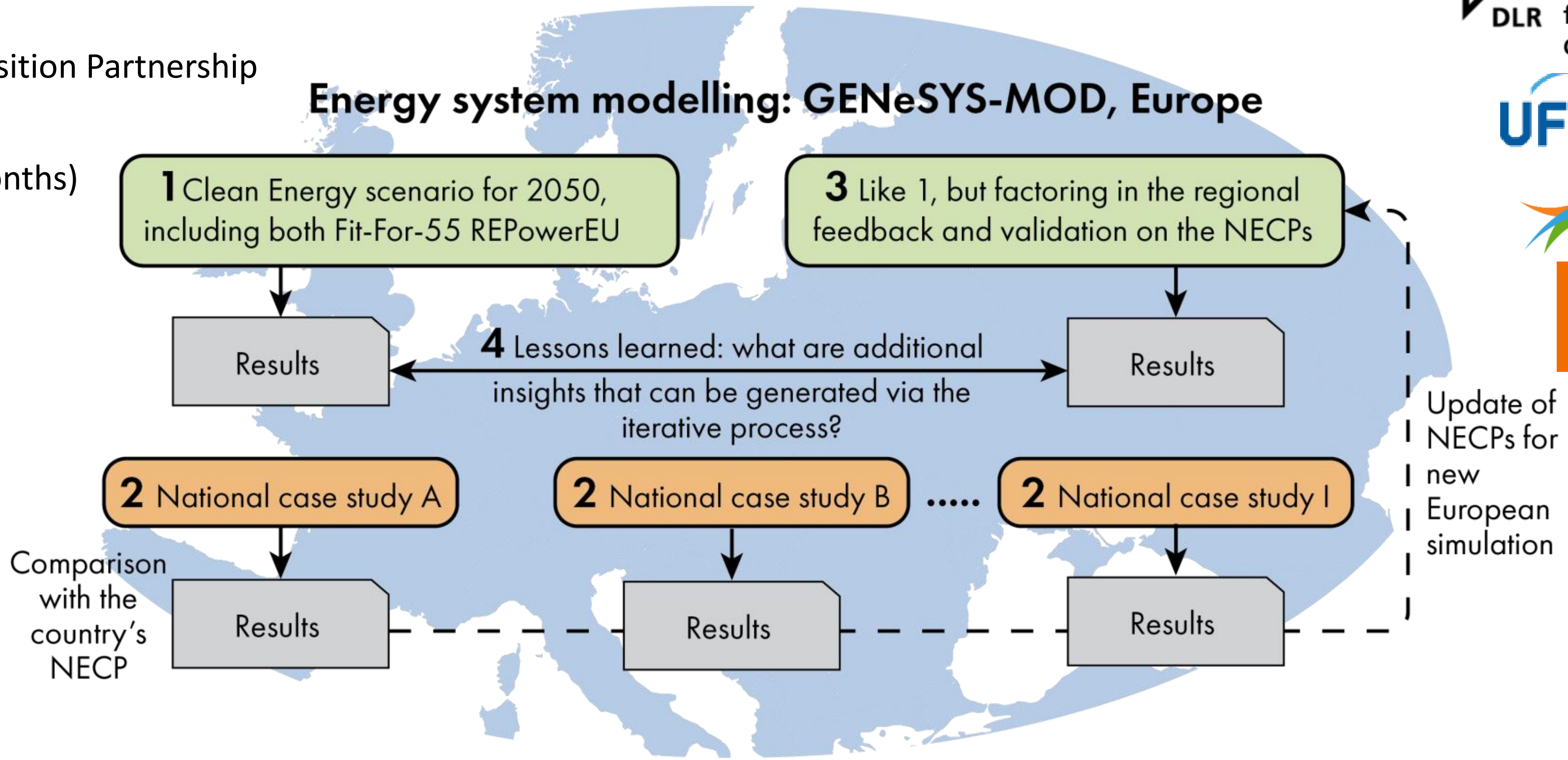
Co-funded by the European Union

cet Partnership

This research was funded by CETPartnership, the European Partnership under Joint Call 2022 for research proposals, co-funded by the European Commission (GA N°101069750) and with the funding organisations listed on the CETPartnership website.

About ManOEUvRE

- Aim:
  - ✓ Improve and coordinate energy system modelling in Europe
  - ✓ Facilitate ambitious emissions reductions for a clean energy transition using recent EU policy suggestions
- Type of project:
  - ✓ Clean Energy Transition Partnership
- Duration:
  - ✓ 2023-2026 (36 months)
- Total Budget:
  - ✓ 3,8 MEUR



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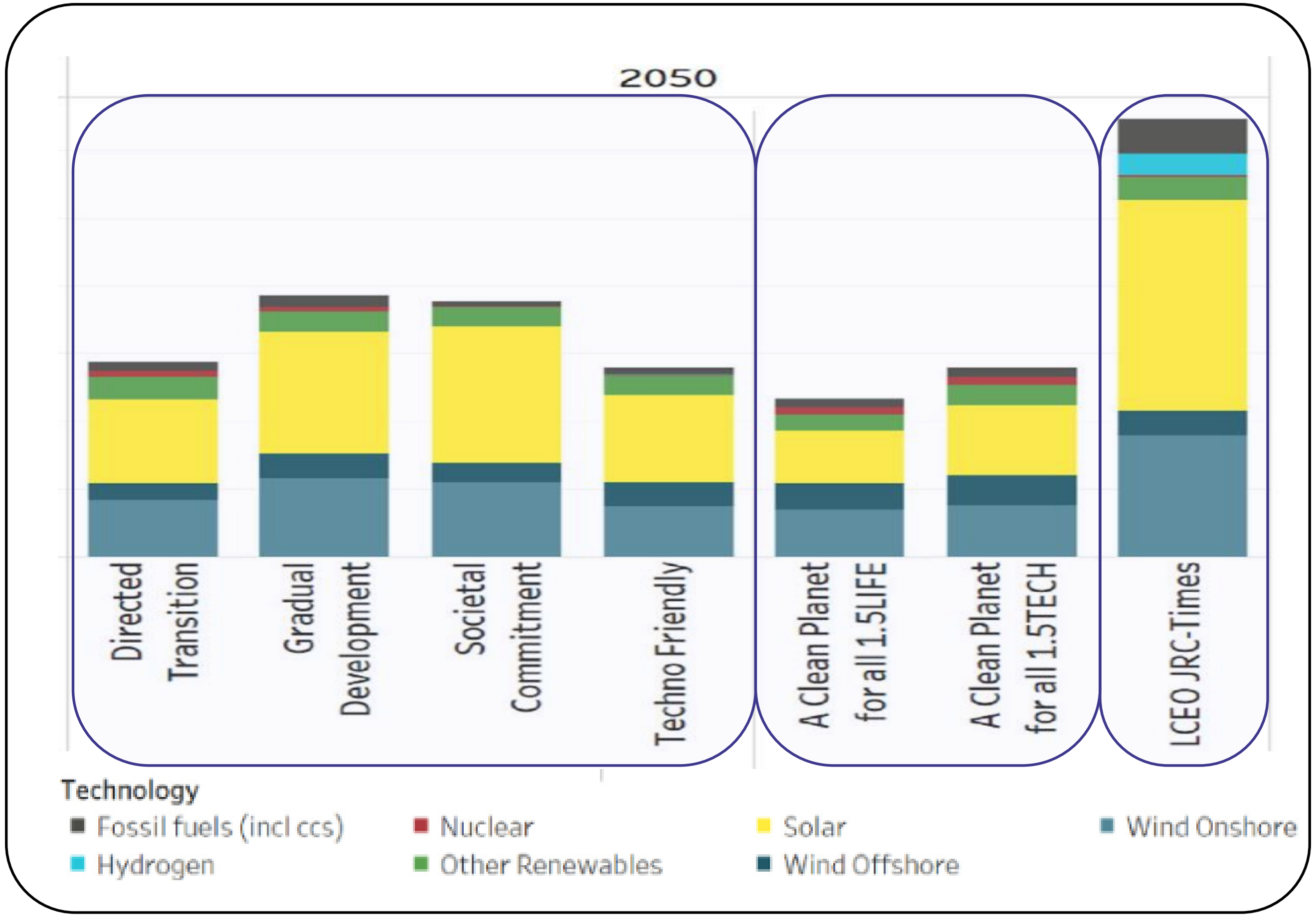
What will the European electricity generation mix look like in 2050?



Karlo Hainsch, Konstantin Löffler, Thorsten Burandt, Hans Auer, Pedro Crespo del Granado, Paolo Pisciella, Sebastian Zwickl-Bernhard, “Energy transition scenarios: What policies, societal attitudes, and technology developments will realize the EU Green Deal?,” Energy, 2022.

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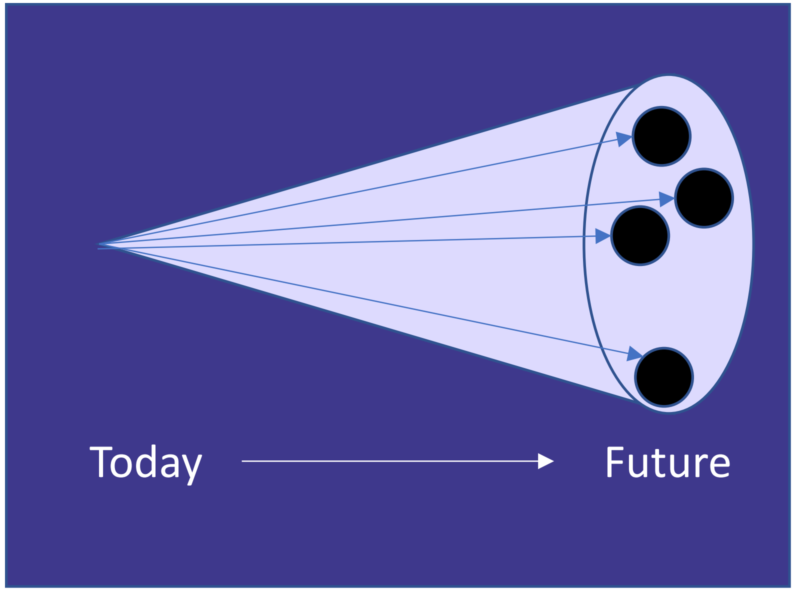
What are (qual.) scenarios?

➢ *"Scenarios are descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will play out." (UNEP 2002, p. 320)*

- Hypothetical futures, but not arbitrary
- Structured **"Tool of thought"** to explore how the future might look like
- Identification of possible futures
- **Without assigning probabilities**
- **Based on expert knowledge or facts –> No prediction**



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Aim and Scope

- **Aim:**
  - ✓ Developing Pan-European scenarios.
  - ✓ Publishing in a peer-reviewed journal
- **Steps:**
  - ✓ Qualitative scenarios
  - ✓ Parametrization and Quantification
- **Scope:**
  - ✓ Geographical Coverage: Europe
  - ✓ Horizon 2050

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Steps

Defining the objective of the study

Collect information:
Current situation,
trend analysis,
drivers, and
hindrances factors.
Methodology

Scenario/Storylines

Parameter/Variable Estimation

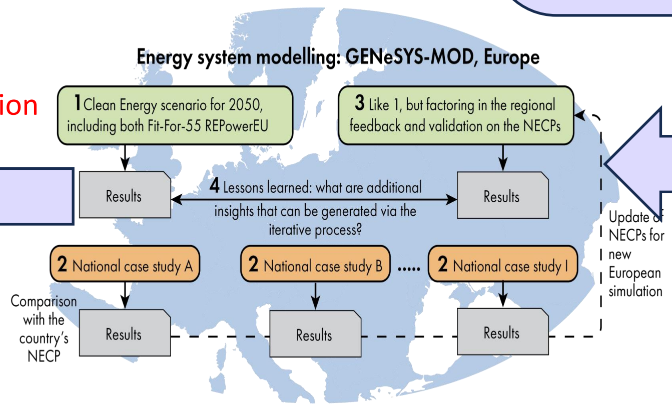
Optimization Model

Quantified scenarios

Enhance European energy system modelling for a clean energy transition (CET), aligning with REPowerEU, Fit for 55, and Net Zero Industrial Act.

Regarding Scenarios: Develop pathways for the European energy system, considering current policies like REPowerEU, to achieve net-zero greenhouse gas emissions.

Policy & Recommendation



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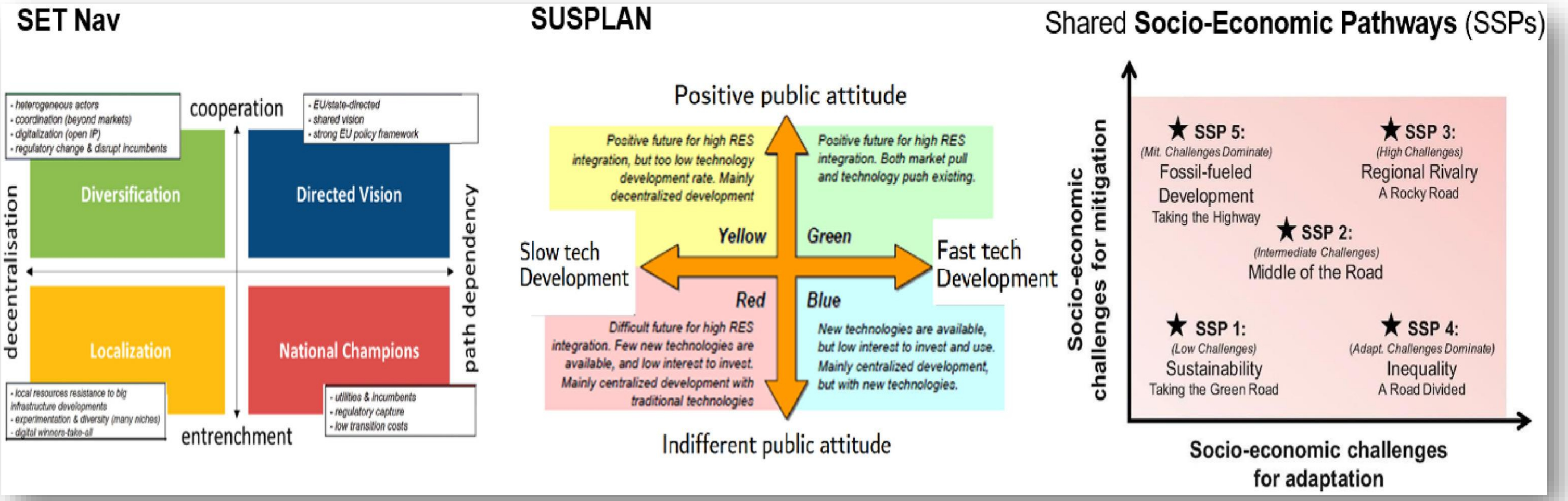
Some Existing Scenarios



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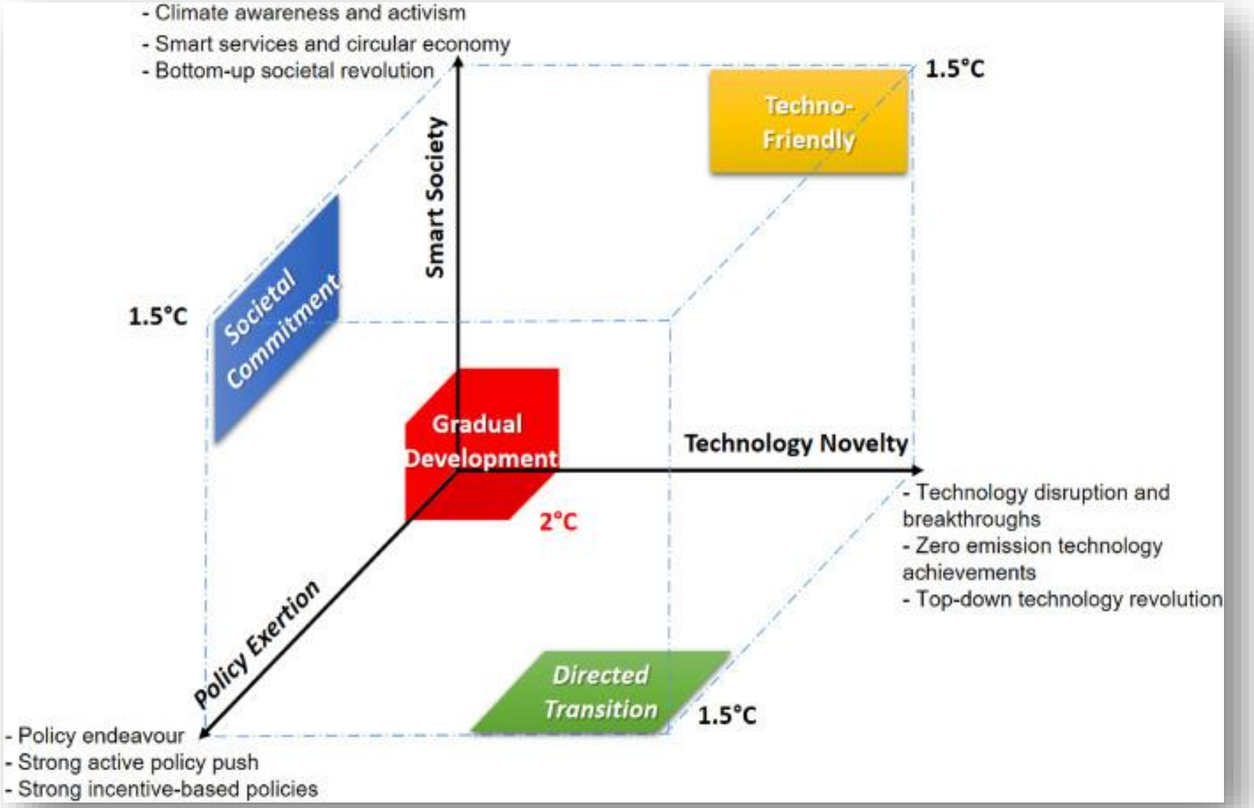
Inclusion of three key factors



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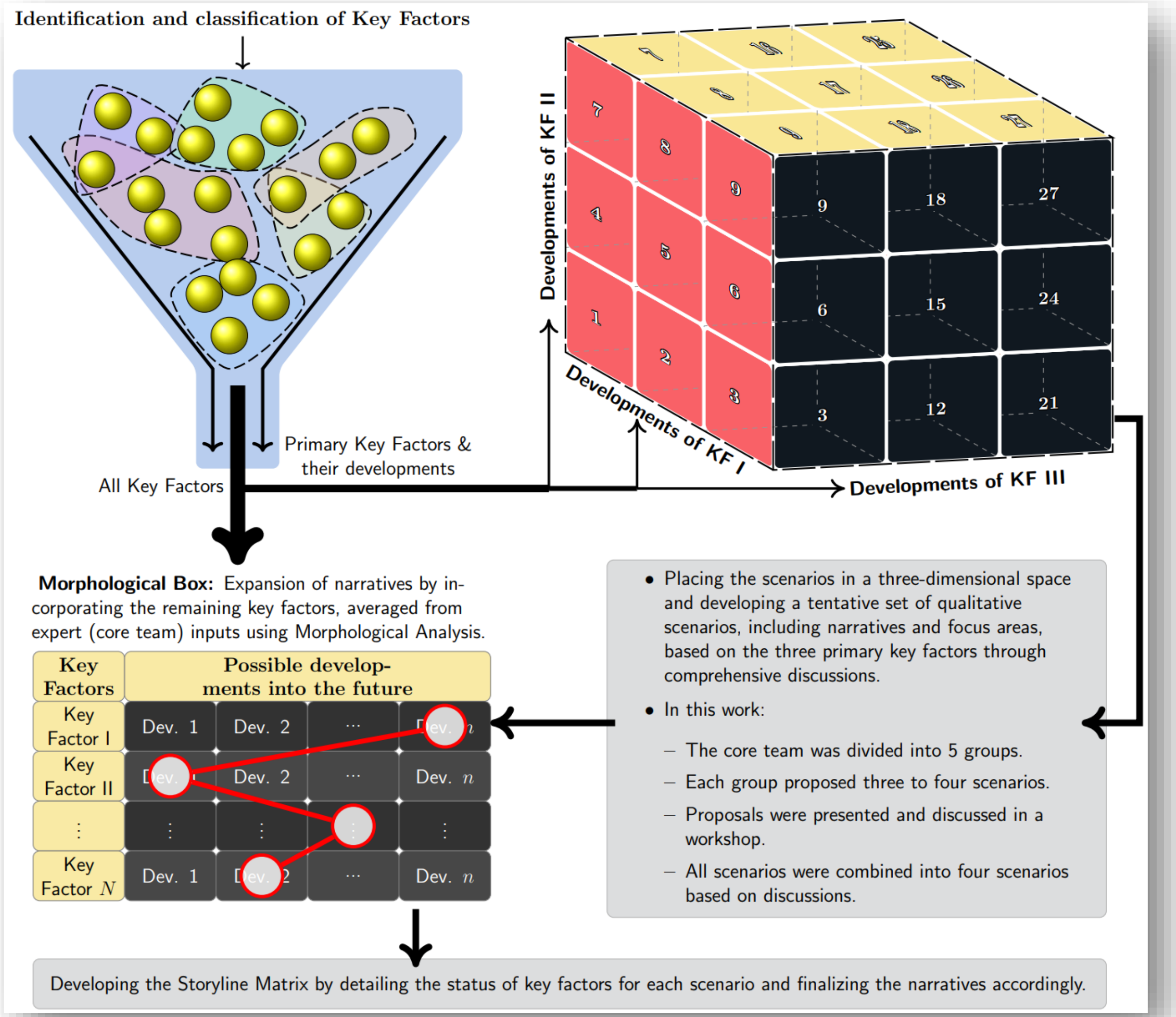
Methodology: Step 1



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Step 1: STEP+G Analysis

Uncertainties / Key Factors

- Social
- Technological
- Economic
- Political
- Geopolitical

Social

- Public awareness of climate change
- Acceptance of new technologies
- Acceptance of green energy policies
- Behavioral shifts: Energy Consumption Behavior
- Social pressure for environmental action

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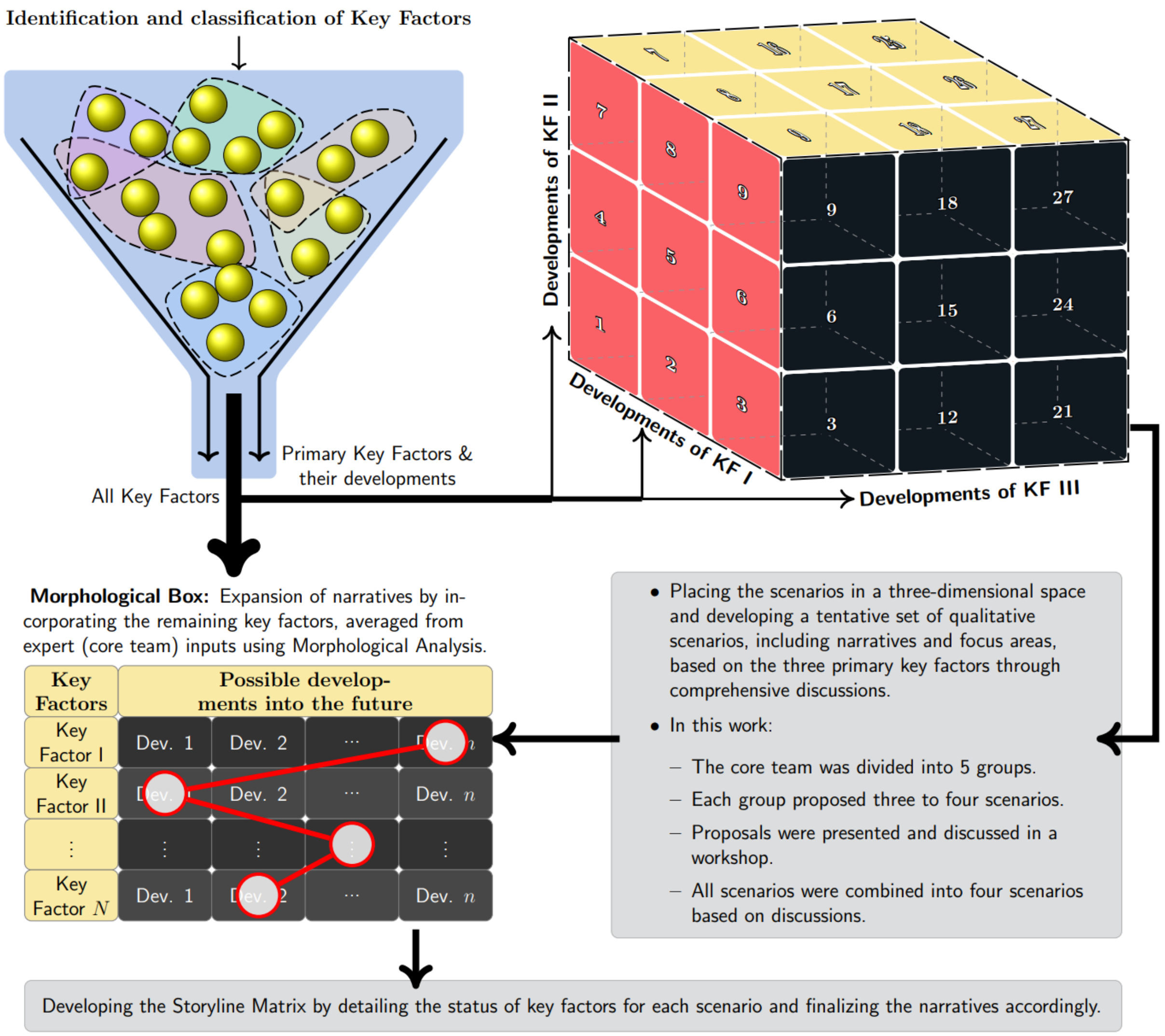
Methodology
Step 2



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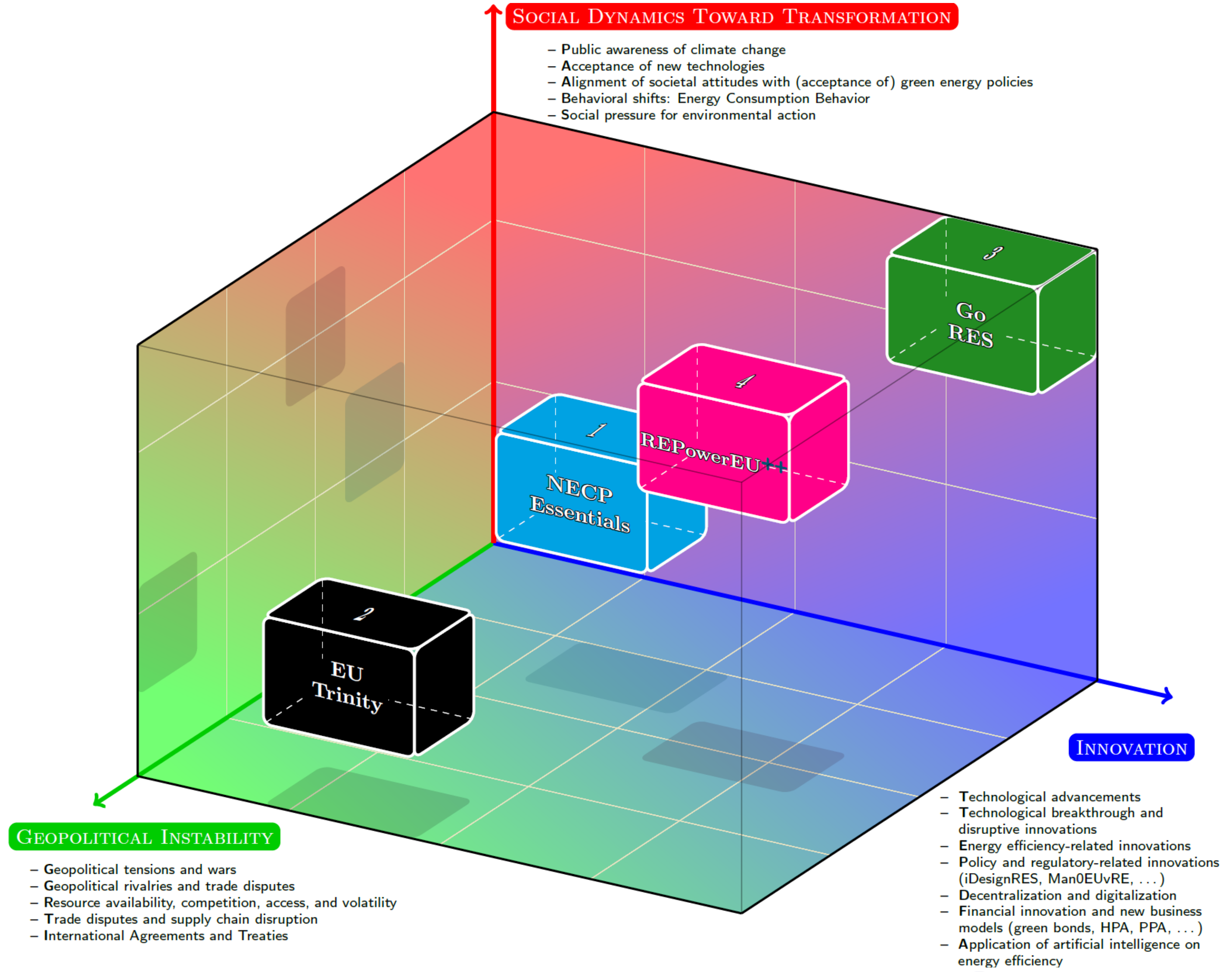
Step 2



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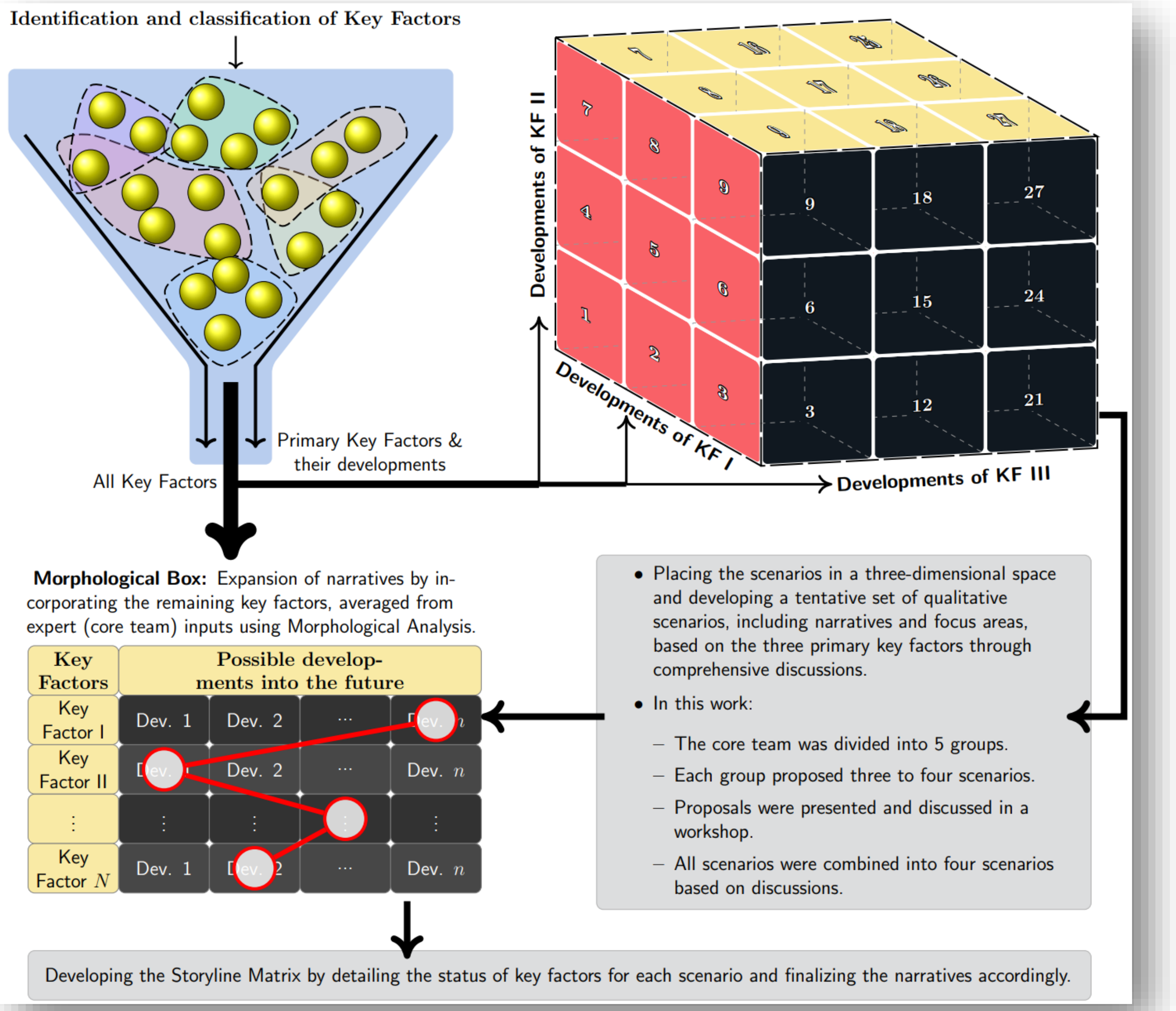
Methodology
Step 3



MANOEUVRE

RepowerEU++

Research Questions

- **Vision of a Self-Sufficient, Independent European Energy System:**

Is it feasible to fully decarbonise Europe's energy system by 2050 while achieving while achieving complete energy independence? What will a (almost) fully self-sufficient European energy system look like in 2050? What steps should be followed from this step forward to secure the vision of a self-sufficient, independent European energy system by2050?

- **Long-Term Energy Security and Sustainability:**

What strategies can be implemented to secure a sustainable, cost-effective, and long-term energy supply for the EU, reducing dependency on external sources such as Russia?

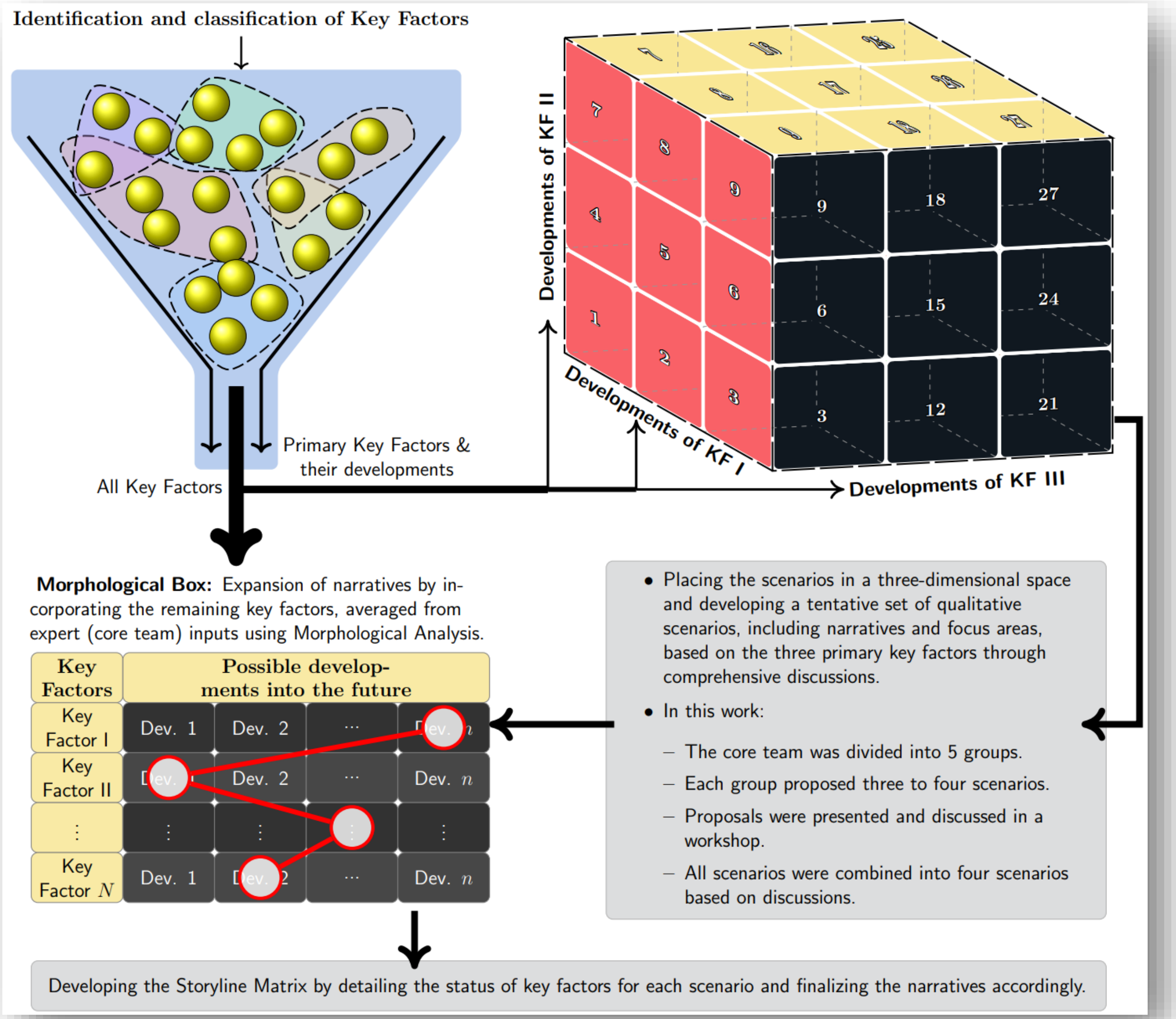
- **Cost-Effective Energy Independence for European Targets:**

What level of energy independence is both cost-effective and sufficient to achieve European climate targets while eliminating reliance on unreliable resources (primary energy resources and critical raw materials)?

Narrative

In the "REPowerEU++" scenario, the European Union launches an ambitious journey towards energy security and sustainability, set against a backdrop of persisting and escalating global geopolitical tensions outside the EU. Despite these external pressures, the EU remains cohesive and united, channelling its collective effort towards achieving energy independence. This unity is reinforced by significant public support for transformative energy policies and advanced technological innovations. The positive trend in renewable energy integration is supported by accelerated innovation in renewable energy technologies, leading to breakthroughs and cost reductions. However, progress is partly constrained by the relocation of production facilities within Europe due to geopolitical rivalries and challenges. By focusing on enhancing its own energy capabilities, the EU strengthens its energy independence, effectively insulating itself from global instabilities. By 2050, the EU aims to set a global benchmark in renewable energy adoption, establishing a resilient and integrated energy system that not only meets its climate targets but also ensures robust energy autonomy despite the challenging international environment!

Methodology
Step 4



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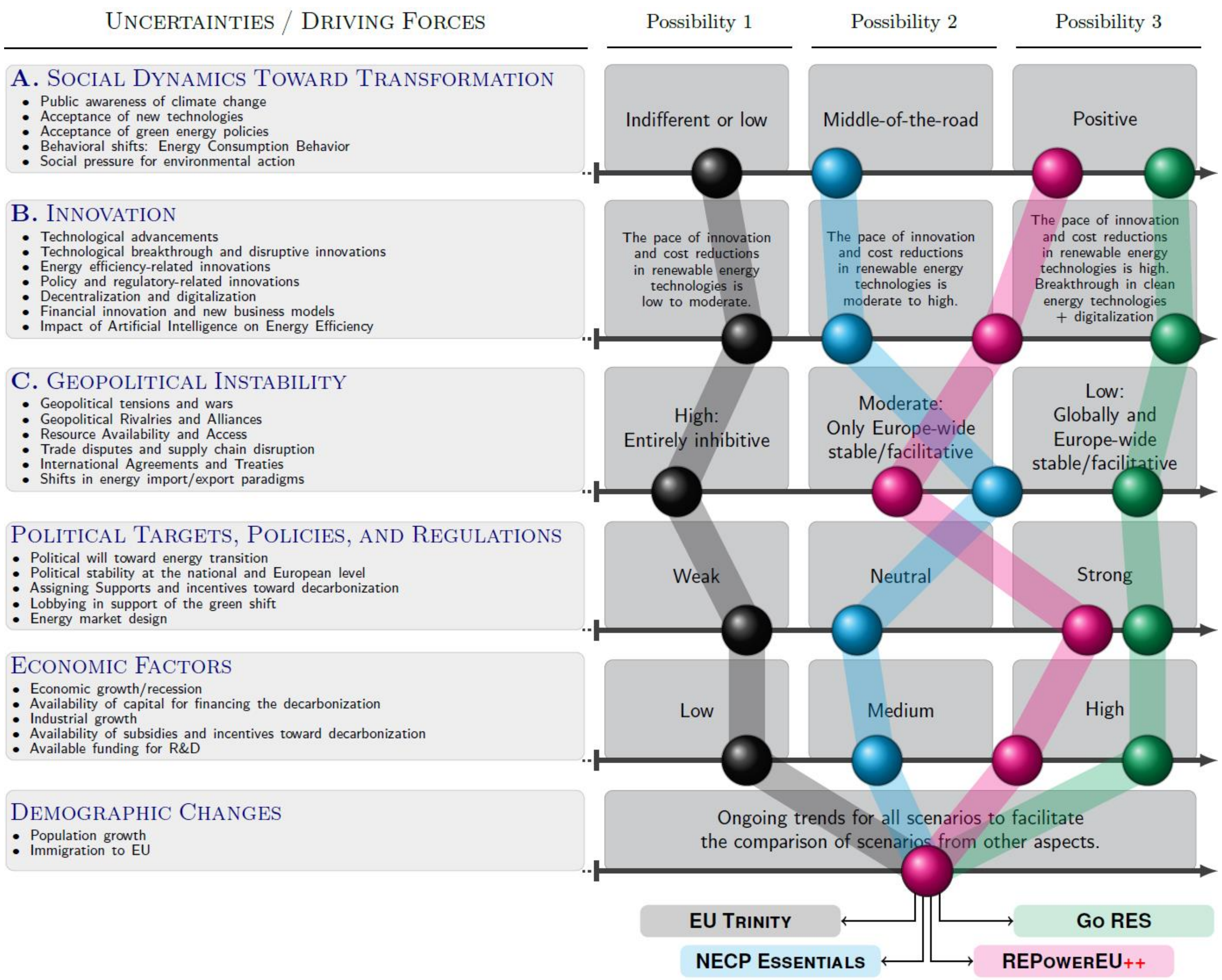
Inclusion of Other Uncertainties



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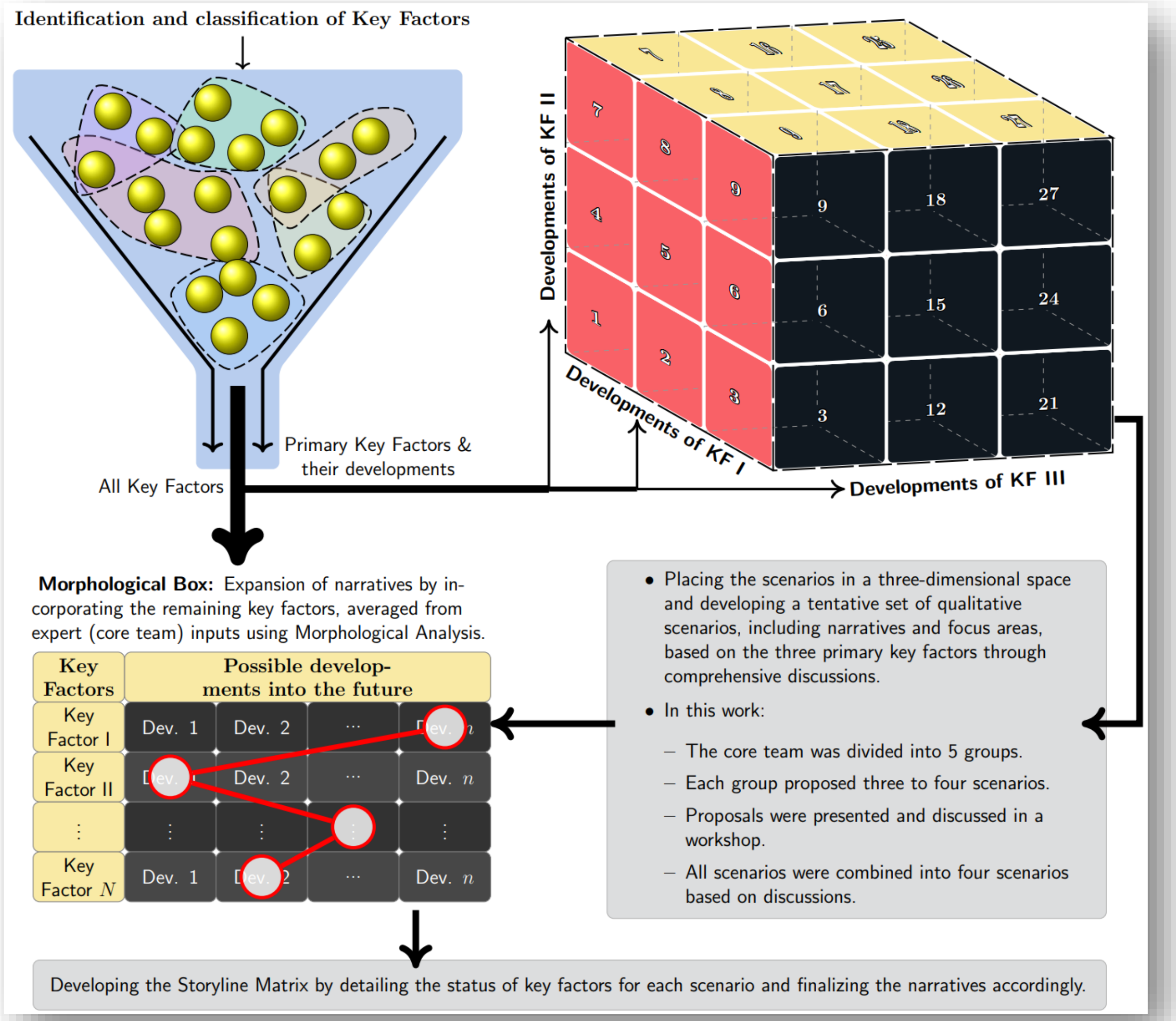
Methodology
Step 5



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Qualitative to Quantitative (Q2Q) Matrix

Description	Primary Influencing factor	EU Trinity	NECP Essentials	REPowerEU++	Go Res
Policies					
GHG Emission Reduction Policies					
Compliant with Green Deal by 2030[1]	D	no	to be determined based on the trajectories outlined in the latest NECPs until 2030.	yes	yes
Compliant with EU Commission CO2 reduction recommendation for 2040[2]	D	not necessarily	to be determined based on the trajectories outlined in the latest National Energy and Climate Plans (NECPs) through 2040.	partial deviation	yes
Net Zero Emission by 2050	D	no - carbon neutrality by 2060	to be determined based on the trajectories outlined in the latest NECPs until 2030. (Either by 2050 or 2055).	yes - carbon neutrality by 2050	yes - carbon neutrality by 2045
Total Carbon Emission Budget until 2050		aligned with a 2° increase	to be determined based on the trends in NECPs	the least expected: in alignment with a 1.8° increase (a final value will be replaced after parametrization)	in alignment with a 1.5° increase
Carbon pricing policies					
Carbon price	-	carbon prices are derived from the dual variable associated with the constraint that limits the carbon budget in the modelling tools.			
ETS (Emissions Trading System) Coverage					
Implementation of EU ETS	D	implementation as planned	implementation as planned	implementation as planned	implementation as planned
Implementation of ETS2[3] (expansion of ETS coverage)	D	delay of plans less ambitious plans (more allowances)	implementation as planned	implementation as planned	implementation as planned
Subsidies					
Fossil-fuel subsidies[4]	D	steady decrease	steady decrease	steady decrease	fast decrease
Green tech subsidies	D	low increase	moderate increase	moderate increase	high increase
LULUCF Targets					
Contribution to carbon sink by LULUCF	D	low increase	ongoing	moderate increase	high increase

[1] The European Climate Law mandates a 55% reduction in net greenhouse gas emissions by 2030 compared to 1990 levels (Read more here)

[2] The current recommendation is a 90% reduction in net greenhouse gas emissions by 2040 compared to 1990 levels. The next Commission will propose legislation to incorporate the 2040 target into the European Climate Law (Read more here).

[3] The EU ETS2 is a new emissions trading system targeting CO2 emissions from fuel combustion in buildings, road transport, and additional sectors, set to become fully operational in 2027 (Read more here).

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Co-funded by the European Union

Contact me:
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The Research Council of Norway

Swedish Energy Agency

General Secretariat for Research and Innovation

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

ADEME
Agence de la Transition Écologique

TÜBİTAK

fct
Fundação para a Ciência e a Tecnologia

Freistaat SACHSEN

This project (Nr. 100695543) is co-financed by means of taxation based on the budget adopted by the representatives of the Landtag of Saxony.

SAB Sächsische AufbauBank

Gobierno de España
Ministerio de Ciencia, Innovación y Universidades

CDTI Innovación

Agencia Estatal de Investigación

Disclaimer

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MANOEUVRE

MANOEUVRE

Energy System Modelling for Transition to a net-Zero 2050 for EU via REPowerEU

European Energy Vision 2060 (EU EnVis 2060) Scenarios

Mostafa Barani

Department of Industrial Economics and Technology Management
Norwegian University of Science and Technology (NTNU)
Trondheim, Norway

NTNU

Co-funded by the European Union

This research was funded by CETPartnership, the European Partnership under Joint Call 2022 for research proposals, co-funded by the European Commission (GA N°101069750) and with the funding organisations listed on the CETPartnership website.

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- NTNU
- TUB
- PSI
- TUW
- E3M
- Kassel University
- EDF

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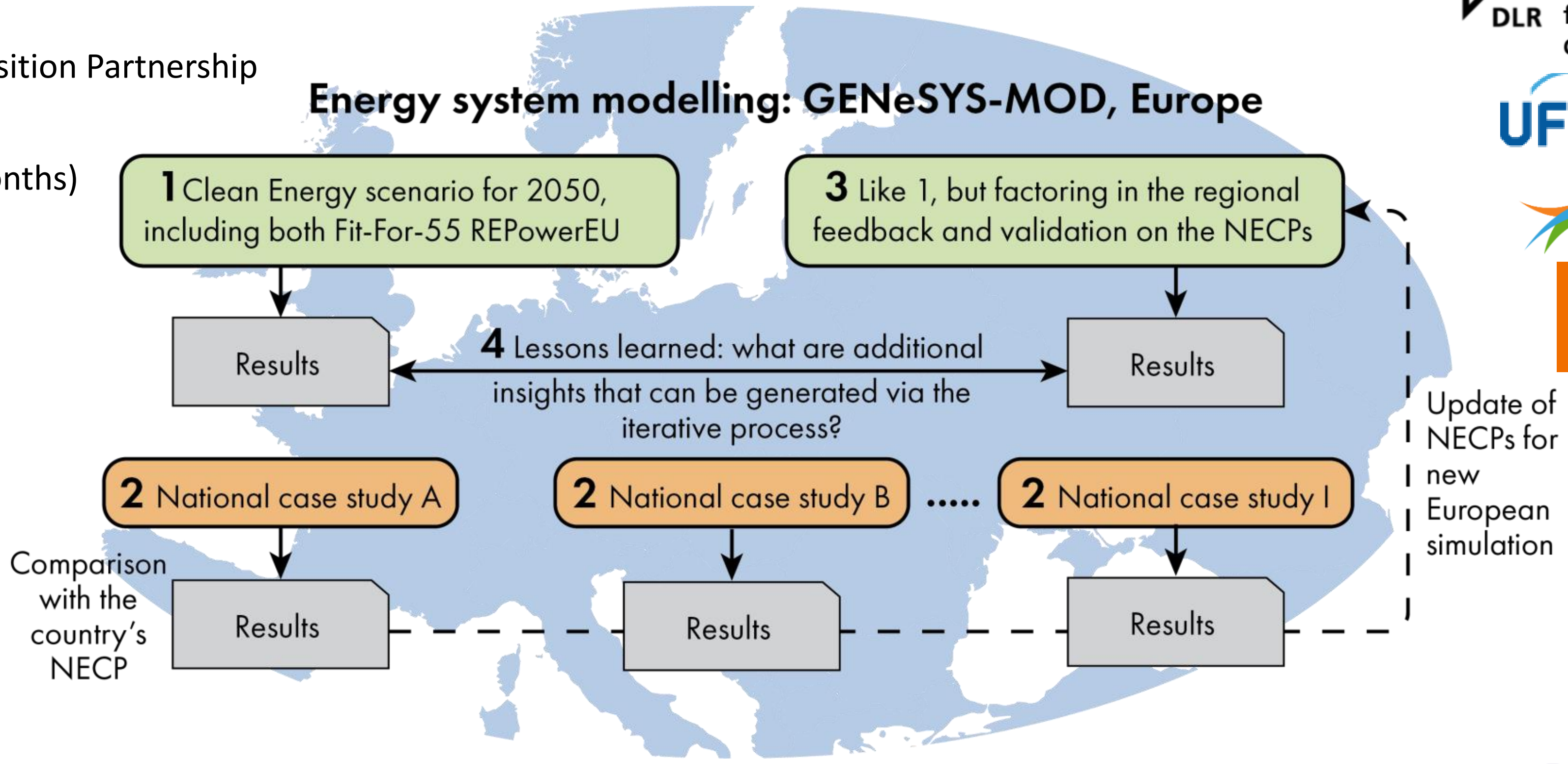
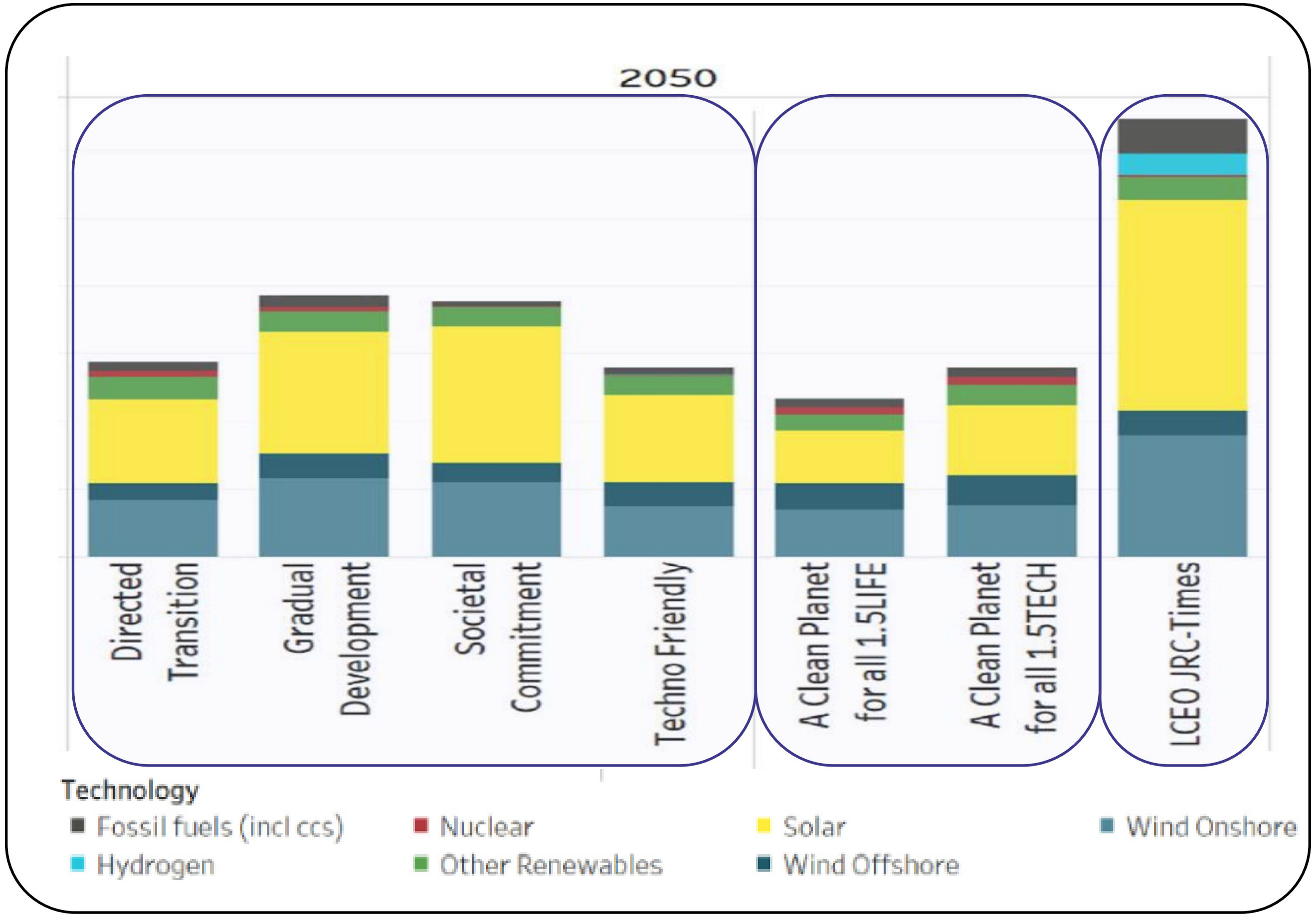
About ManOEUvRE

- Aim:
  - ✓ Improve and coordinate energy system modelling in Europe
  - ✓ Facilitate ambitious emissions reductions for a clean energy transition using recent EU policy suggestions
- Type of project:
  - ✓ Clean Energy Transition Partnership
- Duration:
  - ✓ 2023-2026 (36 months)
- Total Budget:
  - ✓ 3,8 MEUR



What will the European electricity generation mix look like in 2050?



Karlo Hainsch, Konstantin Löffler, Thorsten Burandt, Hans Auer, Pedro Crespo del Granado, Paolo Pisciella, Sebastian Zwickl-Bernhard, “Energy transition scenarios: What policies, societal attitudes, and technology developments will realize the EU Green Deal?,” Energy, 2022.

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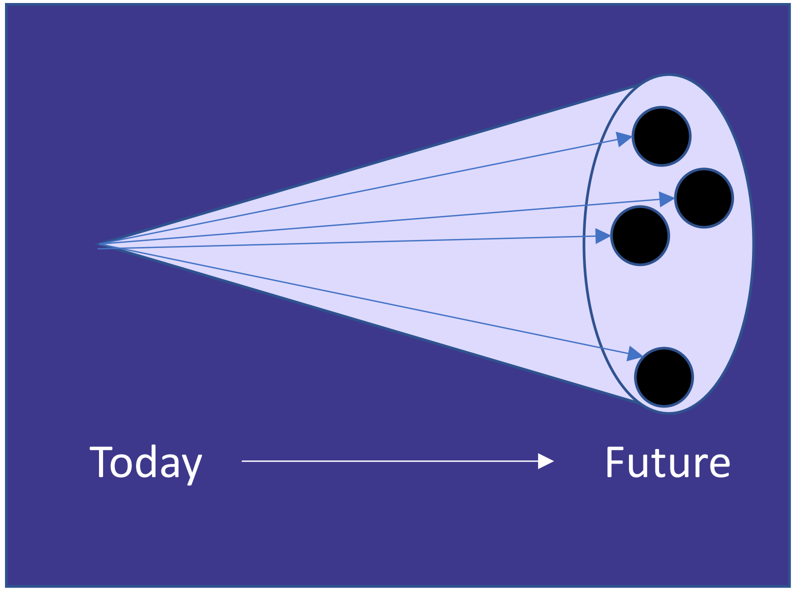
What are (qual.) scenarios?

- *"Scenarios are descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will play out." (UNEP 2002, p. 320)*

- Hypothetical futures, but not arbitrary
- Structured **"Tool of thought"** to explore how the future might look like
- Identification of possible futures
- **Without assigning probabilities**
- **Based on expert knowledge or facts –> No prediction**



MANOEUVRE

Aim and Scope

- **Aim:**
  - ✓ Developing Pan-European scenarios.
  - ✓ Publishing in a peer-reviewed journal
- **Steps:**
  - ✓ Qualitative scenarios
  - ✓ Parametrization and Quantification
- **Scope:**
  - ✓ Geographical Coverage: Europe
  - ✓ Horizon 2050

MANOEUVRE

Steps

Defining the objective of the study

Collect information: Current situation, trend analysis, drivers, and hindrances factors. Methodology

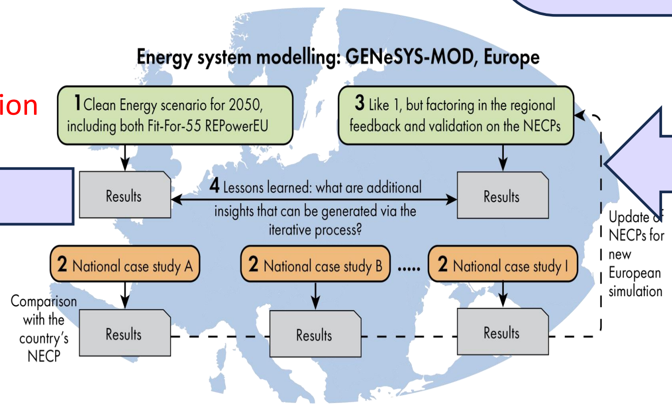
Scenario/Storylines

Parameter/Variable Estimation

Optimization Model

Quantified scenarios

Policy & Recommendation

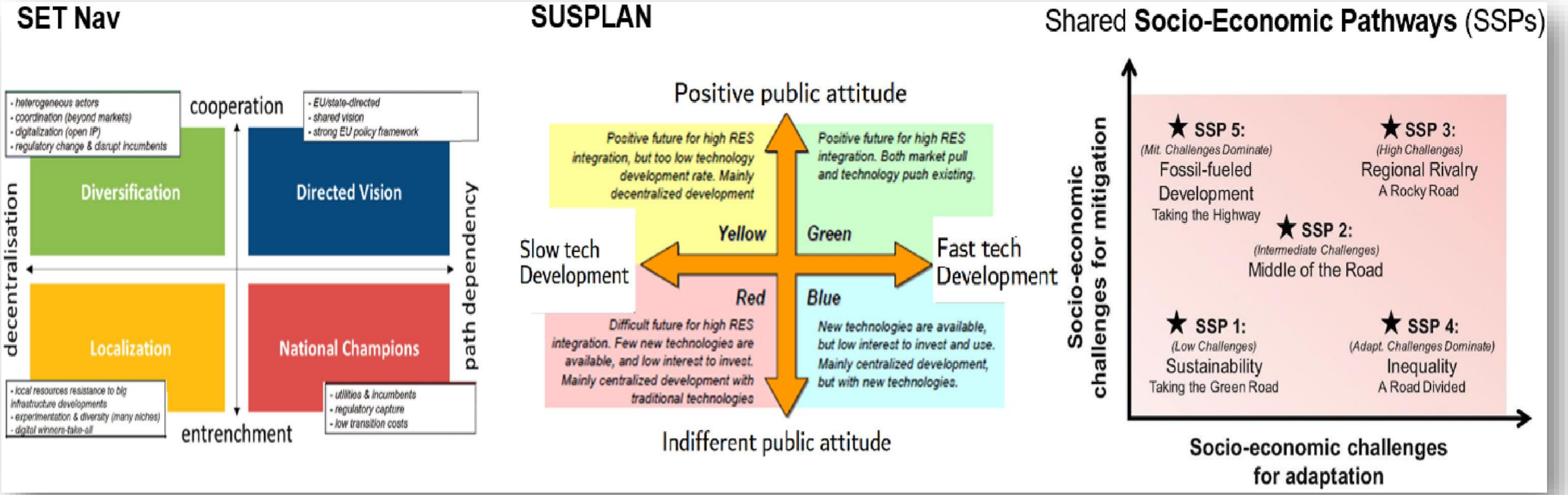


Enhance European energy system modelling for a clean energy transition (CET), aligning with REPowerEU, Fit for 55, and Net Zero Industrial Act.

Regarding Scenarios: Develop pathways for the European energy system, considering current policies like REPowerEU, to achieve net-zero greenhouse gas emissions.

MANOEUVRE

Some Existing Scenarios



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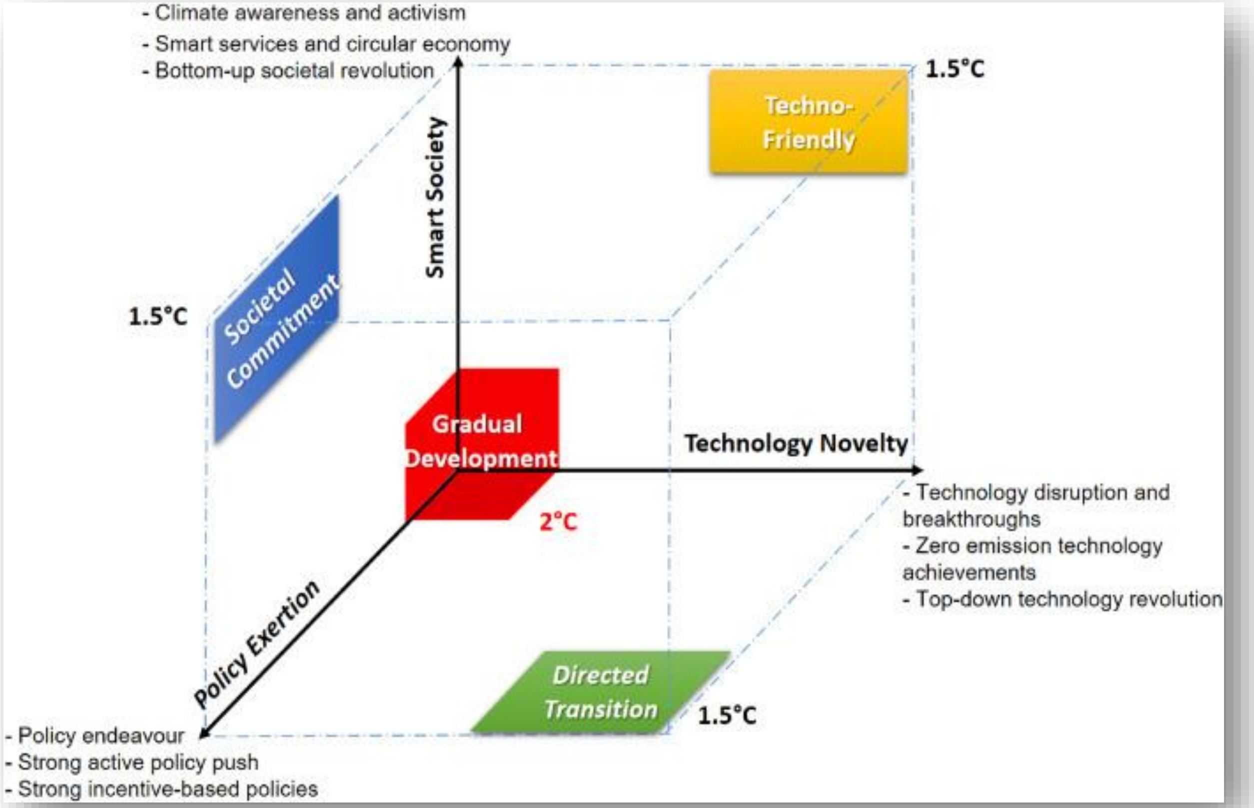
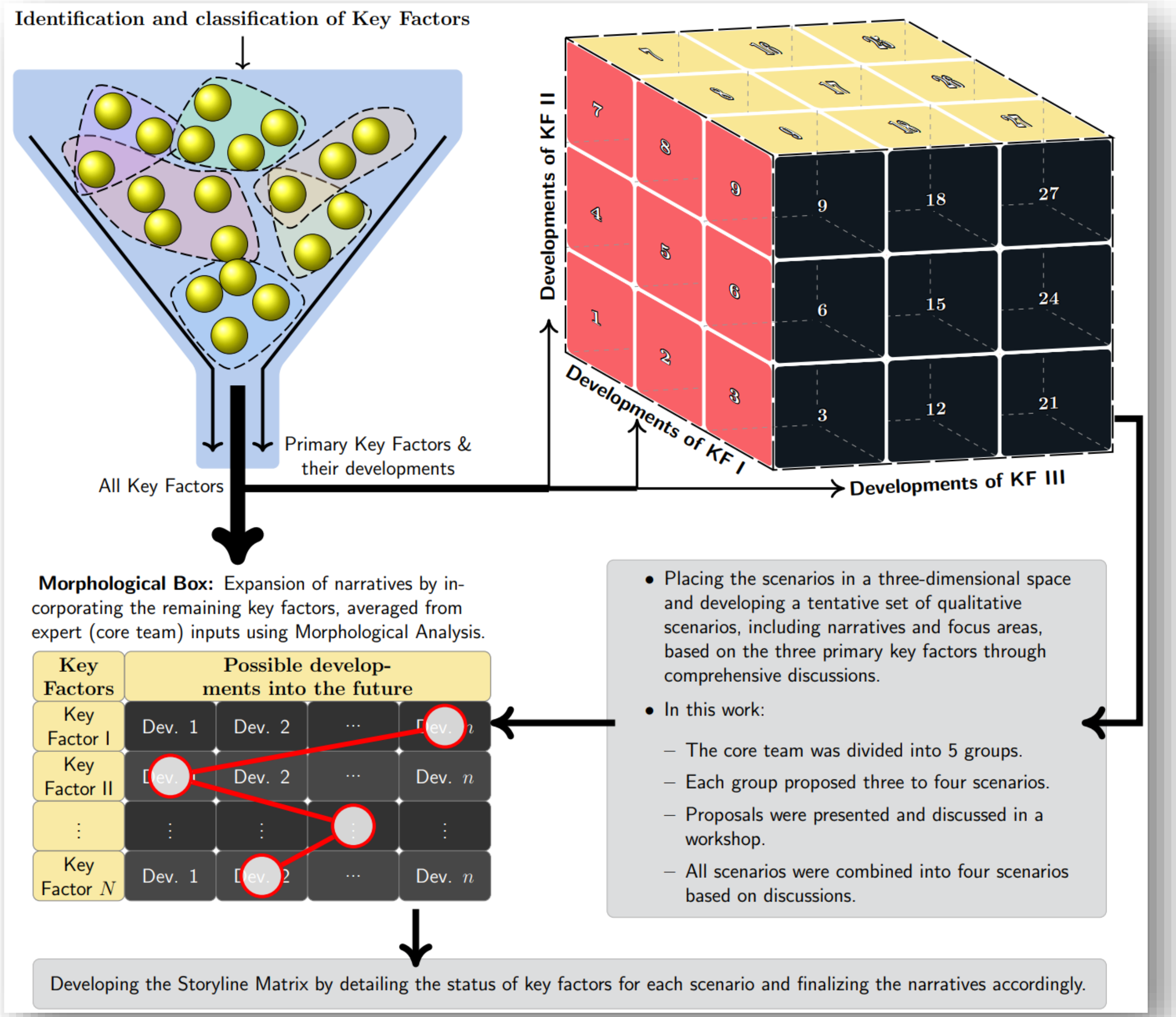
Inclusion of three key factors



MANOEUVRE

Methodology: Step 1



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Step 1: STEP+G Analysis

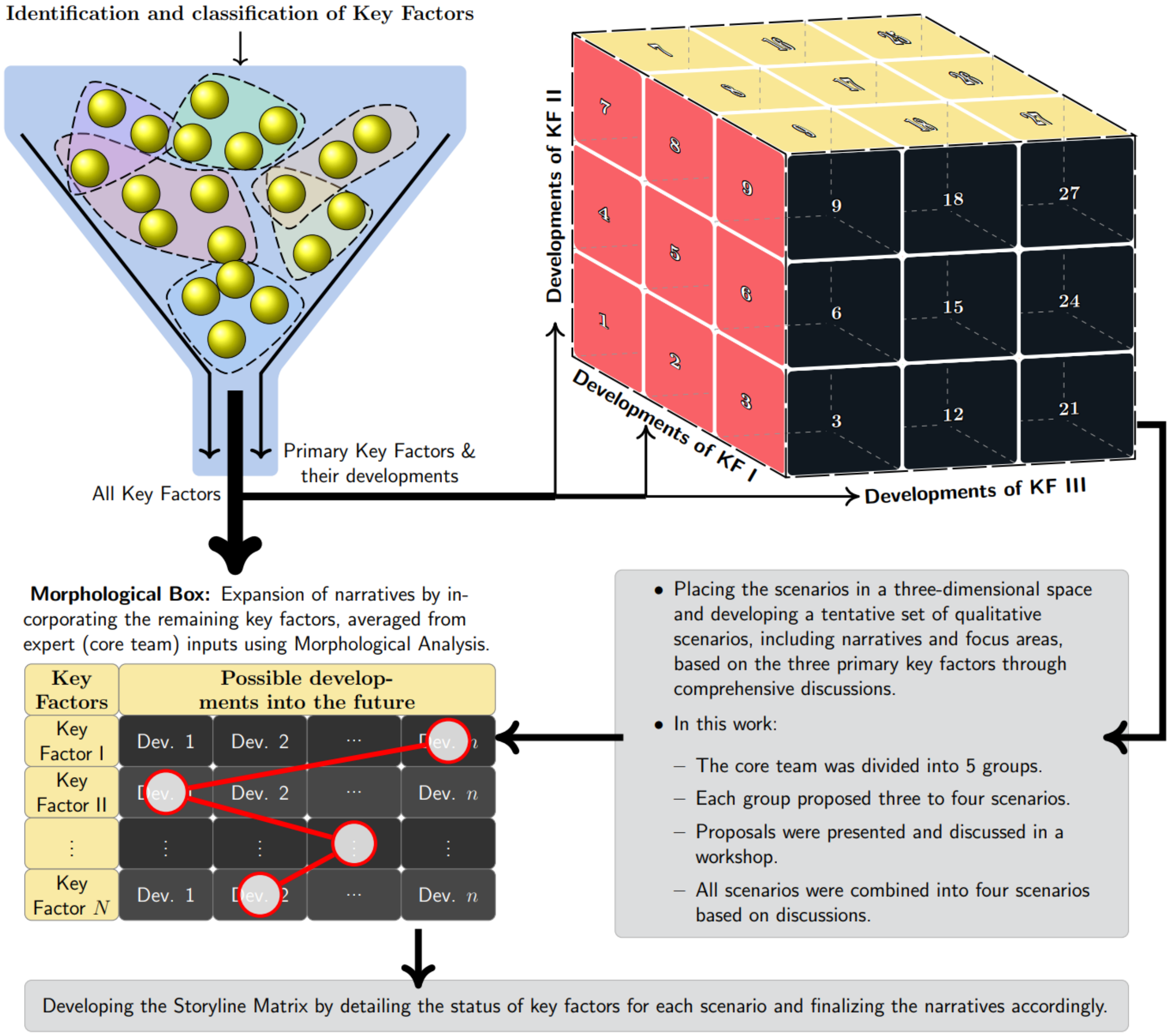
Uncertainties / Key Factors

- ➢Social
- ➢Technological
- ➢Economic
- ➢Political
- ➢Geopolitical

Social

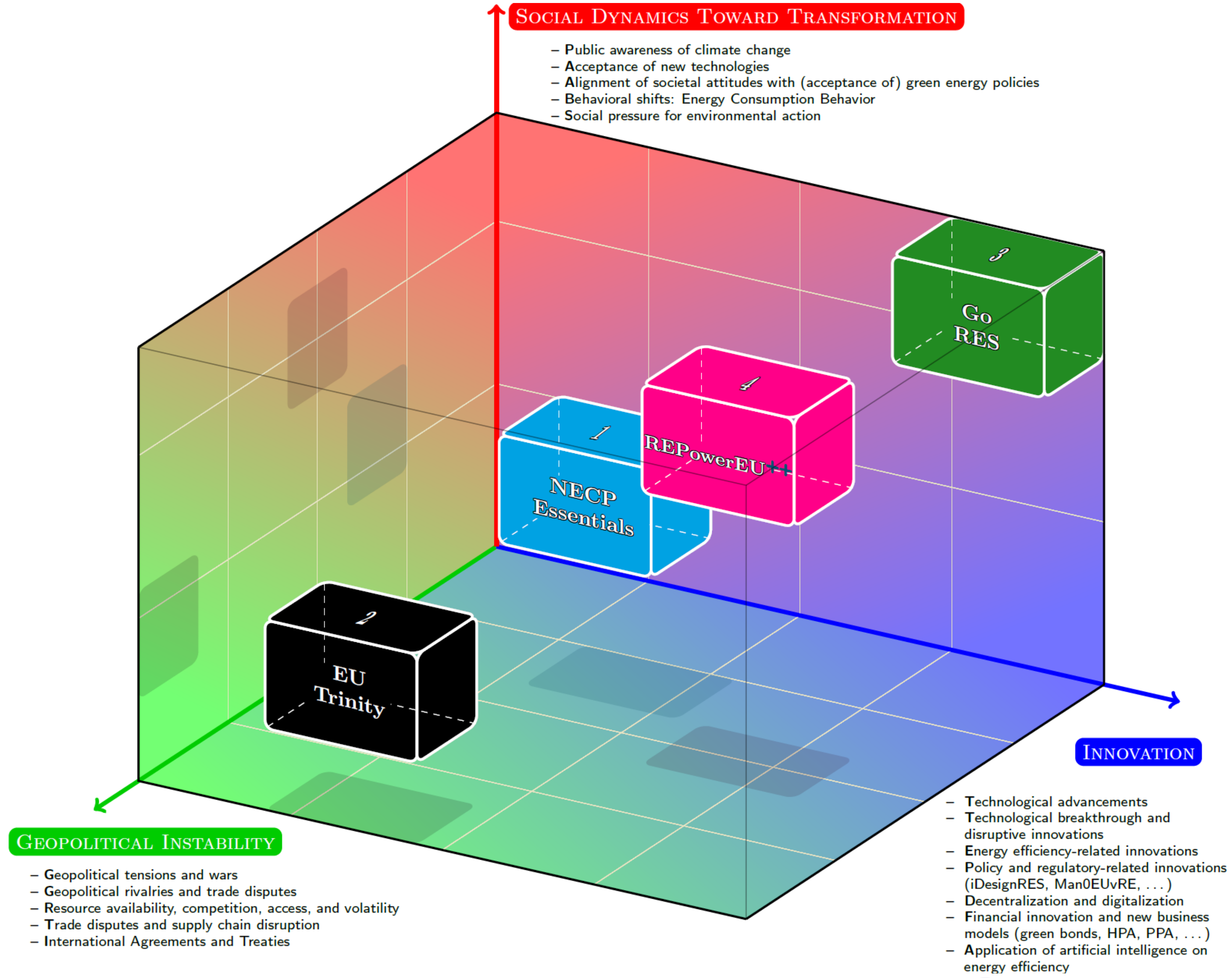
- Public awareness of climate change
- Acceptance of new technologies
- Acceptance of green energy policies
- Behavioral shifts: Energy Consumption Behavior
- Social pressure for environmental action

Methodology
Step 2



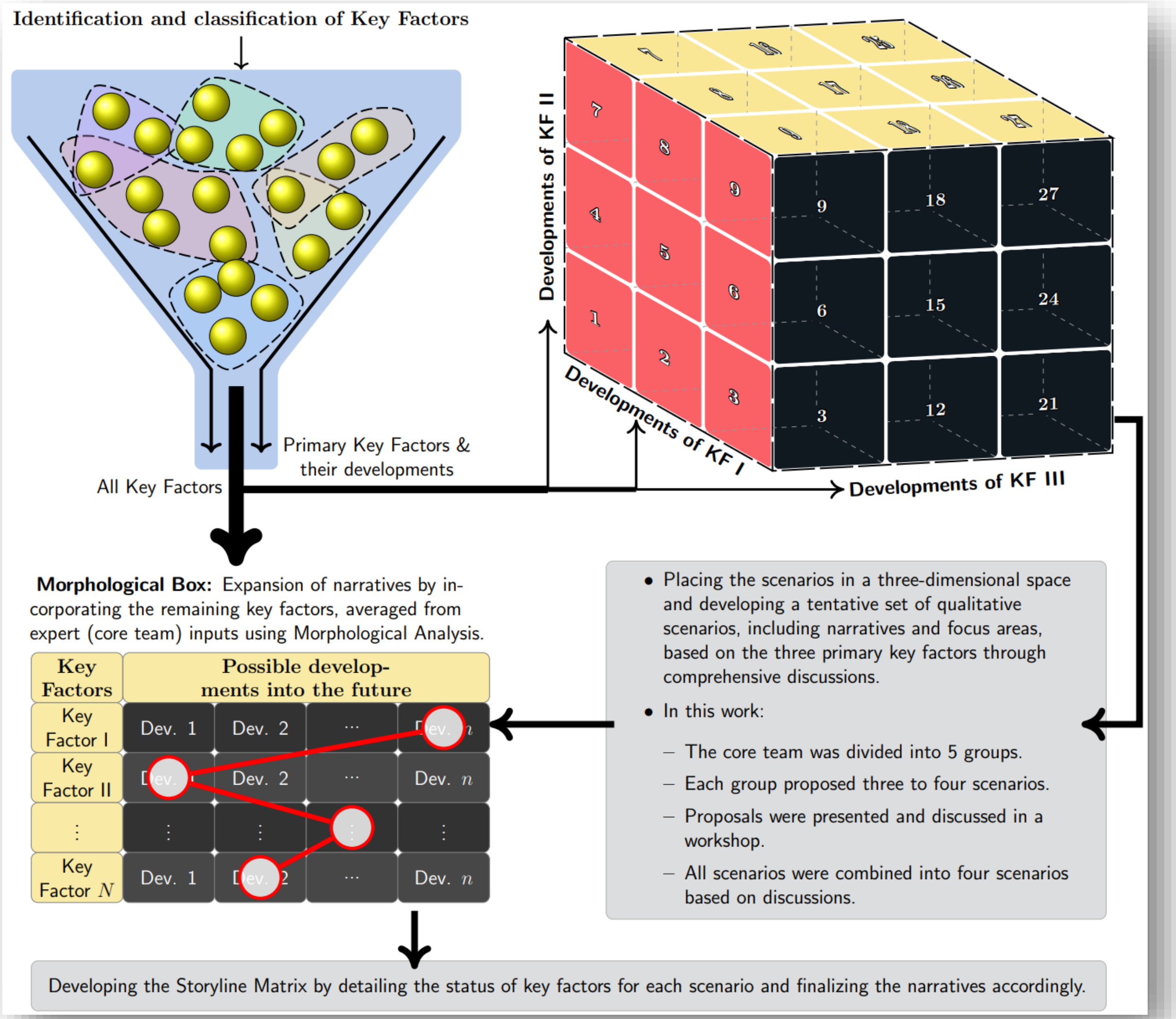
MANOEUVRE

Step 2



MANOEUVRE

Methodology
Step 3



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RepowerEU++

Research Questions

- **Vision of a Self-Sufficient, Independent European Energy System:**

Is it feasible to fully decarbonise Europe's energy system by 2050 while achieving complete energy independence? What will a (almost) fully self-sufficient European energy system look like in 2050? What steps should be followed from this step forward to secure the vision of a self-sufficient, independent European energy system by2050?

- **Long-Term Energy Security and Sustainability:**

What strategies can be implemented to secure a sustainable, cost-effective, and long-term energy supply for the EU, reducing dependency on external sources such as Russia?

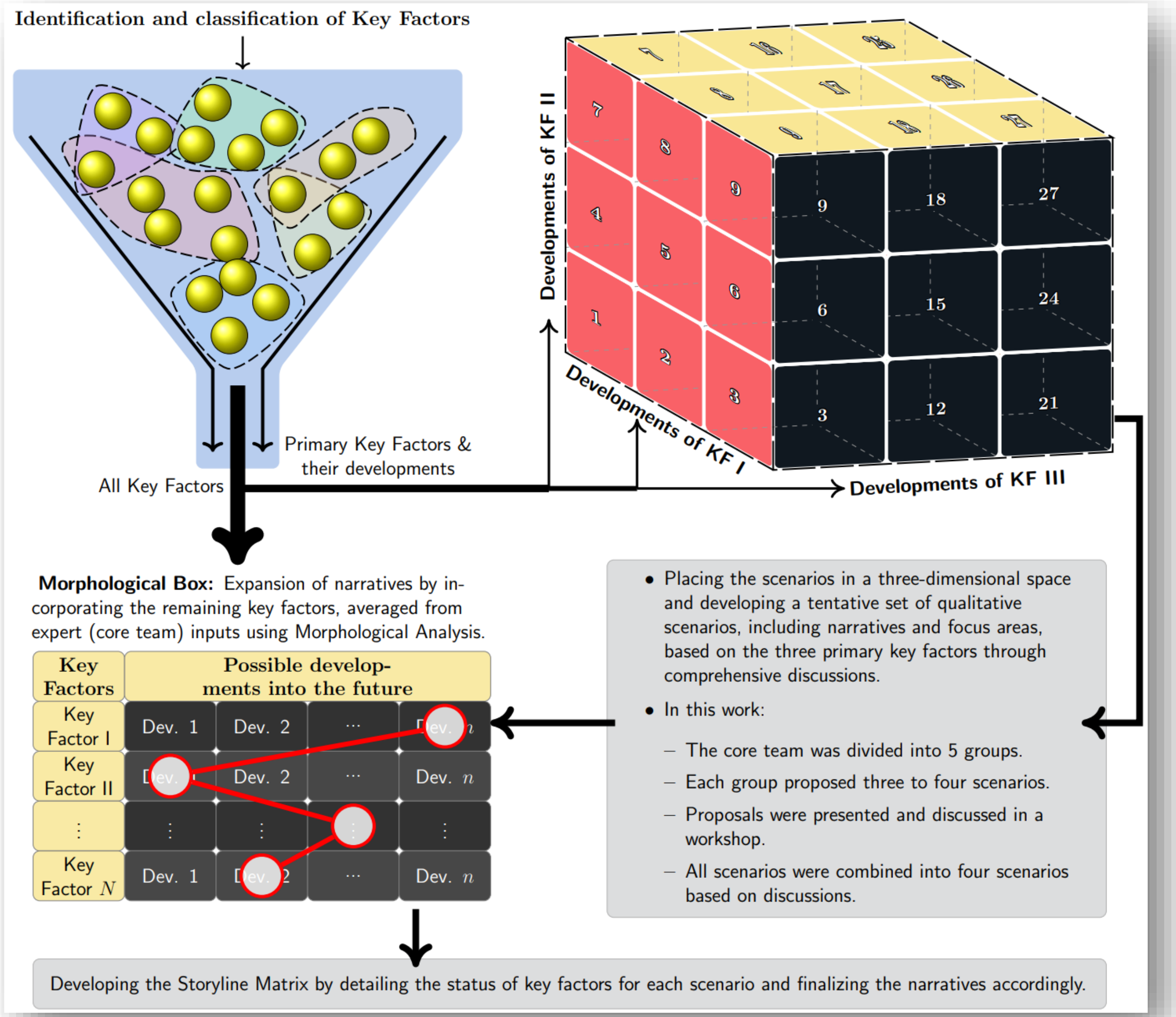
- **Cost-Effective Energy Independence for European Targets:**

What level of energy independence is both cost-effective and sufficient to achieve European climate targets while eliminating reliance on unreliable resources (primary energy resources and critical raw materials)?

Narrative

In the "REPowerEU++" scenario, the European Union launches an ambitious journey towards energy security and sustainability, set against a backdrop of persisting and escalating global geopolitical tensions outside the EU. Despite these external pressures, the EU remains cohesive and united, channelling its collective effort towards achieving energy independence. This unity is reinforced by significant public support for transformative energy policies and advanced technological innovations. The positive trend in renewable energy integration is supported by accelerated innovation in renewable energy technologies, leading to breakthroughs and cost reductions. However, progress is partly constrained by the relocation of production facilities within Europe due to geopolitical rivalries and challenges. By focusing on enhancing its own energy capabilities, the EU strengthens its energy independence, effectively insulating itself from global instabilities. By 2050, the EU aims to set a global benchmark in renewable energy adoption, establishing a resilient and integrated energy system that not only meets its climate targets but also ensures robust energy autonomy despite the challenging international environment!

Methodology
Step 4



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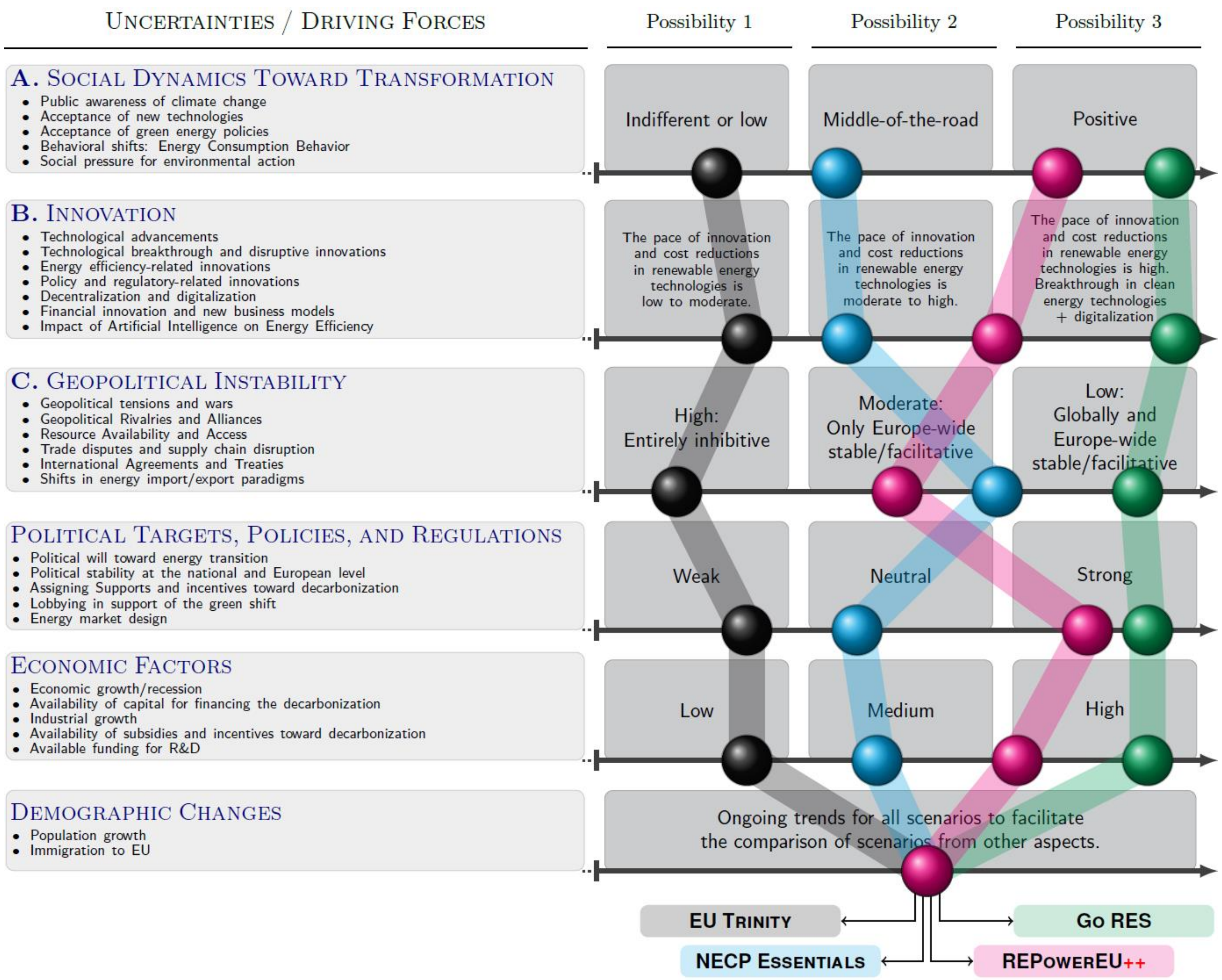
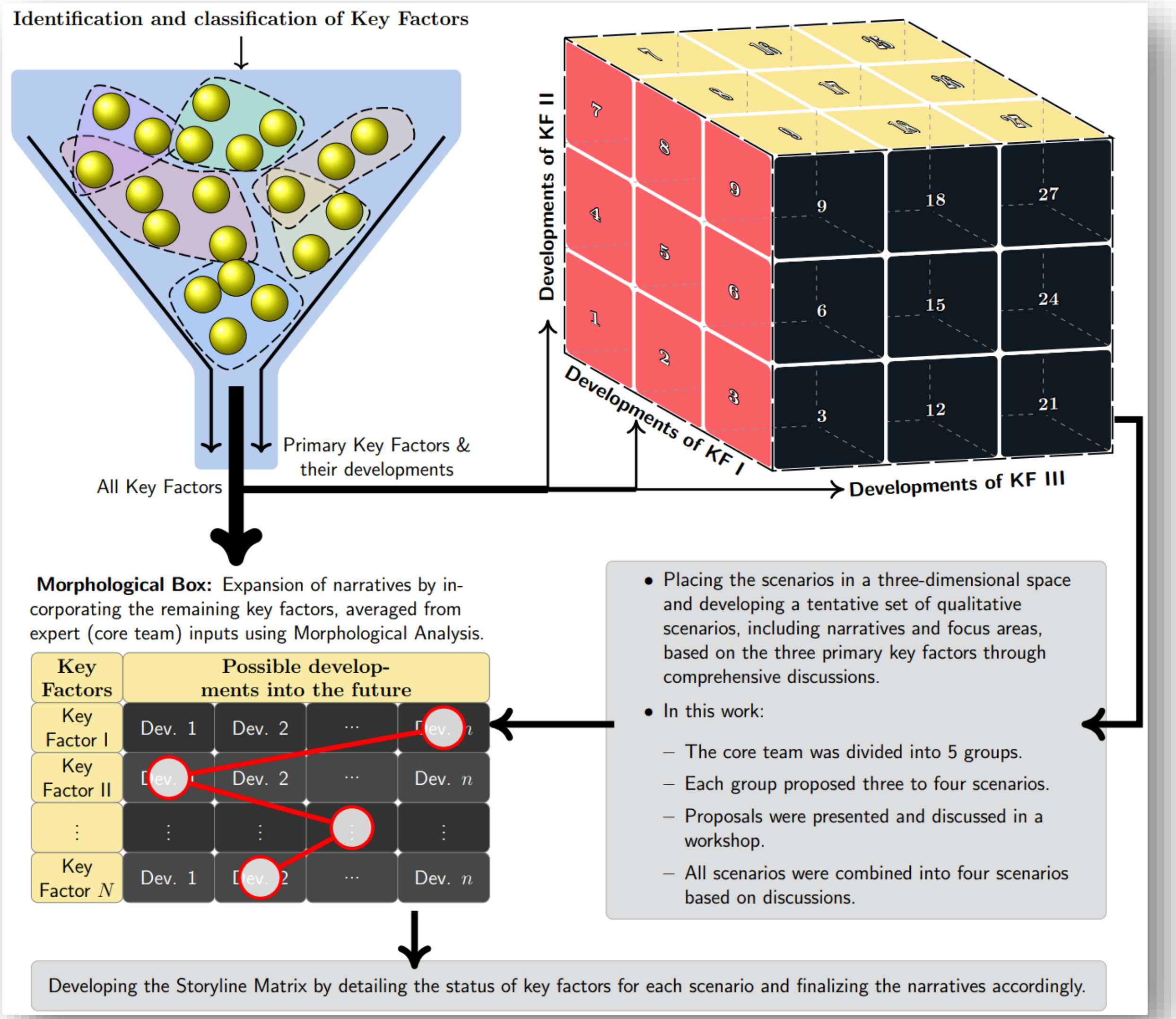
Inclusion of Other Uncertainties



MANOEUVRE

Methodology
Step 5



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Qualitative to Quantitative (Q2Q) Matrix

Description	Primary Influencing factor	EU Trinity	NECP Essentials	REPowerEU++	Go Res
Policies					
GHG Emission Reduction Policies					
Compliant with Green Deal by 2030[1]	D	no	to be determined based on the trajectories outlined in the latest NECPs until 2030.	yes	yes
Compliant with EU Commission CO2 reduction recommendation for 2040[2]	D	not necessarily	to be determined based on the trajectories outlined in the latest National Energy and Climate Plans (NECPs) through 2040.	partial deviation	yes
Net Zero Emission by 2050	D	no - carbon neutrality by 2060	to be determined based on the trajectories outlined in the latest NECPs until 2030. (Either by 2050 or 2055).	yes - carbon neutrality by 2050	yes - carbon neutrality by 2045
Total Carbon Emission Budget until 2050		aligned with a 2° increase	to be determined based on the trends in NECPs	the least expected: in alignment with a 1.8° increase (a final value will be replaced after parametrization)	in alignment with a 1.5° increase
Carbon pricing policies					
Carbon price	-	carbon prices are derived from the dual variable associated with the constraint that limits the carbon budget in the modelling tools.			
ETS (Emissions Trading System) Coverage					
Implementation of EU ETS	D	implementation as planned	implementation as planned	implementation as planned	implementation as planned
Implementation of ETS2[3] (expansion of ETS coverage)	D	delay of plans less ambitious plans (more allowances)	implementation as planned	implementation as planned	implementation as planned
Subsidies					
Fossil-fuel subsidies[4]	D	steady decrease	steady decrease	steady decrease	fast decrease
Green tech subsidies	D	low increase	moderate increase	moderate increase	high increase
LULUCF Targets					
Contribution to carbon sink by LULUCF	D	low increase	ongoing	moderate increase	high increase

[1] The European Climate Law mandates a 55% reduction in net greenhouse gas emissions by 2030 compared to 1990 levels (Read more here)
[2] The current recommendation is a 90% reduction in net greenhouse gas emissions by 2040 compared to 1990 levels. The next Commission will propose legislation to incorporate the 2040 target into the European Climate Law (Read more here).
[3] The EU ETS2 is a new emissions trading system targeting CO2 emissions from fuel combustion in buildings, road transport, and additional sectors, set to become fully operational in 2027 (Read more here).
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TWIN4RESILIENCE

https://t4r.nweurope.eu/

TRANSFORMING TERRITORIAL PLANNING WITH LOCAL DIGITAL TWINS

Dr. Marija BJEKOVIC, LIST

marija.bjekovic@list.lu

TWIN4RESILIENCE - PROJECT FOCUS

Embracing Change in Territorial Planning

In the midst of the transition towards **sustainability** and **digitalisation**, local and regional public authorities are facing increasingly complex challenges in planning their territories.

To foster **resilience** and a high quality of life for humans, animals and environment, it's essential for these authorities to innovate their decision-making processes systematically, and include also **real-time data, simulation and insights** (that can be made) available with innovative technologies.

Local digital twins can act as powerful tools for innovation, allowing for the visualization, analysis, simulation and prediction of territories in ways previously unimaginable.

TWIN4RESILIENCE - PROJECT FOCUS

What are Local Digital Twins ?

Local Digital Twins (LDTs) are virtual representations of territories, such as cities, created using advanced technology that models and/or simulates real-world data.

This technology is now made available even to communities with smaller budgets. Many cities already have different types of data and 3D models, differing widely in their characteristics and maturity. These are typically stuck in Geodata or IT departments, and the potential of their further development and exploitation for decision-making is still underexploited.

The lack of understanding of what a LDT is, and how it can help territorial planning, leads to lack of political support to use LDTs, hence lack of validated use-cases, proof of impact and cooperation.

TWIN4RESILIENCE - PROJECT FOCUS

Problem statement

LDTs are presented as ultimate tech for smart cities, but their developments are for now primarily technology/market-driven. There is still **confusion** around the concept, and the space for independent and critical discussion around LDT.

Further development of LDTs hindered by lack of:

- validated use-cases, cooperation between cities/regions, and lack of standardization
- integration of data sets beyond single use cases, hence lack of data strategies
- opportunities to scale-up and jointly increase innovation capacity

The **gap** between business and technology cases needs to be bridged to effectively develop and use LDTs to steer processes of planning and resources management.

TWIN4RESILIENCE - AMBITIONS, OBJECTIVES + EXPECTED OUTCOMES

1- Enhancing the understanding, **skills and competencies** of civil servants, territorial planning companies, and citizens about the innovation potential as well as limitations of LDTs

Joint strategy for wider uptake of LDT

- Governance framework
- Ethics framework
- Technical design framework
- Train-the-trainer framework

2- Inclusively, democratically, affordably and sustainably **deploying LDTs in the decision-making processes** of a broader range of local and regional public authorities.

8 pilot use cases of testing LDT as decision support in territorial planning (mobility, energy, environment, integrated urban planning)

3- Enhance **innovation capacity of public authorities** through cooperation between innovation leaders/front-runners, followers and newbies.

Transnational development and application of training scheme

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

CONSORTIUM AND TIMELINE

Start Date: 01/01/2024
End Date: 31/12/2028

Interreg
Co-funded by the European Union
North-West Europe

Countries: Netherlands, Belgium, Germany, Ireland, Luxembourg & France

- City of Utrecht (NL)
- Municipality of Amsterdam (NL)
- Dublin City Council (IE)
- Rennes Metropole (FR)
- City of Brussels (BE)
- Intermunicipal association Leiedal (BE)
- Municipality of Schuttrange (LU)

- Flanders Environment Agency (BE)
- LIST (LU)
- K8 (DE)
- Digital Flanders (BE)
- HKU University of the Arts Utrecht (NL)
- Data Competence Centre for Cities and Regions (DE)
- ALL DIGITAL (BE)

Municipalities from 4.000 to 900.000 residents

SMEs and/or Unis
for technological development

Uni/RTOs
as innovation partners

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PILOTS AS LEARNING OPPOTRUNITIES

Pilots thematic clustering

Domain	Energy	Mobility	Environment	Integrated Territorial Plannung
Lead	**Schuttrange**	**Dublin**	**VMM**	**Utrecht**
Participants	Utrecht	Utrecht	Brussels	Amsterdam
		Amsterdam	Rennes	Dublin
			Utrecht	Leiedal
			Dublin	Rennes

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STATUS QUO – INSIGHT INTO CLUSTERS

Energy | Mobility | Environment | Integrated Territorial Plannung

CITY 1

Scope: Operational management of resource consumption in municipal buildings

Expert push: Domain experts/sustainable development dpt well aware of required data and monitoring/prediction potential of LDT towards improved decision-making

Tech hindrance: Heavy reliance on external partners for the digitalisation, low digitalisation and fragmented application landscape, existing IoT and technical investments foreseen in sensors and equipment, no data inventory/scattered and heterogeneous data

CITY 2

Scope: Seeks to improve urban planning with better visualisation and simulations

Tech push: LDT of a city currently used only as a visualisation tool, focussing on static open data. Desire to proceed with simulation scenarios and dynamic data

Business hindrance: use case unclear, no clarity yet on who should LDT serve primarily, domain experts (urban planners) unsure how to include LDT into their processes, and what can it contribute to.

Both cities are grappling with how to make their tools more useful for decision-making

STATUS QUO – INSIGHT INTO CLUSTERS

Energy | Mobility | Environment | Integrated Territorial Plannung

CITY 1

Scope: Clear focus on environmental and health issues, e,g, heat island effect

Business push: Identifying high-level use cases, strong desire to raise awareness and promote transversal work within city departments, seeking for collaboration with front-runner cities in the domain

Tech hindrance: No 3D models, early stages of dvpt of LDT and related architecture, strong emphasis on visualisation

CITY 2

Scope: Seeks to improve urban planning with better visualisation and simulations

Tech push: engaged in multiple LDT projects with 3D models, has many stakeholders and is currently optimising their models. Focussed on establishing foundation architecture before detailing the cases. Strong focus on visualisaiton

Business hindrance: struggling with low interest and responsiveness form urban planners and other end users. Not certain about prioritisation of cases (air quality, flooding, green spaces, mobility, new housing)

Wants to use LDT as an engagement tool to cultivate cultural shift across departments

Both cities struggle with stakeholder engagement and challenge of raising awareness of potential of LDT.

STATUS QUO – INSIGHT INTO CLUSTERS

Energy | Mobility | Environment | Integrated Territorial Plannung

CITY 1

Scope: Already using AI/data for overflow mgt and water quality mgt. Model and govern LDT to support multiple use cases

Business push: Stakeholders involved are municipal and supra-municipal, citizens not directly involved. Broadening the scope - integration and governance strategies needed for supporting broader applications

Tech challenge: Design of LDT to handle multiple cases – manage impact of overflows on water quality

CITY 2

Scope: LDT to support multiple cases and broader applications (solar cadastre, air quality, urban heat islands, etc)

Tech push: 3D model available to citizens but not linked to specific use cases. Open-source data sharing exists, IoT network exists but these are not connected. Create interactive platform with integration into local data-sharing platform, refine tech architecture and integrate with private entities

Business hindrance: seeking clarity on what constitutes LDTs, need for public consultation and user engagement to clarify the use cases and scope

Both cities aim to clarify and integrate LDT into existing work. Expanding LDT capabilities leads to ecosystem-based models, raising more challenges of governance and integration.

STATUS QUO – KEY INSIGHTS

Energy | Mobility | Environment | Integrated Territorial Plannung

1. Most partners struggle with precise definition of their use case (exceptions such as water quality management, urban heat island mitigation, responsible use of energy in municipal buildings). Typically, general trends like efficiency and transparency in decision-making processes, or more informed decision-making drive the explorations of technology

2. User engagement (experts, cross-departmental collaboration, citizens or external stakeholders) is a general challenge, but very important to ensure that LDT meets diverse needs and objectives.

3. Models of LDT governance differ significantly. The maturity of the governance structure seems to correlate with the extent and criticality of data being managed (data mgt, data inventories, data utilization + responsibilities, workflows etc)

STATUS QUO – KEY INSIGHTS

Technological maturity

- Foundational digital architecture (creating or improving DT models and components)
- Growing use of IoT devices and middleware to manage complex urban data
- Application landscape rationalisation
- Information architecture, data inventories and data governance, including data regulation challenges (GDPR)

Relevant LDT capabilities

- Importance of GIS and 3D models (importance of spatial analysis)
- Game engines used for interactive visualisation (more immersive and interactive experience)
- Dashboarding for decision-makers and public engagement (data accessibility and visualisaiton)

Pilot cities that have a strategic vision and existing infrastructure are more likely to successfully implement and benefit from LDT technologies.

JOIN US!

Rather than just developing technology, T4R focuses on building capacity and empowering individuals and governments to navigate change effectively and sustainably in territorial planning.

Let's work together to reshape territorial planning, promoting resilience, inclusivity, and sustainability across North-West Europe and beyond.

https://t4r.nweurope.eu/

Interoperable and Sovereign Data Sharing in Building Permit Management Data Space

Gonzalo Gil, Izaskun Fernandez, Ricardo Romero and Francisco Javier Diez

Francisco Javier Díez | Tekniker | 24/09/2024

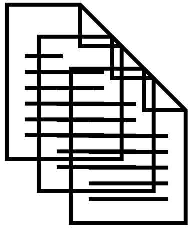
Tekniker
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

SUSTAINABLE PLACES 2024

Index

- Digital building permits and Digichecks
- Data Spaces
- Construction data space
- Tekniker data space conector
- Data sharing semantic interoperability

- Building permit management involves **complex compliance check processes**



Requirements

Low level of digitalization in the construction sector leads to **resource-consuming compliance checks**

Considerable delays in obtaining building permits

DigiChecks

- Topic: HORIZON-CL4-2021-TWIN-TRANSITION-01-10 (IA)
- Project starting date: 01/06/2022
- Project duration: 36 months
- Budget: 6.5 M€

Creation of a new **digital framework** to enable **interoperable, trusted and sovereign data sharing** between platforms of different stakeholders to **facilitate the management of building permits and compliance checks**

Challenges

- To obtain building permits in the construction domain…
  - For different countries, but also regions or municipalities, there is a need **to check compliance with different regulations**

  - To check compliance, coordination issues should be tackled by **sharing** building **data** stored in different **proprietary formats.**

  - The **reluctance to share data** needs to be avoided. To enable data sharing, the **self-determination** regarding **the usage of the data** must be granted

- **Needs**:

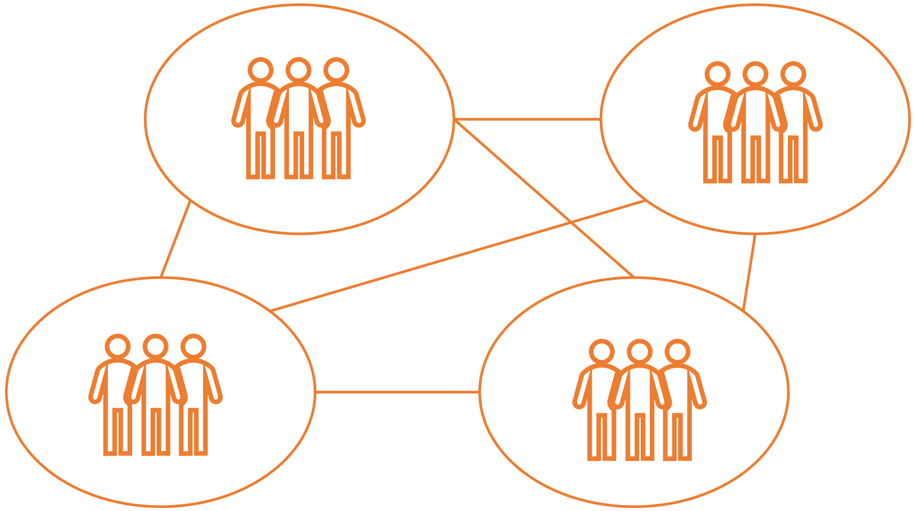
  - Automated compliance checking **cannot be achieved with one-step solution**, but by **combining multiple tools** in the form of services provided by different organizations that gradually makes compliance checking more mature.

  - The wide variety of existing processes, tools and contexts means that there will be **no one-size-fits-all solution**, but a **solution** that enables the **interaction with multiple services.**

  - Individual services communicating with each other need a **common language** so that they can understand each other. The common language should follow a formal, explicit specification of a shared conceptualization.

  - **Data sovereignty** needs to be provided ensuring data owners with the self-determination regarding the usage of their data

- Distributed and open infrastructure to foster the collaboration between services provided by different participants based on data sharing



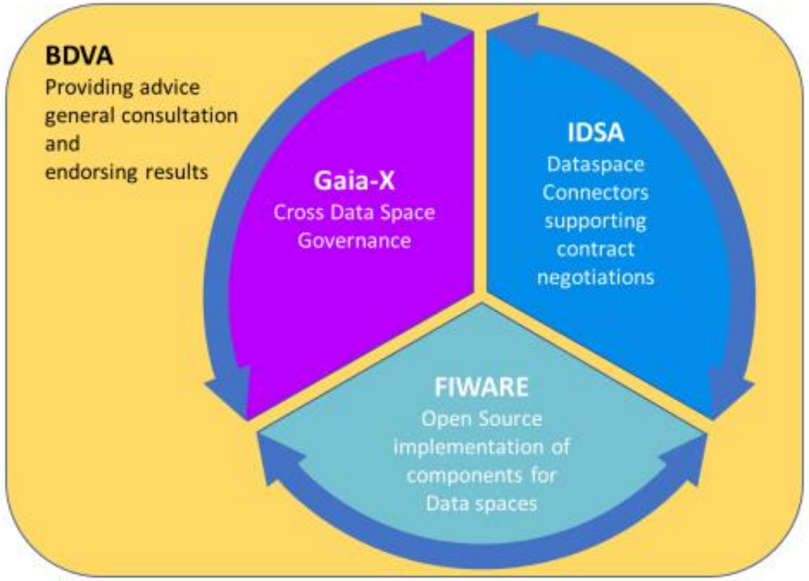
Interoperability

Trust

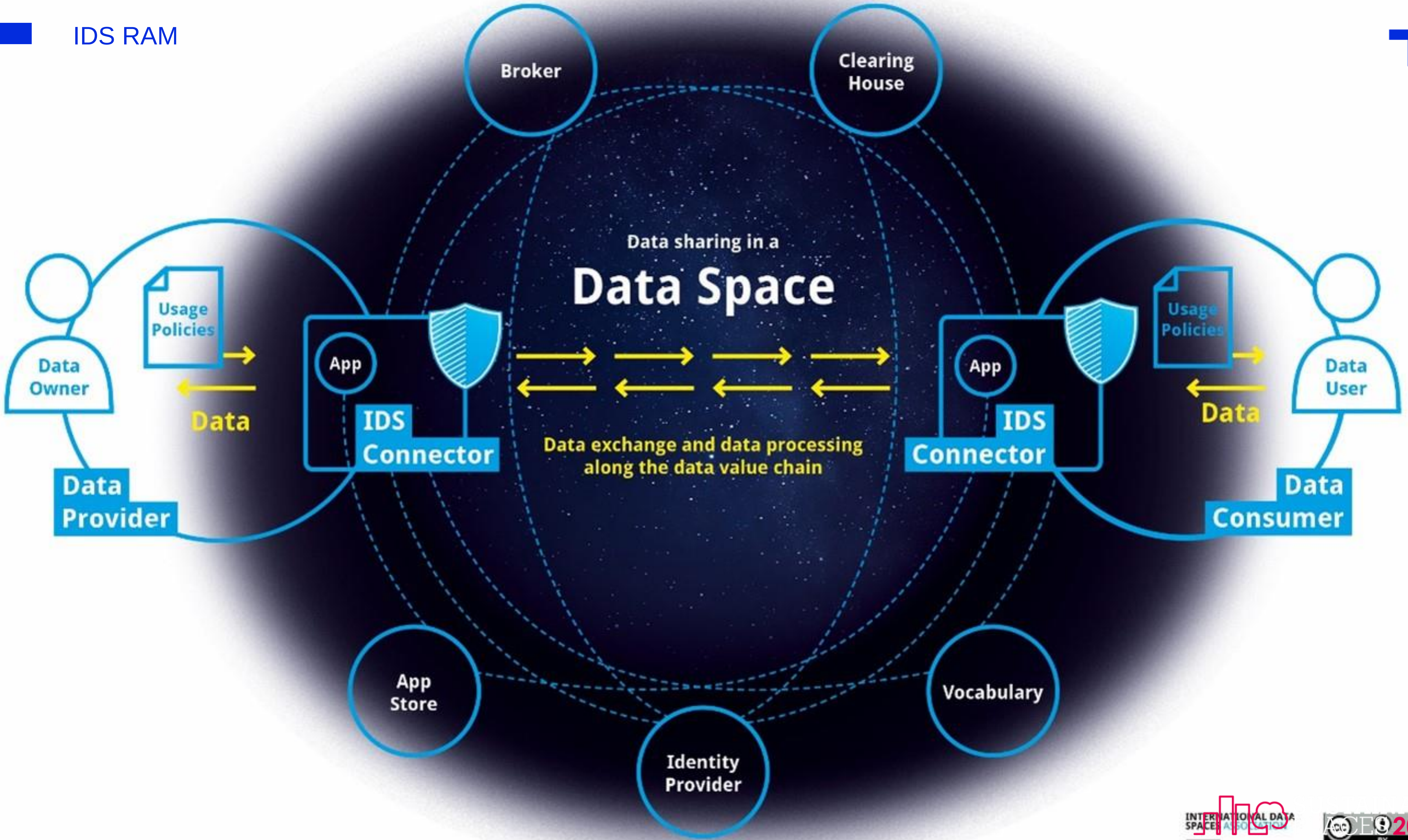
Data Sovereignty

Organizations working on Data Spaces

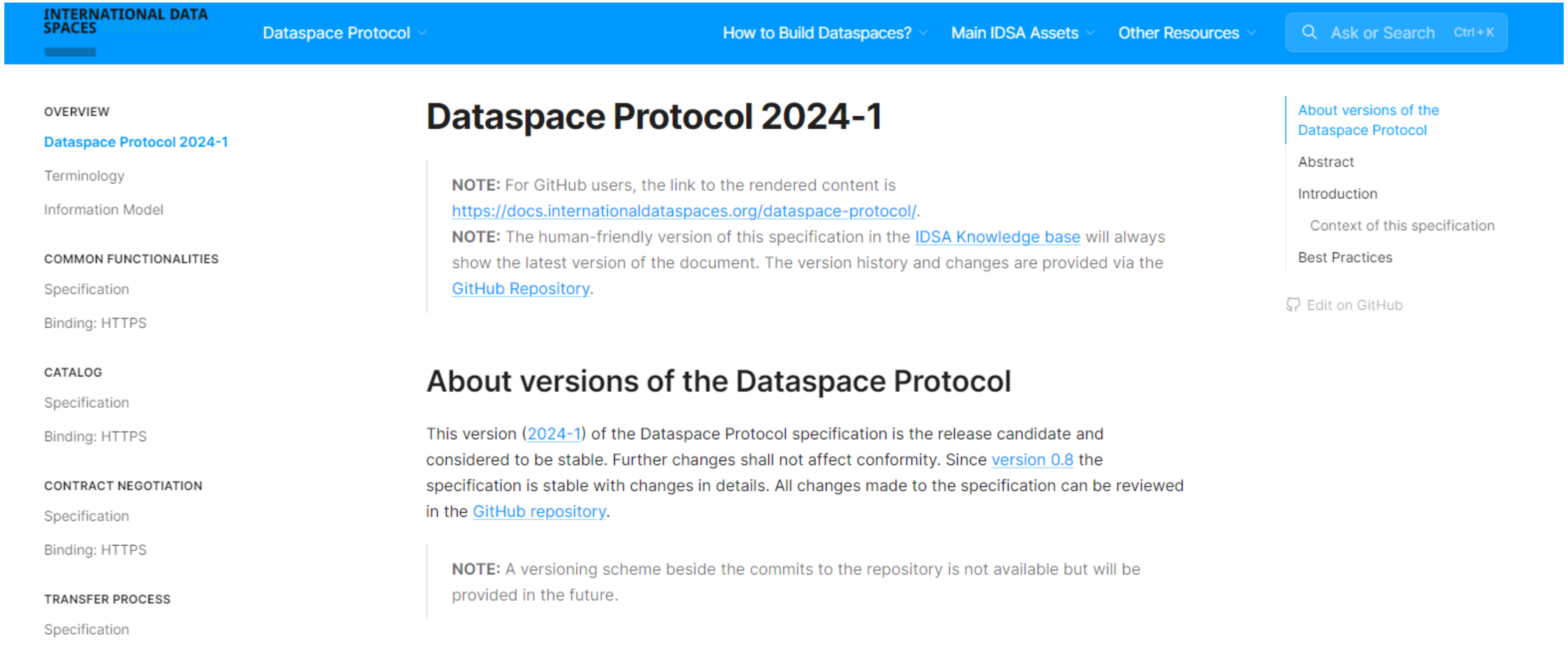
- IDSA –International Data Spaces Association
- GAIA-X
- FIWARE
- BDVA – Big Data Value Association
- DBSA – Data Space Business Alliance
- DSSC – Data Space Support Centre



DBSA – Data Space Business Alliance


Broker
Clearing House
Data sharing in a
Data Space
Usage Policies
Data Owner
Data
App
IDS Connector
Data Provider
Data exchange and data processing along the data value chain
App
IDS Connector
Usage Policies
Data User
Data
Data Consumer
App Store
Identity Provider
Vocabulary
INTERNATIONAL DATA SPACES ASSOCIATION

- Dataspace protocol: “It is a set of specifications that define the protocols and schemas to expose a catalog of datasets, negotiate usage agreements and access negotiated datasets“


INTERNATIONAL DATA SPACES

Dataspace Protocol | How to Build Dataspaces? | Main IDSA Assets | Other Resources | Ask or Search Ctrl + K

OVERVIEW
- Dataspace Protocol 2024-1
- Terminology
- Information Model

COMMON FUNCTIONALITIES
- Specification
- Binding: HTTPS

CATALOG
- Specification
- Binding: HTTPS

CONTRACT NEGOTIATION
- Specification
- Binding: HTTPS

TRANSFER PROCESS
- Specification

Dataspace Protocol 2024-1

> **NOTE:** For GitHub users, the link to the rendered content is https://docs.internationaldataspaces.org/dataspace-protocol/.
> **NOTE:** The human-friendly version of this specification in the IDSA Knowledge base will always show the latest version of the document. The version history and changes are provided via the GitHub Repository.

About versions of the Dataspace Protocol

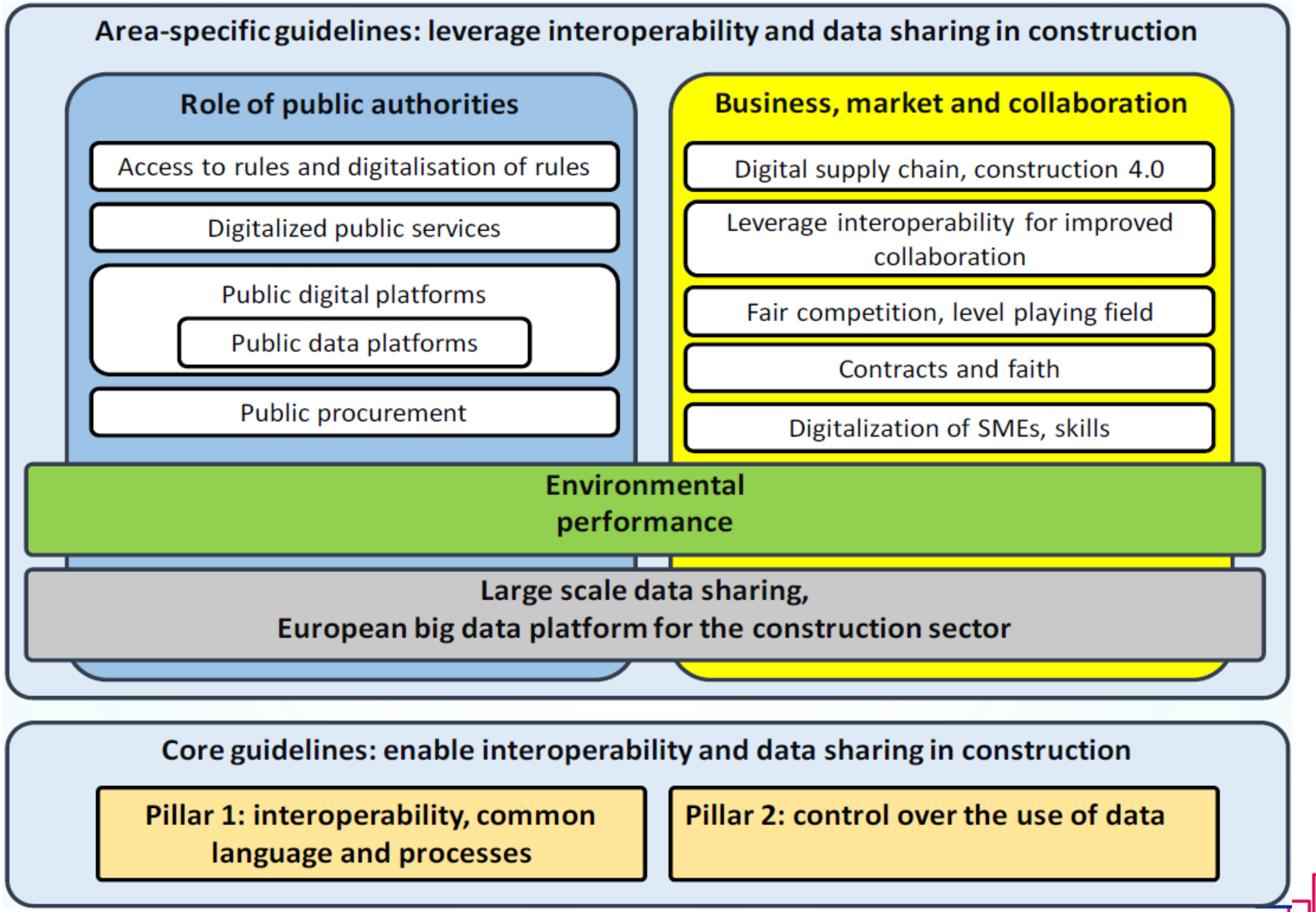
This version (2024-1) of the Dataspace Protocol specification is the release candidate and considered to be stable. Further changes shall not affect conformity. Since version 0.8 the specification is stable with changes in details. All changes made to the specification can be reviewed in the GitHub repository.

> **NOTE:** A versioning scheme beside the commits to the repository is not available but will be provided in the future.

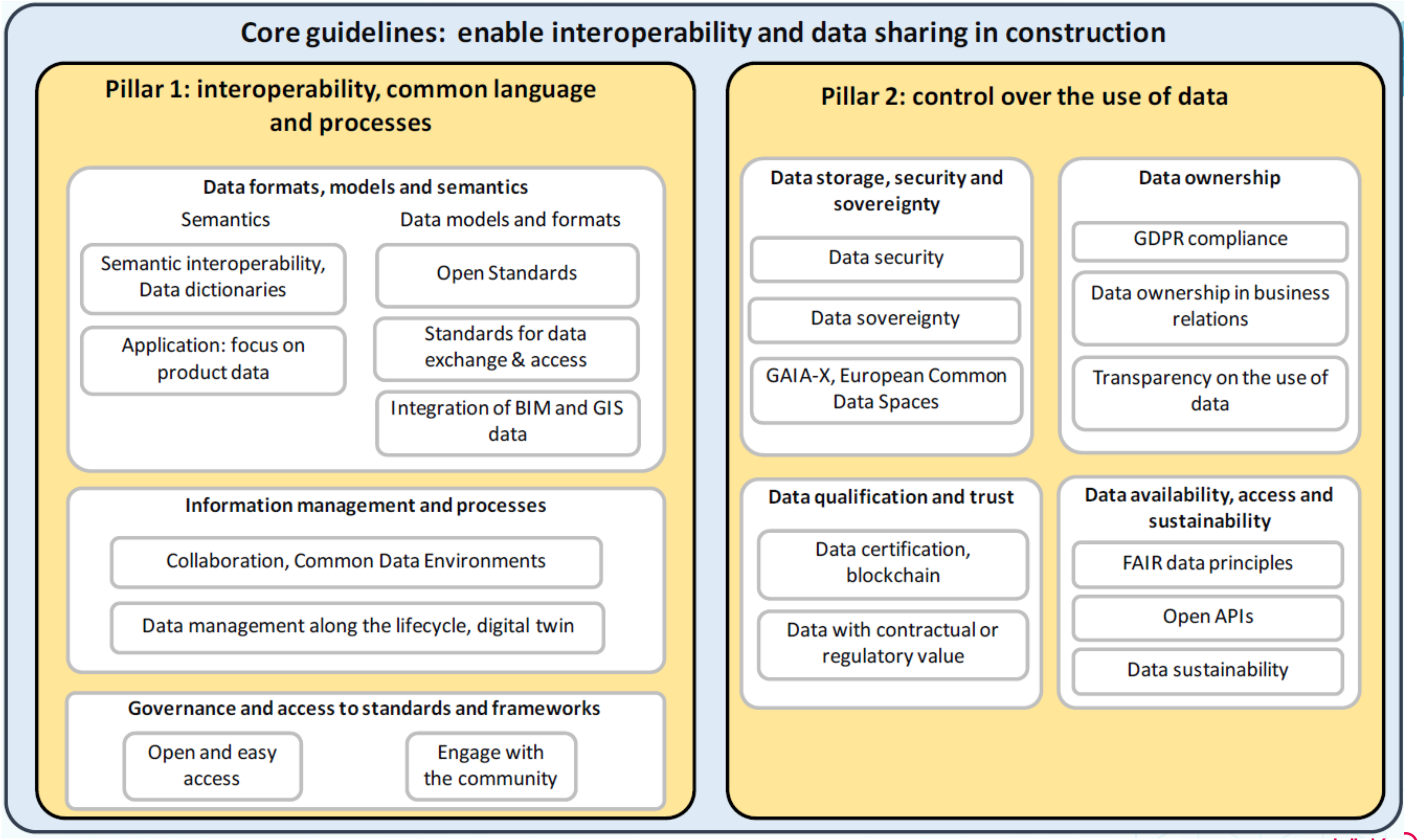
- About versions of the Dataspace Protocol
- Abstract
- Introduction
  - Context of this specification
- Best Practices

Edit on GitHub

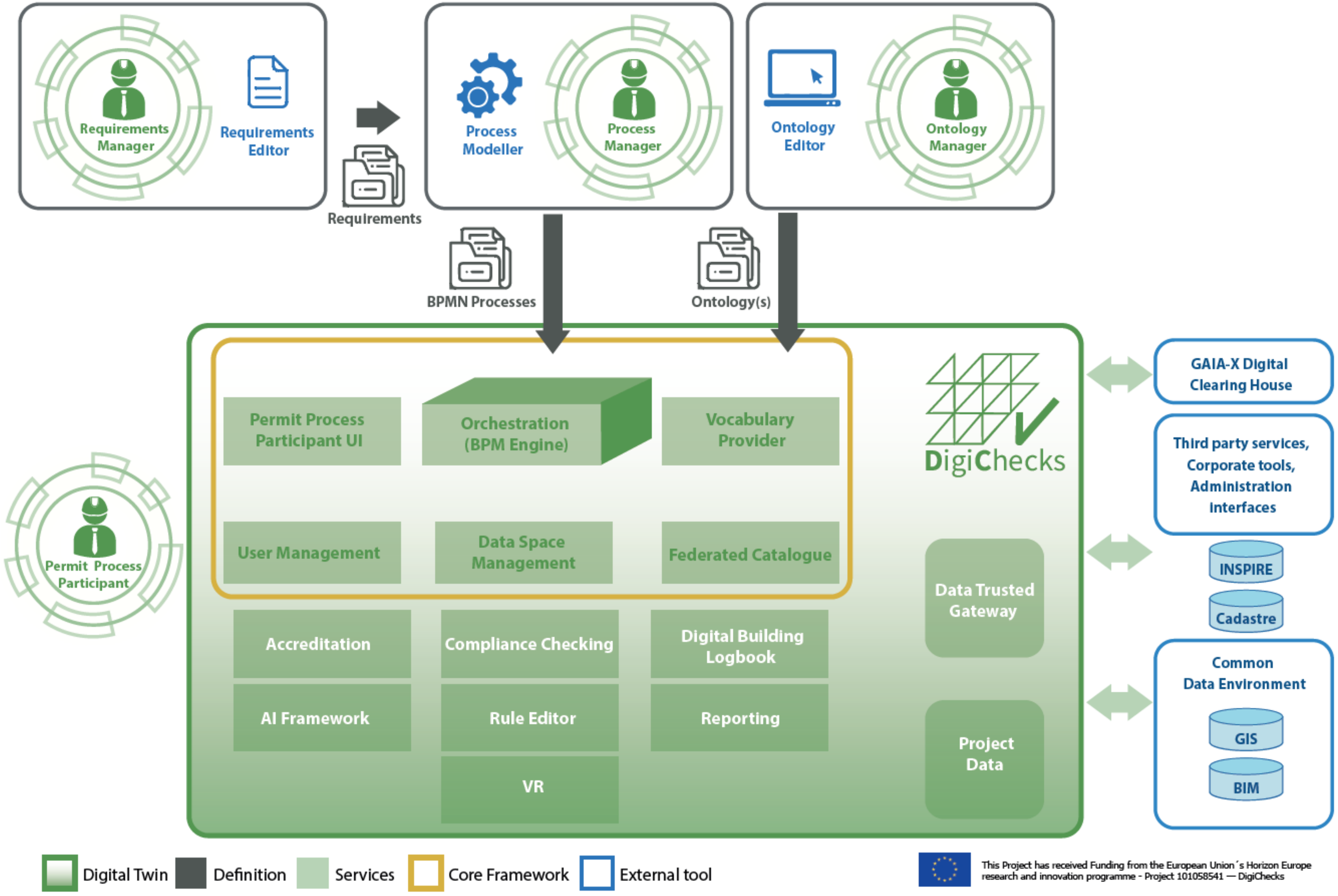
DigiPLACE is a framework allowing the development of future digital platforms as common ecosystems of digital services that will support innovation, commerce, etc.



Digiplace core guidelines

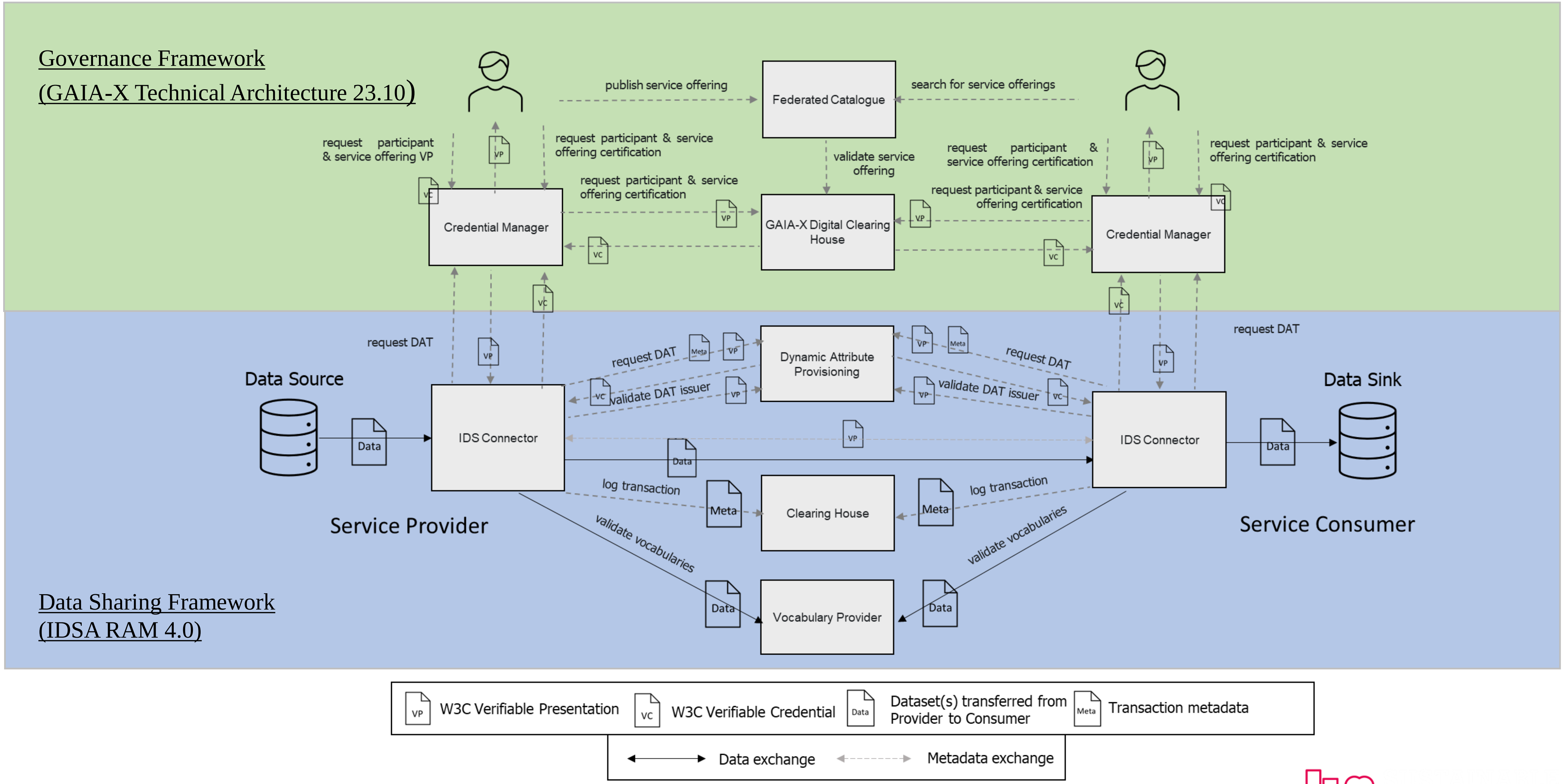


DigiChecks Architecture



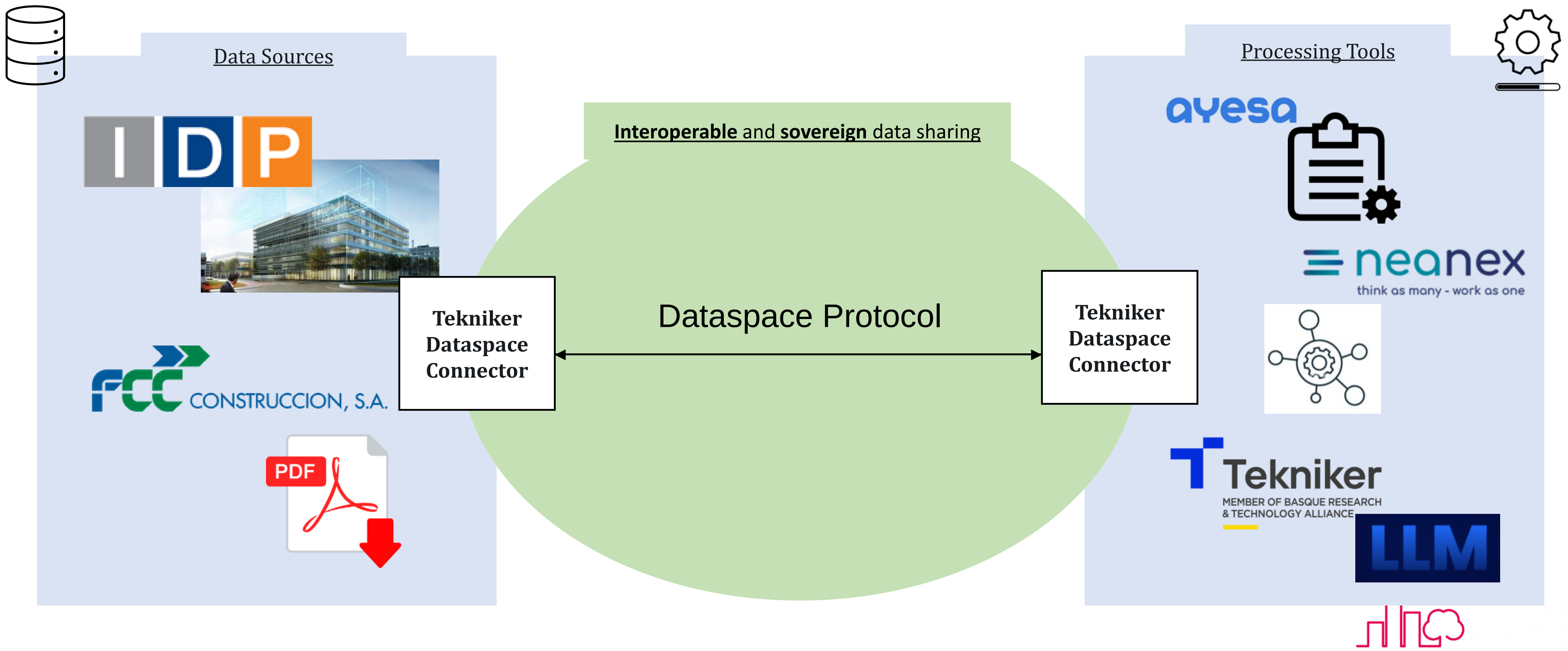
This Project has received Funding from the European Union´s Horizon Europe research and innovation programme - Project 101058541 — DigiChecks

2024


Governance Framework
(GAIA-X Technical Architecture 23.10)
publish service offering
Federated Catalogue
search for service offerings
request participant & service offering VP
request participant & service offering certification
validate service offering
request participant & service offering certification
request participant & service offering certification
request participant & service offering certification
request participant & service offering certification
Credential Manager
GAIA-X Digital Clearing House
Credential Manager
VP
VC
request DAT
request DAT
request DAT
request DAT
Dynamic Attribute Provisioning
validate DAT issuer
validate DAT issuer
Meta
Data Source
Data Sink
IDS Connector
IDS Connector
Data
log transaction
log transaction
Clearing House
Service Provider
Service Consumer
validate vocabularies
validate vocabularies
Vocabulary Provider
Data Sharing Framework
(IDSA RAM 4.0)
W3C Verifiable Presentation
W3C Verifiable Credential
Dataset(s) transferred from Provider to Consumer
Transaction metadata
Data exchange
Metadata exchange

Solution

- Platform of platforms that enable the automated management of building permits based on:
    - Orchestrarion of compliance checks
    - The collaboration between services from different organizations through a data space



Tekniker Data Space Conector

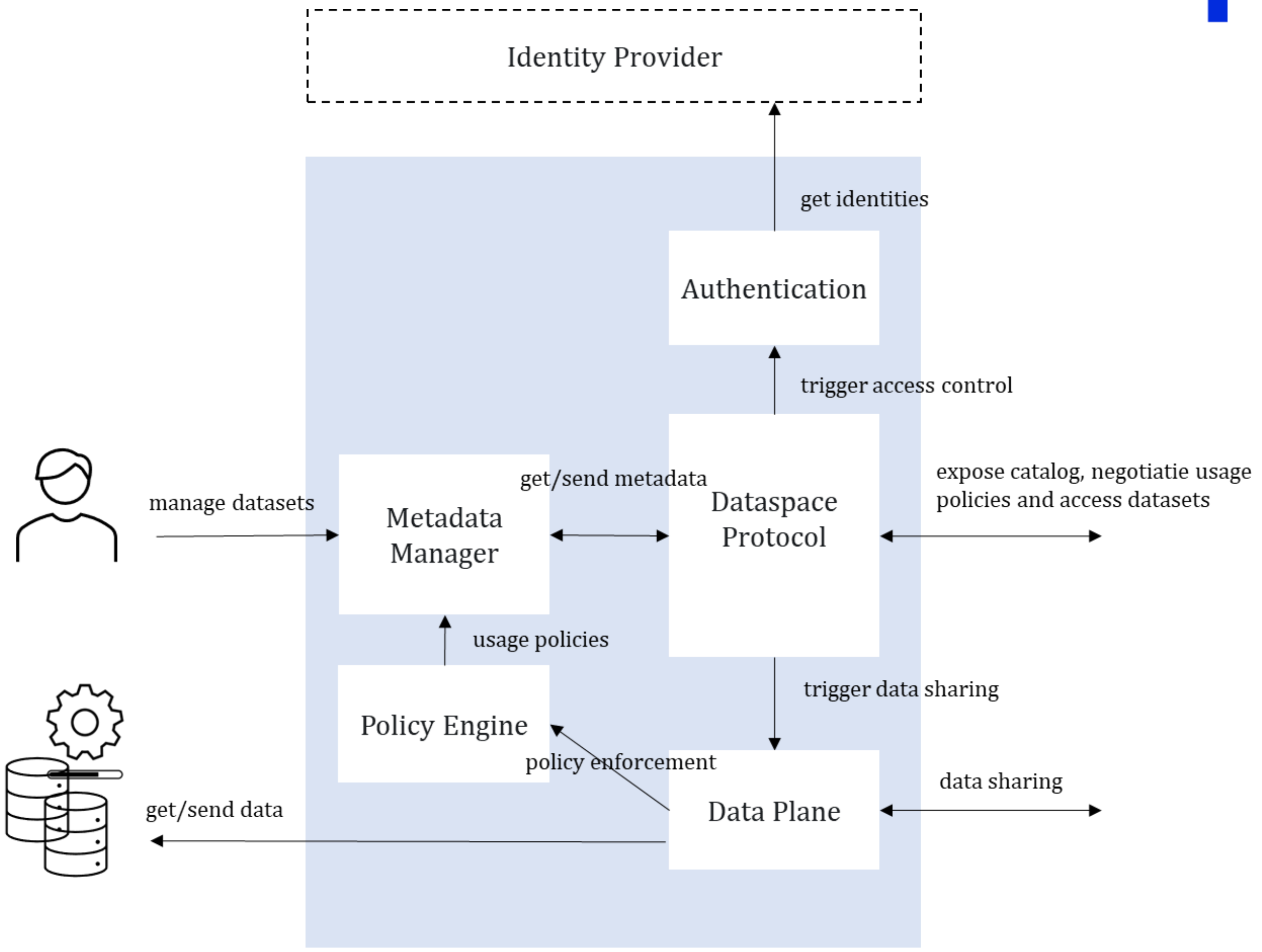
What is it?

Modular solution that allows companies to establish a single point of entry to the data offered and requested through a data space:

- **Interoperability** at data sharing
- **Trust** between the parties involved in data sharing
- **Data Sovereignty** throughout its life-cycle

How does it work?

1. **Metadata Manager:** management of datasets offered and requested through the data space
2. **Dataspace Protocol:** description of catalogs, negotiation of use agreements and standardized access to datasets
3. **Data Planes:** data transfer through different protocols adapted to the requirements of the use cases
4. **Authentication:** implementation of access control
5. **Policy Engine:** enforcement of usage control policies



Contact

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gonzalo.gil@tekniker.es

Tekniker MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

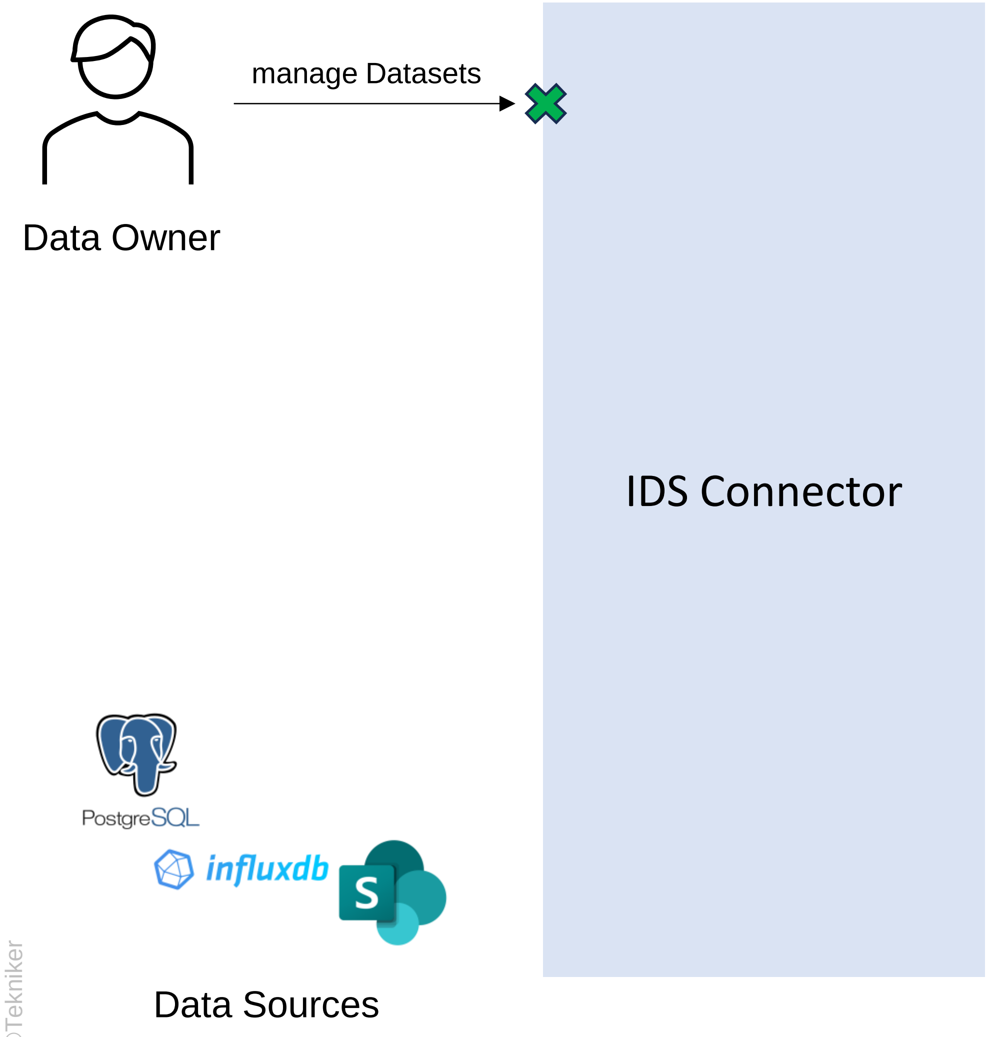
INTERNATIONAL DATA SPACES ASSOCIATION

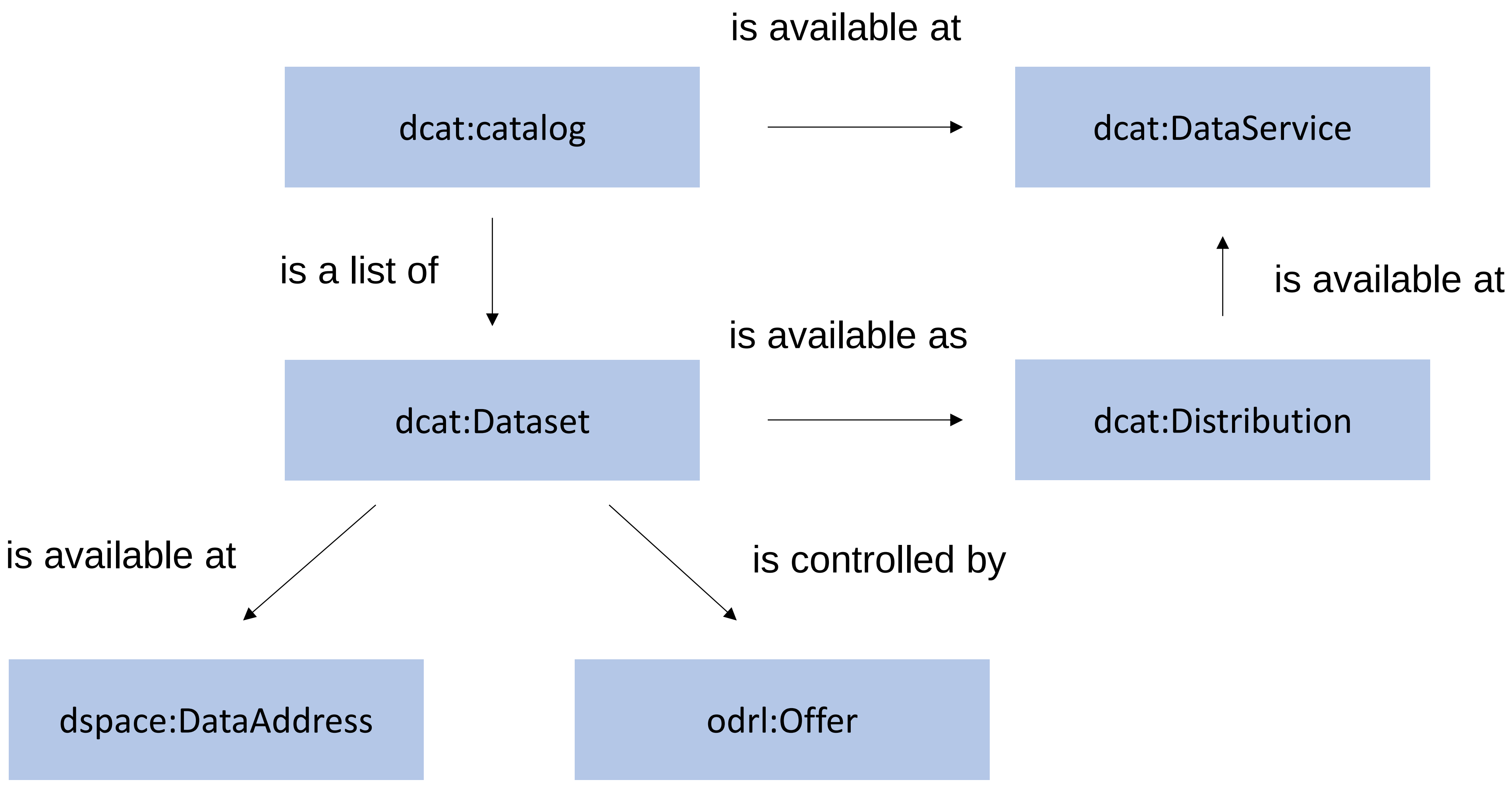
Data Sharing

Data Owner

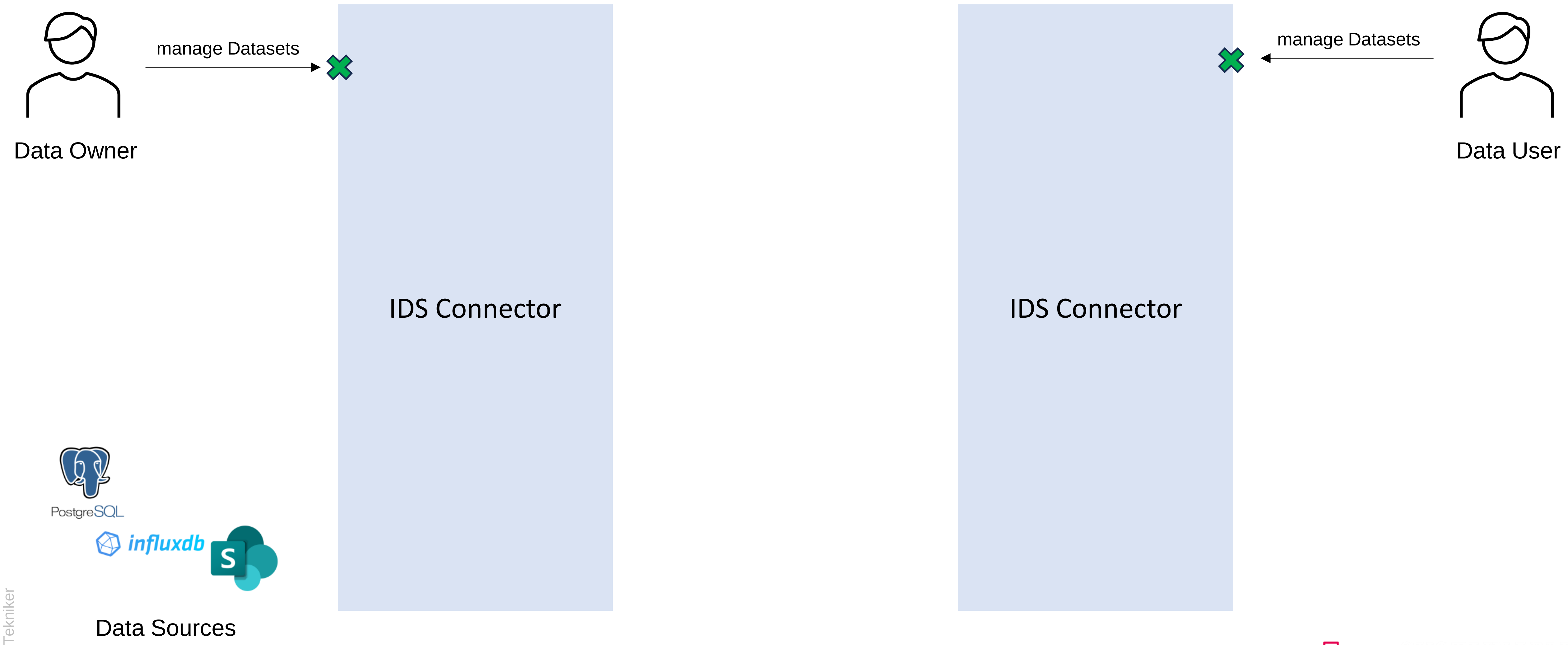
IDS Connector

Data Sources

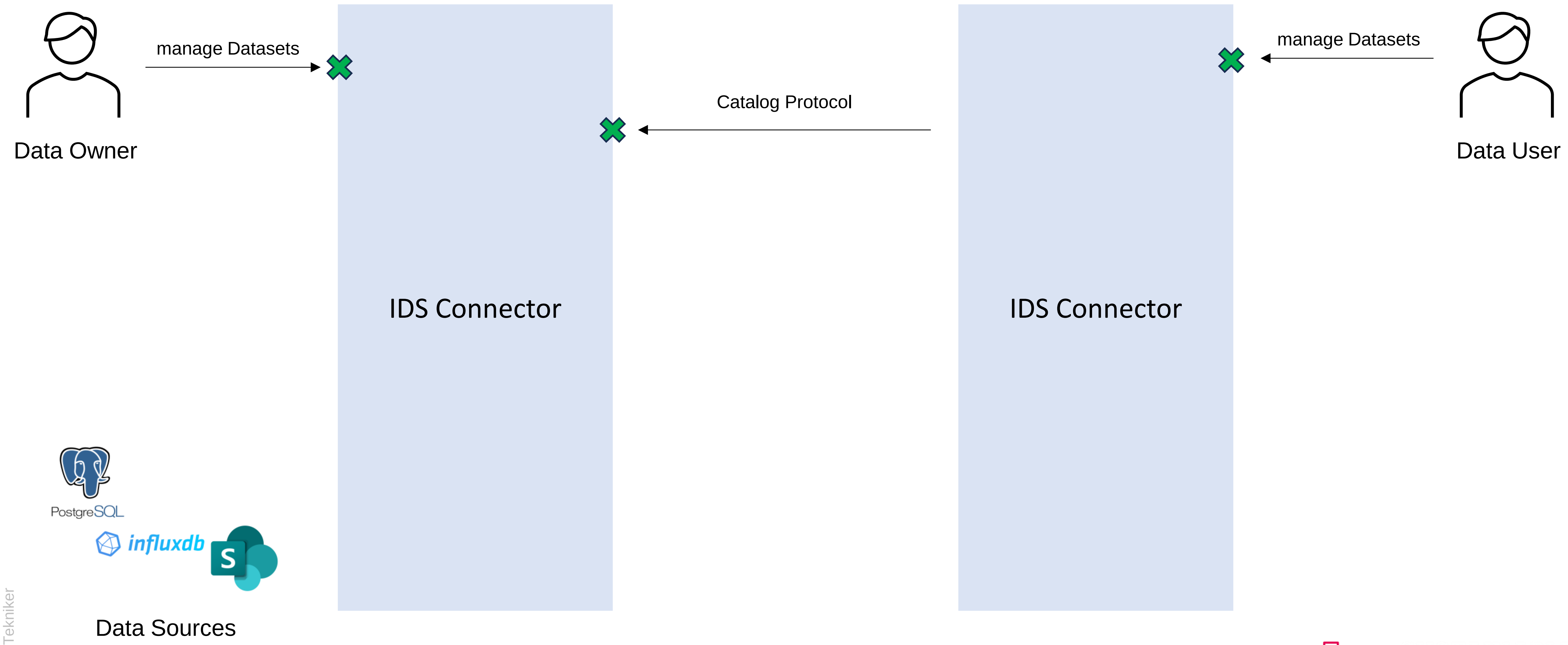

manage Datasets
Data Owner
IDS Connector
PostgreSQL
influxdb
S
Data Sources


is available at
dcat:catalog
dcat:DataService
is a list of
is available at
is available as
dcat:Dataset
dcat:Distribution
is available at
is controlled by
dspace:DataAddress
odrl:Offer

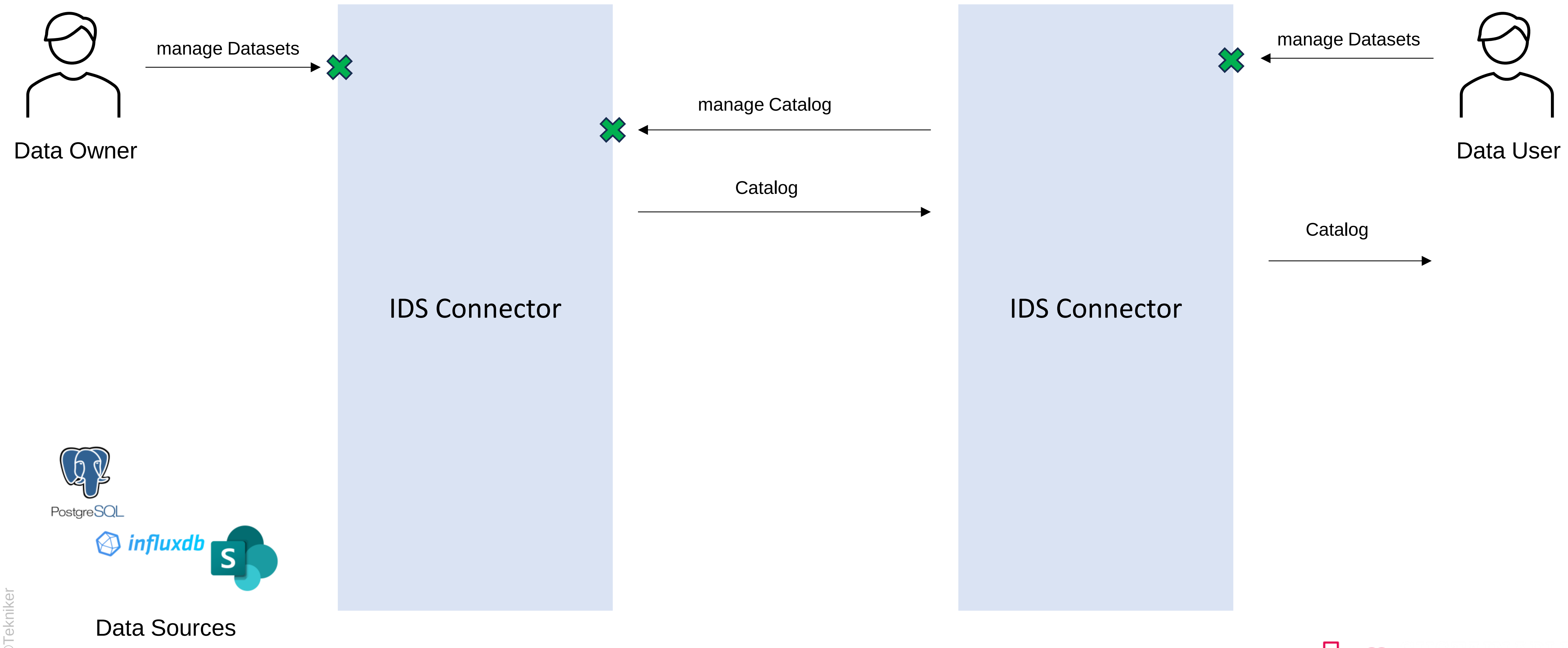
Data User – Request Datasets



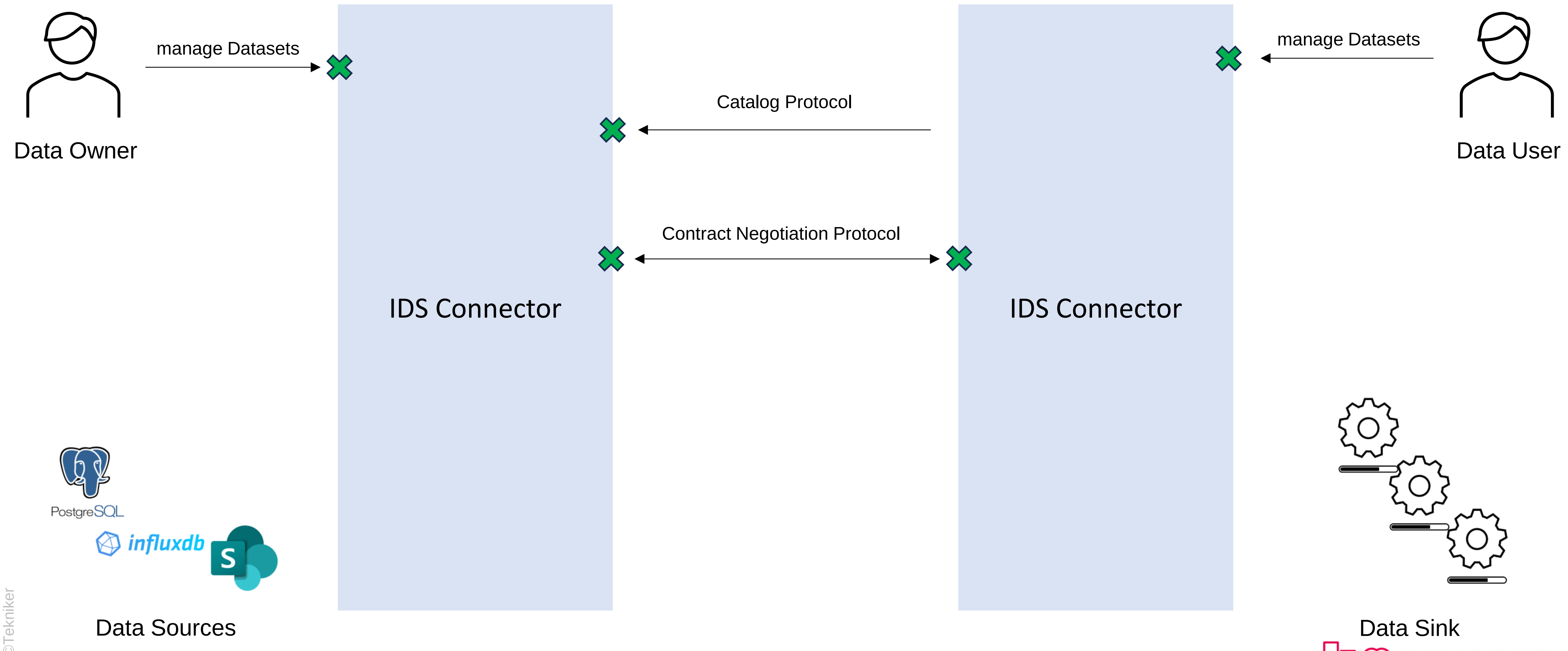
Catalog Protocol



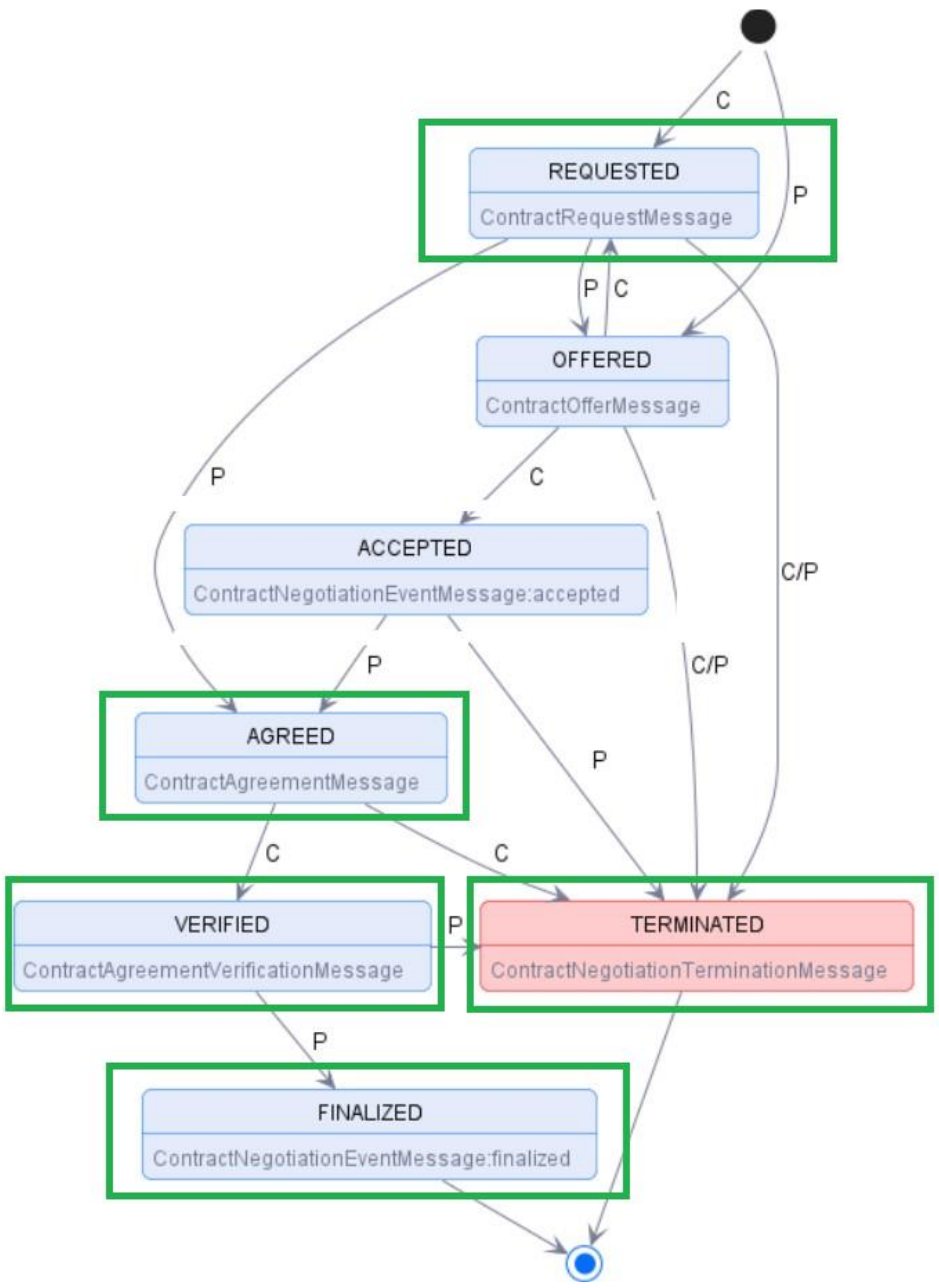
Catalog Protocol



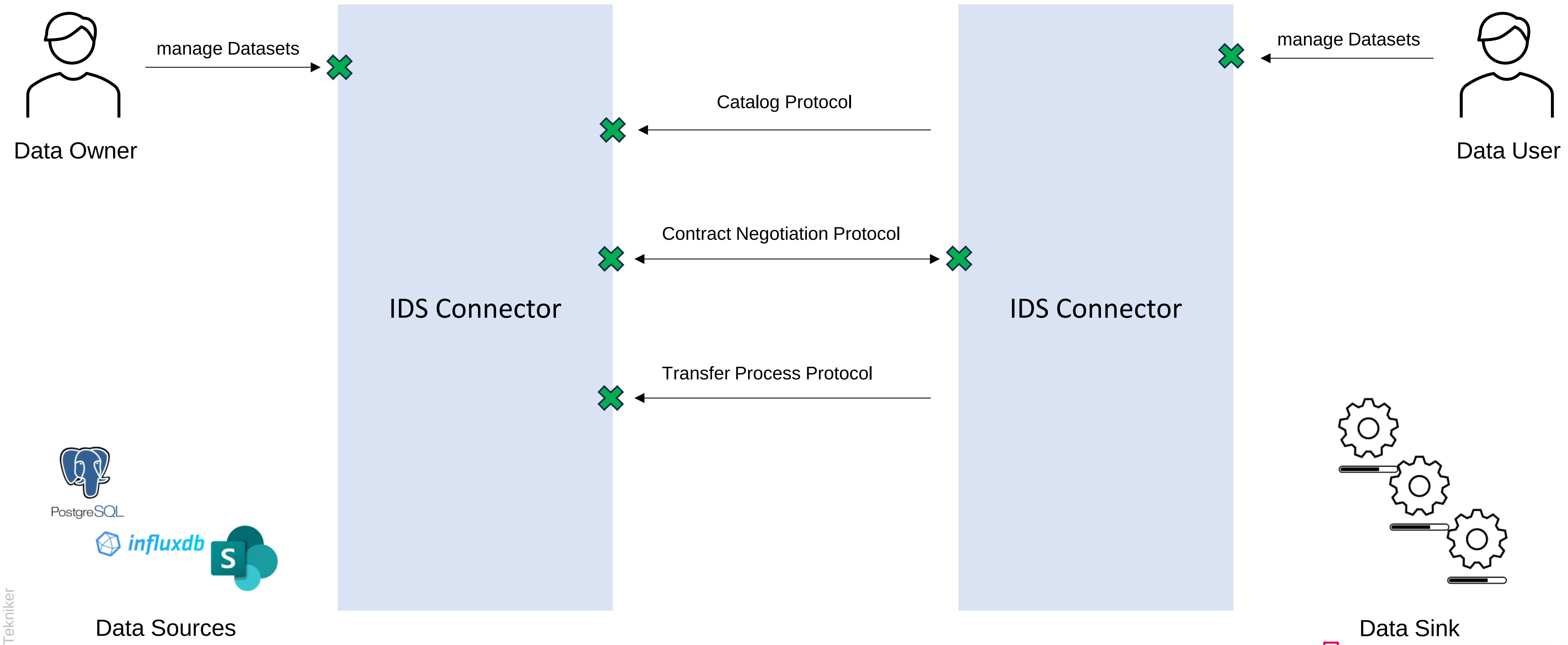
Contract Negotiation Protocol



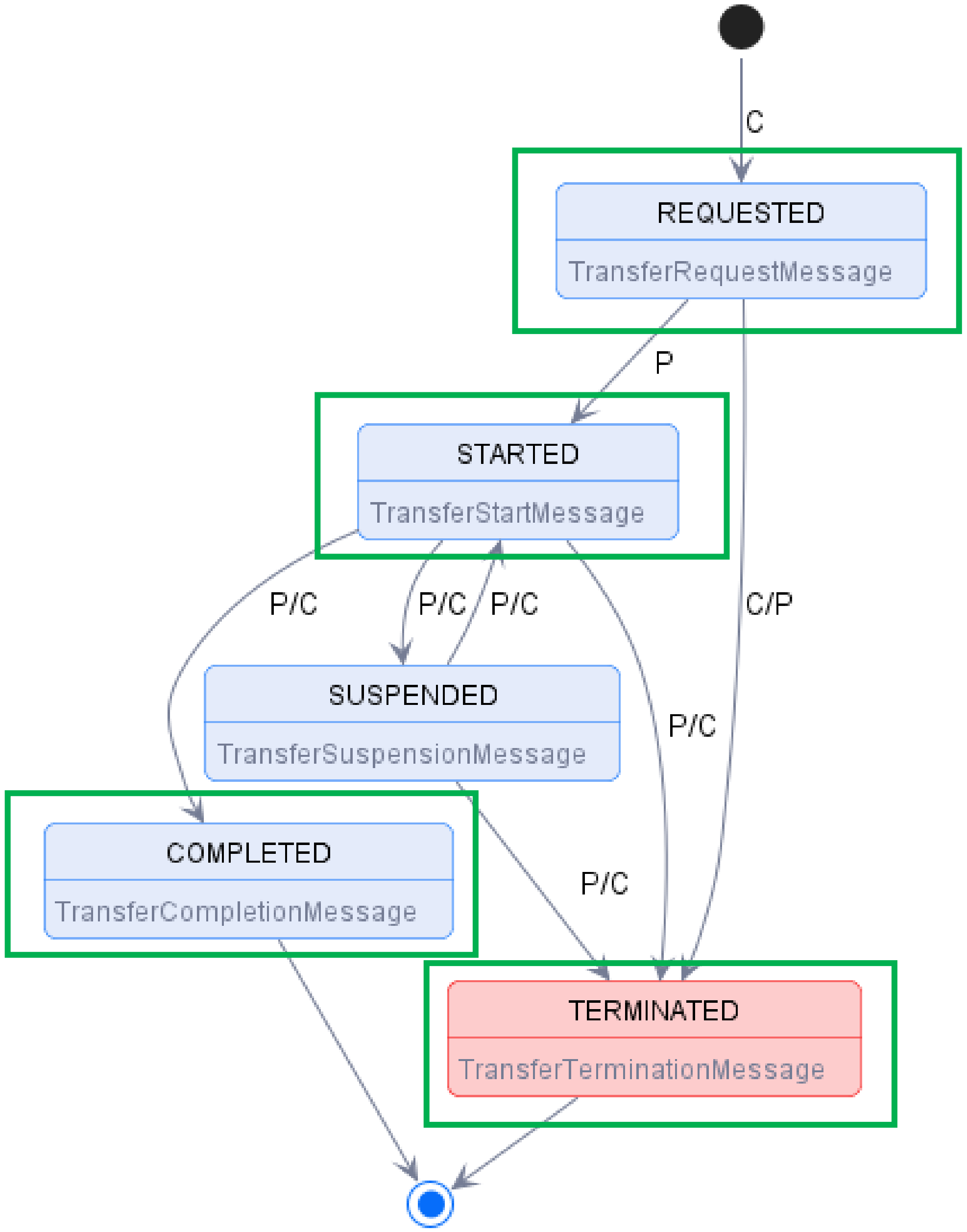
Contract Negotiation



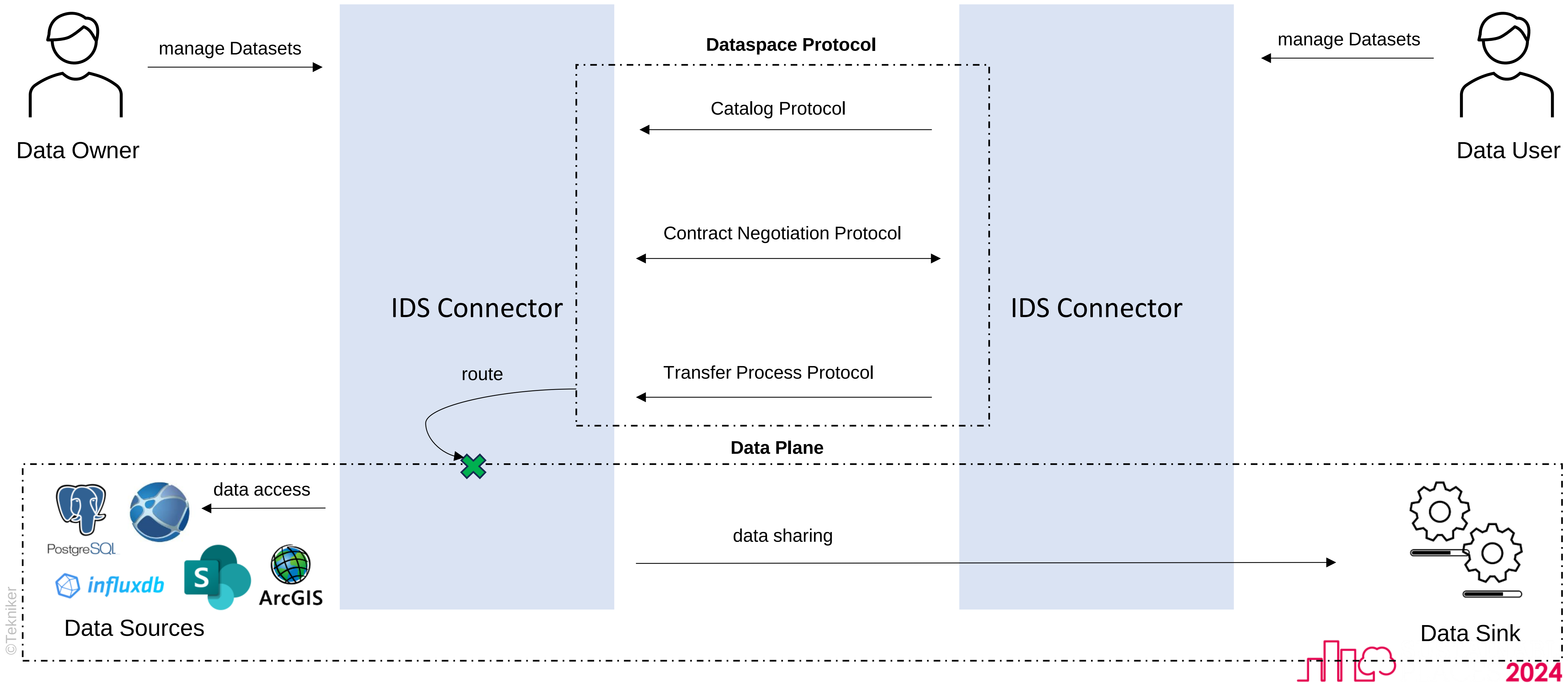
Transfer Process Protocol

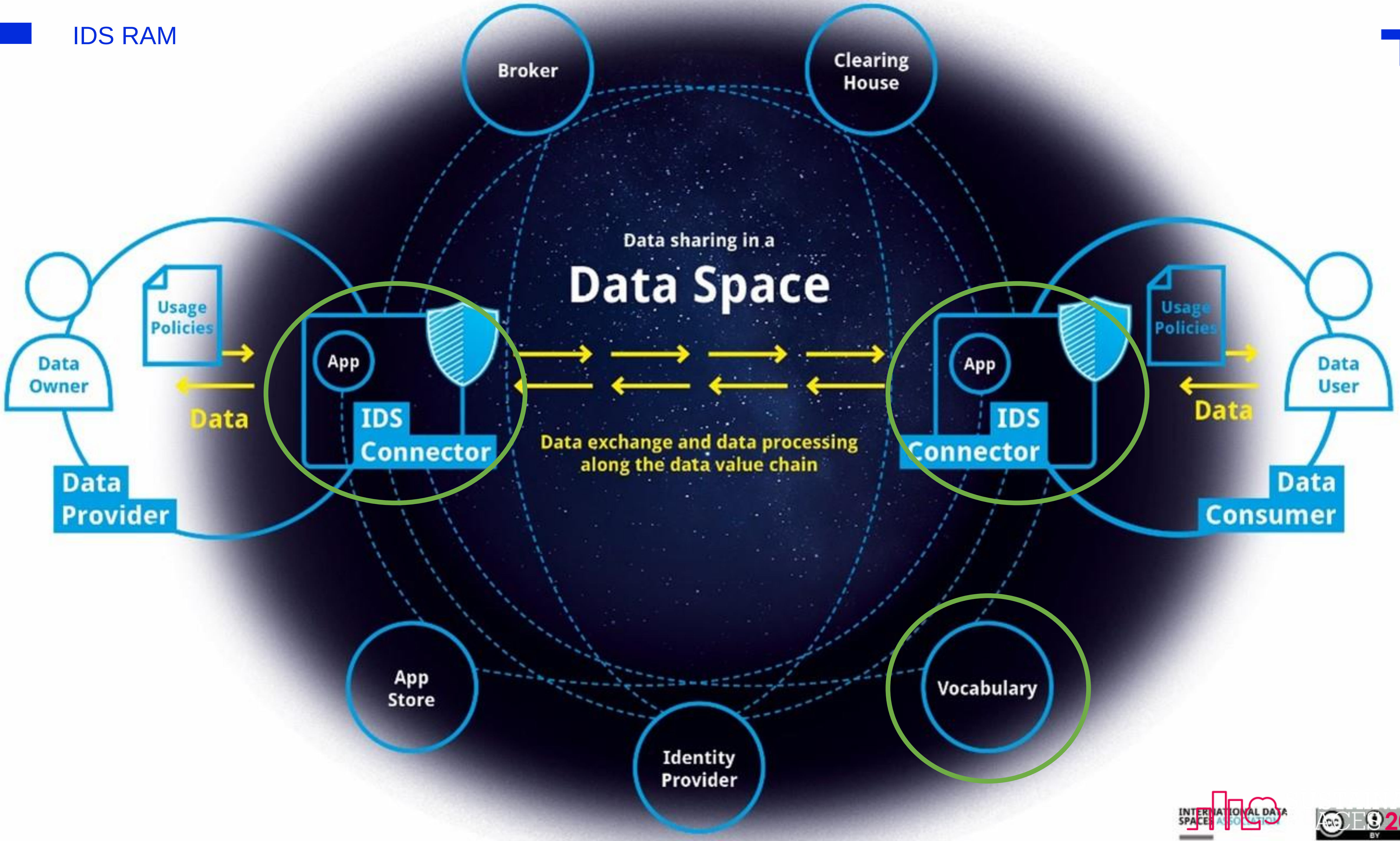


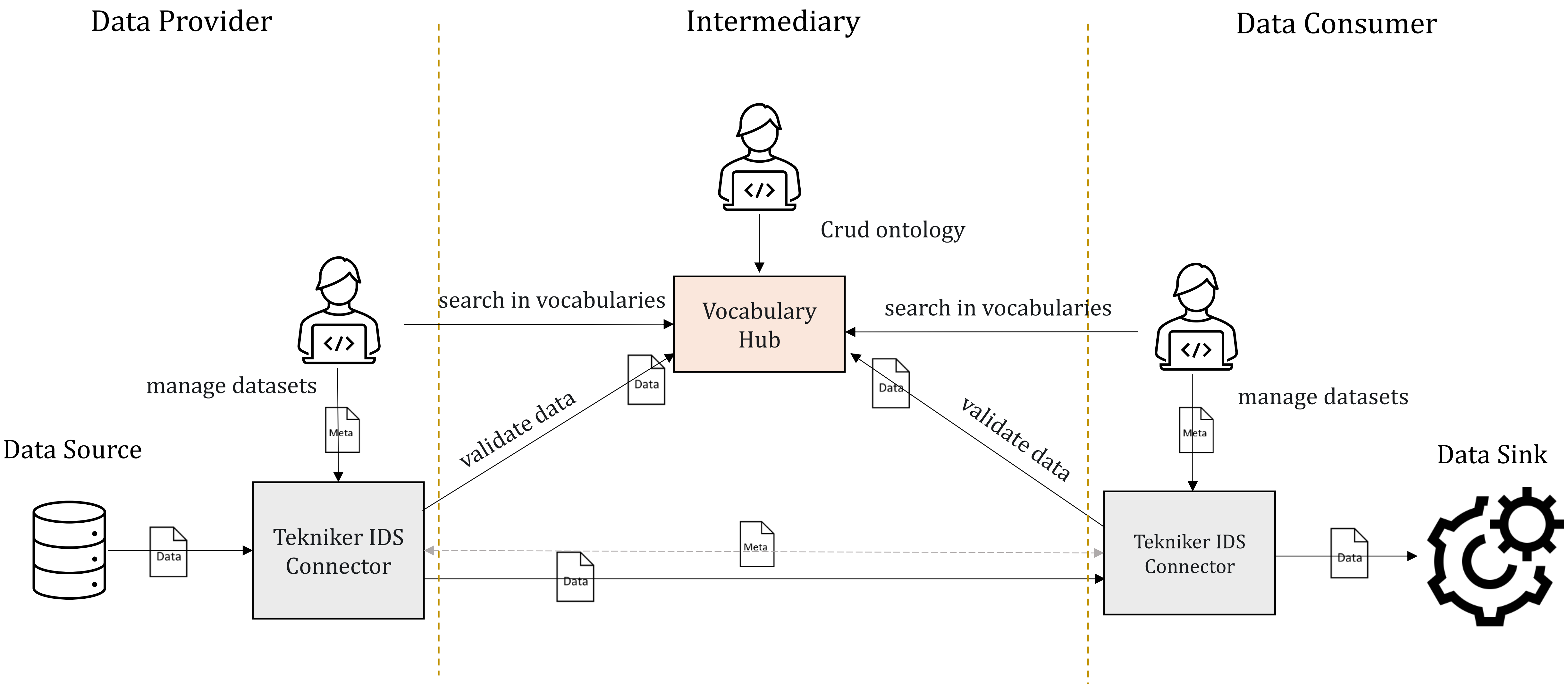
Transfer Process



Data Plane

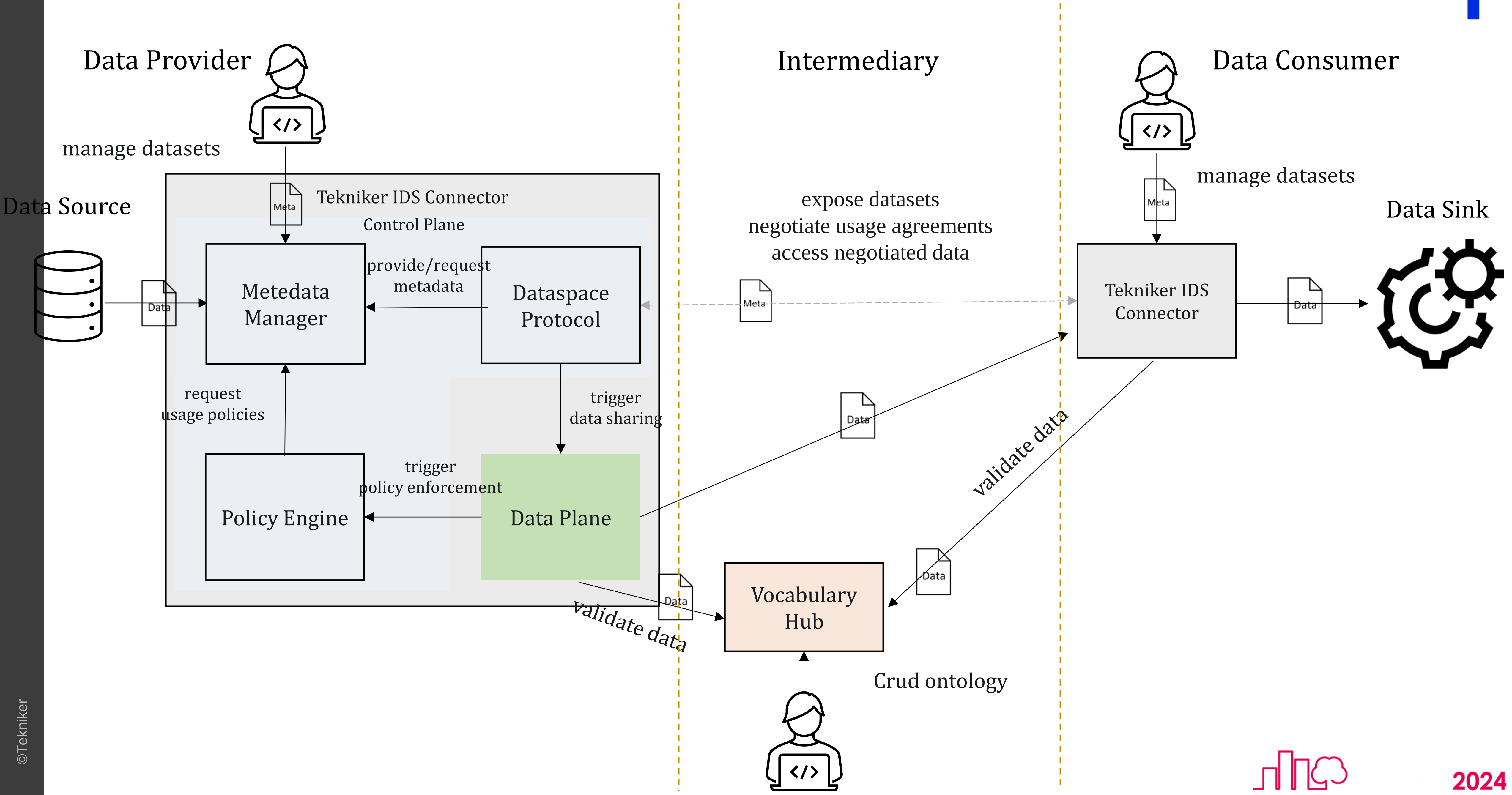

Data Owner
manage Datasets
IDS Connector
Dataspace Protocol
Catalog Protocol
Contract Negotiation Protocol
Transfer Process Protocol
route
IDS Connector
manage Datasets
Data User
Data Plane
data access
PostgreSQL
influxdb
ArcGIS
Data Sources
data sharing
Data Sink
©Tekniker
2024


Broker
Clearing House
Data sharing in a
Data Space
Usage Policies
Data Owner
Data
App
IDS Connector
Data Provider
Data exchange and data processing along the data value chain
App
IDS Connector
Usage Policies
Data User
Data
Data Consumer
App Store
Identity Provider
Vocabulary

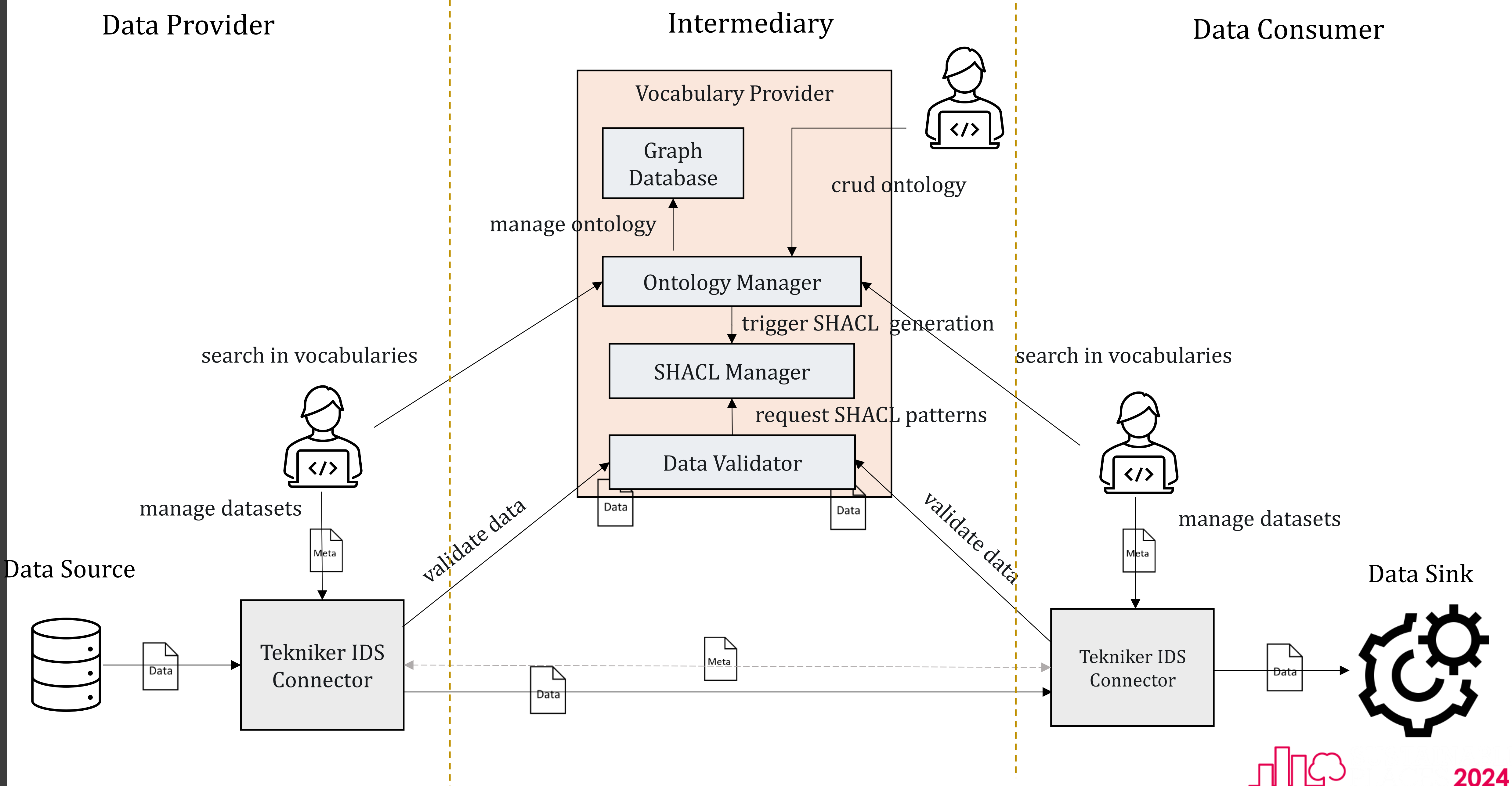


Data Provider
Intermediary
Data Consumer
Crud ontology
search in vocabularies
Vocabulary Hub
search in vocabularies
manage datasets
manage datasets
validate data
validate data
Data
Data
Meta
Meta
Data Source
Data Sink
Tekniker IDS Connector
Tekniker IDS Connector
Data
Meta
Data
Data

Semantic validation



Vocabulary Provider architecture



SUSTAINABLE PLACES 2024

Thank you!

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