PATHFNDR project

Ehub Tool

Empa, Urban Energy Systems Laboratory

Sympheny Web App

Urban Sympheny

sweet swiss energy research for the energy transition

PATHFNDR

sympheny urban energy. optimized.

Andrew Bollinger

ETH zürich | Empa | PAUL SCHERRER INSTITUT PSI | zhaw | HOCHSCHULE LUZERN | UNIVERSITÉ DE GENÈVE | EPFL

Purpose – Ehub Tool & Sympheny Web App

Design optimization of multi-energy systems for buildings, neighborhoods, districts & cities.

National-scale version of the software is currently in development

Background – Ehub Tool

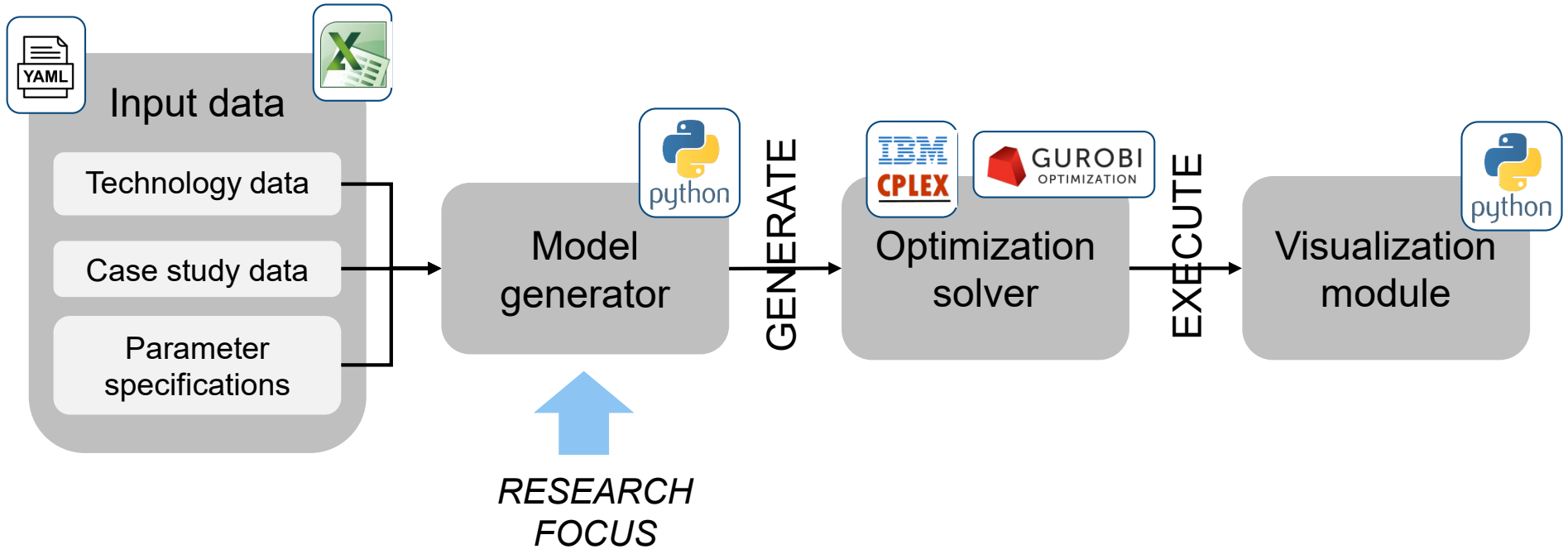
Based largely on methodological developments in SCCER FEEB&D and CCEM SECURE

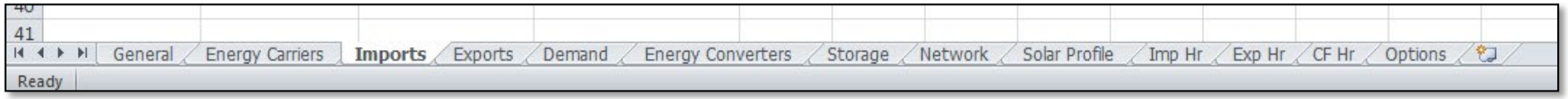
Tool developed & validated in SCCER FEEB&D, SCCER JA-RED, SCCER JASM & various direct contracts with industry partners; Contributions by various researchers at Empa from 2016-2021

- 2016: Development of v1 in Matlab and AIMMS
- 2017: Development of v2 in Python
- 2018-2021: Additional features, Validation in planning projects, Application in education
- 2021: Development of national-scale version; Development of open source version

Currently being further developed and applied in the research projects BFE PATHFNDR, BFE DeCarbCH, EU H2020 Eco-Qube, VSE Vorschau 2022

Software workflow – Ehub Tool





Background – Sympheny Web App

Ehub Tool licensed from Empa by Urban Sympheny in 2020, and further developed as a web application

- May 2020: First prototype of web app completed by Urban Sympheny
- November 2020: v1.0 released by Urban Sympheny; First commercial users (annual subscription basis)
- May 2021: v1.1 released

THE CHALLENGE

ENERGY TRANSFORMATION OF THE BUILDINGS SECTOR

30 kg CO_2 / m^2

Energy planner

0 kg CO_2 / m^2

PV, PVT, Solar thermal?
How big, where?

Energy networks?
What size, structure?

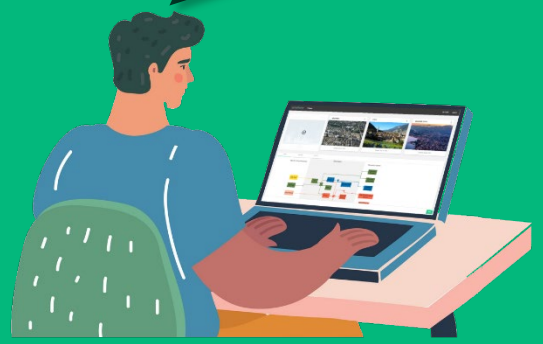
Which Supply technologies?
How big, where?

Which Storage technologies?
How big, where?

Batteries?
How big, where?

What Imports and
Exports? When, where?

What is the best energy supply system for this site?



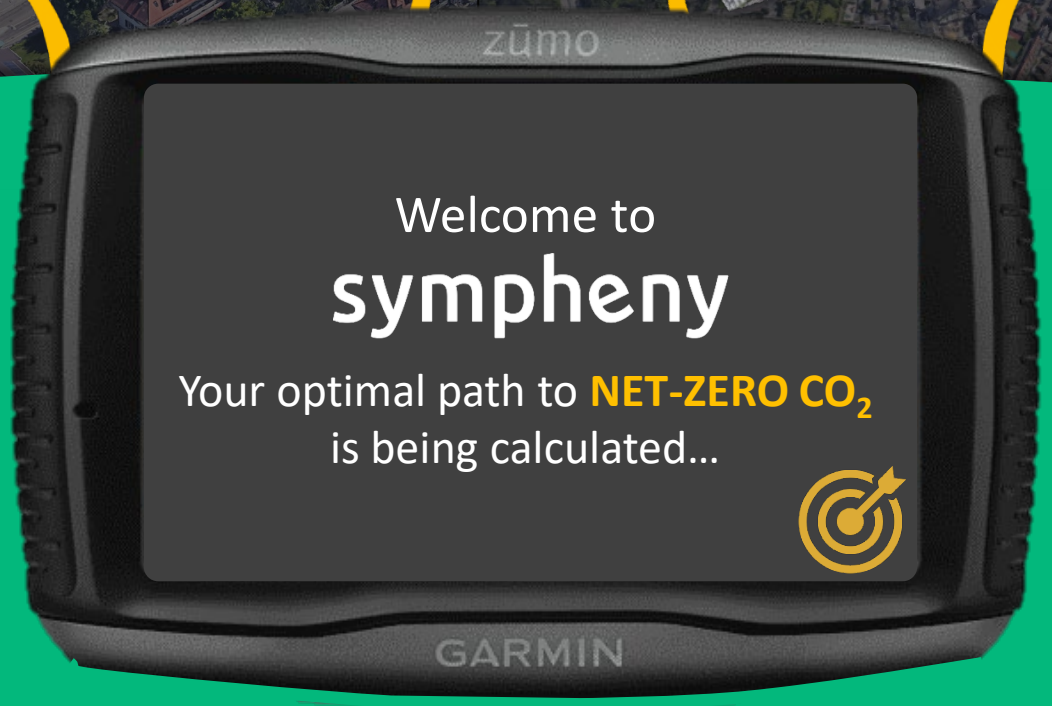
Energy planner

→ **AMBITIOUS SUSTAINABILITY OBJECTIVES** e.g. net-zero CO2

→ **NEW ENERGY TECHNOLOGIES** for energy production, storage & transport

→ **DATA, DATA EVERYWHERE…**

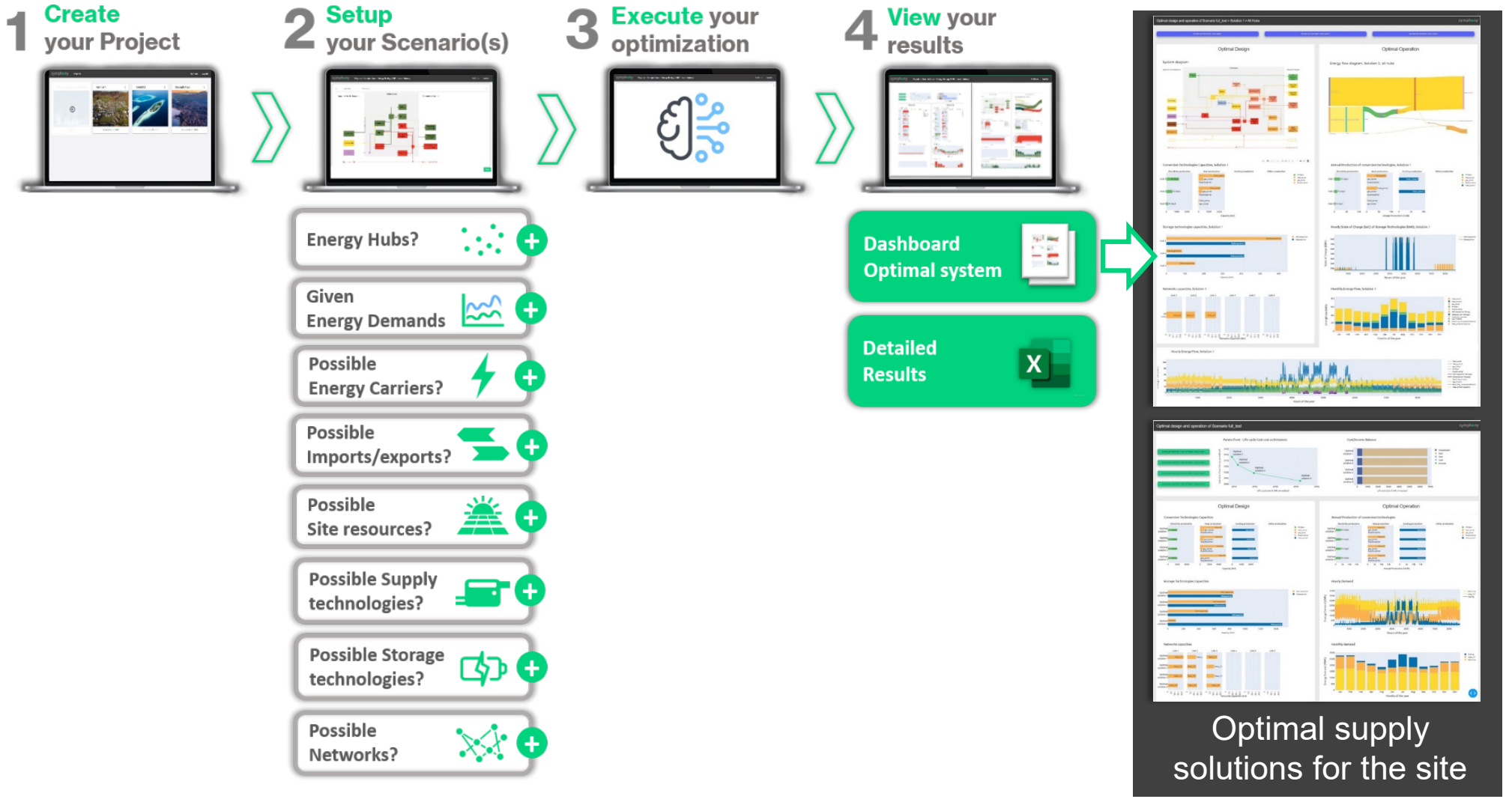
THE CUSTOMER'S PROBLEM



Energy planner

OUR SOLUTION

Software workflow – Sympheny Web App



Features

Ehub Tool (Desktop Tool)

- Multi-energy optimization
- Multi-objective optimization
- Multi-stage optimization
- Optimization of thermal networks & multi-energy grids
- Daily & seasonal storage
- Design optimization and/or Operational optimization
- Sensitivity analysis
- Modular structure / Extensible code base

Closed source, owned by Empa
Code shareable with research partners upon agreement

Sympheny Web App

+ Cloud optimization
+ Built-in databases
+ Browser-based GUI
+ Automated model verification
+ Results visualization dashboards
+ Multi-mode technologies
+ Seasonal constraints on technology operation
+ Complex tariff structures

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Spatial and temporal resolution

Ehub Tool & Sympheny Web App

- Spatial resolution: Building to District/City (single hub or multi-hub)
- Temporal resolution: Hourly (full-horizon / typical days)
- Sector coverage: Flexible (electricity, heat, cooling, gas, H2, …)

Case studies – Ehub Tool & Sympheny Web App

Stadt Chur

Bern, Holligen

Bern, Wankdorf

Lidl Zukuntsfiliale

Baden Nord

SCCER JASM

Roche, Rotkreuz

Zürich, Industrieareal

Areal Sommerau Nord

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Demo – Sympheny Web App

https://app.sympheny.com

Future development under the PATHFNDR project

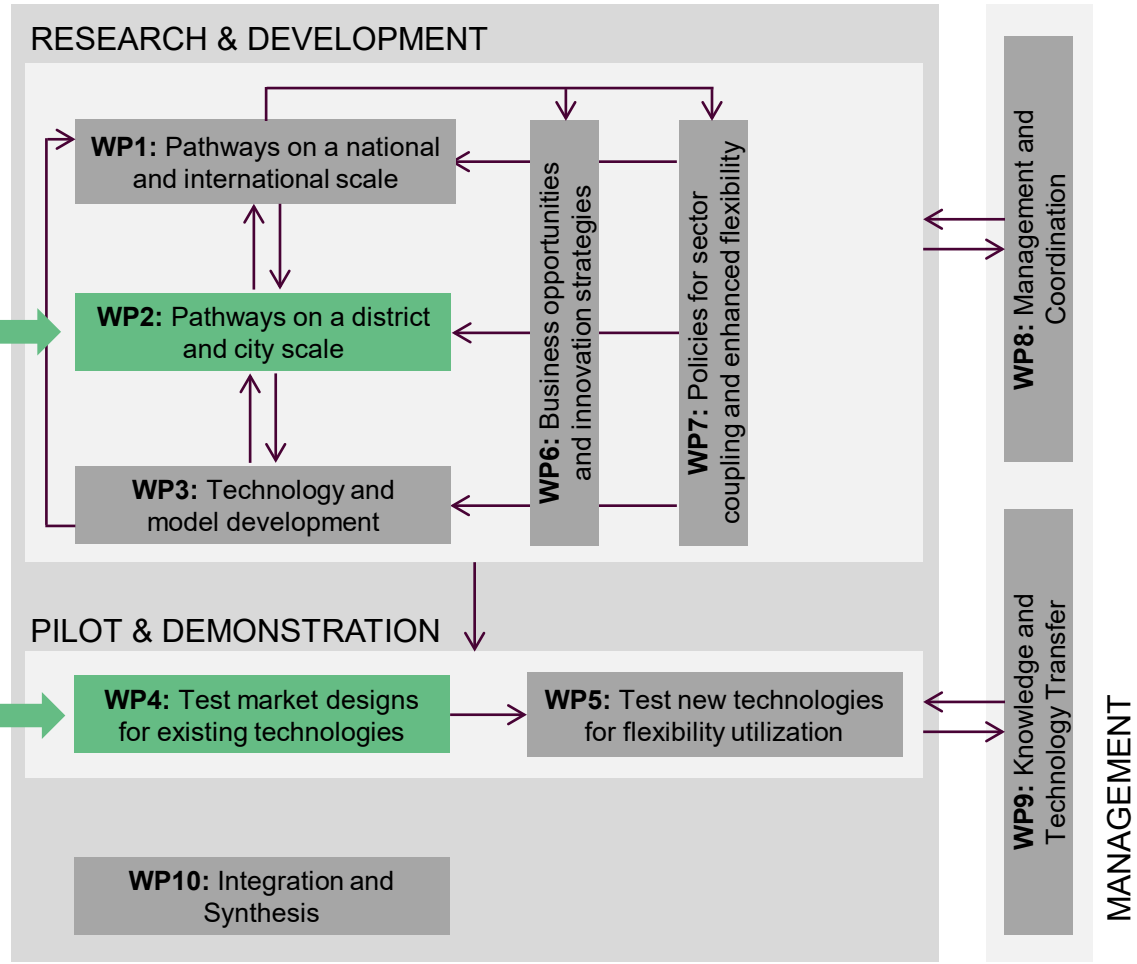
Enhanced representation of flexibility sources:

- Electric vehicles and vehicle-to-grid technology
- Demand-side flexibilities, considering e.g. demand response automation and IoT
- Interactions with ancillary services markets

What financial and sustainability value can be realized through **optimal utilization of existing flexibility sources**, as well as **investments in new flexibility sources** in the context of an **existing site**?

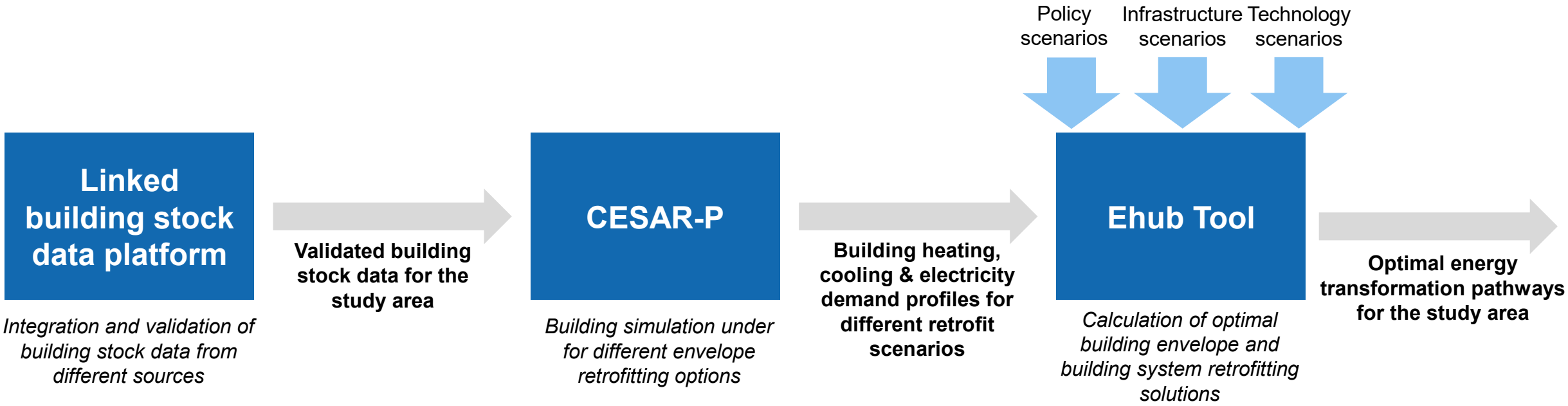
Ehub Tool

Ehub Tool Sympheny



Linkage to other tools of the PATHFNDR project

- To be determined…



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