
Digitalize your
energy planning.
Master complexity.
sympheny
urban energy. optimized.

Sympheny

- ✓ Founded Apr 2020, Spinoff of Empa (Urban Energy System Laboratory)
- ✓ Our team: Experts in Energy modelling & analytics, Energy engineering and Software development

Employees background

Empa, EPFL, University of Oxford, TU Delft, ETH zürich, IRENA (International Renewable Energy Agency), Oliver Wyman, Berkeley Lab

Key partners

iwb, Rockstart, Venture Kick, Technologiefonds, Gurobi Optimization, esri, Empa, aws

Awards & recognitions

Start Up Energy Transition #SET100 Award 2023; Grant Winner Energy Lab.; Solar Impulse Foundation 2021 Efficient Solution

Sympheny

Our Customers:

leading engineering firms, utilities & site owners

in CHE. GER, LUX, NED & BEL

ewz · BURO HAPPOLD · gruner · SIG · ELIMES ENERGIE INGÉNIEURE · RMB Group · LIDL · Lauber IWISA · Empa · BG · AMSTEIN + WALTHERT · IBC · IWB · primeo energie · Qirion

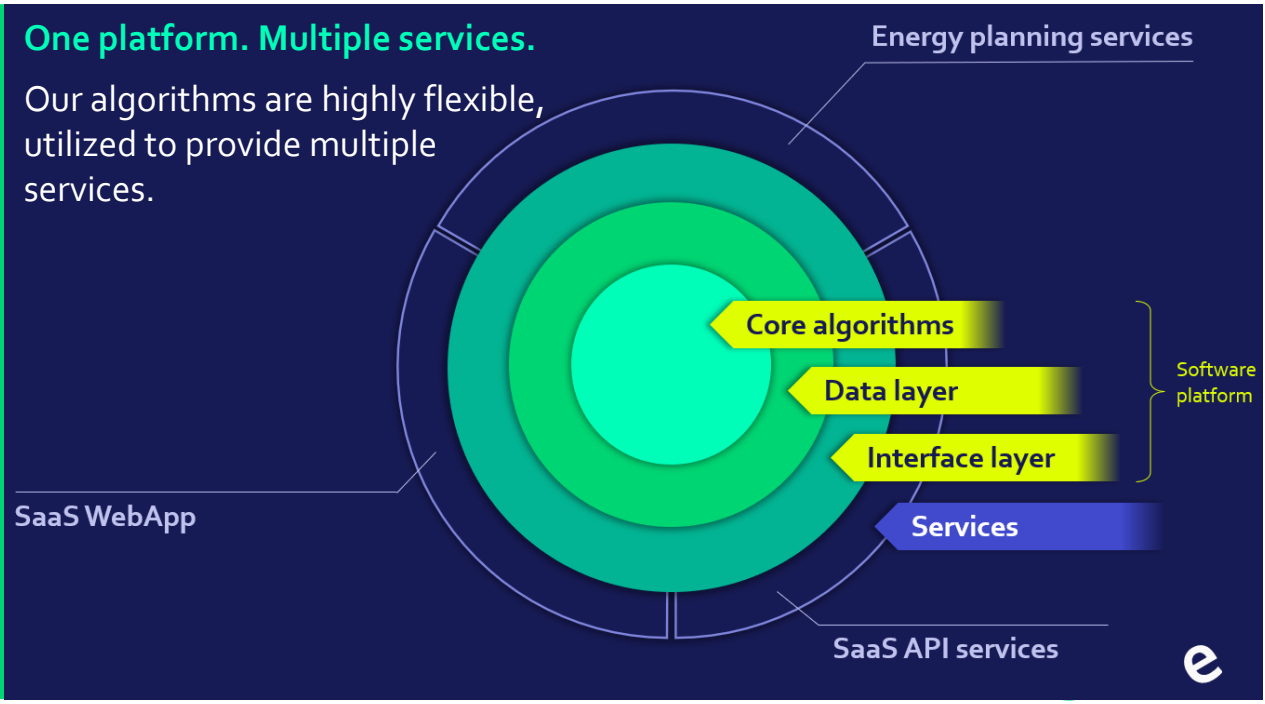
+ 1.6 million	+ 5.1 TWh	+ 4 million	+ 20
tons of CO_2 potentially saved	potentially optimized	configurations analyzed	major planning projects developed

*"Today's energy systems design problems are often so complex that you cannot solve them without algorithms like **Sympheny**'s"*

Sympheny client, int'l engineering firm

One platform. Multiple services.

Our algorithms are highly flexible, utilized to provide multiple services.



Energy systems are changing.

- ✓ Fossil fuel-based
- ✓ Centralized
- ✓ Reliable & predictable

Energy planning is <u>simple</u>.

Energy planning must evolve, too.

- ✓ Renewables-based
- ✓ Decentralized
- ✓ Flexible & dynamic

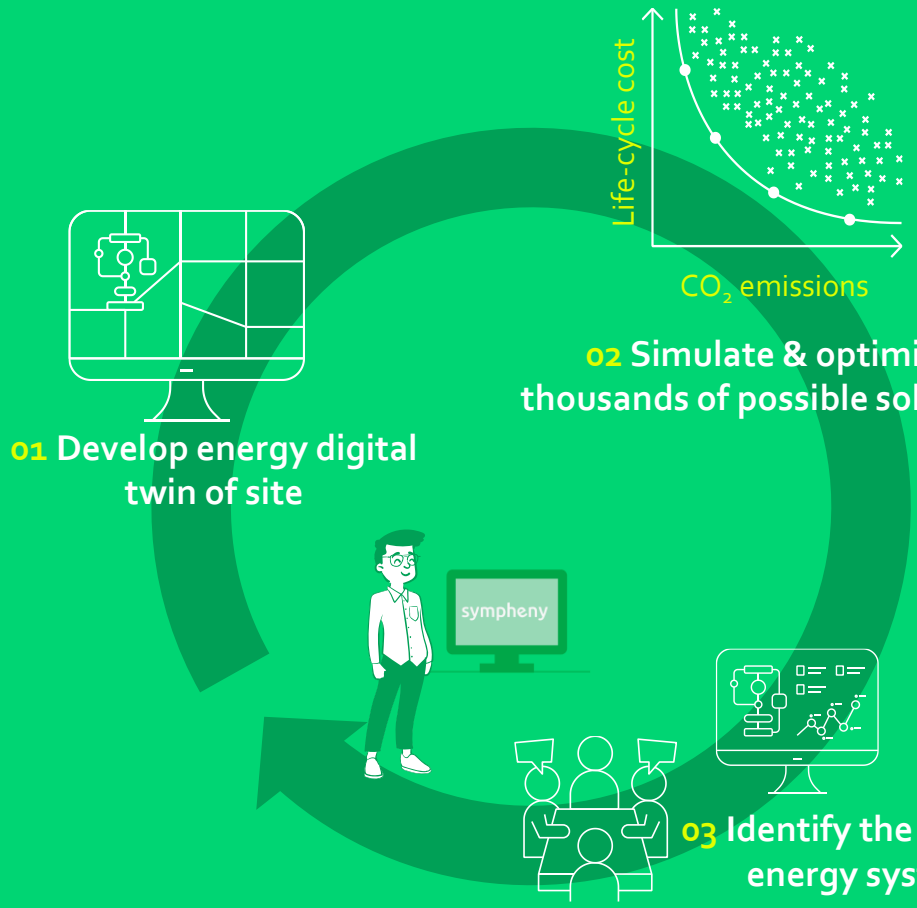
Energy planning is <u>complex</u>.

Energy planners are facing new challenges.

Conventional approaches are no longer sufficient.

Sympheny empowers energy planners

Sympheny's software enables energy planners to thrive in the new energy landscape – to effectively exploit emerging energy technologies & business models, and achieve ambitious energy, CO2 & cost targets.



01 Develop energy digital twin of site

02 Simulate & optimize thousands of possible solutions

03 Identify the optimal energy system

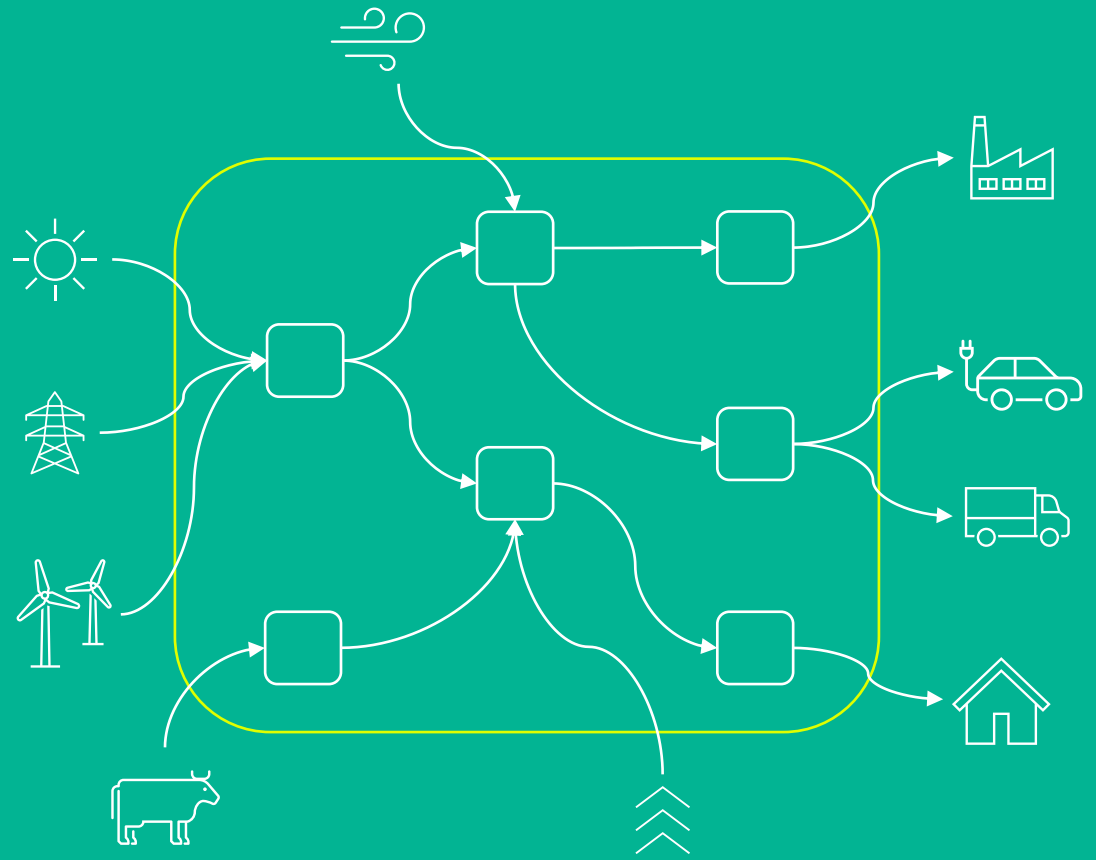
- ✓ Buildings
- ✓ Neighborhoods
- ✓ Districts
- ✓ Communities

- ✓ Newbuild
- ✓ Renovation

How we do this

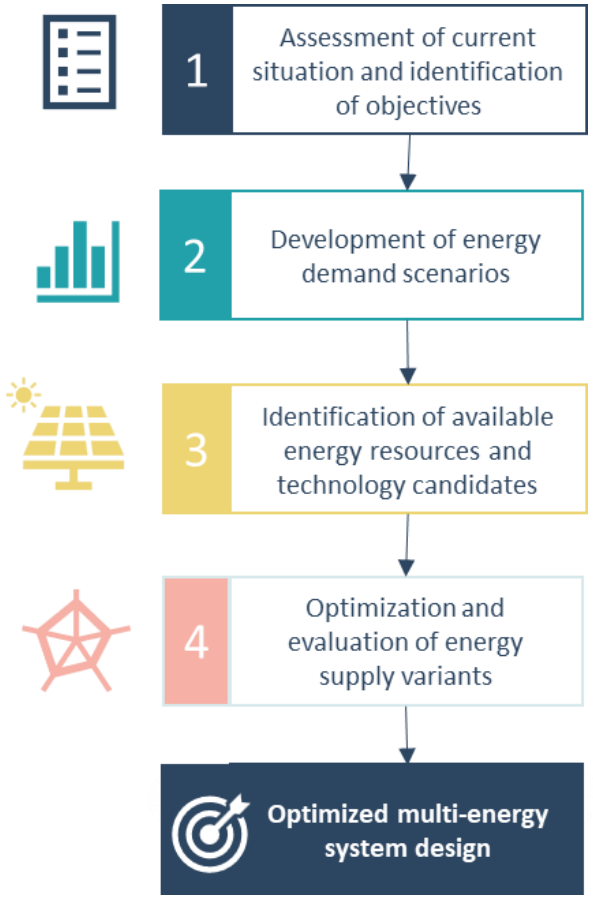
We develop energy hubs – holistic energy concepts that optimally connect, convert and exploit the energy flows of a site.

- ✓ Optimal utilization of on-site renewable resources and flexibility options
- ✓ Optimal connection of complementing energy flows across all elements of a site
- ✓ Optimized sequences of energy conversion and storage technologies
- ✓ Optimal interconnections and energy exchanges with surrounding areas.



Energy design approach

In developing future-proof energy systems designs, we typically apply our technology in a 4-step methodology, with analyses typically being iterated through these steps as the project progresses



Identify baseline and identify goals & priorities with respect to energy and CO_2 performance as well as economic viability

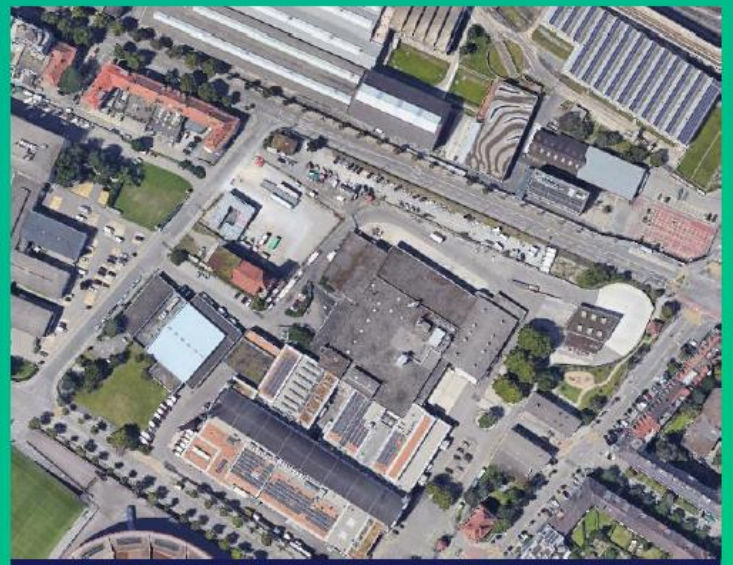
Collect and synthesize demand-relevant site data and project plans with key stakeholders, especially with respect to use of the site, any development timelines, and the resulting demand streams including e.g. any key industrial processes

Identify and model relevant candidate energy sources, storage and conversion technologies as well as infrastructures that are available and can be used at the site

Identify optimal energy supply options taking into account the full solution space, ensuring the maximum possible goal achievement through optimally balancing emissions and costs

Examples

In numerous planning projects, Sympheny's software has proven its ability to deliver holistic energy concepts with substantially improved performance compared with conventional approaches.



Strategic energy plan for an urban industrial site

Result with Sympheny
65% lower CO_2 emissions at life-cycle cost equivalent to status quo solution

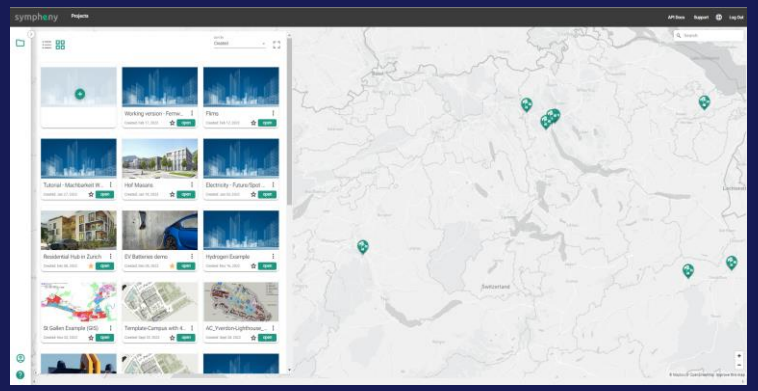
Energy concept for an industrial harbor

Result with Sympheny
20-25% reduced energy costs; improved energy price security

Energy concept for a rural campus

Result with Sympheny
Cost-optimized concept for complete energy self-sufficiency

Cooperation models



Software Platform

Annual subscription

Integration Services

Integration of your data
Tailored results dashboards
Customized software modules

Joint project delivery

Execute your planning projects with the support of Sympheny's team

Advantages

Plan holistically

Develop optimized energy system solutions for supplying multiple demands; consider a large spectrum of possible solutions.

Plan more efficiently

Reduce planning effort with Sympheny's intelligent algorithms and built-in data resources

Plan transparently

Make fact-based, transparent planning decisions; engage stakeholders in the planning process

Expertise & team

Energy analytics

- ✓ Translation of site data into energy digital twin
- ✓ Simulation & optimization of energy system design and operation

Energy systems engineering

- ✓ Development of innovative energy concepts for diverse sites and geographies
- ✓ Expert knowledge of emerging energy technologies & supply concepts

IT Developers

- ✓ Backend technologies
- ✓ Frontend technologies and UI/UX experts
- ✓ DevOps, integration and technology deployment experts

Some of our team members:

Alice Chevrier
MSc Integrated building systems, ETH
Expertise: Building systems | Energy efficiency

Dr. Andrew Bollinger
PhD Energy systems simulation, TU Delft, Empa
Expertise: Energy systems modelling | Emerging energy technologies

Dr. Shanshan Hsieh
PhD Energy systems engineering, ETH
Expertise: Urban energy systems | Energy systems modelling

Dr. Julien Marquant
PhD Energy systems optimization, ETH
Expertise: Energy systems modelling | Energy optimization

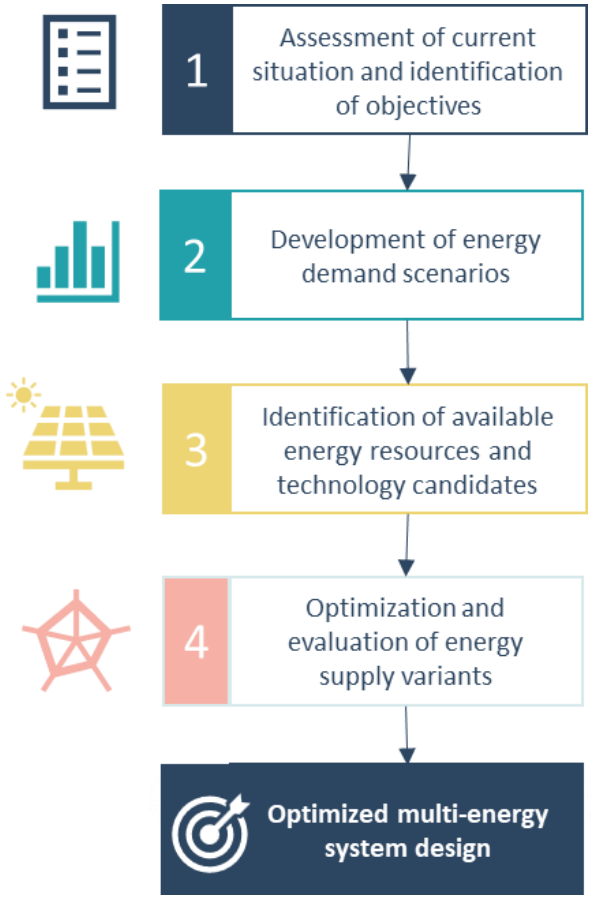
Matthias Sulzer
Senior scientist & researcher, Empa, Lawrence Berkeley Labs
Expertise: District energy systems | Emerging energy technologies

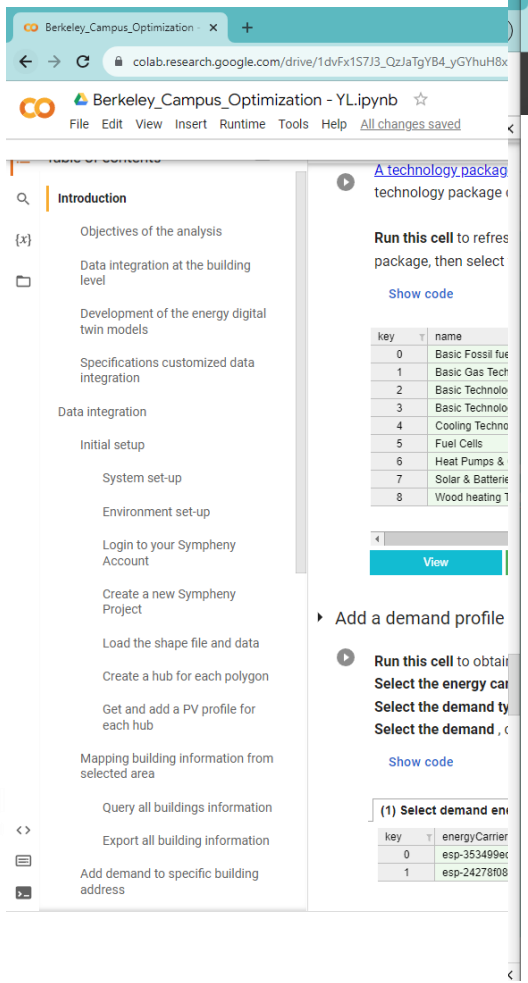
Yunshu Li
MEng Engineering Science, Oxford Univ.
Expertise: Data analysis | Energy systems modelling

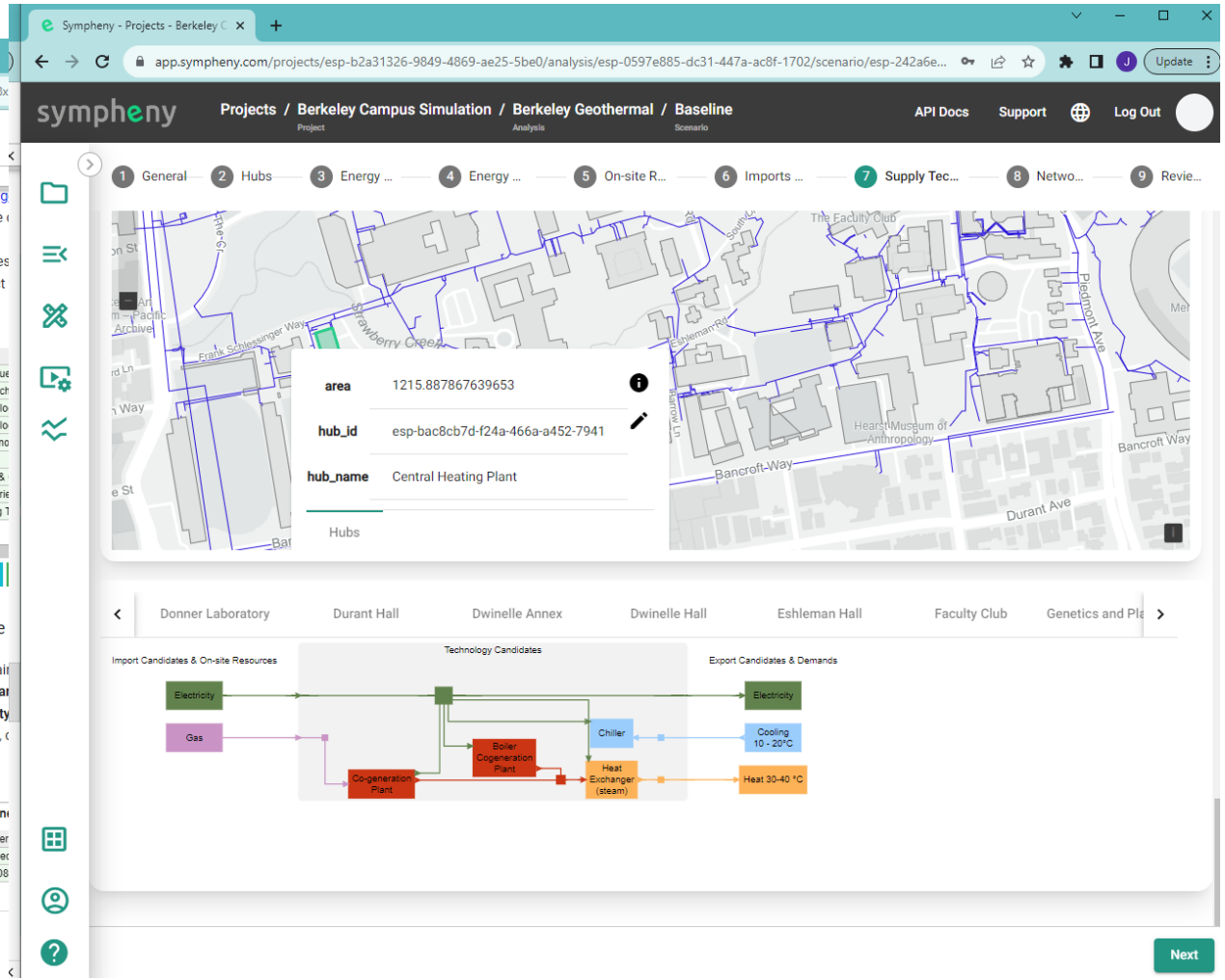
Youssef Sherif
MSc Energy Systems & Technologies, ETH
Expertise: Energy optimization | Software development

Design approach with Sympheny

In developing future-proof energy systems designs, we typically apply our technology in a 4-step methodology, with analyses typically being iterated through these steps as the project progresses

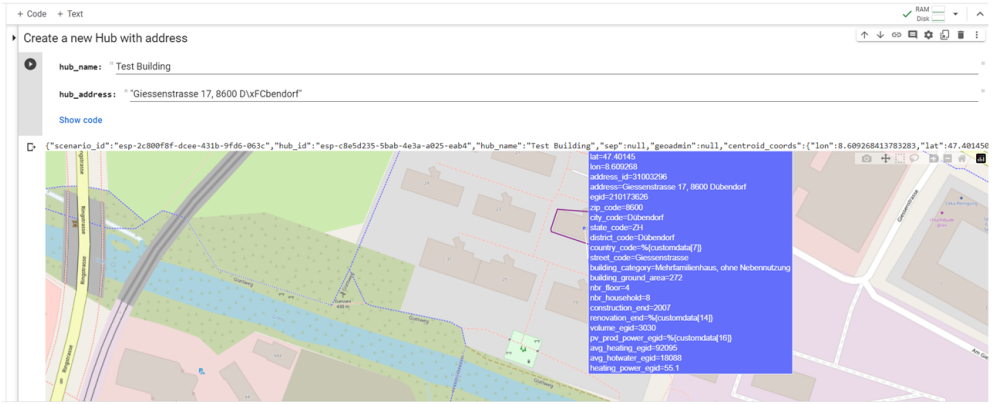


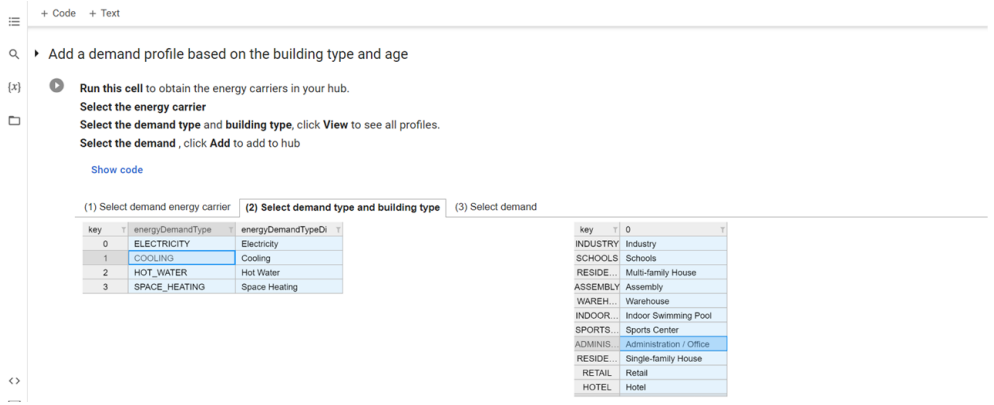




Enervision

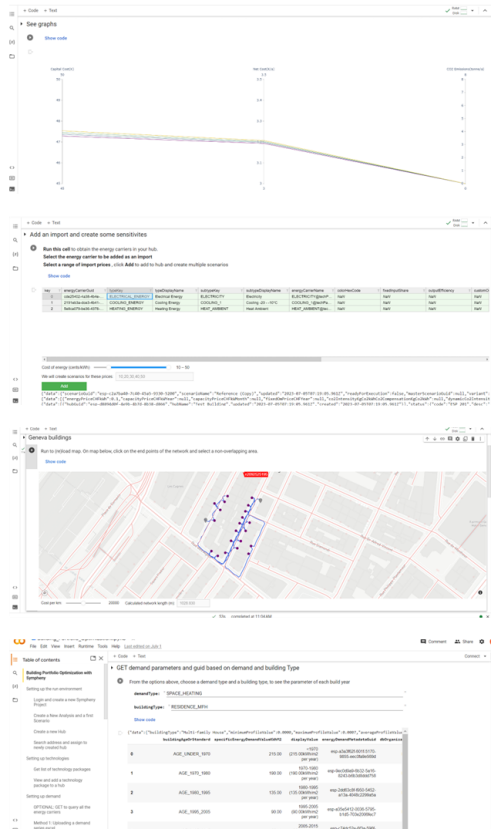
- ✓ Built-in jupyter notebook within Sympheny web-app
- ✓ Customized analysis & graphs
- ✓ Customized workflow integration

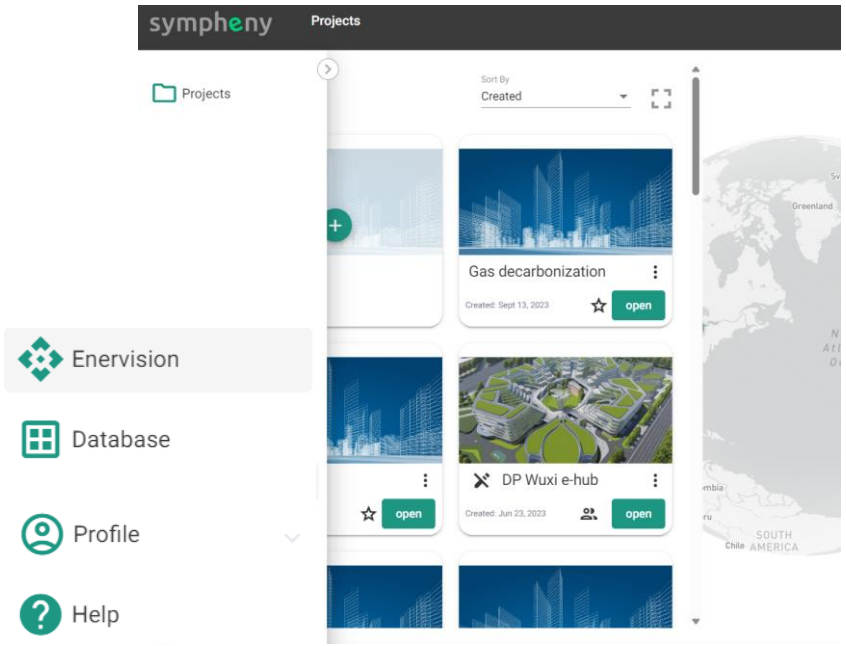




key	energyDemandType	energyDemandTypeDi
0	ELECTRICITY	Electricity
1	COOLING	Cooling
2	HOT_WATER	Hot Water
3	SPACE_HEATING	Space Heating

key	0
INDUSTRY	Industry
SCHOOLS	Schools
RESIDE...	Multi-family House
ASSEMBLY	Assembly
WAREH...	Warehouse
INDOOR...	Indoor Swimming Pool
SPORTS...	Sports Center
ADMINIS...	Administration / Office
RESIDE...	Single-family House
RETAIL	Retail
HOTEL	Hotel





Adaptable Workflow

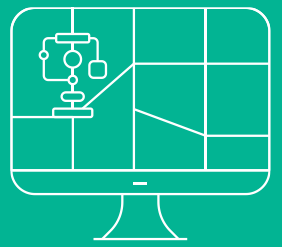
Standard Workflow in Sympheny

Log in
Create new project, and scenario

00 Initial set up

1. Get building information (e.g. use, demand, area, shape, etc.) from Sympheny database and IWB data
2. Get demand profiles of every building
3. Aggregate demand profiles based on attribute/user selection

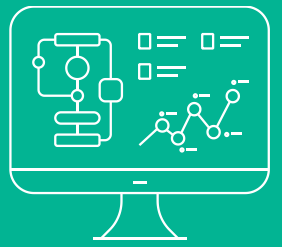
01 Data processing of buildings



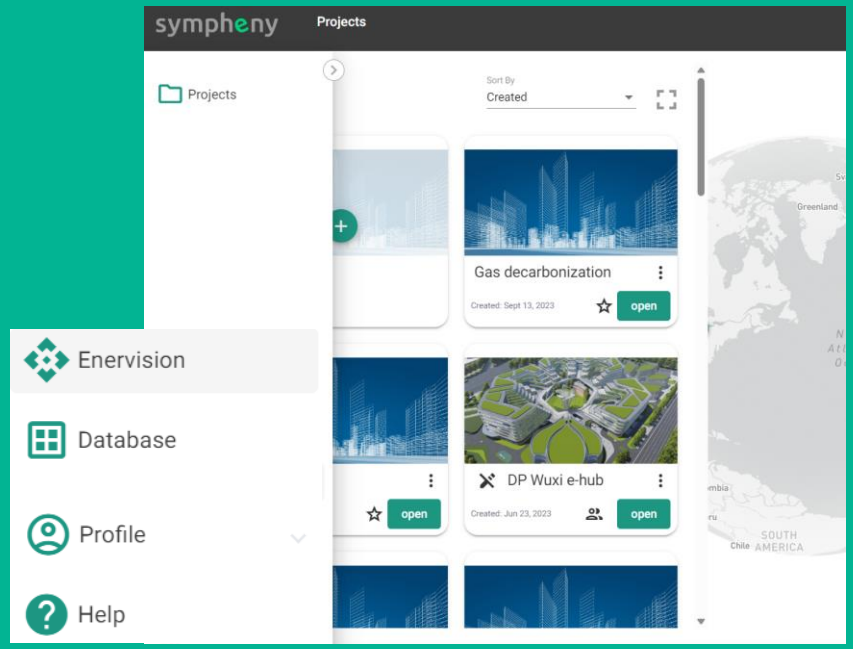
4. Create a hub for every building
5. Using technology packages, create model for every hub/building
6. Execute model and retrieve results

02 Set up model

03 Results visualisation



Flexible Workflow enabled by *Enervision*



examples:
Interactive notebook
Visualisation with powerbi (District scale)
Visualisation with powerbi (City scale)

Product features & Technology

Technology

Our algorithms are a powerful synthesis of optimization & AI.

- ✓ Enabling rapid simulation of thousands of energy systems options for any site, finding the holistically optimal solution
- ✓ Enabling handling of the newest energy technologies, business models & supply concepts
- ✓ Building on 7+ years of research at a leading Swiss research institute
- ✓ Trusted by engineers & validated in practice

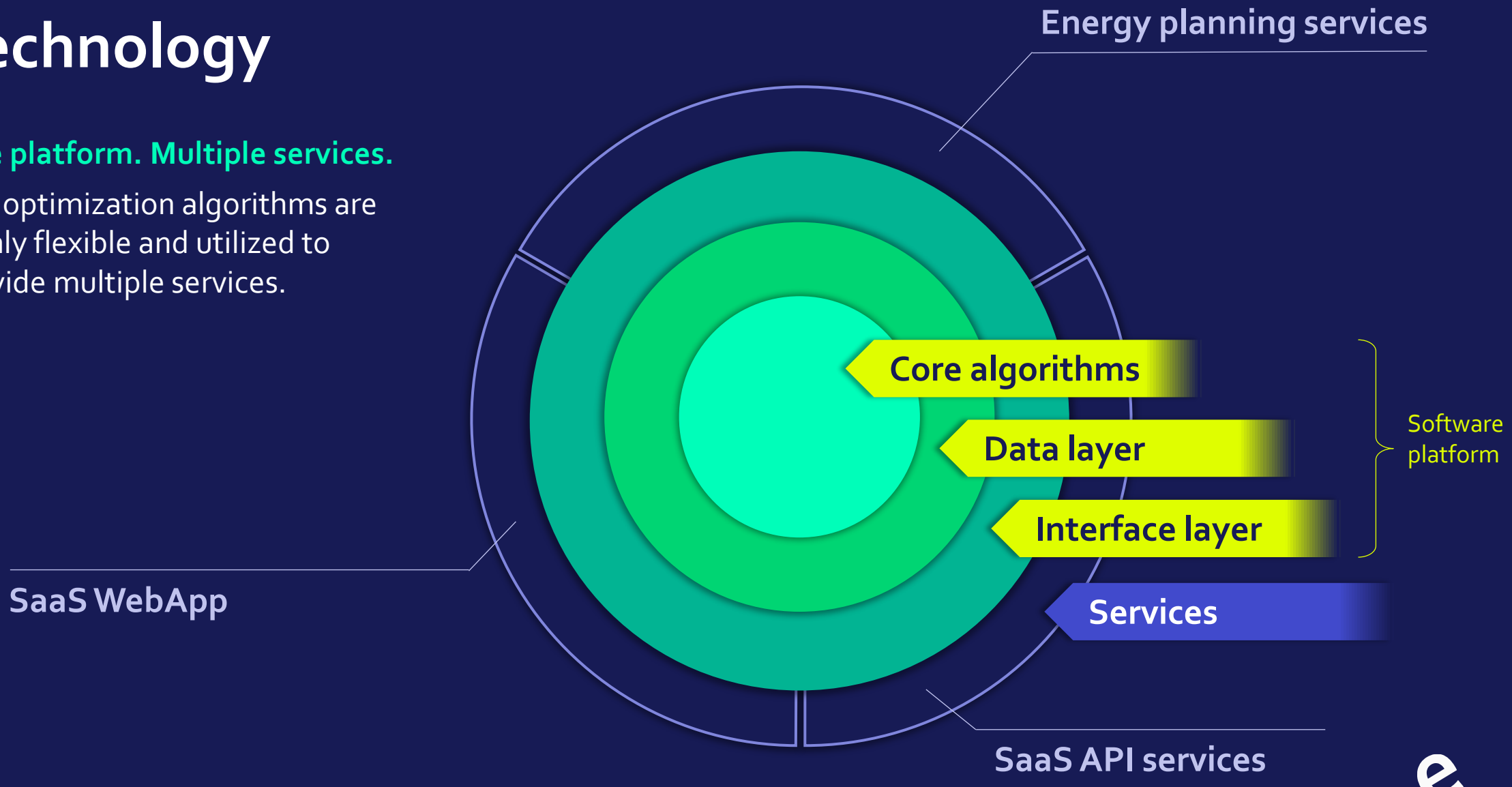
Developed & continually advanced with leading research, analytics & cloud partners.

geoimpact esri Empa GUROBI OPTIMIZATION BERKELEY LAB aws

Technology

One platform. Multiple services.

Our optimization algorithms are highly flexible and utilized to provide multiple services.



DATA SERVICE INTEGRATIONS

OPTIMIZED MULTI-STAGE PLANNING

GUROBI OPTIMIZATION

SENSITIVITY ANALYSIS & ROBUST OPTIMIZATION

GUROBI OPTIMIZATION

INTEGRATION OF REAL-TIME MEASURED DATA

OPTIMIZED BUILDING RETROFITTING

GUROBI OPTIMIZATION

PRODUCT FEATURES

ADVANCED GIS FEATURES (Esri)

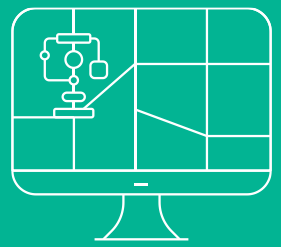
OPTIMIZED NETWORK ROUTING (GILYTICS)

GUROBI OPTIMIZATION

ADVANCED MODEL DECOMPOSITION

GUROBI OPTIMIZATION

Current process



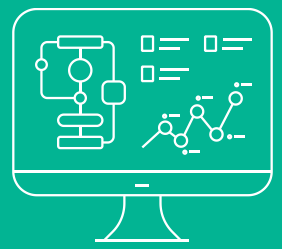
Defining hubs
Visualising layers
Client-side data integration and mapping
Getting network lengths and display
GIS data integration with 3rd parties
Click and select demand and resource potential from map

01 Digital model of a site or area

Multi-objective optimization
MILP formulation
Modular formulation

02 Optimization

GUROBI OPTIMIZATION



03 Decision dashboards

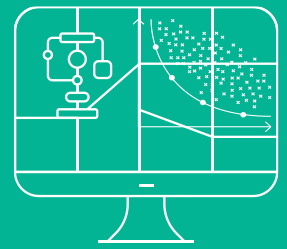
Customized features

Making **OPTIMIZATION & GIS** the centre piece of our platform

\+

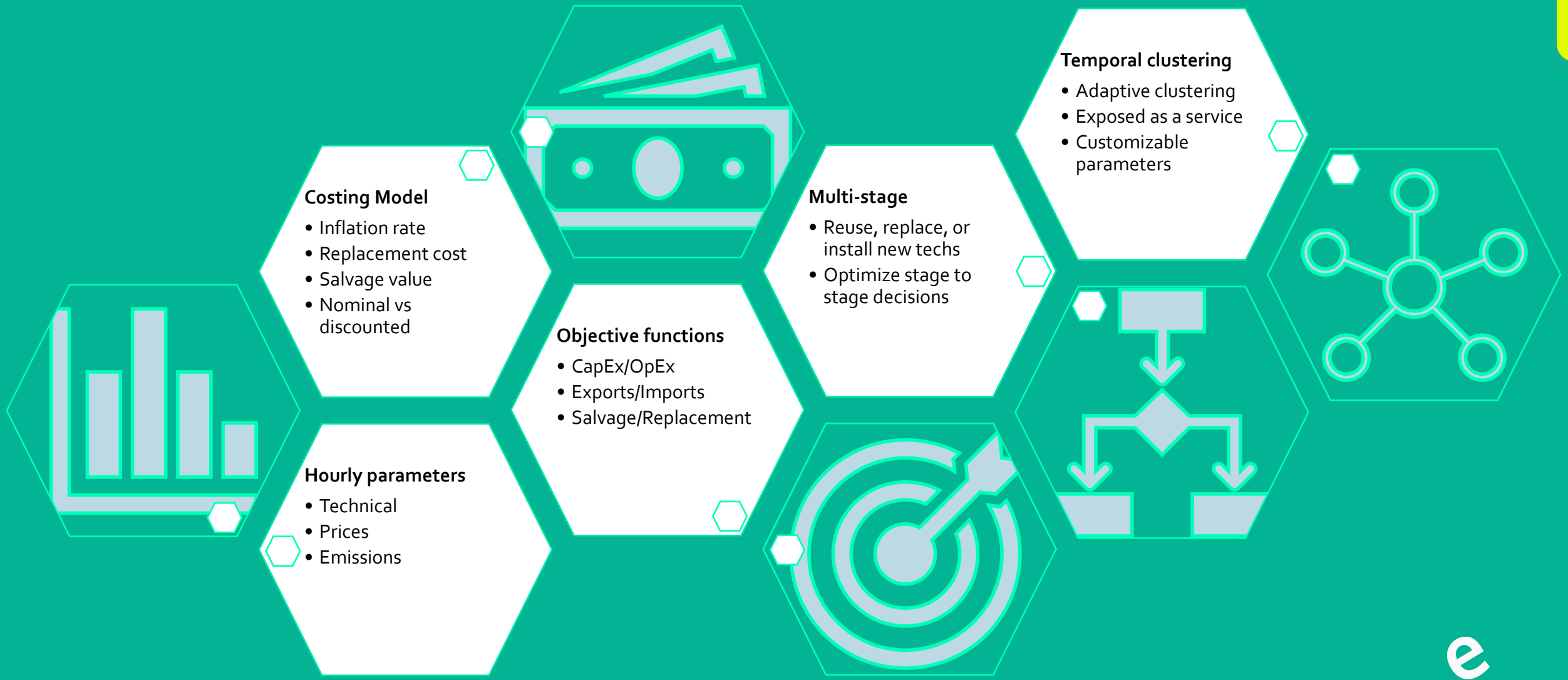
Drag and drop technologies on map
Add and design new buildings/areas ESRI
3D display of buildings ESRI
GIS features, e.g. clustering, measurements ESRI
Automate data acquisition and constraints directly from geospatial info ESRI
Provision of geo-services directly through our platform

Optimisation of network topologies alongside technologies
Multi stage optimization
Sensitivity and robust analysis
Objective functions
Granularity vs. Speed
Intelligent optimisation
Assisted & modular optimisation



Embedded GIS dashboard ESRI

Enhanced modelling, faster performance



Costing Model
- Inflation rate
- Replacement cost
- Salvage value
- Nominal vs discounted

Hourly parameters
- Technical
- Prices
- Emissions

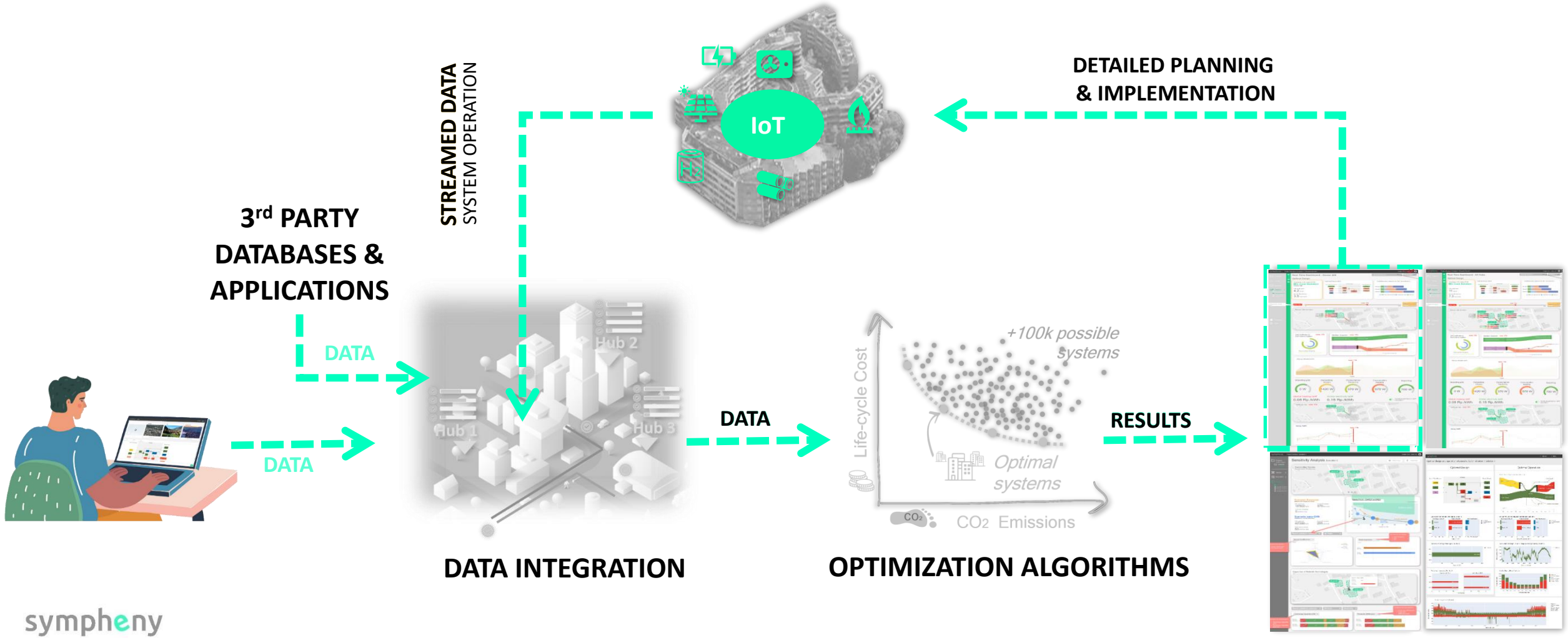
Objective functions
- CapEx/OpEx
- Exports/Imports
- Salvage/Replacement

Multi-stage
- Reuse, replace, or install new techs
- Optimize stage to stage decisions

Temporal clustering
- Adaptive clustering
- Exposed as a service
- Customizable parameters

AGILE ENERGY PLANNING

ADAPTIVE ENERGY PLANNING INFORMED BY REAL-TIME MEASURED DATA



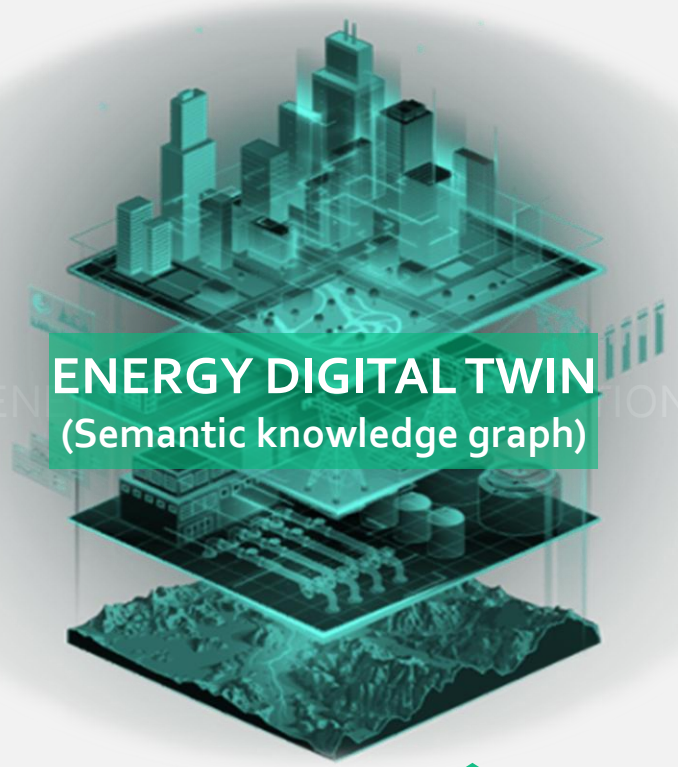
sympheny

DIGITAL TWIN APPROACH

Digicities

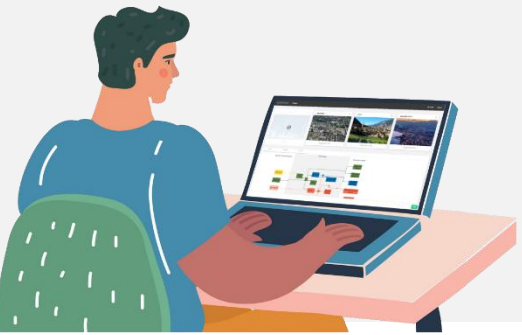
DATA INTEGRATION WITH SEMANTIC-BASED DIGITAL TWINS

DATA RESOURCES
→3rd party data services & data repositories
→Smart meters & IoT devices
→Customer-provided data



ENERGY DIGITAL TWIN
(Semantic knowledge graph)

ENERGY ANALYTICS APPLICATIONS
→Sympheny Web App
→3rd party apps
→Future Sympheny apps



DATA ENRICHMENT ALGORITHMS

3RD PARTY APPLICATIONS

Example Projects

Energy self-sufficient concept for a campus

Birr, Switzerland

Situation: Educational campus in an agricultural setting seeking to achieve energy self-sufficiency

Concept development:

- Agricultural-integrated and rooftop PV systems, with excess summertime electricity converted to hydrogen
- Energetic utilization of on-site agricultural waste and local-sourced organic waste to produce methane for heat and electricity production using CHP plant
- Methane tank for seasonal energy storage, combined with batteries for daily/weekly electricity storage

Result: Concept for complete energy self-sufficiency by exploiting the advantages of the agricultural setting

→ More on PV magazine: click here

Neuhof

Designing an Eco-Friendly Swiss Haven while cutting back emissions

Yverdon-les-Bains, Switzerland

Situation: In their quest to create a mixed-use, eco-friendly neighborhood, the Swiss municipality of Yverdon-les-Bains needed a way to quantify the trade-offs between different system designs and operations.

Concept development:

- Assessment of CO_2 and life-cycle costs of the master plan allowing for a sustainable transformation of the area

Result:

– Identification of optimal energy planning solution with optimal trade-offs between life-cycle costs and CO_2 emissions.
– CO_2 optimal solution with a cut of 83% of the CO_2 emissions by 2040, under increased electricity and heat demand.

→ More : click here

Credit: Jean-Pierre Bösiger, CC BY-SA 4.0, via Wikimedia Commons

Expansion strategy for a district heating supplier

Western Switzerland

Situation:

Municipality and local energy utility seeking network expansion and technology refurbishment strategies to profitably connect new customers to current district heating networks.

Concept development:

- Identification of usable capacity from the existing district heating for network expansion.
- Optimal network connection and sizing
- Optimal decentralized heating plants refurbishment strategies
- Heat contract pricing analysis for new customer connections

Results:

Potential to utilize 100% of previously untapped district heating plant capacity to significantly expand the profitably addressable customer base, and to do so with renewable heat.

Net zero energy concept for a waste incineration plant

Eastern Switzerland

Situation:

Waste incineration plant seeking net-zero emission by 2050 through integration of carbon capture technologies

Concept development:

- Optimal multi-energy integration of heat and electricity sales into the urban area with incineration and carbon capture processes, combined with optimizing plant life cycle investment return
- Cost-benefit analysis for upcoming heat sales contracts
- Optimal energy storage sizing under fluctuating energy prices
- Scenarios to analyze the trade-offs between heat-intensive and electricity-intensive carbon capture technologies

Result:

Identified the financially optimal net-zero systems design and heat sales strategy, preserving the overall plant investment case.

Credit: Waste incineration plant in Oberhausen © King Otto, CC BY-NC-SA 3.0

Energy concept for an industrial harbor

Switzerland

Situation:

Green hydrogen projects are an important asset in the race to zero emissions. Beside being a suitable media for seasonal energy storage, green hydrogen is deemed crucial to decarbonize heavy mobility sector in Switzerland.

Concept development:

Assess the economic and environmental benefits of producing green hydrogen for heavy mobility by integrating waste heat for space heating supply to nearby residential areas.

Result:

Compared to a 100% fossil-based baseline scenario, a first scenario reduces emission by 60% with a return of investment over 15 years. A second scenario reduces emissions by 10% more, mostly due to increase in energy storage.

→ More on client's website: click here

Project lead: BG Consulting Engineers SA (BG)

Sympheny Dashboard

Plan the energy systems of tomorrow. Today.

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