Willkommen
Welcome
Bienvenue

Empa
Materials Science and Technology

Energy Hub:
How Decentralized Energy Systems accelerate Decarbonisation
能源枢纽eHub：分布式能源系统加速低碳化进程

ZEB Talks 2022

中瑞零碳建筑系列研讨会

Prof. Matthias Sulzer

Matthias Sulzer 教授

Challenge 挑战

STRATEGIC PLANNING
战略规划

FEASIBILITY ASSESSMENT
可行性评估

PROJECT
项目

TENDER & CONSTRUCTION
招投标和建造

OPERATION
运营

ENERGY CONCEPT DEVELOPMENT
开发能源方案

Goals 目标

净零二氧化碳排放

NET-ZERO CO_2

不依赖化石能源

FOSSIL INDEPENDENCE

ENERGY AUTARKY 能源自给自足

Problem 问题

Thermal network?
What type? Which buildings?
供热网络？类型？目标建筑？

Which Supply technologies?
How big, where?
供应技术？容量？位置？

Which renewable resources?
Solar? Wind? Geothermal?
哪些可再生能源可被利用？
太阳能？风能？地热能？

DEMAND 需求
PROCESS HEAT
工艺用热

DEMAND 需求
ELECTRICITY 电
HOT WATER 热水
SPACE HEATING 供暖
SPACE COOLING 制冷

DEMAND 需求
EMOBILITY
电动交通

Which Storage technologies?
How big, where?
储能技术？容量？位置？

Which energy system enables meeting my sustainability targets at minimal cost and risk?
何种能源系统可以在最低成本和风险的前提下实现可持续目标？

Electrical Campus grid?
What type? Which buildings?
园区电力网络？类型？目标建筑？

Which grid connections?
How big, where?
网络联接？容量？位置？

X

X

X

X

X

Best out of 4
Solution
4种解决方案
中的最佳方案

Empa

X

Optimal Solution

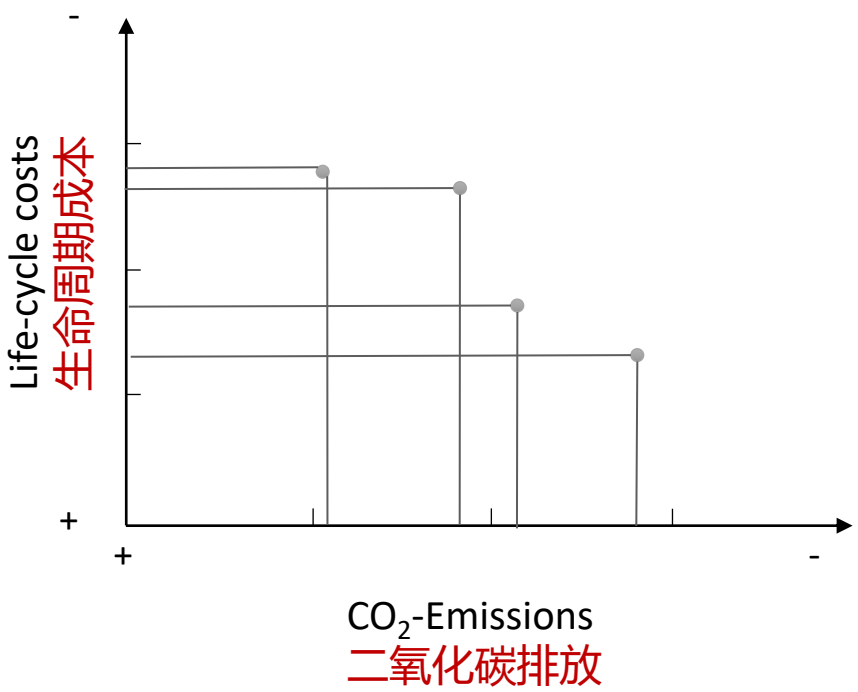
最优解决方案

Energy-Hub Optimisation

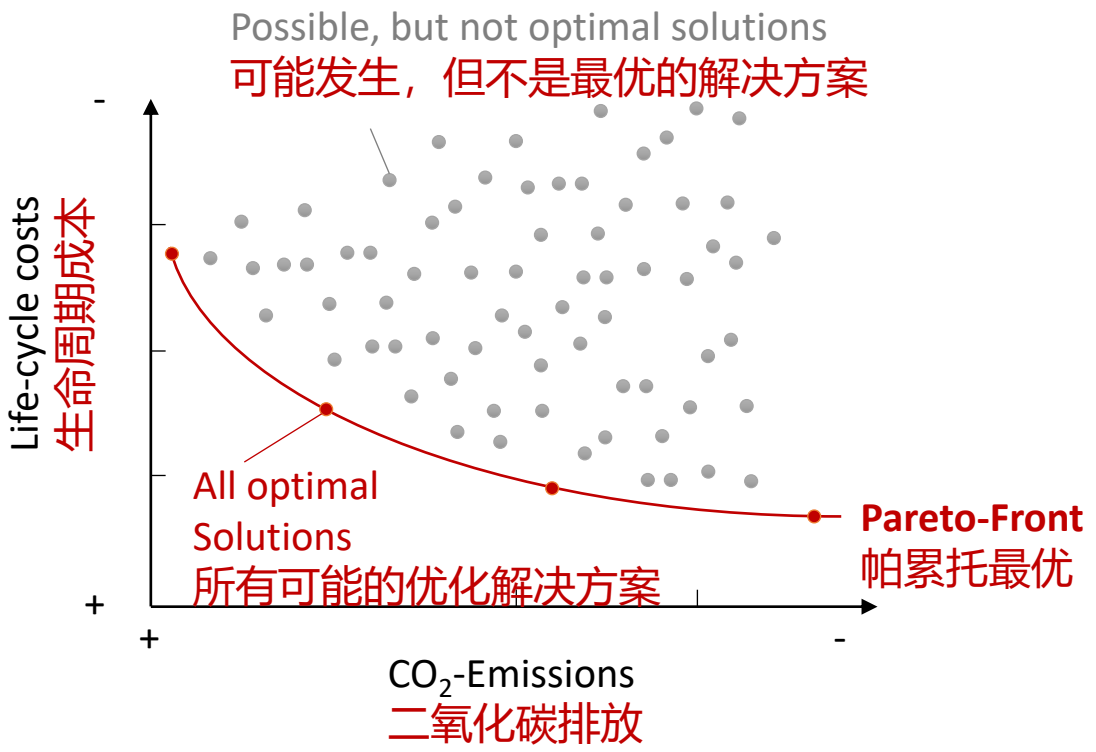
能源枢纽中心的优化

What is an optimal solution? 最优解决方案介绍

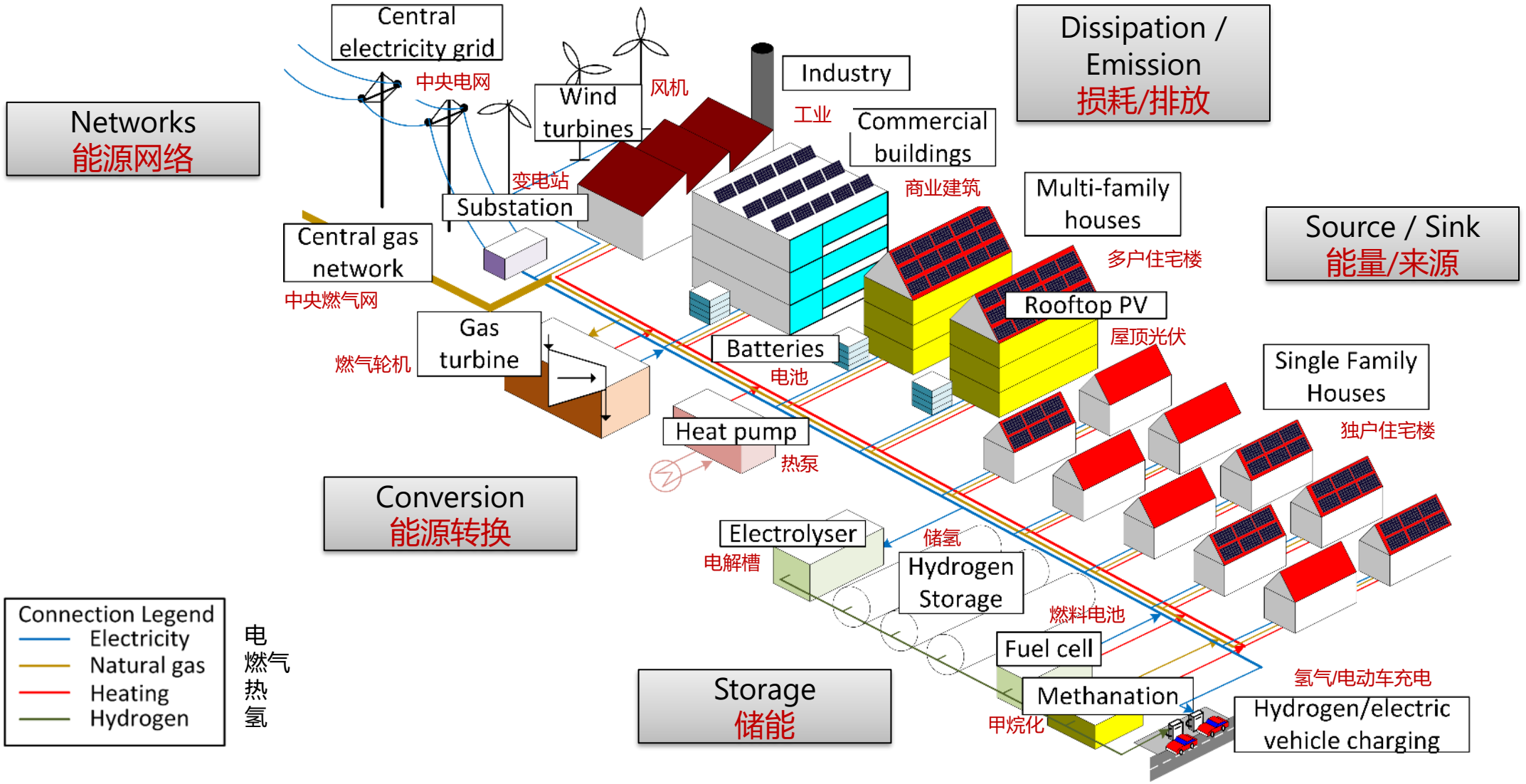
Today's planning workflow
当前的规划工作流程



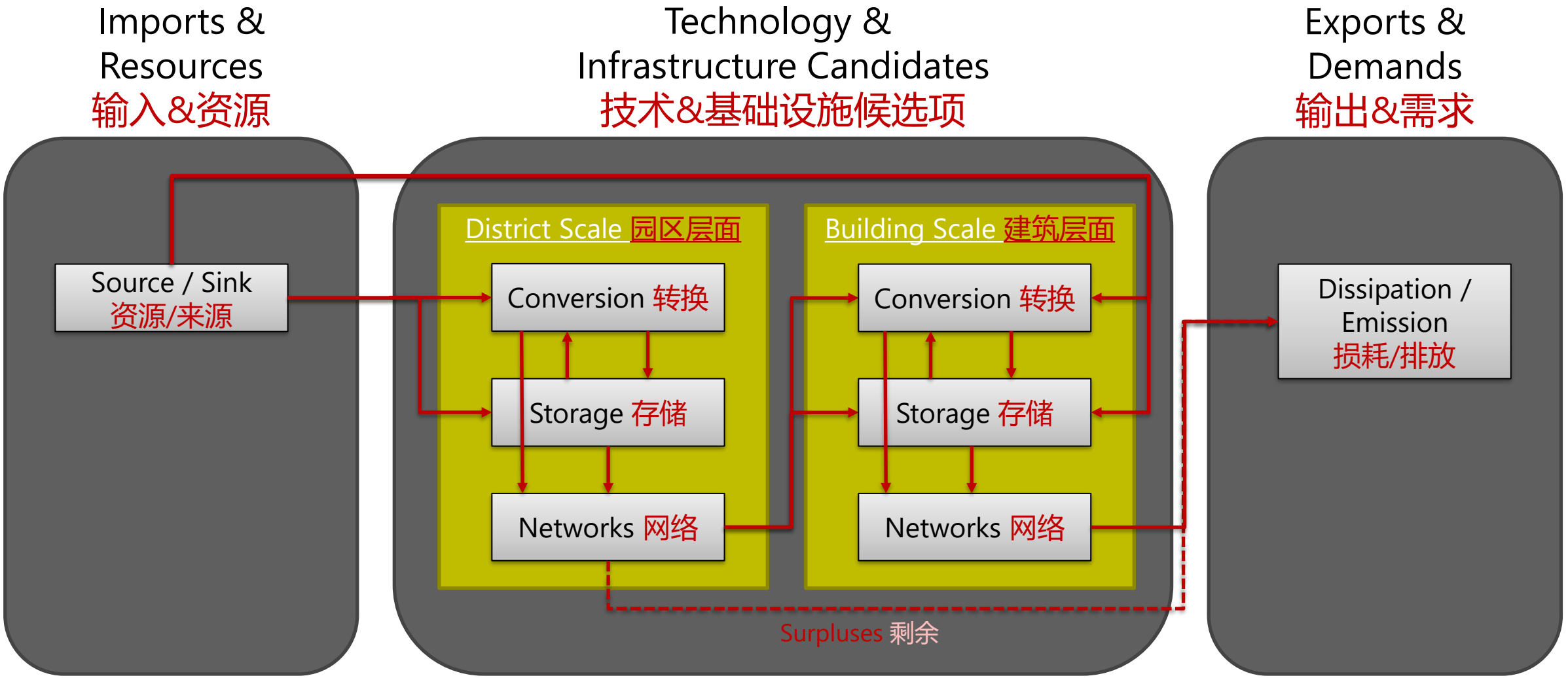
Algorithm-based planning workflow
基于算法的规划工作流程



What is an Energy Hub (ehub)? 能源枢纽(ehub)介绍



Energy Hub modeling → utilising data & algorithms
利用数据和算法建立能源枢纽eHub模型



Energy Hub models for various scales
各种规模的能源枢纽eHub模型

Based on Geidl, M. et al, 2007)

Imports & Resources 输入&资源

- Oil, Gas 油、气
- Syn-Fuel 协同燃料
- H2, Biogas 氢能、生物燃气
- Biomass 生物质
- Solar 太阳能
- Geothermal-energy 地热能
- Environmental heat 环境热
- River/Lake heat 河水、湖水

→ Any supplied energy carriers to, or renewable resources on site 其他任何供应的能源类型或现场的可再生资源

Technology & Infrastructure Candidates 技术&基础设施候选项

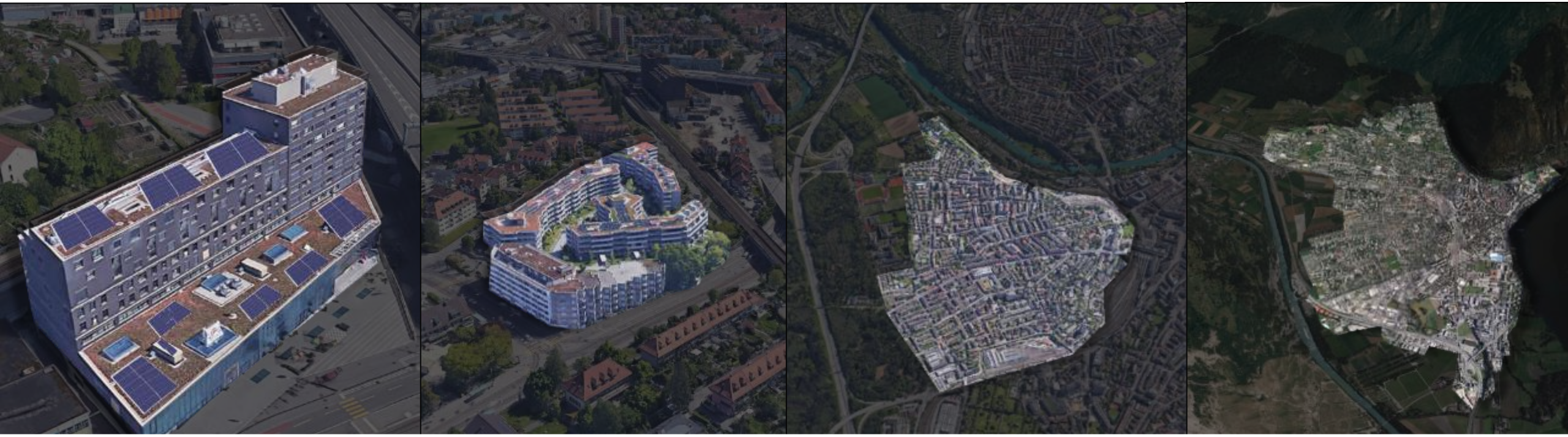
National Scale 国家层面	District Scale 区域层面	Building Scale 建筑层面
• Hydro power 水力发电	• CHP 热电联产	• HP 热泵
• Pump-storages 抽水蓄能站	• Micro-Turb. 微型涡轮机	• CHP 热电联产
• Electrical grid 电网	• PV 光伏	• PV 光伏
• Gas grid 天然气网	• Batteries 电池	• Batteries 电池
	• Storages 储能	• Boilers 锅炉
	• Thermal grids 热网	• Tank 油箱
	• Micro-Grids 微电网	• Storages 储能
		• .. ..

Exports & Demands 输出&需求

- Room heating 供暖
- Cooling 制冷
- Hot Water 热水
- Electricity (Appli.) 电
- Electricity (Mobility) 电（交通）
- H2 Mobility 氢（交通）
- Feed-in el./heat 供电/供热

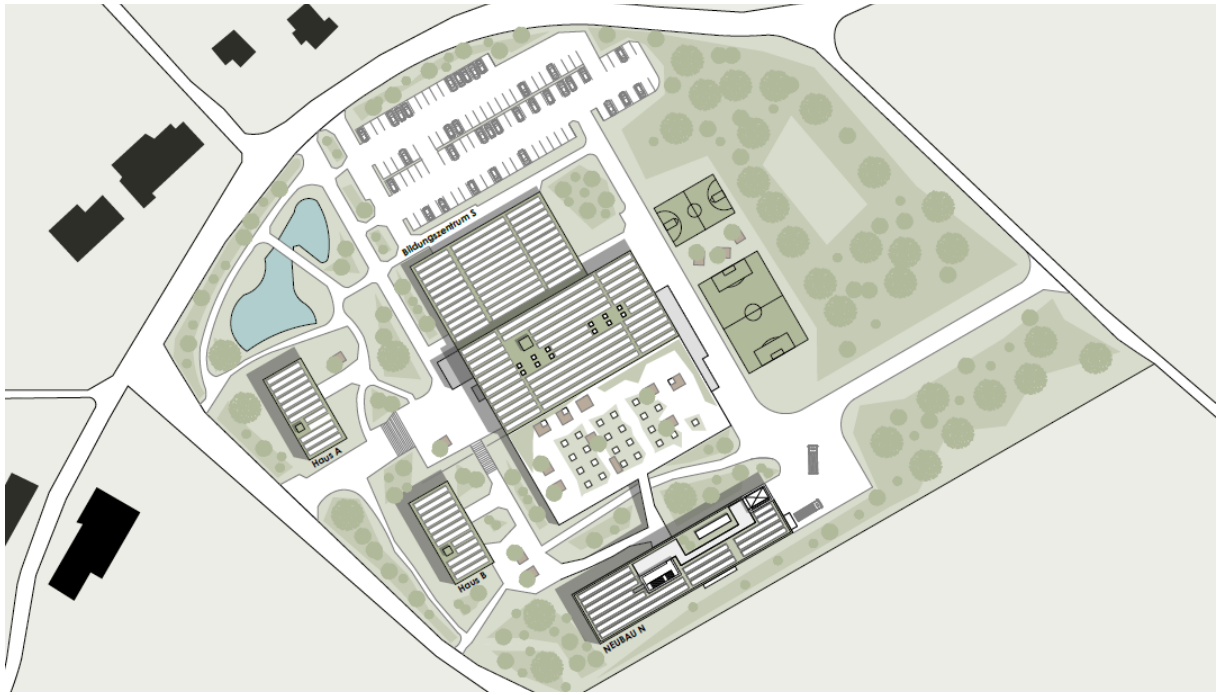
→ One or multiple buildings, districts, areas, neighborhoods, Cities, nations, … 单栋或多栋建筑，区域，城区，城市，国家

Where are Energy Hubs emerging?
能源枢纽eHub的应用区域?

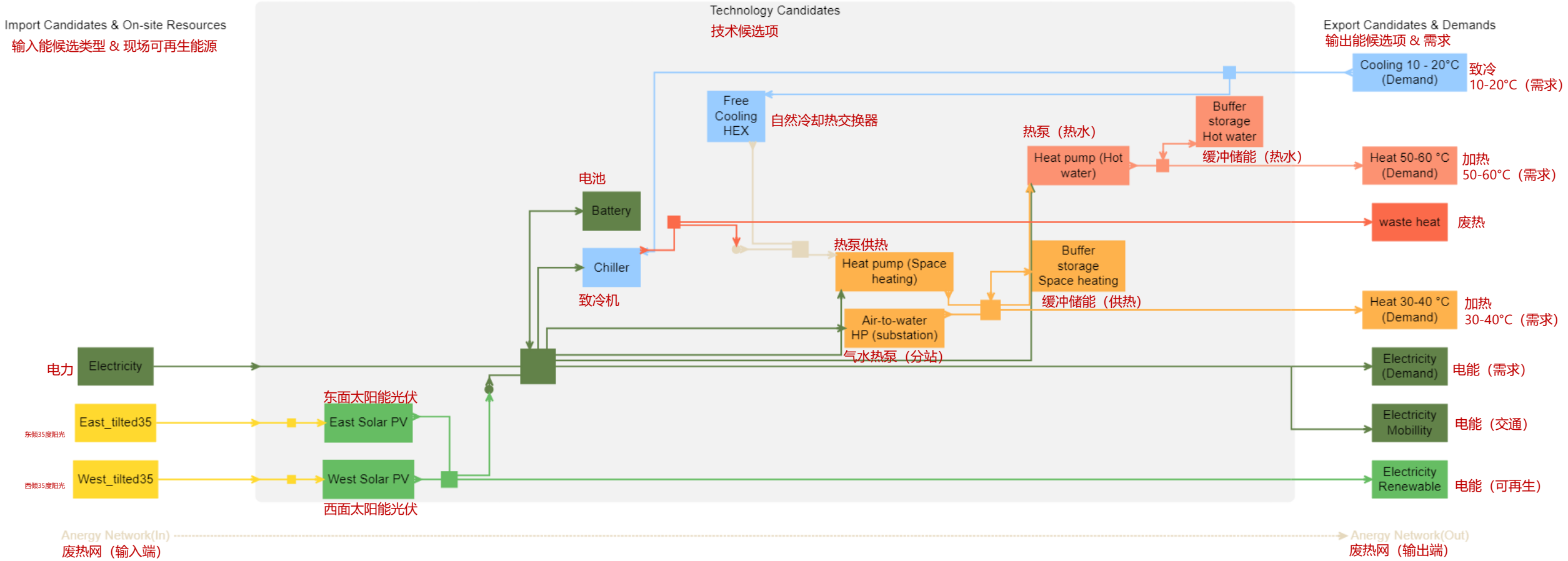


Buildings 建筑 | Neigbourhoods 社区 | Districts 城区 | Cities 城市

Example Campus 园区案例

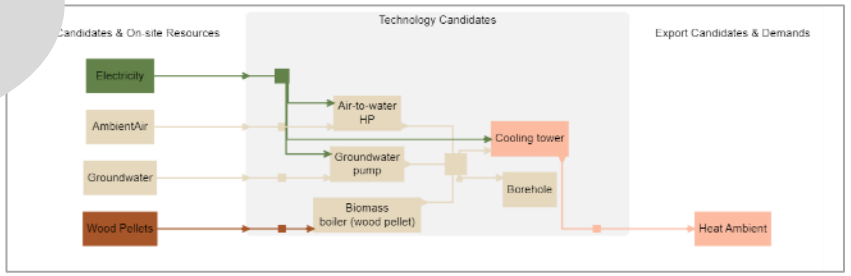


Ehub Modelling on Building scale
建筑层面的能源枢纽eHub模型

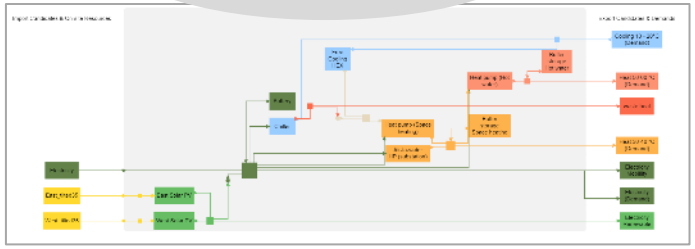


Ehub Modelling on Neighborhood/Campus scale
社区&园区层面的能源枢纽eHub模型

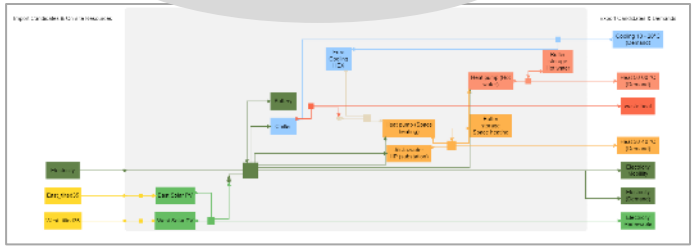
CENTRAL PLANT
中央工厂



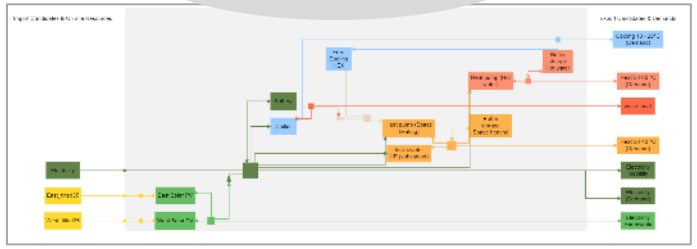
CLUSTER 1
群组1



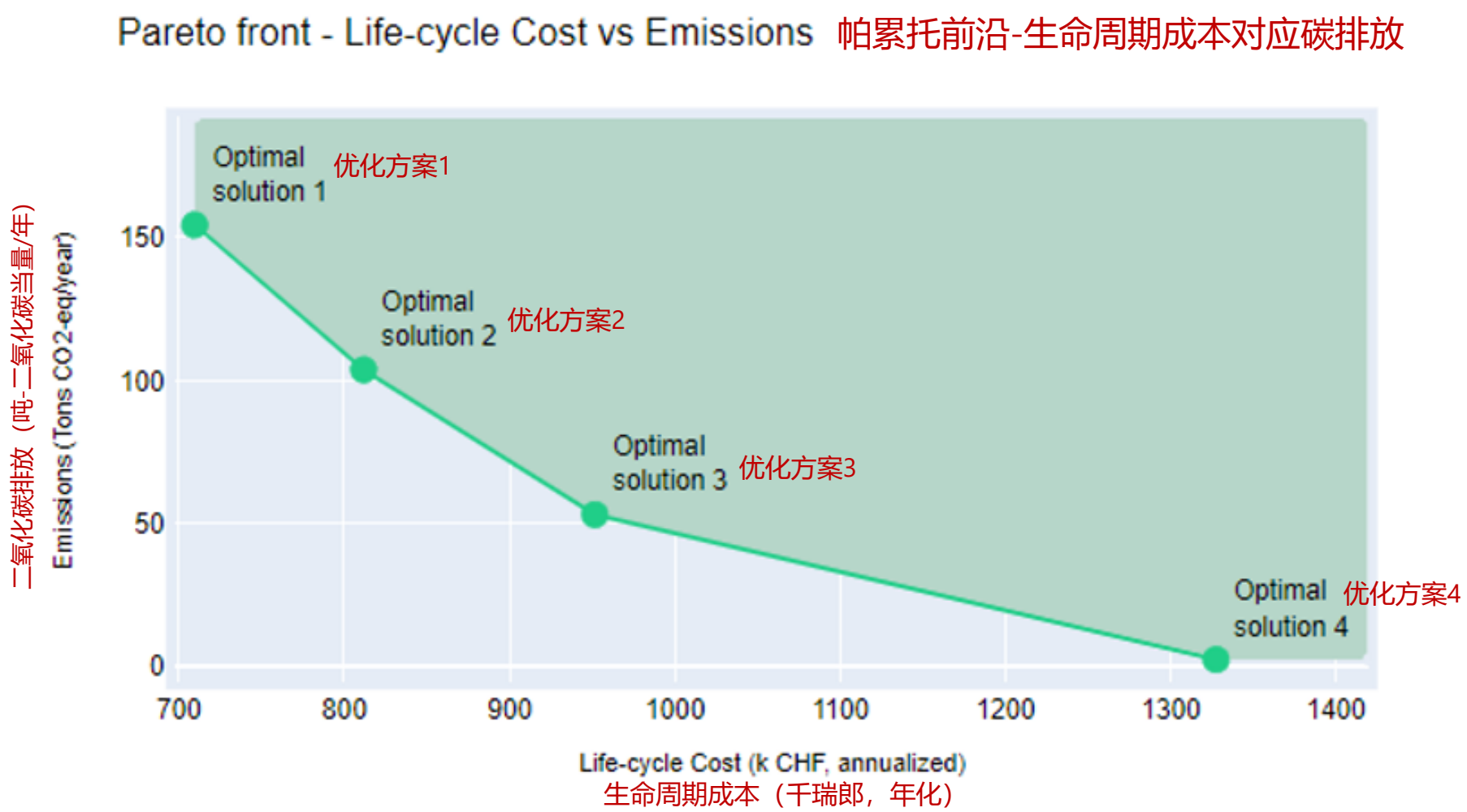
CLUSTER 2
群组2



CLUSTER 3
群组3



Ehub Optimisation Results
能源枢纽eHub优化结果



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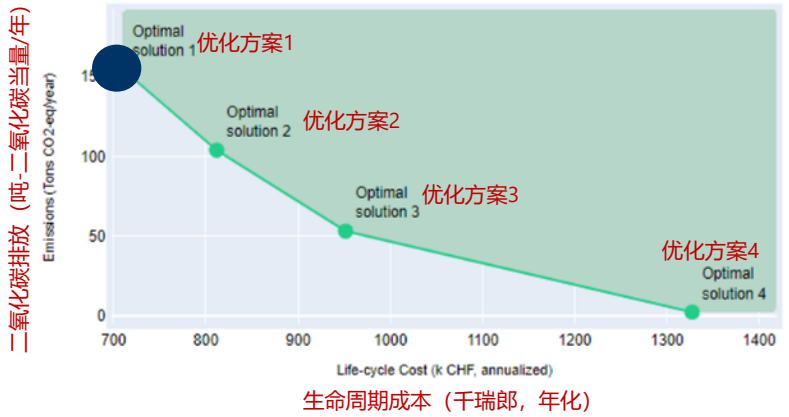


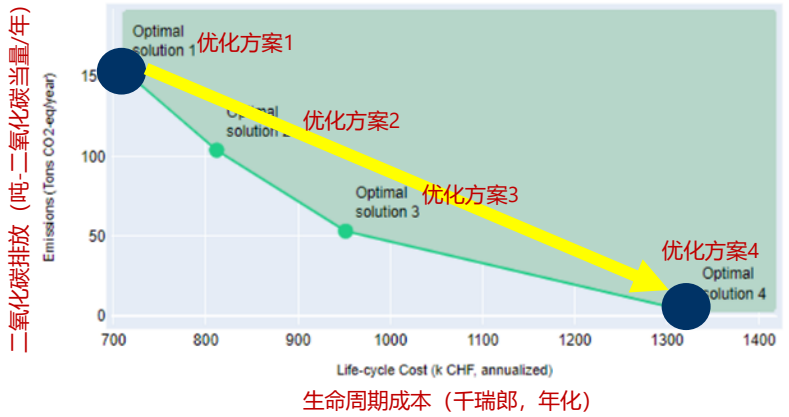
CANDIDATE TECHNOLOGIES
候选技术
- → HEAT PUMPS (NETWORK) 热泵（网络）
- → HEAT PUMP (AIR SOURCE) 空气源热泵
- → CHILLER 致冷机
- → FREE COOLING 自然致冷
- → PV 光伏
- → BATTERY 电池
- → THERMAL STORAGES 热储存

CENTRAL PLANT 中央工厂

CANDIDATE TECHNOLOGIES 候选技术
- → BOREHOLE (SEASONAL STORAGE) 钻井 （季节储能）
- → GROUNDWATER PUMP 地下水源热泵
- → AIR-SOURCE HEAT PUMP 空气源热泵
- → BIOMASS BOILER 生物质锅炉

CLUSTER 1 群组1 — CLUSTER 2 群组2 — CLUSTER 3 群组3

Ehub Optimisation Results
能源枢纽eHub优化结果



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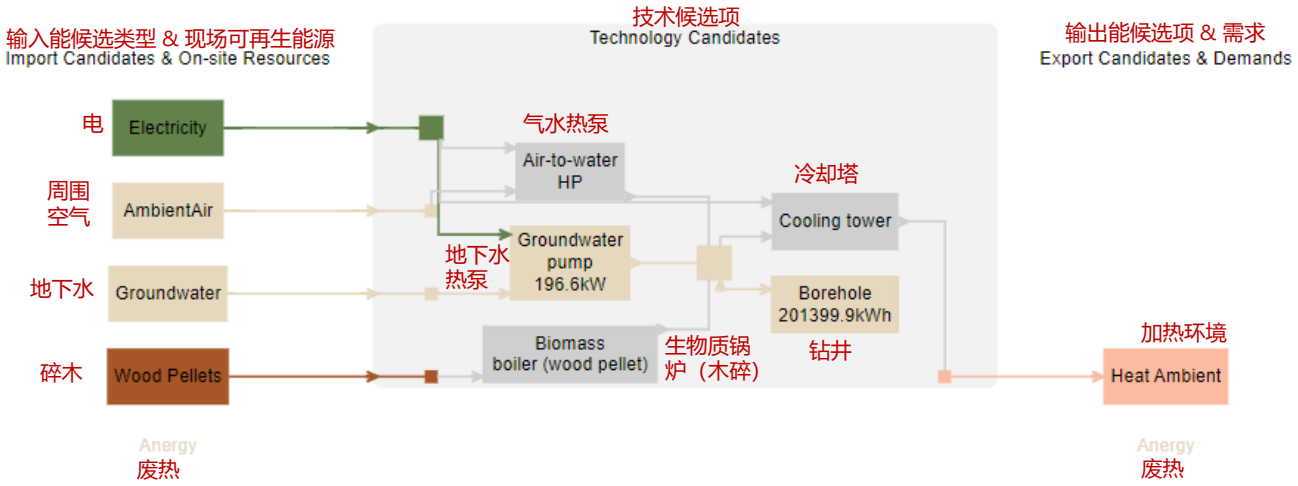
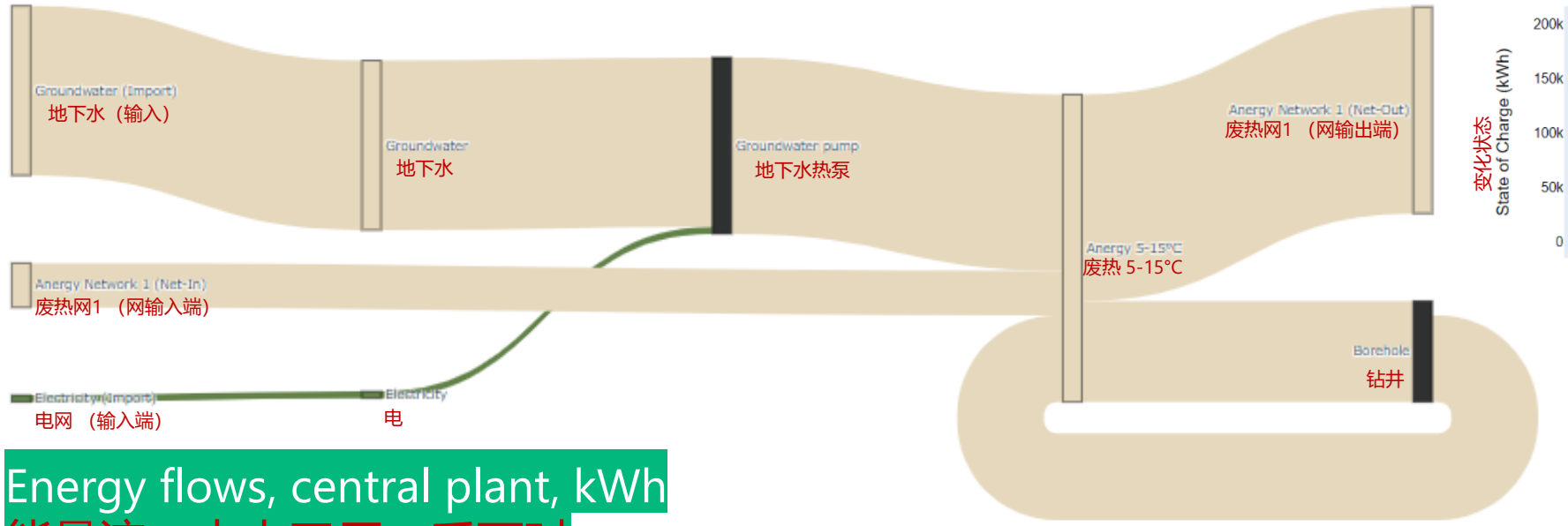
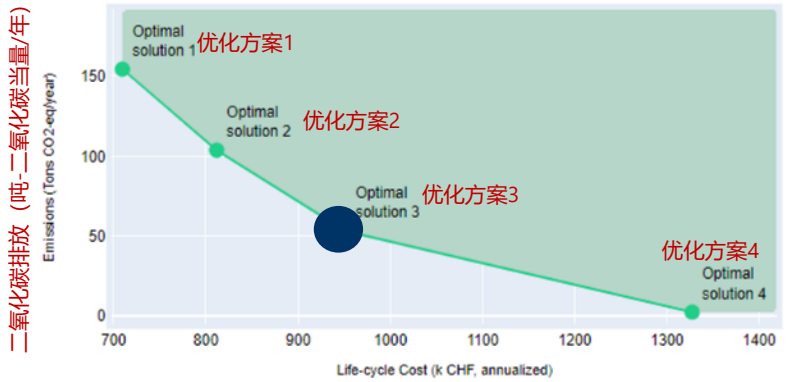
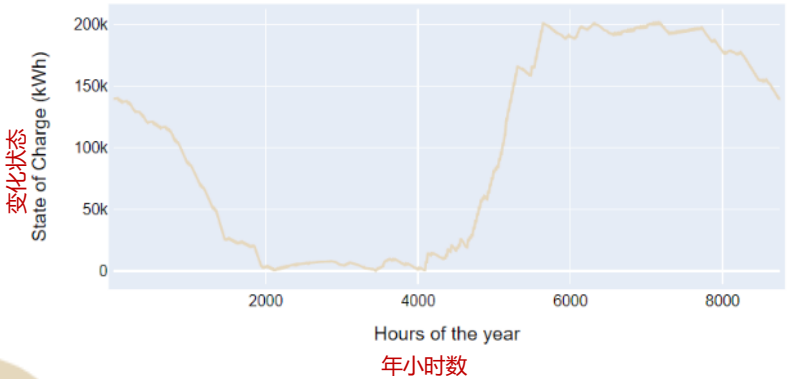


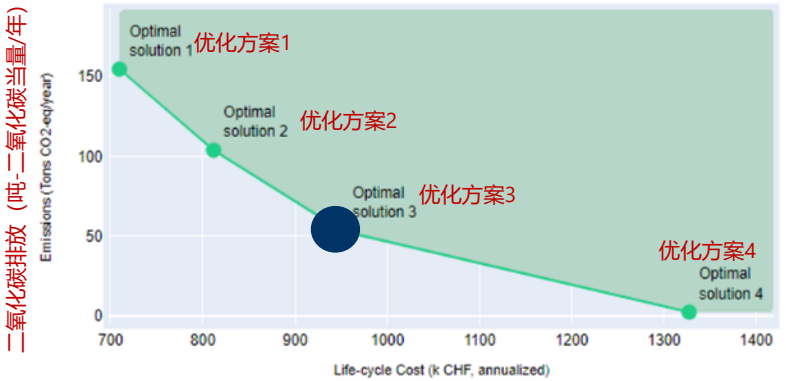




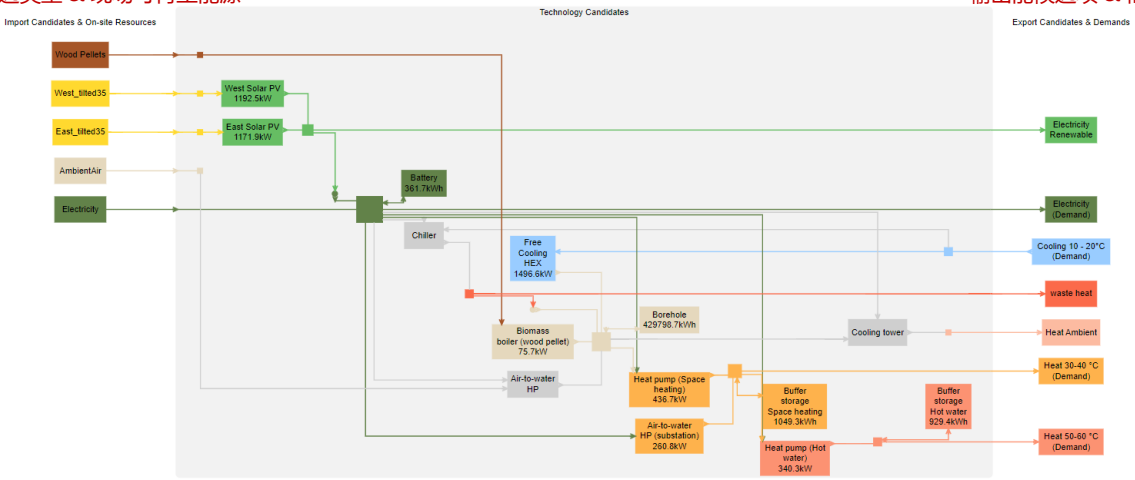


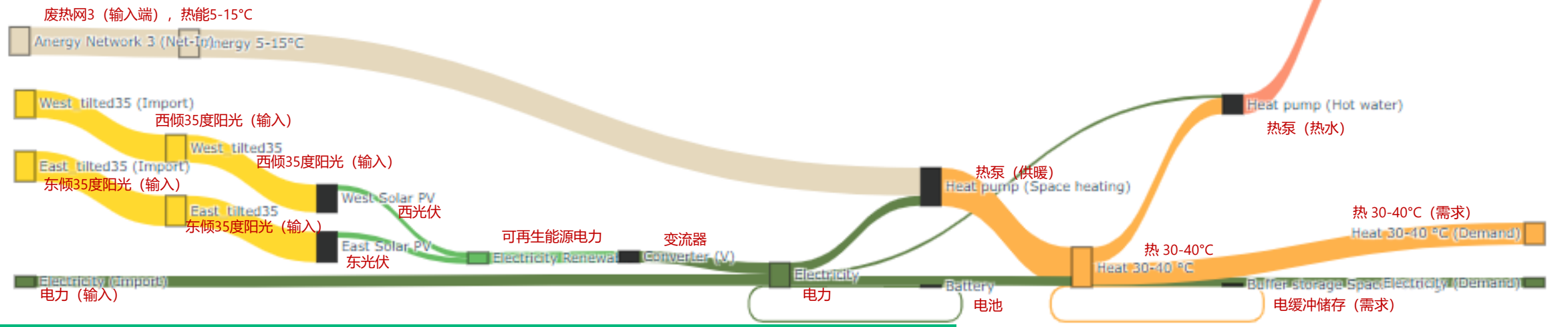
Energy flows, central plant, kWh
能量流，中央工厂，千瓦时

Ehub Optimisation Results
能源枢纽eHub优化结果



输入能候选类型 & 现场可再生能源　　技术候选项　　输出能候选项 & 需求



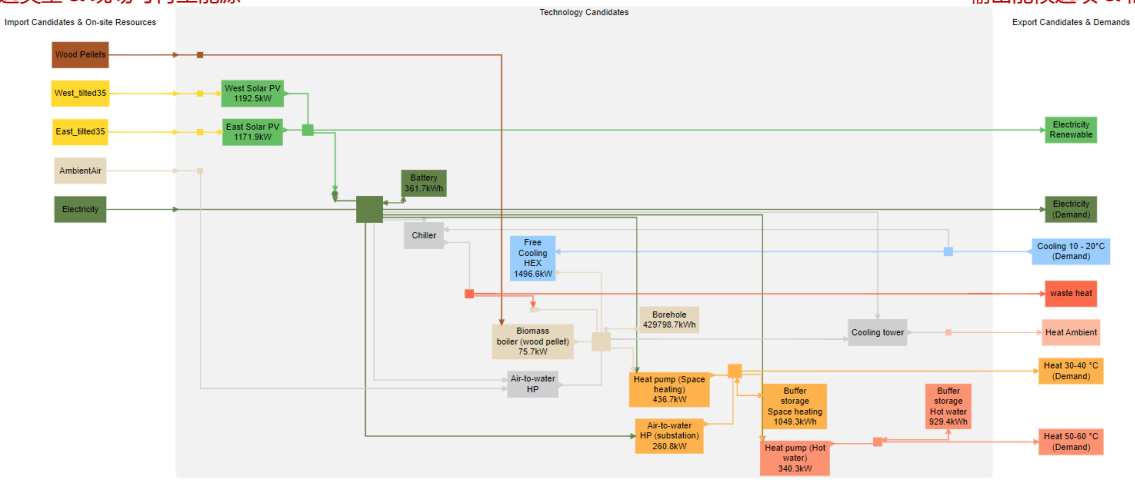


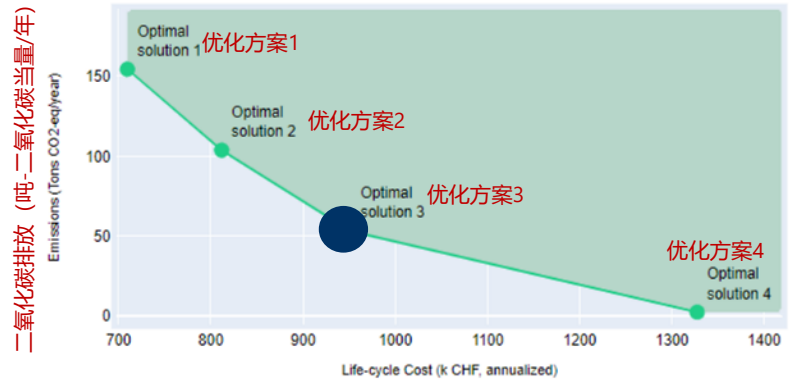
Energy flows, clusters 1-3 plant, kWh 能量流，群组1-3，千瓦时

Winter 冬季

Ehub Optimisation Results
能源枢纽eHub优化结果

输入能候选类型 & 现场可再生能源　　技术候选项　　输出能候选项 & 需求





Energy flows, clusters 1-3 plant, kWh 能量流，群组1-3，千瓦时

Summer 夏季

SYMPHENY EMPOWERS COMMUNITIES, NEIGHBORHOODS & CITIES TO BE…
SYMPHENY 使社区、邻里和城市实现…

sympheny

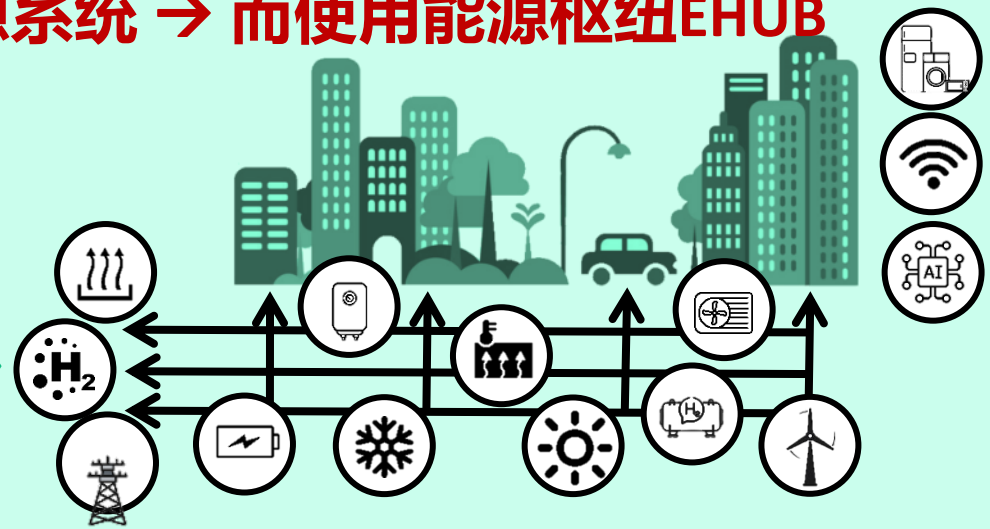
GRID SUPPORTIVE 电网支持性

CO_2 NEUTRAL 碳中和

RESILIENT 稳固

… BY ENABLING THE NEXT GENERATION OF **URBAN ENERGY SYSTEMS → ENERGY HUBS**
…为实施下一代**城市能源系统 → 而使用能源枢纽EHUB**

OPTIMAL INTEGRATION OF…
优化整合
- → **ENERGY STREAMS 能源流**
- → **ENERGY GRIDS 能源网络**
- → **RENEWABLE RESOURCES 可再生资源**



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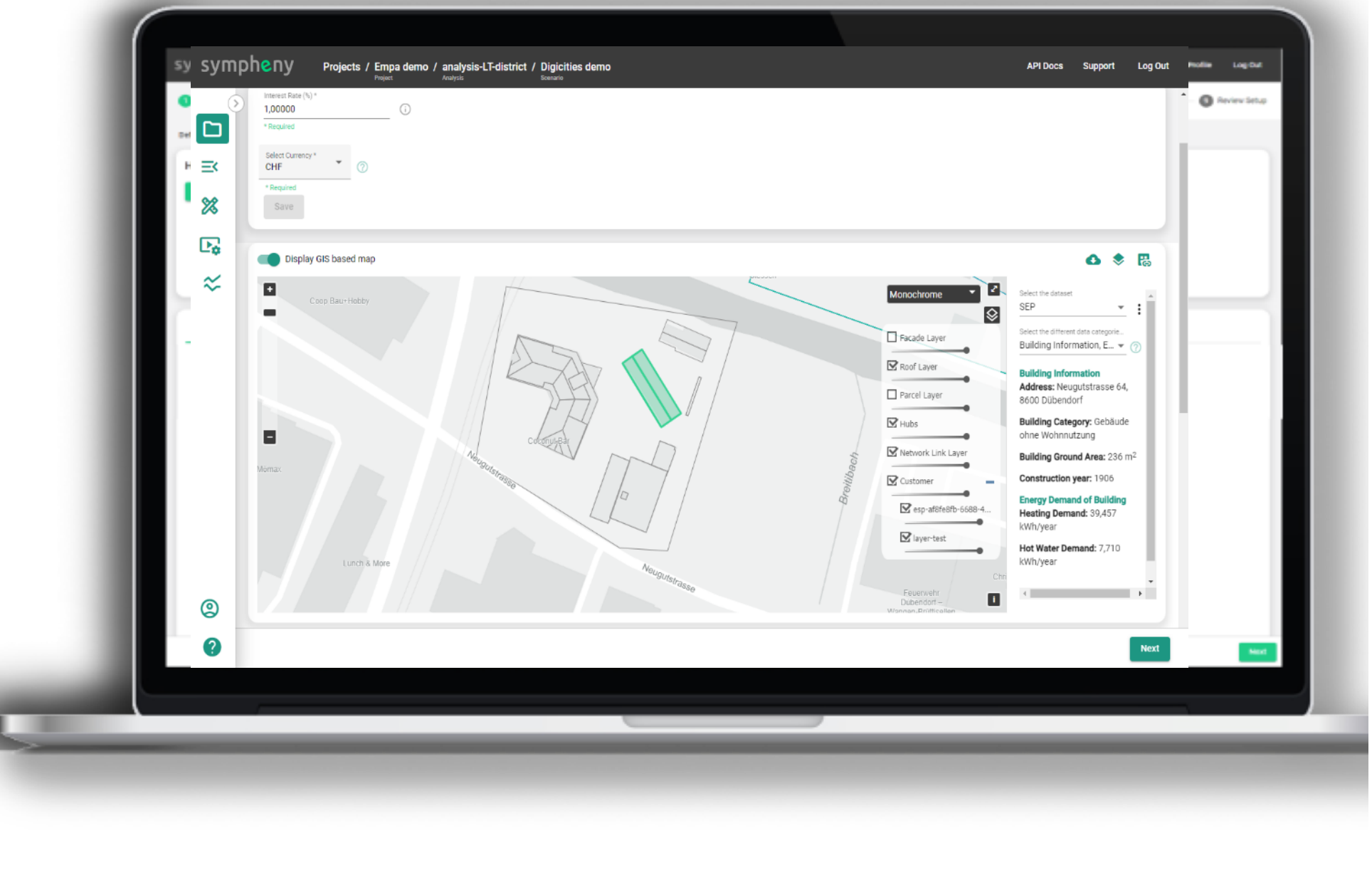

Connection with standardized data

与标准化数据的连接

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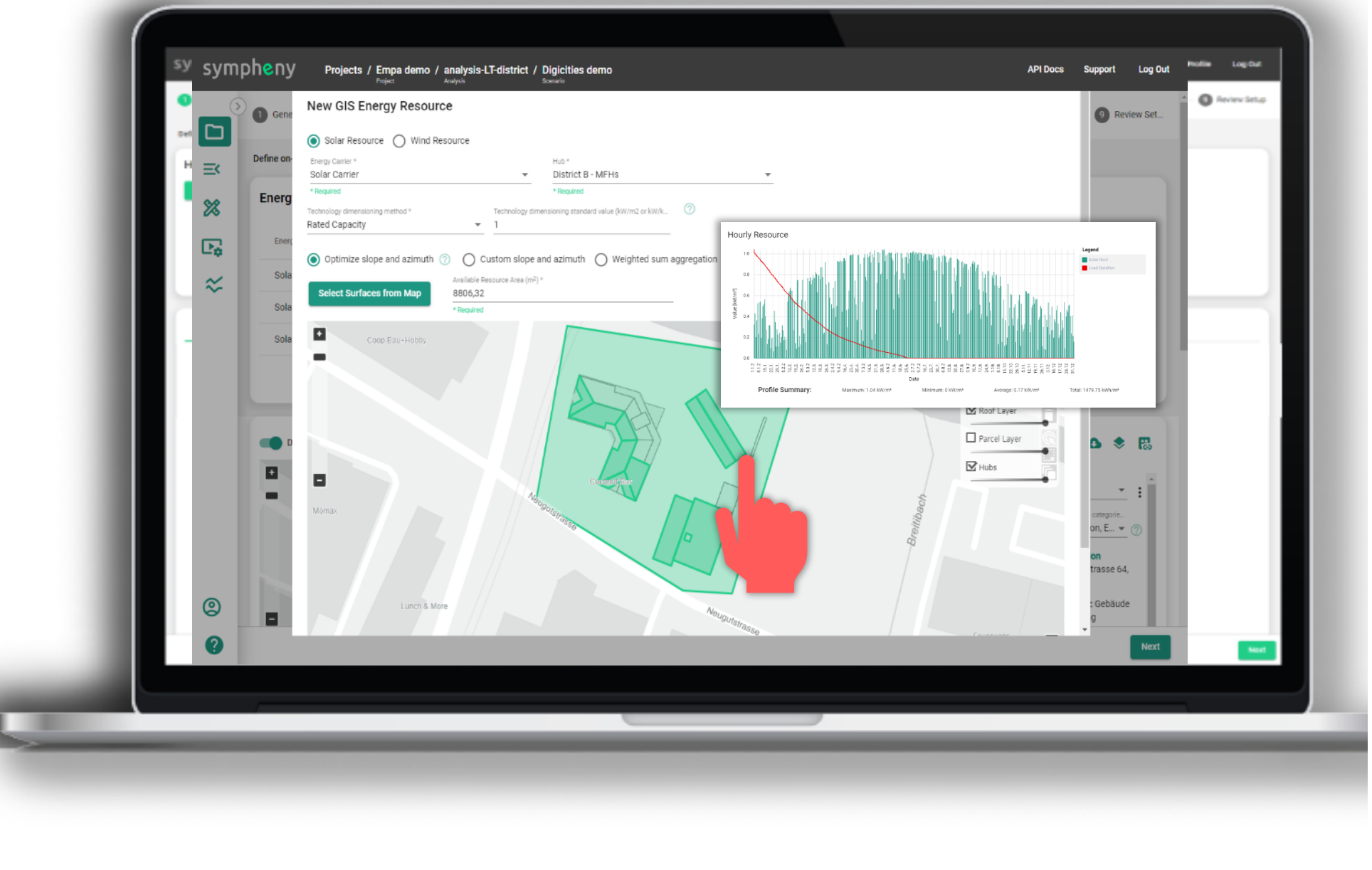

Select geo-referenced data and resource profiles 选择地理位置相关数据和资源概况

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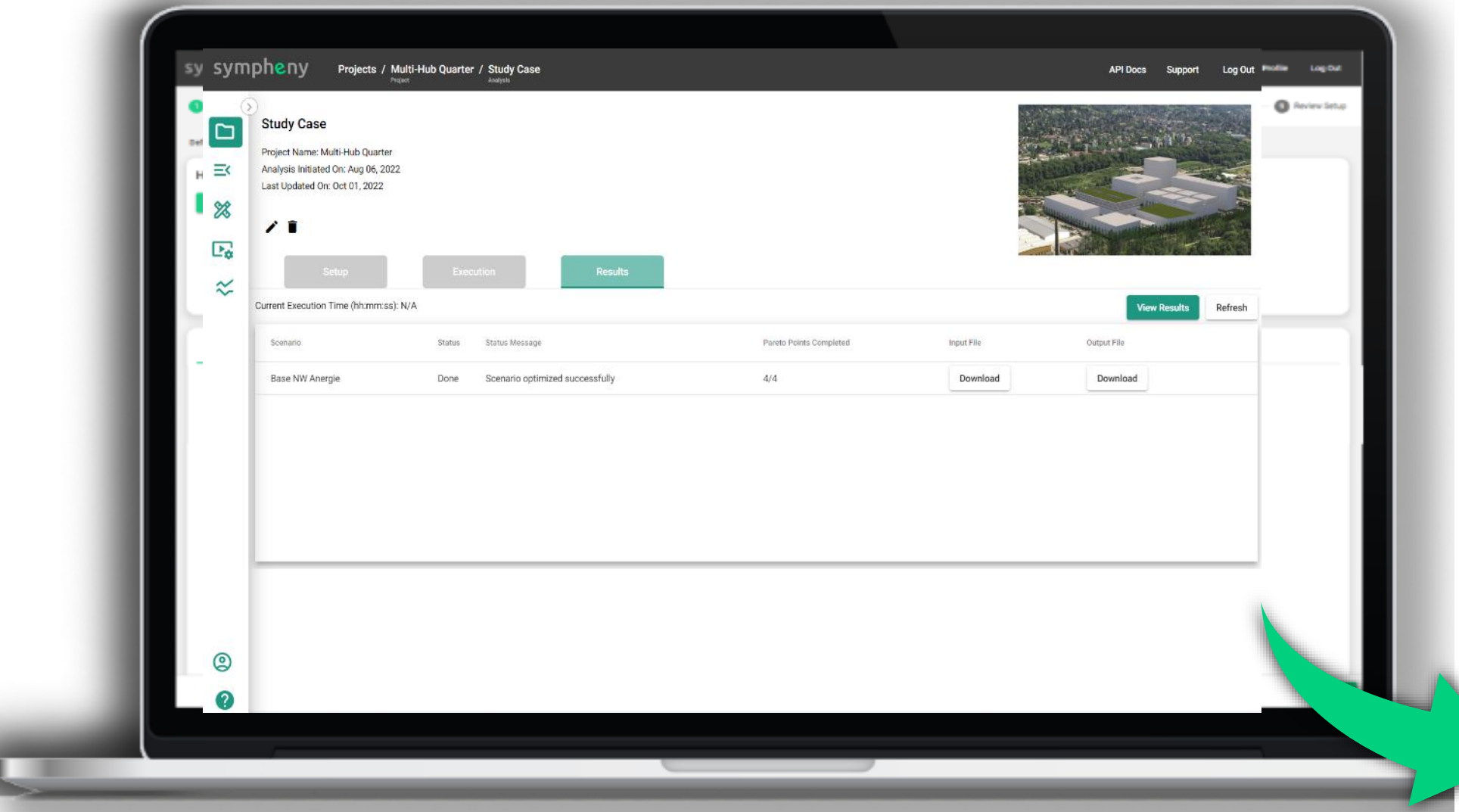

Build Digital Energy Hub Twin; Calculate optimal solution In the cloud

构建数字能源枢纽映射; 计算出最佳解决方案

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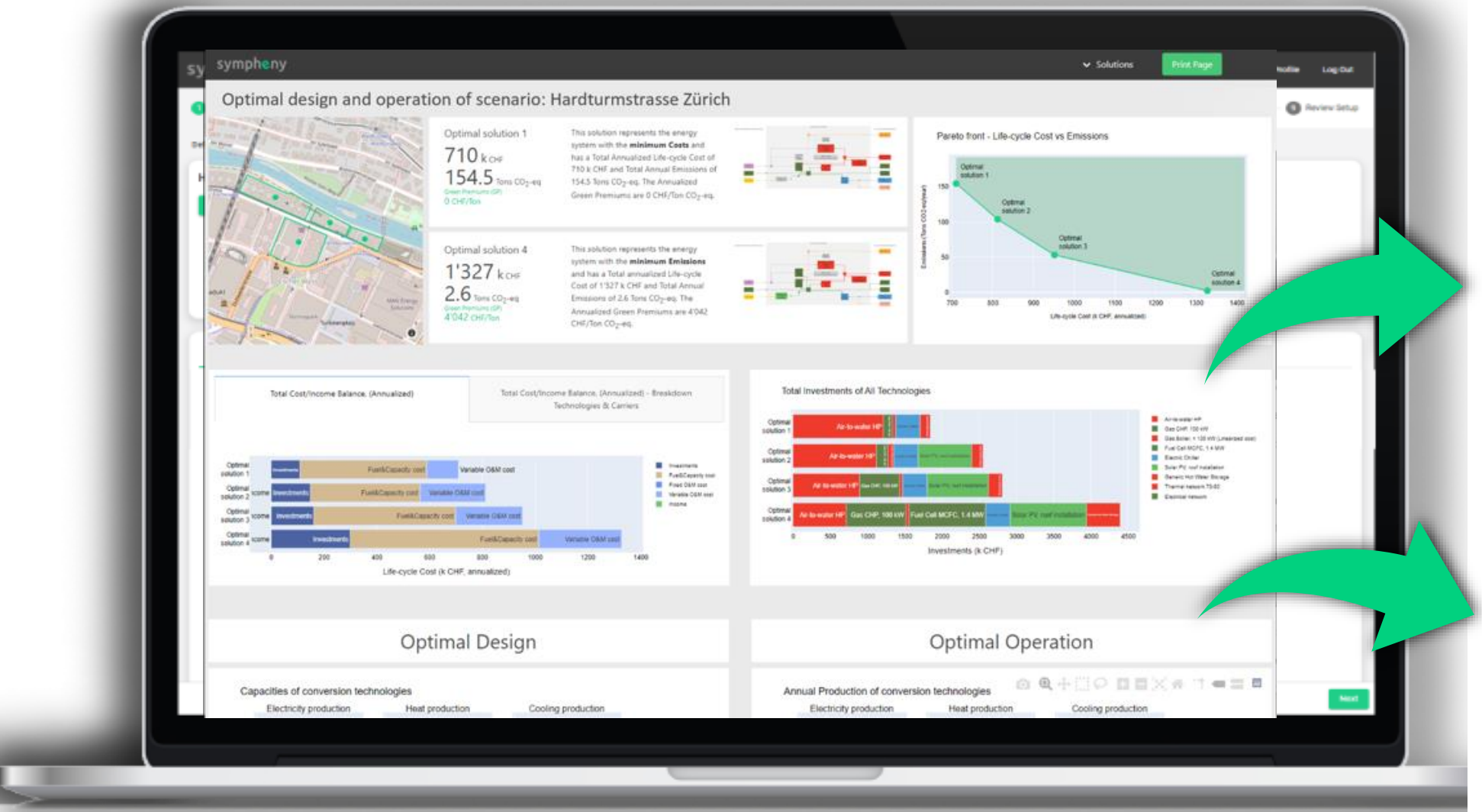

Share link of Optimal Results 分享最佳成果的链接

To users/guests
给到用户及客户

To other software
其他软件平台

https://dashboard.app.sympheny.com/share/solution?uId=esp-f6d054da-f575-49b3-b3c0-6b31&sGId=esp-share-scenario-0c0217c2-7d4a-5aab-8f7d-098e5c6942db&pId=3

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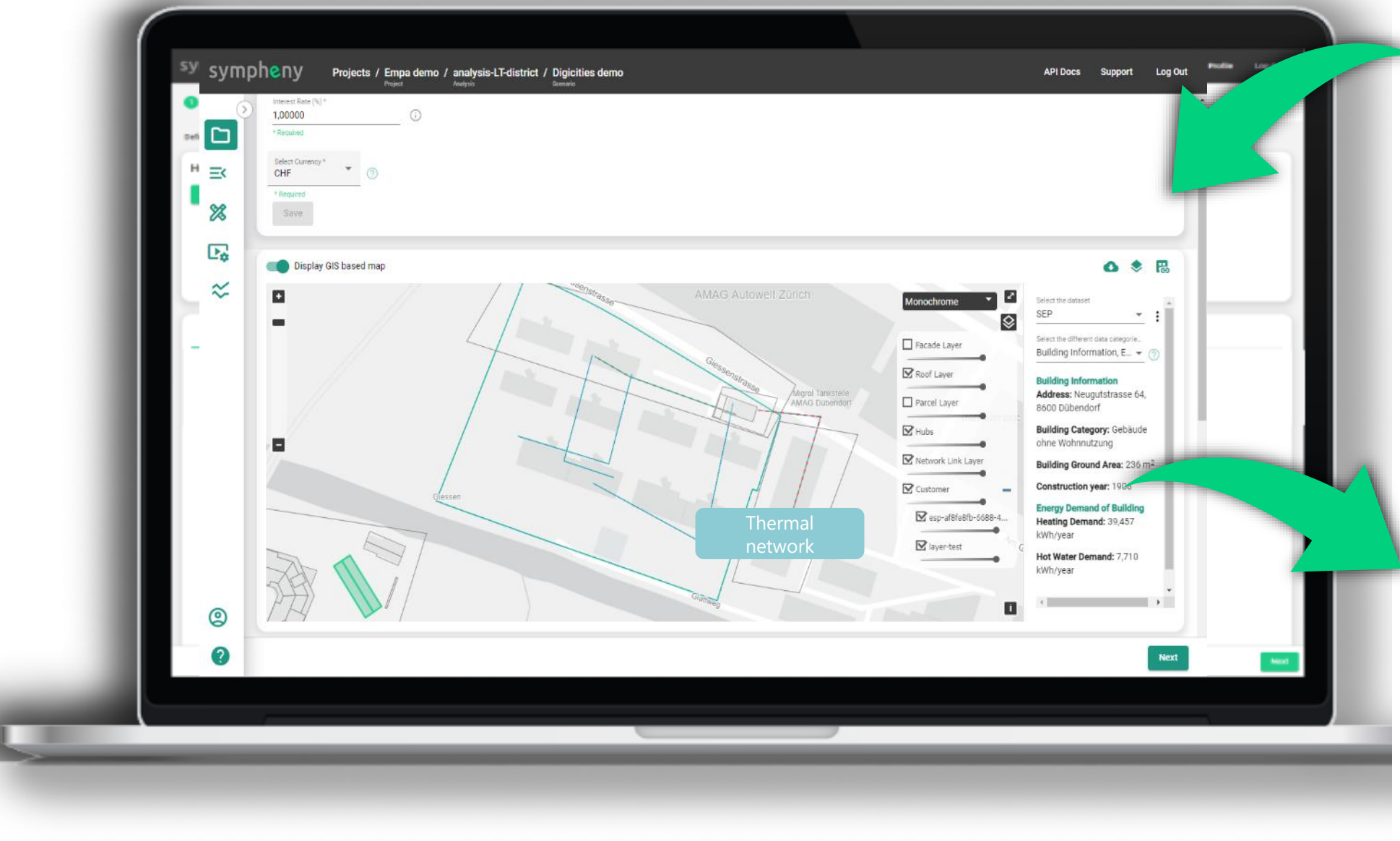

Import geo-referenced data

输入地理位置相关数据

Export geo-referenced data

输入地理位置相关数据

感谢您的关注

THANK YOU FOR YOUR ATTENTION