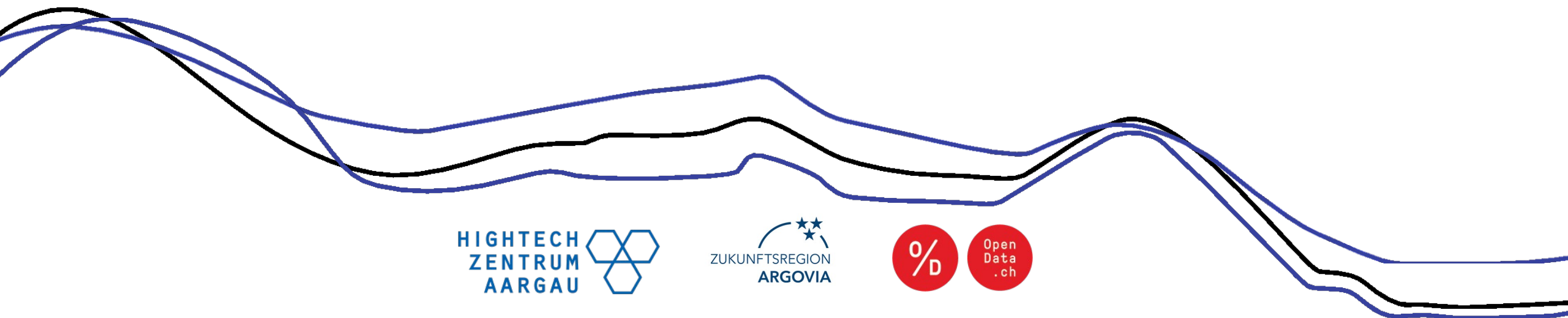


Welcome!

ENERGY DATA HACKDAYS



24-25th of September 2021 in Brugg, Switzerland



ENERGY DATA HACKDAYS



HIGHTECH
ZENTRUM
AARGAU



AEW
Ihre Energie.

swissgrid

Mit Unterstützung von



energieschweiz



Energy
Science
Center

EPFL

Lucerne University of
Applied Sciences and Arts

**HOCHSCHULE
LUZERN**

PAUL SCHERRER INSTITUT



OST
Ostschweizer
Fachhochschule

Kompetenzzentrum
Energy Management (ior/cf-HSG)



Universität St. Gallen

n|w

Fachhochschule
Nordwestschweiz



Empa

Materials Science and Technology



EKZ



sgsw

St. Galler Stadtwerke



**geoPro
Suisse**



KANTON AARGAU



**TECHNOPARK®
AARGAU**



**NCCR
Automation**

NUSSBAUM_{RN}



SEP®
Swiss Energy Planning

BEN Energy

Energy Lab.



KICKSTART

Friday

From 8:30 Registration Desk; Coffee & Gipfeli

9:15 Welcome & Keynotes

- Martin Bopp (Hightech Zentrum AG),
- Matthias Galus (BfE),
- Michael Koller (CTO EKZ),
- Peter Burgherr (Paul Scherrer Institut)

9:45 Presentation of the Challenges

10:45 Constituting Teams

and start Hacking!

12:30 Lunch

17.30 Project documentation

18:00- 18:30 Exchanging about the state of the projects

Open End

Saturday

From 8:00 Coffee & Gipfeli

15:00 Deadline project-slides
documentation

16:00 Keynote

- Cédric Aubert, (geoPro Suisse)

16:15 Final project presentations

17:15 Closing word

- Peter Morf (HTZ)

17.30 Apero!

Practical info before you are too concentrated:

There is an event space and the public space (protection concept and "cordoning off").

- In event zone > certificate and tested
- Outside of the event zone > mask and distance
- Please keep name badges on the top > serve as "identification" for access
- Ventilation is Corona compliant > has been tested and certified
- Food only in event zones

Smokers...should go out in pairs; the door closing mechanism is different from last time...



Welcome to the 3rd Energy Data Hackday

Martin A. Bopp, General Manager Hightech Zentrum Aargau AG

Initiators of the Energy Data Hackdays





An established Event

www.energydatahackdays.ch

2019: 7 Partners
2020: 19 Partners
2021: 23 Partners

Quality of
Challenges



Implementation of
Challenges



An established Event

HIGHTECH
ZENTRUM
AARGAU 

AEW
Ihre Energie.

swissgrid

Mit Unterstützung von
 **energieschweiz**

 Energy
Science
Center

EPFL

Lucerne University of
Applied Sciences and Arts
**HOCHSCHULE
LUZERN**

PAUL SCHERRER INSTITUT
PSI

2019: 7 Partners

2020: 19 Partners

2021: 23 Partners

 **OST**
Ostschweizer
Fachhochschule

Kompetenzzentrum
Energy Management (icm/HSG)
 Universität St. Gallen

n|w Fachhochschule
Nordwestschweiz

 **Empa**
Materials Science and Technology

EKZ

 **sgsw**
St. Galler Stadtwerke



geoPro
Suisse

 **KANTON AARGAU**
 **TECHNOPARK®**
AARGAU

 **NCCR
Automation**

NUSSBAUM_{RN}

 **SEP®**
Swiss Energy Planning

 **BEN Energy**

Energy Lab. 

KICKSTART

Matthias Galus
Head Digital Innovation Office

Bundesamt für Energie



Open Innovation Programme BfE für Bottom Up Innovation

Head Digital Innovation Office BfE; Matthias Galus

Digital Innovation Top Down versus Bottom Up

Top Down

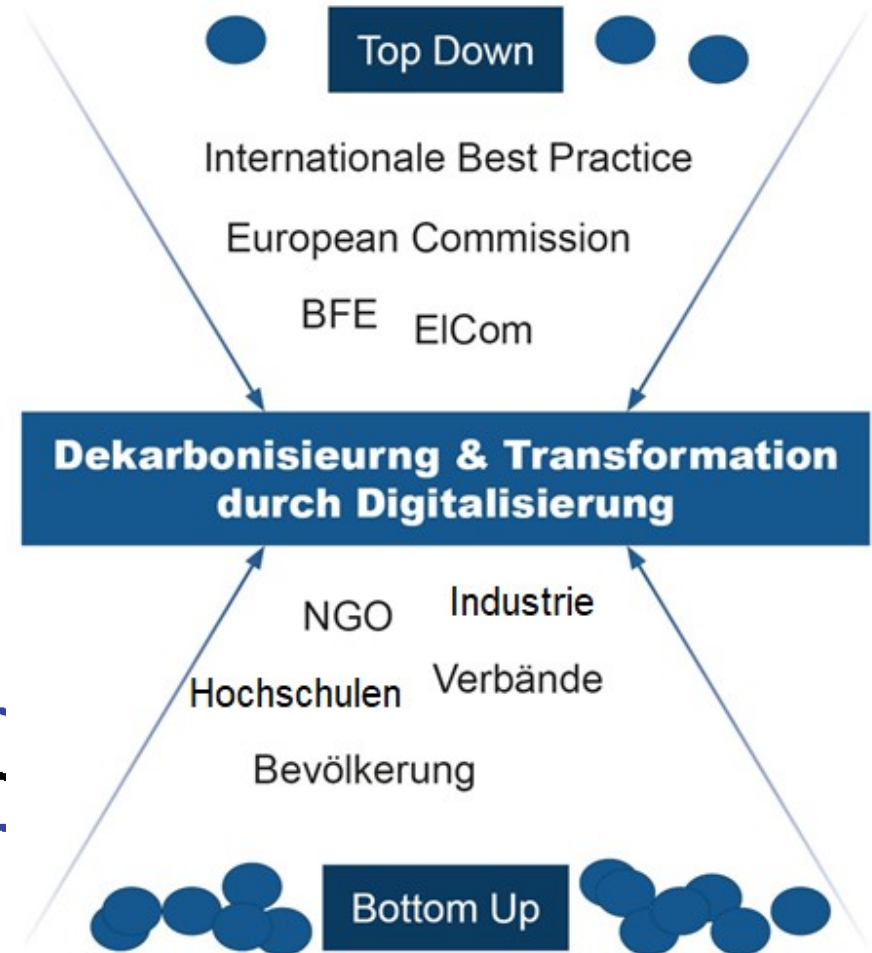
Studien und Regulierung EU, BFE oder ElCom.

Beispiele: Smart Grid Roadmap, Smart Meter, Datahub, Cyber Security, etc.

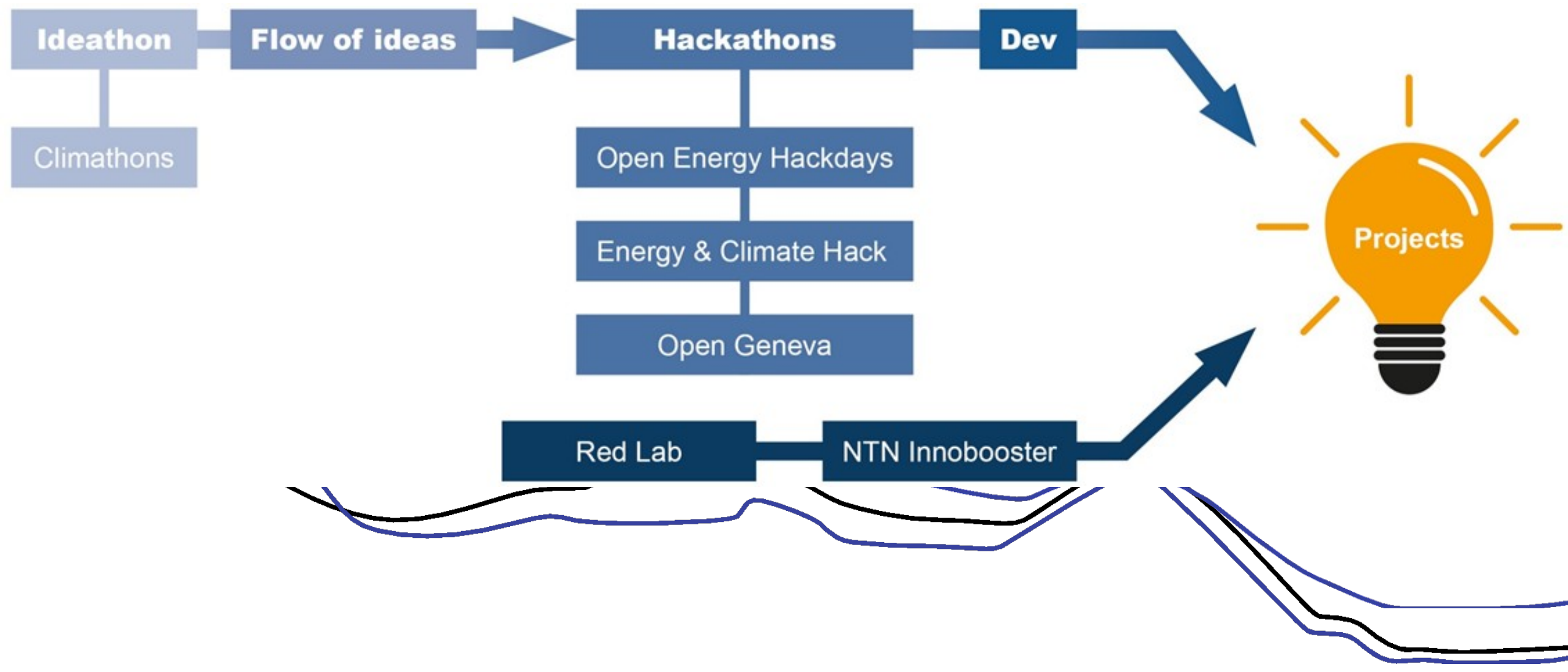
Bottom Up

Bevölkerung (Experten & Andere) bringen Ideen und Ansätze ein für Veränderung des Systems

Beispiele: Ideathons, Climathons Hackathons



Digitale Innovation National & Bottom Up



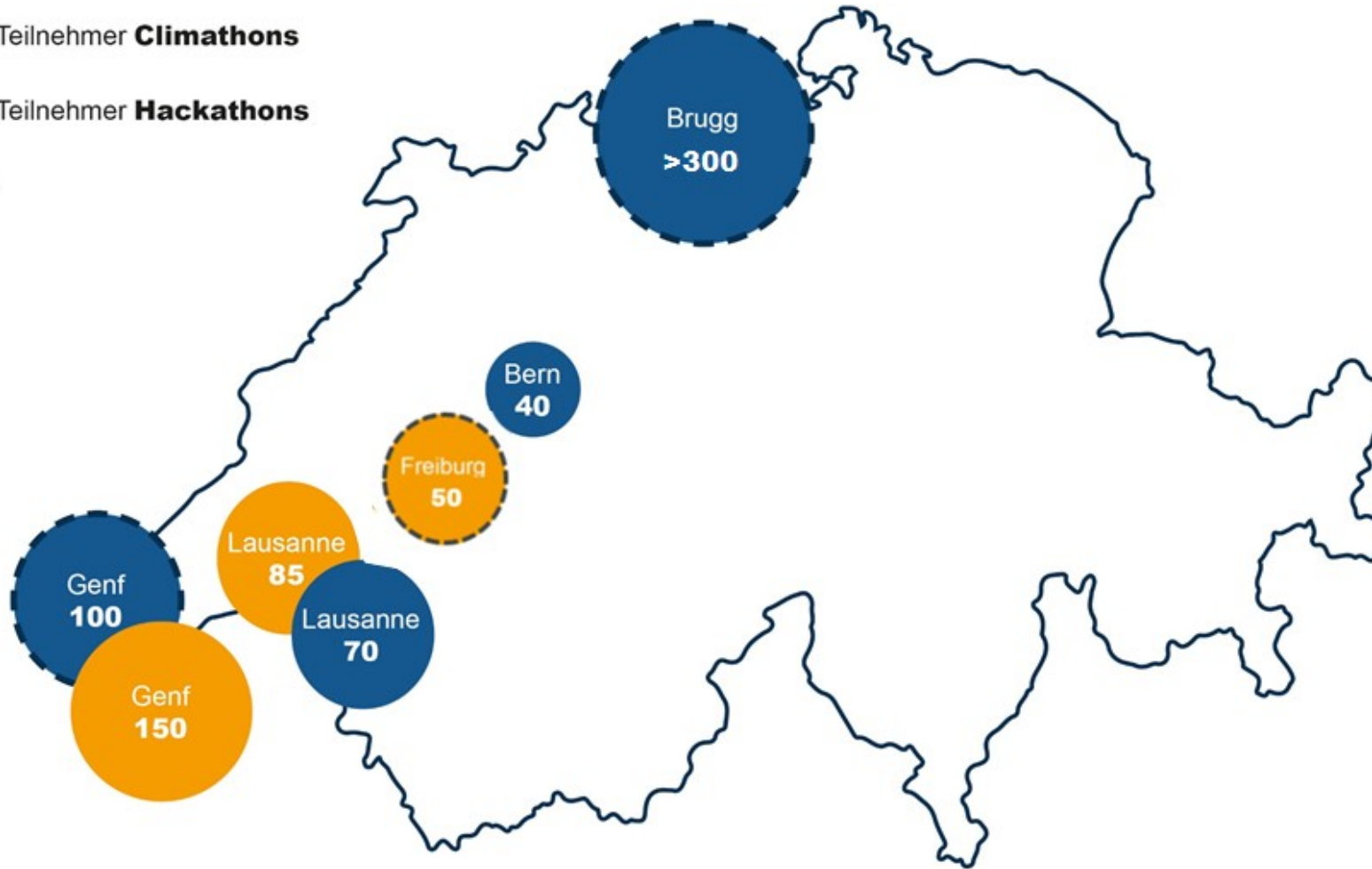
Instrument für “Change” Bottom Up

- Befähigung Konsumenten
- Sensibilisierung Klimabelange
- Verbesserung Verständnis und Faktenlage
- Optimierungspotential heben
- Innovative Produkte für Nachhaltigkeit



- <https://www.electricitymap.org/zone/CH>
- <https://www.energiereporter.ch>

Ein nationales Ökosystem im Wachstum



 energieschweiz

eqlosion

 open
GENEVA

 %D Open
Data
.ch

 ZUKUNFTSREGION
ARGOVIA

HIGHTECH
ZENTRUM
AARGAU 

Michael Koller
Chief Technologie Officer

EKZ Elektrizitätswerke Kanton Zürich



Data for a new normal in Energy

Energy Data Hackdays 2021

20. September 2021, Michael Koller

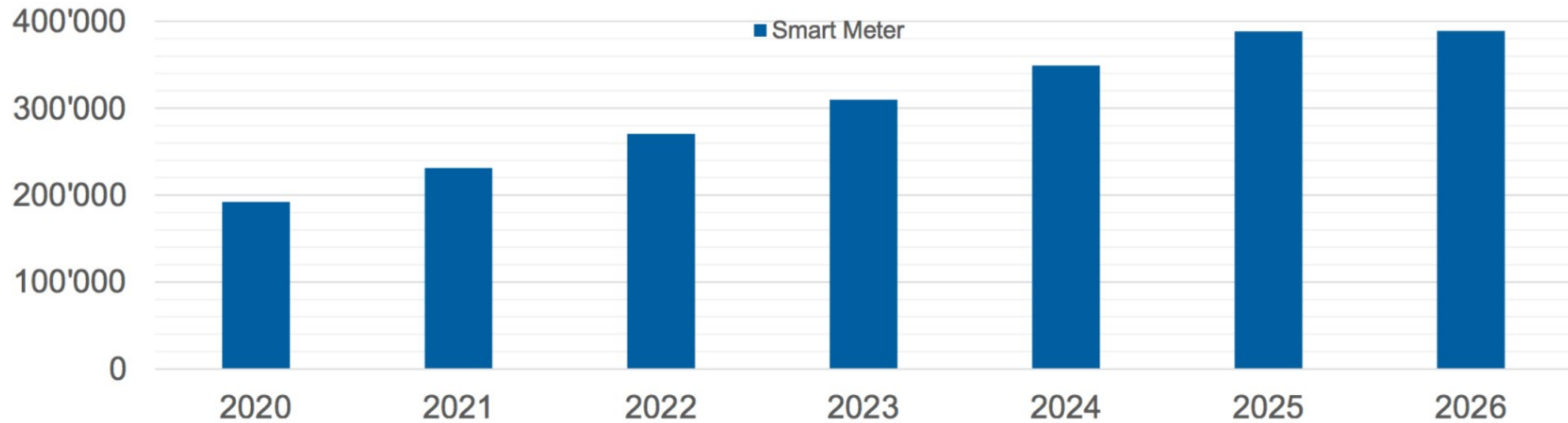
Agenda

- Smart Meter Data – the most valuable ground truth in power systems
- Data driven customer empowerment
- Grid planning in the age of machine learning

Smart Meter Data

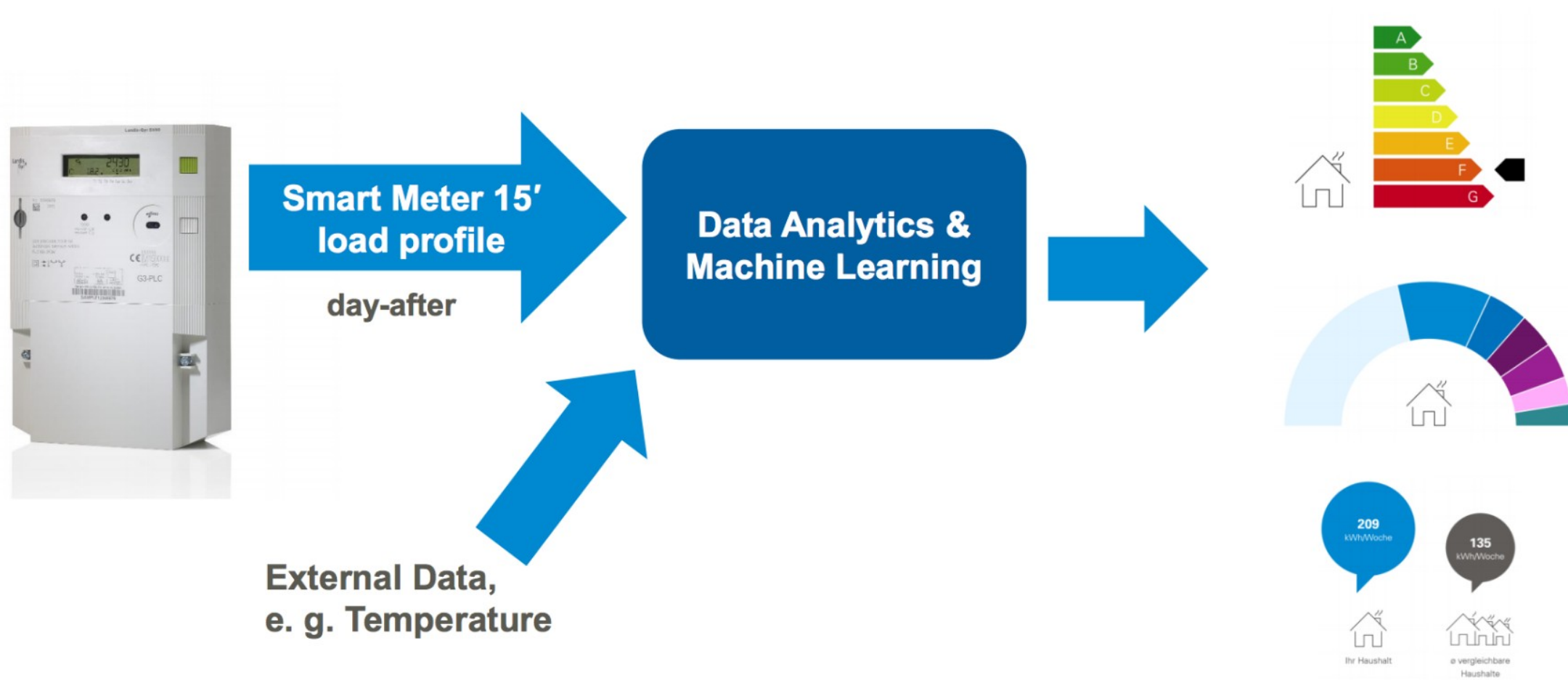
EKZ Smart Meter Rollout

- EKZ plans to have 100 % Smart Metering by 2026 (approx. 400 k meters)
- Ahead of government mandate to have 80 % Smart Meter by 2027



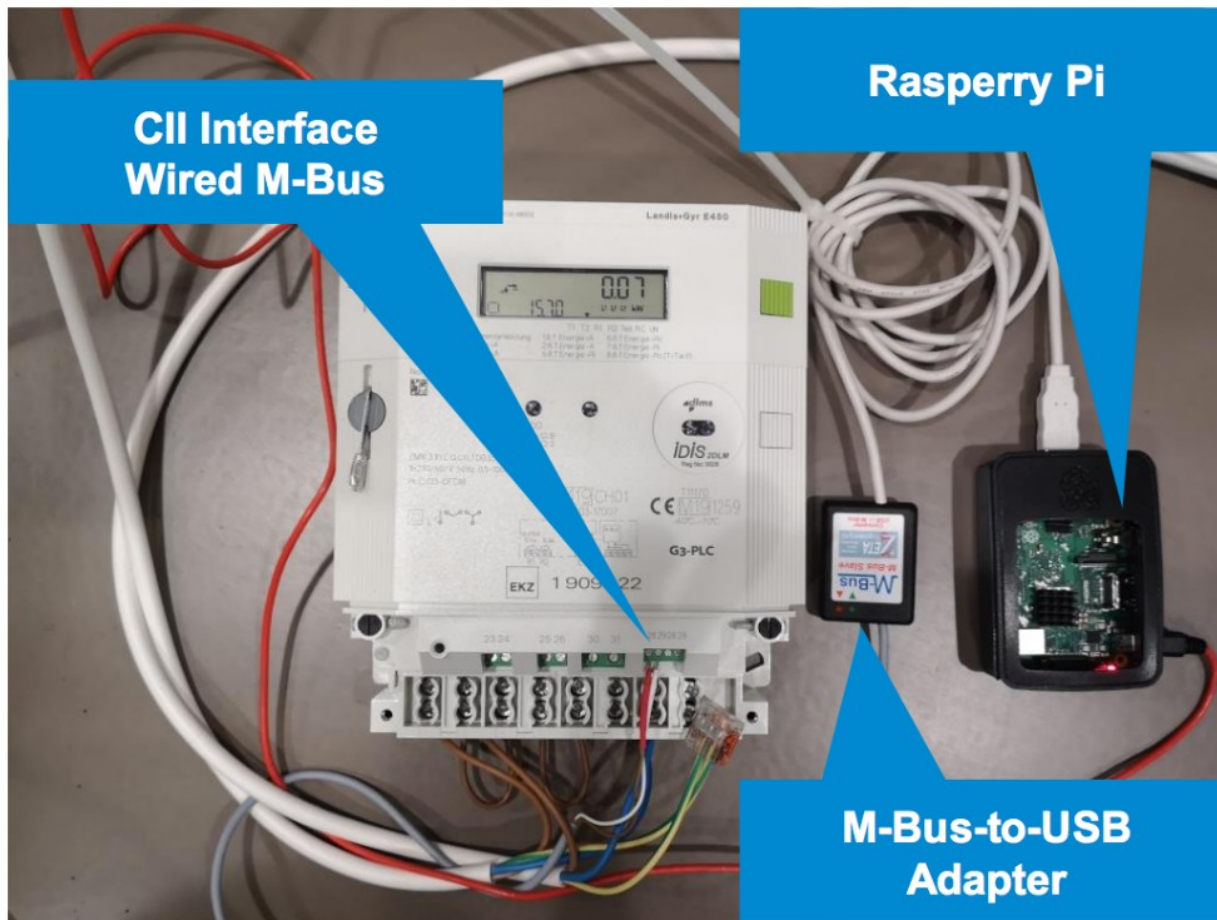
Customer Empowerment

Load disaggregation for customer engagement



Local Customer Interface for Smart Meters

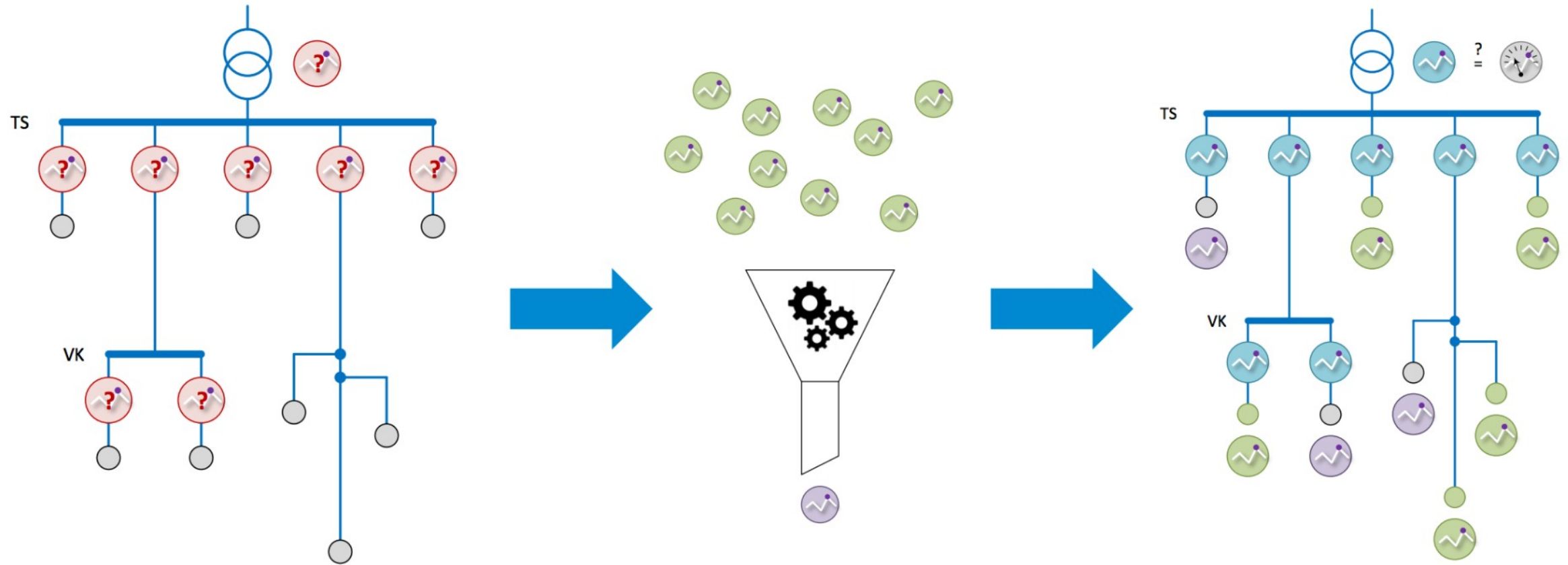
EKZ Challenge Energy Data Hackdays 2020



- Proof of Concept with Raspberry Pi for reading a smart meter locally at the event last year (“Read your own smart meter” challenge)
- **Open source** solution developed by EKZ and software partner to read the local interface of the Landis+Gyr E450 smart meter
- Free collaboration basis for everyone to integrate additional other smart meters – **Feel free to contribute!**

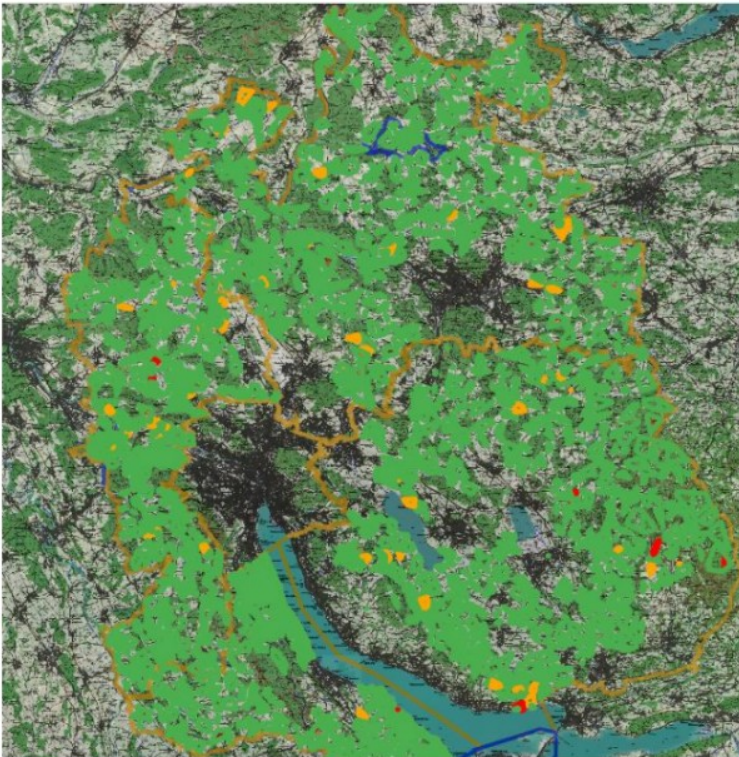
Grid Planning

Synthetic load profiles based on machine learning

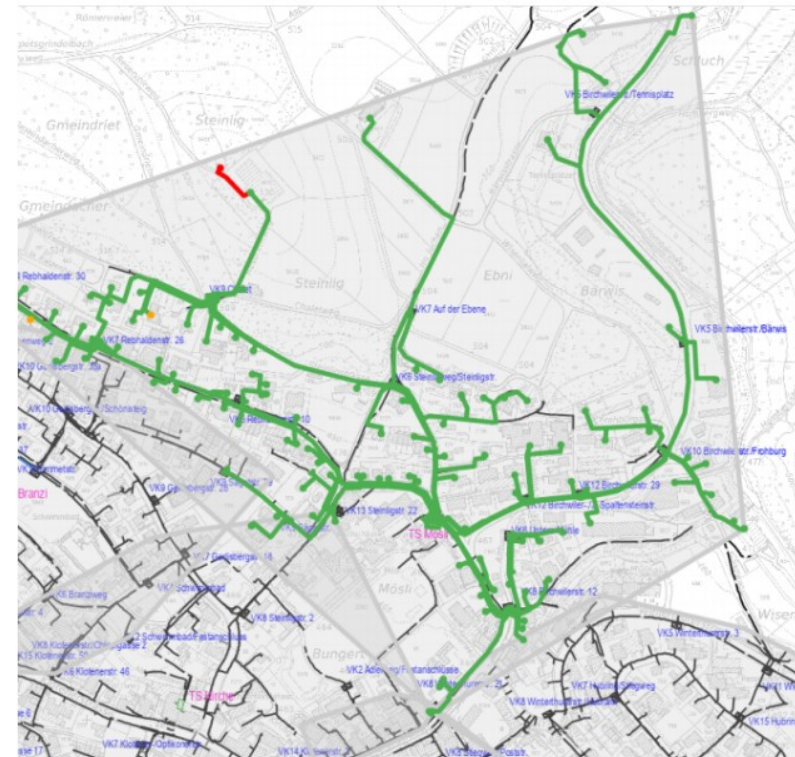


Data driven grid planning

EKZ Grid Area

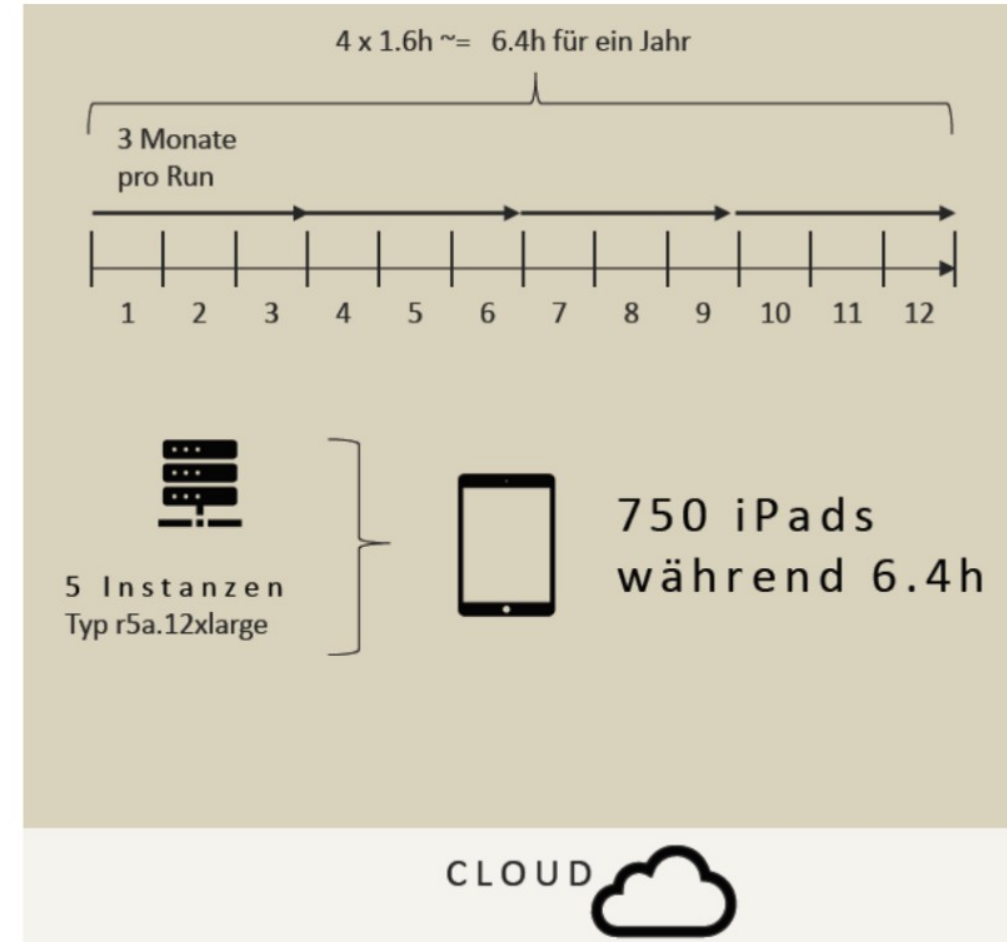


Low Voltage Grid

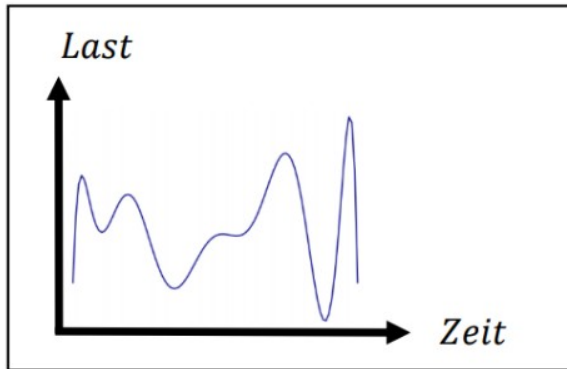


First of a kind load flow simulation with real and synthetic 15 min Smart Meter load profiles

Cloud computing for scalability

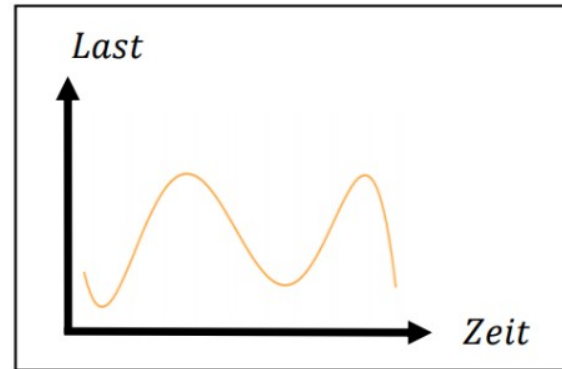


Top down machine learning and bottom up physical modelling for scenario generation



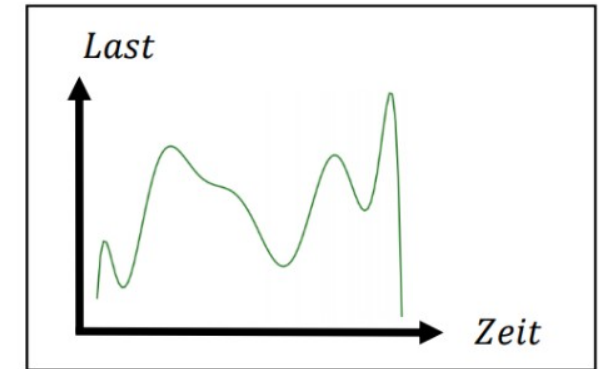
Synthetic load profiles
from machine learning

+



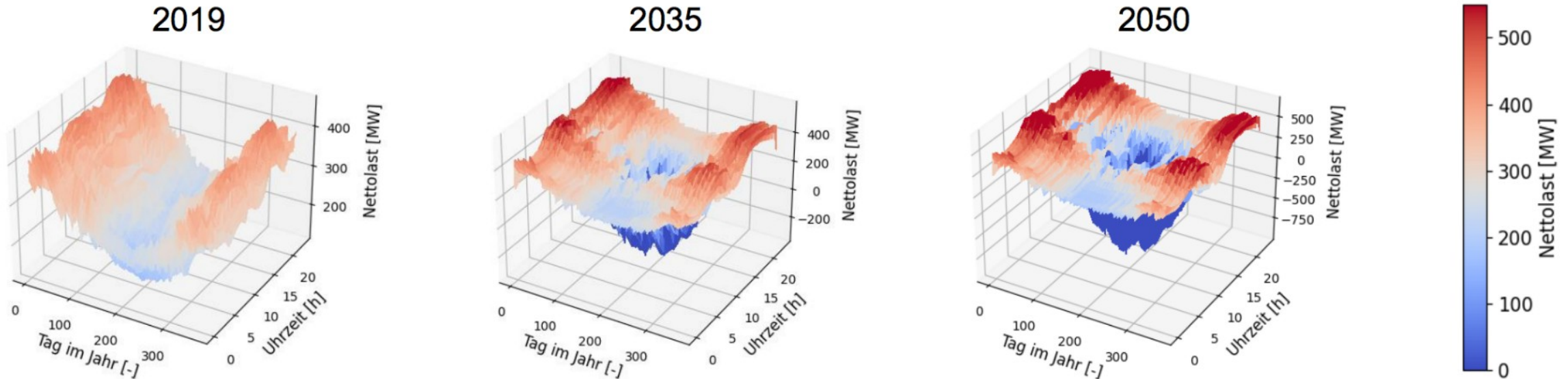
Physical model for
flexible loads (heat
pump, charging station
etc.)

=



Realistic customer load

Example scenario results



- Stochastic grid simulations for grid investment allocation
- Data driven strategic asset management

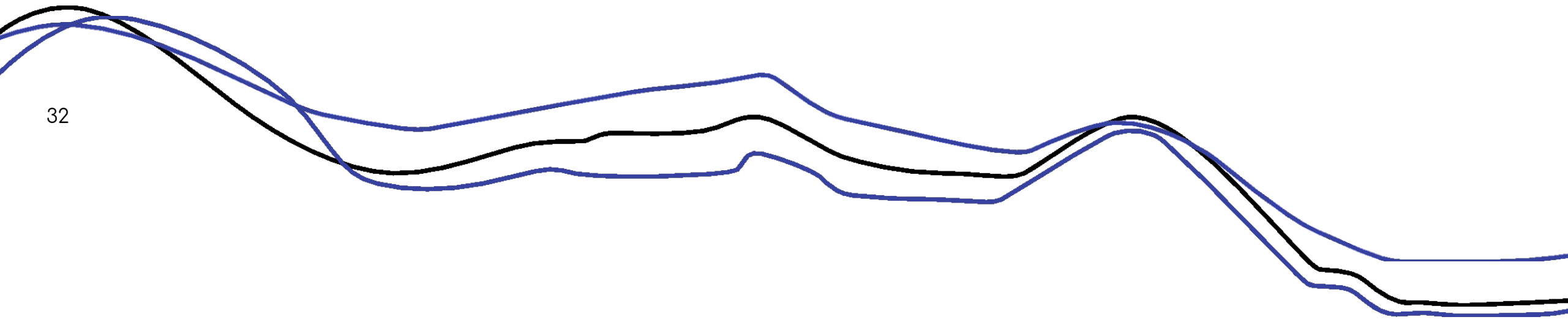
Conclusion

- Data enables the energy transition
- Empowering the customer with data analytics drives energy efficiency
- Data driven grid planning for significant savings in the context of the uncertainties in the energy transition

Join an EKZ challenge if you like data!

Peter Burgherr Head Technology Assessment

Paul Scherrer Institute





Evidence-based Technology Assessment as a Foundation for the Energy Transition

g Peter Burgherr:: Head Technology Assessment :: Paul Scherrer Institute

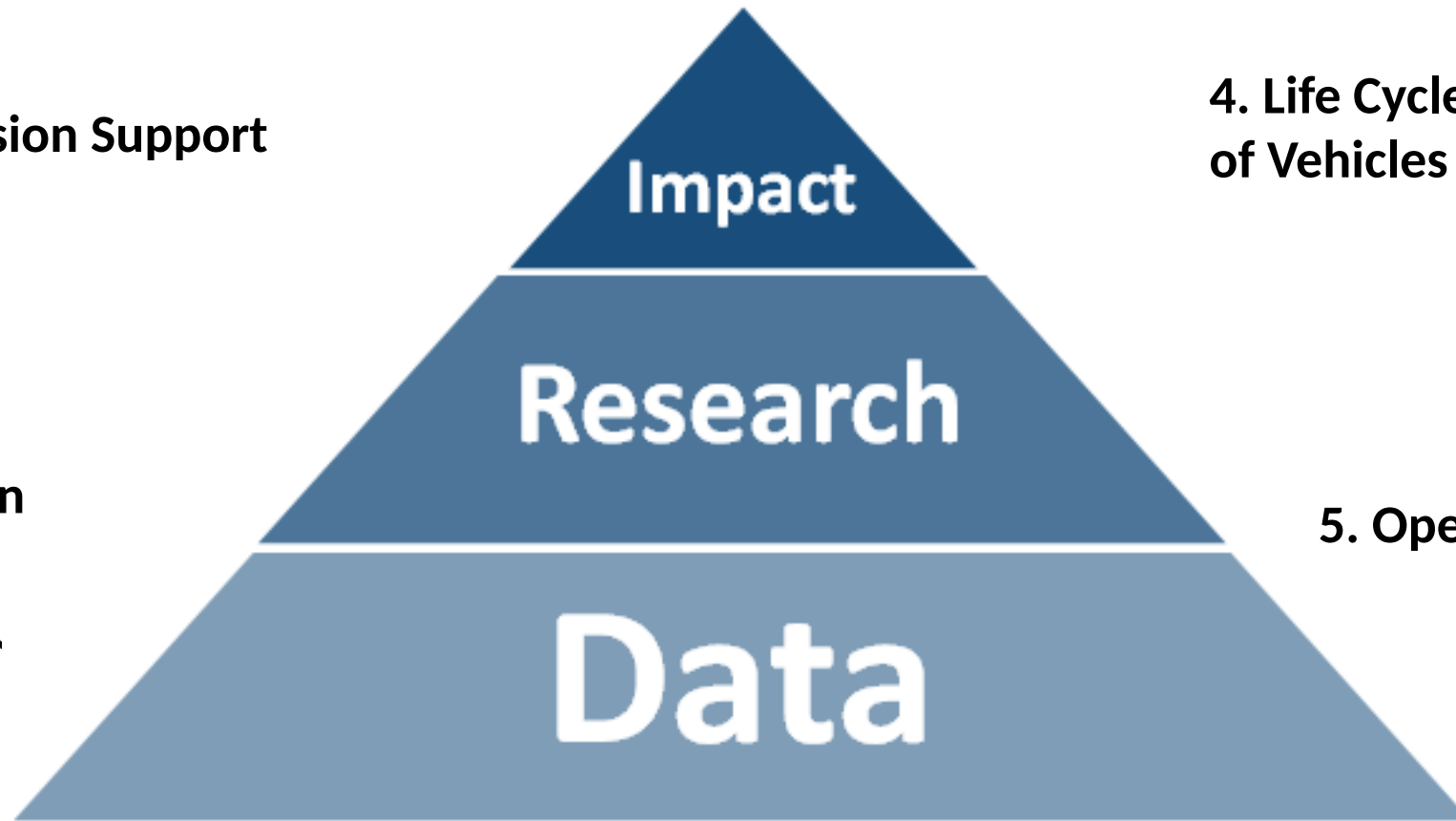
1. Energy Strategy 2050

2. Decision Support

4. Life Cycle Assessment
of Vehicles

3. Negative Emission
Technologies

5. Open-source Tools



SCCER SoE Synthesis Reports



The „Red Thread“ through the energy transition

- > Complex issues, systemic impacts, sectoral interactions, etc.
- > Overarching perspective and evidence-based assessment

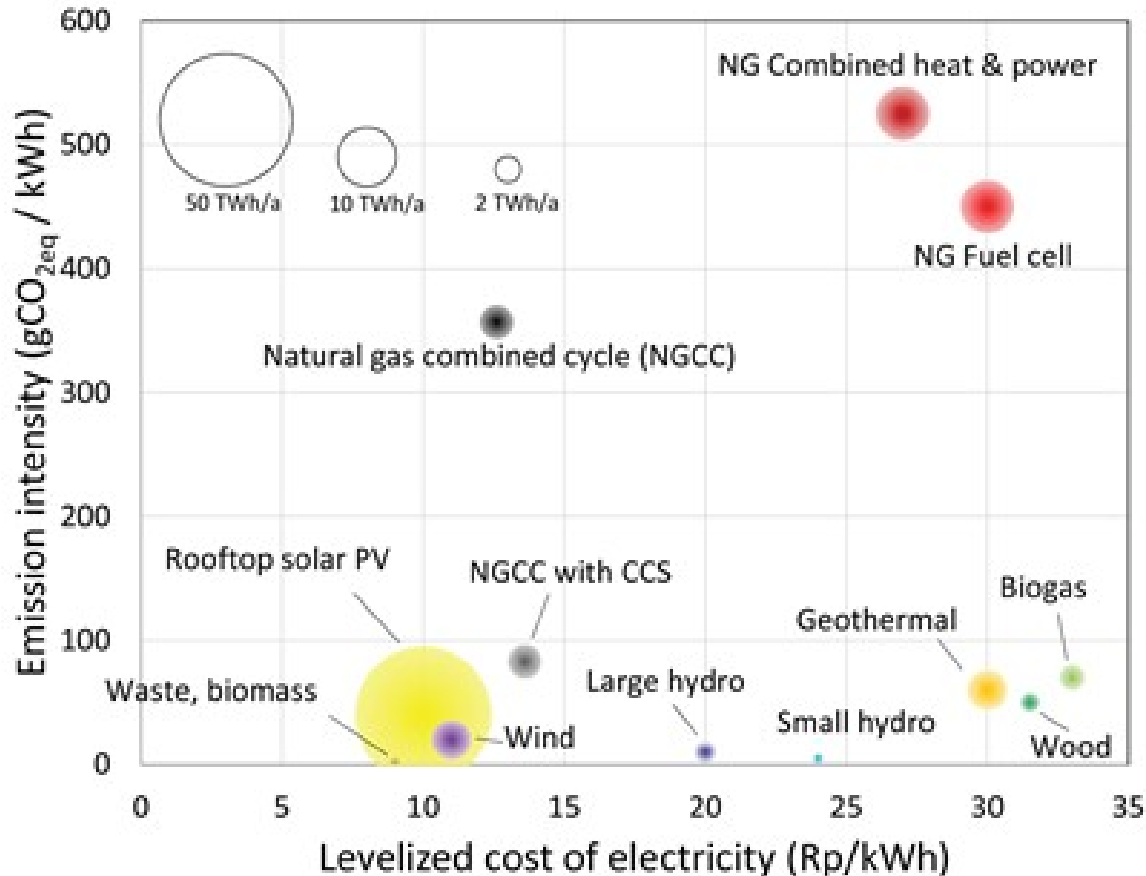


Potential, costs and environmental impacts of electricity generation technologies (domestic and import)

<http://sccer-soe.ch/en/publications/synthesis-reports/>

- > Contribution to energy perspectives and continuous technology monitoring of SFOE.
- > Key inputs for scenario analyses (e.g. SCCER JASM).

Potentials, Costs and CO₂ Emissions of Power Generation (2050)



- Photovoltaic (PV) power generation exhibits largest potential in Switzerland.
- Smart PV installations allow for shifting summer peak generation to winter.
- Exploitation of other renewables is crucial for a resilient power sector.
- Electricity supply costs are likely to increase, despite of declining costs of renewables.
- All renewables are expected to represent “low-carbon” generation by 2050, with hydro, wind and PV performing best.

Suitability of Areas for DGE Systems

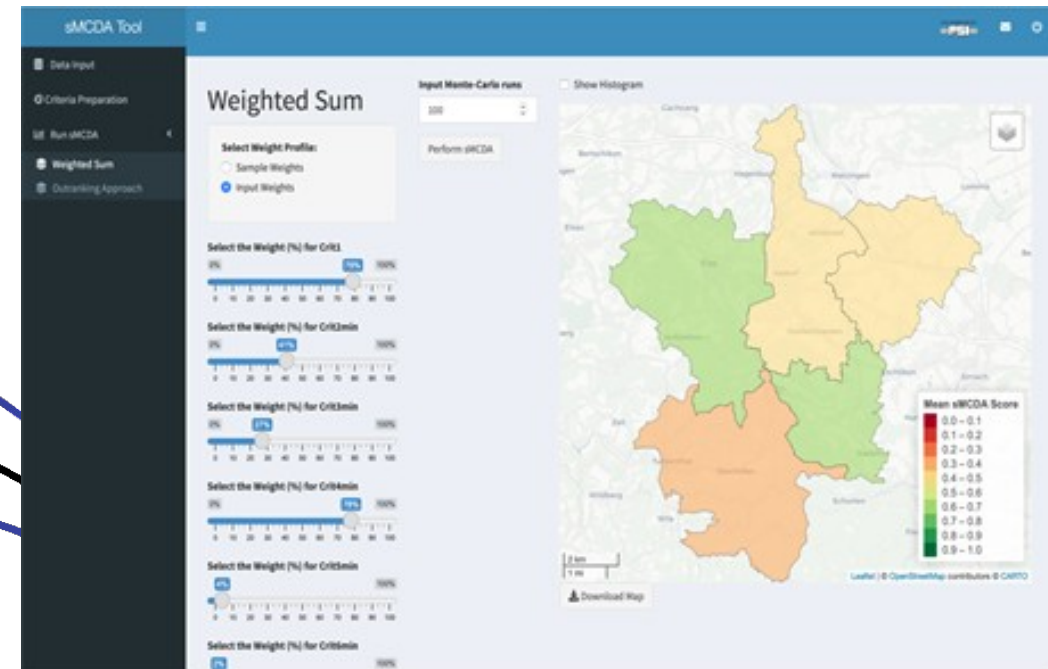
- Potential **geothermal power plant locations are constrained** by geological conditions as well as economic, environmental and social aspects.
- Development of a **spatial Multi-Criteria Decision Analysis (sMCDA)** tool to develop indices and rank alternatives at high spatial resolution, using an **intuitive Graphical User Interface (GUI)**.
(https://github.com/mspada/sMCDA_Tool)

1. **Dataset** (e.g. shapefiles) with **alternatives** and **indicators**.

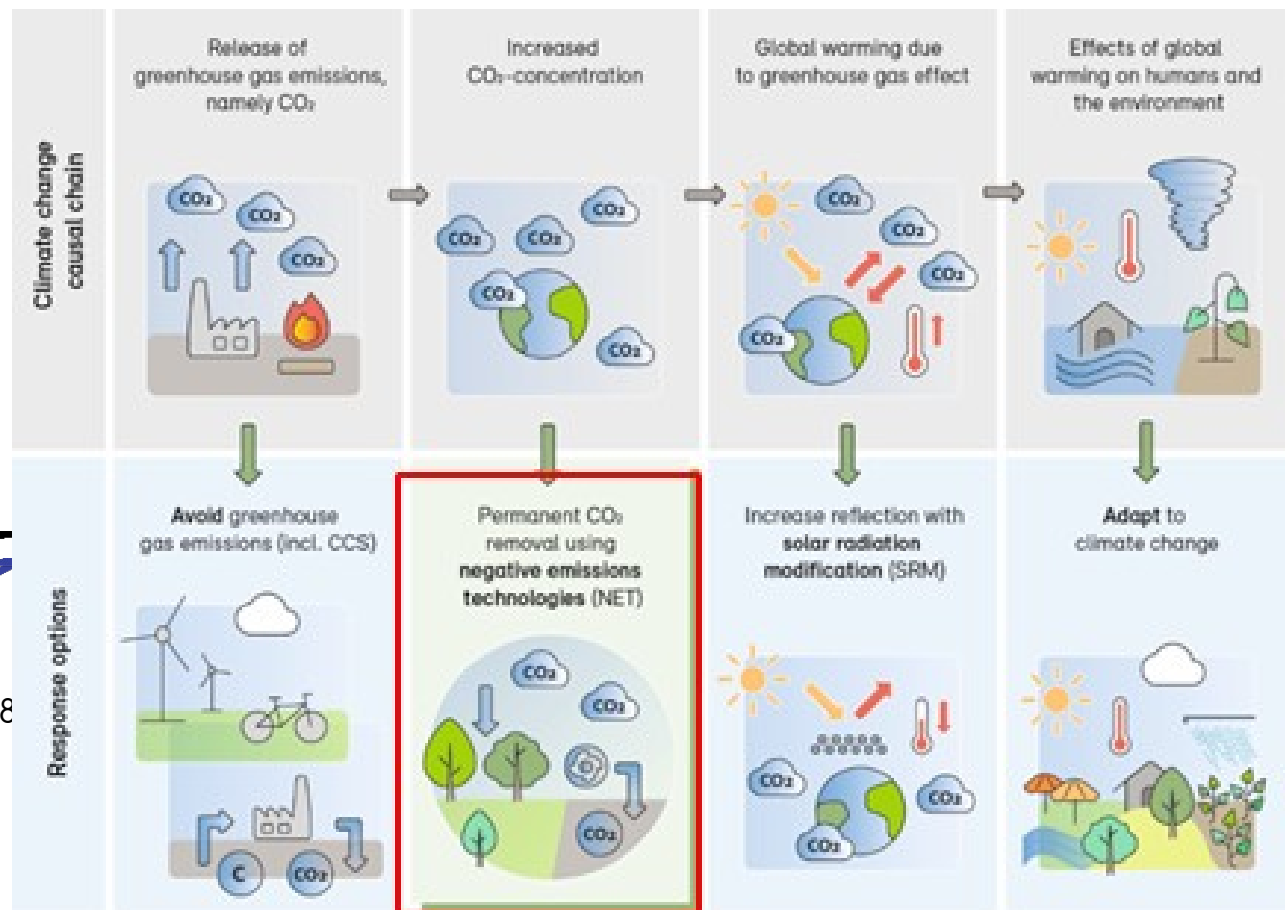
2. **Calculate scores and ranks** (Weighted Sum or Outranking method)

3. **Quantify uncertainty** using a Stochastic Multi-criteria Acceptability Analysis (**SMAA**)

4. **Visualize, compare and download the scores, rankings and maps**



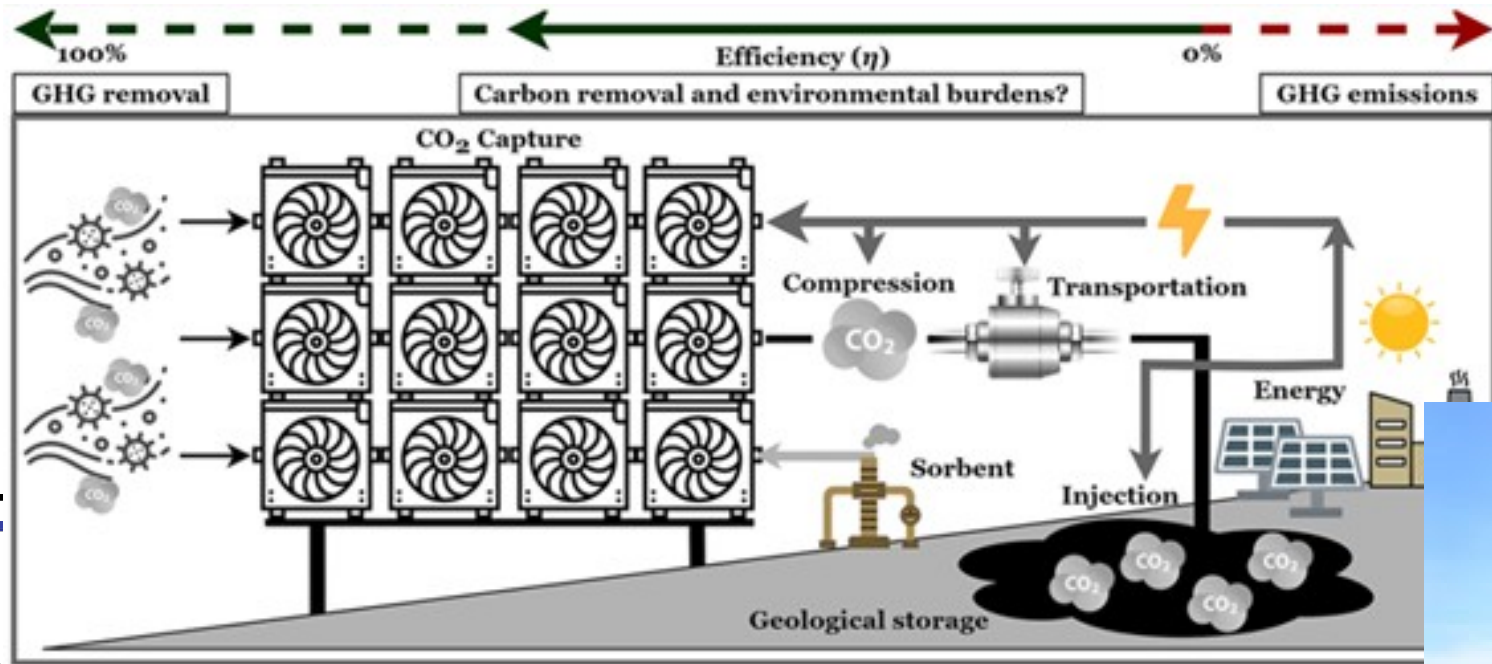
Negative Emission Technologies (NET)



Goals

- Permanent removal of CO₂ from the atmosphere.
- Required for achieving “net-zero” CO₂ target.
- Compensation of “hard to avoid” GHG emissions from e.g. industry and agriculture.

Direct Air Carbon Capture Storage (DACCS)



39

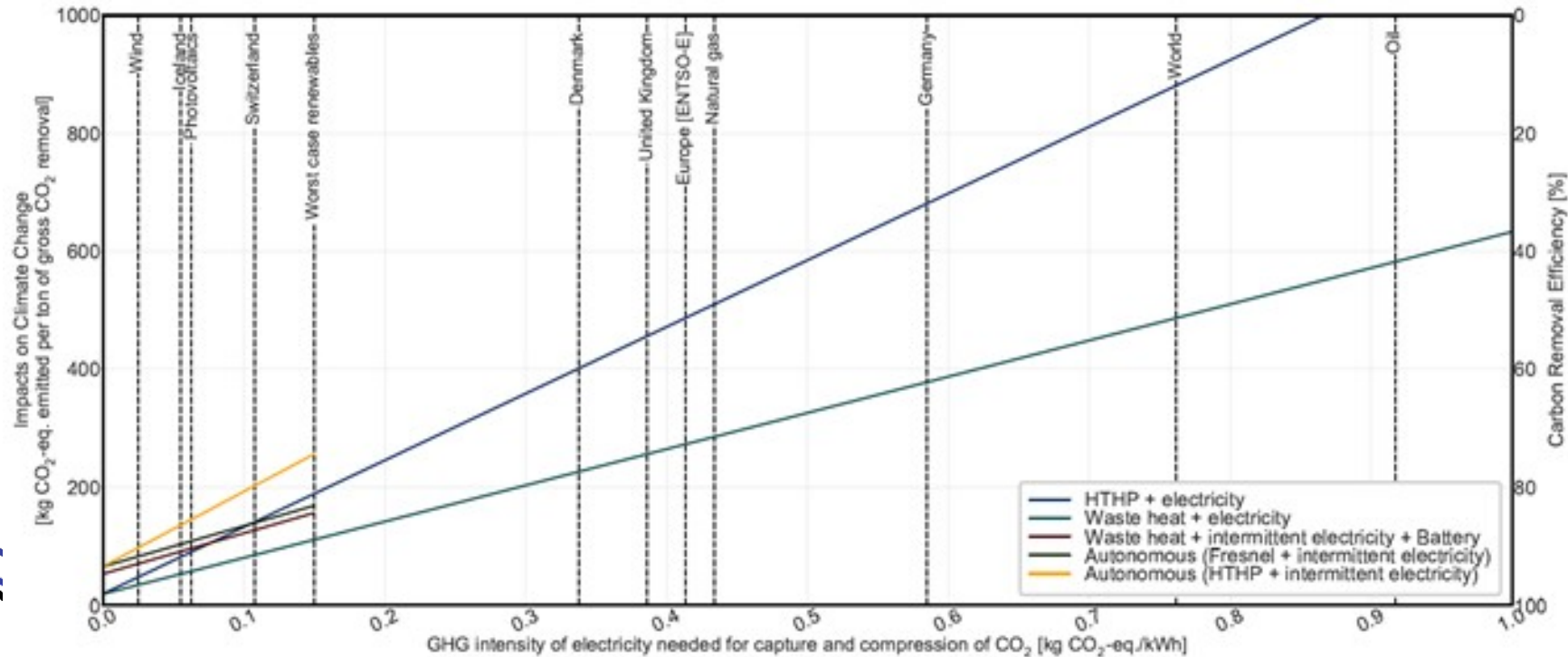
Terlouw et al. (2021)

Orca – the world’s largest plant in Iceland can filter and store up to 4000 t CO₂ per year



Climeworks (2021)

Negative Emission Technologies: DACCS

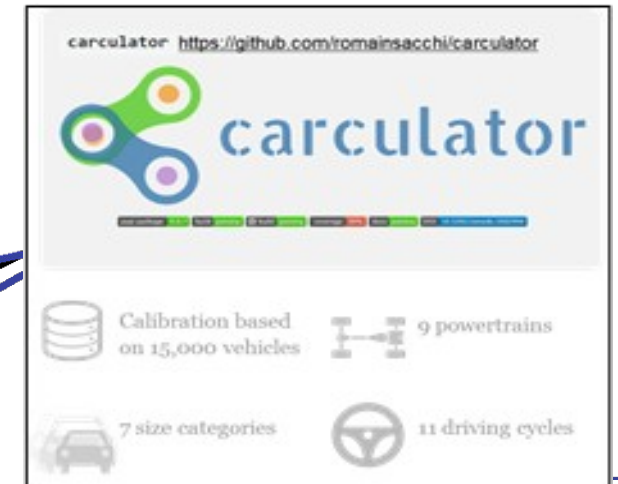


PSI & ETHZ (2021) <https://chemrxiv.org/articles/preprint/Life-Cycle Assessment of Direct Air Carbon Capture and Storage with Low-Carbon Energy Sources/14346182>

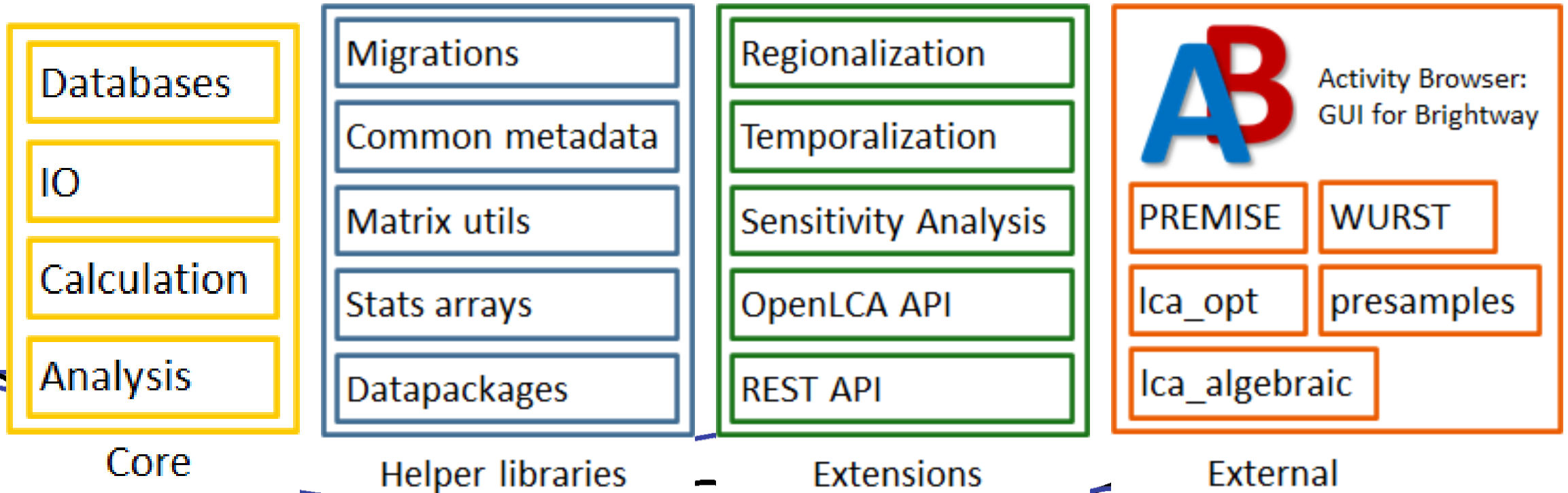
40

- (Linear) dependence of the climate change impact on the GHG intensity of electricity generation for the different DACCS configurations.
- Different slopes reflect the electricity demand of each specific DACCS system layout.
- The CO₂-intensity of the national grid electricity mix turns out to be the decisive factor for grid-coupled system layouts.
- The more electricity required, the more sensitive on the GHG intensity of electricity (for example with a HTHP).
- In general, energy supply – and its GHG intensity - is the key factor driving GHG emissions of DACCS configurations.
- **DACCS can effectively remove CO₂, but requires low-C electricity and heat.**

A circular flow diagram illustrating the lifecycle of a car. The cycle includes: 1. Production (factory icon), 2. Distribution (truck icon), 3. Use (car icon), 4. Fueling (gas pump icon), 5. Maintenance (wrench icon), 6. Disposal (trash can icon), and 7. Recycling (recycling symbol icon). A central car icon is labeled "1 km". The flow is indicated by colored arrows: orange for production and distribution, green for use and fueling, and blue for maintenance and disposal. A recycling symbol is also shown in orange.



Brightway: An open framework for LCA

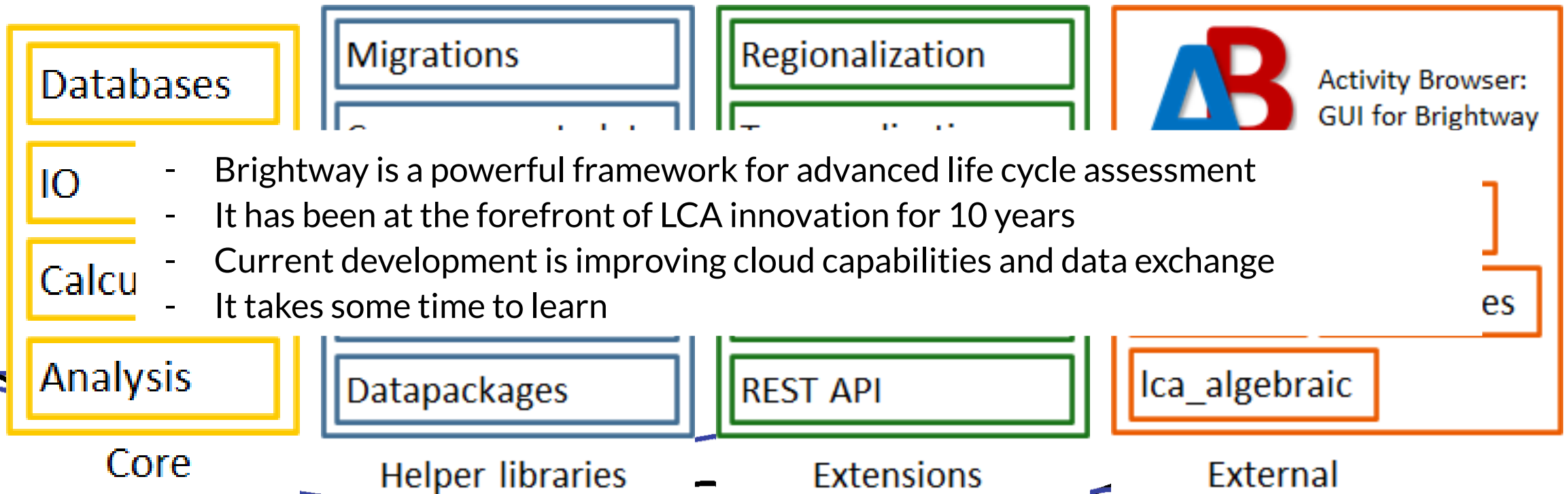


42

- Website: <https://brightway.dev/>
- Conference: <https://brightcon.link/>
- Mailing list: <https://groups.io/g/brightway/>

- Community: 100s of users worldwide
- Brightway has been cited > 300 times in academic literature

Brightway: An open framework for LCA



- Brightway is a powerful framework for advanced life cycle assessment
- It has been at the forefront of LCA innovation for 10 years
- Current development is improving cloud capabilities and data exchange
- It takes some time to learn

43

- Website: <https://brightway.dev/>
- Conference: <https://brightcon.link/>
- Mailing list: <https://groups.io/g/brightway/>

- Community: 100s of users worldwide
- Brightway has been cited > 300 times in academic literature

Thank you for your attention!

Contributors:
Christian Bauer
Chris Mutel
Romain Sacchi
Matteo Spada
Tom Terlouw

**Laboratory for Energy Systems Analysis
(LEA)**

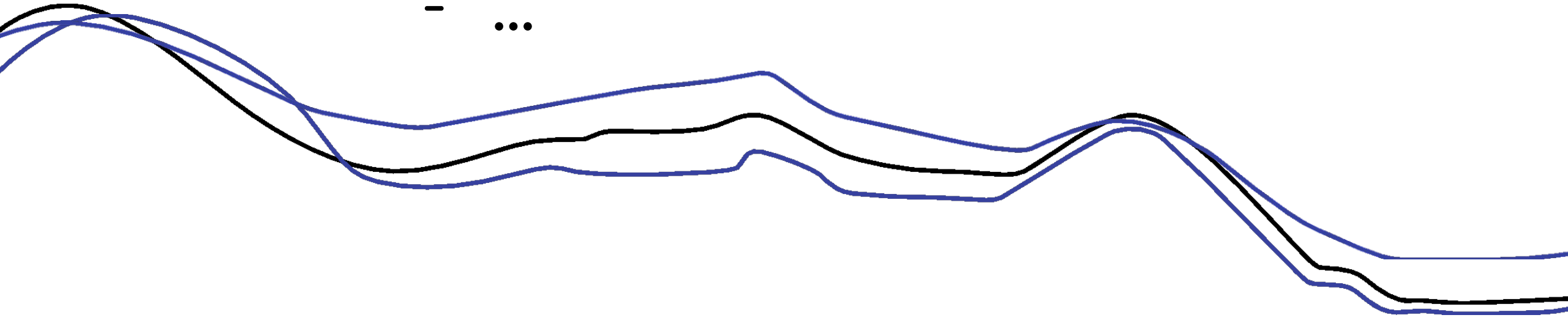
Technology Assessment Group (TAG)

<http://www.psi.ch/ta>

peter.burgherr@psi.ch

We are going to work with a few tools:

- Slack
- hack.opendata.ch
- Airtable
- Zoom
- ...













Open Energy Data Hackdays ▾

 Erwähnungen & Reaktionen

 Entwürfe 1

 Lesezeichen

 Slack Connect

 Mehr

 Favoriten

 oleg

 Channels

 __org

 _announcements

 **_choose-your-challenge**

 _datasets

 _hackchat

 _heeeeeeeelp

 _social

 _tools

 # 001_short-term-photovoltaic-forecasting

 # 002_cybersecurity-navigator-for-building-iot

 # 003_energiereporter

 # 004_merging-big-data-today-and-yesterday

 # 005_smart-meter-open-dataset

 # **006_on-shore-wind-farm-spatio-temporal...**

 # **007_can-you-beat-the-model**

 # **008_data-analytics-of-a-decentralized-heat...**

 # **009_customer-data-analysis**

#_choose-your-challenge ▾

+ Channel-Lesezeichen hinzufügen

Freitag, 10. September ▾



Maud Châtelet 10:22 Uhr

You will find below the list of the Channels dedicated to our challenges.

Let me know if you need an extra channel for your group.

#001_short-term-photovoltaic-forecasting (Challenge description -> <https://hack.opendata.ch/project/731>)

#002_cybersecurity-navigator-for-building-iot (-> <https://hack.opendata.ch/project/738>)

#003_energiereporter (-> <https://hack.opendata.ch/project/735>)

#004_merging-big-data-today-and-yesterday (-> <https://hack.opendata.ch/project/734>)

#005_smart-meter-open-dataset (-> <https://hack.opendata.ch/project/733>)

#006_on-shore-wind-farm-spatio-temporal-model (-> <https://hack.opendata.ch/project/740>)

#007_can-you-beat-the-model (-> <https://hack.opendata.ch/project/741>)

#008_data-analytics-of-a-decentralized-heat-boiler (-> <https://hack.opendata.ch/project/742>)

#009_customer-data-analysis (-> <https://hack.opendata.ch/project/743>)

#010_trends-in-tertiary-energy-prices (-> <https://hack.opendata.ch/project/732>)

#011_pre-qualification-test (-> <https://hack.opendata.ch/project/744>)

#012_climate-neutral-cities-stgallen-example (-> <https://hack.opendata.ch/project/745>)

#013_where-does-my-electricity-come-from (-> <https://hack.opendata.ch/project/746>)

#014_-trend-scouting-for-the-energy-industry (-> <https://hack.opendata.ch/project/766>)

#015_electricity-heartbeat-2035-in-the-canton-of-zurich (-> <https://hack.opendata.ch/project/767>)

#016_green-charging-e-mobility (-> <https://hack.opendata.ch/project/768>)

#018_interoperability-plug-test-for-smart-meter (-><https://hack.opendata.ch/project/783>)

#019_refi-regenerative-finance (-><https://hack.opendata.ch/project/785>)

#020_how-sustainable-is-this-property (-> <https://hack.opendata.ch/project/779>) (bearbeitet)

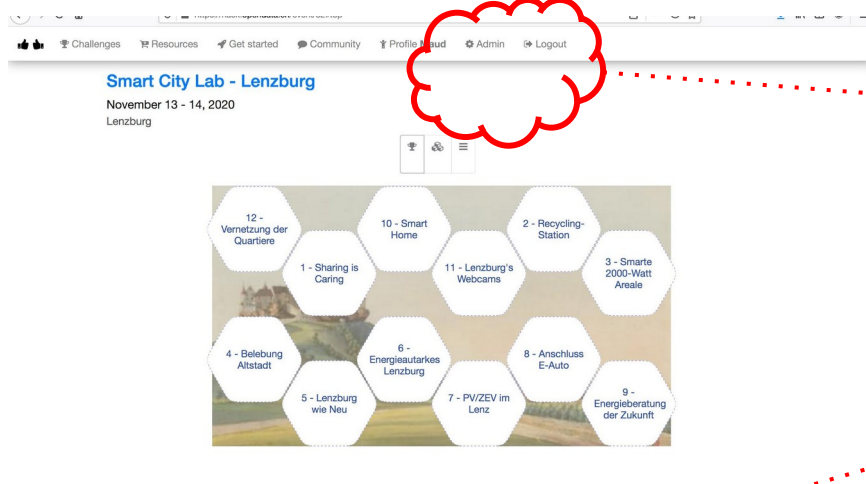


Ben Bowler 14:16 Uhr

ist `#_choose-your-challenge` beigetreten.

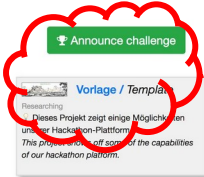
Nachricht an #_choose-your-challenge





Register

Start project & examples



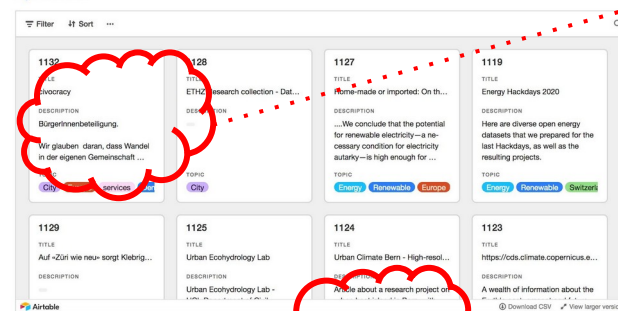
Offene Daten / Open Data

Mit dem Form hier kannst du auf Daten, die die Smart City Themen in Lenzburg betreffen, hinweisen. Als vorigen Veranstaltung wie die Energy Data Hackdays und auf Datenportale wie opendata.swiss gibt es weitere offene Datensätze zu entdecken. Achten Sie auf die Einhaltung der Nutzungsbedingungen und die korrekte Angabe Ihrer offenen Datenquellen.

With this form you can make suggestions of datasets for the upcoming event. The crowdsourced and championed data will be made available here during the event. From previous events such as [Energy Data Hackdays](https://energydatahackdays.com) and on data portals like opendata.swiss you can discover more open datasets such as these. Make sure to follow the [Terms of Use](#) and [correctly attribute your open data sources](#).

Entwickle hier weitere Daten und Ressourcen, die bei der Umsetzung eines Hackathon-Projekts helfen können. Wenn du Fragen hast, wende dich bitte über den [requests](#) Kanal.

Discover more data and resources here that will help you to implement your Hackathon project. If you have questions, reach out via the [requests](#) channel.



Datensatz vorschlagen / Suggest a dataset

find more Data..?

Suggest Datasets you know of

Smart City Lab - Lenzburg wird am 13-14 November Online veranstaltet. Registrieren Sie sich bitte auf die [Hackdays Website](#).

Möchtest du unsere intelligenten Städte mitgestalten? Nimm am Smart City Lab teil und entwickle in interdisziplinären Teams neue digitale Lösungen für die Stadt Lenzburg innerhalb von 32 Stunden!

The Smart City Lab - Lenzburg will take place on November 13-14. Keep yourself informed by registering from the [Hackdays Website](#).

Hackdays make a valuable contribution to the development of new solutions for complex problems. By bringing all the actors of the field as well as designers, programmers, data analysts, students and creative minds in general together in a collaborative process, great ideas bloom and prototypes come to life. Let's build a sustainable and smarter city together!

Smart City Lab - Lenzburg

November 13 - 14, 2020
Lenzburg

[Post](#)
[Edit](#)
[Join](#)

1 - Sharing is Caring

Wie kann durch "sharen" von bestehenden Ressourcen im Lenz eine Gemeinschaft gründet werden?

Warum ist das Problem relevant?

Der neuen Stadtquartier im Lenz ist weniger belebt als erhofft. Die Identität als "Energie Stadt" Quartier ist attraktiv aber es wird in diesen Wohnviertel einen hohen Firmen-Mietwerwechsel beobachtet.

Frage?

Wie könnte man die zwei trends von Sharing und Community Building vereinigen? Welche Bedürfnisse erkennt man in Lenz? Welchen "Raum" wäre geeignet um die Gemeinschaft aufzubauen und eine lebendigeren Alltag zu generieren?

Was möchte man während dem 36h am Smart City Lab Hack Day in Lenzburg erreichen?

Smart City Lab - Lenzburg

November 13 - 14, 2020
Lenzburg

Edit project data

Title

1 - Sharing is Caring

[Required] a short project name, max 80 characters

Summary

Wie kann durch "sharen" von bestehenden Ressourcen im Lenz eine Gemeinschaft gründet werden?

Max 120 characters

Pitch

Warum ist das Problem relevant?
Der neuen Stadtquartier im Lenz ist weniger belebt als erhofft. Die Identität als "Energie Stadt" Quartier ist attraktiv aber es wird in diesen Wohnviertel einen hohen Firmen-Mietwerwechsel beobachtet.

Was möchte man während dem 36h am Smart City Lab Hack Day in Lenzburg erreichen?

To format, use Markdown or HTML. Links on their own line get previews for supported providers.

[Upload image](#)

Project link

URL to a live demo, presentation, or link to further information

☐ Embed project link

Sync

URL to external source of documentation in GitLab, GitHub, Bitbucket, Data Package or Web site

Source link

URL of your repository

Contact link

URL of an issues page, forum thread, chat channel, e-mail, hashtag, ...

Image link

URL to an image to display at the top

[Upload image](#)

Custom color

Background color of your project page

Challenge category

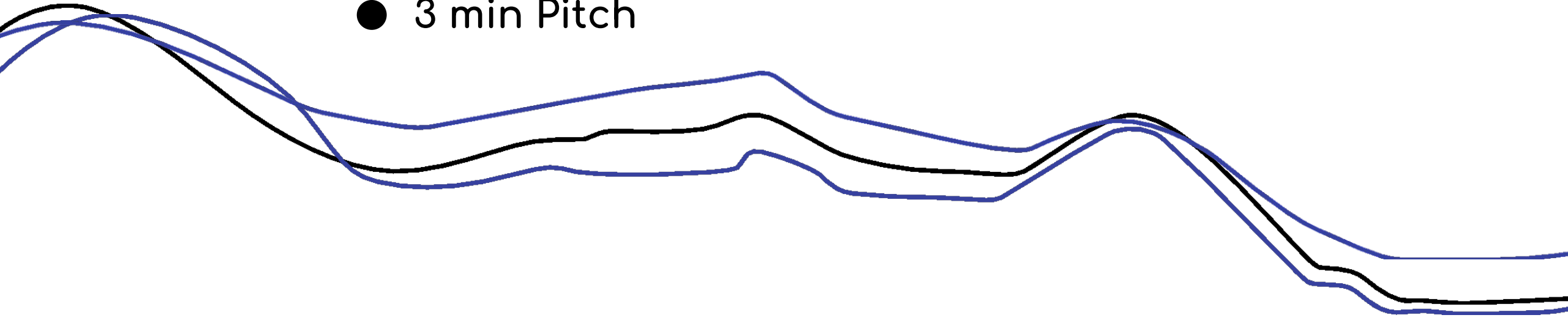
[Save changes](#)

We want you to document:

- What was achieved during the Hackdays?
- -> a good executive summary helps us too
- What problems did you encounter?
- What are the next steps for this project?
- Links to source code, pitches, demos and prototypes and contacts.
- What data did you use? In what formats?
- Any relevant terms of use or licences.

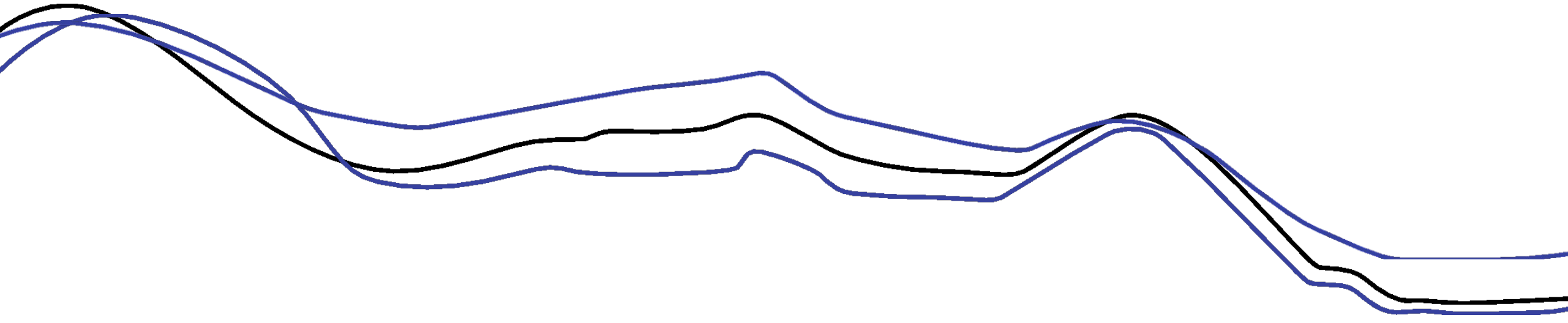
Presentations:

- about documentation at 17:30 tonight
- state of the projects at 18:00 tonight
- Final slides tomorrow at 15:00
 - in the Google-template (16:9)
 - link on Slack
- 3 min Pitch



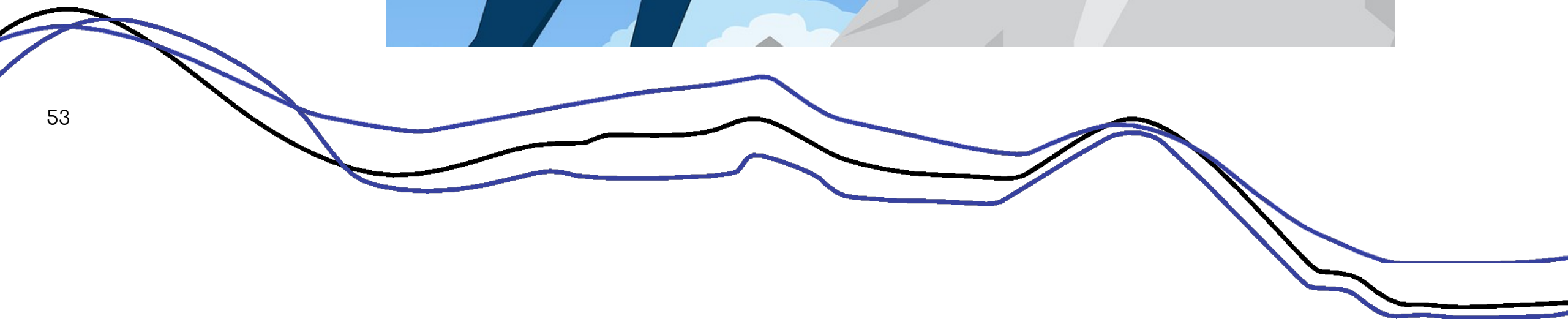
Challenges

- Will be presented right now!
- Are visible on hack.opendata.ch,
- Choose your challenge and
- Meet your team in real life and in Slack!



- 1 - Photovoltaic Forecasting
- 2 - Building IoT Security
- 3 - Local Sustainability Booster
- 4 - Understanding Big Energy Data
- 5 - Smart Meter Open Dataset
- 6 - Spatio-temporal Model of an On-Shore Wind Farm
- 7 - Smart Meter Insights Market
- 8 - Digital Twins for Domestic Heating Systems
- 9 - Customer Data Analysis
- 10 - Trends in Tertiary Energy Prices
- 11 - Pre Qualification Test
- 12 - Climate-Neutral Cities - St. Gallen Example
- 13 - Where Does My Electricity Come From?
- 14 - Trend Scouting For The Energy Industry
- 15 - Electricity "Heartbeat" 2035 in the Canton of Zurich
- 16 - "Green" Charging E-Mobility
- 18 - Interoperability plug-test for smart meter's local CII
- 19 - ReFi - Regenerative Finance

Photovoltaic Forecasting 01

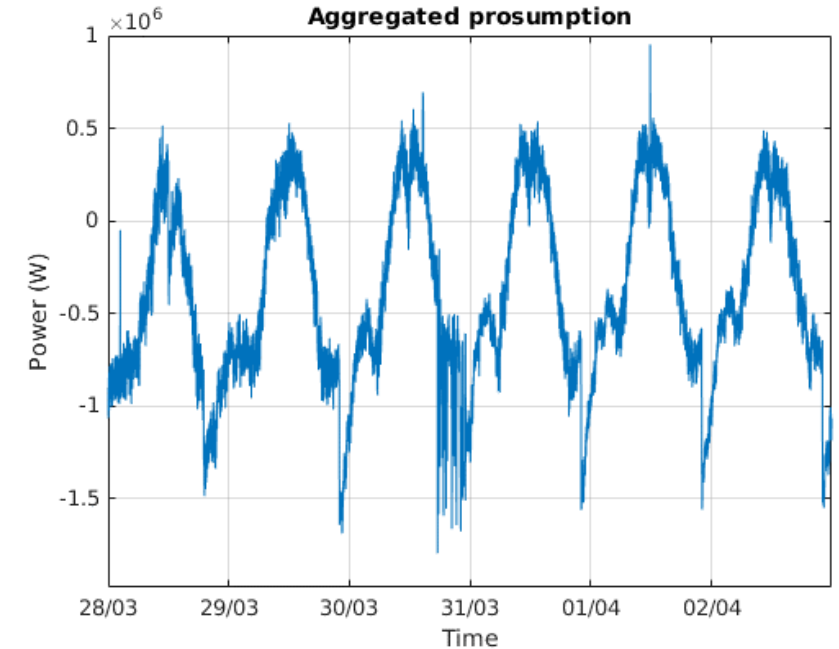


Short-term forecasting of unmonitored photovoltaics generation

01

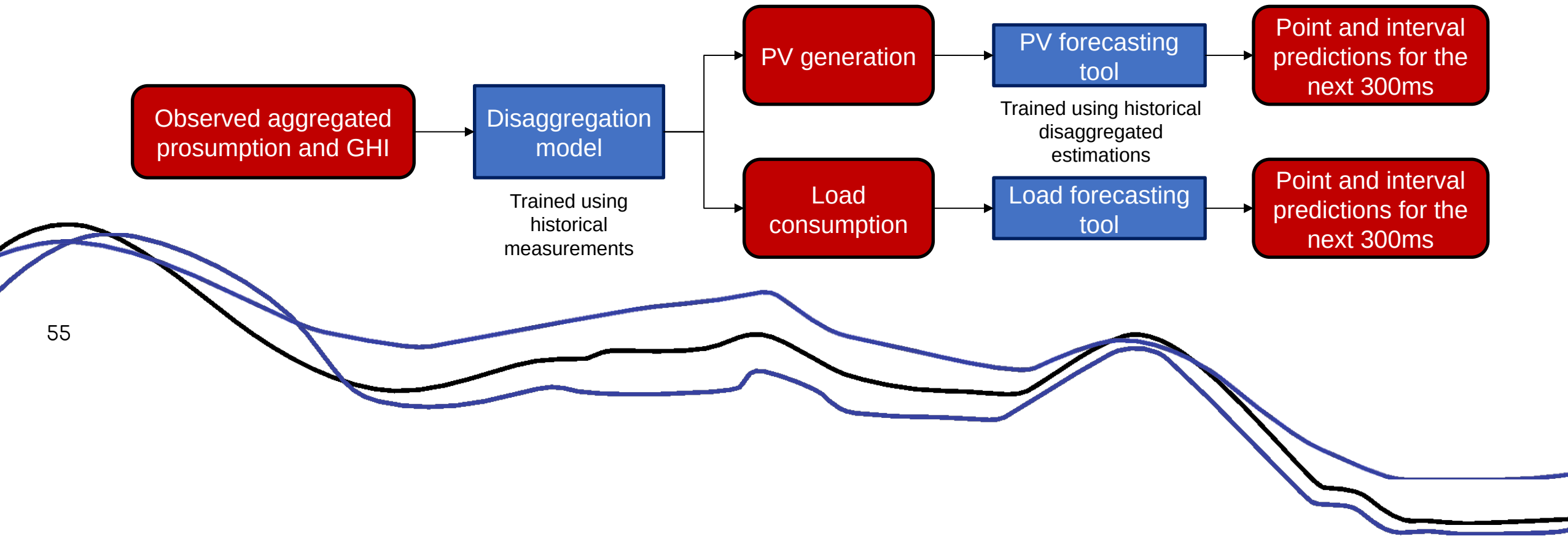
Real-time grid control strategies require accurate predictions of photovoltaics (PV) generation and load consumption to ensure the safe operation of the grid

Problem: In many practical applications, the PV cannot be monitored



Challenge:

Can we compute short-term (sub-second) probabilistic forecasting of PV generation and load consumption when only their aggregated prosumption is being monitored?



Data

The available dataset includes high-resolution (300ms) historical measurements from a single node located in Aigle-Switzerland

Training data: Aggregated prosumption, global horizontal irradiance (GHI) and PV cell temperature

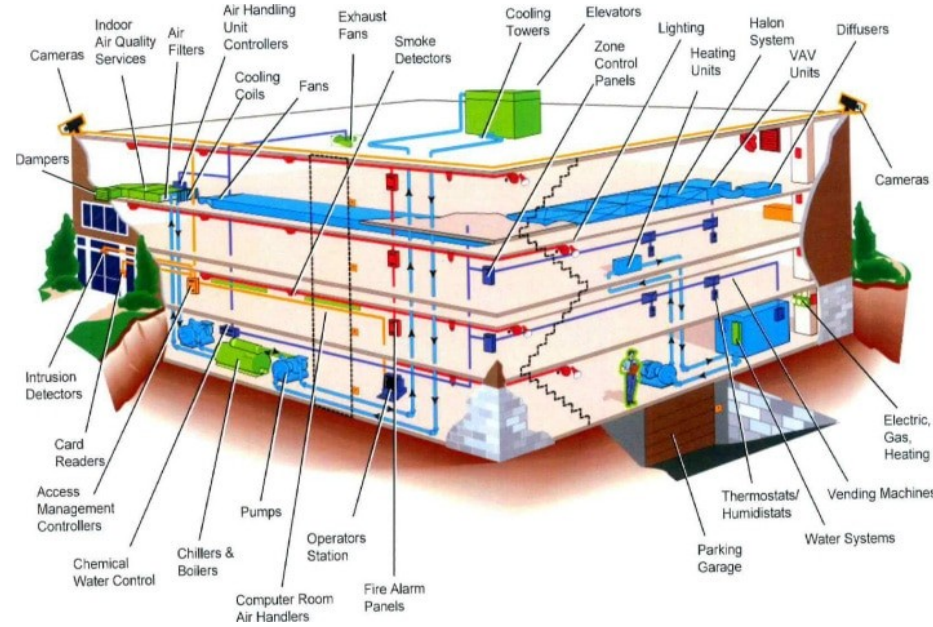
Validation data: Disaggregated PV and load power

The validation data should not be used to train your models



Building IoT Security

02



Building IoT Security

02



- Digitalization as an instrument for increasing energy efficiency through smart solutions
- IoT systems as a prerequisite for smart buildings
- Challenges are interoperability and connectivity, data protection and cybersecurity

How can we increase acceptance of IoT systems and support digital innovation?

58

Extract from market analysis survey

02

- What importance do you attach to the cyber security of your building and building automation? → 60% Very important
- How important do you think cyber security is for your customers? → 52% Very important
- Where do you see the challenges when it comes to cyber security? → 45% Missing Knowhow (most answered)

Building IoT Security Navigator

02

Let us create a public information security tool and support digitalization in the building sector

- Transparency in the area of cybersecurity and data protection showing policies, norms and guidelines
- Interesting for all actors in the building sector (investors, planners, manufacturers, managers and tenants)
- Provided by a neutral entity free from commercial interests

“Cybersecurity Navigator for Building IoT”

02

Challenge:

We create a cyber security tool! But it goes even further: with a public information security tool, we can provide transparency in the area of cybersecurity and data protection to all interested actors in the building market (investors, planners, manufacturers, managers and tenants), and thus support digitalisation in the building sector.

By means of a user-friendly interface, users of the tool could get a list of documents relevant to them based on a selection of criteria.

If you...

- are a web developer
- or
- have knowledge in document classification automation
- or
- have experience in the field of cyber security or data protection
- or
- have knowledge in data engineering or architecture
- or
- are curious and a team player

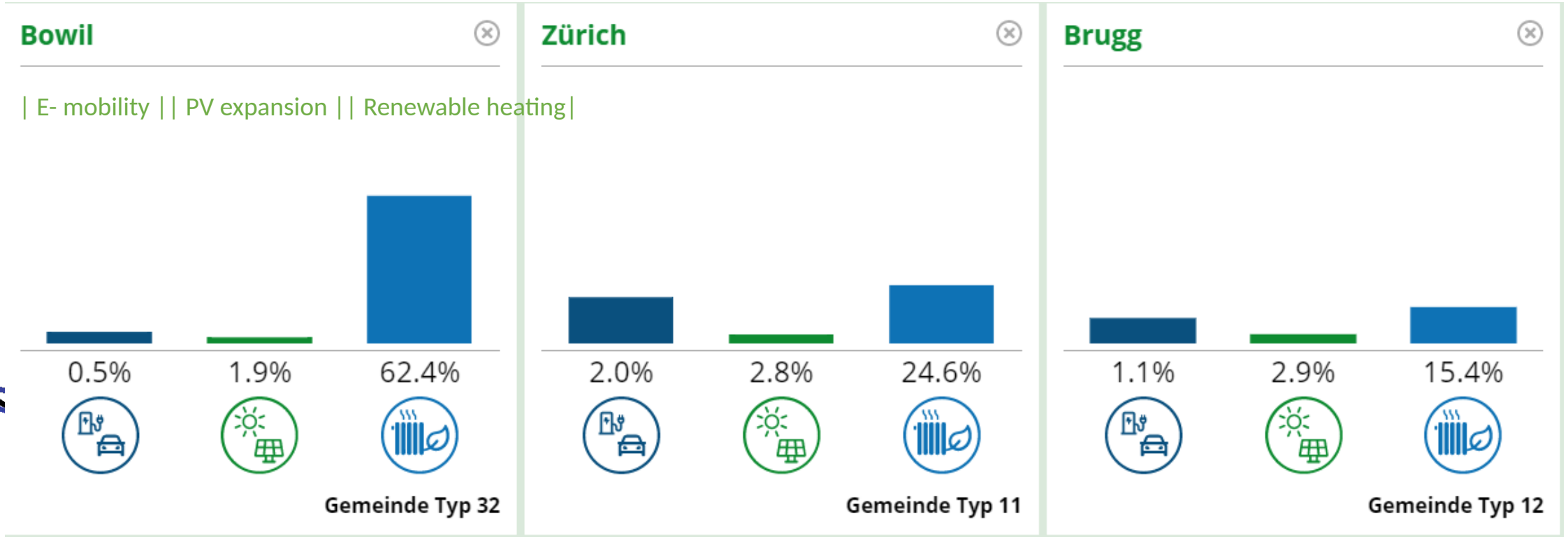
**...then join
challenge #2**

02

Local sustainability booster

03

Question: Which local features boost local sustainability?



Screenshot from [EnergieReporter.ch](https://energiereporter.ch)

Zürich: Higher average income more Teslas?
 Bowil: More detached houses more renewable heating?
 Brugg: Why is PV expansion relatively higher in Brugg ?

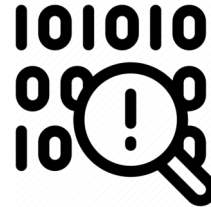
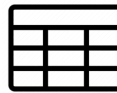
Challenge

03

Can we find features at municipality level which can explain those KPIs?

opendata.swiss 

- Demographics
- Topographic
- Prices
- Weather
- Politics
- ...



Insights for policy recommendations

Allocate resources and funds in a
efficient and effective way

Machine Learning and statistical methods

Challenge:

With the complete data set of the Energy Reporter including the sustainability KPI's and other (e.g. demographic) data on municipality level, the participants could identify the most important influencing factors leading to sustainability.

A small machine learning project would be suitable for this analysis. Participants are free to choose the algorithm or statistical method.

Data:

csv with all municipalities and indicators of the energy reporter.
Csv with all municipalities, attributes on population demographics and electricity prices.

In addition, a wide range of municipal data is publicly available. We encourage participants to use opendata.swiss to find interesting data at the municipality level that can explain sustainable development.

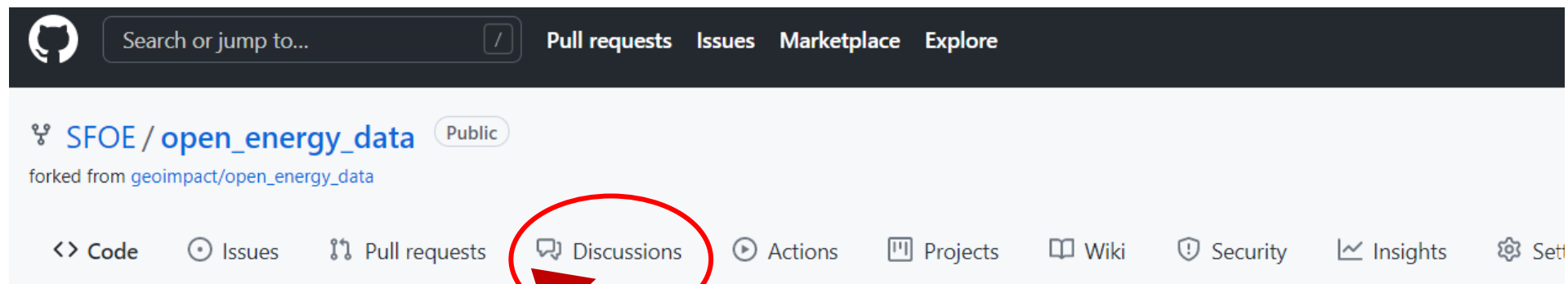
This project is a follow up of the challenge proposed at the Energy & Climate Hack. Accordingly, the precise frame of the challenge might be influenced through the results of the teams.

If you...

- are a data scientist
- or
- know statistics
- or
- know to handle spatial data
- or
- have bright ideas for which data to include
- or
- are curious and a team player

**...then join
challenge #3**

03



have a look at:
github.com/SFOE/open_energy_data

leave a comment





Understanding big energy data

04

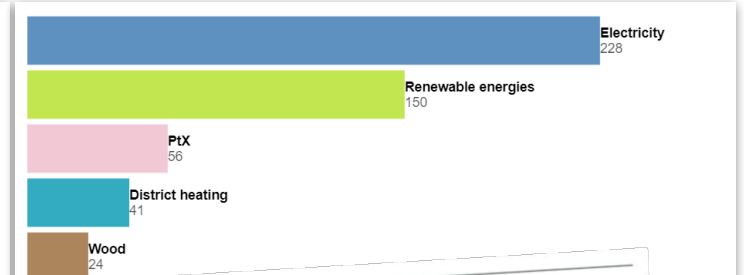
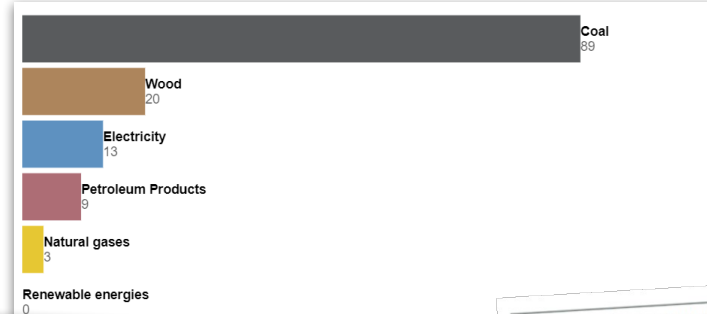
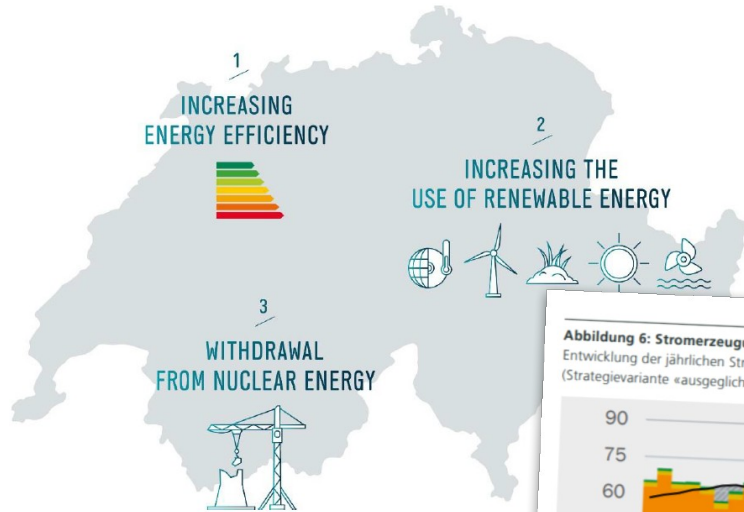
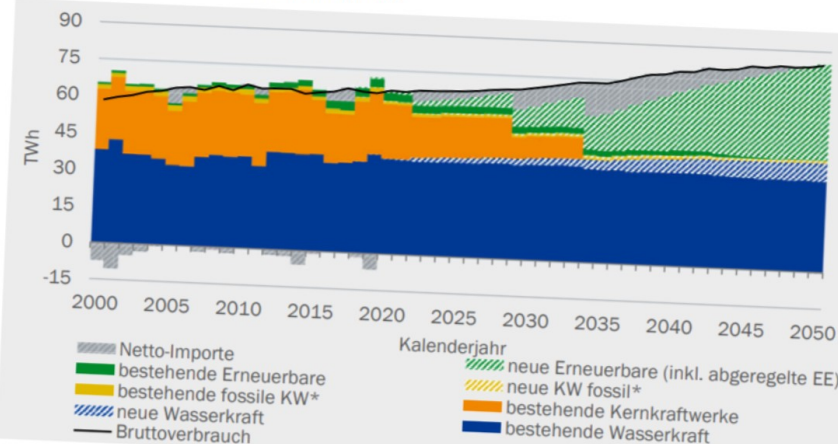
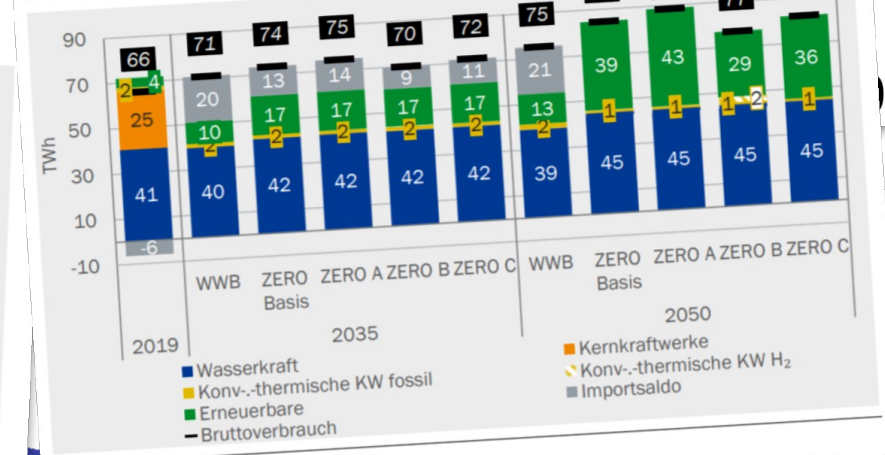


Abbildung 6: Stromerzeugung nach Technologien
Entwicklung der jährlichen Stromerzeugung nach Technologien im Szenario ZERO Basis (Strategievariante «ausgeglichene Jahresbilanz 2050»), in TWh



* gekoppelt und ungekoppelt
© Prognos AG/TEP Energy GmbH/INFRAS AG 2020

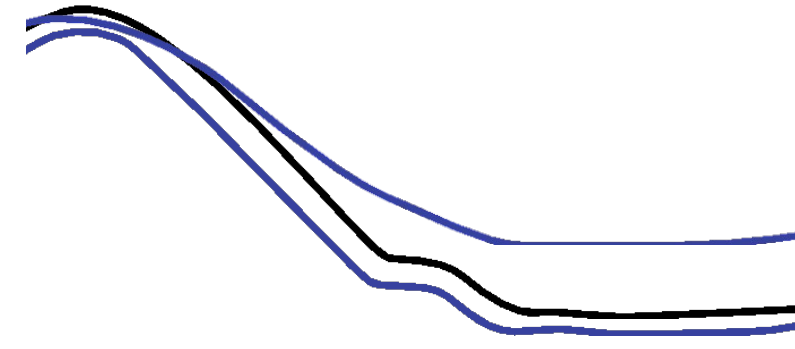
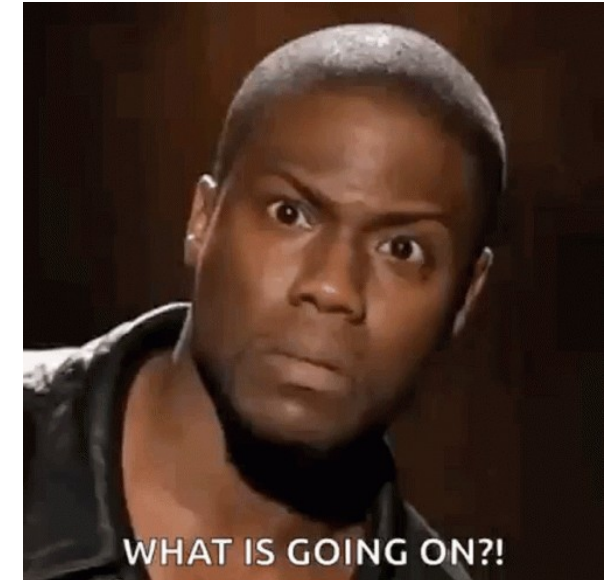
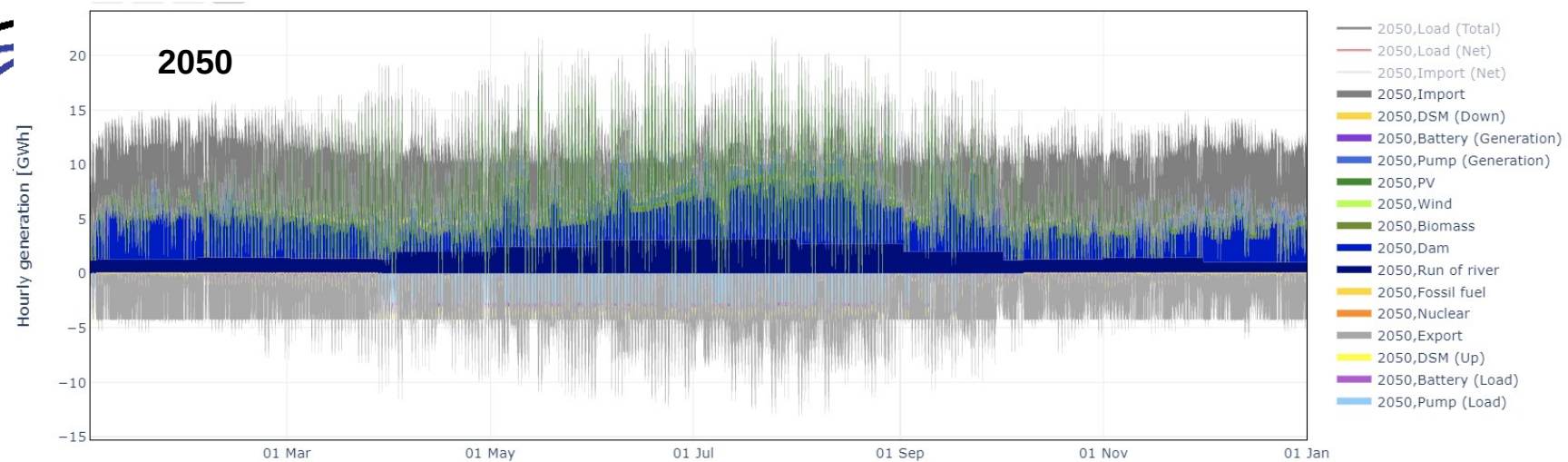
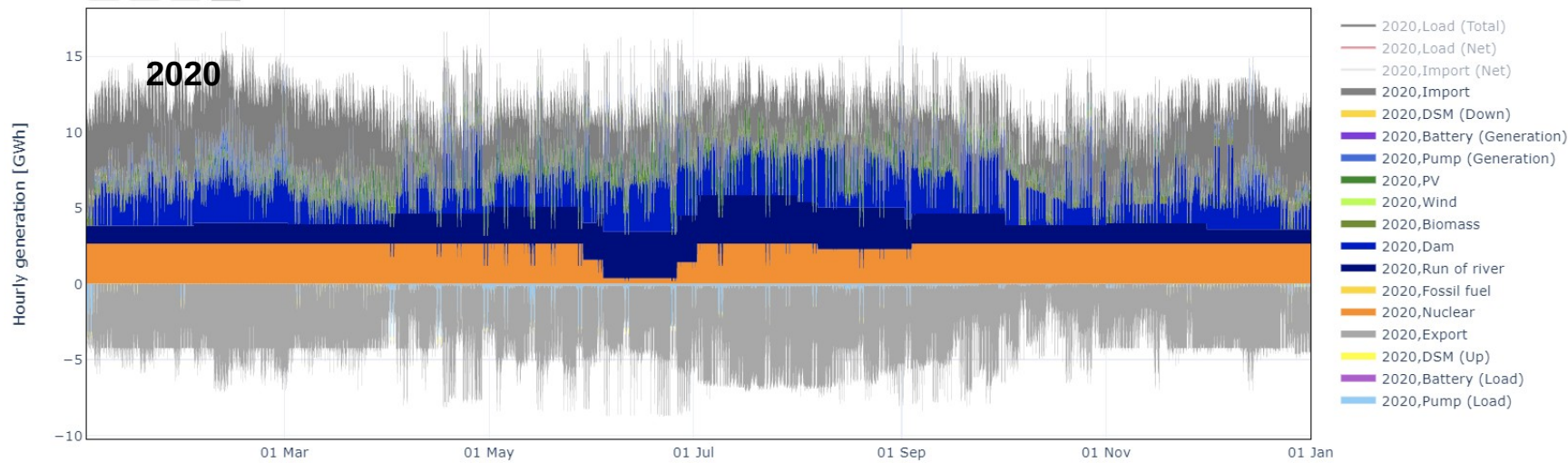
Abbildung 12: Stromerzeugungsstruktur (Szenarienvergleich)
Entwicklung der Stromerzeugungsstruktur im Vergleich der Varianten des Szenarios ZERO (Strategievariante «ausgeglichene Jahresbilanz 2050») und des Szenarios Weiter wie bisher, in TWh



© Prognos AG/TEP Energy GmbH/INFRAS AG 2020

Understanding big energy data

04



Vision: Developing a platform, in which users can upload big energy data (e.g., time series of electricity generation) and compare their data with other historical or model-based energy data, using novel indicators of energy system changes.



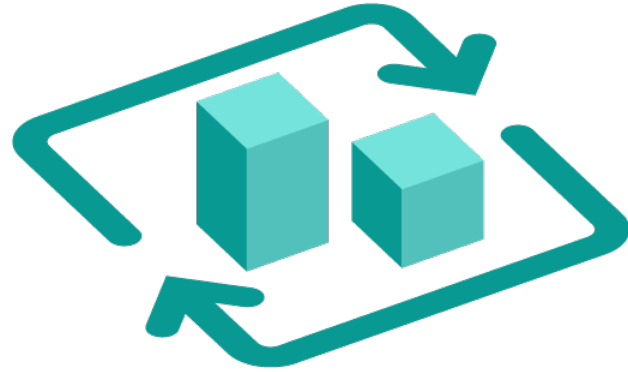
Python Virtuoso

- Develop python script to read and process big energy data
- conceptualize web-based platform for comparing energy data
- Put thoughts on indicators and visualization into code



Energy Enthusiast

- Understand the energy system and its development
- Identify state-of-the art evaluation of big energy data (i.e., time series of electricity generation and demand)
- Development ideas on novel indicators and visualization of big energy data

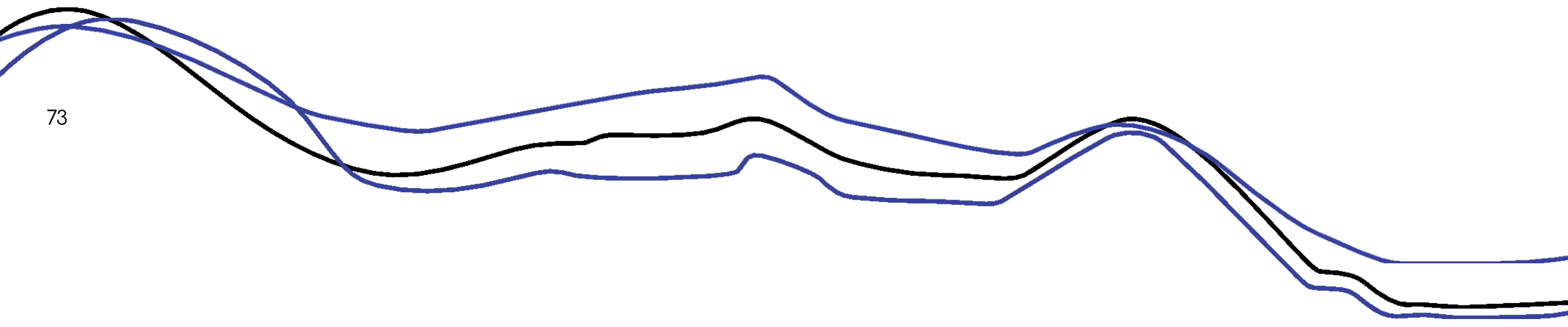
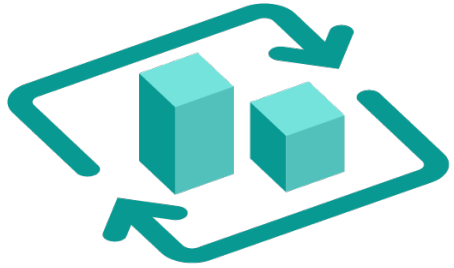


National Centre of Competence in Research **Automation**

Smart Meter Open Dataset

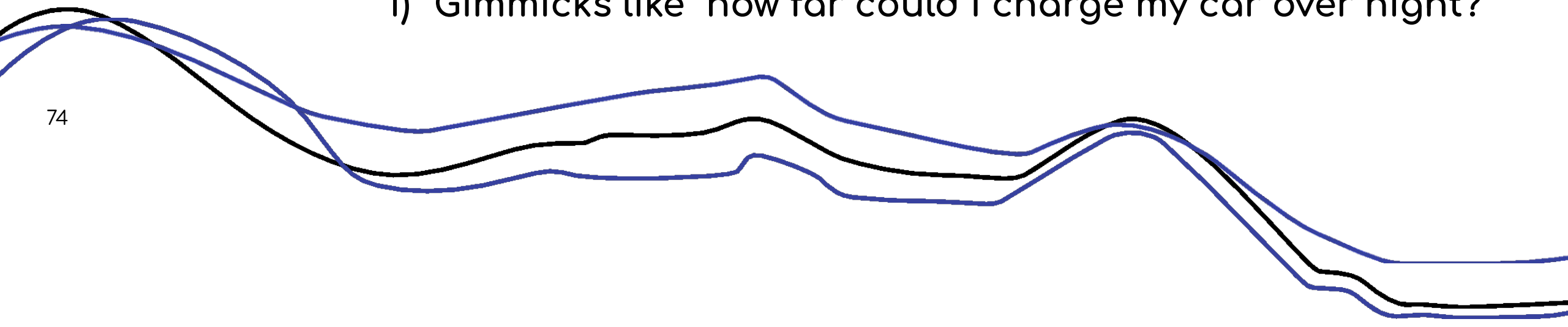
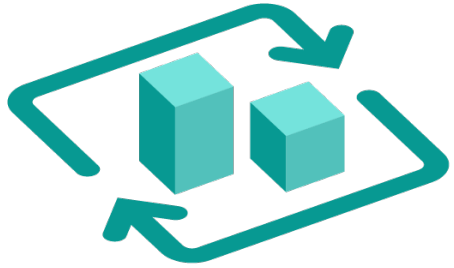
We want to build a platform

- where people can freely donate their energy data.
- that scientists can use to validate their theories.
- that engineers can use to build fair algorithms.
- where everyone can gain useful insights.

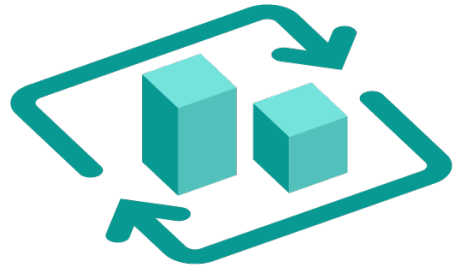


Challenge:

- 1) Build a web platform to upload data
- 1) Comply with privacy law similar to wikipedia / CC0 platforms
- 1) Check for unique uploads / missing data
- 1) Gimmicks like “how far could I charge my car over night?”

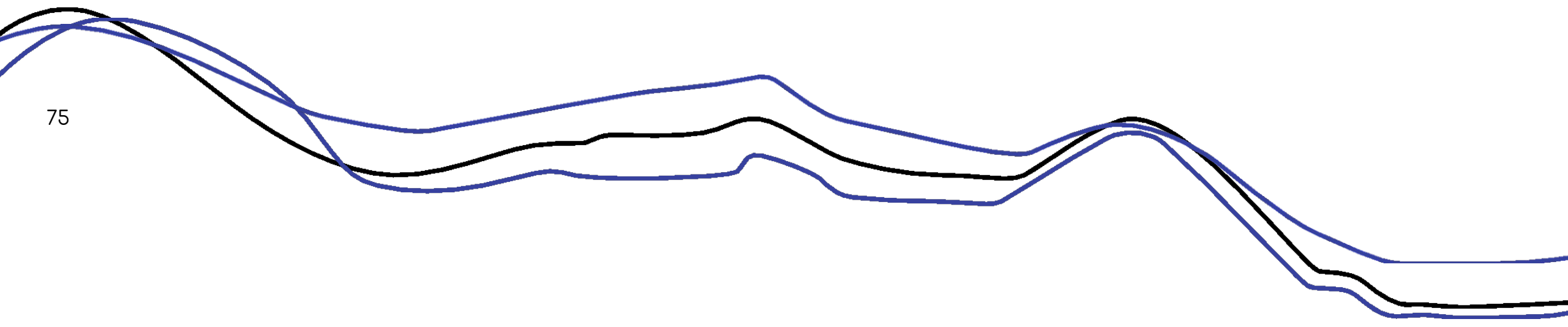


Data / Assets:



- 1) User donations from real smart meters
- 1) Dedicated private server environment with root access
- 1) Everyone can contribute - *even if you don't join us!*

75

A line graph with multiple data series plotted over time. The graph features several lines in black and blue. The lines show a general downward trend with some fluctuations. A specific data point on the leftmost line is labeled with the number '75'.

Spatio-temporal model of an on-shore 06 wind farm

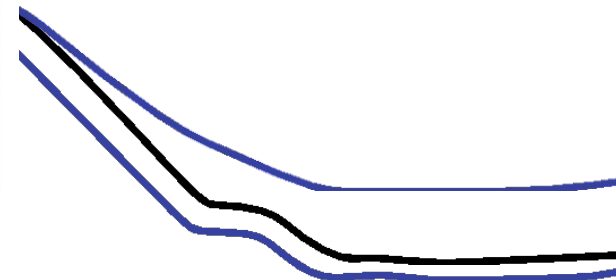
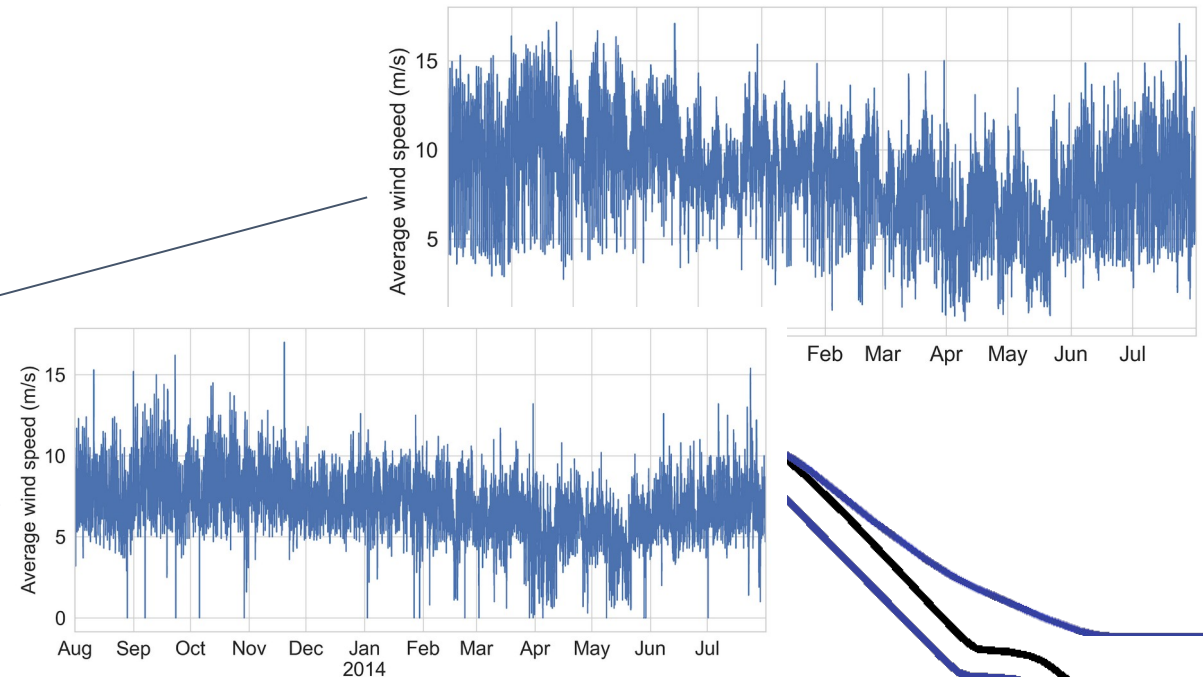
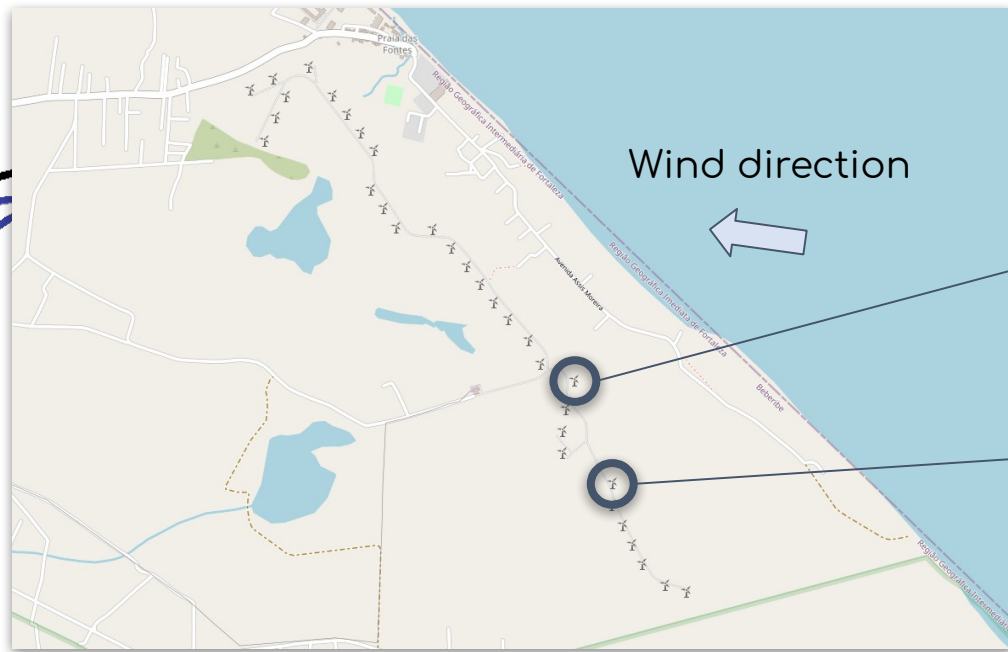


On-shore wind farm near a coast in Brazil



Spatio-temporal model of an on-shore 06 wind farm

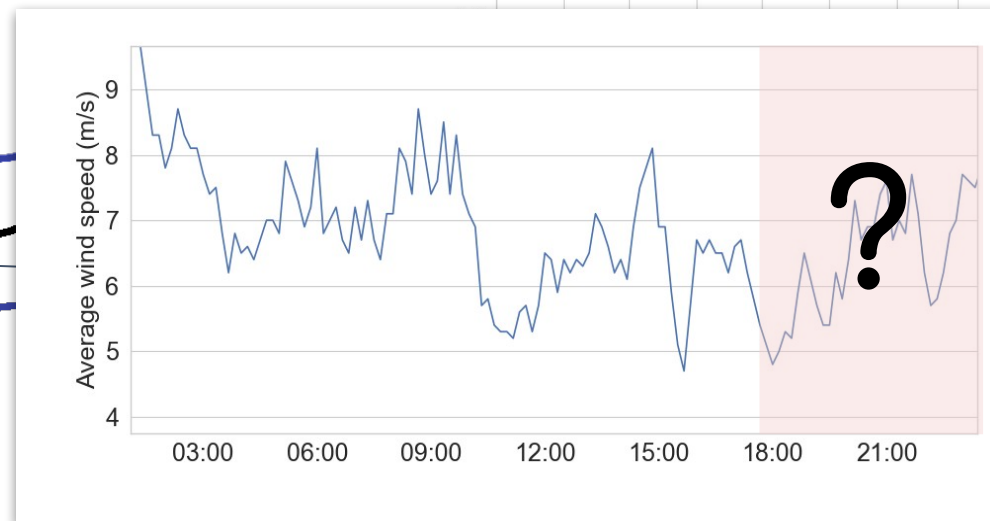
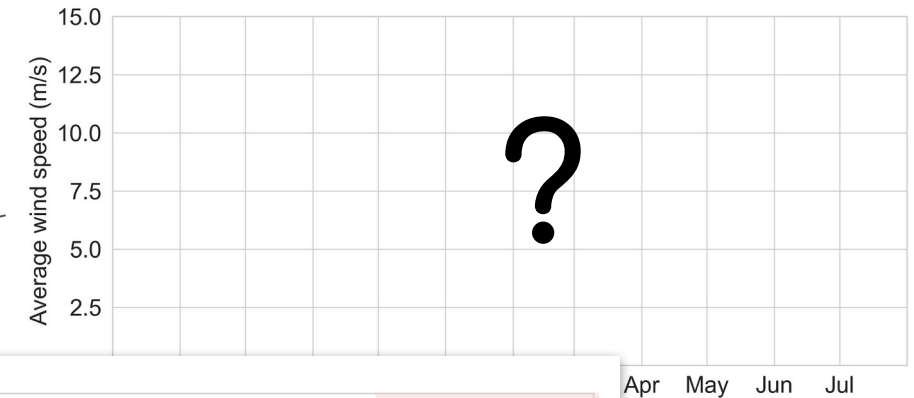
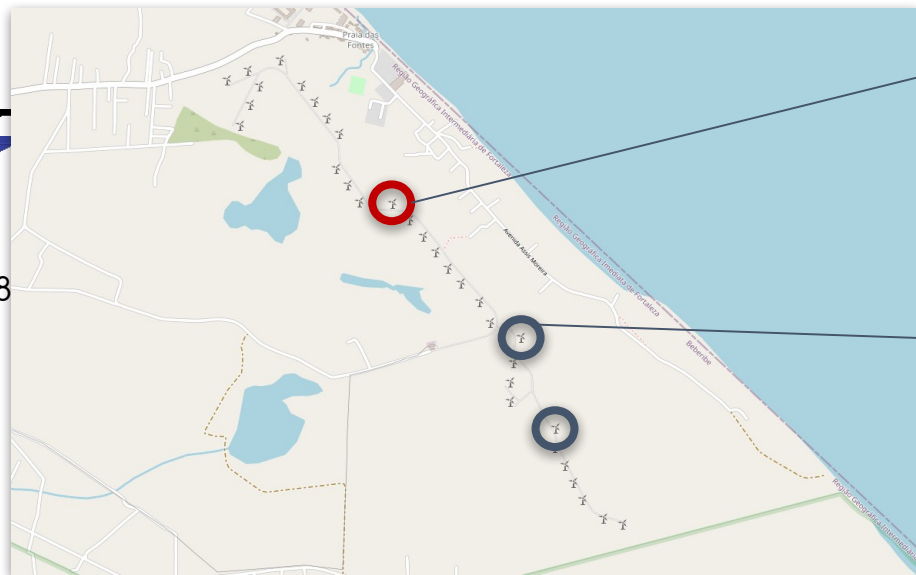
A spatio-temporal model is of great interest within the wind energy community for more accurate wind speed forecasting, which helps to better estimate power production and to develop optimized control strategies.



With the spatio-temporal model we want to

06

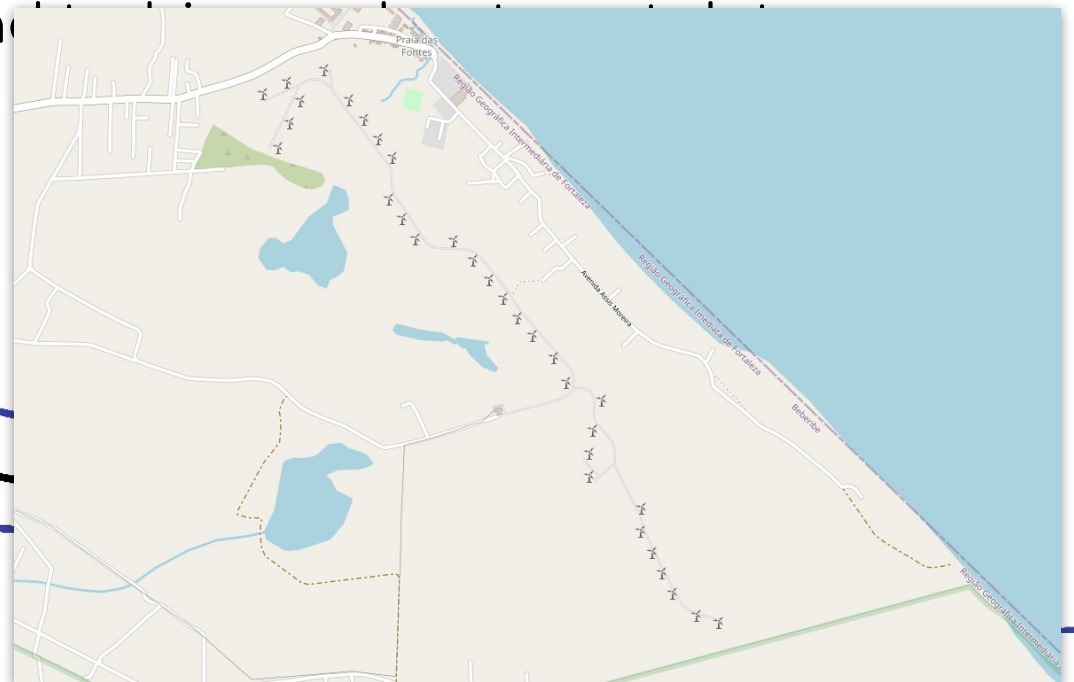
- ☐ Visualize and investigate the local winds and the interaction between turbines
- ☐ Fill data gaps
- ☐ Forecast time series



Data:

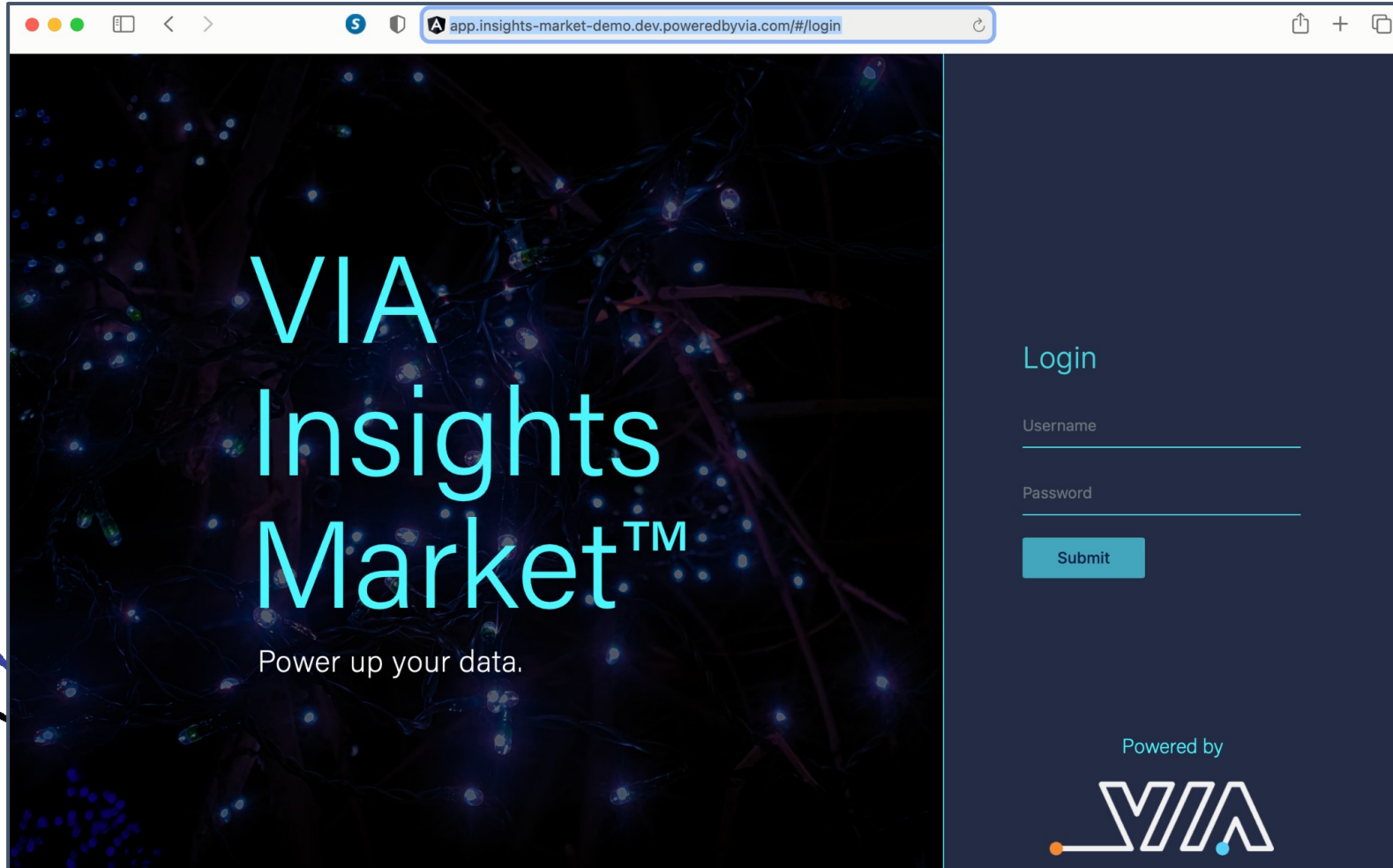
For this we provide a dataset that contains the 10-minute average wind speeds, the wind directions, the geographic coordinates and more of 32 wind turbines and 1 met mast tower for a period of 1 year.

- ☐ NetCDF file containing wind
- ☐ Geographic coordinates
- ☐ All necessary metadata
- ☐ Some Python methods to get started



Smart Meter Insights Market

07



The screenshot shows a web browser window with the URL `app.insights-market-demo.dev.poweredbyvia.com/#/login`. The page features a dark background with a network of glowing blue nodes and lines. On the left, the text "VIA Insights Market™" is displayed in a light blue font, with the tagline "Power up your data." below it. On the right, there is a login form with the heading "Login", fields for "Username" and "Password", and a "Submit" button. At the bottom right, it says "Powered by" followed by the VIA logo, which consists of the letters "VIA" in a stylized, outlined font with a small orange dot and a blue dot.

VIA
Insights
Market™

Power up your data.

Login

Username

Password

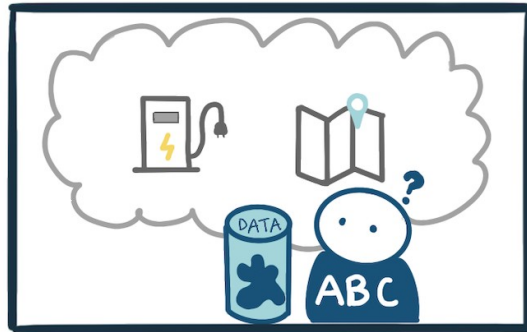
Submit

Powered by

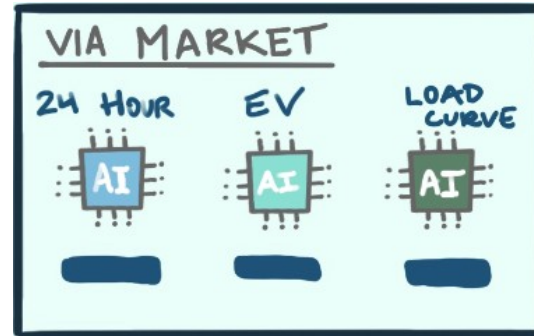
VIA

Smart Meter Insights Market

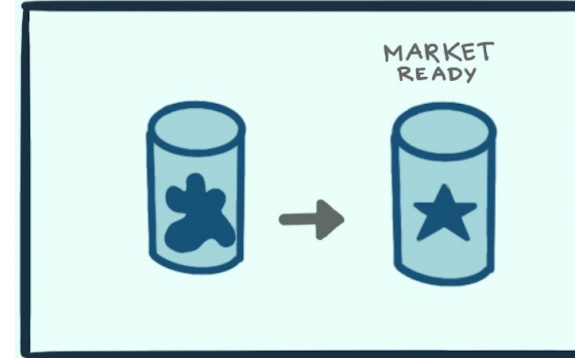
07



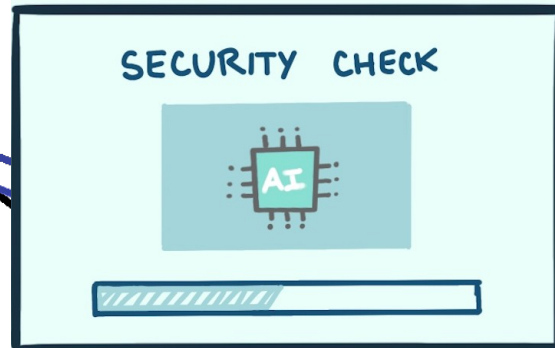
1. ABC Utility has a problem.



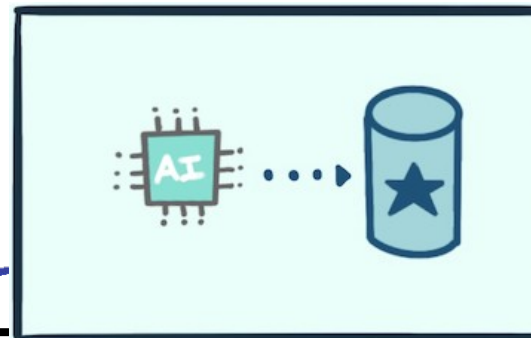
2. ABC Utility finds a possible solution (a model).



3. Insights Market automatically transforms your data to the right format for the model.



4. Insights Market ensures the model is cybersecurity.



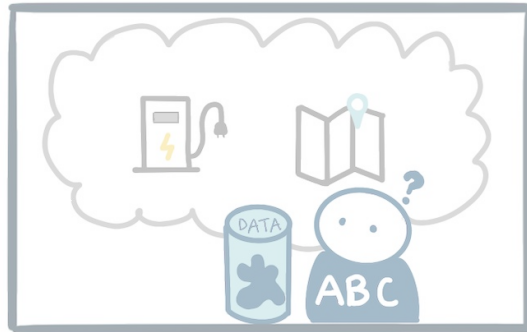
5. ABC Utility runs the model local to them.



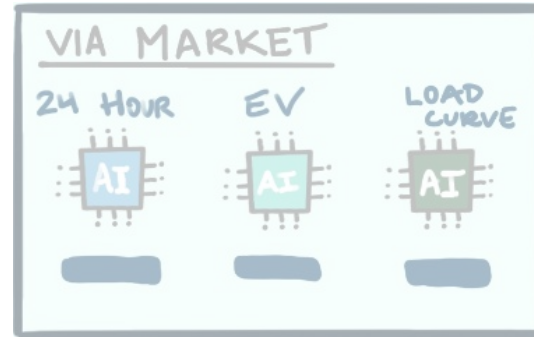
6. ABC Utility solves their problem!

Smart Meter Insights Market

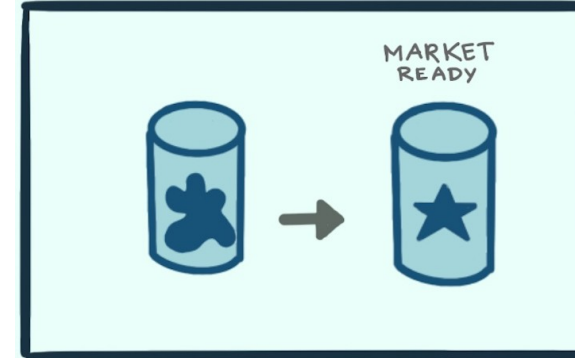
07



1. ABC Utility has a problem.



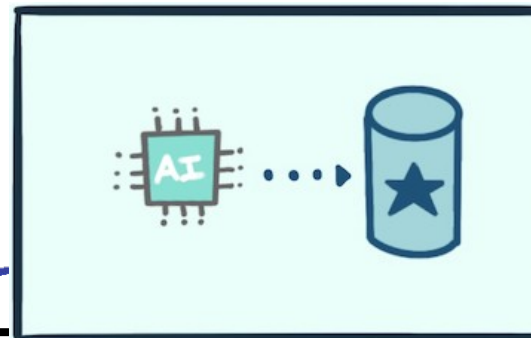
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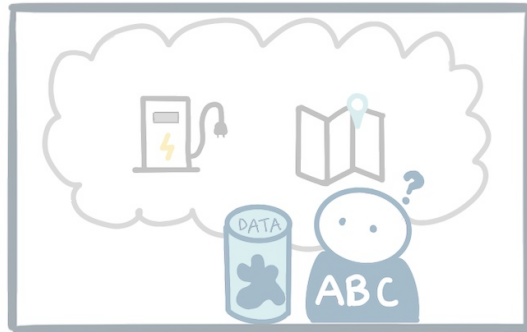
5. ABC Utility runs the model local to them.



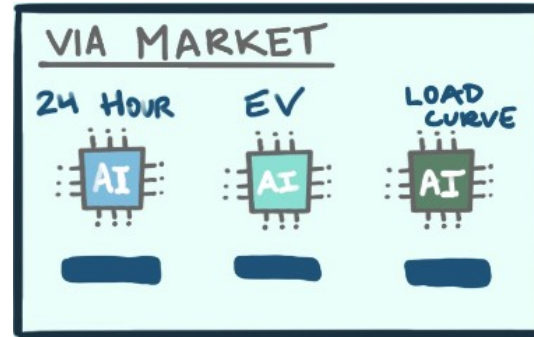
6. ABC Utility solves their problem!

Smart Meter Insights Market

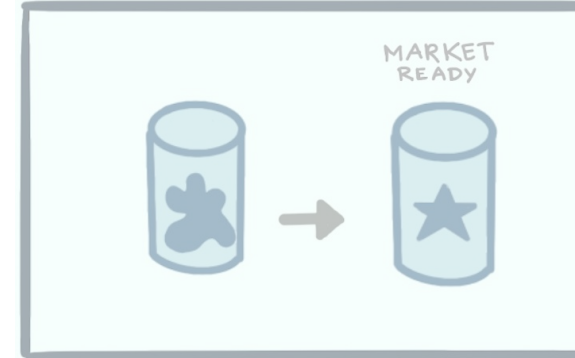
07



1. ABC Utility has a problem.



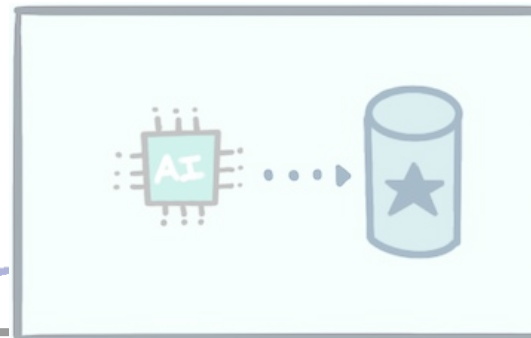
2. ABC Utility finds a possible solution (a model).



3. Insights Market automatically transforms your data to the right format for the model.



4. Insights Market ensures the model is cybersecurity.



5. ABC Utility runs the model local to them.



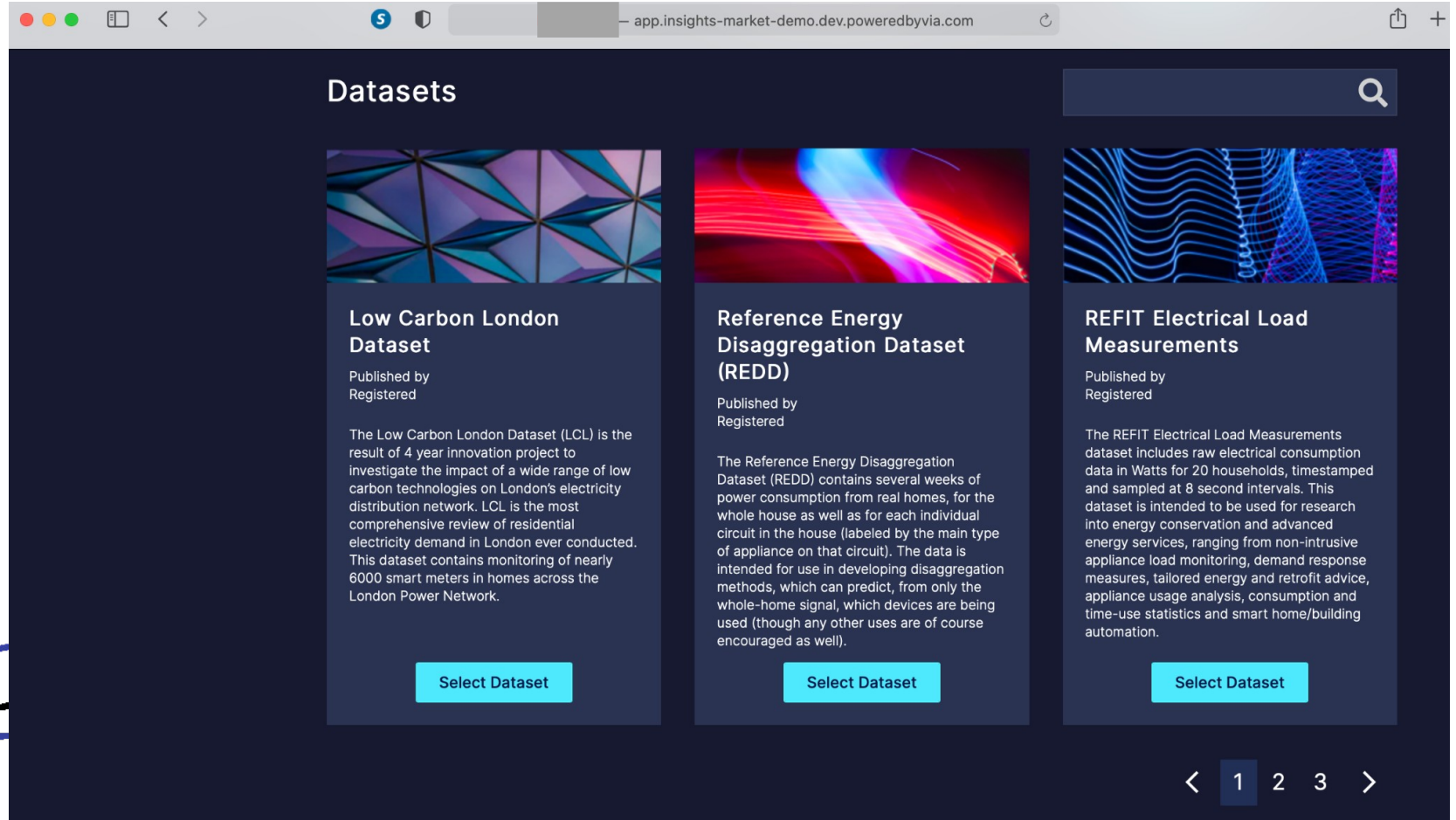
6. ABC Utility solves their problem!

Challenge:

07

Beat the benchmarks!

- Load forecasting
- NILM
- Anomaly Detection



app.insights-market-demo.dev.poweredbyvia.com

Datasets



Low Carbon London Dataset

Published by Registered

The Low Carbon London Dataset (LCL) is the result of 4 year innovation project to investigate the impact of a wide range of low carbon technologies on London's electricity distribution network. LCL is the most comprehensive review of residential electricity demand in London ever conducted. This dataset contains monitoring of nearly 6000 smart meters in homes across the London Power Network.

Select Dataset



Reference Energy Disaggregation Dataset (REDD)

Published by Registered

The Reference Energy Disaggregation Dataset (REDD) contains several weeks of power consumption from real homes, for the whole house as well as for each individual circuit in the house (labeled by the main type of appliance on that circuit). The data is intended for use in developing disaggregation methods, which can predict, from only the whole-home signal, which devices are being used (though any other uses are of course encouraged as well).

Select Dataset



REFIT Electrical Load Measurements

Published by Registered

The REFIT Electrical Load Measurements dataset includes raw electrical consumption data in Watts for 20 households, timestamped and sampled at 8 second intervals. This dataset is intended to be used for research into energy conservation and advanced energy services, ranging from non-intrusive appliance load monitoring, demand response measures, tailored energy and retrofit advice, appliance usage analysis, consumption and time-use statistics and smart home/building automation.

Select Dataset

< 1 2 3 >

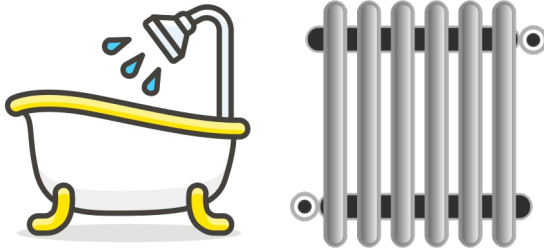
Digital Twins For Domestic Energy Systems 08



Digital twins for domestic hot water and heating distribution systems

08

Topic:



Challenge:

How to operate domestic energy systems 24/7 efficiently?

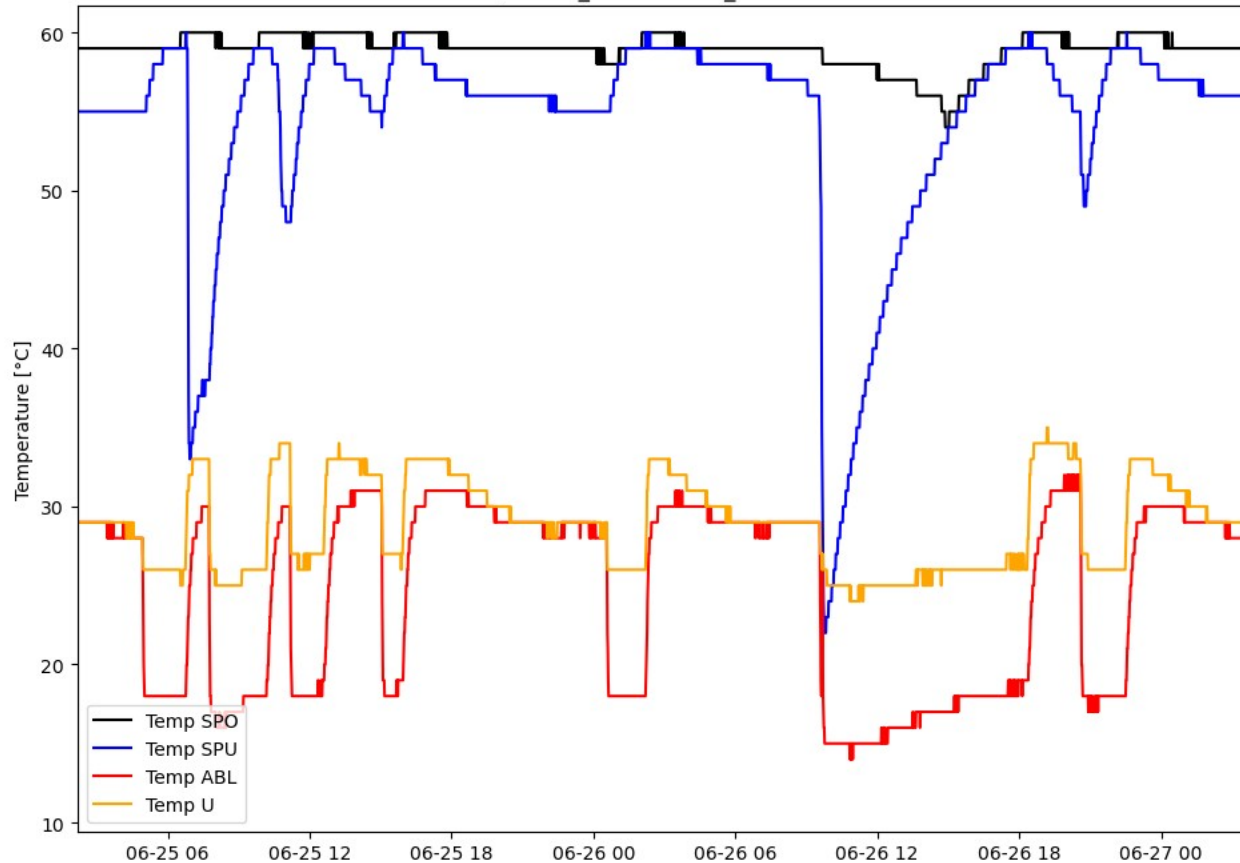
Opportunity:

IOT and ubiquitous sensors provide access to real-time measurement data.

80 % of domestic energy

consumption

Digital twins enable in-silico optimisation of system without discomfort to user.



Hot water boiler

Task:

Find patterns in smart boiler monitoring data

Hidden treasure:

How does your lifestyle influence your water consumption?

Ideal for:

data enthusiasts,
number crunchers,
sherlocks ho(l)mes

Less space heating

Task:

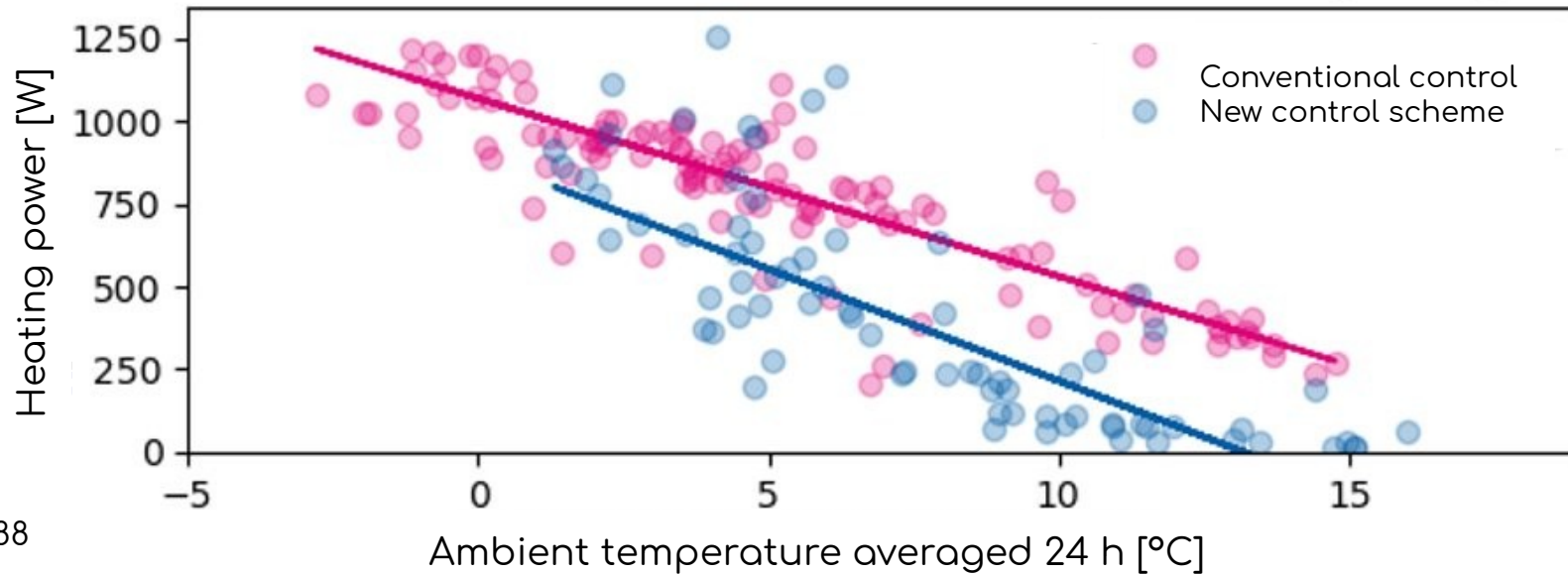
Model heating system
and optimise it

Hidden treasure:

A small step for a
thermostat a giant leap
for energy consumption

Ideal for:

data enthusiasts,
number crunchers,
sherlocks ho(l)mes





How to use data?

Task:

Find novel applications of home monitoring data

Hidden treasure:

Repair person rings the bell before your water pipe breaks

Ideal for:

Enthusiasts, business opportunity seekers, angry homeowners

Interested in

- Defining the feature of smart DHW systems?
- Enabling smart thermostat control?
- Finding new applications to residential monitoring data?



...then join
challenge #8

Customer data analytics

09



Customer Orientation



Anonymized exemplary Dataset of 4'000 Customers
from 5 big municipalities

Attributes:

- Municipality ID (no clear name)
- Power Product Type
- Consumption (High and low tariff)
- Payment and Invoice Type
- Amount of Contacts to Service Center
- Bonity-Number
- E-Mail Address available (yes/no)



Development of

of a Tool / App / Service / API

Which helps us (in future) to identify

Patterns,

Correlations or

Other important stuff

In our Datasets

In order to

Get to know our customers better and
develop products and services tailored to
their needs

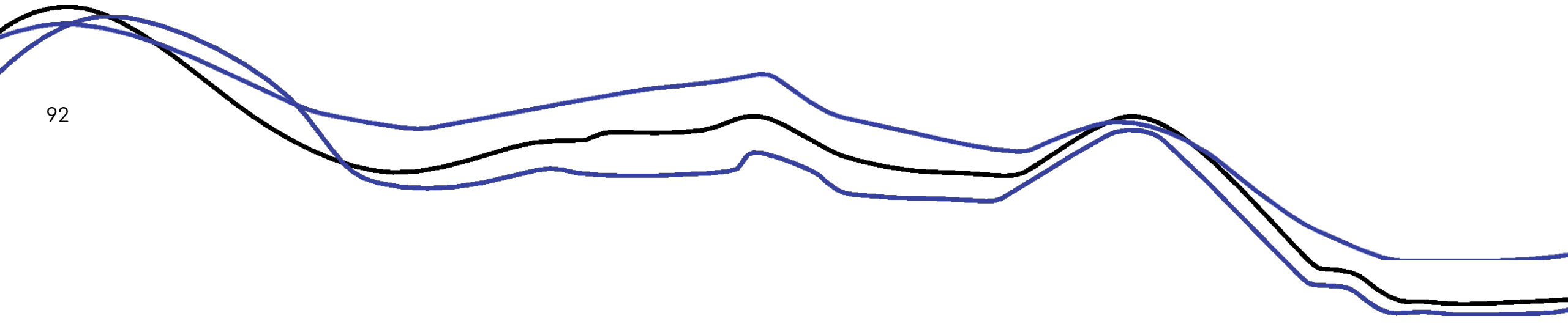
Data:

09

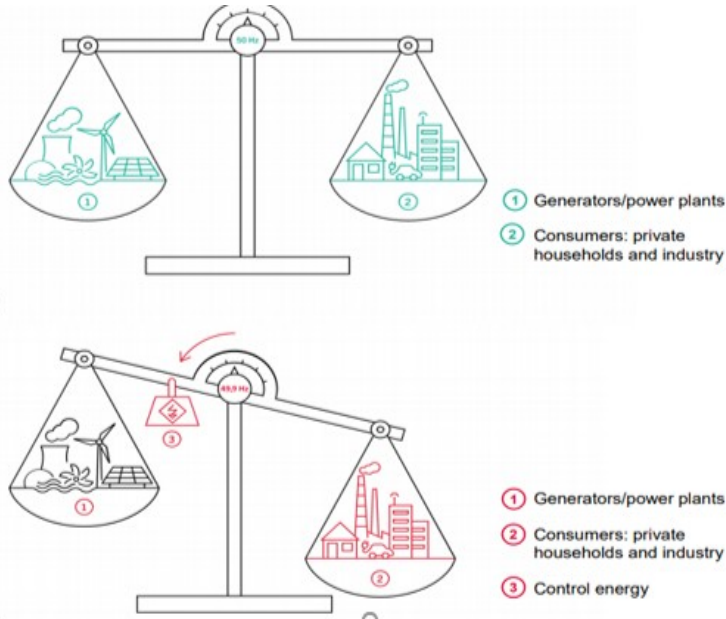
Anonymised and exemplary master data (4'000 Datasets)

1	Municipality I	E-Mail-Addr (Boolean)	Produkt / Tariftyp	Own PV?	HT Consumption (2020, kWh)	NT Consumption (2020, kWh)	Total Consumption (2020, kWh)	Payment-Type	Invoice-Type	Contacts Customer Service	Bonity
2	53	ja	AEW classic		939	1138	2078	Einzahlungsschein	physischer Postversand	10	1413
3	53	ja	AEW classic naturstrom		1085	765	1850	Einzahlungsschein	physischer Postversand	3	1061
4	4	nein	AEW classic naturstrom		13546	16334	29879	Einzahlungsschein	physischer Postversand	2	890
5	18	ja	AEW classic naturstrom		673	1305	1977	Einzahlungsschein	physischer Postversand	17	850
6	2	nein	AEW classic naturstrom		462	633	1095	Einzahlungsschein	physischer Postversand	6	725
7	53	ja	AEW classic		1769	2229	3997	Einzahlungsschein	physischer Postversand	2	597

92



Trends in Tertiary Energy Prices



Primary control:
0.5 min. after outage

- **Automatically** generated within seconds by the generators
- Rapid response due to frequency measurement in the power plants
- **Across Europe**



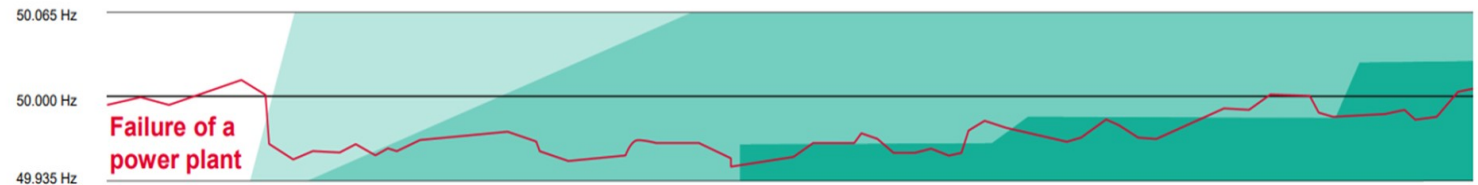
Secondary control:
5 min. after outage

- **Automatically** activated by the central load frequency controller at Swissgrid
- Measurements taken on Switzerland's cross-border lines
- **Across Switzerland**



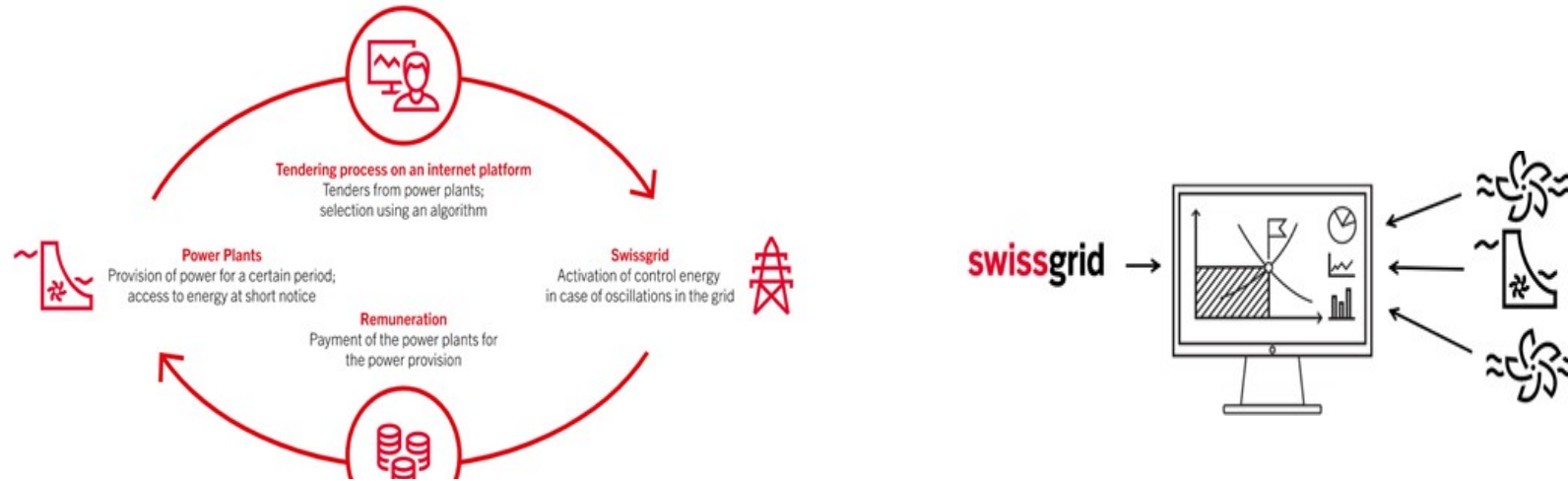
Tertiary control:
15 min. after outage

- **Activated by the operator**
- In case of larger and longer deviations
- Contracts with **individual** international providers



- ☐ In the event of an imbalance between production and consumption, Swissgrid draws on control energy
- ☐ This is a reserve that power plants keep available on Swissgrid's behalf and which it can access at short notice.

Trends in Tertiary Energy Prices 10

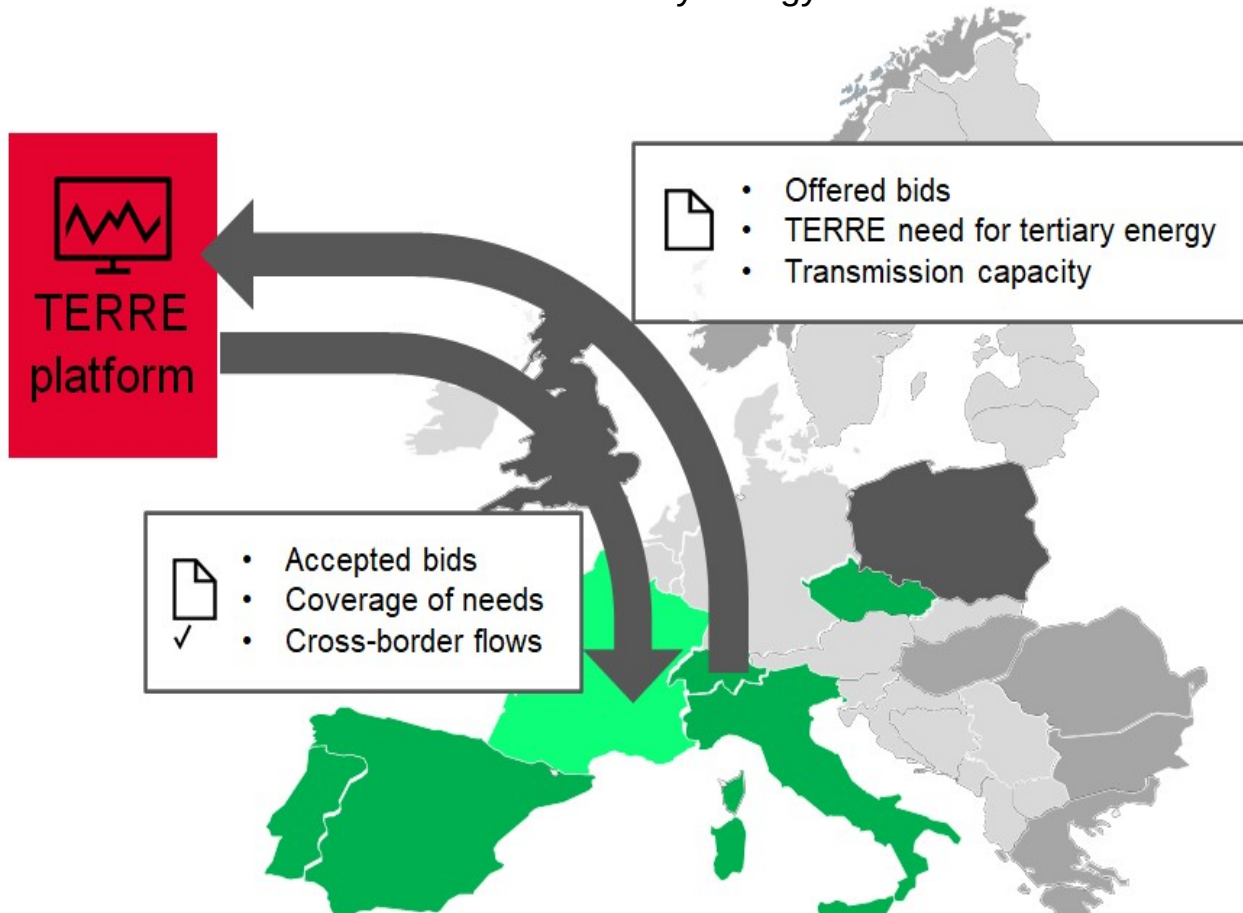


- ☐ Swissgrid procures the control energy on an internet platform using tenders. • The power plants offer a certain power at a certain price. • The best offers are selected using according to the merit order
- ☐ If fluctuations occur in the grid, the control energy is automatically or manually activated by the Swissgrid control room. • The power plants receive additional compensation for requests for control energy (secondary and tertiary)

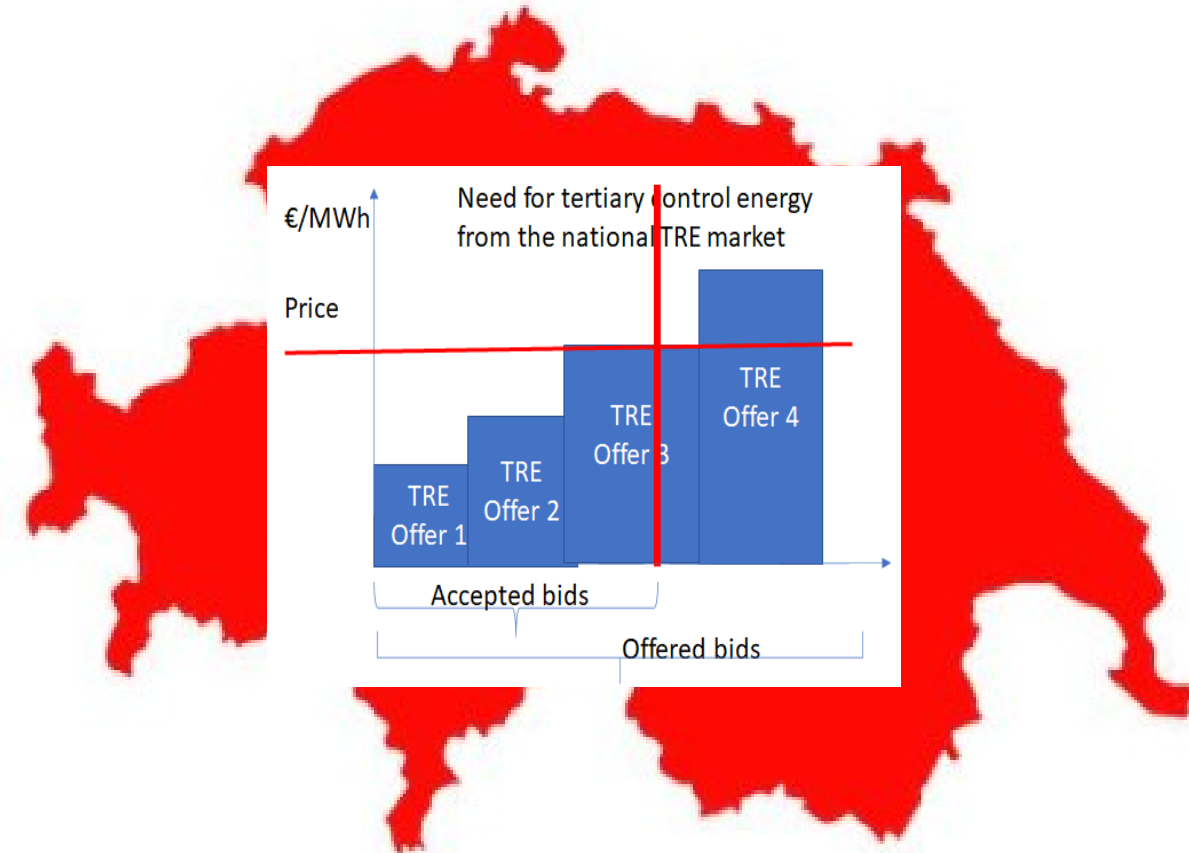
Trends in Tertiary Energy Prices 10

Swissgrid splits the total need for tertiary energy need between international and national markets

TERRE international market for tertiary energy



TRE national market



Trends in Tertiary Energy Prices¹⁰

Your task!

- ☐ Which factors have a major influence on TRE energy prices and subsequently cost of TRE activations in Switzerland? Extract patterns and trends in TRE bidding energy prices based on historical data.
- ☐ Investigate the impact of TERRE introduction in October 2020 on the overall TRE Product (Activation volumes/prices)

Input data

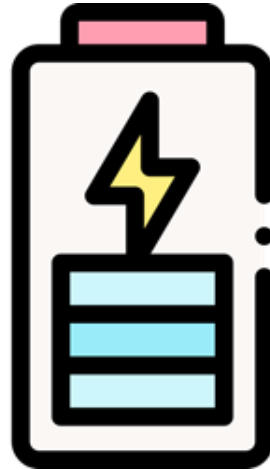
- ☐ Historical TRE/TERRE merit order lists with prices, volumes, activations
- ☐ TRE/TERRE control energy needs
- ☐ Historical data on hydro production, intraday prices, demand, CH export/imports

Added value

- ☐ Understand the influencing factors on TRE activations/ prices in order to help Swissgrid enhancing the development of its products

Prequalification of resources with Limited Energy Reservoir (LER)

11



- ☐ To participate in the ancillary services markets, providers must be prequalified.
- ☐ Today's prequalification test focuses on traditional power plants.
- ☐ More and more LER resources (e.g., batteries) provide ancillary services.
- ☐ Revise prequalification (for primary and possibly secondary frequency control).

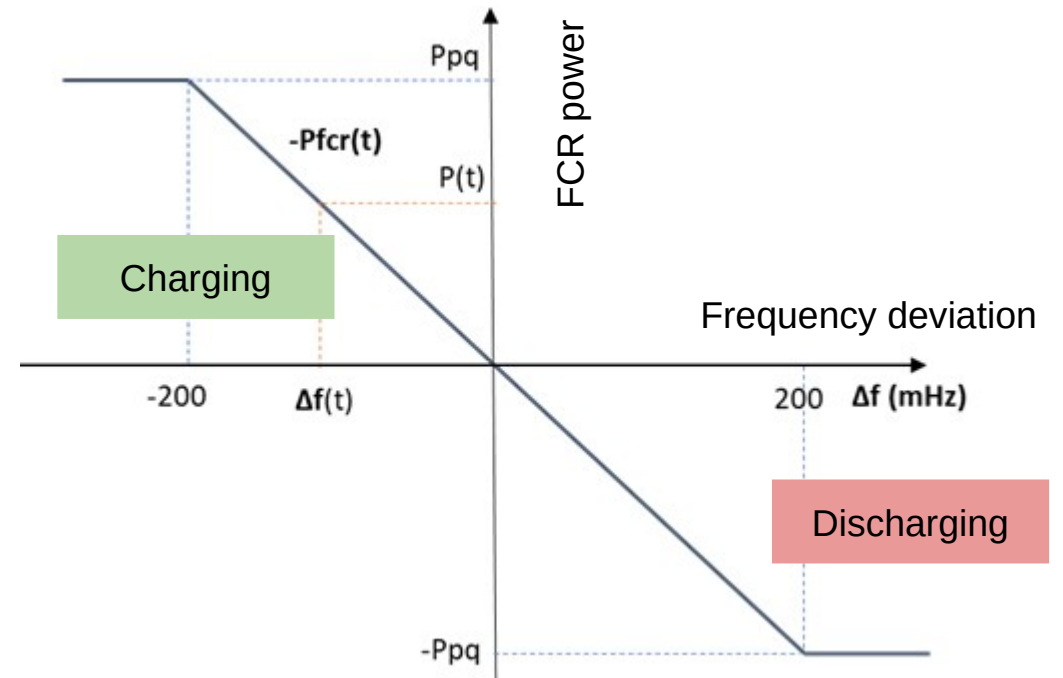
Prequalification of resources with Limited Energy Reservoir (LER)

11

Primary control: Frequency Containment Reserve (FCR)

- ☐ Each resource measures the frequency deviation locally and adjusts its control power proportionally.
- ☐ The power grid can be either in a “normal state” or an “alert state” (for severe frequency deviation).
- ☐ Enough stored energy must be available to continuously provide FCR in the normal state and for at least 15 minutes in the alert state.

Droop control curve for FCR (Δf to ΔP)

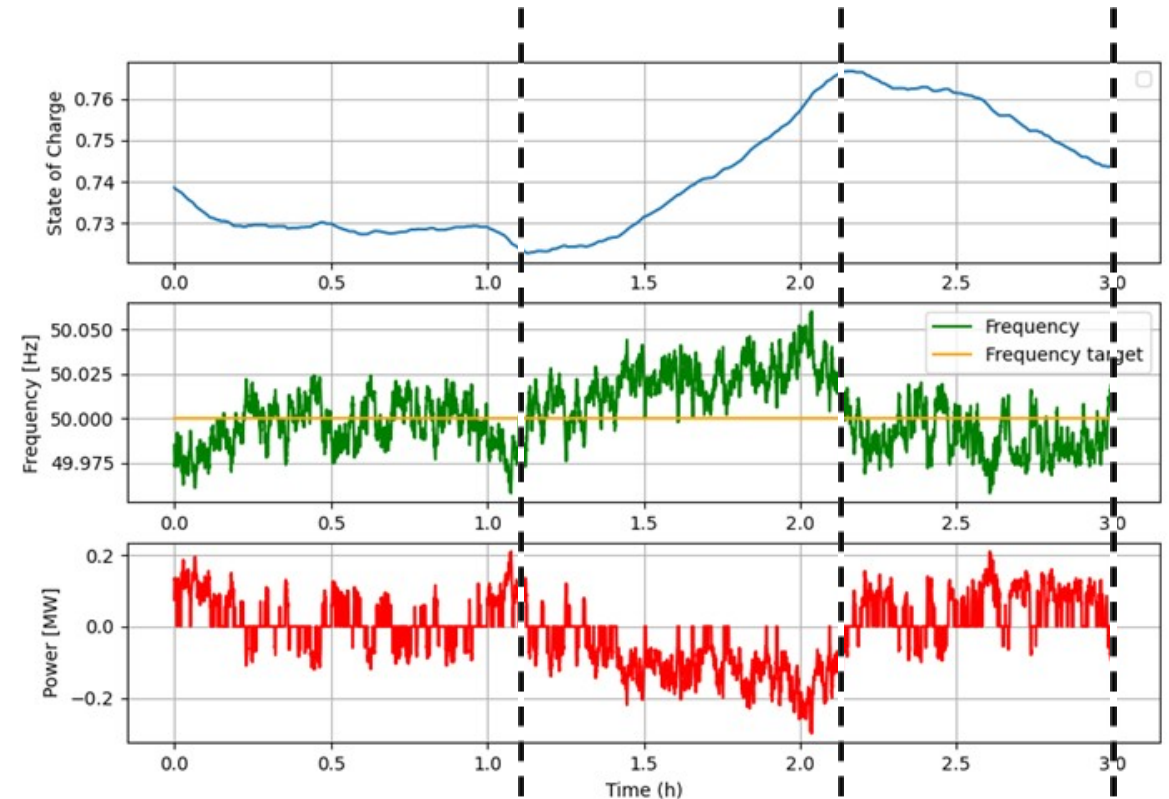


Prequalification of resources with Limited Energy Reservoir (LER)

11

FCR and LER resources

- ☐ Due to energy losses and frequency biases, storage depletion is a risk.
- ☐ Need for a State of Charge (SoC) management strategy (controlled charging or discharging).
- ☐ The SoC management can be activated only with an appropriate lead time (30 min).
- ☐ The energy-to-power ratio and the SoC management strategy affect FCR performance.



- | | |
|--|---|
| ☐ Frequency > 50 Hz | ☐ Frequency < 50 Hz |
| ☐ Battery charges ($P_{FCR} < 0$) | ☐ Battery discharges ($P_{FCR} > 0$) |
| ☐ SoC increases | ☐ SoC decreases |

Prequalification of resources with Limited Energy Reservoir (LER)

11

Objectives of this challenge

- ☐ Analyze the statistical properties of frequency deviations and derive patterns (also for the aFRR signal).
- ☐ Create a data set of representative historical and/or synthetic extracts of frequency deviations that are demanding for LER resources to follow, but yet realistic.
- ☐ Use the created data set as input in simulations to evaluate the performance of LER resources in FCR provision under different conditions (simulation model is provided).

Prequalification of resources with Limited Energy Reservoir (LER)

11

Input data

- ☐ Historical measurements of frequency deviation.
- ☐ Historical measurement of aFRR control signal.

Added value

- ☐ Using the created data set, Swissgrid can check if a LER resource with fixed technical characteristics (e.g., energy-to-power ratio and SoC management strategy) can provide FCR or aFRR under various conditions while respecting the requirements.
- ☐ Improved prequalification process for LER resources.

Prequalification of resources with Limited Energy Reservoir (LER)

10+11

Why you should participate in Swissgrid's challenges

- ☐ Build up knowledge and experience in ancillary services and balancing.
- ☐ Try out and further develop your coding and data analysis skills using real data.
- ☐ Use your creativity to help answering important questions for the industry.



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- ☐ More information and documentation will become available to the participants of these challenges.
- ☐ Note: Participants in Swissgrid's challenges will need to sign an NDA.





Climate-Neutral Cities

St.Gallen Example

12

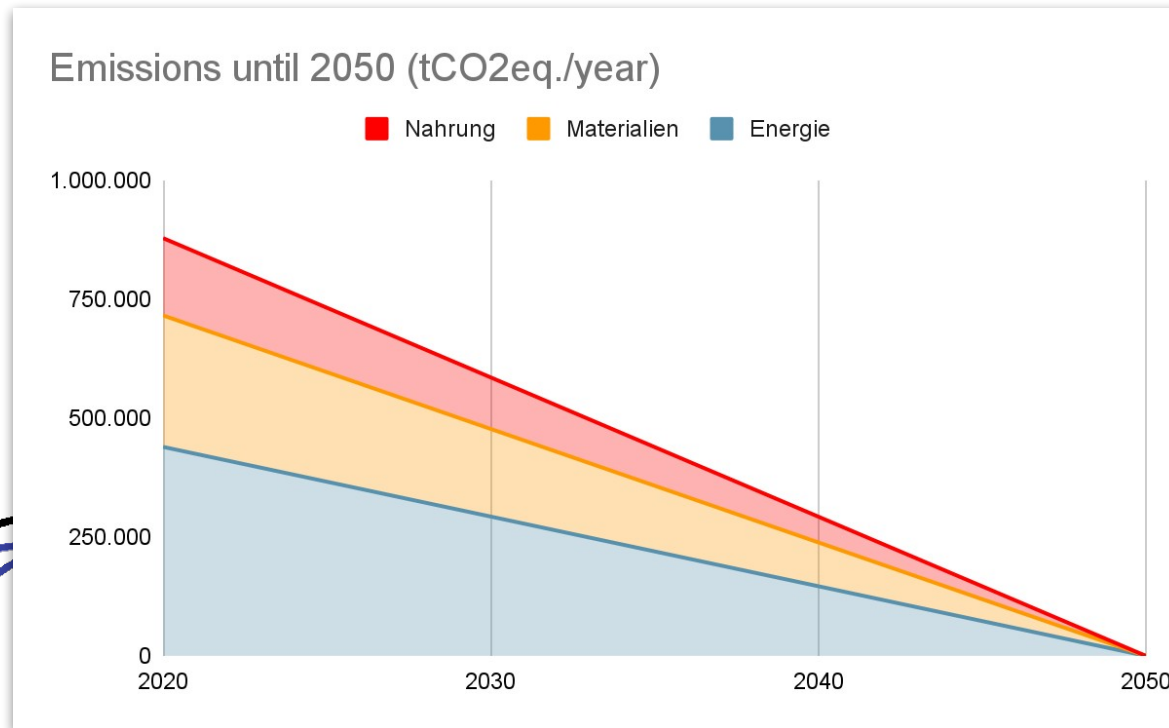


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Climate-Neutral Cities

St.Gallen Example

12



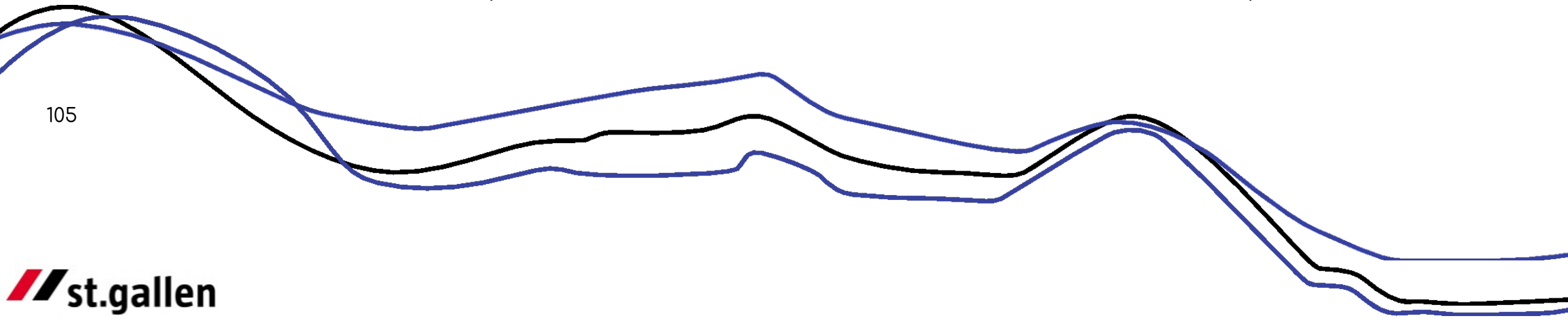
Climate-Neutral Cities

St.Gallen Example

12

Challenge:

1. Identify main emission reduction levers (sectors, stakeholders)
1. Empower influential stakeholders thanks to adapted information



X-Achse Kategorie

Max. Punktzahl Alles anzeigen

Aufstellung Serien

Stapel Kein Stapel

Baumkarte

Y-Achse Summe

Tonnen CO2-eq./a Stadt St.Gallen

EMPA MATCH Synthese 2020 Konsum (Tonnen & CO2)

Energy Hackdays

Tabelle
Analysen
Exporte
API

EMPA MATCH Synthese 2020 Entsorgungswege (Tonnen & CO2)

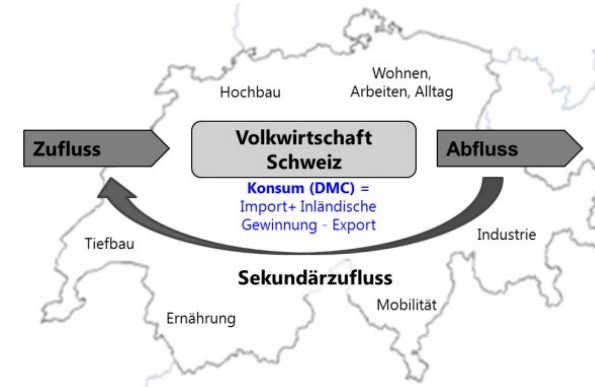
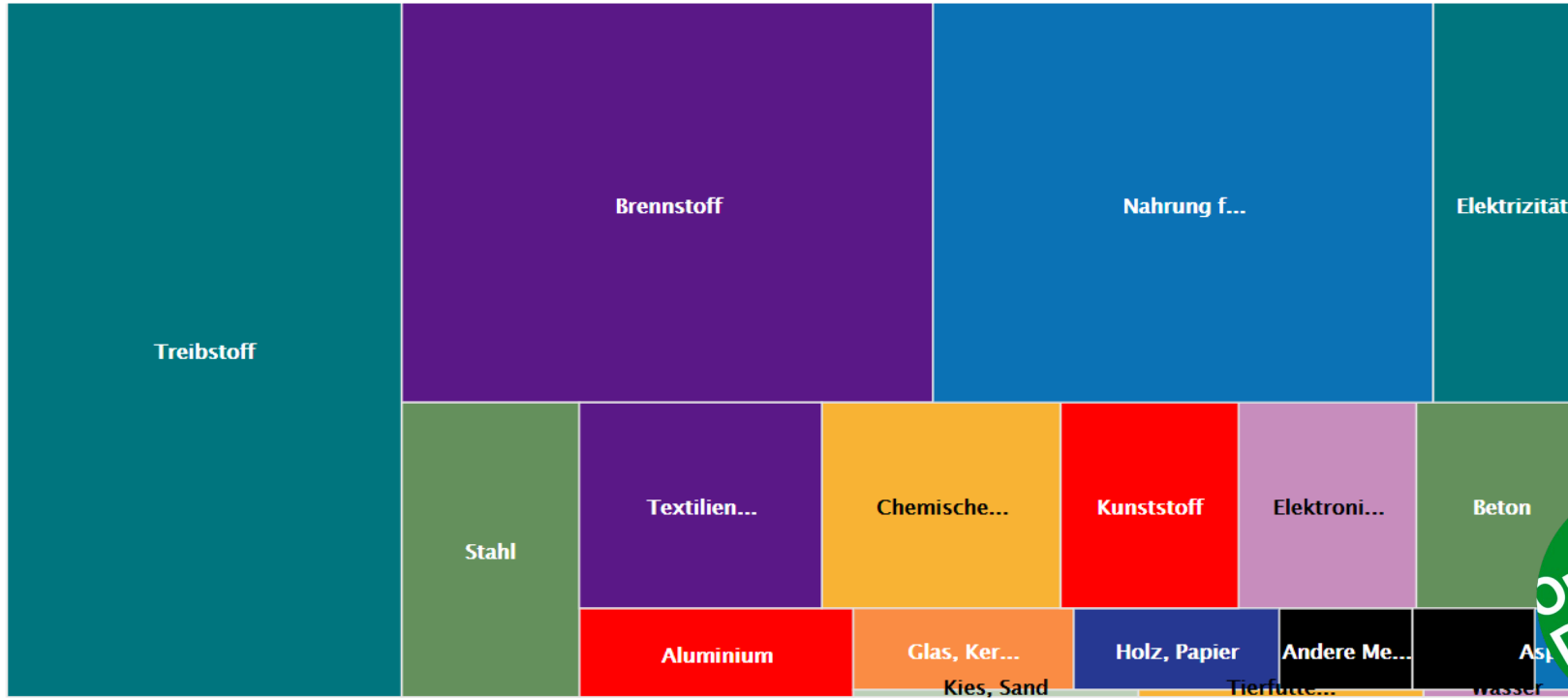
Energy Hackdays

Tabelle
Analysen
Exporte
API

Energieplan Gebäude 2020 Stadt St.Gallen [Anonymisiert]

Energy Hackdays

Tabelle
Analysen
Exporte
API



Materials Science & Technology

12

10.898 Dateneinträge

Energieplan Gebäude 2020 Stadt St.Gallen [Anonymisiert]

Information Tabelle **Analysen** Exporte API

Aktive Filter [Alles löschen](#)

RW_Bedarfstyp Wohnen
RW_Bedarfstyp Arbeiten
RW_Bedarfstyp reduzierte_RT
RW_Bedarfstyp Pflege
RW_Bedarfstyp Sport

Filter

Suche nach Einträgen ...

Baujahr Kategorie

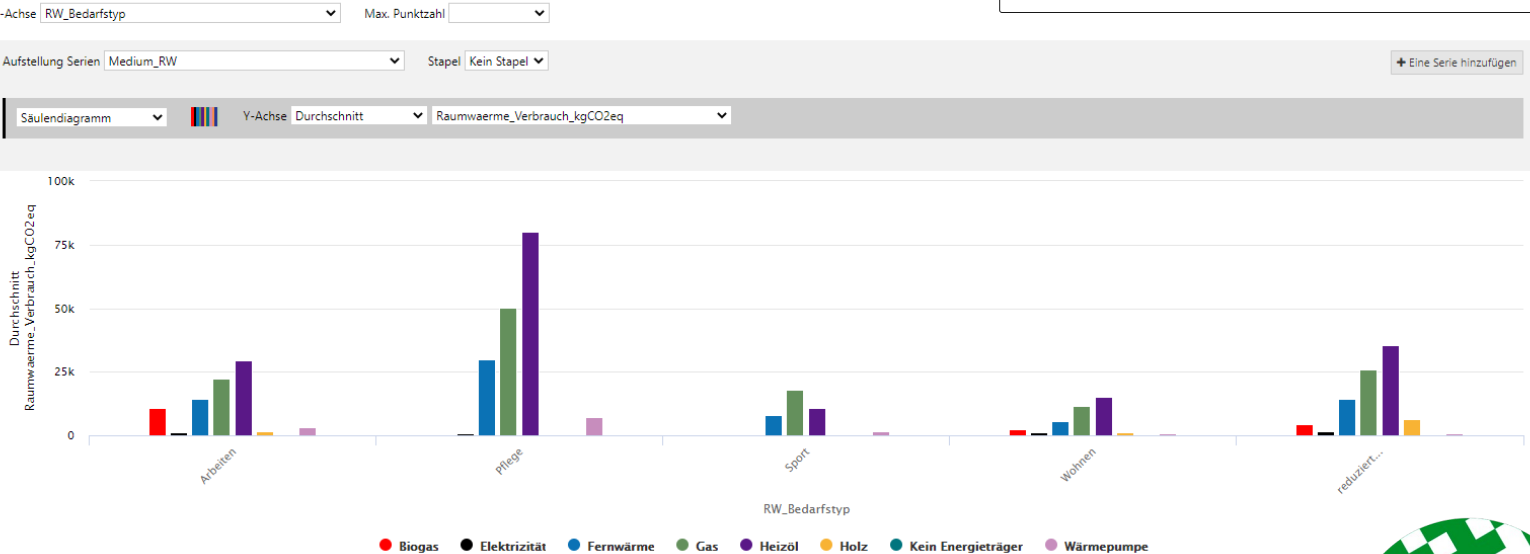
1918 4.064
1961-1970 1.192
1971-1980 1.073
1951-1960 958
1981-1990 802
1991-2000 642
> Mehr

RW_Bedarfstyp

Wohnen 9.037
unbeheizt 3.386
Arbeiten 1.501
reduzierte_RT 234
Pflege 71
Sport 55

Nutzung_GWR

MFH 5.182
EFH 3.228
Büro 808



Teilen Einbetten Widget

https://daten.stadt.sg.ch/explore/embed/dataset/energieplan-gebäude-2020-stadt-stgallen-anonymisiert/analyze/?disjunctive.baujahr_kategorie&disjunctive.rw_bedarfstyp&disjunctive.nutzung_gwr&disjunctive.raumw_verbrauch_kgco2eq

ods EMPA MATCH Synthese 2020 Konsum (Tonnen & CO2)

Energy Hackdays

Tabelle
Analysen
Exporte
API

ods EMPA MATCH Synthese 2020 Entsorgungswege (Tonnen & CO2)

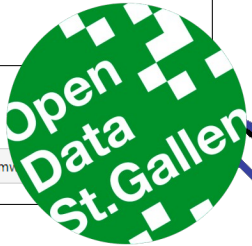
Energy Hackdays

Tabelle
Analysen
Exporte
API

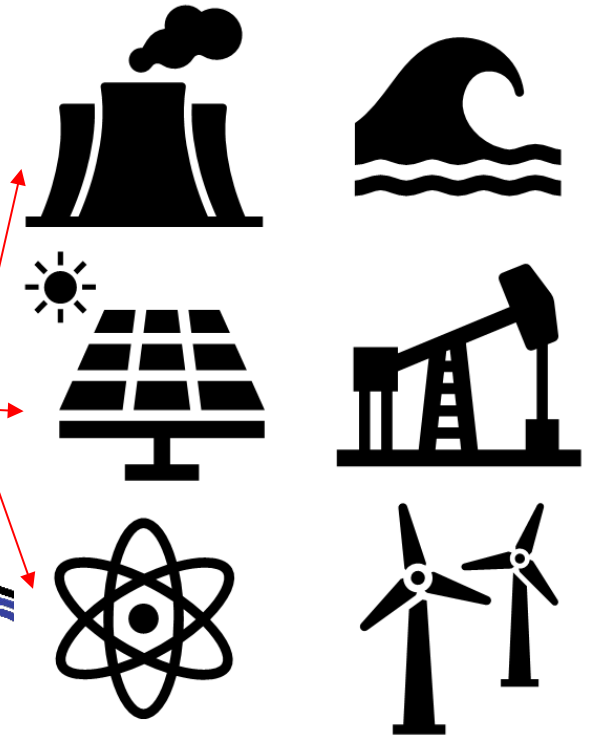
ods Energieplan Gebäude 2020 Stadt St.Gallen [Anonymisiert]

Energy Hackdays

Tabelle
Analysen
Exporte
API



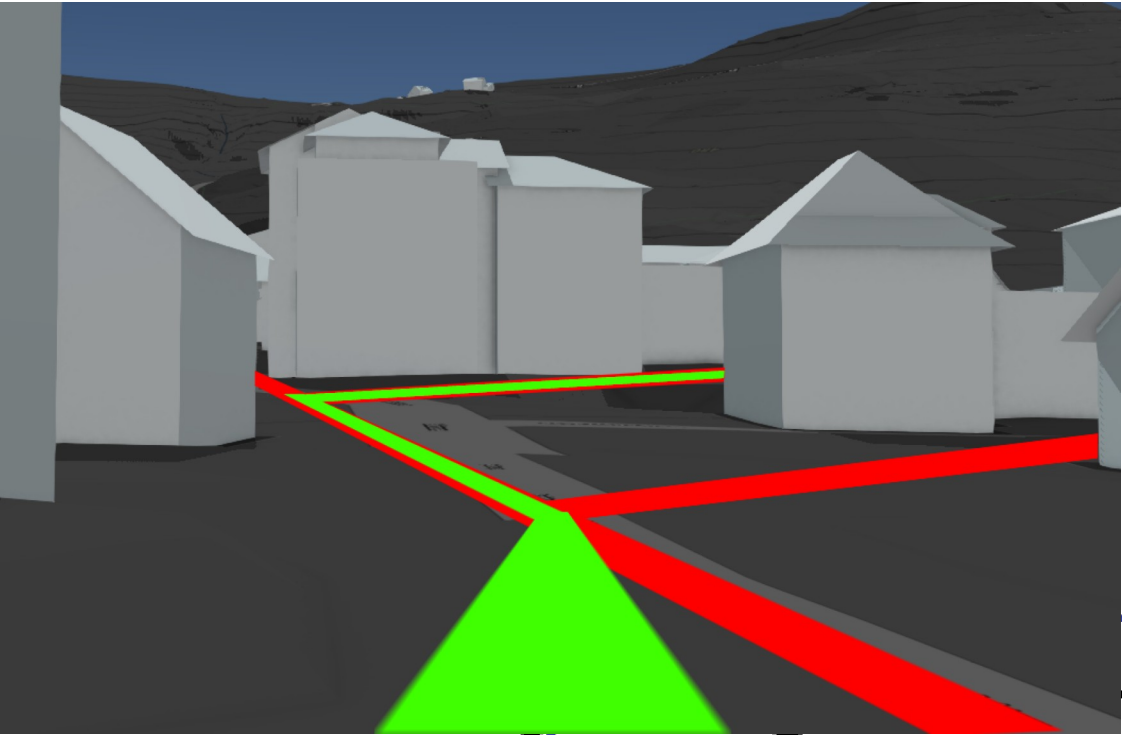
Where does my electricity come from?



Challenge:

Development of a web application that:

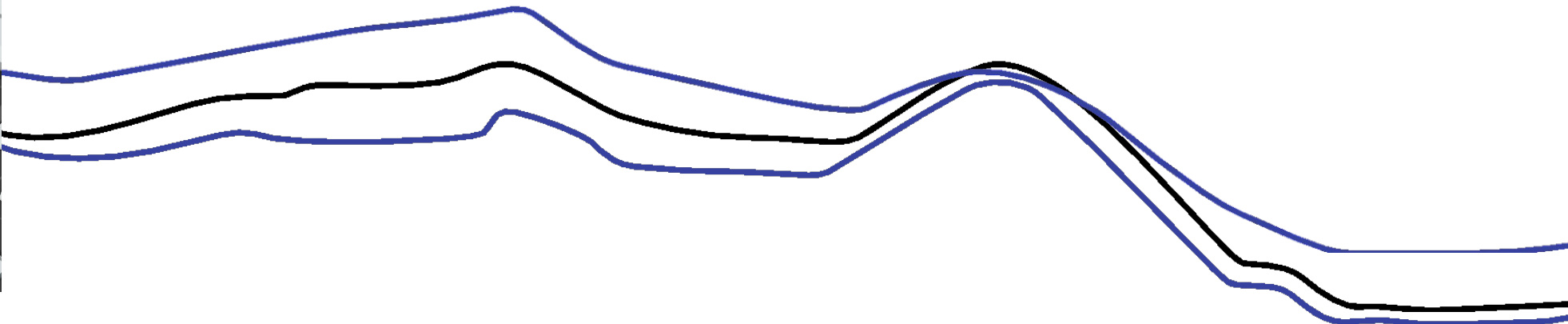
- takes an address of a customer and an electricity mix as input
- traces the path of the electricity back through the local network from the house connection to the end of the local network
- visualizes this “path of the electricity” in an attractive manner (e.g highlight, moving camera, 3D scene, 2D map... creativity is key)
- finally displays a symbolic representation of the chosen electricity mix



Data:



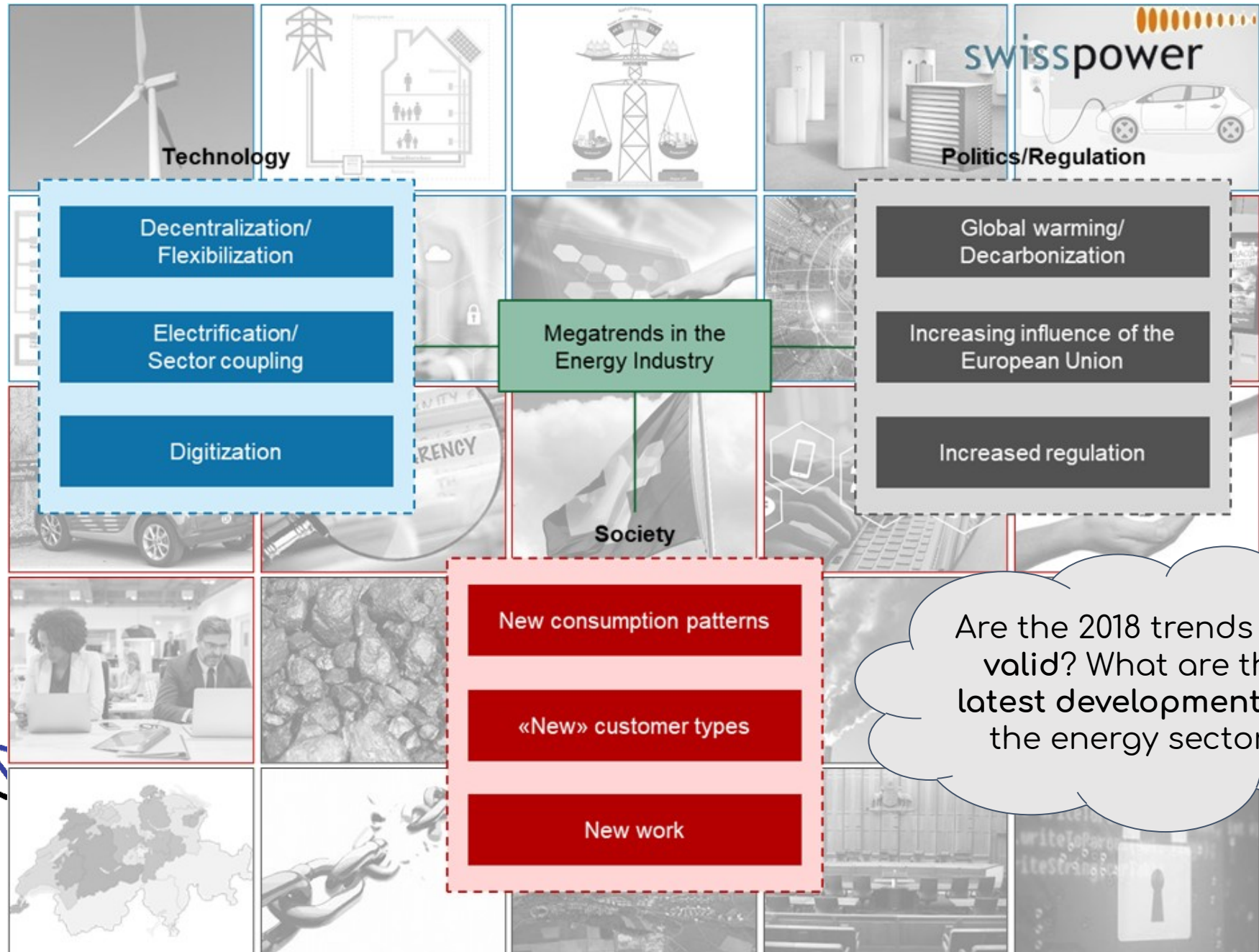
- Electricity network data of Neuenhof (provided by Regionalwerke AG Baden)
- Table with “electricity mix” possibilities
- Open Data:
 - 3D buildings data (swissBUILDINGS3D)
 - Cadastral data (“Amtliche Vermessung”) Neuenhof
 - ...



Trend Scouting for the Energy Industry

14





14

Are the 2018 trends still valid? What are the latest developments in the energy sector?

Trend Scouting for the Energy Industry

14



Challenge

- Verification of the 2018 trends (deductive)
- Identification of the latest developments (inductive) by using advanced AI- and statistics-based information and text analysis methods



Possible methods

- Word Count
- Text Mining
- Topic Modelling
- Sentiment Analysis
- etc. (stay curious)

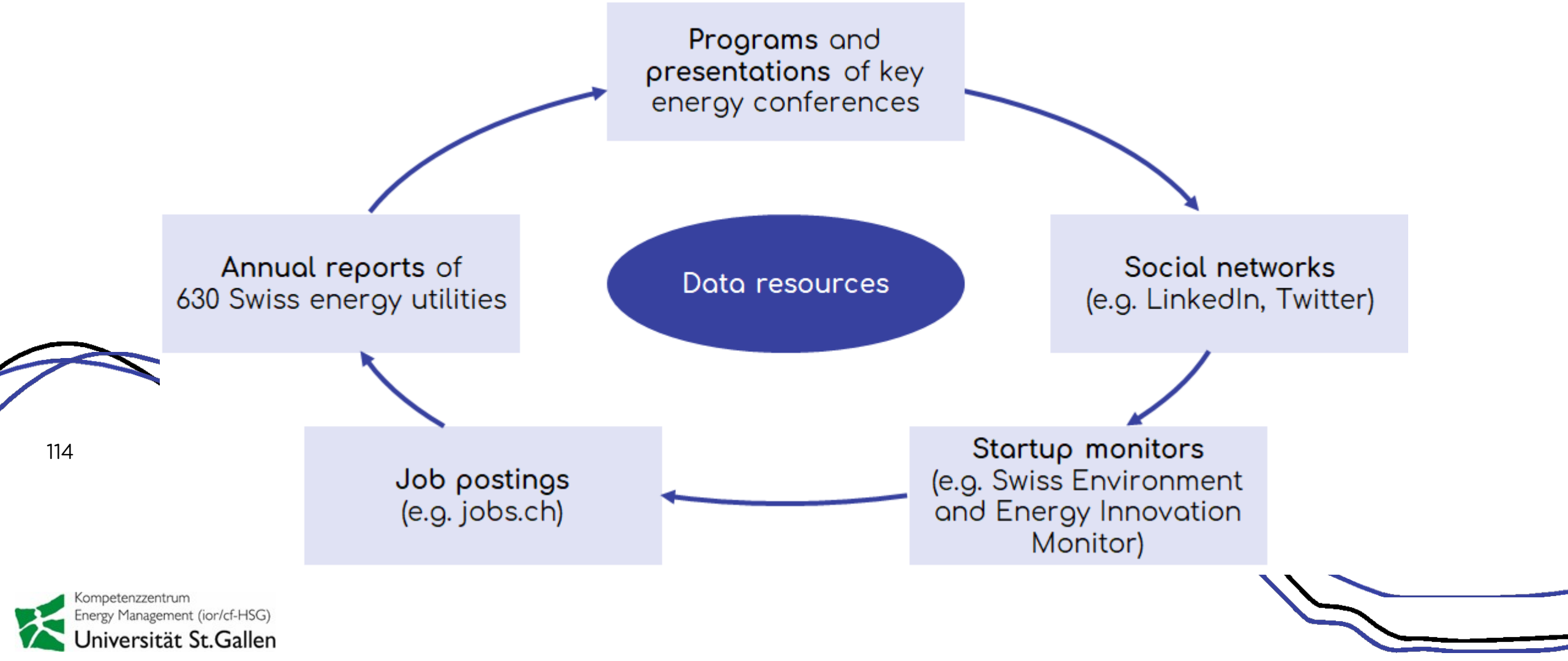


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Trend Scouting for the Energy Industry

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Data



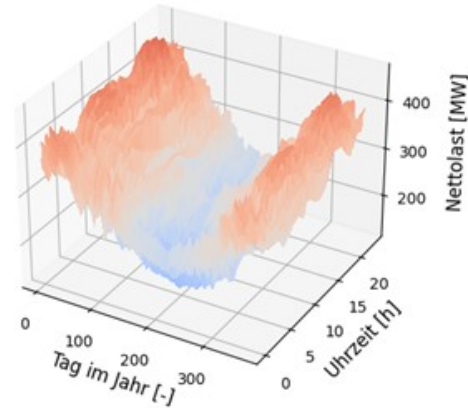


Electricity “Heartbeat” 2035 in the Canton of Zurich

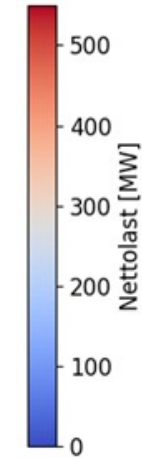
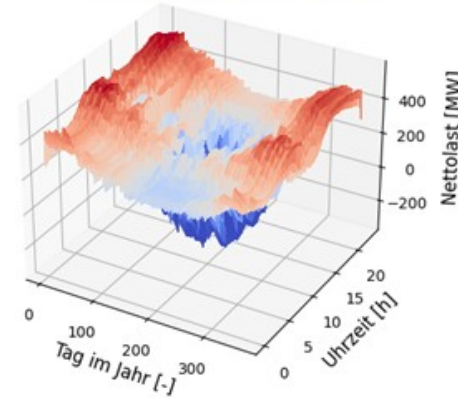
15



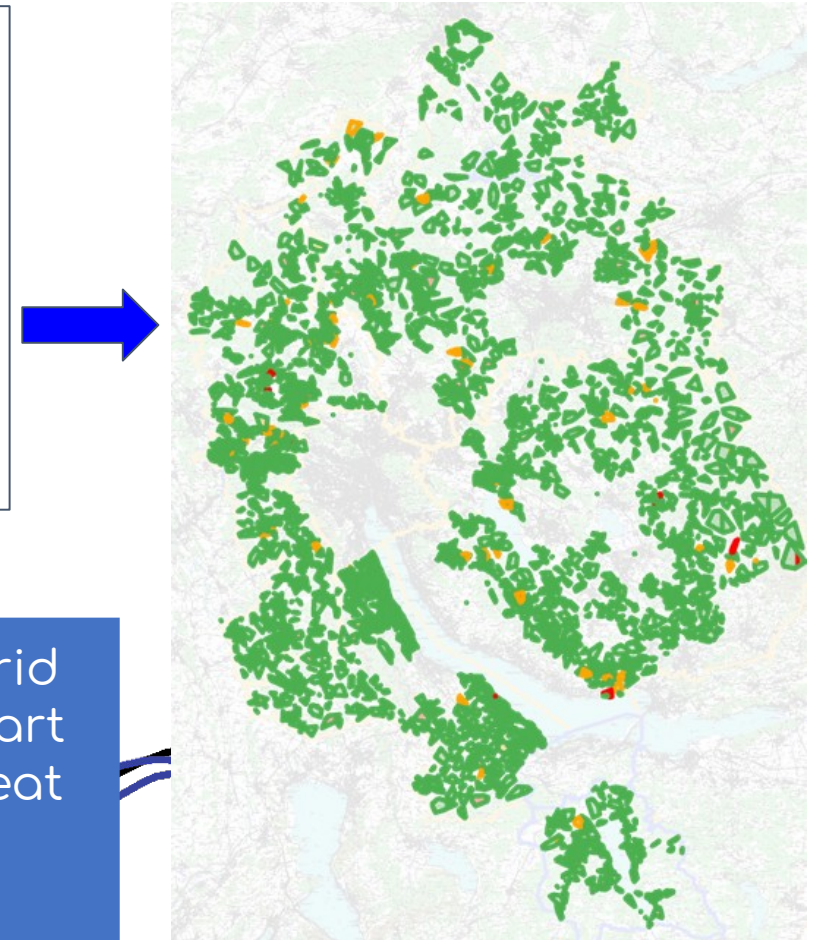
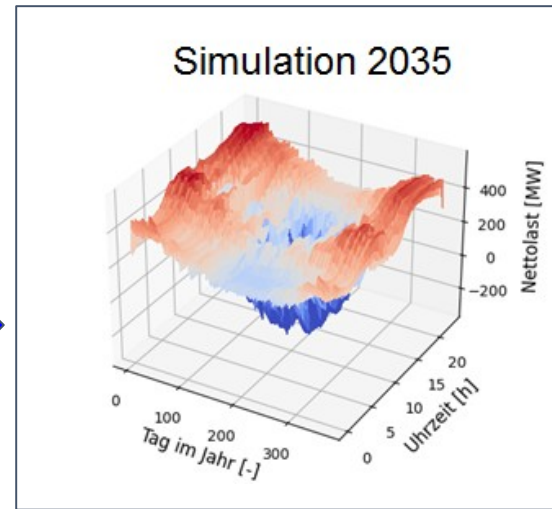
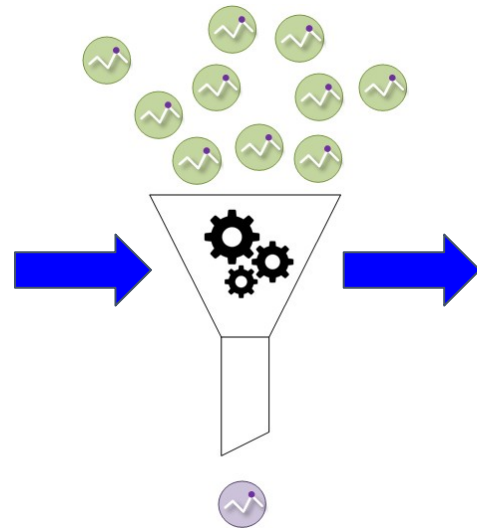
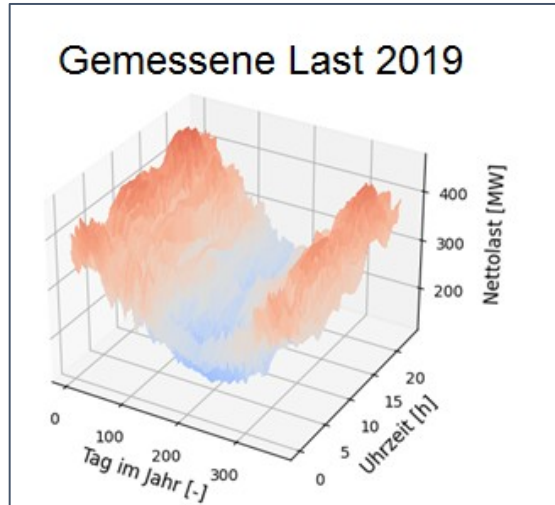
Gemessene Last 2019



Simulation 2035



What do changes in the way and in the intensity electricity is consumed mean for our grid? **15**



Comprehensive load-flow simulations of the whole low-voltage grid with synthetically generated profiles (Machine Learning with Smart Meter data) and modelled new loads (E-Mobility, PV, batteries, heat pumps) based on Energiestrategie 2050 scenarios

→ A lot of data are waiting for you to visualize

Challenge:

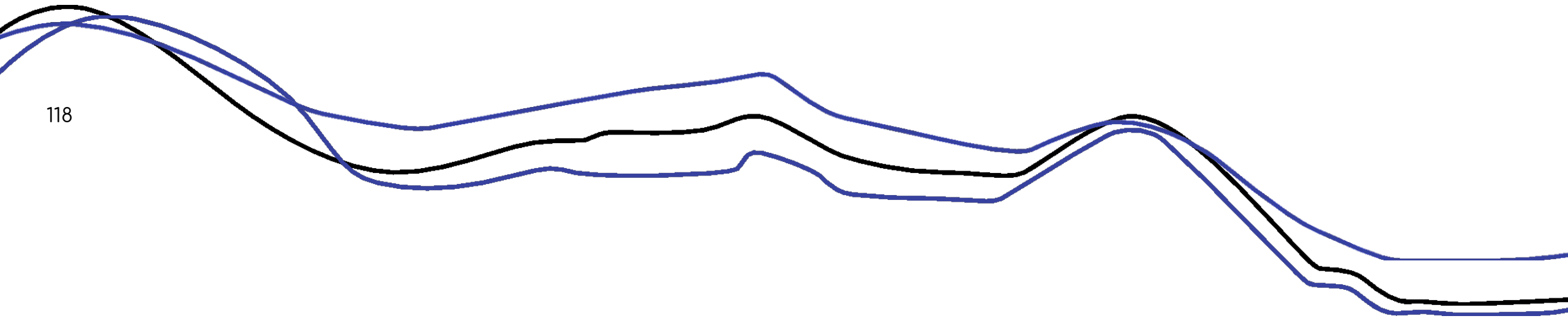
- Create geospatial visualizations in order to understand where and when electricity is produced and consumed in the grid region of EKZ
- Be creative!!!



Source: <https://www.visualcapitalist.com/population-pulse-manhattan/>

Data:

- 100% synthetic – but realistic – consumption and production data for 2035 in transformer granularity for most of the transformers in our grid region - about 1'500 transformers
- Geolocation data (coordinates) of transformers

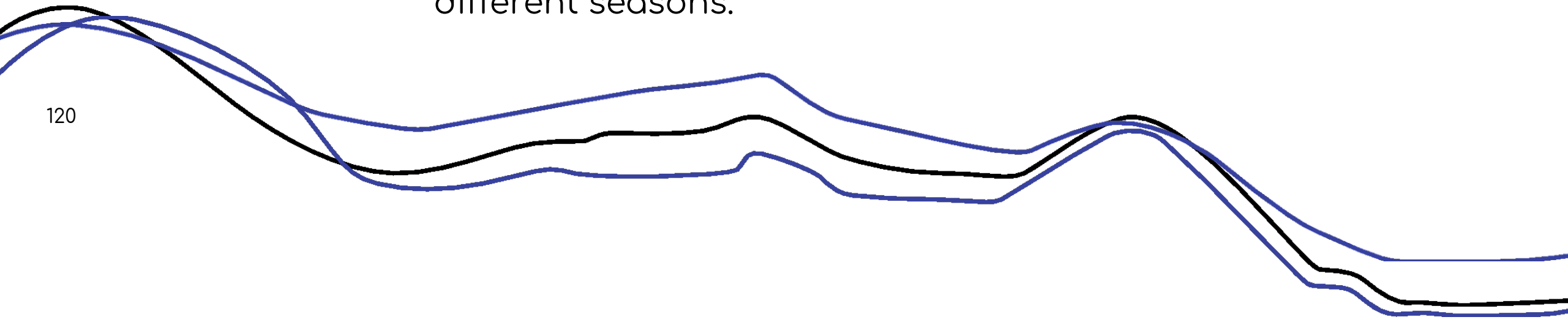


“Green” Charging E-Mobility¹⁶



Challenge:

- Analyze what is the environmental impact of charging electric cars and compare it with the one from conventional cars
- Develop a logic in order to charge electric cars as “green” as possible during the day, taking into account the environmental impact of electricity with respect to the time of the day and the different seasons.



Could we offer a “green charging mode”?

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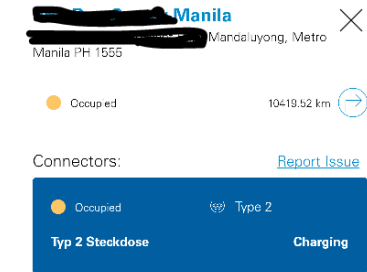
EKZ-Lademanagement



- “live” since Mai ‘21
- logic can be adapted by EKZ according to market needs
- compatible with lots of charging stations (OCPP)



Emobility App



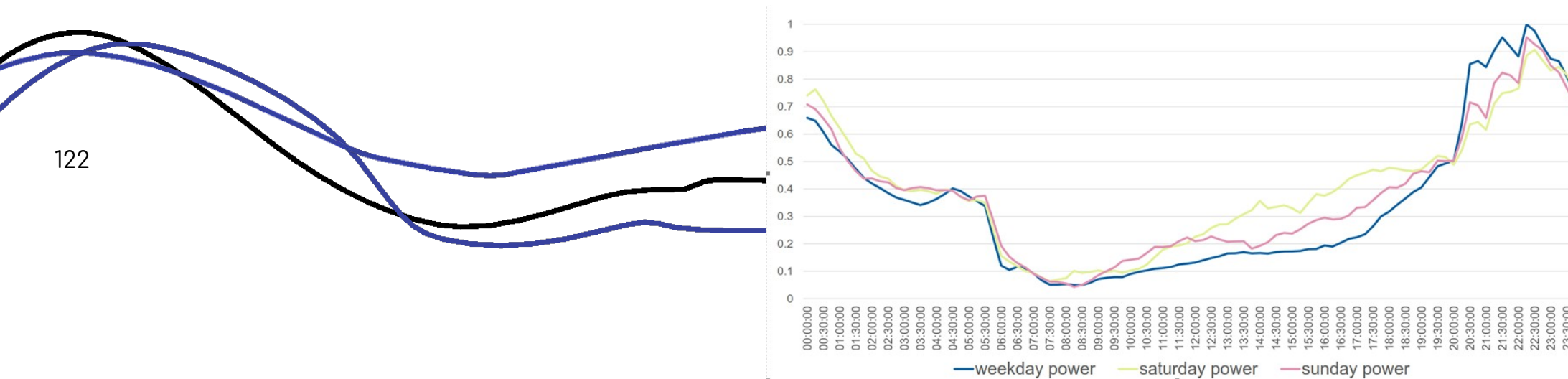
- release in late ‘21
- offer “green mode”
- show CO2 intensity of charging behavior (on public AND private chargers)

Data:

- *CO₂ specific emissions of electricity consumption in Switzerland*



- *Charging station electricity consumption profiles on the connector level!*



**Empower citizens to use their own energy data.
Using the smartmeter's local interface for visualization and automation**

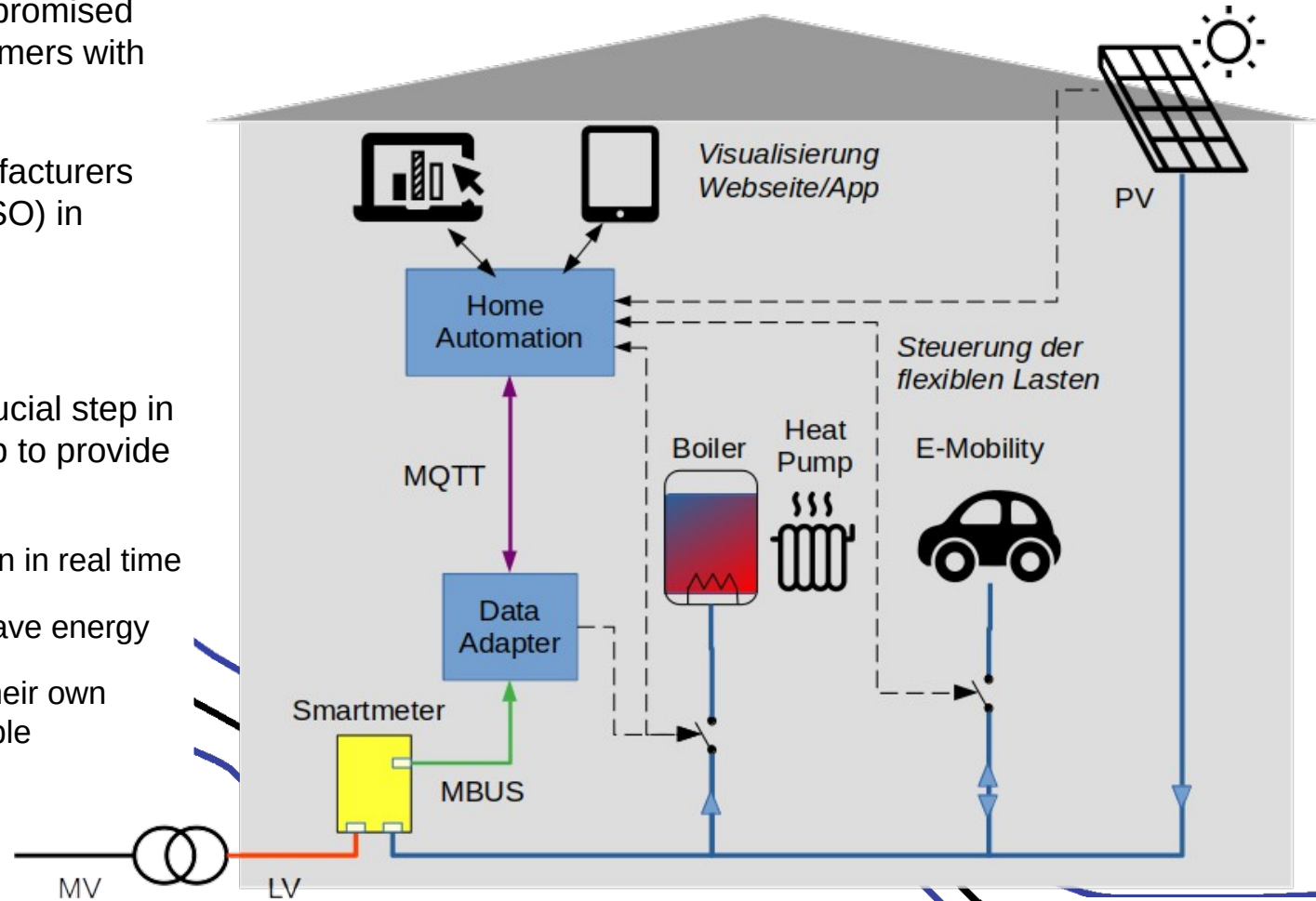
● **Intro**

- Smart Meters rollout in Switzerland hardly deliver the promised energy savings because they do not yet provide customers with easy access to their data by a local interface CII.

- Interfaces are not implemented uniformly by the manufacturers and are rolled out by distribution system operators (DSO) in different configurations.

● **Motivation**

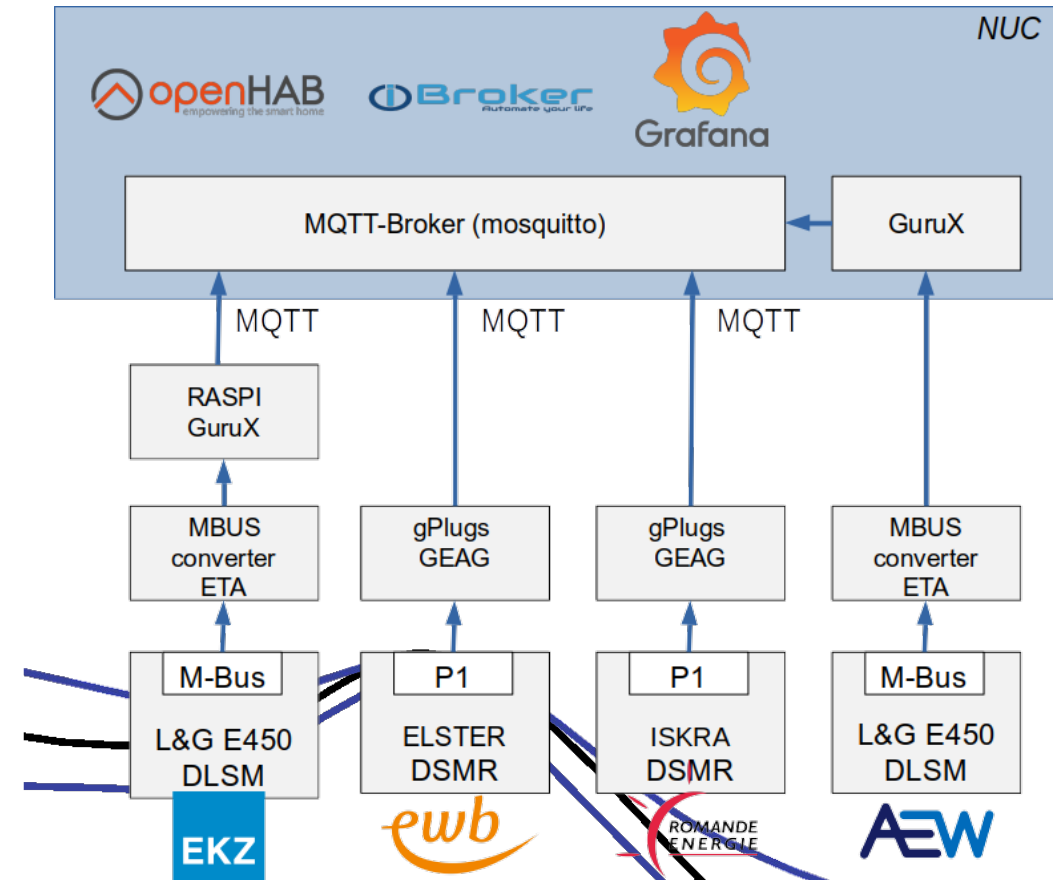
- The easy and free access of consumption data is a crucial step in the energy transition and CO2 reduction and shall help to provide the following contribution
 - give customers transparency about their consumption in real time
 - change customer behavior in a sustainable way to save energy
 - create innovations that help customers to optimize their own consumption with self-generation (PV) and controllable consumers (car charging station, heat pump)



**Empower citizens to use their own energy data.
Using the smartmeter's local interface for visualization and automation**

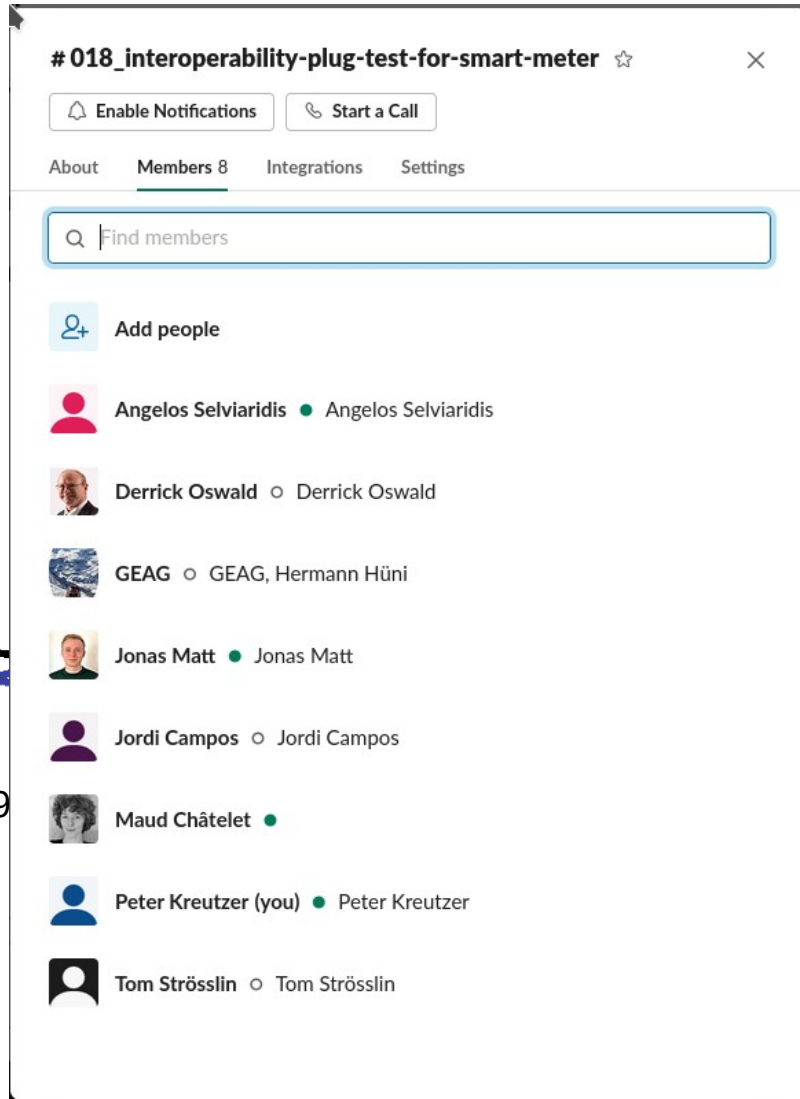
- **Idea**
- Reading of data from smart meter CII (DLMS, IDIS CII, DSRM-P1, MBUS), from different DSO (EKZ, AEW, EWB, Romande Energie)
- Harmonized MQTT profile
The MQTT topics should be standardized to provide interoperability between different smart meters and various applications.
- **Data**
- The data from the different meters are sent via MBUS or DSRM to an adapter which converts the data into MQTT. Different meters are provided by the DSO. The MQTT stream is then integrated into OpenHab and ioBroker.
- **Tasks**
- Setup of the different metering systems
- Conversion of MBUS-DLMS/COSEM data into MQTT using the open-source library from gurus.fi and Adaption of the DSRM-P1 Protocol to MQTT
- Integration of the smart meter data into ioBroker and OpenHab
- Documentation of the interoperable MQTT interface

Interoperability test setup



Empower citizens to use their own energy data.
Using the smartmeter's local interface for visualization and automation

All meters up and running !!!!



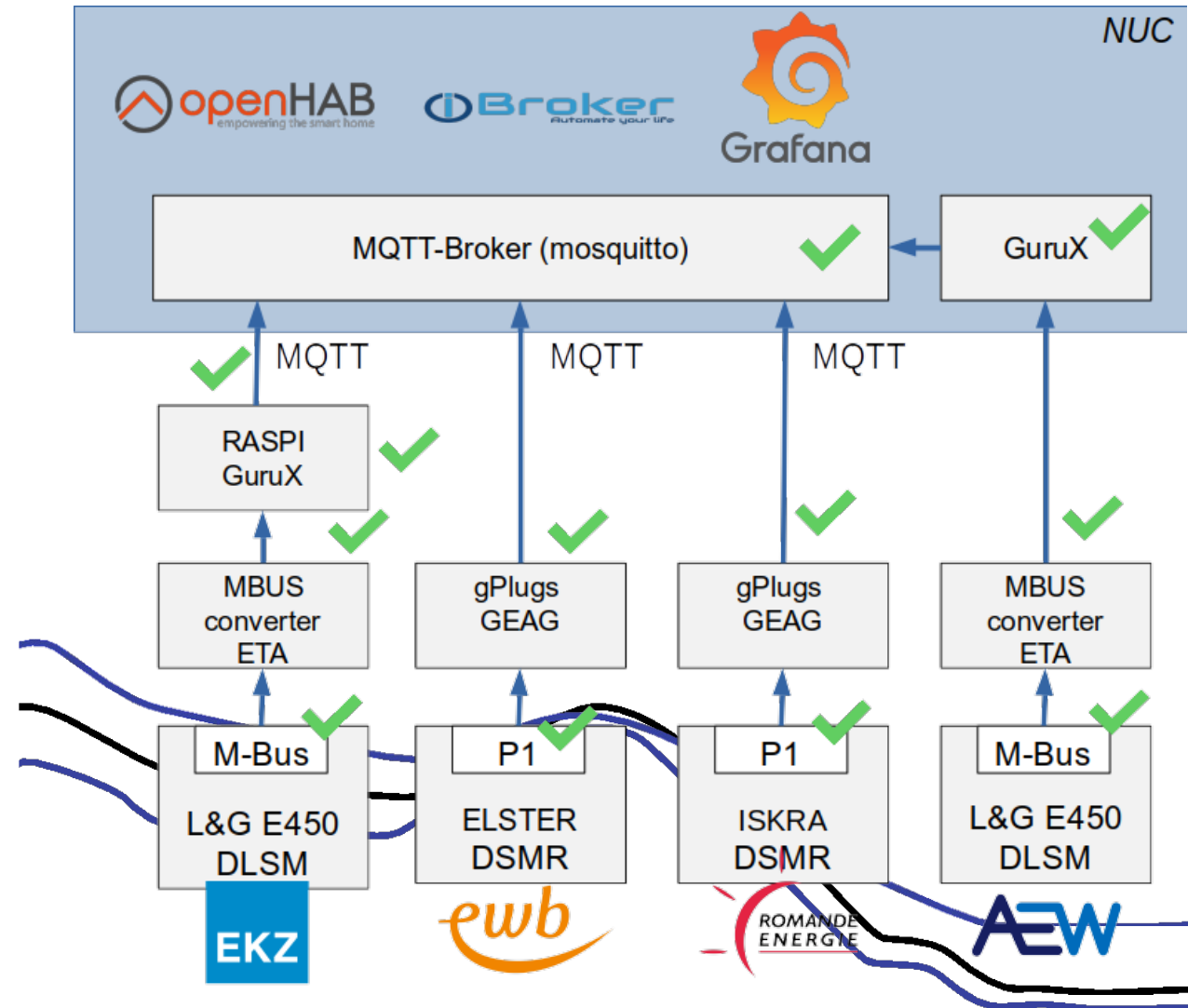
Empower citizens to use their own energy data.
Using the smartmeter's local interface for visualization and automation

Interoperability test setup

All data are flowing from the smart meters up to the central MQTT broker

The EKZ open source library is now able to read data from different smart meters !

MQTT transformation adapter implemented



Empower citizens to use their own energy data.
Using the smartmeter's local interface for visualization and automation

Central broker shows all data from smart meter

different MQTT messages:

EKZ: smartmeter/LGZ1030655933512/ACTIVE_POWER_P {"value": 0.0, "timestamp": 1629055611}

Romande Energie: tele/gPlug11/SENSOR {"Time":"2021-09-24T17:56:38","z":{"Pi":0}}

AEW: smartmeter/12345/ACTIVE_POWER_P {"value": 71.0, "timestamp": 1632499152}

EWB: tele/gPlug10/SENSOR {"Time":"2021-09-24T17:03:45","z":{"Pi":0}}

Visualization to be done as next step – today

Tomorrow we can start analyzing the common profile and start implementing it into the setup



ReFi - Regenerative Finance

Tokenisation of Energy and Fractional Ownership of Digital Assets provide new possibilities for financing renewable energy projects



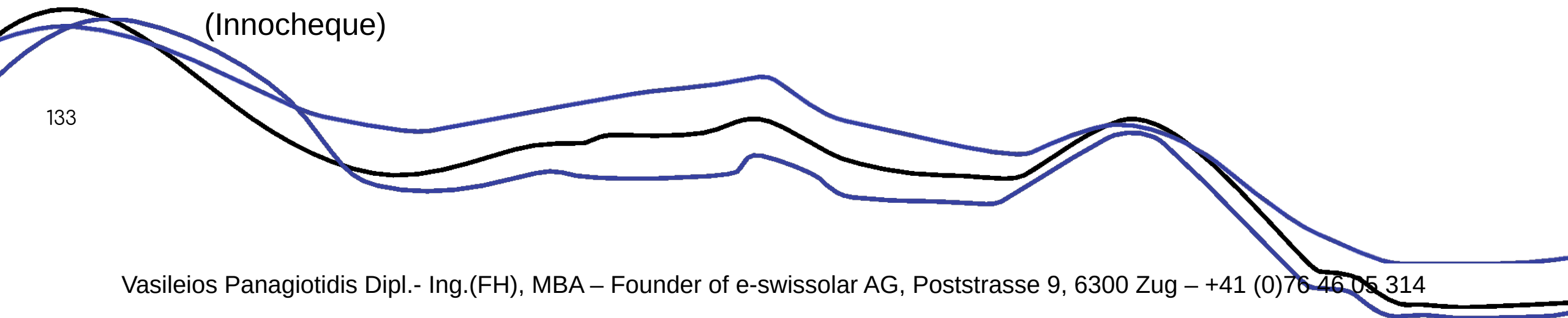
Mission

- Mobilise funding for renewable energy projects
- Fund the (un)bankable
- Increase liquidity of renewable energy investments

Introduction

- e-swissolar AG is working at the intersection of renewable energies and blockchain technology
- Recently initiated ReFi a project that would like to implement the concept of fractional ownership and tokenisation of energy for creating a framework and platform for mobilising funding for PV-projects
- Under the supervision of Prof. Dr. Christoph Imboden HSLU is conducting a preliminary study (Innocheque)

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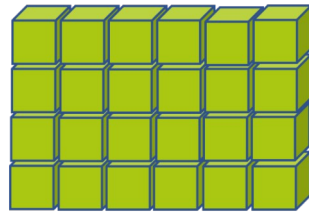


Topic

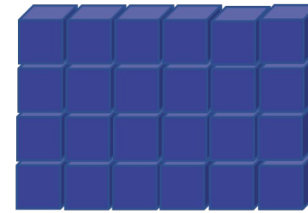
Fractional ownership is an investment approach in which the cost of owning an asset is split between individual shareholder, in ReFi are token holders.

Digital Twin -> Digital Asset -> Digital Ownership -> Fractional Ownership -> Financing Instrument

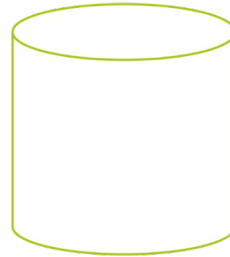
Fractional Ownership
(Digital Asset)



Crowdinvestors



ReFi's
Liquidity Pool



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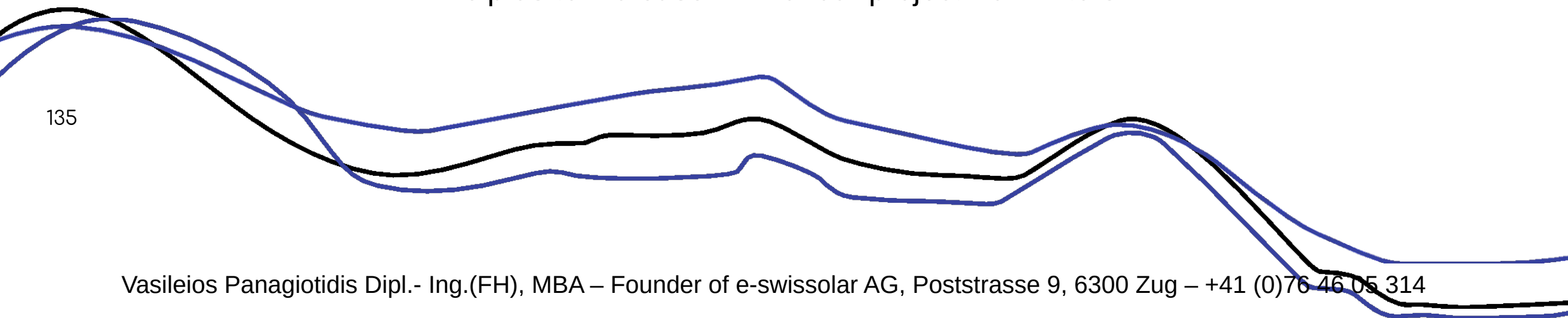
Challenge

Implement the concept of fractional ownership, tokenization of energy by utilizing blockchain technology and open-source DeFi protocols.

Build an MVP (front-end, back-end) for fractionalisation, auctioning and trading of ownership rights, lending, borrowing and auctioning of those fractions of ownership.

Help us to increase TLR of our project from 2 to 3!

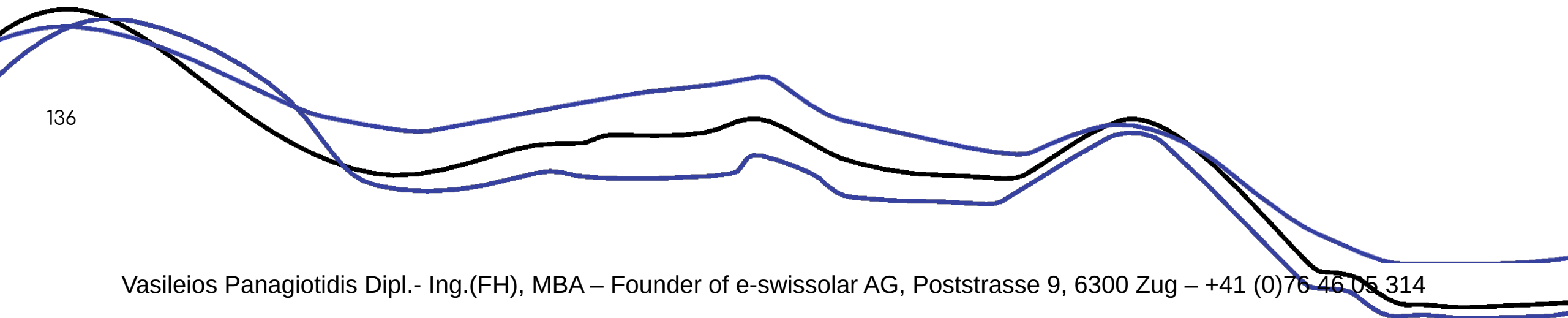
135



Skills and Resources

You do not have to be a full stack developer. Basic knowledge of solidity, javascript or how to build DApp using the react framework, next.js and IPFS would be very helpful. Also, if you are new in blockchain you are very welcome to join the project. During the hackathon I will provide information about the architecture, existing code solutions and tools.

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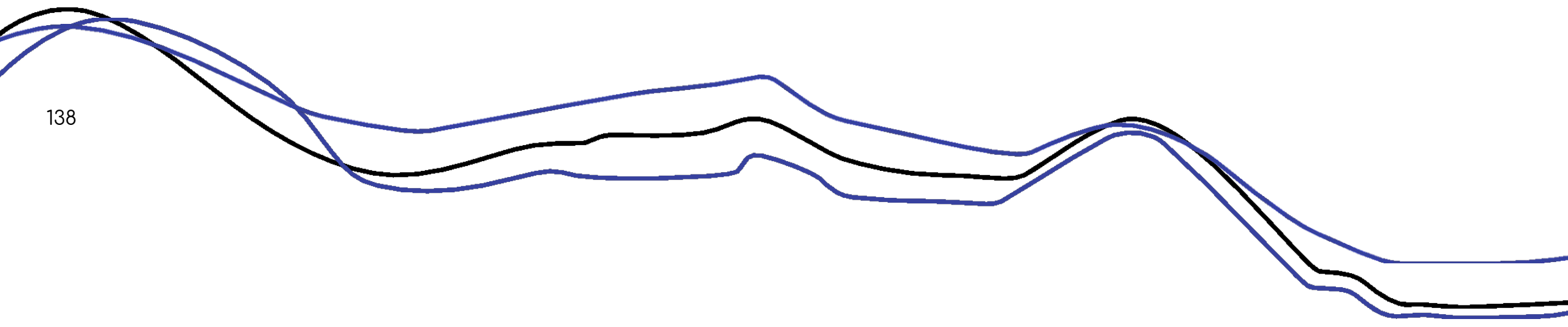


- 1 - Photovoltaic Forecasting
- 2 - Building IoT Security
- 3 - Local Sustainability Booster
- 4 - Understanding Big Energy Data
- 5 - Smart Meter Open Dataset
- 6 - Spatio-temporal Model of an On-Shore Wind Farm
- 7 - Smart Meter Insights Market
- 8 - Digital Twins for Domestic Heating Systems
- 9 - Customer Data Analysis
- 10 - Trends in Tertiary Energy Prices

- 11 - Pre Qualification Test
- 12 - Climate-Neutral Cities - St. Gallen Example
- 13 - Where Does My Electricity Come From?
- 14 - Trend Scouting For The Energy Industry
- 15 - Electricity "Heartbeat" 2035 in the Canton of Zurich
- 16 - "Green" Charging E-Mobility
- 18 - Interoperability plug-test for smart meter's local CII
- 19 - ReFi - Regenerative Finance



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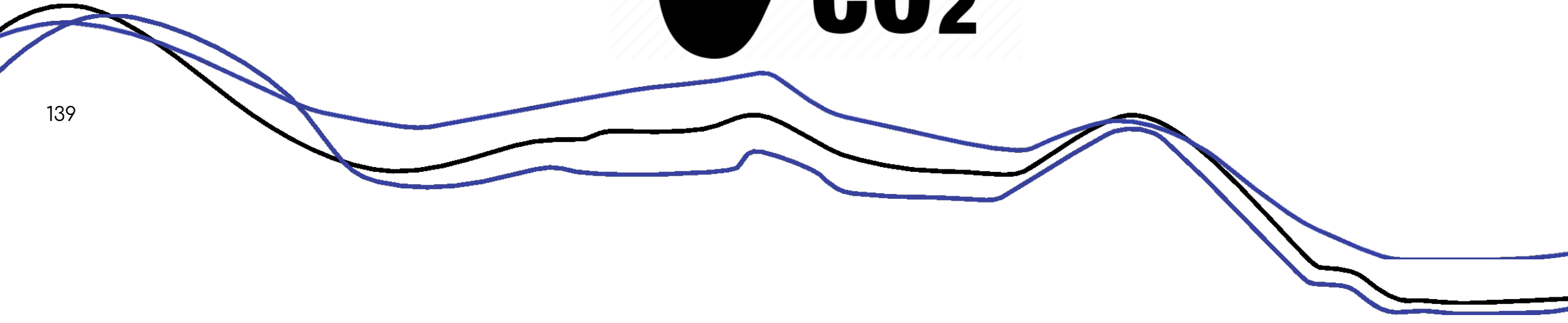




How Sustainable is this Property? 20



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How Sustainable is this Property? 20



homegate.ch

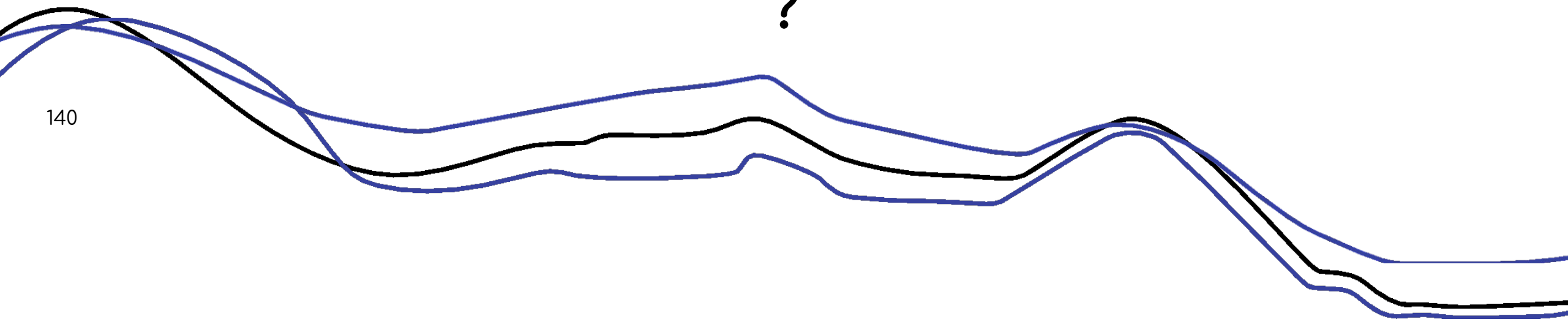
IMMO

SCOUT 24

newhome

eco criterias
?

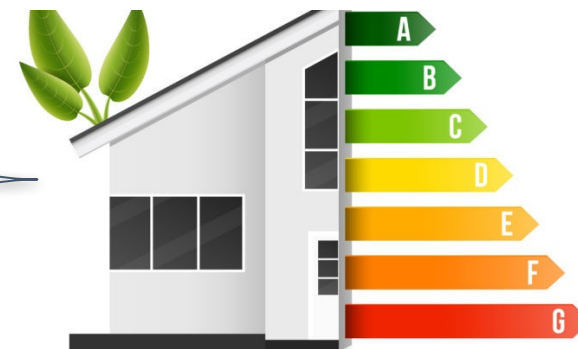
140

A line graph with multiple data series plotted over time. The graph shows several peaks and troughs. The first major peak is labeled with the value '140'. The series are represented by black and blue lines. The graph is partially cut off on the right side.



How Sustainable is this Property? 20

*Missing Information /
Missing Criterias*
Heating System
Space Heating Demand
Grey Energy
Photovoltaics
EV-Charging
Biodiversity



How Sustainable is this Property?

20

Challenge:

