Webinar2
March 1^{st}, 2022
10 a.m. until 11:30 a.m.

Store4HUC Energy management Tools

Store4HUC

Agenda

10:00- 10:05 Welcome and Opening words
[Katja Karba, Development agency Sinergija]

10:05- 10:25 Autarky Rate Tool
[Robert Pratter, 4ward Energy Research Ldt.]

10:25- 10:45 Optimal Sizing Calculator
[Filip Rukavina, University of Zagreb]

10:45- 11:05 Optimal Heat Source Scheduler
[Filip Rukavina, University of Zagreb]

Agenda

11:05- 11:30 Pilot action results
[Andrea Dorfhofer, Energy and Innovation Centre of Weiz]
[Martina Krizmanić Pećnik, North- West Croatia Energy Agency]
[Elisa Marino, City of Cuneo]
[Štefan Žohar, Development agency Sinergija]

Questions and Answers

online, 1.3.2022

D.C.6.1 and D.C.6.6 2nd Webinar - Tools

Store4HUC, Katja Karba, Development agency Sinergija

3 SPECIFIC OBJECTIVES

SETTING THE TOOLS

ADOPTION OF STRATEGY – IMPROVING ENERGY PLANNING

REACHING THE ENERGY EFFICIENCY AND INCREASE USAGE OF RES BY INTRODUCING THE PILOT ACTIONS FOR ENERGY STORAGES

STORE4HUC PILOTS

HR pilot - Manor Bračak

SI pilot - library Lendava

IT pilot - sloping elevator in Cuneo

AT pilot - parish Weizberg

OUTPUTS

Autarky rate tool + EMS tool

https://www.interreg-central.eu/Content.Node/Store4HUC.html

Workshop on tools, Train the trainers, Webinars

https://www.facebook.com/store4huc/

Transnational strategy for the implementation and capitalisation of energy storages in HUCs

Pilot actions

RESULTS


1 STRATEGY
12 INSTITUTIONS APPLIED FOR STORE4HUC TOOLS
2 NEW JOBS
571 PARTICIPANTS INVOLVED IN PROJECT EVENTS
186 TRAINED PEOPLE
AROUND 236 ENTITIES INVOLVED & ACTIVATED

RESULTS

External energy needs of the pilot system – ENERGY SAVINGS:

PILOT	WEIZ	CUNEO	LENDAVA	BRACAK
Pre-investment status [kWh]	**1.833.500**	**18.226**	**84.351**	**138.219,67**
Target (prediction) [kWh]	1.726.607	12.226	80.133	107.811
Status quo (after pilot implementation) [kWh]	**1.812.965**	**7.431**	**69.930**	**126.879,67**

CONTACTS

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2. Webinar – 01.03.2022 (online)

Store4HUC - Autarky Rate Tool

Store4HUC | Robert Pratter | 4ward Energy Research GmbH

Overview Store4HUC Tools

Autarky Rate Tool

- web application
- no / little previous knowledge necessary

EMS Module 1: Optimal Sizing Calculator

- Excel based – available for download
- PV-Systems in combination with electrical storages
- advanced knowledge required

EMS Module 2: Optimal heat source scheduler

- Excel based – available for download
- Thermal storages
- advanced knowledge required

Goals and Motivation

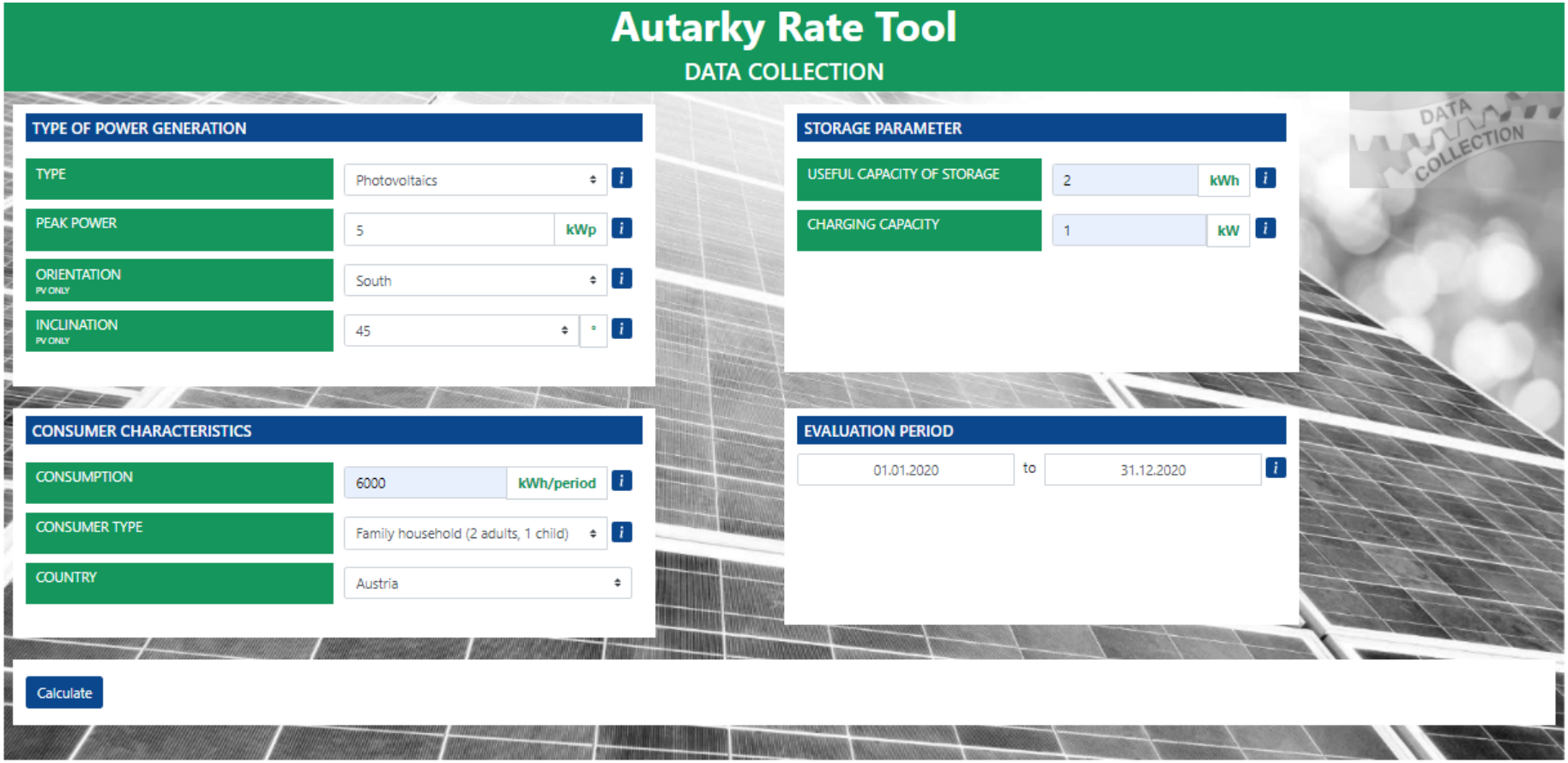
- Show the potentials of electrical storages

- technical
- economic
- ecological

Evaluation of different producer and storage constellations

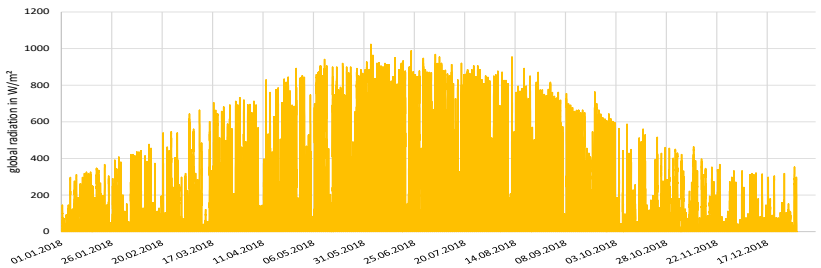
- Easy usability -> Target Group: general public
- High availability-> Web application

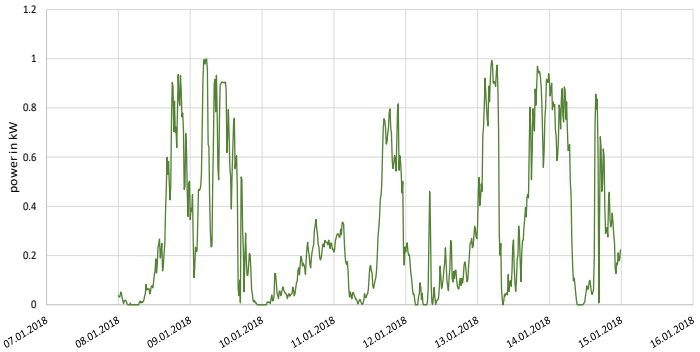
Input data

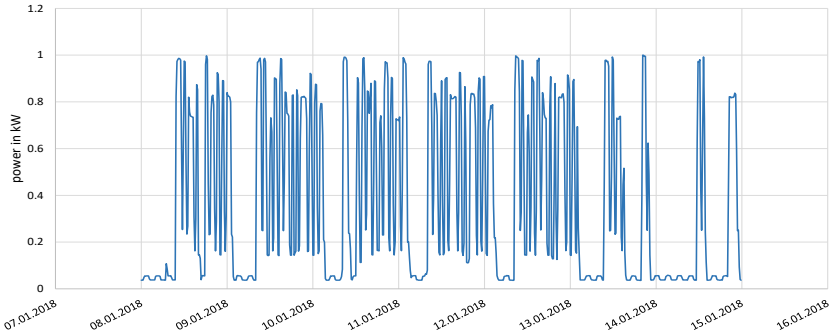

Autarky Rate Tool
DATA COLLECTION
TYPE OF POWER GENERATION
TYPE
Photovoltaics
PEAK POWER
5
kWp
ORIENTATION
PV ONLY
South
INCLINATION
PV ONLY
45
°
STORAGE PARAMETER
USEFUL CAPACITY OF STORAGE
2
kWh
CHARGING CAPACITY
1
kW
DATA COLLECTION
CONSUMER CHARACTERISTICS
CONSUMPTION
6000
kWh/period
CONSUMER TYPE
Family household (2 adults, 1 child)
COUNTRY
Austria
EVALUATION PERIOD
01.01.2020
to
31.12.2020
Calculate

Producer

- Photovoltaic
  - Orientation
  - Inclination
- Wind energy
  - Measurement data
- Small scale hydropower
  - based on measurement data







Consumer

- Household profiles
  - Single household vs. Family household
  - at home vs workers (not at home)
  - Generated with the Loadprofilgenerator
- Industrial profiles
  - Standard load profiles
- Castle & Slope elevator
  - Measurement data of the pilot plant
- Scaled with the annual energy demand

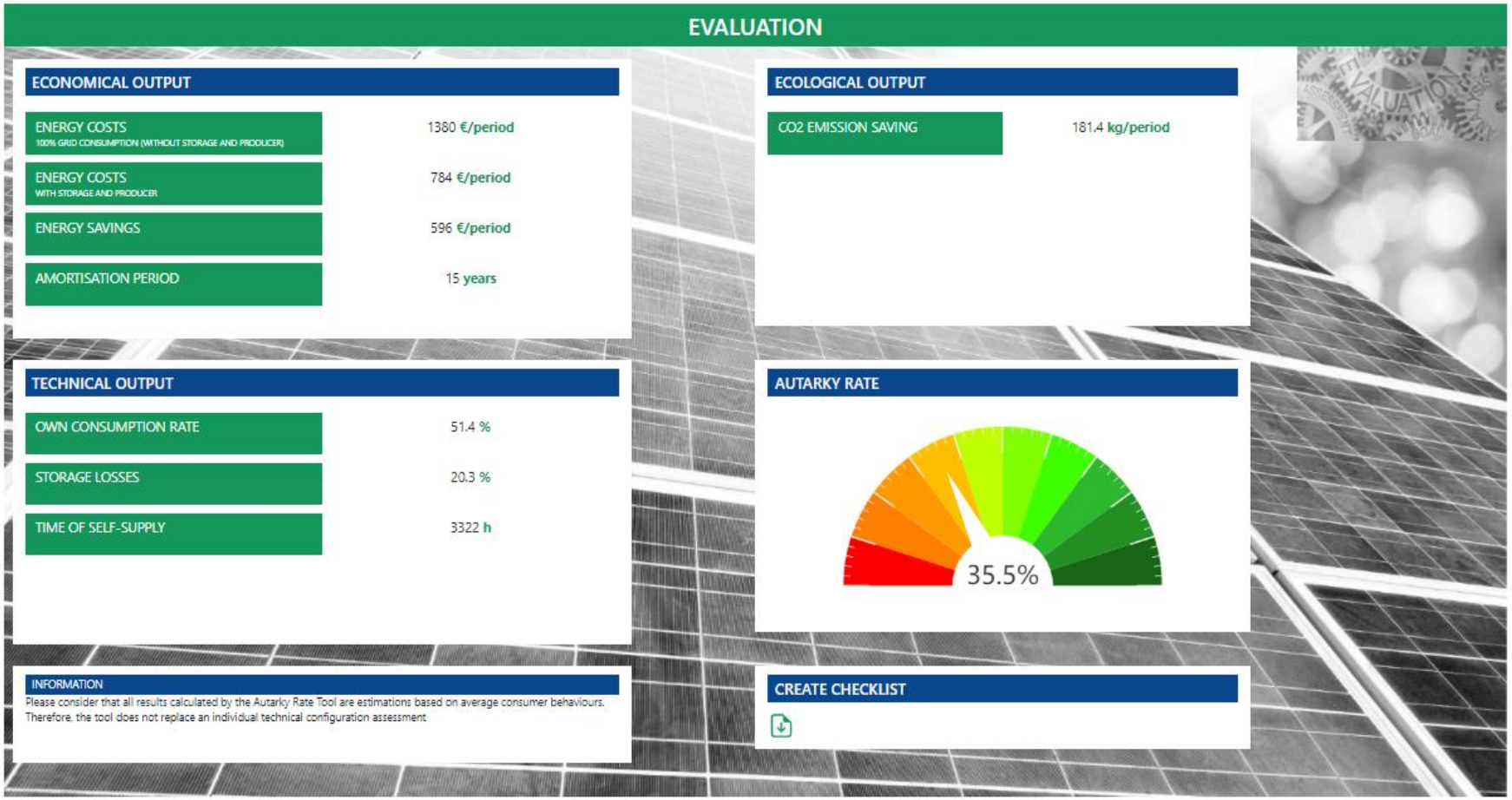
Storage

- Useful capacity [kWh]
- max. charging power [kW]
- Internal calculation of the charging losses
  - Depending on the relation between the maximum and the actual charging power
  - Best efficiency with similar proportions

Priorities

1. Priority: direct own consumption (without storage)
2. Priority: Storage (charging/discharging)
3. Priority: public grid (feed-in/purchase)

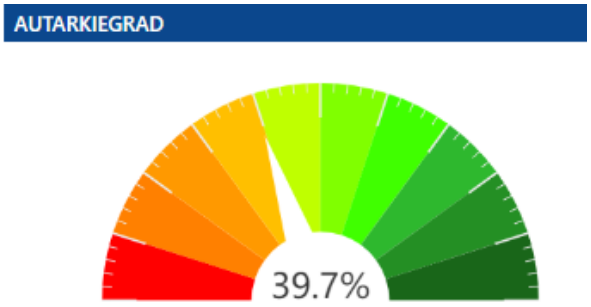
Results


EVALUATION
ECONOMICAL OUTPUT
ENERGY COSTS
100% GRID CONSUMPTION (WITHOUT STORAGE AND PRODUCER)
1380 €/period
ENERGY COSTS
WITH STORAGE AND PRODUCER
784 €/period
ENERGY SAVINGS
596 €/period
AMORTISATION PERIOD
15 years
ECOLOGICAL OUTPUT
CO2 EMISSION SAVING
181.4 kg/period
TECHNICAL OUTPUT
OWN CONSUMPTION RATE
51.4 %
STORAGE LOSSES
20.3 %
TIME OF SELF-SUPPLY
3322 h
AUTARKY RATE
35.5%
INFORMATION
Please consider that all results calculated by the Autarky Rate Tool are estimations based on average consumer behaviours. Therefore, the tool does not replace an individual technical configuration assessment.
CREATE CHECKLIST

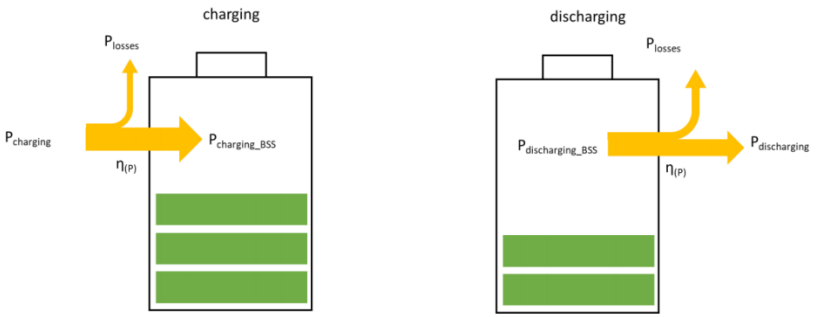
Economic & Ecological Evaluation

- Energy Cost Savings
  - Reference: 100% grid consumption (without PV and storage)
  - Calculated with country specific average electricity costs
- Amortisation period
  - Estimation!
  - Calculated with average investment costs
  - Funding possibilities are considered (simplified)
- Reduction of CO_2-Emissions

Technical Evaluation

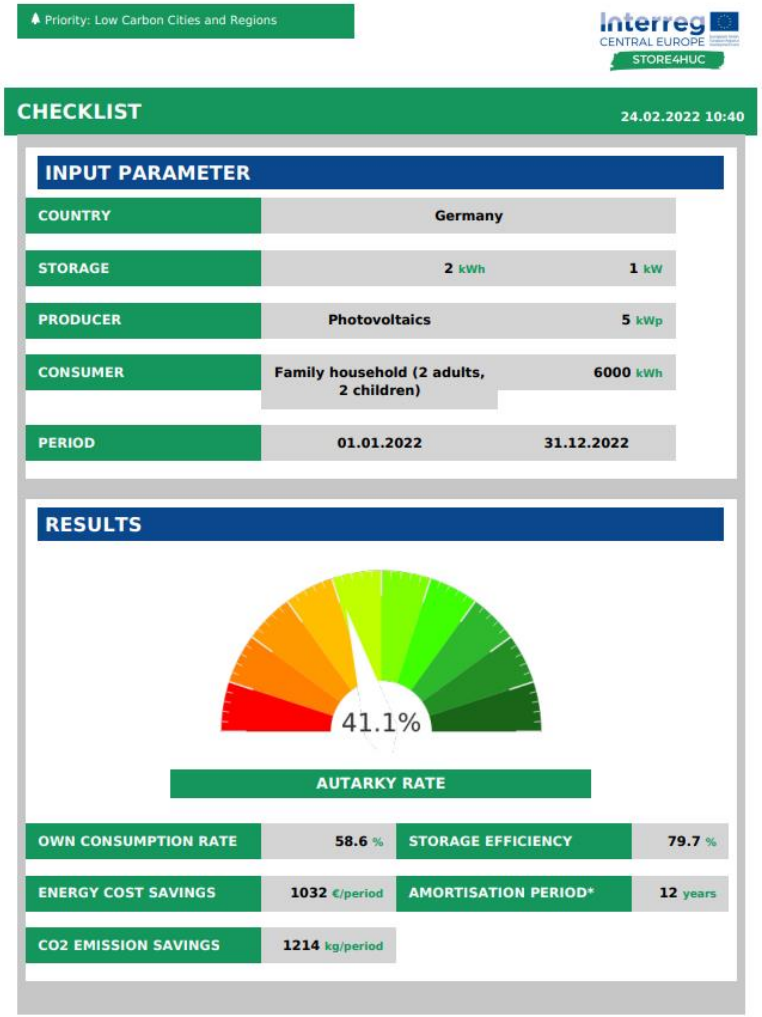


- Autarky Rate $= \left(\frac{E_{self\_RES}}{E_{tot}}\right) * 100\%$
- Own Consumption Rate $= \left(\frac{E_{self\_RES}}{E_{prod\_RES}}\right) * 100\%$
- Storage efficiency / Storage losses
- Time of self-supply
- More details are shown in the Checklist



Checklist

- Pdf-Document
- Save the calculation
- Explanation of the results
- Advices on implementing storages in HUC


Priority: Low Carbon Cities and Regions

Interreg CENTRAL EUROPE STORE4HUC

CHECKLIST 24.02.2022 10:40

INPUT PARAMETER

COUNTRY	Germany	
STORAGE	2 kWh	1 kW
PRODUCER	Photovoltaics	5 kWp
CONSUMER	Family household (2 adults, 2 children)	6000 kWh
PERIOD	01.01.2022	31.12.2022

RESULTS

41.1%

AUTARKY RATE

OWN CONSUMPTION RATE	58.6 %	STORAGE EFFICIENCY	79.7 %
ENERGY COST SAVINGS	1032 €/period	AMORTISATION PERIOD*	12 years
CO2 EMISSION SAVINGS	1214 kg/period		

Link

The tool is available under following link:
https://store4huc-autarky.4wardenergy.at

or via the Store4HUC Homepage:
www.interreg-central.eu/Store4HUC

Video Tutorial: Link
Background information: Link

THANK YOU FOR YOUR ATTENTION

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Autarky Rate Tool: https://store4huc-autarky.4wardenergy.at

Online – 2nd Store4HUC webinar
01.03.2022.

Webinar on EMS tools

Store4HUC | UNIZGFER |Filip Rukavina, prof. dr. sc. Mario Vašak

OPTIMAL SIZING CALCULATOR

CALCULATOR FOR OPTIMAL SIZING OF A PV SYSTEM AND A BATTERY STORAGE SYSTEM

BASIC PARAMETERS		
Country	Croatia	
Consumer type	Manor	
Peak power billing	Yes	
Yearly consumption	17320	kWh
Maximal payoff period	20	years
Maximal possible investment	1000000	€
Optimality criterion	Yearly cost of the energy exchanged with the utility grid	

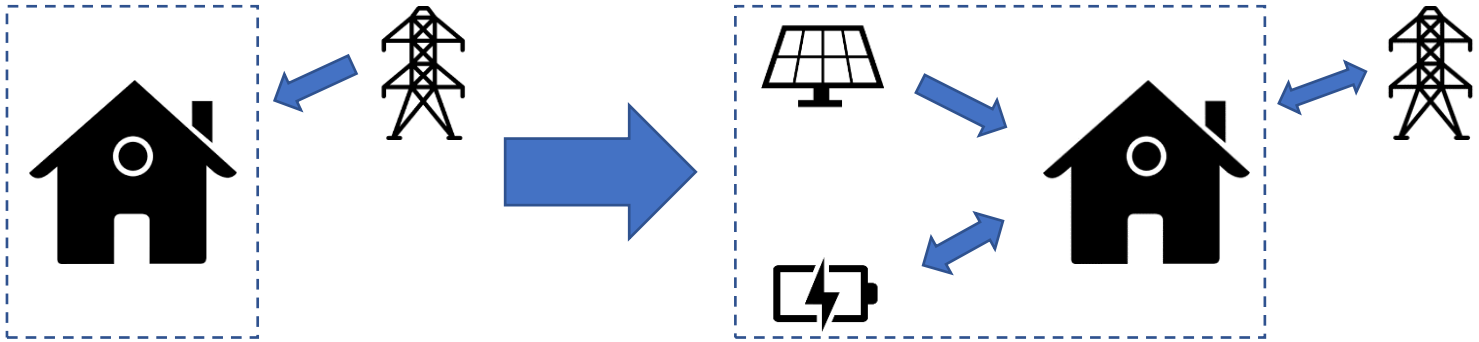
BATTERY STORAGE PARAMETERS		
Number of cycles	2000	
Depth of discharge (DoD)	0.8	
Charging efficiency	0.9	
Discharging efficiency	0.9	
Lifetime of power converter	25	years
Price of new battery pack	770	€/kWh
Price of new power converter	660	€/kW

PV SYSTEM PARAMETERS		
Max. possible peak power	10	kWp
Orientation	South West	
Inclination	15	°
Lifetime of PV system	25	years
Price of PV system	1050	€/kWp

Calculate optimal sizes | Cancel calculation | Default values

IDEA

- Increase energy from RES → adding photovoltaic (PV) system
- Unfavorable feed-in prices, increasing flexibility → adding battery energy storage system (BESS)



- Calculation of optimal sizes of PV + BESS:
  - battery capacity [kWh]
  - power converter size [kW]
  - power of PV system at STC [kWp]
- Calculation based on yearly consumption profile

FEATURES

- Prices
  - depend on chosen country
  - separate prices for buying and feed-in of el. en.
  - peak power billing
  - user enters return on investment period
- Yearly consumption profile
  - several generic profiles, or custom user profile
  - 15 min samples of mean power
- Solar irradiance on the PV system
  - calculated according to orientation and inclination angles
- BESS
  - charging and discharging efficiency included
  - battery degradation included

LINKS

- Free download from Store4HUC website
  - https://www.interreg central.eu/Content.Node/Store4HUC.html
- Video tutorials
  - https://youtu.be/NafE1-uytKQ
  - https://youtu.be/K-x0SnfTLB8
- Mathematical background in project's publications
  - https://www.interreg-central.eu/Content.Node/Store4HUC/D.T3.1.3-Finalized-software-tools-final.pdf
- Published scientific article
  - https://ieeexplore.ieee.org/document/9244462
- Contact
  - filip.rukavina@fer.hr; mario.vasak@fer.hr

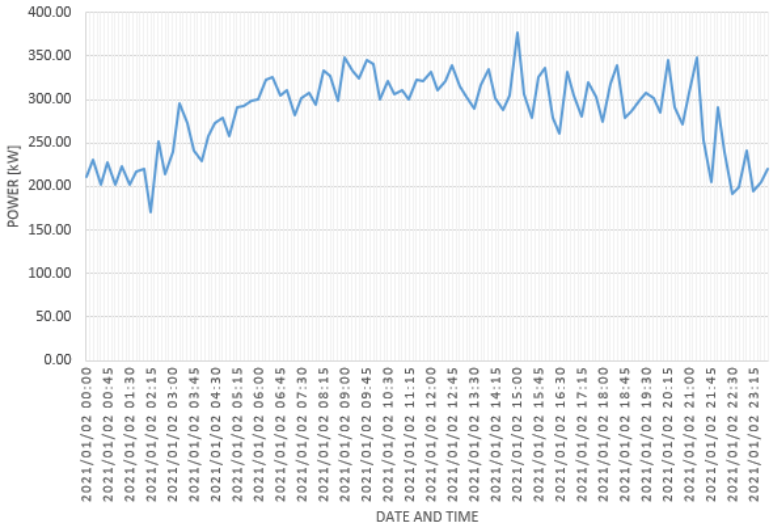
OPTIMAL HEAT SOURCE SCHEDULER

SCHEDULER FOR OPTIMAL OPERATION OF A HEAT SOURCE IN A COMBINATION WITH A THERMAL ENERGY STORAGE

DEMAND SIDE PARAMETERS

Supply temperature	80	°C

POWER DEMAND PROFILE



Import data from a file

Date and time	Power [kW]

HEAT SOURCE PARAMETERS

Maximal power	750	kW
Minimal power	80	kW
Efficiency at maximal power	90	%
Efficiency at minimal power	92	%
Warm-up time	30	min

STORAGE TANK PARAMETERS

Volume	38	m^3
Height	7	m
Insulation type	Polyurethane foam (PUR)	
└ Thermal conduction coefficient	0.0245	W/(m K)
Insulation thickness	400	mm
Maximal allowed temperature	95	°C
Typical temperature difference between top and bottom	40	°C
Surrounding air temperature	-2	°C

SIMULATION PARAMETERS

Number of power changing intervals	24	
└ Power change every	1	h
Start time (hours)	0	h
Start time (minutes)	0	min
Date	2.1.2021	Pick date

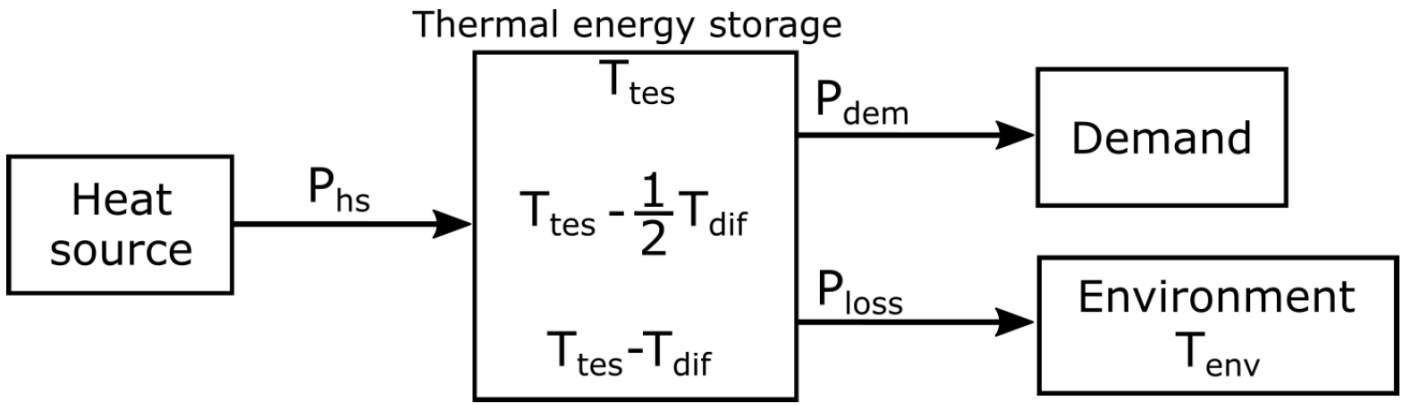
Run scheduler

Save default values

Restore default values

IDEA

- Thermal energy storage (TES) in heating systems → flexibility
- Full potential of TES → adequate control technique required



- Calculation of optimal schedule of the heat source:
  - 24-h profile of reference powers [kW]
  - minimizes usage of primary energy
- Designed primarily for plant operators

FEATURES

- Application inside Excel document
- Calculation based on power demand predictions
  - easy import into Excel
- Assumptions on TES
  - insulated cylindrical tank
  - water as heating medium
  - constant temperature difference during 24 h
- Heat source
  - variable output power
  - variable efficiency (depending on power output)
  - warm-up time taken into account
- Comparison with classical control
  - plant operator chooses the best option

LINKS

- Free download from Store4HUC website
  - https://www.interreg central.eu/Content.Node/Store4HUC.html
- Video tutorials
  - https://youtu.be/DPByStew7B0
  - https://youtu.be/kK6PyaWraUk
- Mathematical background in project's publications
  - https://www.interreg-central.eu/Content.Node/Store4HUC/D.T3.1.3-Finalized-software-tools-final.pdf
- Contact
  - filip.rukavina@fer.hr; mario.vasak@fer.hr

Implementation of a thermal storage in the historical urban city of WEIZ

Store4HUC - PP3 – W.E.I.Z. - Energy and innovation Centre of Weiz

CITY OF WEIZ

Inhabitants:
2019: 11.701
(2017: 11.508)

Employed persons:
2017: 11.994

Main Strategies:
City – for living!
City – full of Energy!

Source: http://www.innovationszentrum-weiz.at/360-grad-weiz

PILOT WEIZBERG

Location Weizberg = historic monument and landscape protection zone

Pilot: Basilica with the biomass heating plant Weizberg

Source: http://www.innovationszentrum-weiz.at/360-grad-weiz

PILOT WEIZBERG

INVESTMENT SPECIFICATION OF THE INTEGRATION OF AN ENERGY STORAGE IN HUCS FOR WEIZ

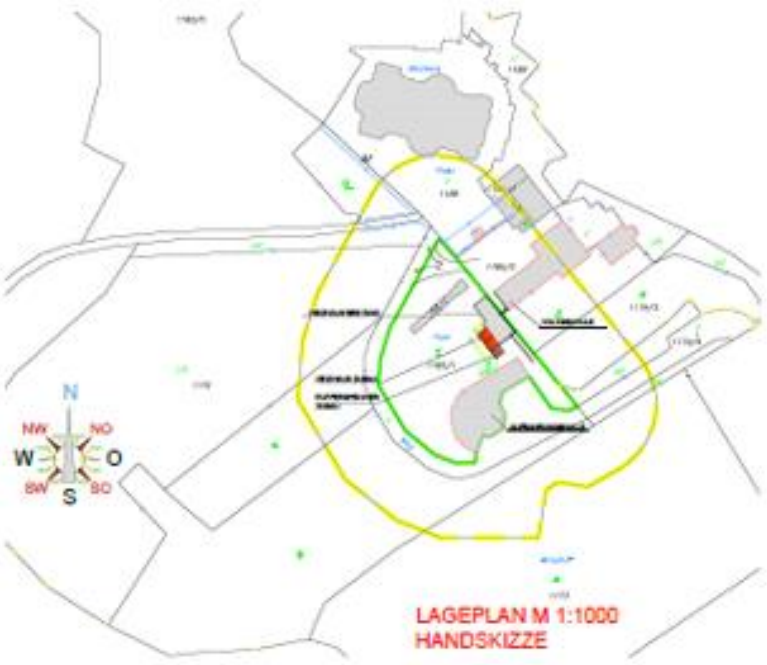
- Old church at Weizberg was built in 1065 by the lords of Radmansdorf
- In November 1758 the new building was completed
- Since 2019 the Weizberg church is a basilica
  - Basilica church is under monumental protection
  - Biomass heating plant Weizberg is working insufficient
    - Too high fuel consumption
    - Too high emissions (CO, NOx, dust and volatile unburned CnHm)
- **Challenge - of finding an innovative solution**
  - Implement a central thermal energy storage tank in connection with decentralized hot water storage tanks
    - Decrease fuel consumption & emissions
    - Increase EE & RES

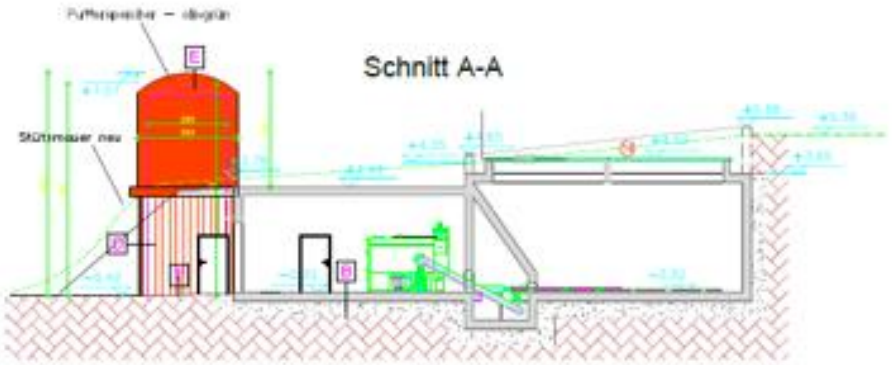
Biomass heating plant Weizberg

- Built in 1999
- Heat supply for 12 consumers is ensured by two biomass boilers fired with regional wood chips (1500 MWh/a)
- Largest consumers
    - Hotel, parish, primary school
    - Requirements concerning monumental protection

INVESTMENT SPECIFICATION OF THE INTEGRATION OF AN ENERGY STORAGE IN HUCS FOR WEIZ

- Protection of the landscape presupposes that **landscape is not changed or threatened by the construction** of the storage tank
- The zone marked in red show **minor structural measures**, as well as the uppermost part of the water buffer tank will reach out of the ground, but **not or only barely visible for visitors of the basilica**, as it is covered by bushes and the parish buildings





Source: W.E.I.Z. 2019

But we have also other good news !

- The **building phase started in February 2020** and **was completed** with the installation of the water buffer storage tank **at the end of June 2020.**

Costs categories	Costs [€]
Storage	55.633,75
Heating pipes	44.687,49
Regulation	18.961,07
Electrical installation	19.251,60
Emergency heating station and water treatment	15.466,15
Construction costs	116.174,56
Planning and tendering	22.227,90
Total excluding VAT	292.402,53

Source: W.E.I.Z. & AEE Intec 2019

KPI	Initial situation	After the pilot action
External energy needs (kWh/year)	1930 m^3	1939m^3
External energy cost (€/year)	125€/t	125€/t
CO_2 emissions (t/year)	29,34t	29,01t
Autarky rate (%)	100%	100%
Use of energy from RES (kWh/year)	1833,500 kWh	1812,965 kWh
Hours without service interruptions/discomforts	8692,17 h	8729,75 h
Average power peak (kW)	479 kW	409 kW

As construction is finished

THANK YOU

https://www.youtube.com/watch?v=L3DyPew9t2s

D.C.6.1 and D.C.6.6: WEBINAR, 1.3.2021

Implementing photovoltaic plants and storage systems at the Manor Bračak in Croatia

Martina Krizmanić Pećnik

CROATIA - THE MANOR BRAČAK

Cultural heritage Building with new technologies:

- Built in 1889.
- In 2017. reconstructed and restored in accordance with best practices in renewing heritage on the principle of energy efficiency.
- Restored to the highest standards of energy efficiency.
- Used as central place for organizations, companies and institutions interested in renewable energy.
- It also serves as business incubator for young companies.

BACKGROUND OF THE PILOT

Building insulation

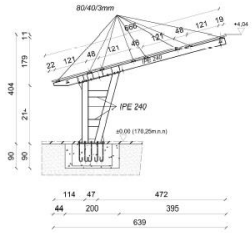
- Internal wall insulation
- Energy efficient windows and doors

HVAC system

- Wood pellets boiler
- Micro CHP - Combined Heat and Power
- Air-water heat pump
- Heat recovery ventilation system

- Efficient lighting system

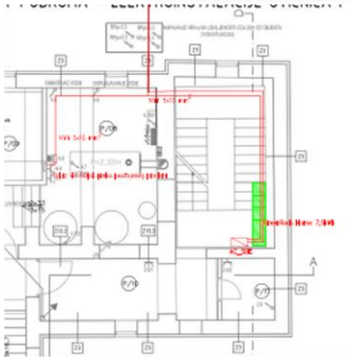
Photovoltaic System

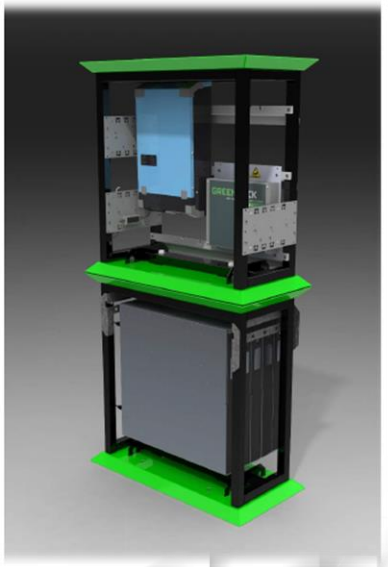


- Location - parking lot
- Steel canopy covers three parking spaces
- **10,8 kWp**
- Overall, 36 installed PV modules on site (300 Wp/module)
- Monocrystalline PV modules
- 36 microinverters
- Grid-connected PV (surplus goes to battery and grid)
- Roof surface ~ 60m2
- Projected production ~ 11 MWh annually

Battery System

- Inside the building (under the stairs)
- GREENROCK Carbocap battery system
- 8 kWh capacity
- LTO cell (lithium titanate) – a modified version of the lithium-ion cell with a longer lifespan
- 20.000 cycles (3 times longer than other battery technologies)
- Safe (non-combustible, non-flammable, non-explosive)
- Efficiency >95%
- Depth of discharge (DoD) 90%
- A source of electricity at a time when there is no sun





ELECTRICITY CONSUMPTION AND PRODUCTION - SAVINGS

- Production 11,340.00 kWh per year
- Electricity consumption energy at the billing metering point - average of 20,500.00 kWh per year
- 55% less

D.C.6.1 and D.C.6.6: WEBINAR, 1.3.2021

Italian pilot intervention on the energy efficiency of the sloping elevator in the City of Cuneo

Store4HUC | City of Cuneo | Elisa Marino

THE PILOT ACTION IN CUNEO

THE PILOT ACTION IN CUNEO

AFTER...

PILOT ACTION SPECIFICS

Pilot action, energy efficiency oriented, consists of →

- PV plant installation along the runway of the elevator
- Storage unit + inverter = storage system
- Technical room for hosting all electric equipment
- Underground cable ducts

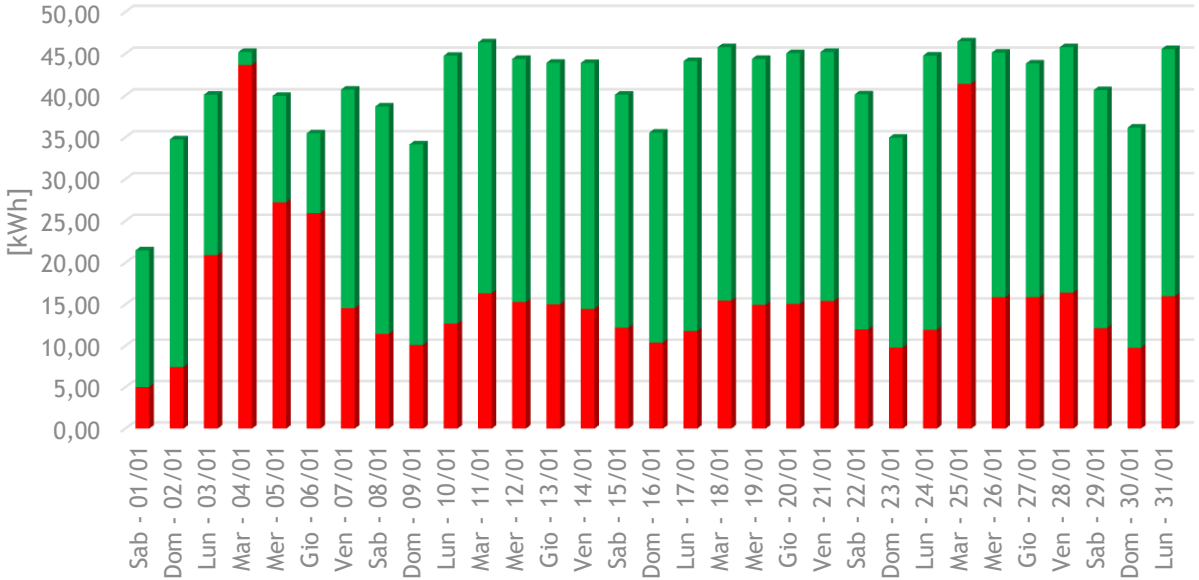
↓

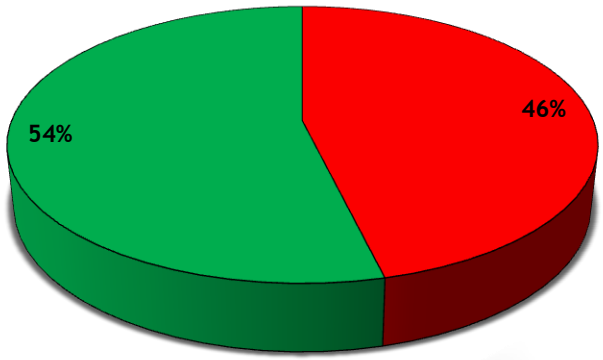
Reduce the consumption of energy from the public grid and make the system as most independent from it as possible, optimizing the energy sources management

PILOT ACTION TESTING RESULTS

Testing period: 20 October 2021 – 19 February 2022

- **54% auto-production** of energy coming from the PV plant/storage
- **46% energy** provided by the public grid

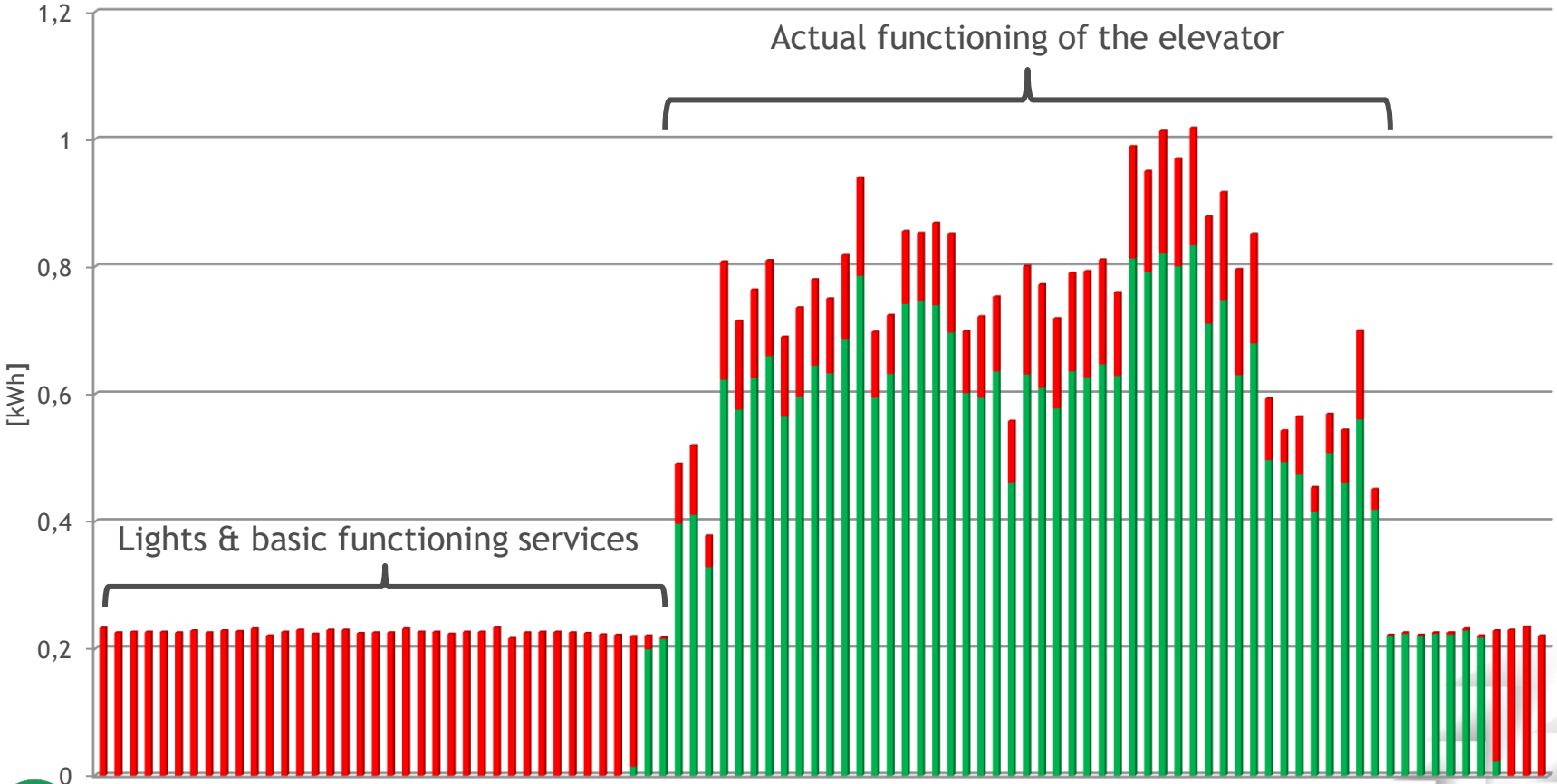




PILOT ACTION TESTING RESULTS

Testing period: 20 October 2021 – 19 February 2022

Daily consumption example



FORECASTS FOR THE FUTURE

At least 60% of the total energy consumption of the elevator will be provided by the PV plant during Spring and Summer months

Thank you for your attention!

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PP07 – City of Cuneo - Store4HUC

https://www.interreg-central.eu/Content.Node/Store4HUC.html

Second Store4HUC WEBINAR

1st of March 2022

Paraffin based latent storages in connection with geothermal district heating system in Lendava

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PILOT IN LENDAVA (SI)

Paraffin based latent heat storage system in connection with the geothermal DHS

Aim: to change fossil fuel with RES, reduction of consumption (4.000 kWh/a or 3%) and CO_2 emission (22 t/a) and the costs for heating; use of innovative solution

Target groups: municipality/public (transferable to private sector)

Challenge: low temperatures in the geothermal DHS - purchase of a suitable material (PCM material, storages)

Transferability: unique in Slovenia - to areas with the geothermal potencial, or combined with the biomass heating system

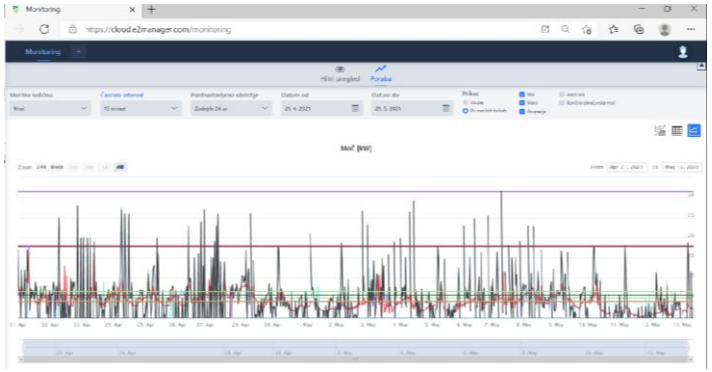
Sustainability: in accordance with the current *LEC* and *SEAP*, maintenance is ensured by the municipality - owner of the infrastructure

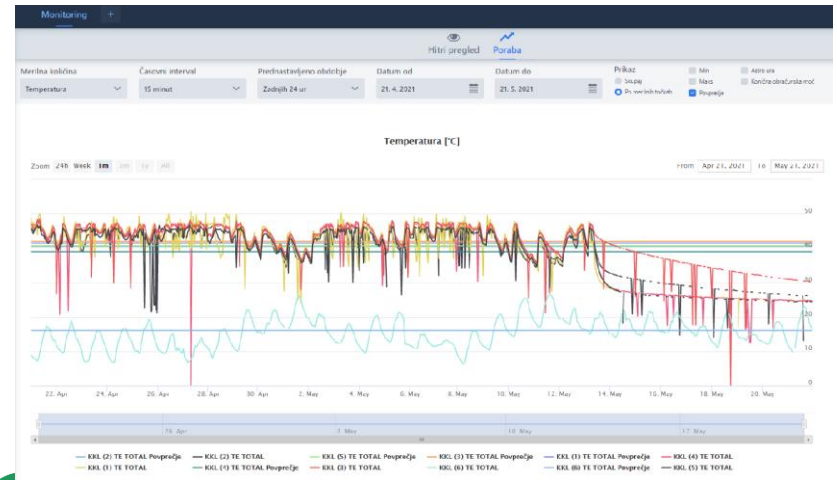
1. **investment:** Pipelaying and connection of the building to the geothermal network
2. **investment:** Installation of the storage system and PCM material

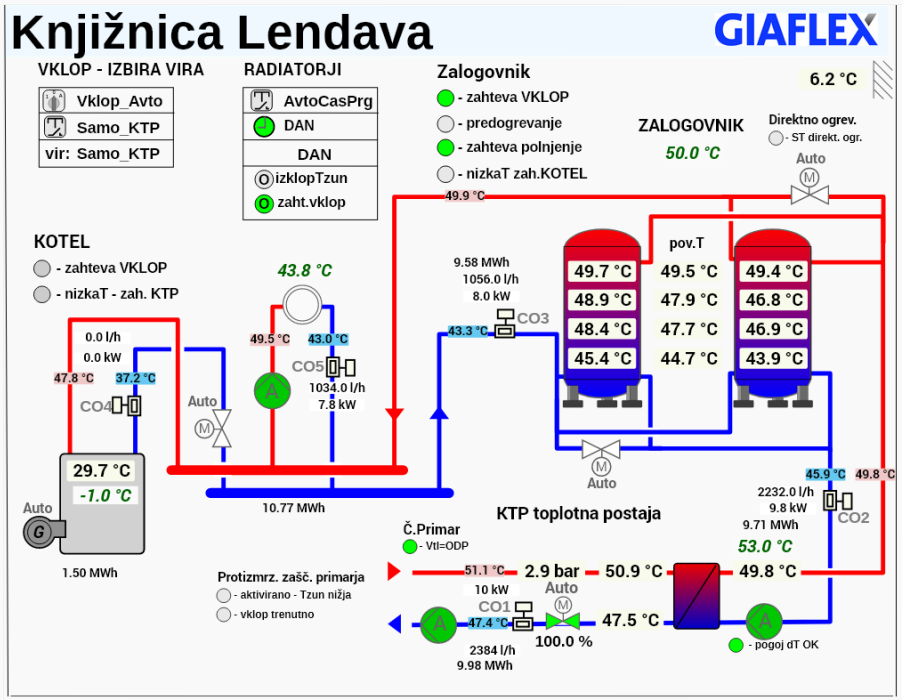
Progress: Investment is FINALISED; Monitoring process IN PROGRESS

Installed central control system for pilot in Lendava

The testing and monitoring works are still running …







PILOT IN LENDAVA (SI)

… RESULT´s !!!

KPI	ENERGY NEEDS	ENERGY COST´s	CO_2	AUTARKY RATE	RES SHARE	SUPPLY SECURITY	POWER PEAK	PROFITIBILITY	LOCAL ECONOMY
	kWh	EUR	t CO_2	%	kWh	-	kWh	-	-
Pre-investment status	84.351	8.460,45	23,53	0	0	99	22,25	n/a	n/a
Target (prediction)	80.133	5.272,93	0	0	0	100	16,5	1,49	0,48
Status quo (after pilot implementation)	69.930	2.102,42	0	0	0	100	21,6	1,99	0,48