Innovative clean energy technologies for coal regions

6th Just Transition Platform Conference –
Coal Regions in Transition and Carbon-Intensive Regions
24 October 2022

Agenda / Speakers

Facilitator: Timon Wehnert, CRiT Secretariat

Presentations:

- ***Uptake of clean energy technologies in coal regions*** - Felicia Aminoff, BloombergNEF
- ***Underground Energy storage*** - Charlie Blair, Gravitricity
- ***Geothermal projects in post-mining areas*** - Noel Canto, Hunosa
- ***Renewable Solutions for district heating networks*** - Nicolas Graveline, Newheat

Uptake of clean energy technologies in coal regions

6th Just Transition Platform Conference – Coal Regions in Transition and Carbon-Intensive Regions
24 October 2022

Felicia Aminoff,
Energy Transitions Analyst (BloombergNEF)

Innovative Technologies for Coal Regions

Just Transition Platform Conference, Brussels

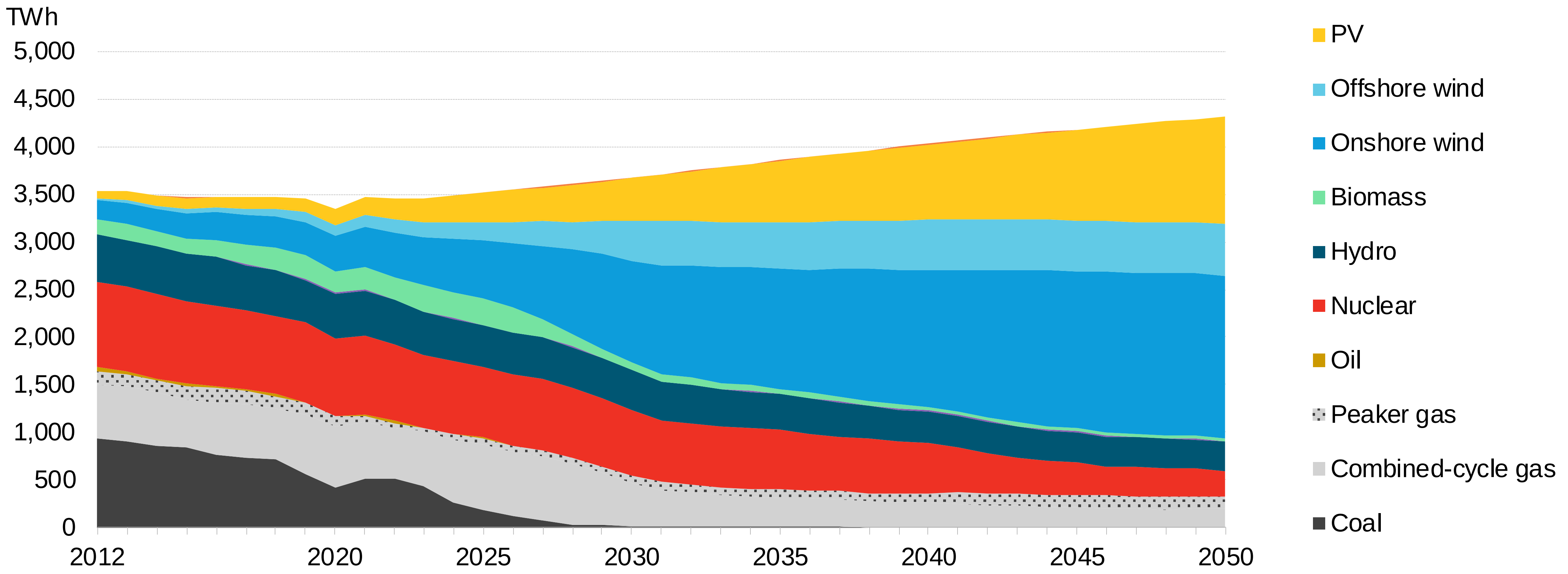
Felicia Aminoff

October 24, 2022

BloombergNEF

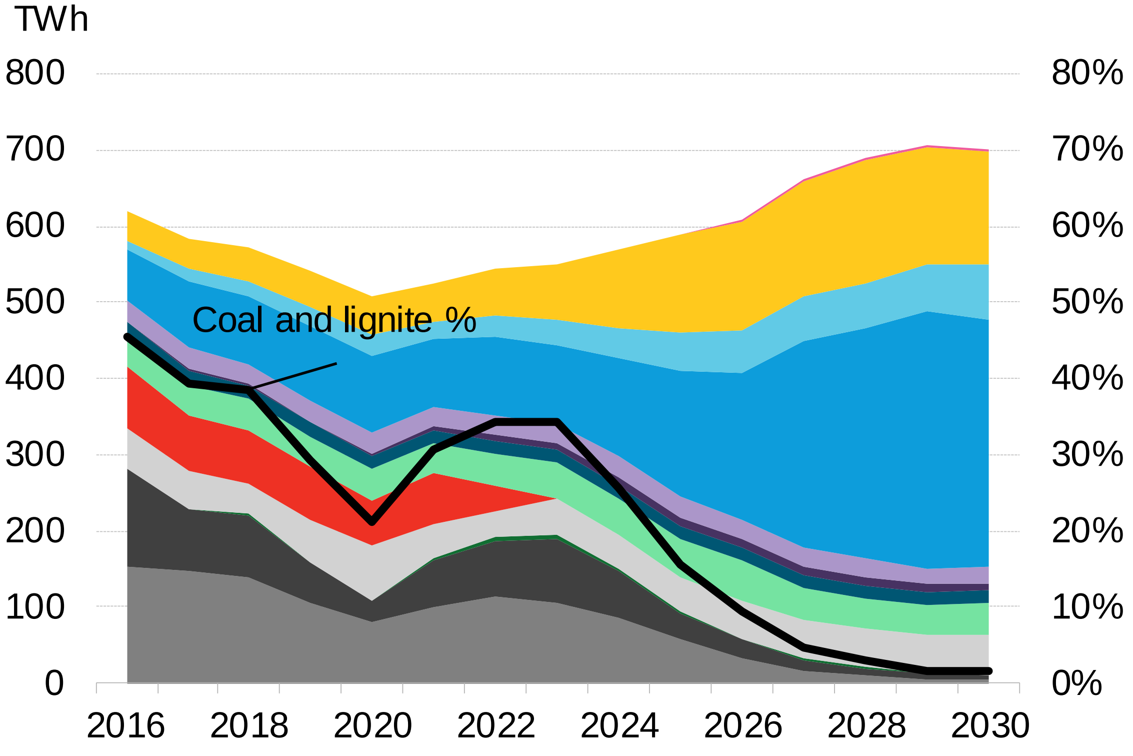
Economics push coal generation to near-zero by 2030…

Europe Power Transition Outlook 2022, Economic Transition Scenario



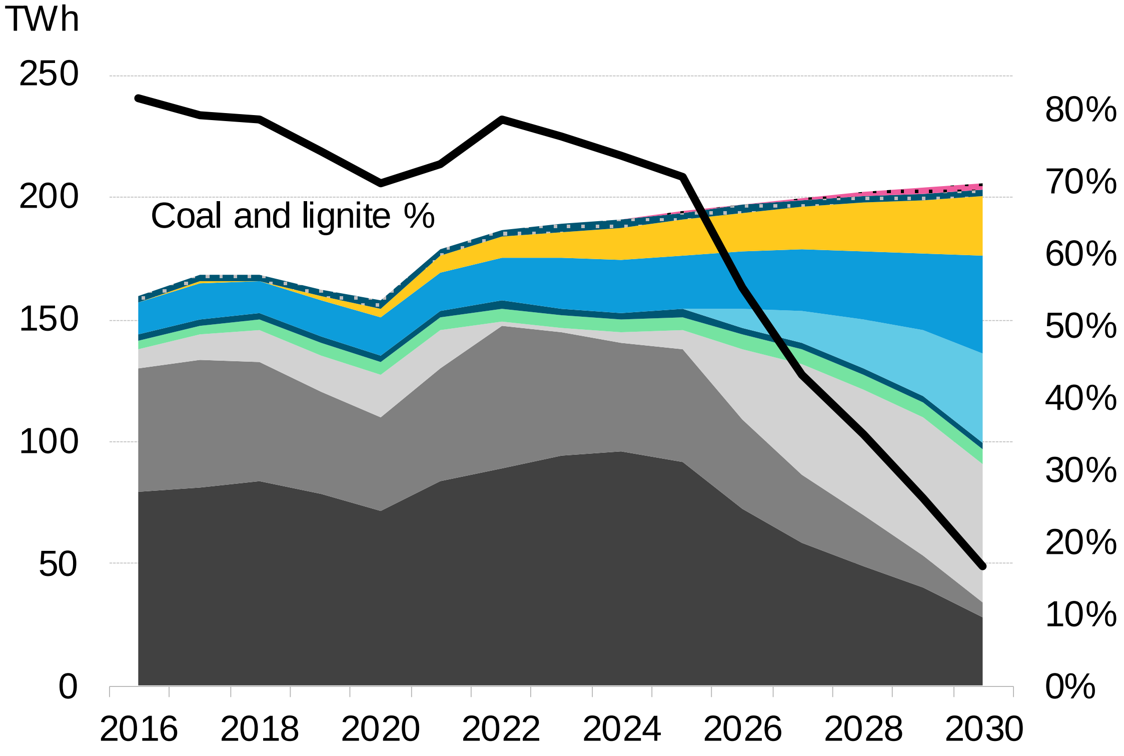
… even if coal generation rebounds in the short run

Germany, "Easter Package Scenario"



Source: BloombergNEF

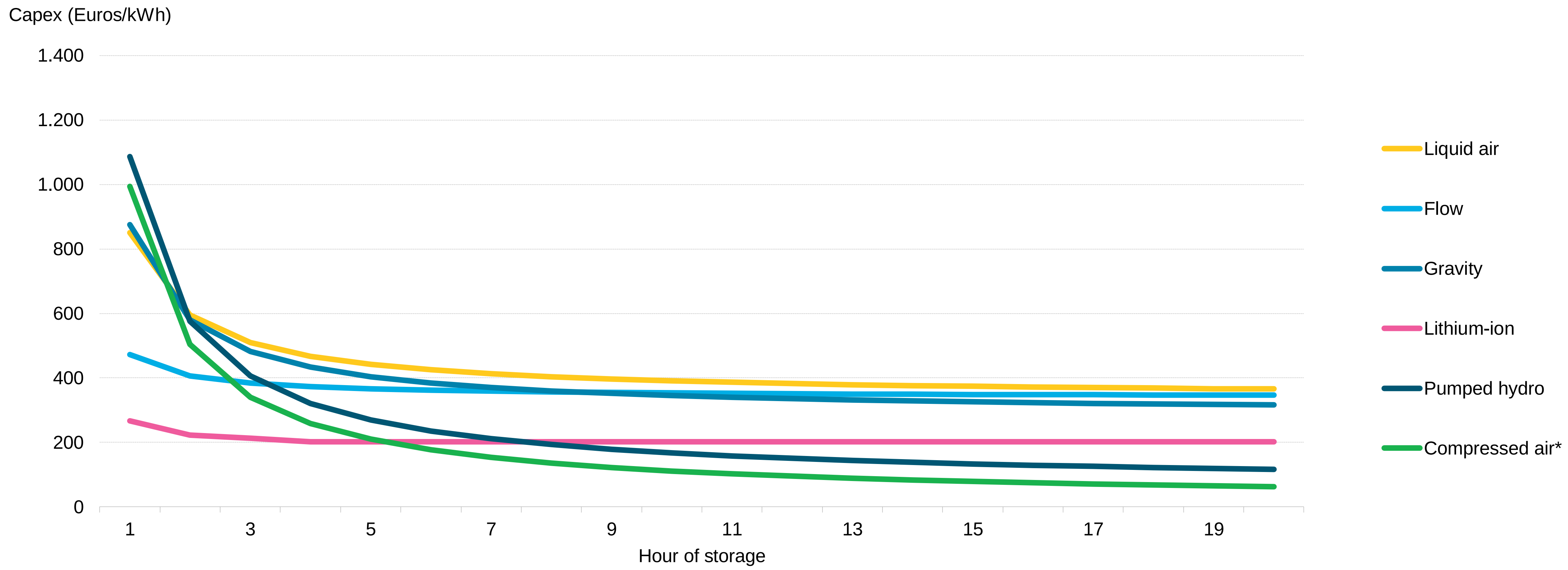
Poland, Economic Transition Scenario gas price update and onshore wind limits



Source: BloombergNEF

Pumped hydro and compressed air storage can be cheap but depend on topography

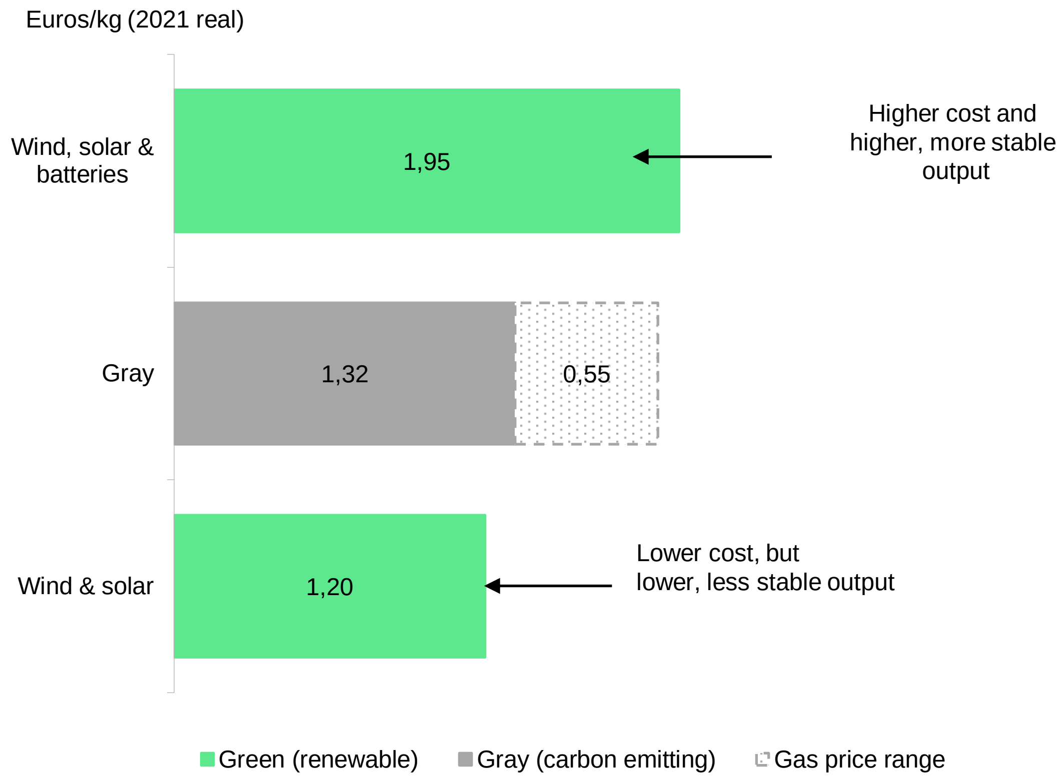
Capex and duration of energy storage technologies



*Source: BloombergNEF. Note: *compressed air with underground storage.*

Emerging opportunities for green hydrogen use and production post-2030

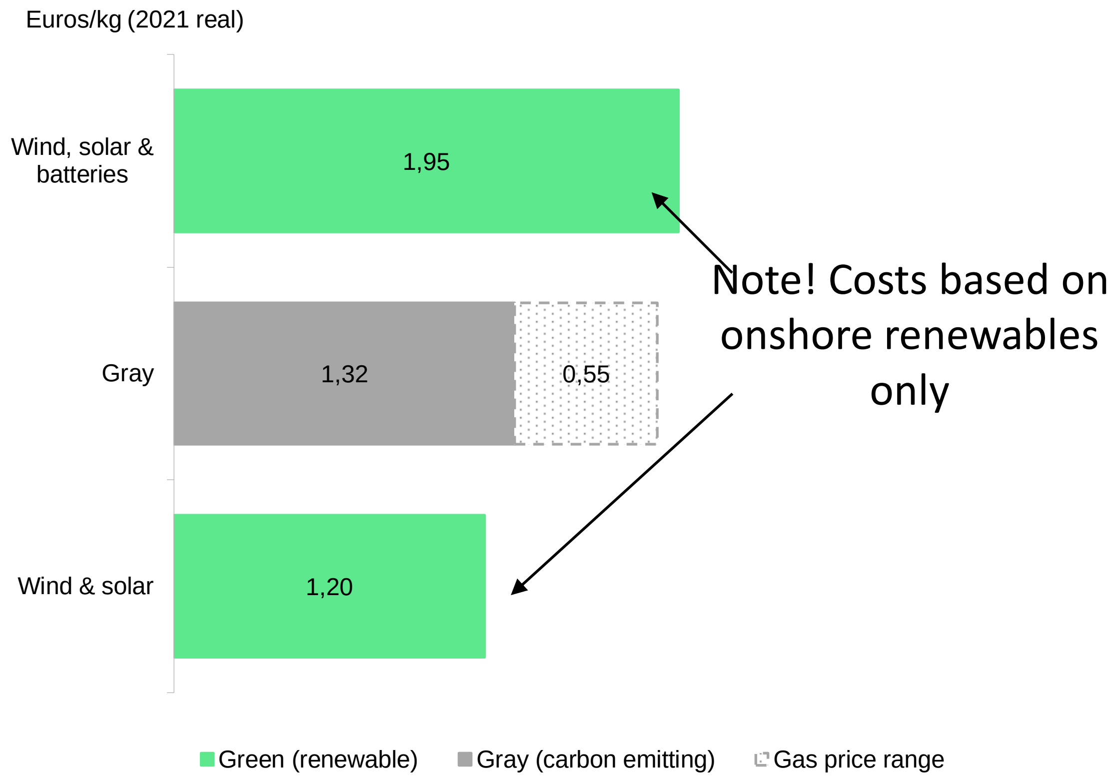
Levelized cost of grey and green hydrogen in Poland, 2030



Source: BloombergNEF. Note: based on Belchatow RES resources

Emerging opportunities for green hydrogen use and production post-2030

Levelized cost of grey and green hydrogen in Poland, 2030



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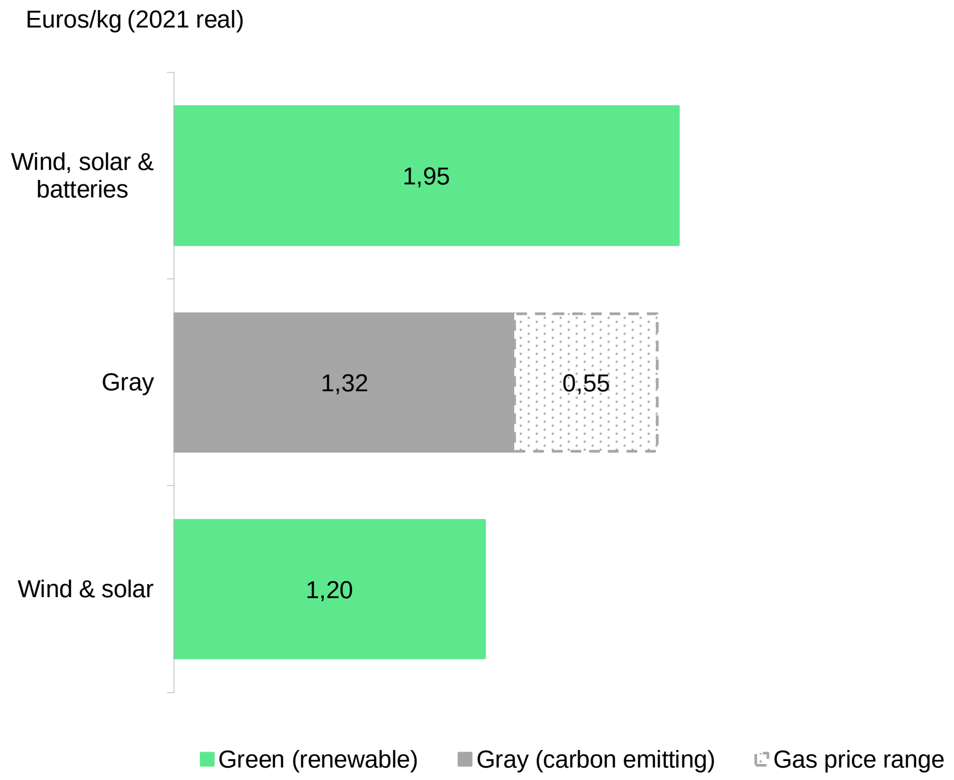
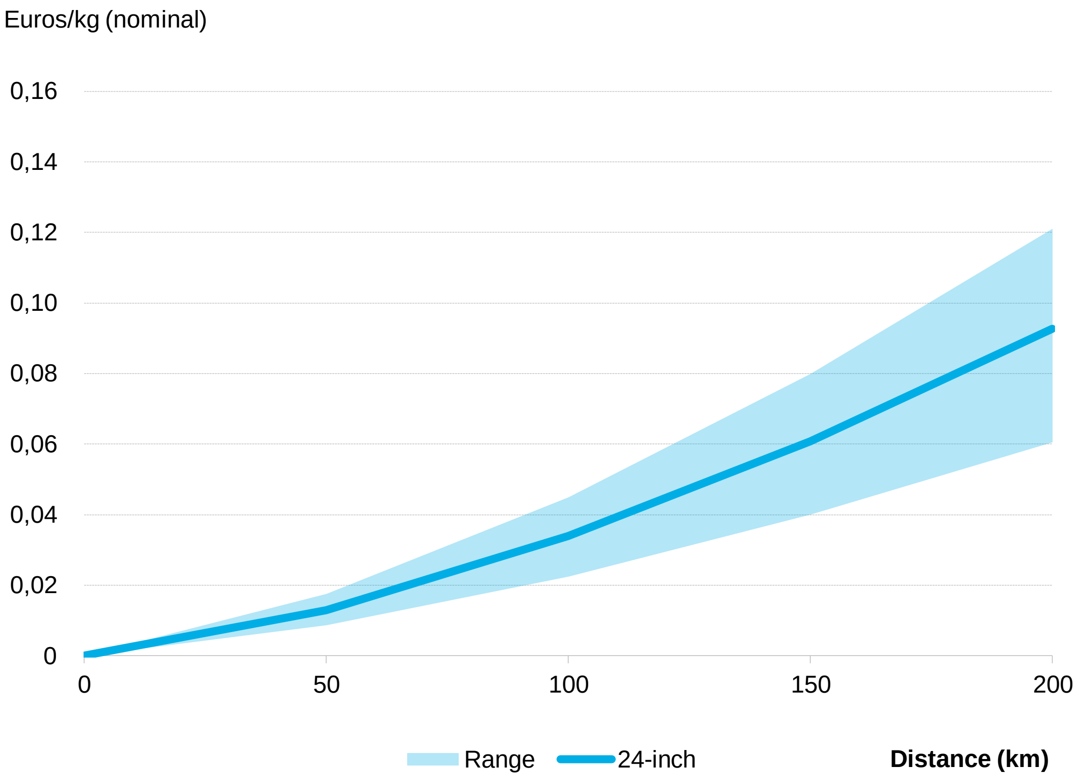
Emerging opportunities for green hydrogen use and production post-2030

Levelized cost of grey and green hydrogen in Poland, 2030



Source: BloombergNEF. Note: based on Belchatow RES resources

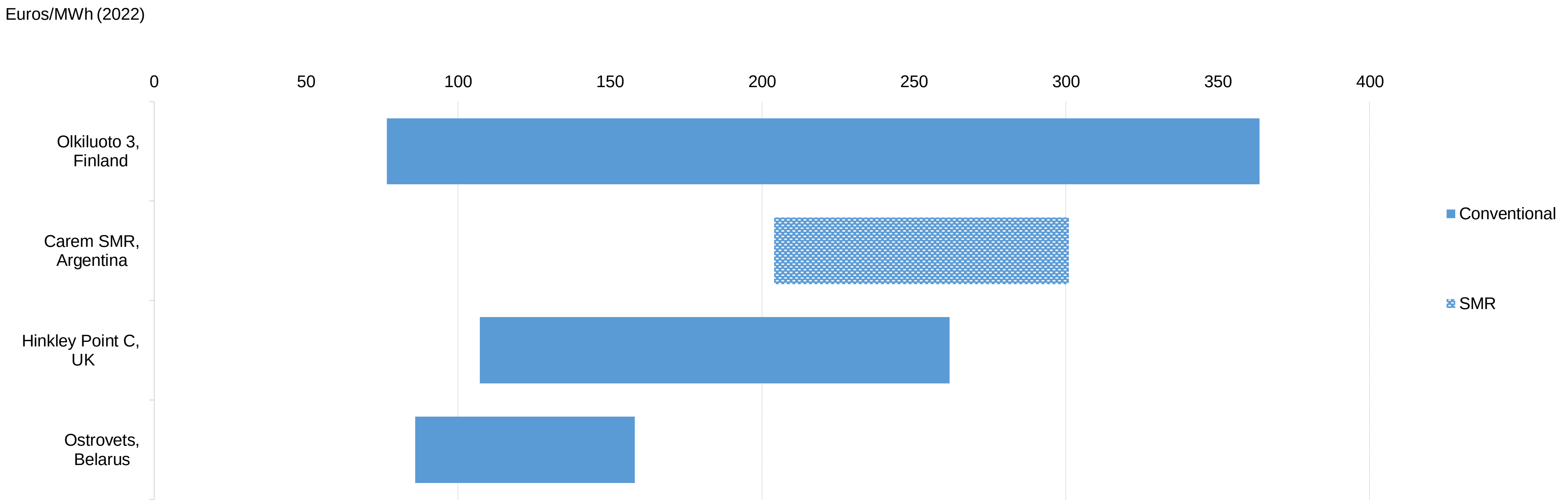
Levelized cost of hydrogen pipeline transport per distance up to 200km



Source: BloombergNEF

Nuclear costs are unpredictable but SMRs could complement renewables post-2030

Nuclear LCOEs



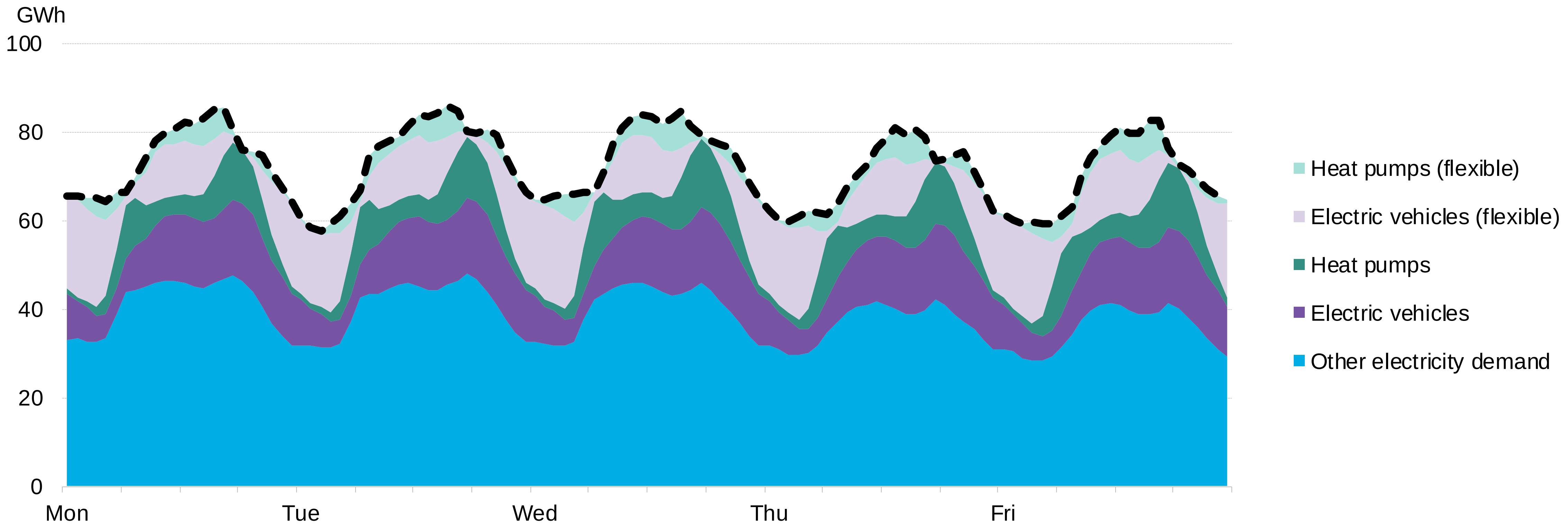
Source: BloombergNEF

Bloomberg Philanthropies

Forum Energii

Flexible demand solutions will be crucial in high-renewables power system

U.K. hourly demand in a typical winter week in 2050, Net Zero Scenario



Source: BloombergNEF.

Case study: Europe’s largest coal plant

Belchatow power plant in Poland

Belchatow is the 6th largest coal power plant on Earth

Source: Flickr

5.1GW

Installed capacity in Belchatow

33.2 MtCO2

Belchatow carbon emissions in 2021

7,500

Number of people employed in mines and power plants

Belchatow is the 6th largest coal power plant on Earth

Source: Flickr

5.1GW

Installed capacity in Belchatow

33.2 MtCO2

Belchatow carbon emissions in 2021

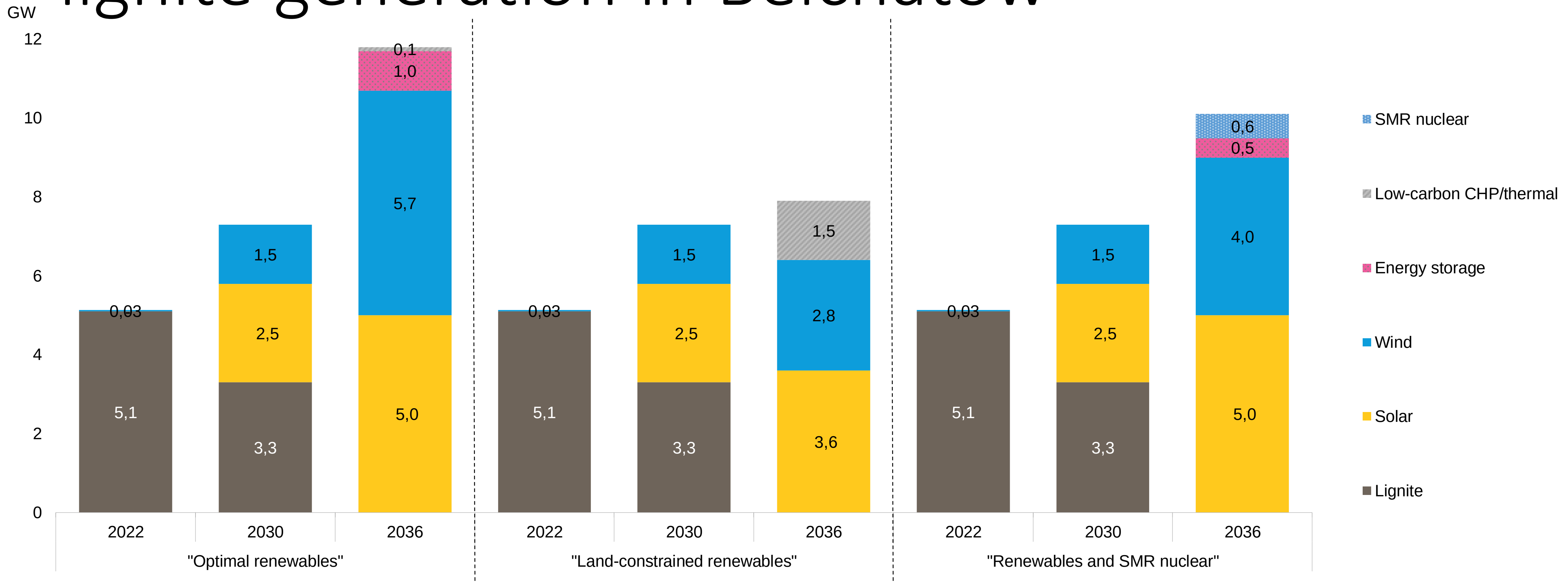
~10% of all Poland CO_2 emissions

7,500

Number of people employed in mines and power plants

Case study: Europe’s largest coal plant

Three potential capacity mixes to replace lignite generation in Belchatow



Source: BloombergNEF

BloombergNEF (BNEF) is a strategic research provider covering global commodity markets and the disruptive technologies driving the transition to a low-carbon economy.

Our expert coverage assesses pathways for the power, transport, industry, buildings and agriculture sectors to adapt to the energy transition.

We help commodity trading, corporate strategy, finance and policy professionals navigate change and generate opportunities.

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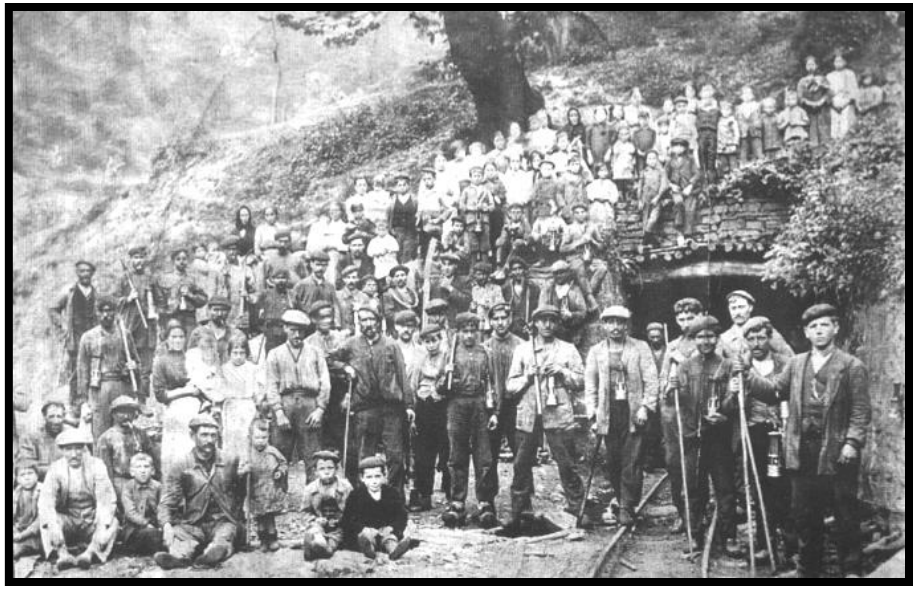
Geothermal projects as a method of developing post-mining areas

Noel Canto Toimil
Head of Department of Innovation of HUNOSA
noelcanto@hunosa.es

Where and who are we?

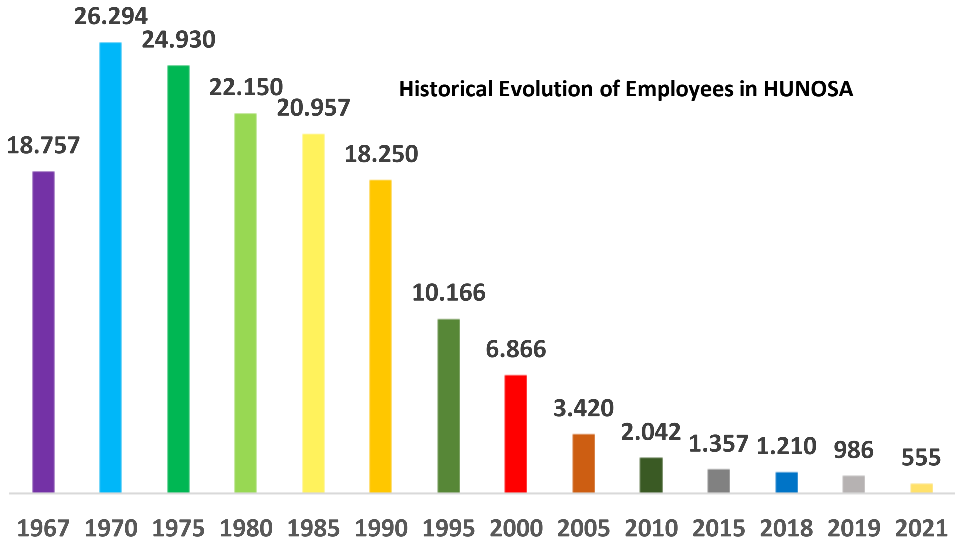
- HUNOSA. Founded in 1967
- Integration of coal mining private companies
- Coal extraction: underground and open pit
- More than 70 collieries and more than 2.000 mountain mines



HUNOSA nowadays

Current situation

- One underground mine in operation
- Power plan (50 MW_e) + CO_2 capture plant
- Coal treatment plan
- Diversification activities



Continuous reduction in the number of collieries and workers

Colliery: *San Nicolás*

Power station: *La Pereda*

Treatment plan: *Batán*

Our present and our future

Diversification activities

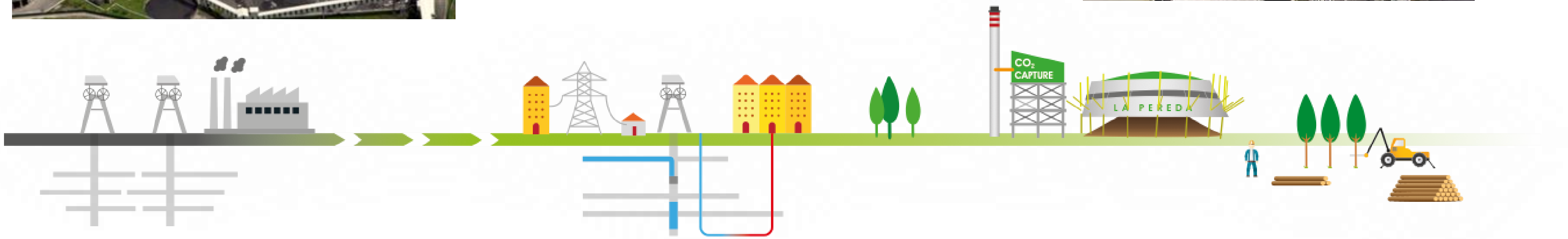
- Geothermal energy from mine water
- Biomass
- New uses for the coal treatment plan
- Adaptation of La Pereda Power Plant for new fuels
- Hydrogen

BIO
MASS

ECO
COMBUSTION

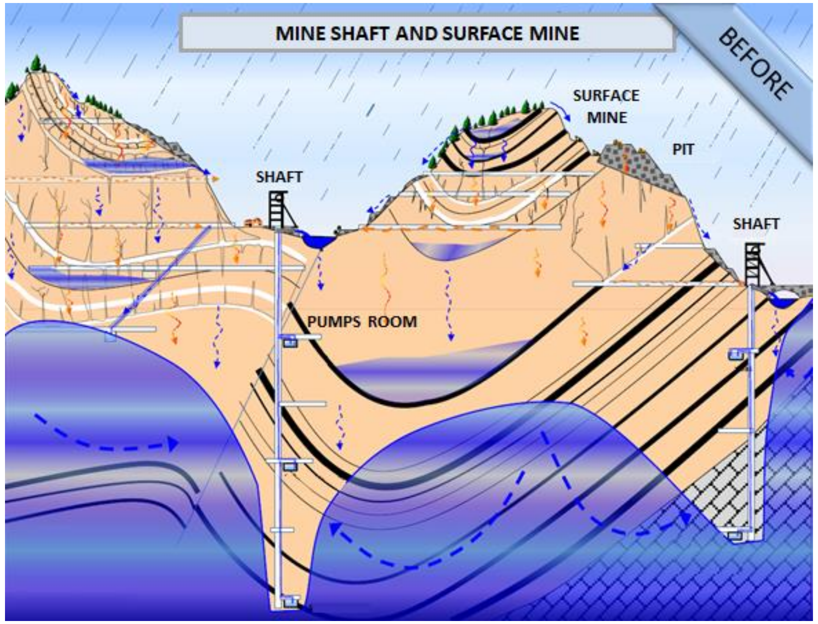
NEW
USES

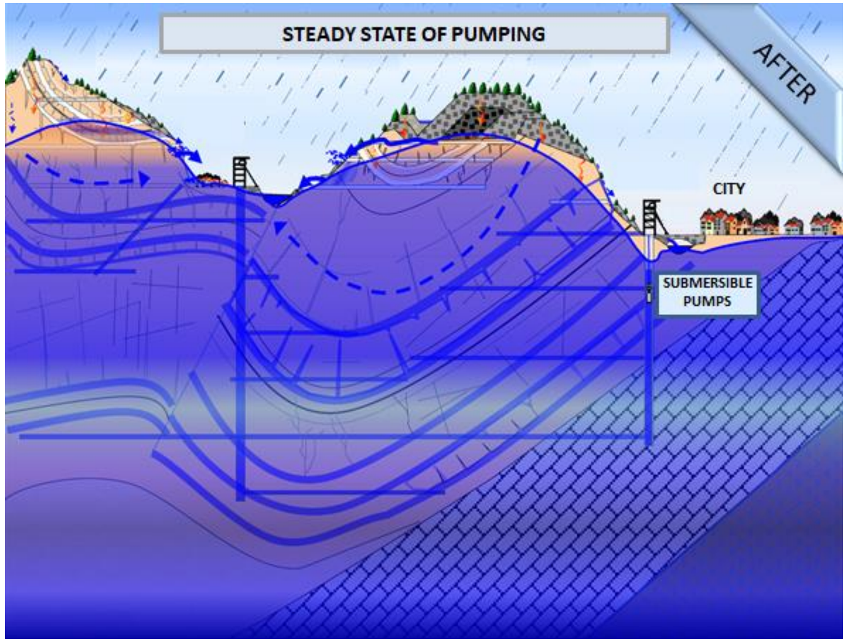
GEO
THERMAL



Mine water: our resource

WHY DID WE START THINKING ABOUT GEOTHERMAL ENERGY?





- Flooding after mine closure
- Keeping a safety water level to avoid damaging buildings, infrastructures, etc.
- Permanent pumping costs (ever-lasting charges).
- Geothermal energy:
  - source of income to offset pumping expenses
  - renewable resource with mine water (from being considered a waste product to being a resource)

Geothermal energy. Our facilities

Geothermal facilities linked to Barredo Colliery

Barredo First facilities, in Mieres (1st phase). *Heating and cooling*
(in operation since 2014 - 2016):

- Hospital of Mieres
- Research Building of the University of Oviedo - Campus of Mieres
- Headquarters of Asturian Energy Foundation

Barredo District Heating, in Mieres (2nd phase). *Heating and domestic hot water*
(in operation since 2020):

- Dwellings: Blocks of apartments
- Secondary School
- Main building of the University of Oviedo – Campus Mieres.


Junio 2020

Dirección de Energía, Desarrollo de Negocio e Innovación de HUNOSA

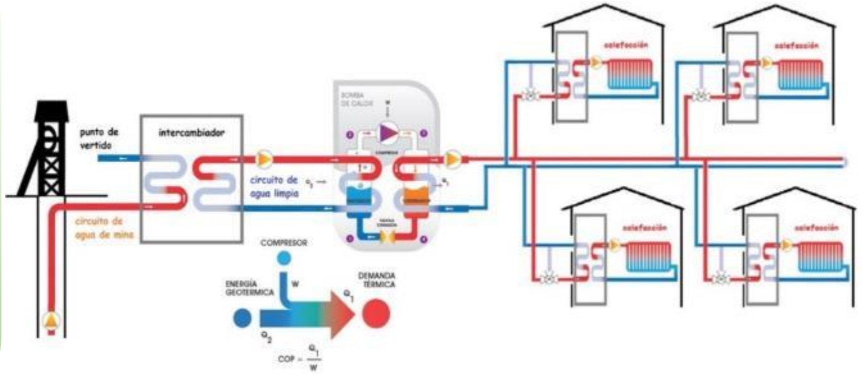
PLAN GENERAL DE DESARROLLO DE REDES DE CALOR

Plan for the development of district heating systems

Geothermal facilities linked to El Fondón Colliery

Langreo District Heating (1st phase). *Heating and domestic hot water*
(in operation since 2022)

- Residential building
- Public Health Centre
- Hotel and Geriatric Centre (elderly residence)
- Sport Centre



Geothermal energy. Our facilities

First and second phase.
Barredo Colliery (Mieres)


1- Hospital Álvarez-Buylla


2- Edificios Campus Universitario


3- Fundación Asturiana Energía


4- Instituto Bernaldo Quirós


5- Edificio M9 - Mayacina


6- Edificio M10 - Mayacina


7- Escuela Politécnica Mieres

First phase.
El Fondón Colliery (Langreo)


1 – C. Deportivo Juan Carlos Beiro


2 – Edificio C/ Dolores Ibárruri 9


3 – Residencia N.S. del Fresno

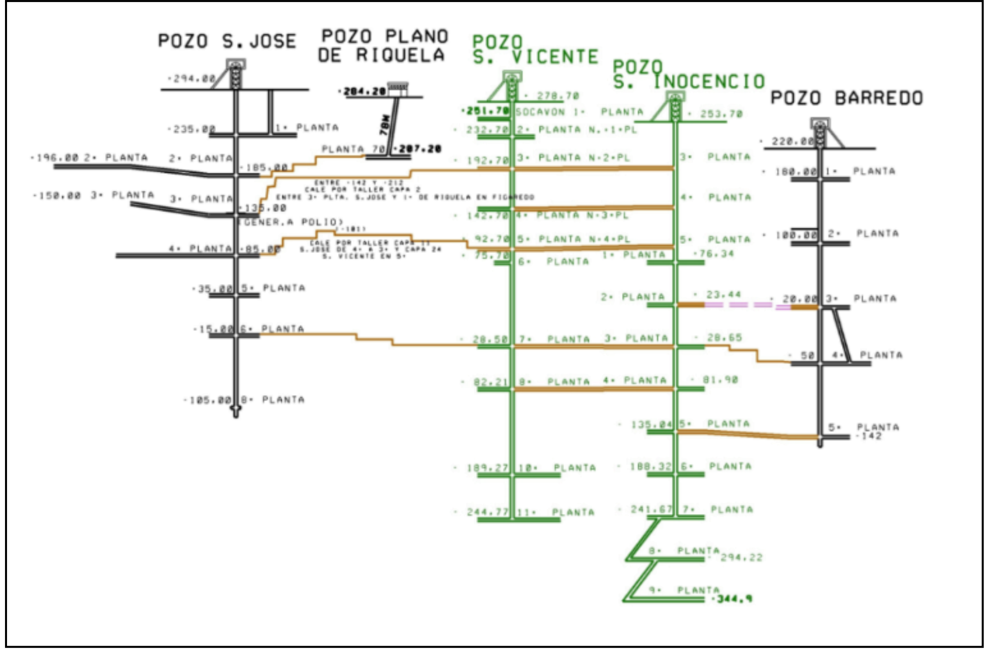

4 – Langrehotel


5 – Centro de Salud La Felguera

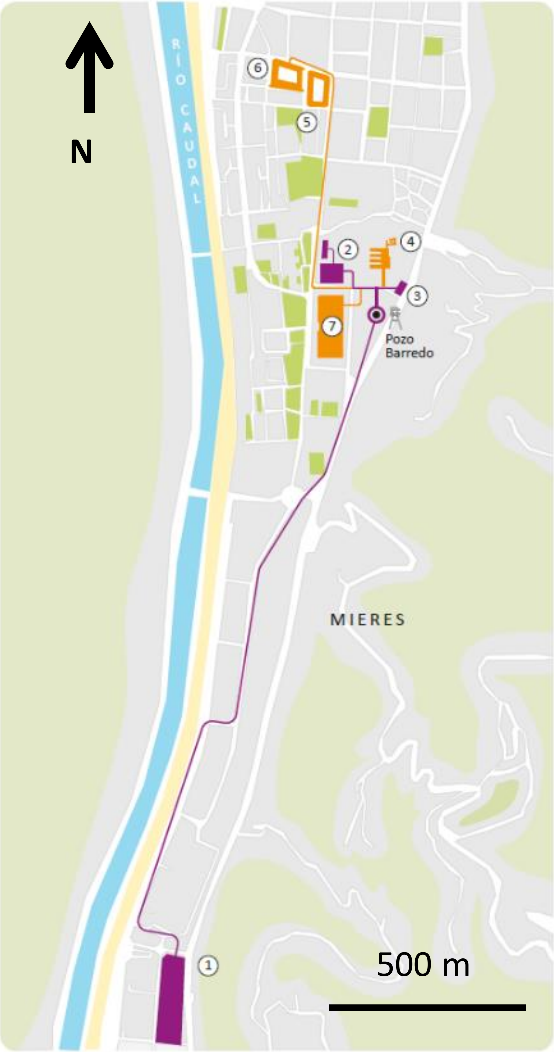
Geothermal energy. Barredo Colliery

- Mine connected hydraulically with others
- In operation from 1937 to 1995
- Depth: 355 m
- Number of levels: 5
- Annual pumped water from Barredo Colliery ≈ 4 Hm^3

  (Total HUNOSA ≈ 35 Hm^3 per year)
- Water temperature: 23 ºC (constant)



Geothermal energy. First phase. Barredo Colliery



1- Hospital Álvarez-Buylla
2- Edificios Campus Universitario
3- Fundación Asturiana Energía

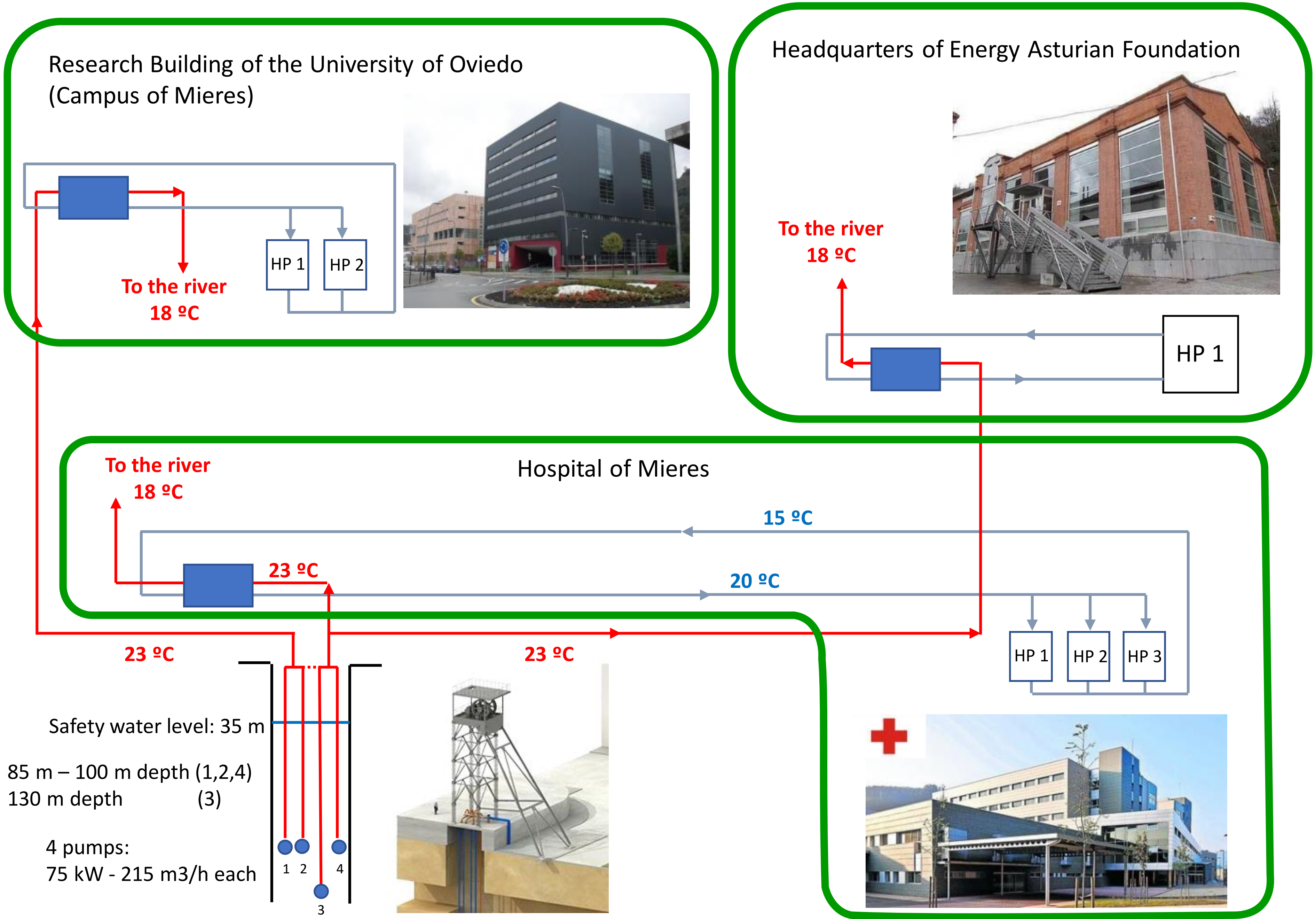
Investment (€)
1.452.156,94

Data referred to 2021

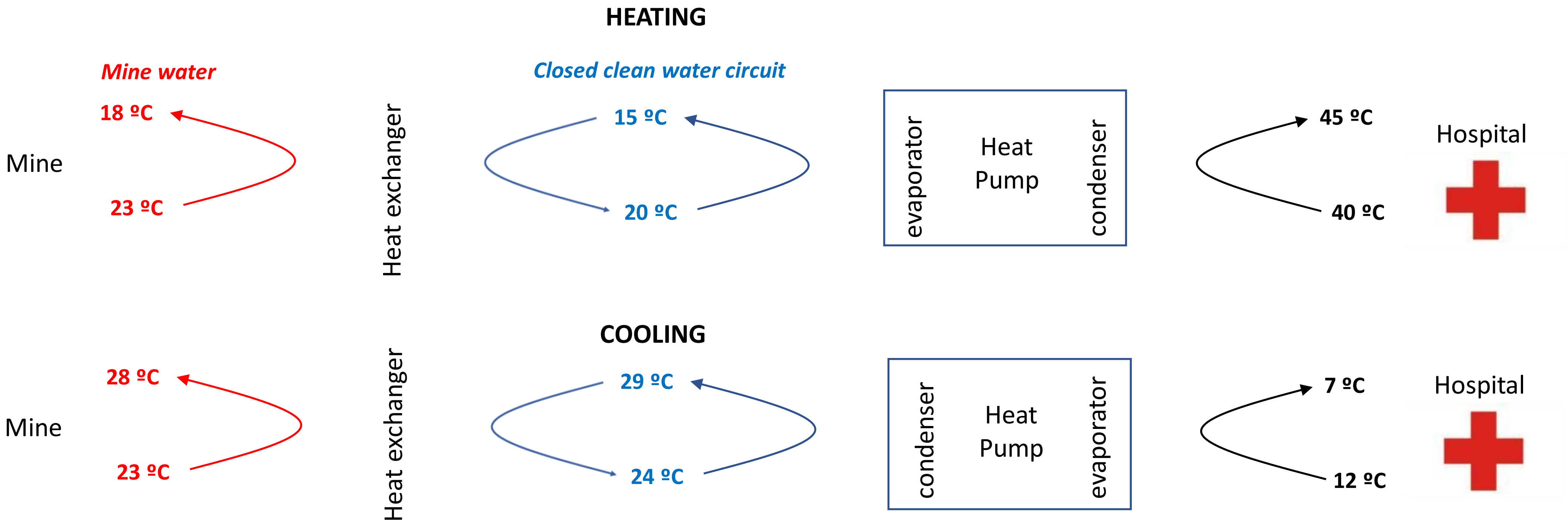
- Energy supplied:
  - Heating: 5.058 MWh
  - Cooling: 2.063 MWh
- Reduction of CO_2 emissions: 1.567 t

		Installed power (kW)	**Thermal energy supplied (MWh)**
Hospital of Mieres	heating	3.800	**4.797**
	cooling	3.000	**2.063**
Research building UO	heating	725	**241**
	cooling	530	**0**
Asturian Energy Foundation	heating	125	**20**
	cooling	100	**1**
Total heating		**4.650**	**5.058**
Total cooling		**3.630**	**2.063**

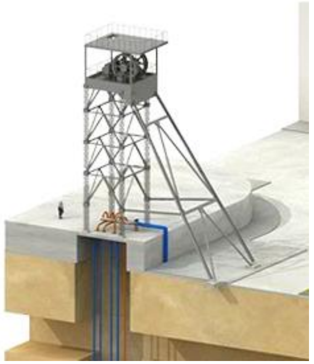
Geothermal energy. First phase. Barredo Colliery



Geothermal energy. First phase. Barredo Colliery



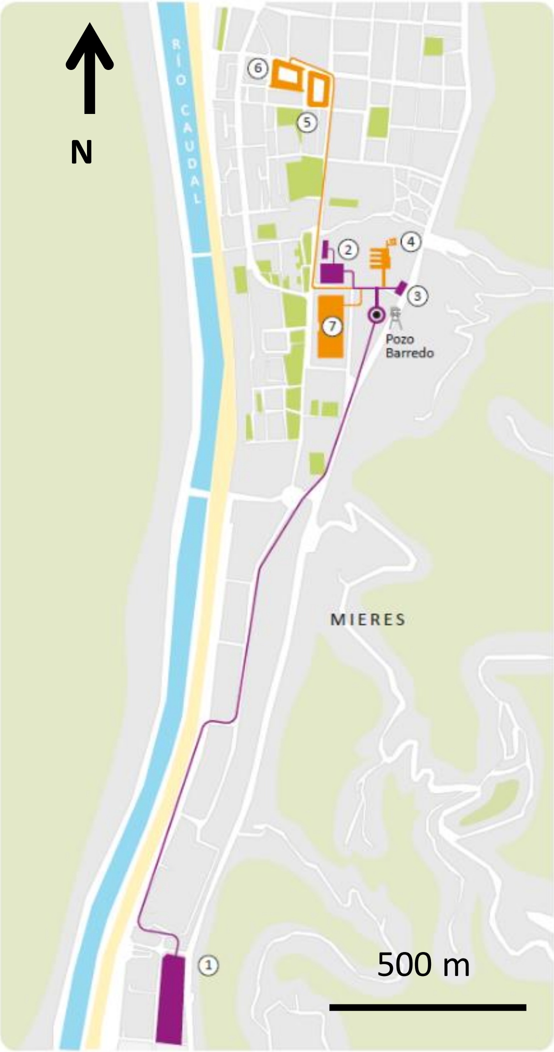
Example for the Hospital of Mieres. The other facilities work in similar way


Shaft


Heat exchanger


Heat pumps

Geothermal energy. Second phase: Barredo District Heating



Investment (€)
1.421.541

SUBVENCIÓN FEDER Fondo Europeo de Desarrollo Regional 503.125 €

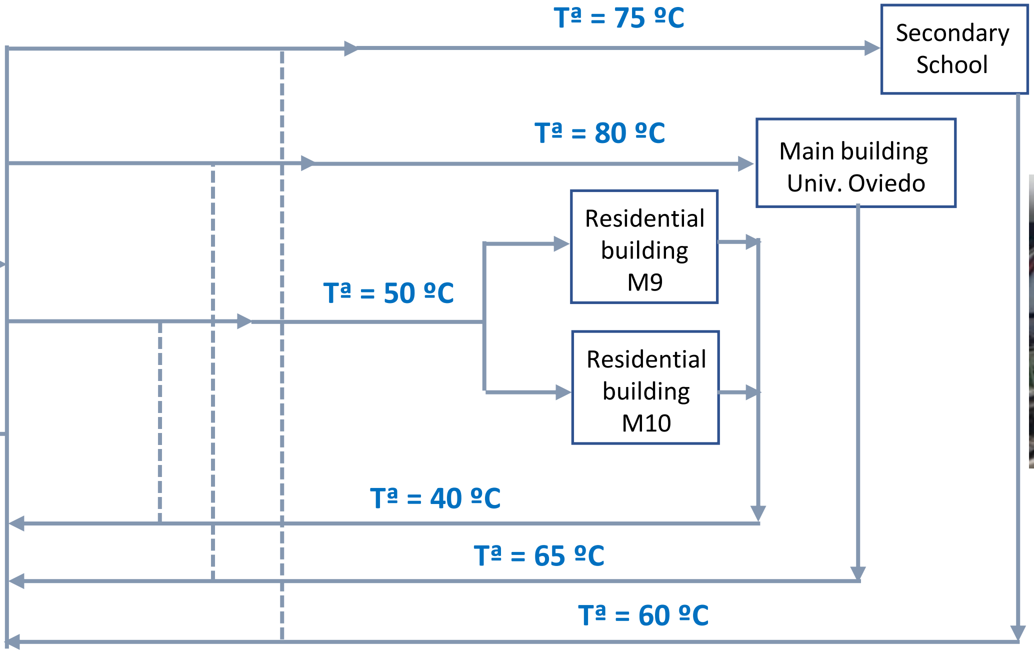
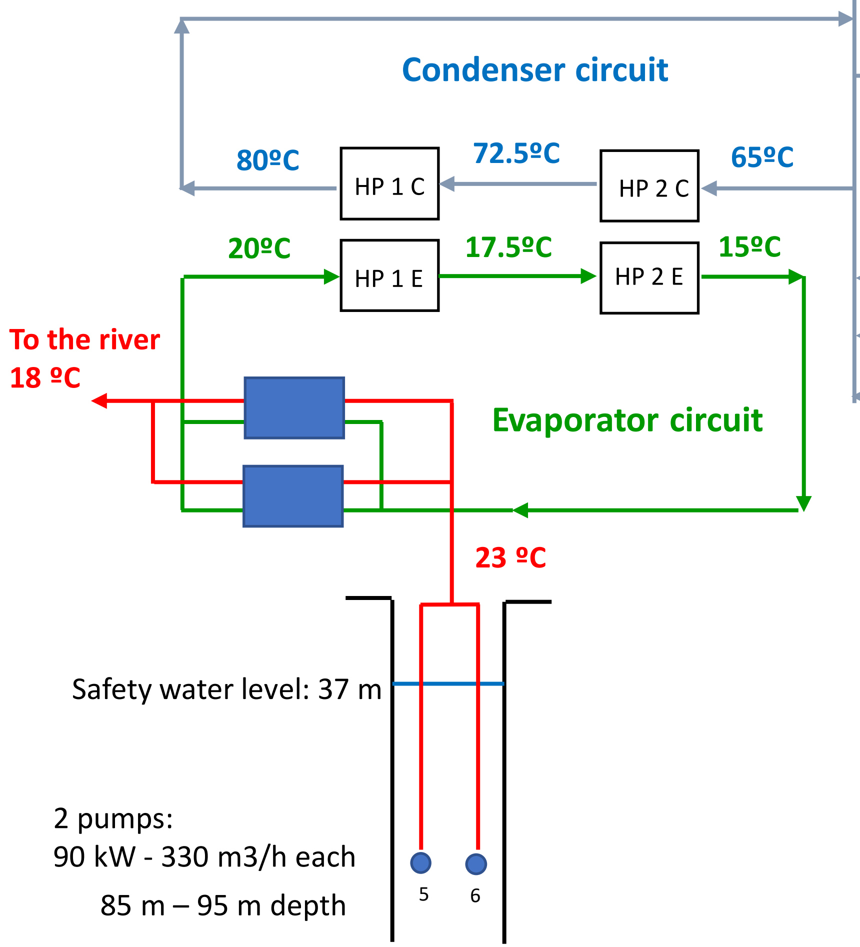
Data referred to 2021

- Energy supplied:
    - Heating + domestic hot water: 1.789 MWh
- Reduction of CO_2 emissions: 451 t

		Installed power (kW)	Thermal energy supplied (MWh)
Main building UO	heating (generation plant) 2 MW	2.000	1.008
Secundary School		500	0
Residential building M9		720	407
Residential building M10		840	374
Total heating		4.060	1.789

Geothermal energy. Second phase: Barredo District Heating


Barredo District Heating generation room


Barredo District Heating pumping system

Barredo District Heating heat pumps


Barredo District Heating heat pumps

Geothermal energy. Barredo Colliery

AWARD OF EXCELLENCE in the category of EMERGING MARKET

International Energy Agency - 6th Global District Energy Climate Awards. 2019

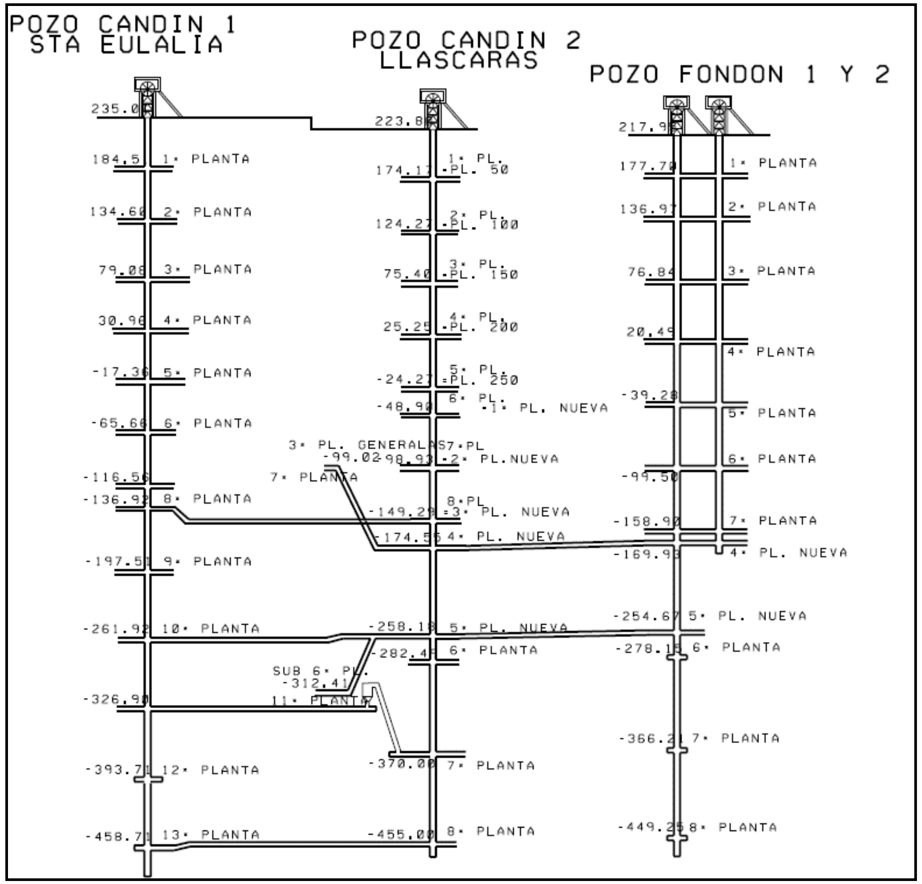
Participation in European Commission funded projects:

GREENJOBS (2022-2025) — GreenJOBS RFCS RESEARCH PROJECT — Research Fund for Coal & Steel

POTENTIALS (2021-2023) — POTENTIALS RFCS AM PROJECT — Research Fund for Coal & Steel

REWARDHEAT (2019-2023) — REWARDHeat — Horizon 2020 European Union Funding for Research & Innovation

Geothermal energy. El Fondón Colliery



- Mine connected hydraulically with another colliery
- In operation from 1905 to 1995
- Depth: 482 m
- Number of levels: 12
- Annual pumped water from El Fondón Colliery ≈ 1.7 Hm^3

  (Total HUNOSA ≈ 35 Hm^3 per year)
- Water temperature: 23 ºC (constant)

Geothermal energy. Langreo District Heating. El Fondón Colliery

Investment (€)
2.235.359,82

1 – C. Deportivo Juan Carlos Beiro

2 – Edificio C/ Dolores Ibárruri 9

3 – Residencia N.S. del Fresno

4 – Langrehotel

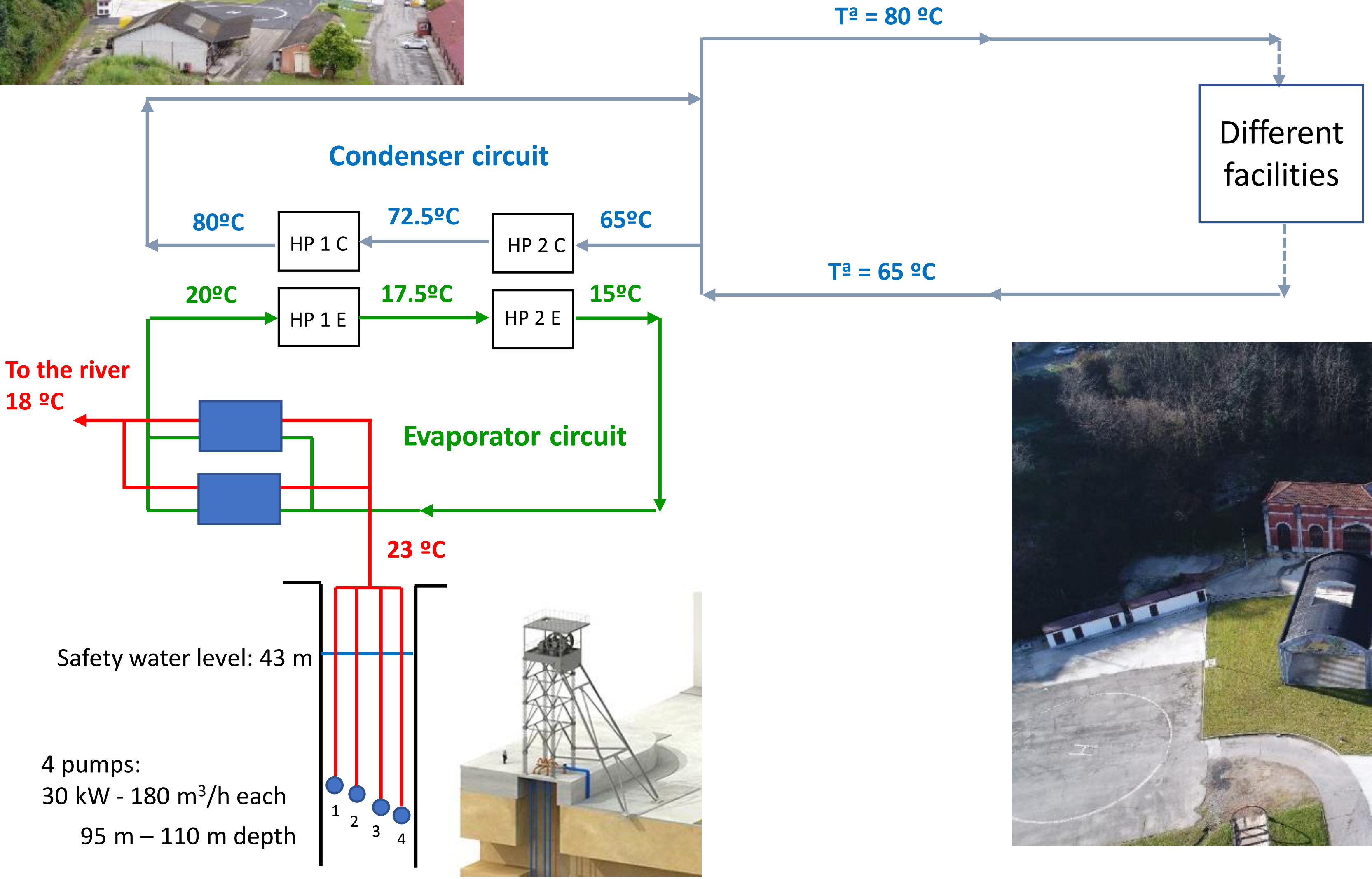
5 – Centro de Salud La Felguera

Estimations for 2022

- Energy supplied:
  - Heating + domestic hot water: 3.488 MWh
- Reduction of CO_2 emissions: 887 t

		Installed power (kW)	**Thermal energy supplied (MWh)**
Sport Centre	heating (generation plant) 1,45 MW	1.000	**1.715**
Health Centre		500	**299**
Hotel and Geriatric Centre		800	**1.302**
Residential building		200	**132**
Total heating		**2.500**	**3.448**

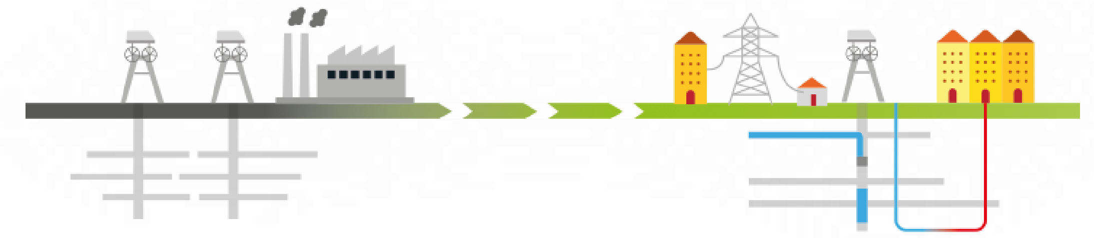
Geothermal energy. Langreo District Heating. El Fondón Colliery



Lessons learnt

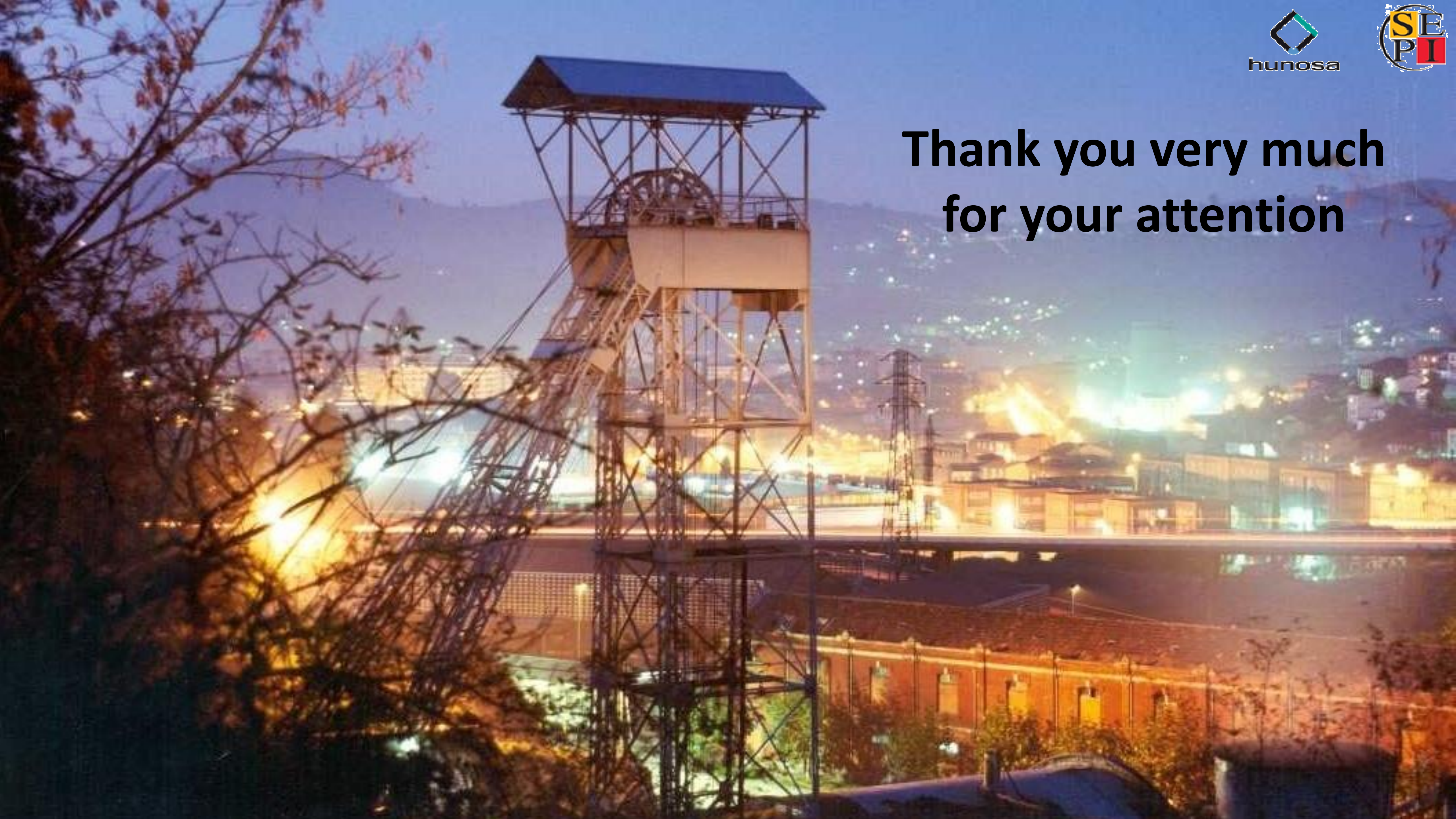
Key aspects to have into account to harness the heat of the mine water.

- Centralized heating system.
- Shaft close to the clients.
- Profitability. Need to pump water.
- Difficult to persuade clients about the feasibility of the project even when we:
  - provide renewable energy.
  - guarantee saving in the energy cost.
  - carry out maintenance, replacement of components, etc.
- Detailed study of the:
  - Resource: “mine aquifer”, flow rate, temperature, etc.
  - Demand: temperature, timing, heating/cooling, etc.



Why to development of district heating instead of individual facilities?

- Lack of space for geothermal equipment in the buildings which we supply energy to
- No enough electrical power installed in the buildings for the use of heat pumps
- Efficiency


Thank you very much
for your attention

gravitricity

Underground Energy Storage

Just Transition Introduction

Charlie Blair
Managing Director
Charlie.blair@gravitricity.com

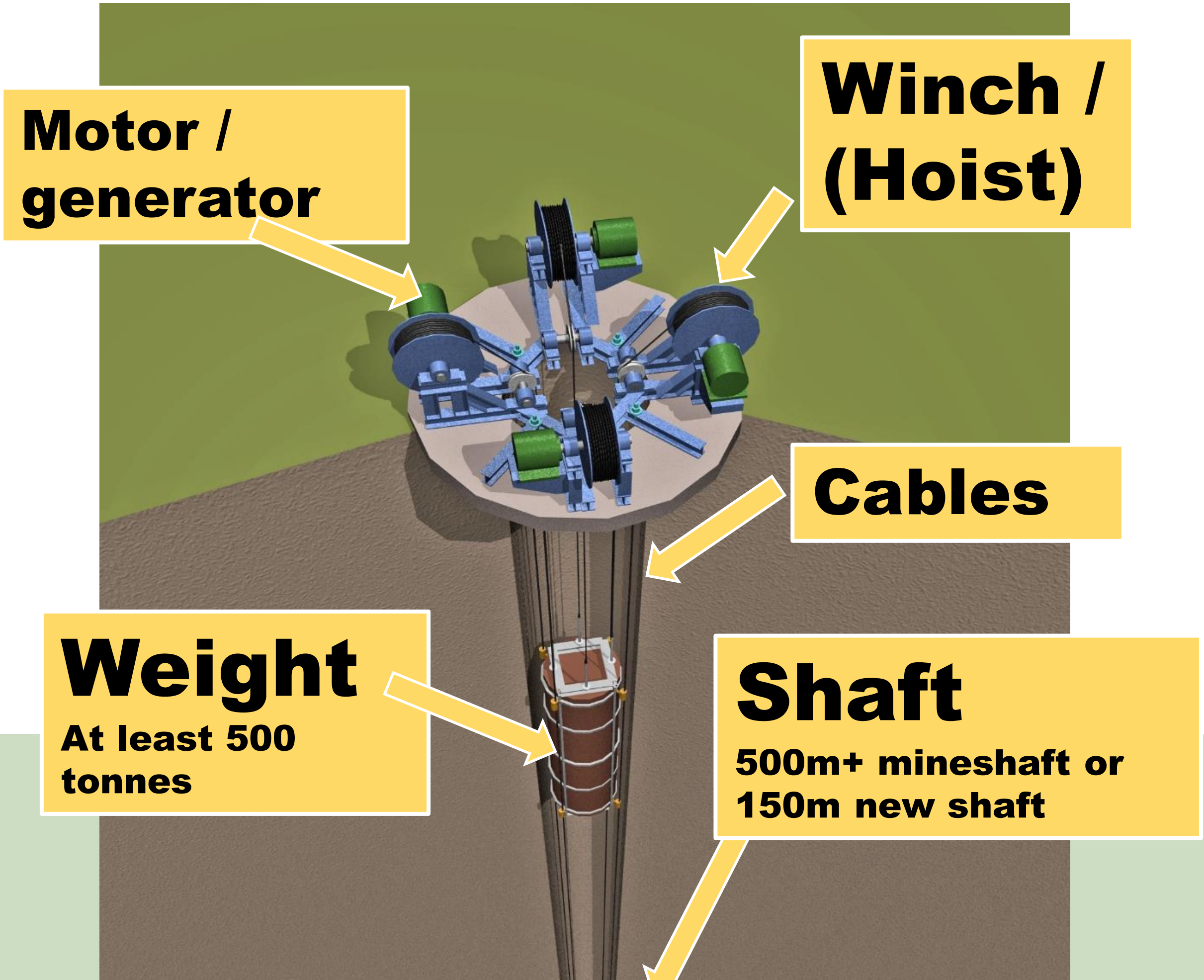
Brussels 2022

Gravitricity exists to accelerate the global transition to 100% renewable energy

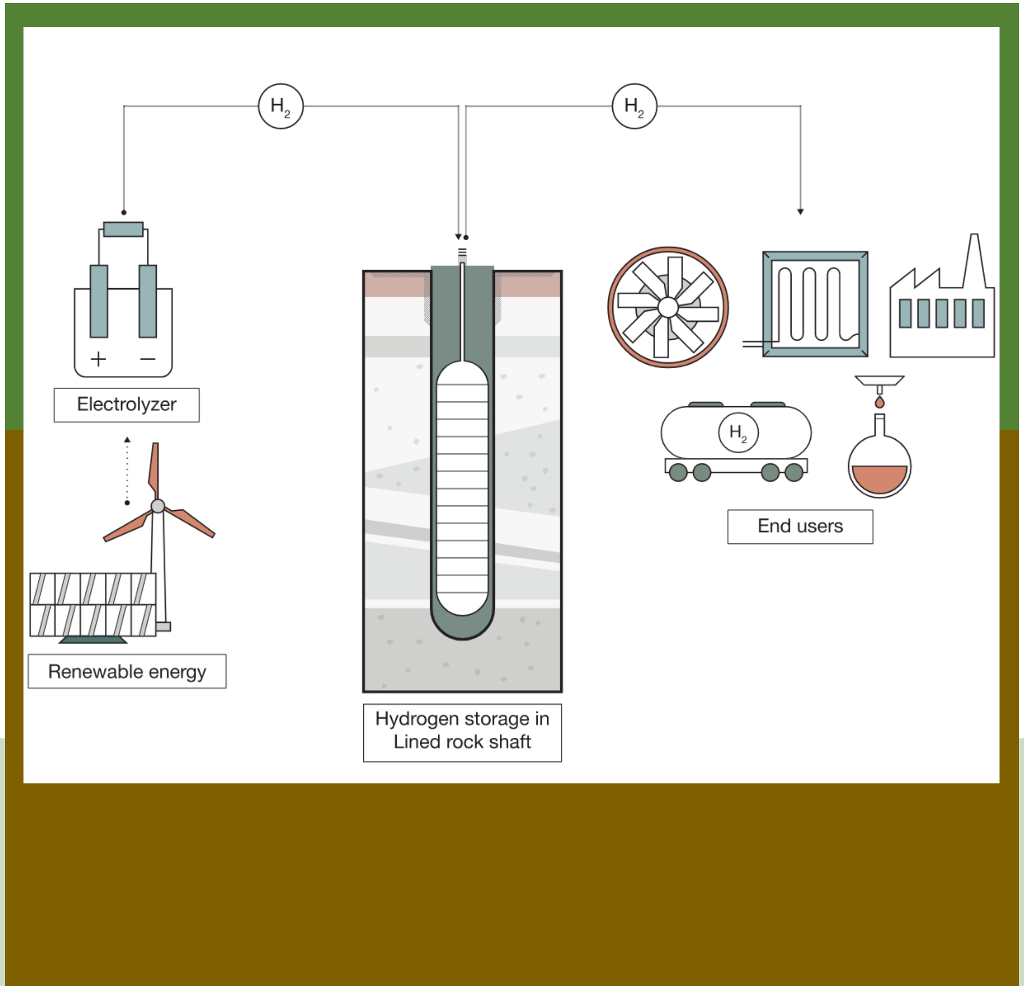
Technology

gravitricity

Underground Power Storage



Underground fuel-gas storage (H2)



Technology

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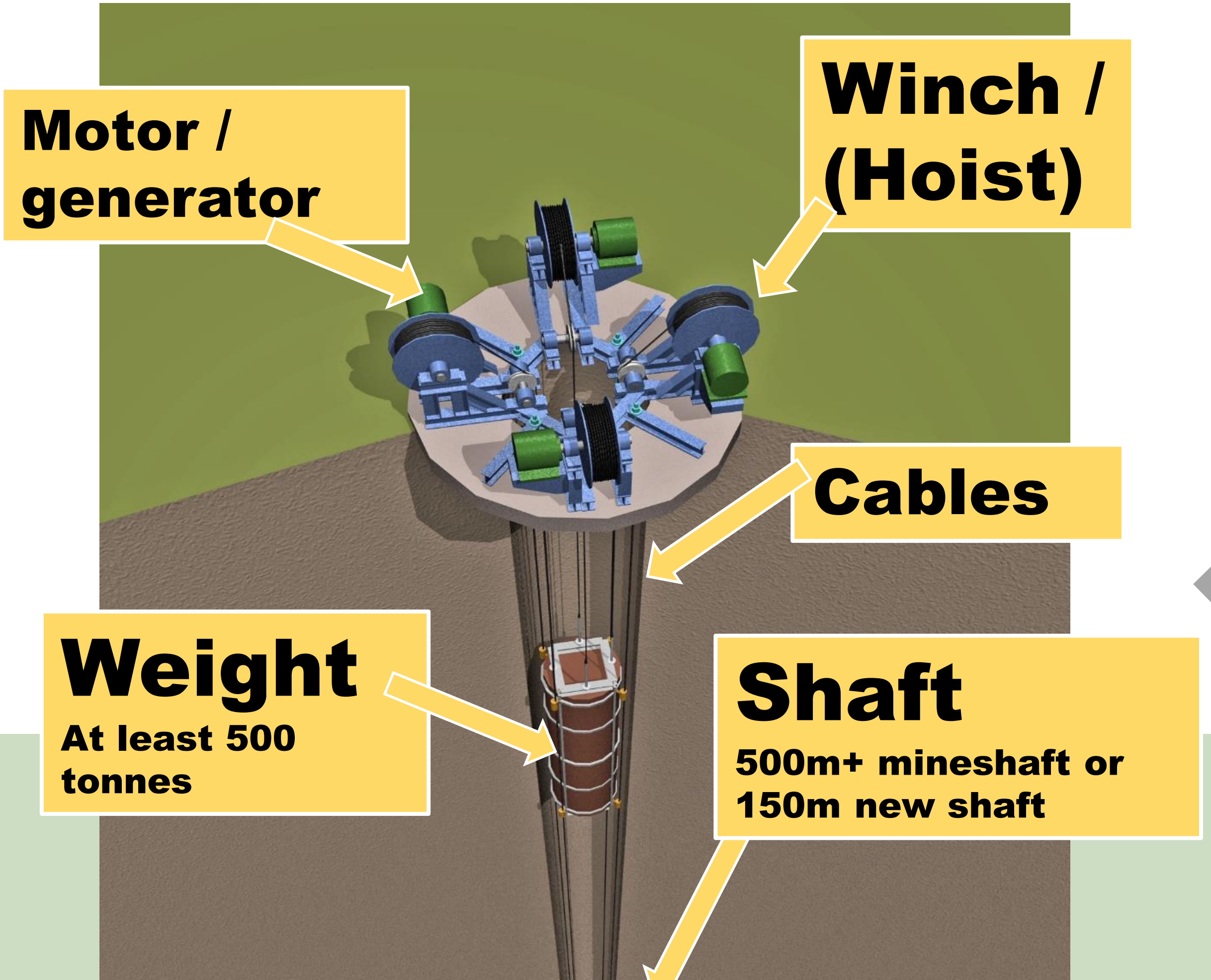
Underground Power Storage



This is why I'm here: Mineshaft Power Storage

European Coalmines:

- Typically ~750m deep
- Multiple Opportunities – 2x shafts each mine
- Currently closing – mine closure opportunity

250kW Demo 2021

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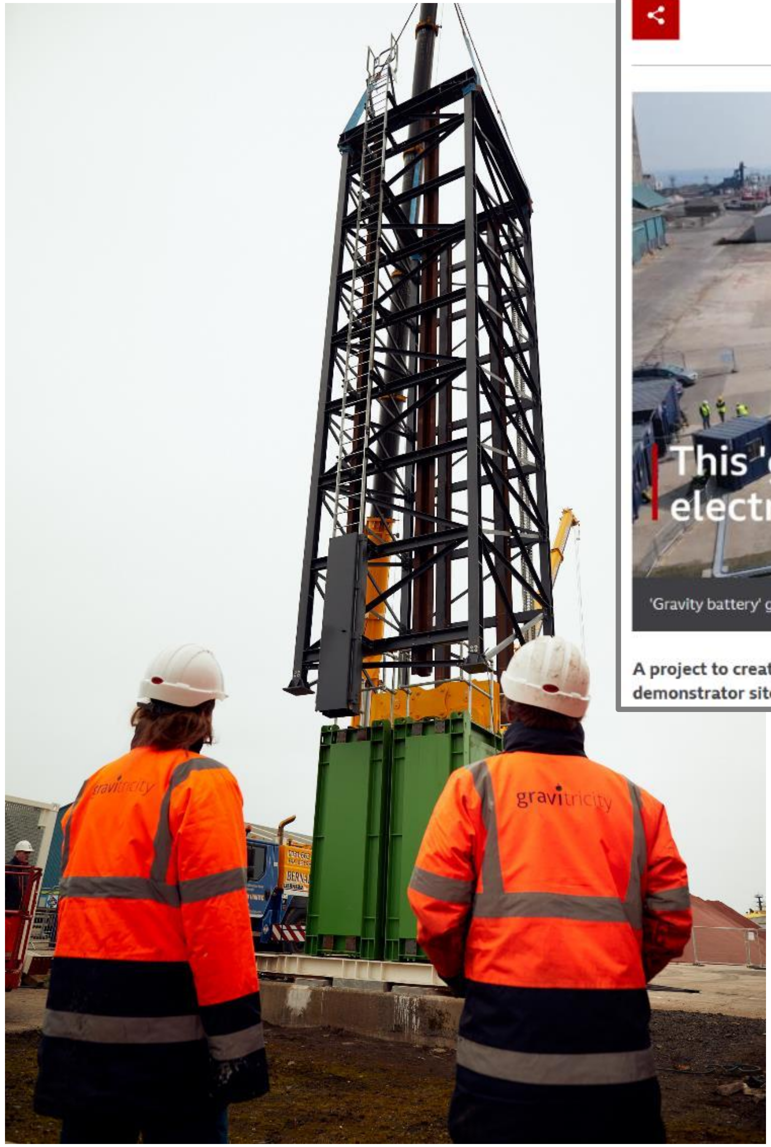
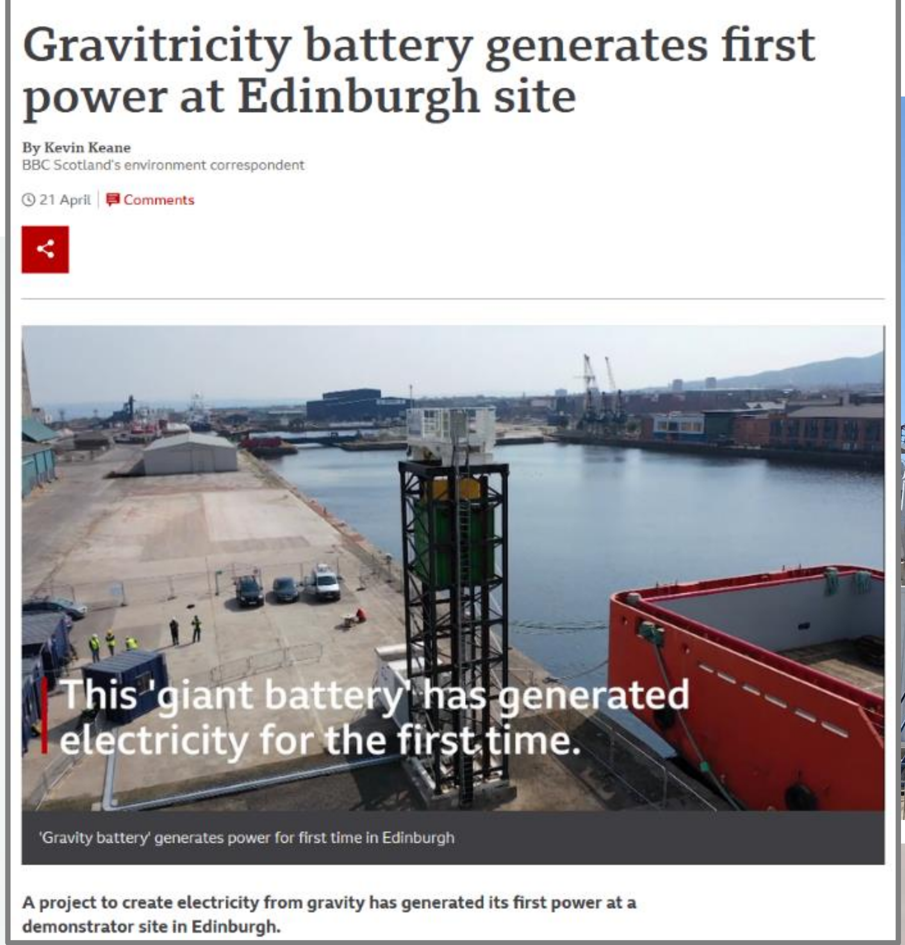




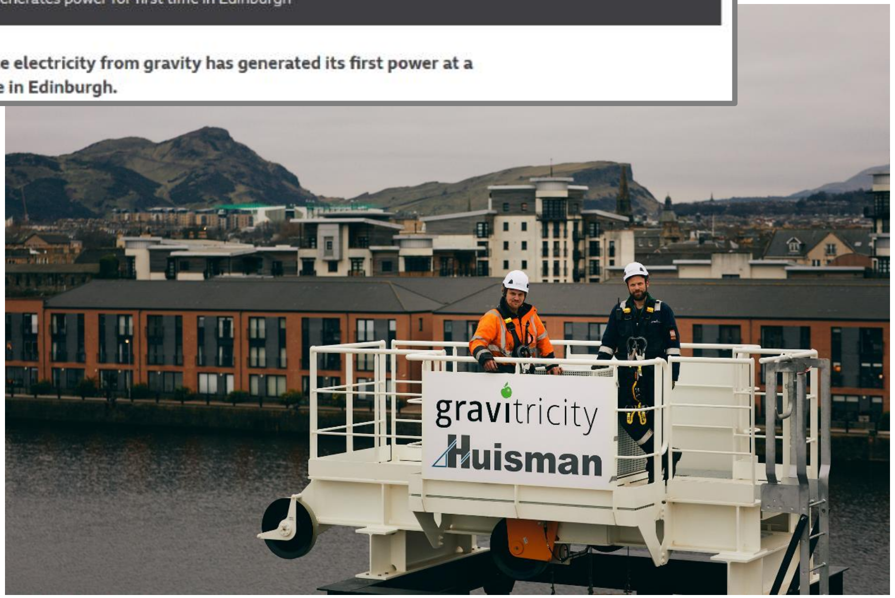
Gravitricity battery generates first power at Edinburgh site

By Kevin Keane
BBC Scotland's environment correspondent

21 April | Comments

'Gravity battery' generates power for first time in Edinburgh

A project to create electricity from gravity has generated its first power at a demonstrator site in Edinburgh.



Technical Characteristics

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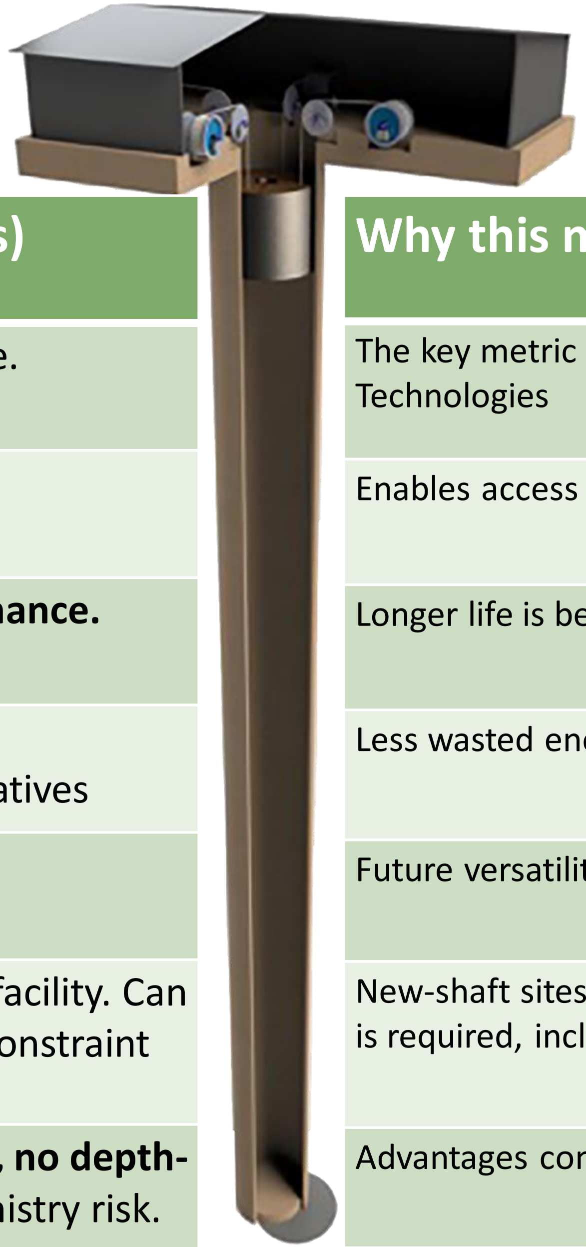

Technical Characteristics (USPs)	Why this matters
Low levelised (lifetime) cost of storage.	The key metric for comparing Energy Storage Technologies
Rapid response: Full rated power <1s	Enables access to higher value revenue streams
Long cycle life with no loss of performance. (75,000+ cycles)	Longer life is better value for customers
High efficiency: 75-85%. As good or better than alternatives	Less wasted energy. No heat management issues
Versatile Power/Energy ratio: 15 min to 4 hour output.	Future versatility is essential. Modular system
Small footprint: <30mx30m for 8MW facility. Can be sunk below ground. No locational constraint at new-shaft sites.	New-shaft sites can be deployed exactly where storage is required, including urban sites.
No parasitic loads, no standing losses, no depth-of-discharge limits. No explosive chemistry risk.	Advantages compared to chemical batteries

August 2022

March 2022

2021

gravitricity

Cz Market

gravitricity

Accessible Revenues emerging (though unproven)

(Study completed in late 2021 for Gravitricity by Nano Energies)

Category	Service/product	FAT*	Auction	Volumes	Renumeration	Capable for Gravitricity
Ancillary services	FCR	30s	Quarterly	90 MW	reservation	✓
Ancillary services	aFRR	5m	Daily	1 100 MW	reservation + activation	✓
Ancillary services	mFRR	12,5m	Daily	500 MW	reservation + activation	✓
Short-term markets	Day-ahead + intra-day	No limit	N/A	No limit	Market prices	✓
Imbalance market	Imbalance market	No limit	N/A	No limit	Market prices	✓

Partnership Approach

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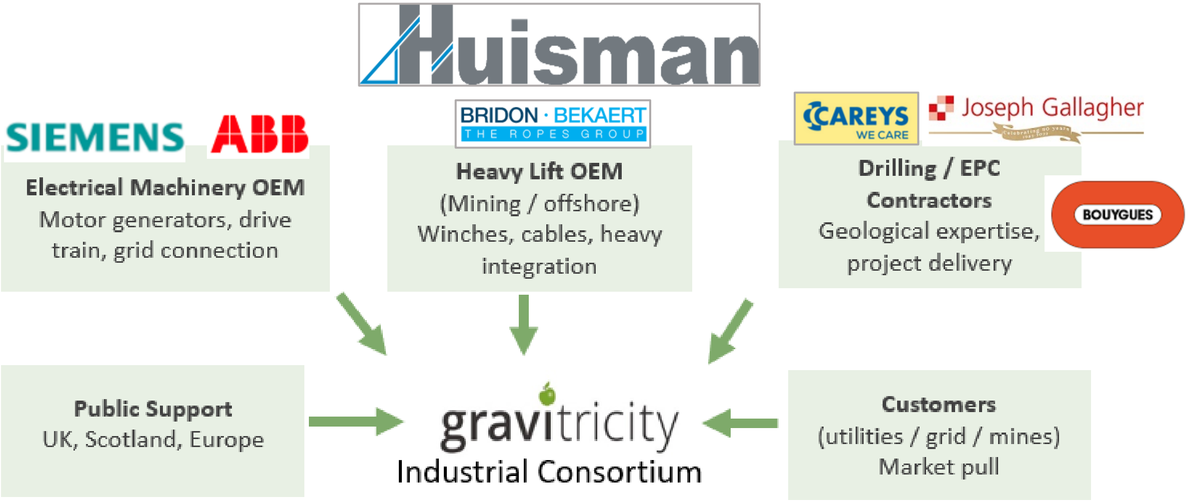
Delivery Partners



Project Partners

- Local & Regional Authorities
- Member State Mining Regulators
- Mine operators
- Mine-closure specialists
- DNOs and TSOs
- Funders
- YOU….

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Long Life Underground Energy Storage

Charlie Blair
Managing Director
Charlie.blair@gravitricity.com

Brussels, October 2022

The solution for green district heating networks

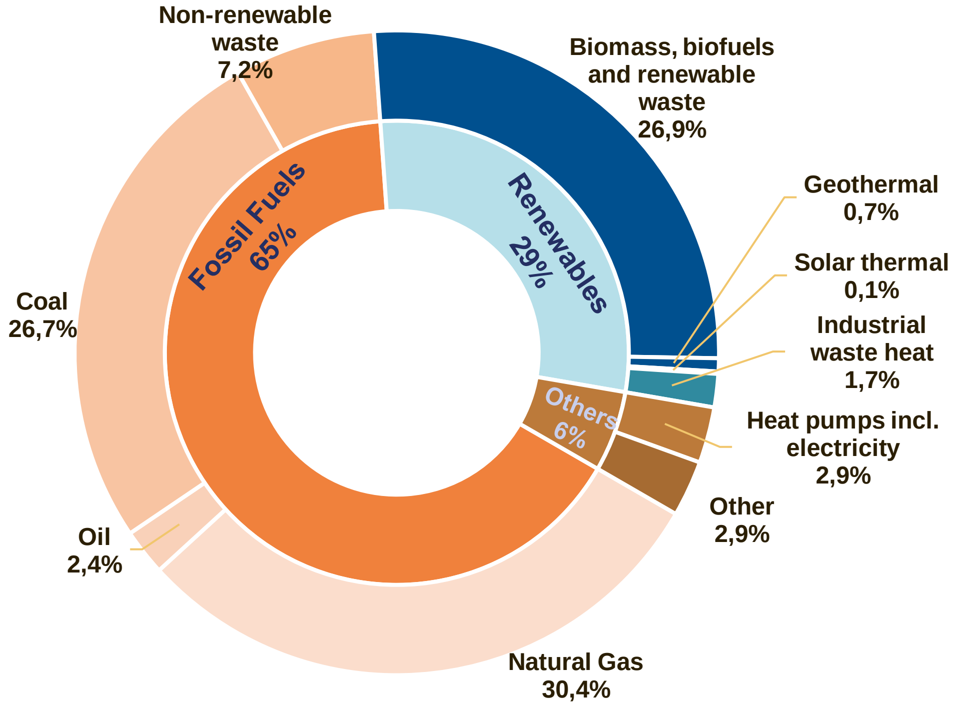
Oct 2022

newheat
fournisseur de chaleur renouvelable

Renewable District Heating

District heating networks - major assets to decarbonize Europe

District Heating - Energy Mix (EU -27)



A key challenge for reducing CO_2 emissions

- The heating and cooling sector represents **50%** of the EU's final energy consumption.
- DHN represent **446TWh** per year of energy provided to residential, commercial and industrial client in the EU
- **Around 65%** of energy consumption of DHN in the EU comes from fossil fuels

Source : Overview of District Heating and Cooling Markets and Regulatory Frameworks under the Revised Renewable Energy Directive

District heating networks are one of the main infrastructures allowing decarbonisation at large scale by integrating renewable and carbon neutral energy sources

Newheat, a 100% renewable heat provider

Decarbonise industrial sites and district heating networks without combustion

Our model

An independent heat supplier, managing projects throughout their entire life cycle

Design → Develop → Build → Operate

Finance

Our vision

Selection of the most virtuous technologies without combustion, combined with innovative heat storage systems

Solar thermal

Short or long-term storage

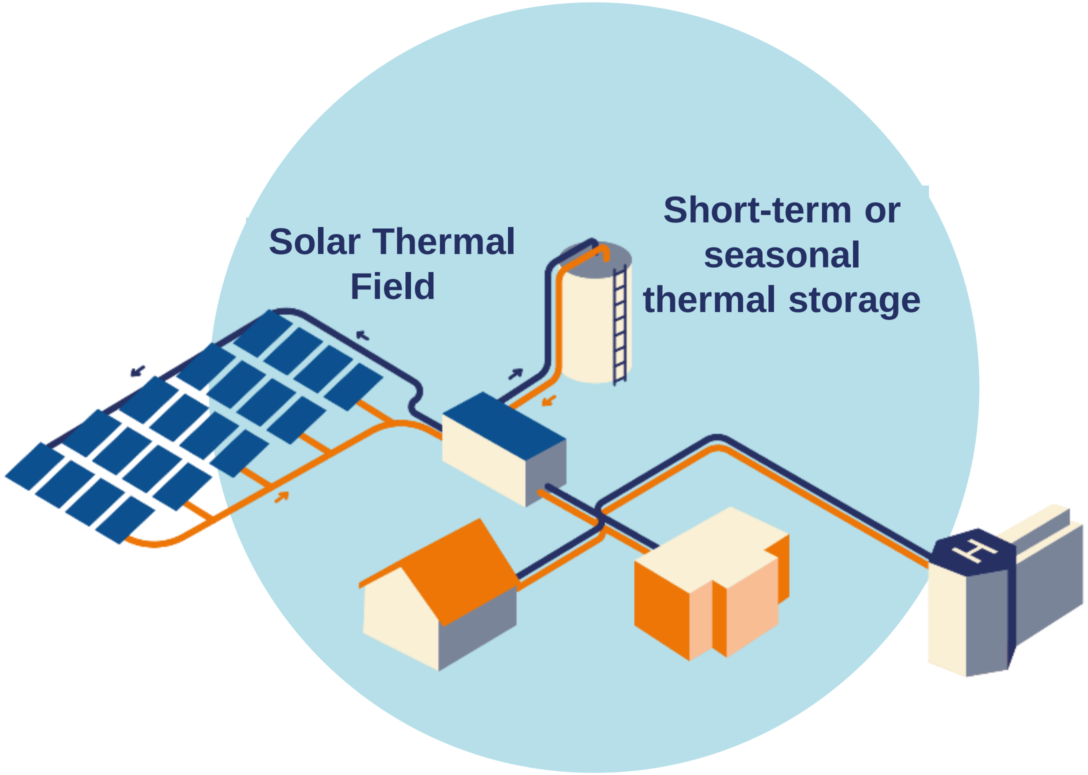
Heat recovery

And also: Heat pumps, geothermal, …

We provide our clients with complete, reliable and competitive decarbonisation solutions, for which we handle the entire set-up and financing over their lifetime

Our technical know-how

Design and operate renewable heating installations, tailor-made your local requirements



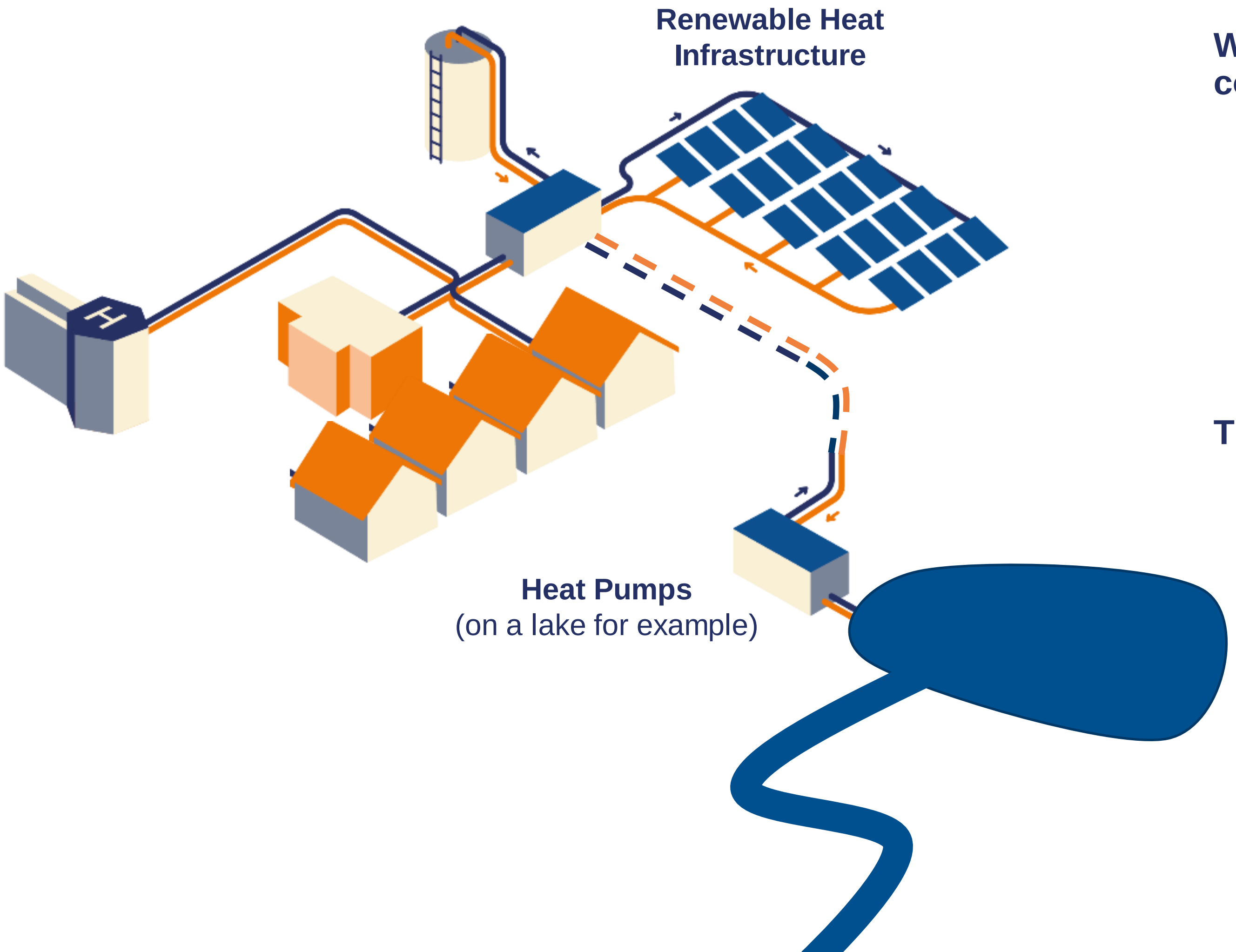
Our approach

- **We model your heat requirement** (energy flow, temperatures, dynamic behaviour, etc.)
- **We analyse the potential for heat recovery and energy efficiency**
- **We design a renewable heat plant tailor-made for your site**:
  - Taking into account the local context (available area, specific administrative rules, etc.)
  - Aiming for an optimal energy mix depending on local ressources and relevant technologies
  - Committing on reliable and competitive technical solutions

A project-by-project approach ensuring a competitive heat price and securing the delivery of energy “at the meter”

Our solution to future-proof your DH network

An evolutive infrastructure to allow for connection of various renewable heat sources



We can propose a Renewable Heat Infrastructure (RHI) which could include:

- renewable heat source(s) (e.g. solar thermal plant)
- thermal storage capacity (short or seasonal storage)
- an optimized heat management plant with dedicated control system

This RHI is designed to accept future evolutions:

- to connect additional heat sources (heat pumps, biomass plants, power-to-heat solutions, heat recovery from mine…)
- increase the renewable share of the district heating network
- allow for flexibiilty on the use of different heat sources thermal storage capacity (short or seasonal storage)

Our offer: third-party investment

Supply of renewable heat as-a-service supply

Our Heat Purchase Agreement with mutual delivery commitment over 15 to 25 years: a competitive heat price with decisive advantages

Lower your energy bill

Maintain your investment capacity

Preserved your independence (inputs, energy market …)

Reduce your greenhouse gas emissions

Stabilize your heat cost

We take care of all aspects of the project:

- Technical: design, implementation and operation
- Financial: financing the entire project, obtaining finance aid (ACCU, Energy Saving Certificate, grants, etc.)
- Administrative: administrative authorizations and land management (search and rental of land, etc.)

Our references

Newheat, leader of solar heat supply for industrial processes and district heating

1st FPC solar thermal plant with trackers in the world

Condat Paper Mill (3,4MW$_{th}$)

Storage: 500 m^3
Commissioning date: January 2019
Design – Build – Own – Operate

LECTA

Largest solar thermal plant in the EU for industry (in operation)

Malteries Franco-Suisses (12,7MW$_{th}$)

Storage: 3000 m^3
Commissioning date: November 2020
Design – Build – Operate

BOORTMALT
> MASTERS OF MALT

Largest solar thermal plant in the EU for industry (in construction)

Milk powder factory (13,1 MW$_{th}$)

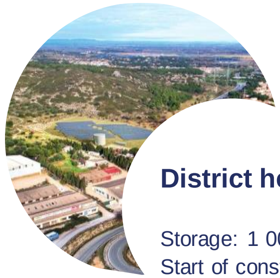
Storage: 3 000 m^3
Commissioning date (expected): Dec 2022
Design – Build – Own - Operate

LACTALIS

Terracotta bricks factory

Storage: 2 000 m^3
Start of construction: Q1 2023
Design – Build – Own - Operate

bouyer leroux



District heating – Narbonne (2,3 MW$_{th}$)

Storage: 1 000 m^3
Start of construction: September 2020
Design – Build – Own - Operate

Malt house in Croatia (15 MW$_{th}$)

Sources: Solar + Heat Pumps
Storage: 6 000 m^3
Start of construction: Q1 2023
Design – Build – Own - Operate

BOORTMALT
> MASTERS OF MALT

2 x bricks factory (4,5 + 6 MW$_{th}$)

Storage: 1 500 m^3 & 2000m^3
Start of construction: Q1 2023
Design – Build – Own - Operate

TERREAL

District Heating City of Pons (1,4 MW$_{th}$)

Storage : 500 m^3
Commissioning date: July 2021
Design – Build – Own - Operate

Focus on Solution for the DHN of Pons

Our references: district heating

District heating of the Pons

PONS

- **Commissioning: July 2021**
- **1st solar thermal plant using trackers**

Newheat's role

Design | Develop | Build | Operate

Finance

Key indicators

- **Power peak:** 1,5 MW_{th}
- **Solar collectors area:** 1 800 m²
- **Total land area:** 0,5 ha
- **Storage capacity:** 500 m^3
- **Annual energy delivery:** ~1 000 MWh pa
- **Avoided CO2 emissions:** ~200 tons pa

Specificity of the site

- The district heating requires 5 GWh pa
- Integration with the biomass boiler
- Storage used for the solar plant as well as for the biomass boiler during winter time

Details on the HPA

- **Grants:** French Energy Agency (ADEME), Région Nouvelle-Aquitaine
- **Client:** Dalkia (district heating manager) and City of Pons
- **HPA duration:** 25 years

Context : district heating network of Pons

Initial situation of the DH network

Description of the DH network :

- Pons, city of 6000 hab. located in the southwest of France (area of Cognac production)
- 5 GWh of annual consumption (public buildings, schools, swimming pool, gymnasium, housing for the elderly, for students, etc.)
- DH network operated since 2009 by DALKIA (EDF subsidiary for energy services) under a public service delegation (DSP)

Situation of the current heat production :

- During the heating season a biomass boiler (2,5 MW) is used as « base load »
- As the biomass boiler cannot be used at low power without significantly degrading its performance, it operates only during the heating period.
- 3 different gas boilers (5 MW in global) are used as complementary during the heating season and as the only produced during the summer season (May to September).
- Over a full year, 73% of the heat is supplied by biomass and 27% by fossil gas

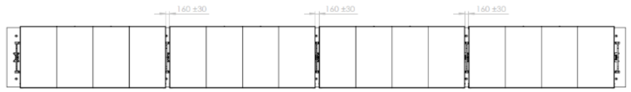
Initial situation (before 2021) : the DH network reach a renewable energy share of 73% but is still emitting CO2 and stays exposed at 27% to the volatility of fossil gas and to the necessary increase in CO2 taxation

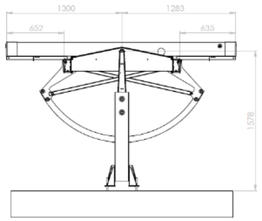
Pons solar project - Technical description

Main components

Solar thermal Field :

- 1800 m² of large Flate Plat Collectors (double glazed)
- Mounted on 1-axis tracking systems (2 objectives: optimize production and prevent overheating)



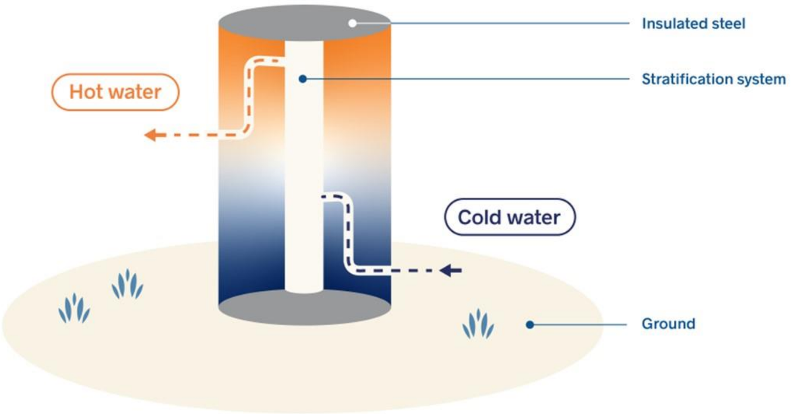


Pons solar project - Technical description

Main components

Heat Storage Tank :

- 500 m3 (12m high)
- Nitrogen inerting to prevent oxidation
- Integration of a stratification system to avoid mixing temperature levels

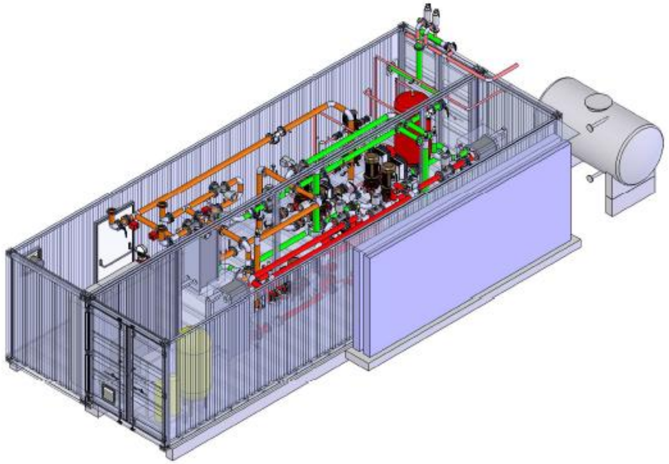


Pons solar project - Technical description

Main components

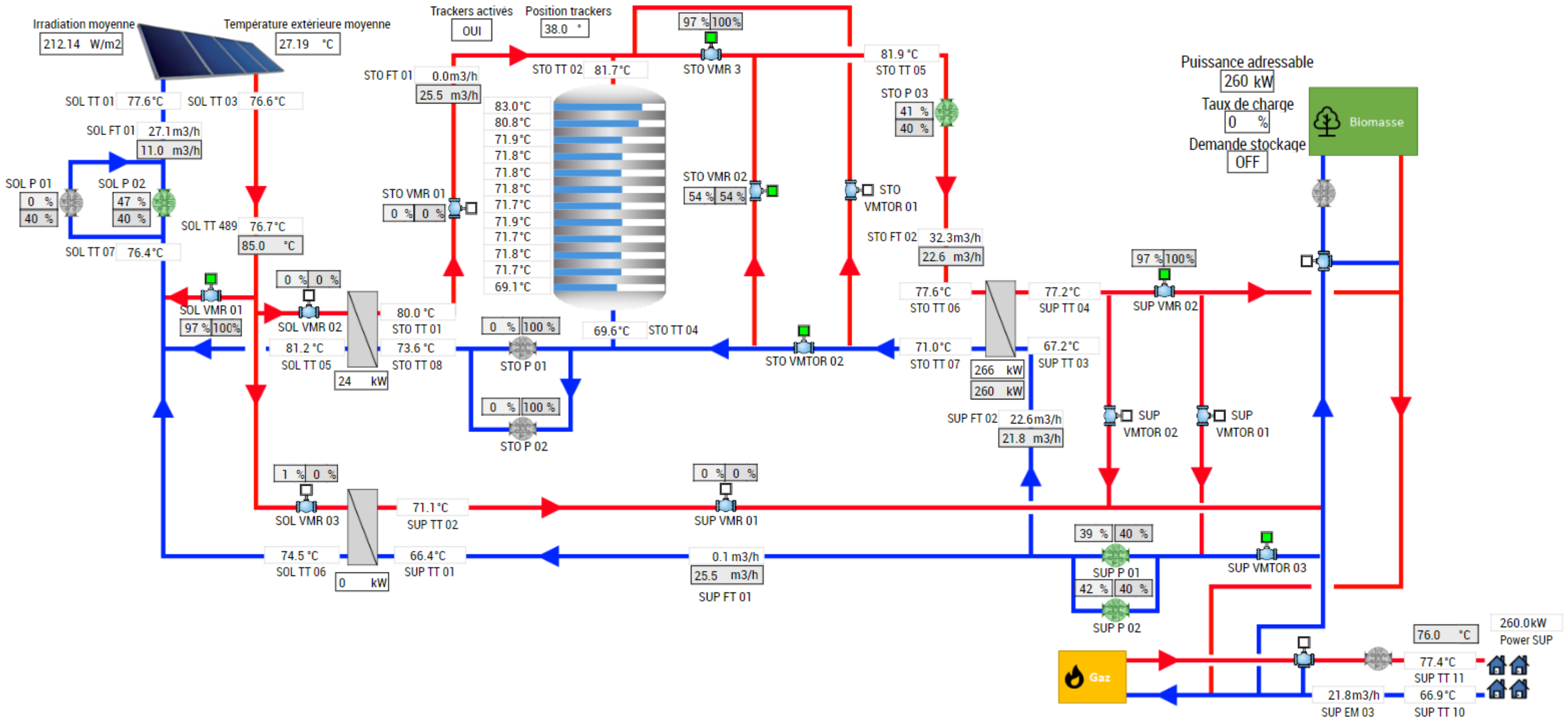
Pumping and control station :

- 3 W/W Heat Exchangers
- All pumps doubled
- Optimized control system allowing full remote control



Pons solar project - Technical description

Remote control



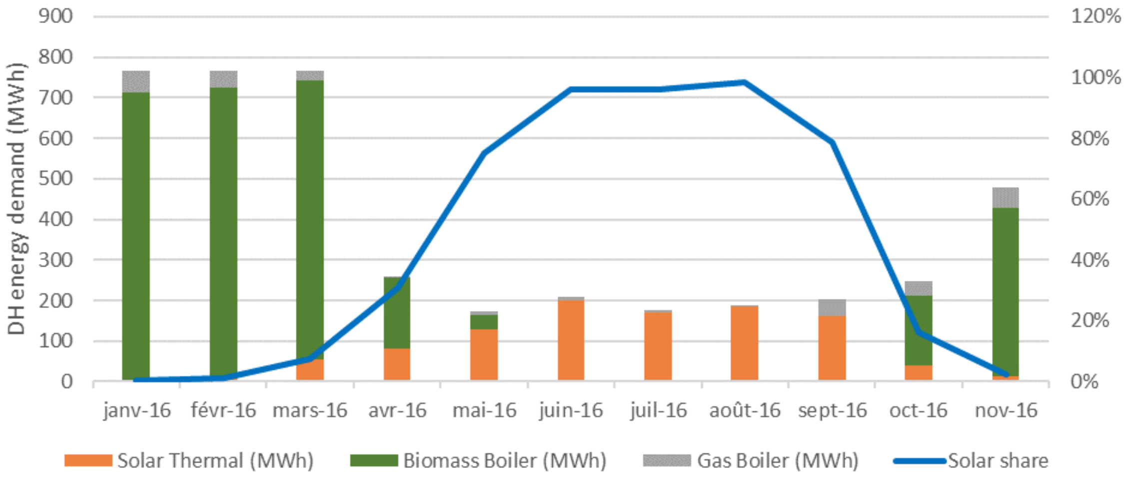
The control of the plant is linked to a dynamic optimization tool which defines the best setpoint of the global system (Newheat's R&D program)

Pons solar project - Summary and main feedback

Key figures and main results

Energy and environmental results

- **Annual energy delivery:** ~1 000 MWh pa
- **Avoided CO2 emissions:** ~200 tons pa
- **Solar thermal Share** : >20%
- **Global share of Renewable Heat :** >92%



A project commissioned in July 2021. The 3rd largest DH solar thermal project in France and the 1st FPC solar thermal plant using trackers

Pons solar project - Summary and main feedback

Key figures and main results

Economic results

- **Total investment (global CAPEX) :** >1,3 M€
- **Public support:** 65% subsidies
- **Solar heat price:** same level as the fossil heat cost at the time of 2019 (5 to 10 lower than today… excluding tariff shield)
- **The guarantee of a low and stable price for the users of Pons** (exposure to the "gas risk" has been reduced from 24% to 8%)
- **A competitive and stable price for all the users of the network**

Practical feedback for the project set-up

- **Technical / contractual :** lowering return temperatures is absolutely essential for the competitiveness of solar thermal, it is necessary to have commitment from the DH operator in the HPA contract
- **Technical:** the heat demand in summer must be precisely assessed over several years, and future energy savings actions must be taken into account, to avoid oversizing the installation
- **Relational:** a good coordination with the DH operator is imperative, the solar thermal plant and the other producers are a single global system that works together

A project commissioned in July 2021. The 3rd largest DH solar thermal project in France and the 1st FPC solar thermal plant using trackers

Thank you – Your Contacts

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Outlook

Upcoming Knowledge Products:

- new toolkits
- revisions of existing toolkits
- case studies of current practice

European Commission

Outlook


CRIT Knowledge Support Survey

The EU Initiative for coal regions in transition will continue supporting affected regions in their efforts towards a climate-neutral future.

By filling out this short questionnaire, you can help us align our upcoming knowledge support products to the actual needs of coal+ regions on the ground.

Thank you in advance for your answers!

We need your support

please go to:

https://forms.gle/bfmVUyxEgiwrRc8W6

and fill in the survey

Thank you

[secretariat@coalregions.eu]

[Website]

#CoalRegionsEU

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[DG Energy’s YouTube channels]

European Commission