Gravity Storage

Introducing Gravity Storage technology

BlueWeek2022, Rotterdam 15 June 2022,
Blue Forum & FPSO Research Forum

Large Scale Storage will make Renewables 24/7

Gravity Storage

The Challenge:

There is currently **no large-scale storage solution** for electricity that addresses affordability, investment cost, environmental impact and ubiquity, to respond to the pressing macrotrends of general renewable spread and grid balancing challenges.

Independent Power Producers (IPPs), transmission grid and system operators, utilities and mining industry need mass balancing power to respond to mass generation of solar and wind power.

The Solution:

Gravity Storage solves this challenge with a unique sustainable large scale storage solution for huge amounts of electricity with:

- **Unrivalled economic efficiency**
- **Lifetime: 60 years and more,**
- **lower CAPEX and LCoS than any other bulk storage**
- **Minimal environmental impact (max energy/sqm, limited water use**
- **Integration in high voltage grid**
- **Perfectly matching with PV and wind power**
- **Patent protection**

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Basic function of Gravity Storage

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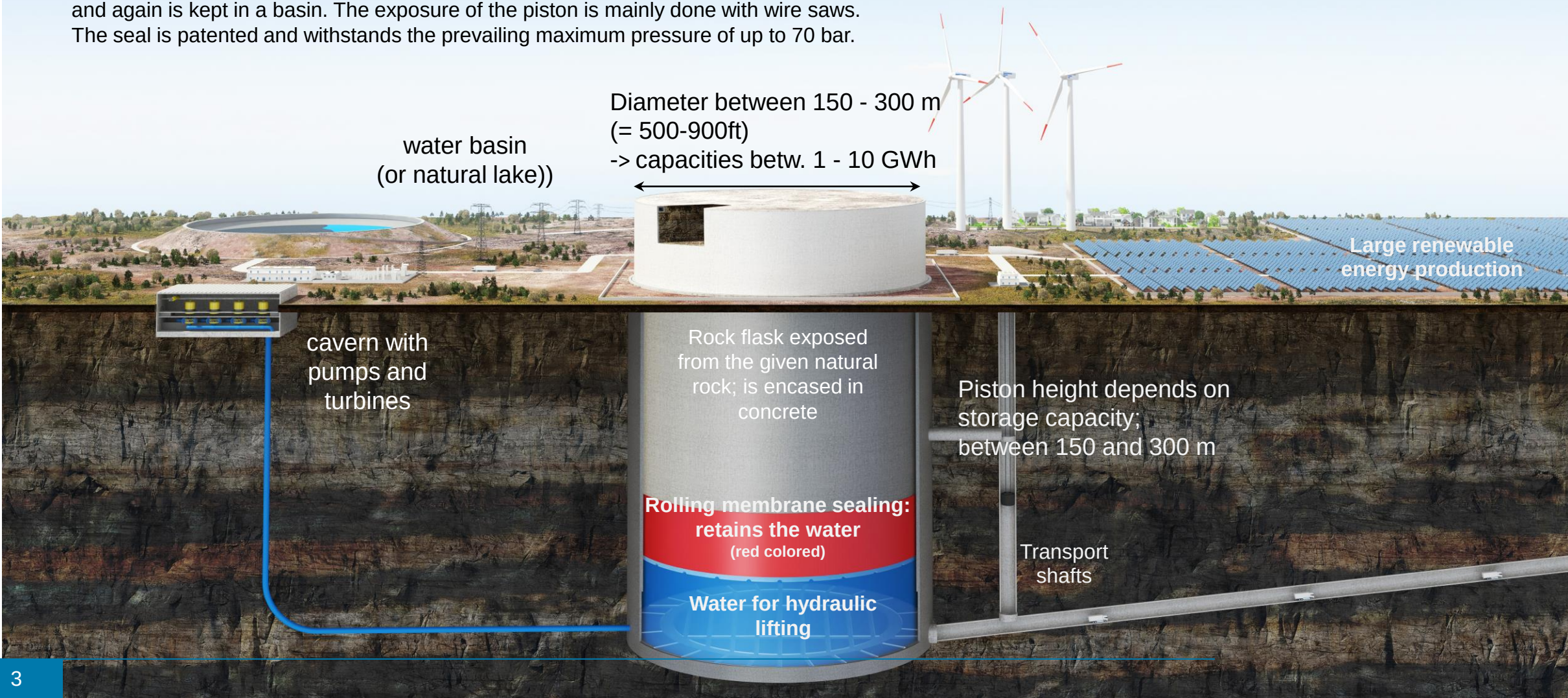
A rock piston exposed from the natural rock is pushed upwards by means of pumped water. When electricity is needed, the piston is lowered and the water is passed through turbines to produce electricity, as in a hydroelectric power plant. The water used again and again is kept in a basin. The exposure of the piston is mainly done with wire saws. The seal is patented and withstands the prevailing maximum pressure of up to 70 bar.



The business case of bulk energy storage

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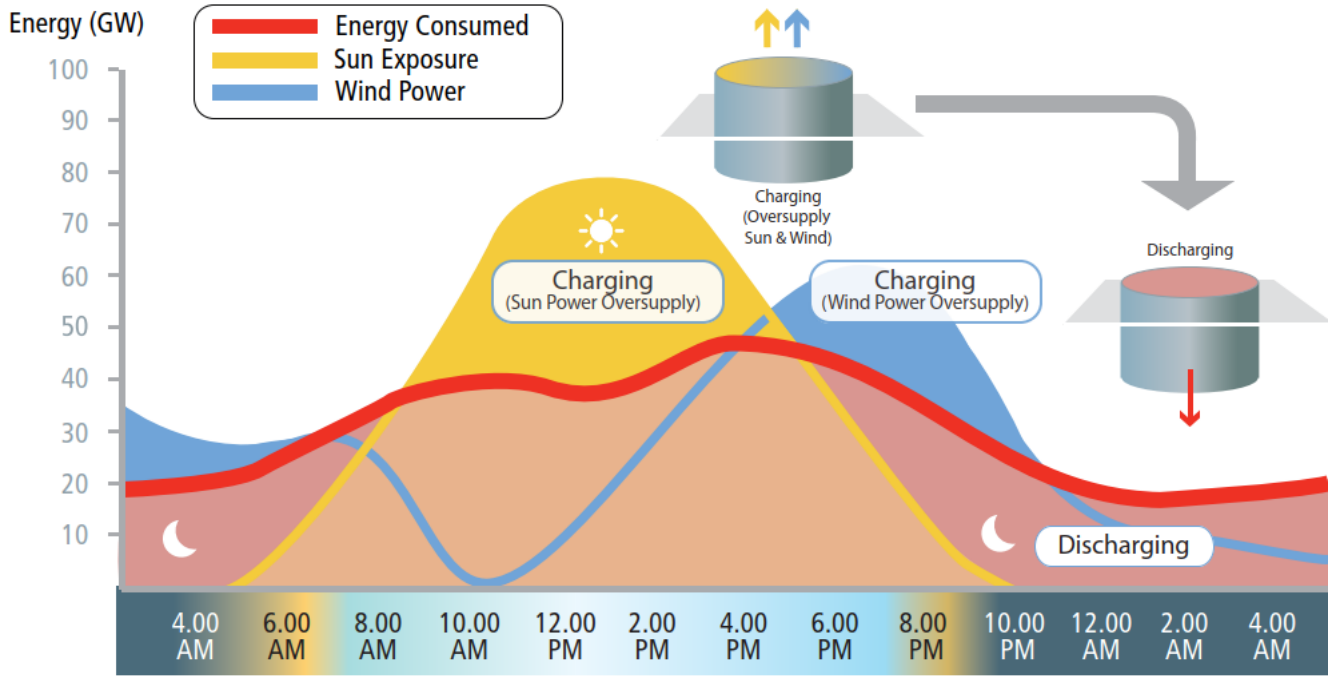
- Excess power from Wind and PV plants are stored (purchased) during the day and discharged (sold) at night.
- Utilities and operators must provide a reliable power supply, at all times of day or night.
- Grid operators need bulk storage to catch the ramping loads occurring during sunrise and sunset periods.



Gravity Storage supports all options to earn money in storage business:

- **Arbitrage Business**: Charge at low whole sale prices and discharge at higher prices
- **Customized Electricity Supply**: Combine generation and storage capabilities to deliver electricity as requested by the customer and as 24/7 green PPA at a calculable price.
- **Provision of Balancing Power**: Intermittent generation requires fast ramping capacities.
- **Provision of ancillary services** such as frequency regulation, voltage support, black start capability (inertia to rotating masses) and spinning reserve capacity.

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Each level of storage capacity will find its business case: Large scale renewable generation needs large scale storage

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kWh-level

0,002 ~ 10 MWh

MWh-level

10 ~ 500 MWh

GWh-level

500 – 8.000 MWh

Pumped Hydro Storage:

Restrictions:

- requires elevation and water
- expensive

GW-scale generation of fluctuating power needs corresponding GW-scale storage capacity.

Otherwise the value of PV and wind will suffer.

Transmission grid operators must solve this new challenge of fluctuating power.

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Gravity Storage works cost efficiently in different sizes starting from 100 m diameter

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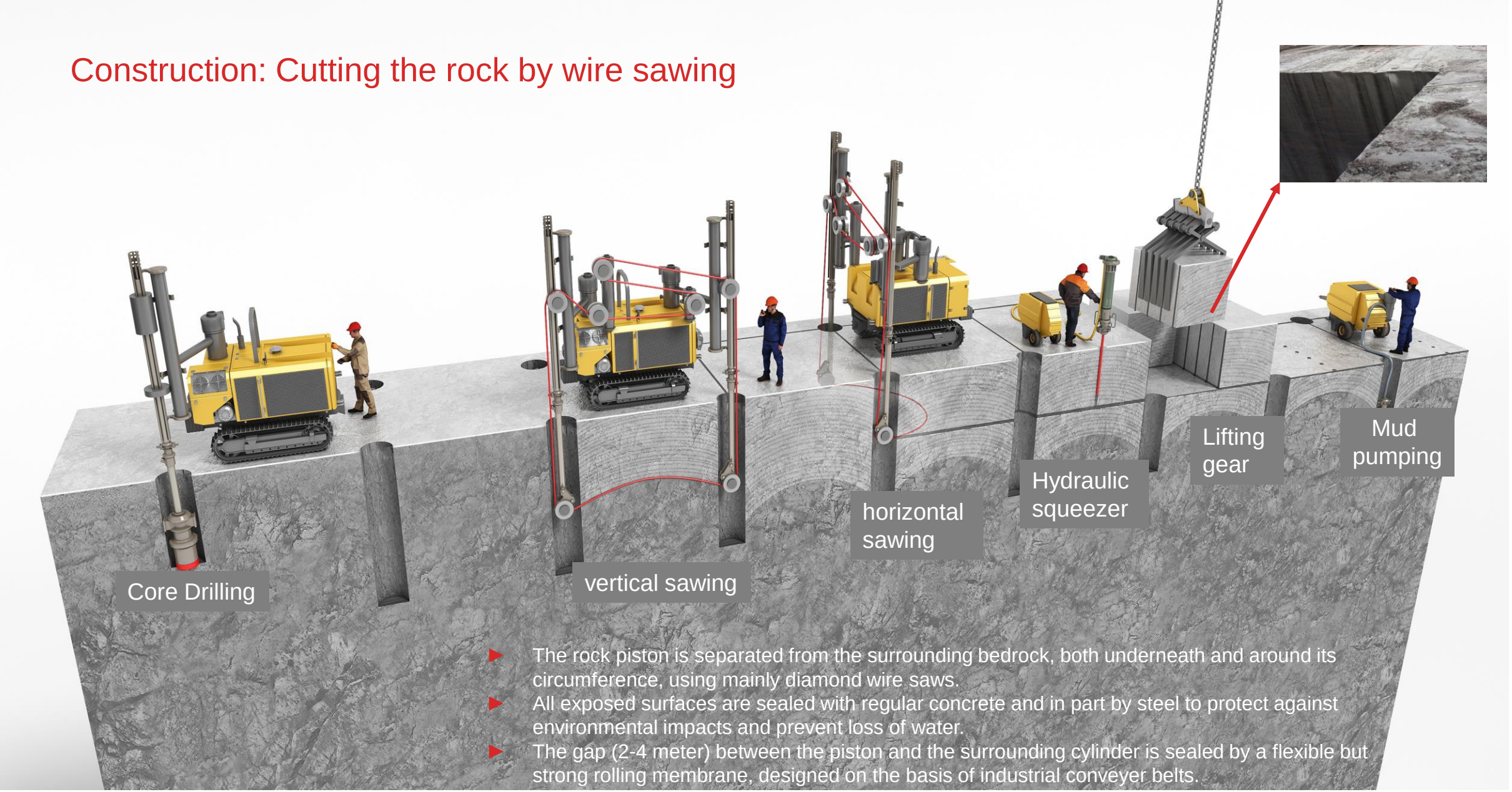
Construction: Cutting the rock by wire sawing



- The rock piston is separated from the surrounding bedrock, both underneath and around its circumference, using mainly diamond wire saws.
- All exposed surfaces are sealed with regular concrete and in part by steel to protect against environmental impacts and prevent loss of water.
- The gap (2-4 meter) between the piston and the surrounding cylinder is sealed by a flexible but strong rolling membrane, designed on the basis of industrial conveyer belts.

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Major component: Rolling Membrane Sealing

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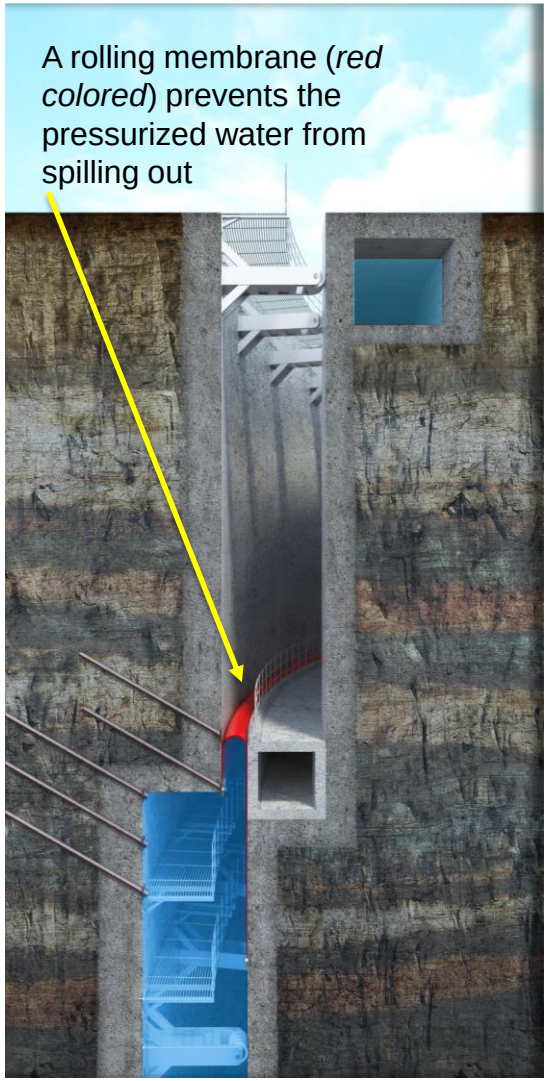

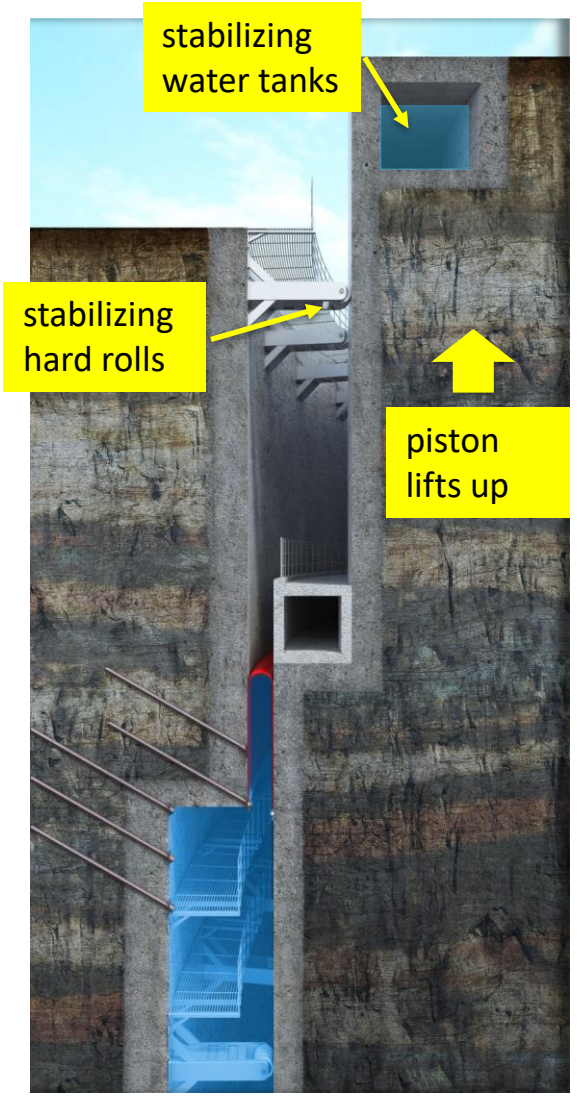

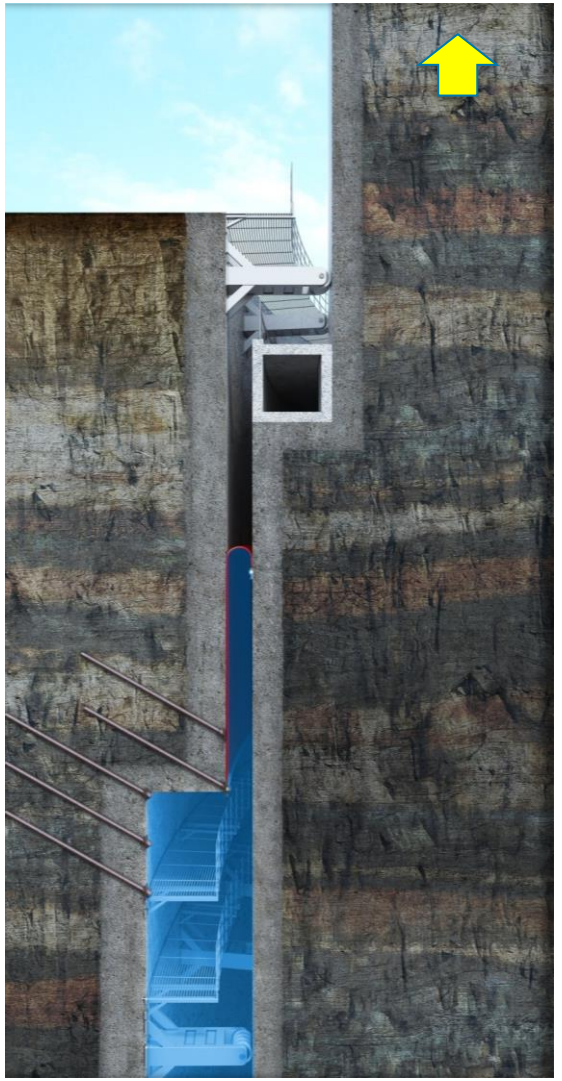

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Geological requirements

- Compact homogeneous rock with little tendency to fracture.
- The more compact the rock, the lower the cost of construction.
- Rock Mass Rating (RMR) of I or II
- Magmatic rocks indicate a higher probability of a suitable RMR (I or II), followed by metamorphic rocks and finally by sedimentary rocks
- In addition to sites with crystalline rocks, sites with thick formations of sandstone, limestone or greywacke can also be considered.
- Young's modulus (E) of at least 10.000 Mpa
- No mountain or elevation difference required!

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Path for further development

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- Research on Feasibility is done
- Next Step: Demonstration plan of small size, but with full functionality;
  - Ongoing scouting for locations (preferable granite Quarries)
  - Search for new investors

Basic research on feasibility	Search for new Venture Capital	**Demonstrator & Proof of Concept**: 30-40 meter diameter	First **commercial size** 1 GWh capacity 150 meter diameter
2014-2021	2022	2023-2024	2025-2027

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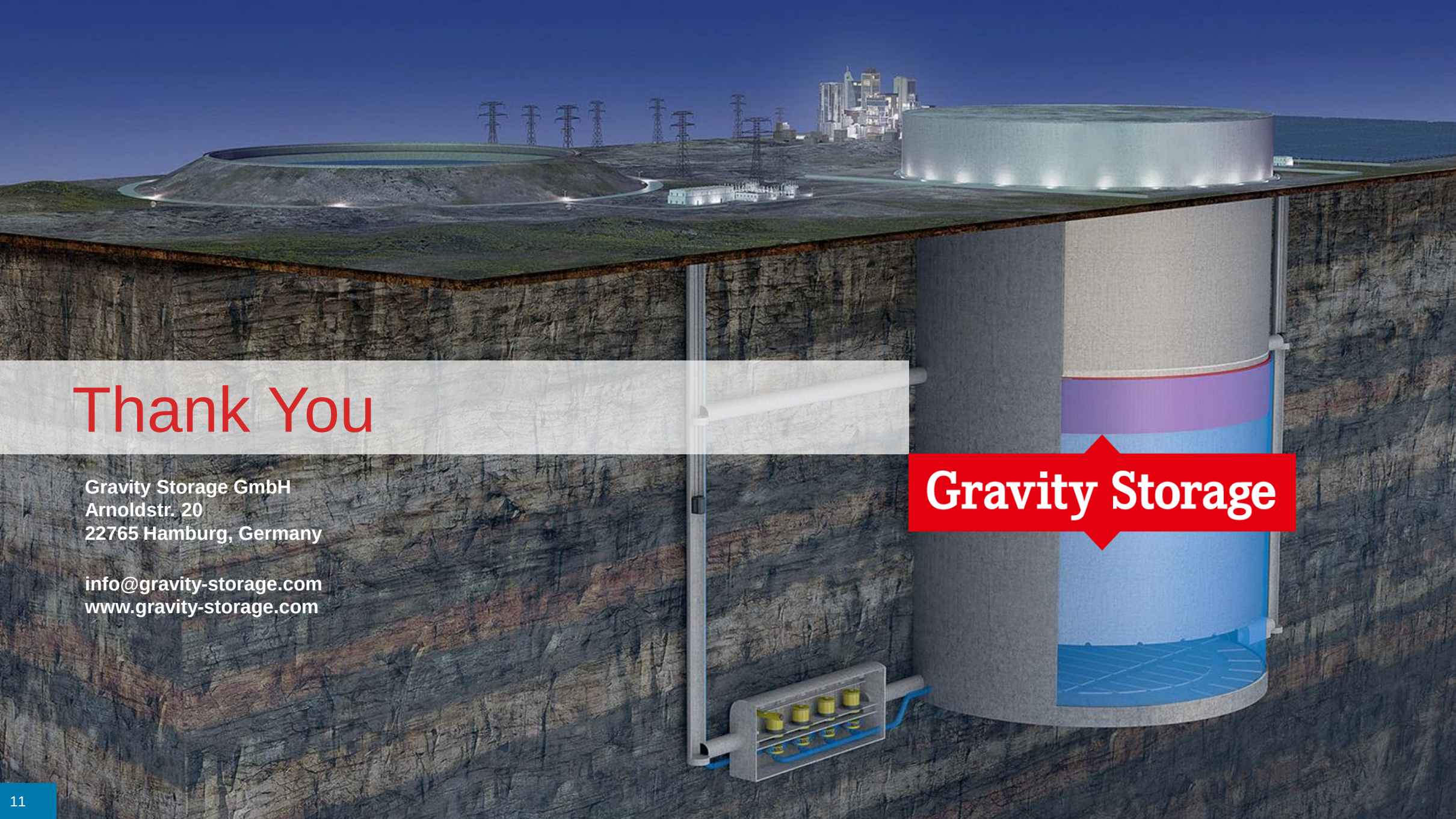

Thank You

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