GRAVITEQA

Project overview

University of Western Macedonia

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GRAVITational Storag**E**, **Q**uantum computing, and **AI** for enhanced Circularity and Reliability in Clean transition-affected sector-coupled electricity grids

Project no: 101192566

Funded by the European Union

general information

- HORIZON-CL5-2024-D2-01-04
  Cross-sectoral solutions for the climate transition
- Ten European partners from Greece, Spain, Bulgaria
- Project starting date: 1 January 2025
- Project end date: 31 December 2027
- Project duration: 36 months

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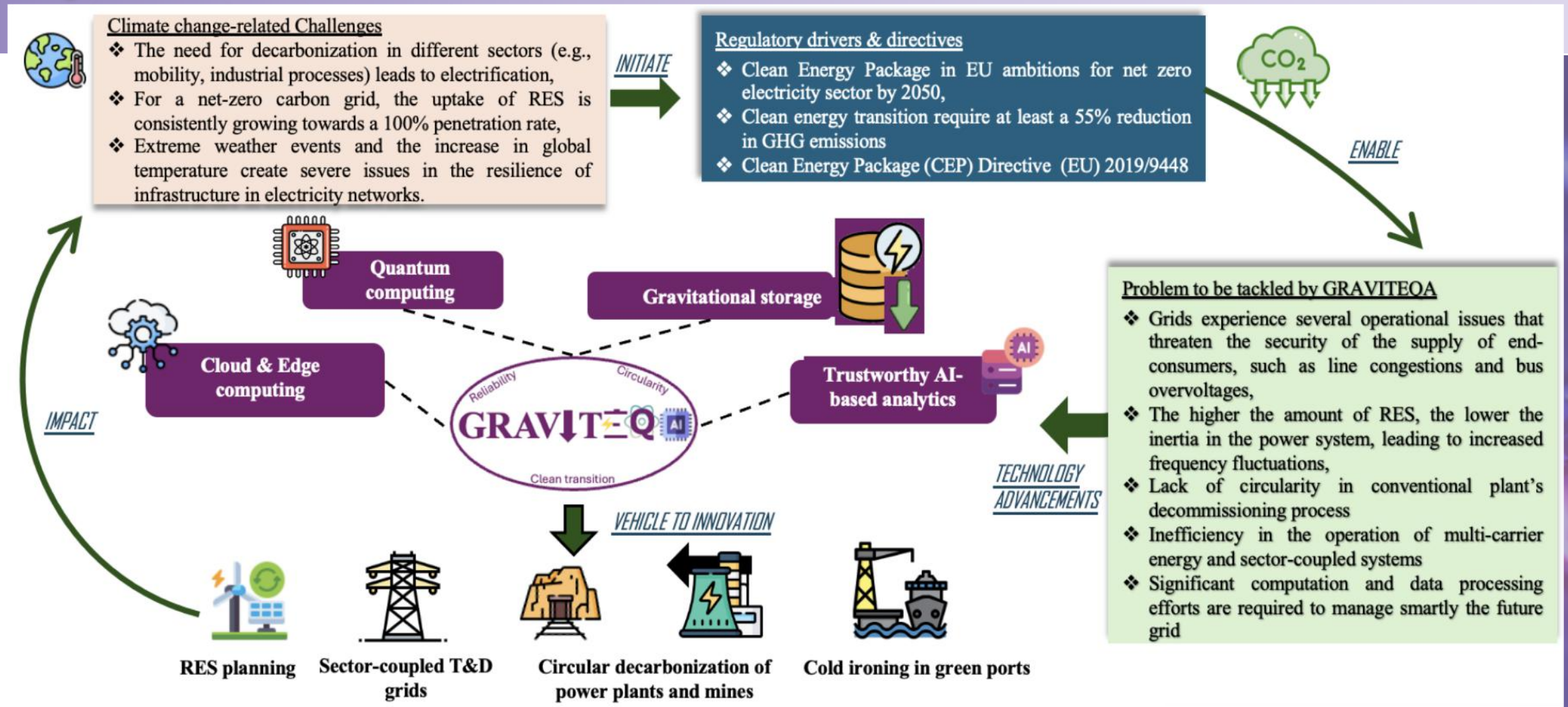
why GRAVITEQA?



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objectives

O1:	Demonstrate **technical feasibility** of solutions that enable reliability and circularity of sector-coupled electricity grids affected by clean energy transition, by combining emerging technologies, such as **gravitational storage, QC, QIC, trustworthy AI, and edge intelligence.** (Use Cases and Simulations)
O2:	Showcase the **applicability of a holistic methodology** to **turn decommissioned coal plants and abandoned mines into hybrid high-energy** (long-term through gravitational) **and high-power** (through mechanical, i.e., flywheels) **storage solutions.**
O3:	Showcase the **potential of QC and QIC** in case of two optimization problems in power systems domain: 1. Facility Location Allocation problem and 2. Load-side assets management problem
O4:	Showcase technical feasible solutions that increase sustainability of **cold ironing in green ports strategy**.
O5:	Showcase the **technical feasibility of trustworthy AI** and **edge intelligence** for the calculation of grid-aware flexibility potential in sector-coupled distribution grids through end-to-end learning.
O6:	Ensure **just and fair societal impact** from the development and use of technologies to assist the green transition and promote understanding of societal acceptance.
O7:	Ensure **ethical conduct** of the research.
O8:	**Environmental assessment** of GRAVITEQA technologies through **LCA studies**.
O9:	Implement an **effective dissemination and communication** plan to promote GRAVITEQA's achievements. The strategy includes engaging with academia, industry, and the public through diverse channels and events, alongside networking with existing projects and entities.

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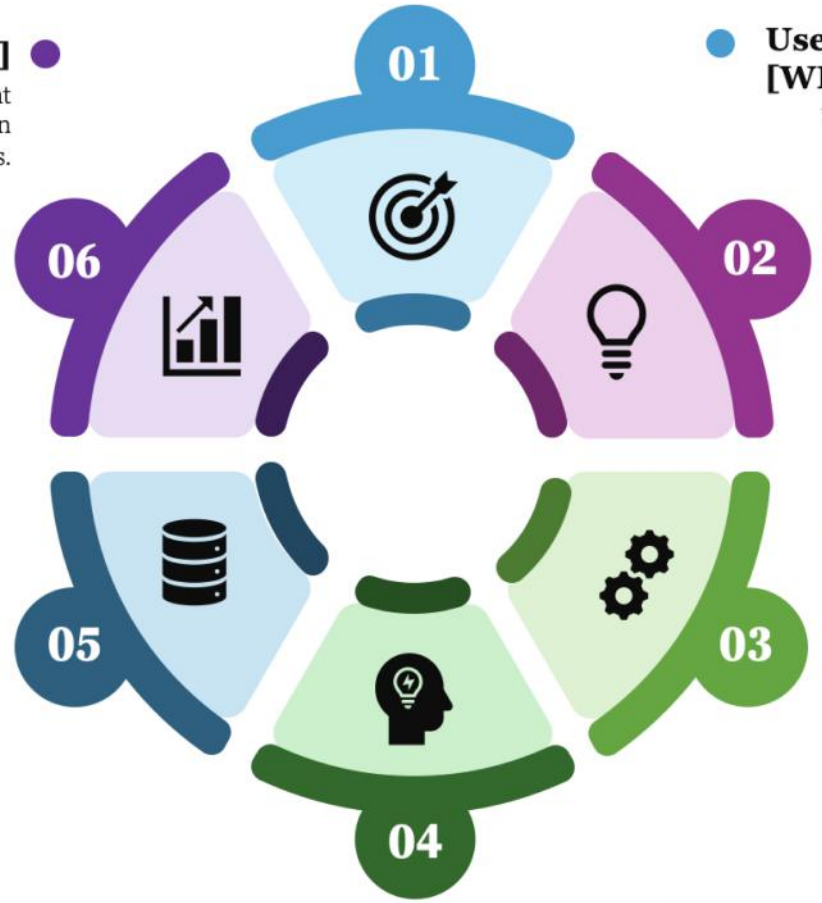
methodology

The six phases of the GRAVITEQA methodology



Use cases and KPIs for monitoring [WP2]

Understand and model UCs based on IEC 62559 standard

Requirements & specifications [WP2]

Requirements elicitation based on stakeholder needs (i.e., grid operators, plant and mine owners, aggregators)

Solutions development [WP3]

- Quantum computing for power systems
- Trustworthy AI for distribution grid operators
- Methodology for circular transformation of mines and conventional plants
- AI for mass electrification of grid-aware mobility & maritime

Impact quantification [WP5]

Stakeholders' engagement
Policy and standardization
Market potential & business models.

Sustainability evaluation [WP2]

Technoeconomic
Environmental
Social.

Lab validation [WP4]

- Technology validation through rigorous simulations testing for the defined UCs.
- Fine-tuning and validation in lab-controlled environment

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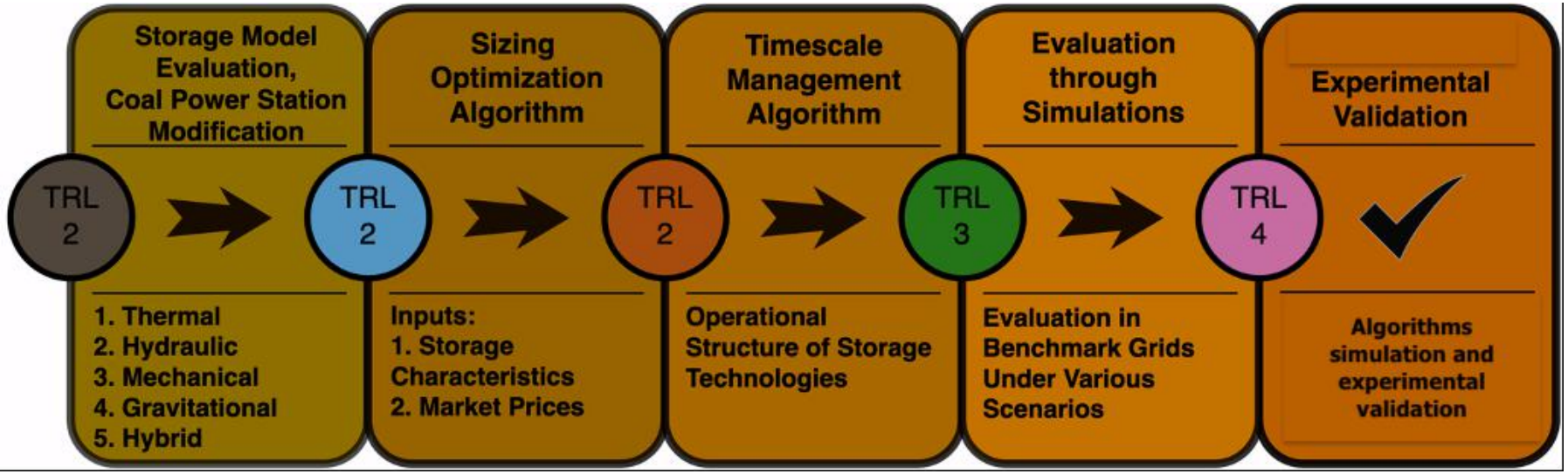
methodology



Grid Simulator

PV Simulator

OPAL RT

El. Loads

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impact

Gaps and Innovations:

Lack of comprehensive and generic methodologies	Provide a generic and holistic methodology
Limited focus on hybrid energy storage systems	Examine the hybridization of storage technologies
Underutilization of assets in abandoned coal plants	Utilization of assets in abandoned coal plants
Lack of market integration	Applying a market-based optimization
Neglect of cyclic economy	Enhancing the cyclic economy

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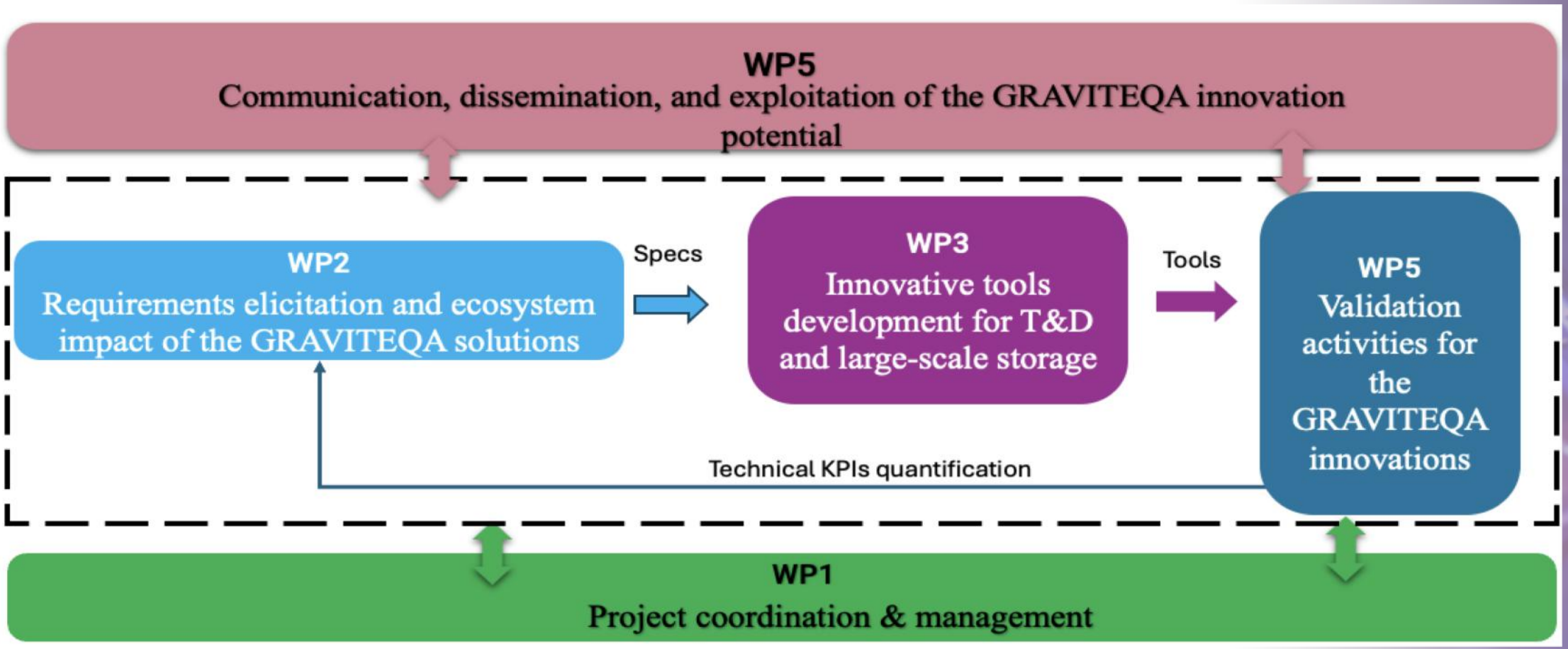
work package structure



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role of UOWM

- Perform LCA, TEA and feasibility analysis of GRAVITEQA solutions
- Design a holistic methodology to transform a coal power plant and mine into a long duration energy storage plant
  - Evaluate storage models
  - Apply an optimization algorithm for sizing
  - Develop different timescale management algorithm
- Laboratory validation of the proposed solution
- Evaluation of the solutions (KPI measurement, use cases, tools, stakeholder feedback, recommendations)

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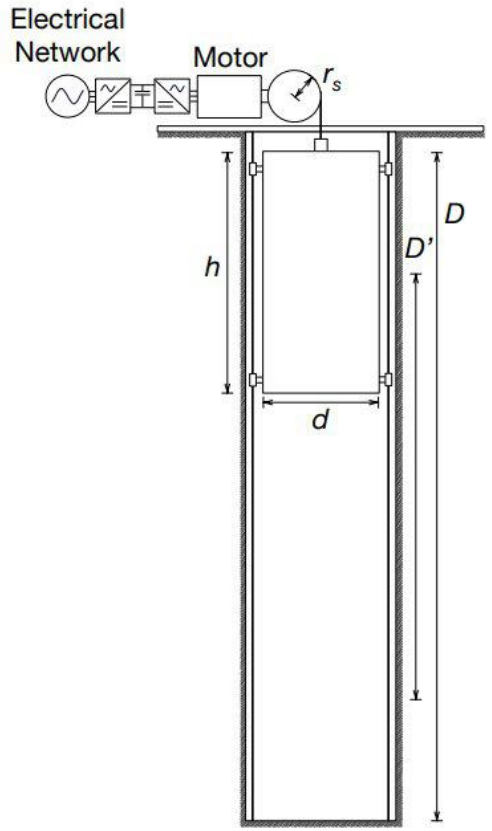
gravitational energy storage system

- Shaft-GES
  - Height of shaft
  - Height of weight
  - Diameter of weight
  - Density of weight material
  - Maximum mass size



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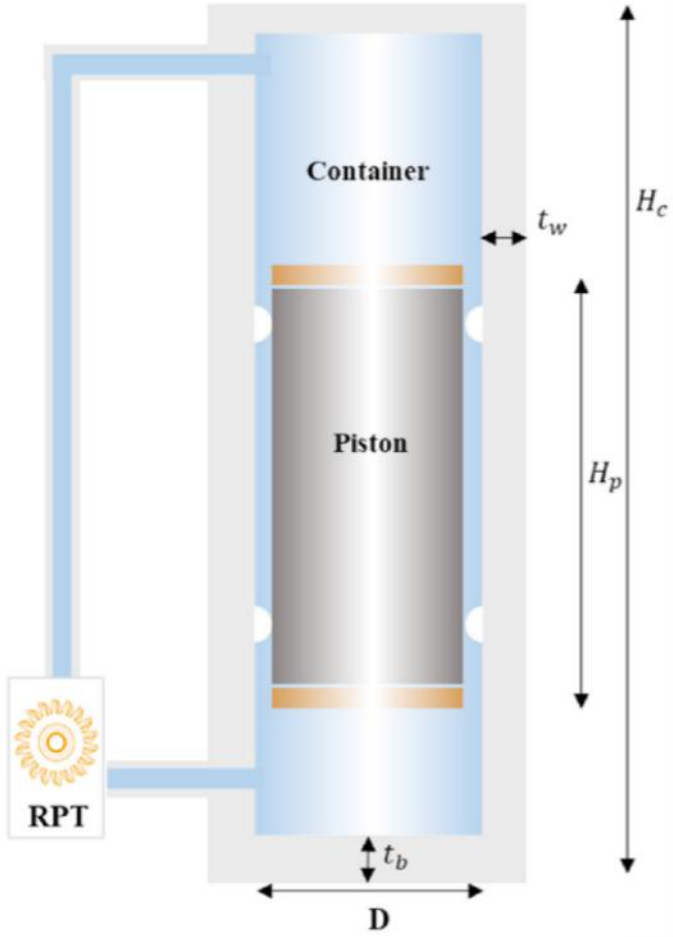
gravitational energy storage system

- Piston-GES
  - Height of container
  - Height of piston
  - Piston density
  - Thickness of container



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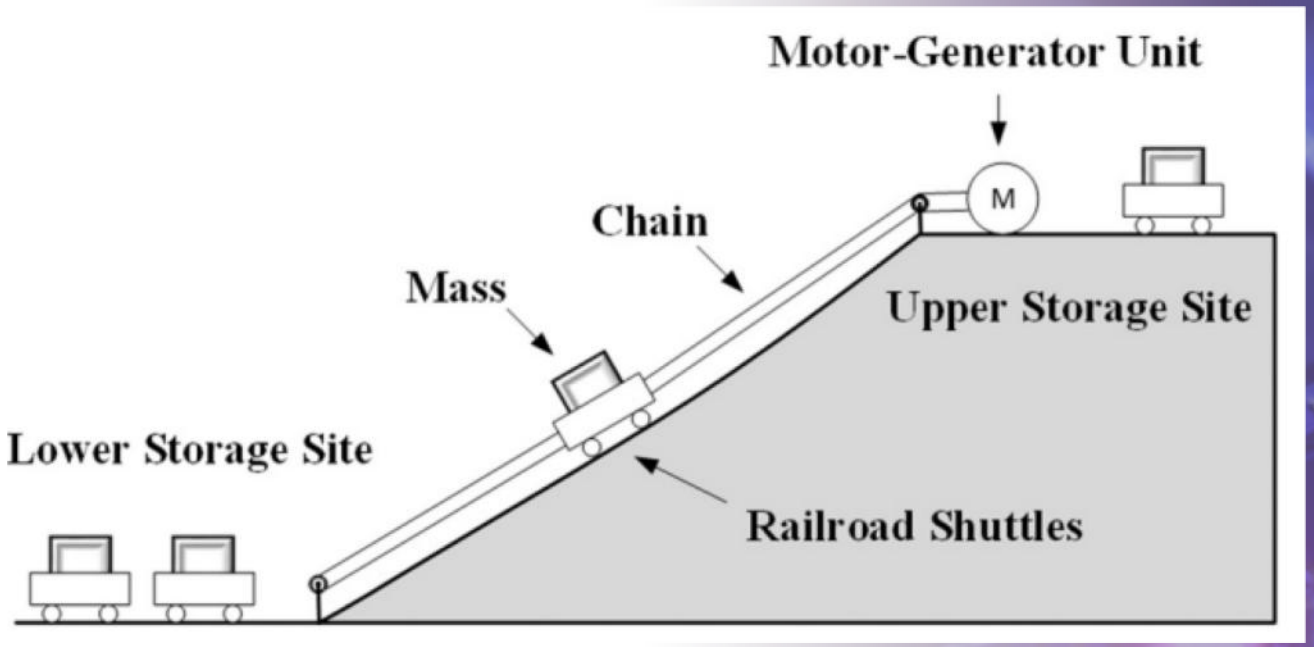
gravitational energy storage system

- Mountain mine-car GES
  - Inclination
  - Elevation difference
  - Line length
  - Railways
  - Weight of mine-cars
  - Max mass to be moved



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Questions or comments

Thank you!

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