

LCA/LCC Evaluation Tool for the GRAVITEQA Technology Stack

Date: July 2026 | **Type:** Digital – Environmental & Technoeconomic Assessment | **Partners:** UOWM (lead), all technology providers

OVERVIEW

GRAVITEQA develops a combined **Life Cycle Assessment (LCA)** and **Life Cycle Cost (LCC)** evaluation tool that quantifies the environmental and economic performance of the project's technology stack, available in its alpha version. The workflow builds a **life-cycle inventory** per technology configuration, models **new-build versus reuse scenarios**, computes environmental impacts (CO₂eq), and couples them with **cost libraries** for equipment and processes and standard **economic indicators** (NPV, IRR, payback period, ROI). The alpha application covers three technology groups: gravity energy storage (Shaft- and Piston-GES, new vs retrofitted), quantum and quantum-inspired computing deployments, and AI-based solutions (edge AI infrastructure and berth-level onshore-power-supply electrification of green seaports). Results directly quantify project KPIs and feed investment and design decisions.

BENEFITS

- **Quantified circularity:** reuse of decommissioned infrastructure shown to cut construction emissions by 80.75% (Shaft-GES) and 49.75% (Piston-GES).
- **Design steering:** material sensitivity analyses (e.g., cement/iron/steel weights, iron/lead pistons) link engineering choices to CAPEX and NPV.
- **Technology comparability:** consistent economic treatment of conventional cloud vs quantum-inspired computing, and of edge-AI deployment scenarios.
- **Investment de-risking:** berth-level NPV evaluation of seaport electrification identifies which berths are financially viable and when.
- **KPI evidence:** outputs directly quantify the project KPIs for the validation phase.

CURRENT ENABLERS

- Standardised LCA practice: life-cycle inventories, functional units and impact models per technology configuration.
- Cost libraries for equipment and processes compiled per technology, with documented economic parameters (discount rate, lifetime, tax, depreciation).
- Market datasets (day-ahead electricity prices) linking operation to revenues.
- Project KPI framework defining what must be measured and reported.

R&D NEEDS / NEXT DEVELOPMENTS

- **Life-cycle breadth:** extend beyond the construction phase to operation, maintenance and end-of-life stages.
- **Complete quantum cost model:** include R&D, licensing, maintenance, staffing and deployment costs currently out of scope.
- **Data refinement:** replace literature-based assumptions with pilot-measured data from the project validation.
- **Beta release:** consolidated evaluation of the full technology stack in the next release, aligned with the tool beta versions.

APPLICATIONS

- **Asset owners & investors:** environmental and financial due diligence for storage retrofits and port electrification.
- **Technology developers:** eco-design feedback identifying impact and cost hotspots per component.
- **Programme evaluation:** KPI quantification for Horizon Europe reporting and impact assessment.
- **Policy makers:** evidence on circular-economy gains of repurposing coal-era infrastructure.

TECHNOLOGY READINESS LEVEL

1	2	3	4	5	6	7	8	9
■ Current level	■ After validation							
TRL 3 currently (alpha methodology applied to the technology stack with literature- and design-based data); TRL 4 to be reached upon completion of the validation with pilot-measured data.								