

Advanced AI/ML in Local Energy Markets

The INTELLIGENT Project

Providing advanced, open-source Peer-to-Peer technology to optimize economic and environmental benefits for citizens while actively supporting grid stability.



Smart Tools subgroup of the BRIDGE's Consumer and Citizen Engagement Working Group
5th of March of 2026

Project Contact

Francisco Luque

✉ francisco.luque@r2msolution.es

Biswarup Mukherjee

✉ biswarup.mukherjee@tum.de



Funded by
the European Union

Project funded by



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Government of Economic Affairs,
Education and Research, LRMA
State Secretariat for Education,
Research and Innovation SERI

The Grid Gap: From Passive Consumption to Active Trading

The Current Friction



Grid Blindness: Operators lack tools to manage Distributed Energy Resources (DERs).



Restrictive Regulation: "Peer-to-Market" models prevail over true P2P trading.



Passive Citizenship: Citizens lack equipment to participate in energy markets.

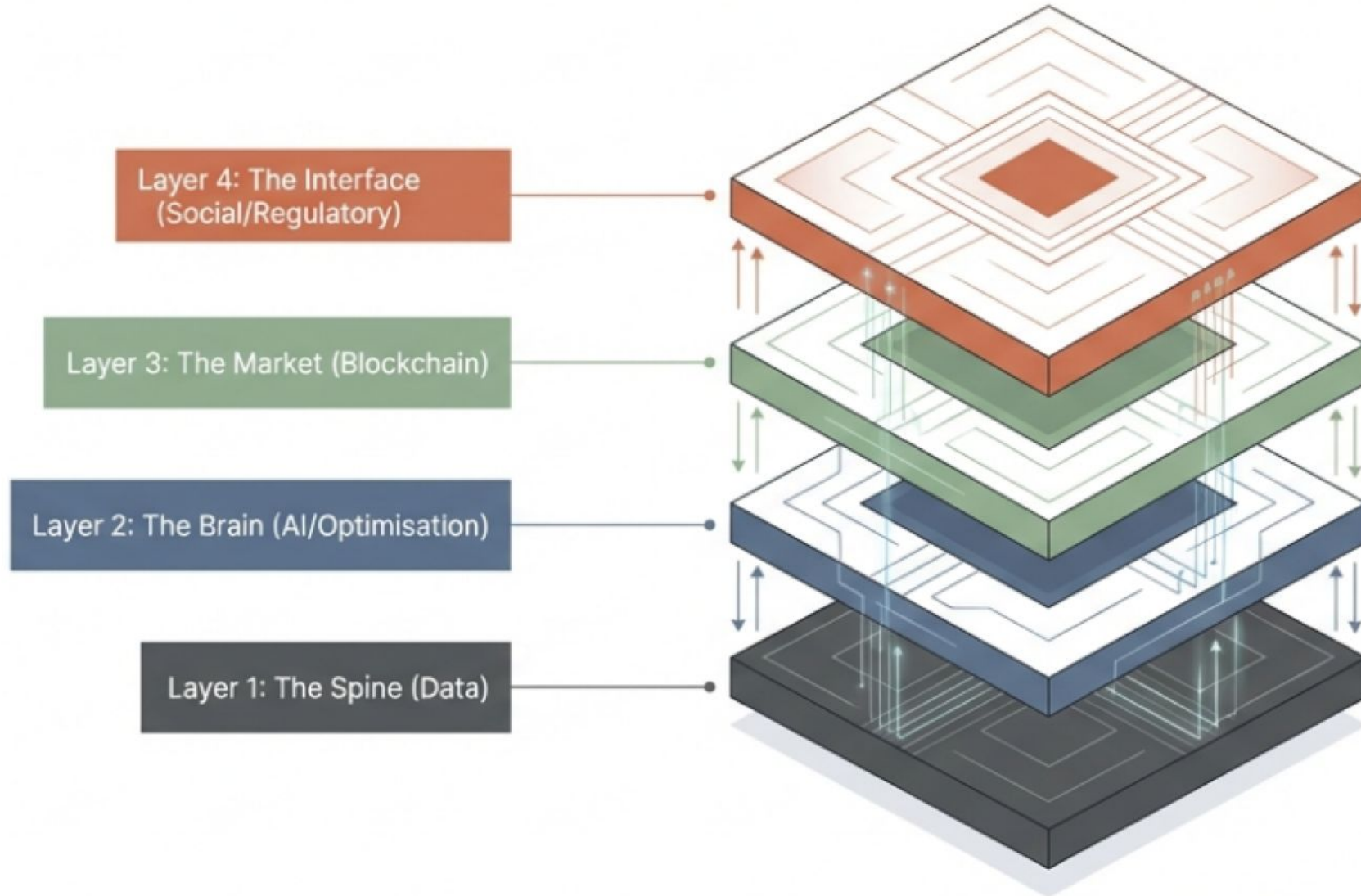
The Mandate & Opportunity

Net-Zero 2050 Goal: Annual clean energy deployment must triple by 2030.

Opportunity: Empowering advanced local energy sharing to support grid stability and congestion management.

The INTELLIGENT System Stack

A cohesive infrastructure: Physical Assets → Data Spine → AI Optimisation → Blockchain-based Market in Interface



INTELLIGENT Work Package 4

Work Package 4 Focus

Led by **TUM (Technische Universität München)**, this package focuses on the Flexibility and Energy Optimisation Service (**FOS**).

Primary Objective:

To coordinate local energy flows optimally and enable Local Energy Community (LEC) members to participate effectively in P2P energy and flexibility markets.

Key AI/ML Functions

The system utilizes advanced machine learning across four core areas:

- **Prediction:** Forecasting demand and prices.
- **Optimisation:** Computing control signals.
- **Flexibility Estimation:** Determining up/down Flexibility.
- **Trading:** Optimising market participation.

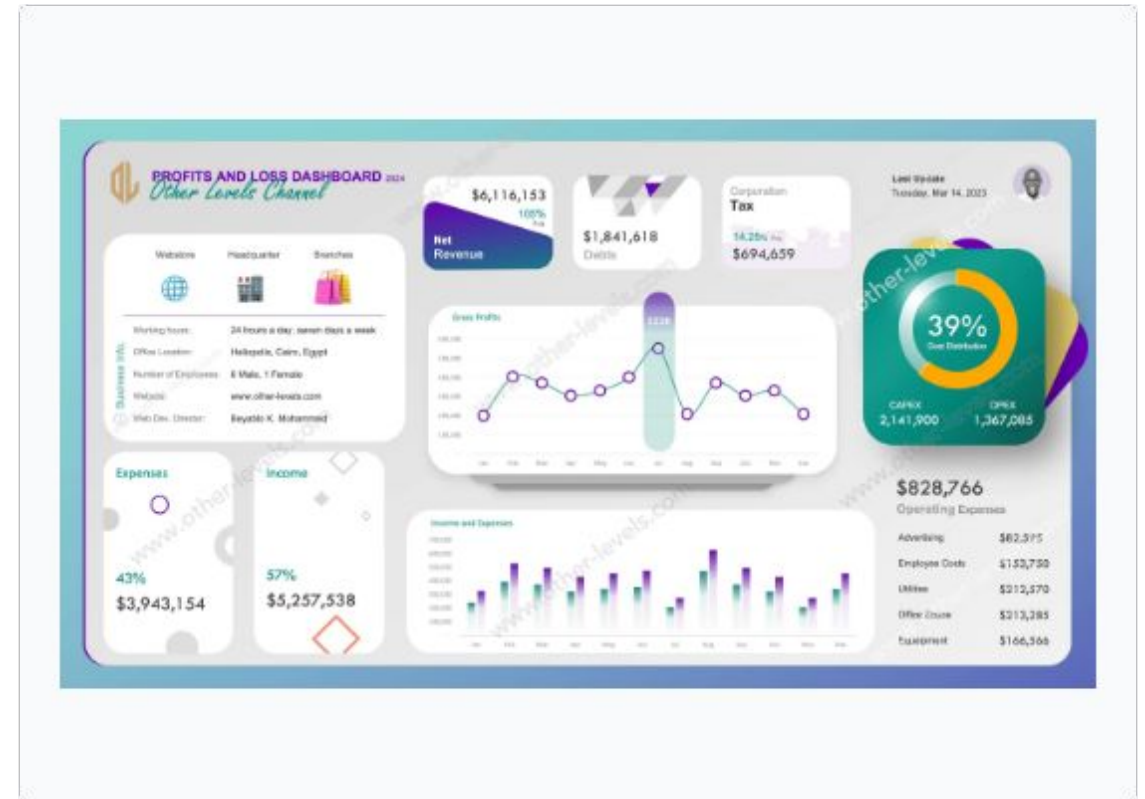
Prediction and Optimisation

Prediction Module (T4.1)

- Develops systems to predict key values using Machine Learning trained on pilot site data.
- Analyzes electricity/heat demand, RES generation, asset degradation, and local market prices.

Optimisation Module (T4.2)

- Develops the core software for FOS optimisation.
- Applies Model Predictive Control (MPC) and Deep Reinforcement Learning (DRL).
- Translates user preferences directly into constraints.



Flexibility and Trading

Estimates member flexibility for optimal market bidding, crucial for grid congestion management. The Trading Module uses Deep Reinforcement Learning to automate activities, feeding directly into the peer-to-peer exchange to drive a bottom-up energy market design.



Advanced AI in P2P Trading



Core Platform

Operates on the open-source, blockchain-based GSY DEX, providing a transparent and secure trading environment.



AI Support

Smart algorithms enable optimal bidding in Flexibility Markets, supporting both Pay-as-Bid and Pay-as-Clear mechanisms.



Market Novelty

Develops an Automated Market Maker (AMM) trading mechanism to address liquidity limitations in small local markets.

Grid-Aware Data Foundation

Grid Awareness (T4.6)

AI in FOS actively supports grid-aware trading by generating flexibility offerings tailored for the Distribution System Operator (DSO).

- Allows DSOs to actively avoid local grid congestion.
- Facilitates the integration of dynamic utility tariffs.
- Develops a Digital Twin to simulate complex energy systems.

Data Foundation (WP3)

Establishes an interoperable infrastructure for data exchange to ensure AI systems receive accurate and verifiable inputs.

- Uses the Energy Web Digital Spine (EWDS) for data integration.
- Embeds privacy directly into the data architecture.
- Supports diverse devices like EV chargers and smart meters.

Compliance: The EU AI Act

Fully committed to Trustworthy AI based on a human-centric approach.



Lawful Operation

Strictly complying with all applicable laws, prioritizing the EU AI Act and GDPR for data processing.



Ethical Alignment

Adhering to core ethical principles, ensuring technology serves the community without discrimination.



Technical Robustness

Ensuring social and technical robustness to avoid unintentional harm and maintain security against attacks.

EU AI Act Requirements



Human Agency & Oversight Ensuring fundamental rights and retaining human control.



Technical Robustness & Safety Guaranteeing accuracy, reliability, and security resilience.



Privacy & Data Governance Absolute GDPR compliance and structural Privacy by Design.



Algorithmic Transparency Utilizing interpretable AI to avoid opaque decision-making.

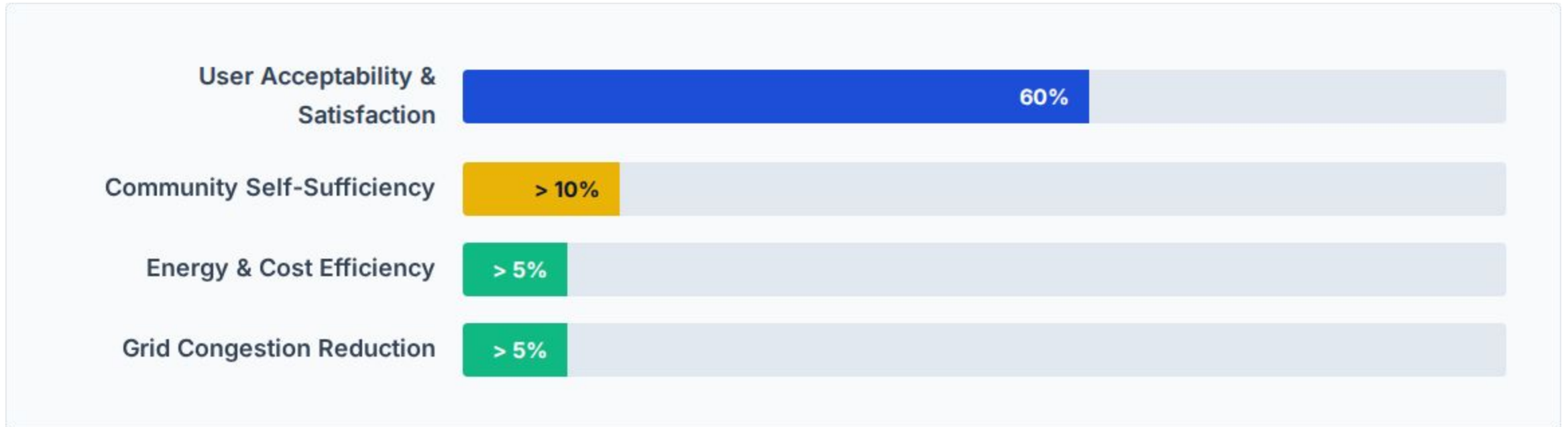


Diversity & Non-discrimination Actively testing for and avoiding unfair demographic bias.



Societal Wellbeing Promoting energy efficiency via Proof-of-Stake blockchains.

Validation & Expected Impact



Testing Framework: Validated in 4 diverse energy community pilots across Portugal, Ireland, and Switzerland. Expected to achieve 100% efficient and secure data transactions within 3 years post-project.



Project funded by

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs,
Education and Research EAER
State Secretariat for Education,
Research and Innovation SERI

Swiss Confederation



Comharchumann Forbartha Árann Teo.
"Buaiteoirí Gradaim Pobail Gaeltachta"