Digital Energy Grid Hackathon

Team Name: Haikara

Institutions: Imperial College London, University of Manchester

Team Members (Role, Contact Emails, Discord User Name):

Sofie Rüffer, UX Designer, s.ruffer25@imperial.ac.uk, sofie_99776
Kamila Bereket, AI Engineer, kb1025@ic.ac.uk, kaa._.mila
Adeline Wong, Business Strategist, adeline.wong25@imperial.ac.uk, ling5154
Rucha Agashe, Energy Analyst, ra2425@ic.ac.uk, rune_1.618
Rana Rustamli, Technical Strategist, rana.rustamli@student.manchester.ac.uk, rena_78514

Problem 2: Compute-Energy Convergence in a DEG World

Solution Overview:

Data centres are among the fastest-growing energy consumers, creating grid stress as prices, carbon intensity, and availability shift hourly. Yet many compute workloads are inherently flexible. Instead of running jobs immediately, the future DEG ecosystem needs compute that adapt intelligently to grid conditions[2].

We propose "*Haikara*", a multi-agent system that co-optimises data-centre workloads with real-time energy signals. Compute agents publish flexible job slots (capacity, energy use, SLA windows), while Grid agents stream price data, carbon forecasts, and P415 flexibility events. The Decision Agent forecasts short-term conditions and schedules, defers, or shifts workloads to minimise cost and carbon while unlocking revenue from P415. The Audit Agent ensures full traceability through Beckn transaction flows.

Haikara lets data centres earn from demand-side flexibility, cut energy costs, and prove greener operations, without changing customer pricing. Our business model captures part of the new flexibility revenue while delivering scalable, verifiable sustainability outcomes.

Technical Architecture:

- **Compute Agent:** Provides real-time workload data (job status, capacity, energy use) and exposes its workload flexibility based on SLA windows.
- **Grid Agent:** Continuously streams energy system data such as price signals, price forecasts, availability, and P415 flexibility events.
- **Decision (Orchestrator) Agent:** Ingests data from the Compute and Grid Agents, runs short-horizon forecasts, and optimises workload scheduling. It balances cost, carbon intensity, job priority, and execution windows while maximising revenue from P415 flexibility. It generates orchestration commands.
- **Audit Agent:** Records all inputs, forecasts, scheduling decisions, Beckn transaction IDs, cryptographic signatures, and timestamps.

API / Models: National Grid Carbon Intensity API, Octopus Energy pricing API, Beckn Sandbox, Nord Pool API, Prophet library

Decision logic: The system takes compute and grid data, runs short-horizon forecasts, optimises task scheduling considering cost, P415 opportunities, job priority, and available windows, then sends commands to execute in order, and logs everything for auditing and settlement.

Assumptions: Job energy estimates available; data centres can delay some jobs without breaking SLAs as long as in the given window; P415-style flexibility product exists; real-time price streams (or simulated for prototype); constant carbon cap.

Agent Workflow:

We will build a Multi-Agent system with four core agents working through Beckn protocol flows:

- **Compute Agent:** Publishes its available compute slots as Beckn catalog items (energy usage, time windows, SLA constraints). It shares real-time workload data and responds to Beckn discovery and selection requests.
- **Grid Agent:** Streams real-time price, availability data, price forecasts, and P415 flexibility events. It uses Beckn **/search** to discover available compute flexibility and confirms matched flexibility offers through **/select** and **/confirm**.
- **Decision (Orchestrator) Agent:** Takes Compute and Grid data, runs short-horizon forecasts, and optimises scheduling. It creates flexibility proposals, triggers Beckn order flows where needed, and issues execution commands (run, defer, shift).
- **Audit Agent:** Logs all inputs, decisions, forecasts, Beckn transaction IDs, cryptographic signatures, and timestamps, providing full traceability and settlement verification. It finalises the carbon impact, flexibility revenue, and deviations vs forecasts and feeds back into the Decision Agent's learning cycle.

Business Model & Impact:

Our system helps data centers optimize compute workloads by scheduling jobs when energy prices are lower and leveraging the P415 flexibility product. This enables them to reduce energy costs, earn additional revenue from flexibility programs, and receive green certifications, all without affecting the prices charged to their customers. We generate revenue by taking a percentage of the additional revenue data centers earn from P415 participation, along with a service fee for using the platform. This way, we share in the value our system creates, directly linking our success to the benefits delivered to data centers. The solution is scalable, practical and designed to maximize both financial savings and sustainability outcomes.

References / Inspiration:

[1] Takci, M.T., Qadrdan, M., Summers, J. and Gustafsson, J. (2025). Data centres as a source of flexibility for power systems. Energy Reports, [online] 13, pp.3661–3671. doi:https://doi.org/10.1016/j.egyr.2025.03.020.
[2] Shah Danish, M.S. and Senjyu, T. (2023). Shaping the future of sustainable energy through AI-enabled circular economy policies. Circular Economy, 2(2), p.100040. doi:https://doi.org/10.1016/j.cec.2023.100040.