



# A DEG System that gives back

Presented by ECAs



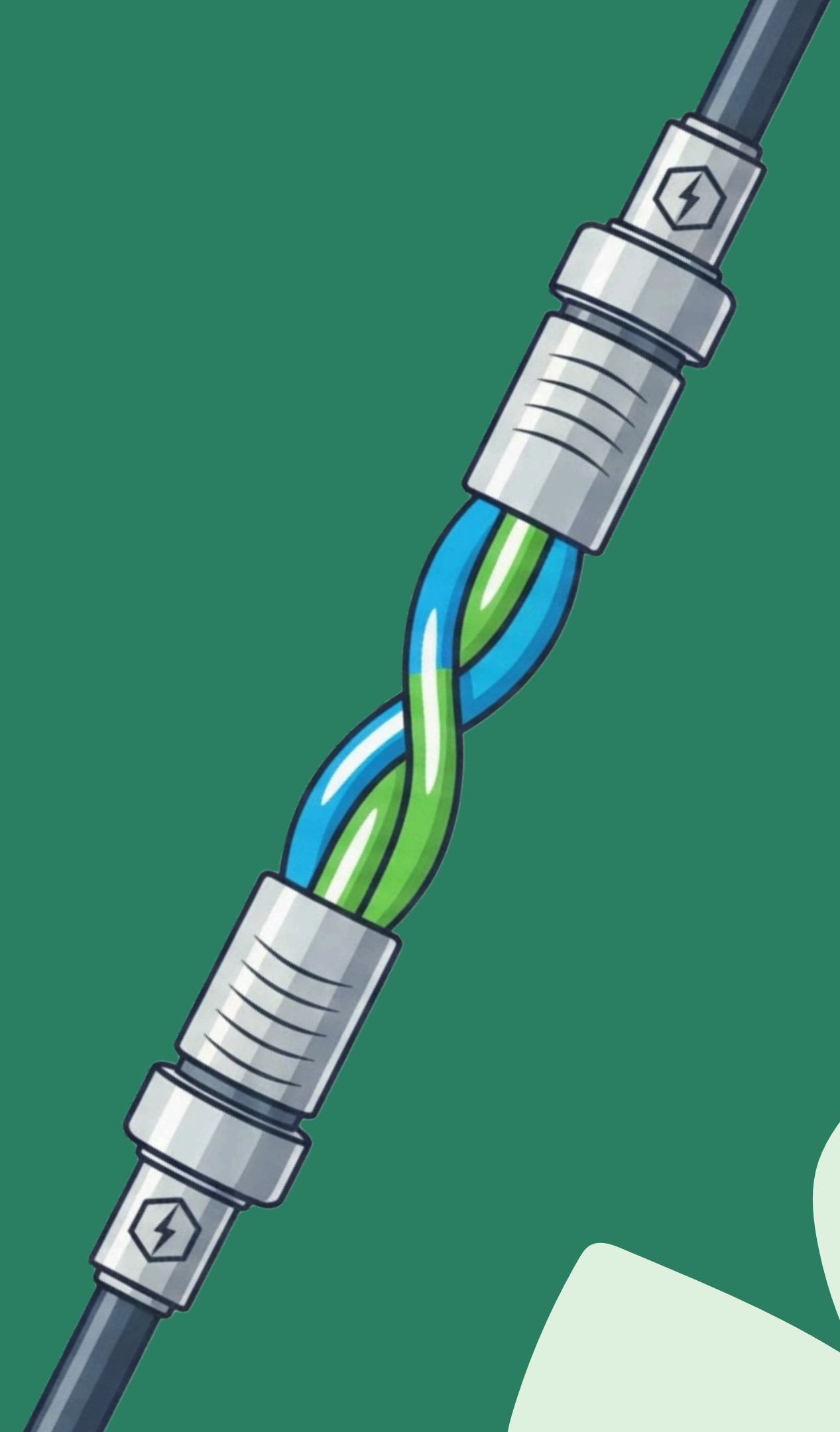
# Solution Overview

## COMPUTE-ENERGY CONVERGENCE IN DEG

ECA's objective is to minimise £ per inference under a configurable carbon-intensity cap, while respecting workload SLAs.

Using grid price, congestion, and carbon forecasts, plus a lightweight workload-forecasting module (e.g., time-of-day patterns), an optimisation engine schedules compute slots across time and regions, deciding when to run, defer, or migrate workloads.

When the Grid Agent signals a P415 flexibility opportunity, ECA can pause low-priority jobs, shift them to greener regions, discharge on-site storage, and sell verified "Negawatts" via the Beckn protocol. Every decision is logged as a machine-verifiable DEG record, enabling P444 settlement and "green inference" reporting.



# Technical Architecture

## SIGNAL LAYER (BECKN PROTOCOL)

The system operates as a Peer-to-Peer (P2P) network. The Grid Agent acts as the Beckn Application Platform (BAP) or 'Seeker,' publishing real-time signals for price, congestion, and carbon. The Compute Agent acts as the Beckn Provider Platform (BPP) or 'Provider,' exposing a machine-readable catalogue of compute slots (power draw, deferral window, SLA, carbon budget, region options). The DER Agent reports battery SoC and on-site renewable forecasts.

## DECISION LAYER

A Model Predictive Control (MPC) engine continuously solves a Mixed-Integer Linear Programming (MILP) problem to minimise £ per inference. It ingests rolling forecasts to satisfy (i) a carbon-intensity cap, (ii) job-specific latency/SLA constraints, and (iii) P415/VLP rules. It continuously decides when to run, defer, region-shift, or execute renewables-only compute windows, and how much storage to charge/discharge.

## EXECUTION LAYER

Decisions are enacted via Beckn. The Compute Agent orchestrates workloads via Kubernetes API hooks (utilising checkpointing to pause training states) and interfaces with on-site storage via Modbus/MQTT to execute charge/discharge commands. All messages are signed using Ed25519 private keys, creating immutable, machine-verifiable DEG logs that ensure non-repudiation for P444 settlement and ESG reporting.



# Agent Workflow

The workflow follows the standard **Beckn lifecycle**, augmented with DEG-style verifiable records.

## DISCOVERY (SEARCH/ON\_SEARCH)

The Grid Agent broadcasts an intent for "10MW load reduction." The Compute Agent consults its optimisation engine and forecasted workload queue, selects deferrable compute slots that respect SLAs and carbon budgets, and responds with offers (e.g., "pause 5MW for 1 hour @ £500/MWh").

## FULFILMENT (STATUS/ON\_STATUS)

The Compute Agent suspends/migrates workloads and coordinates storage discharge. It streams power telemetry via on\_status messages, aggregated into standard 30-minute settlement periods (simulated at accelerated speed for demonstration) to prove delivery of the committed flexibility.

## ORDER (INIT/CONFIRM)

The Grid Agent selects an offer. A P415-compliant init message creates the draft contract; the confirm message locks the OBP ID and settlement terms.

## SETTLEMENT

Once the event ends, a per-event record of £/inference, kWh, and kgCO<sub>2</sub> avoided is hashed into a DEG log, enabling P444 settlement and "Green Inference Certificate" issuance.





# Business Model & Impact

01

## REVENUE STREAMS

ECA uses a dual-arbitrage model. First, it reduces data-centre OpEx by shifting flexible workloads into low-price, low-carbon windows, cutting the effective £ per inference. Second, it generates new revenue by selling Negawatts (P415 flexibility) to DSOs and “Green Inference Certificates” to ESG-focused AI clients that need auditable kgCO<sub>2</sub>/inference metrics. ECA is designed as a reusable DEG-native component: any data centre with a job-queue API and power telemetry can adopt it, enabling rapid ecosystem scaling via Beckn protocol.

## 02 SOCIAL IMPACT

Optionally, operators can configure ECA so that a small, transparent share of this flexibility revenue flows into a DEG Social Tariff Fund, which is used by existing fuel-poverty schemes to reduce energy bills for vulnerable households. All contributions and distributions are logged as verifiable DEG records.

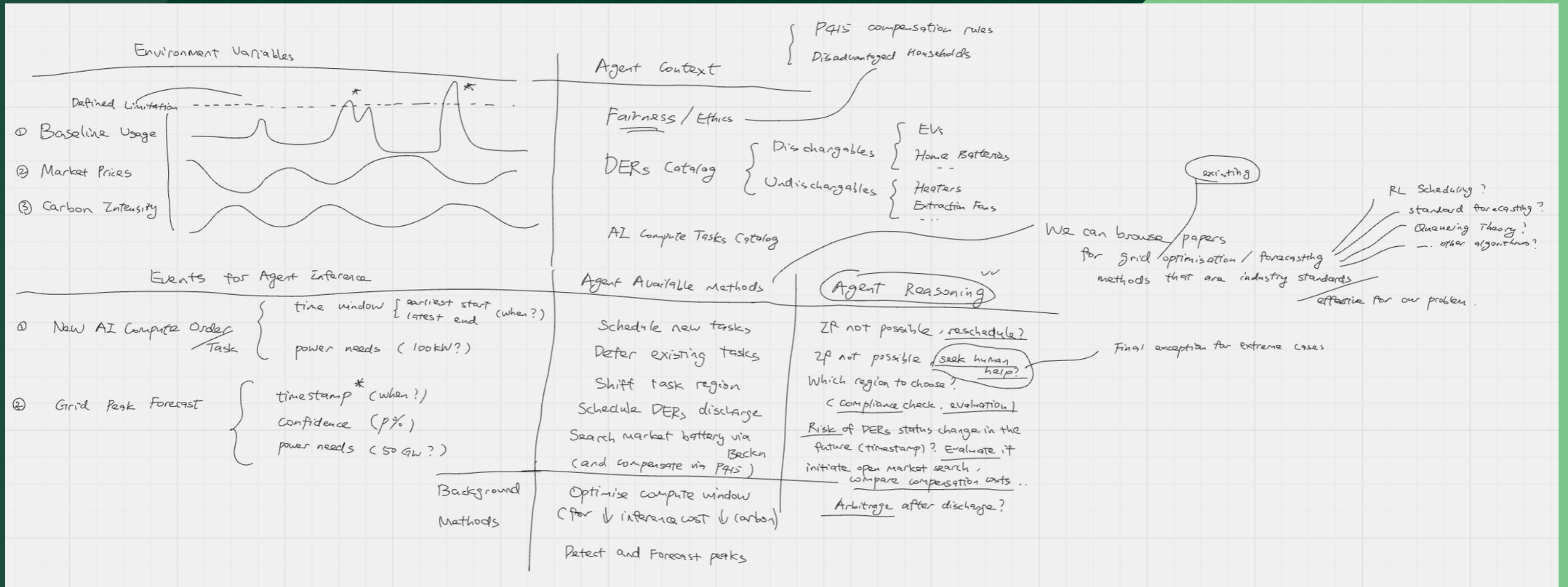
03

## STAKEHOLDER IMPACT

DSOs gain fast, granular demand response; data centres unlock new revenues; renewable producers face less curtailment; regulators and governments receive machine-verifiable logs that support P444 settlement, ESG reporting and a more just and inclusive energy transition.



# Brainstorming Canvas



# Eco-Compute Arbitrageurs

**Institution / Organisation:** Imperial College London & University of the Arts London

## **Team Members:**

**Dylan Pan, AI Engineer**

**Mana Blumicz, Business Strategist**

**Qi Gu, Full Stack Developer**

**Qijun He, System Designer**

## **Contact Emails:**

**dp325@ic.ac.uk**

**manablumicz@gmail.com**

**qg325@ic.ac.uk**

**1116828@qq.com**

**Discord Usernames:**   dylan\_logic   katakaigo   neg2sode.   。



# References

## **FIDE Digital Energy Grid Vision Paper**

FIDE & IEA. (2025). Digital Energy Grid: A Vision for a Unified Energy Infrastructure. Chapter 7 (DEG and AI) on agentic orchestration; Section 6.3 on Cloud Energy Storage; Section 5.4 on Inclusive Access.  
<https://energy.becknprotocol.io/vision-paper/>

## **Beckn Protocol Specification**

Beckn Protocol Core Specification. (2025). Unified Energy Interface (UEI) for Energy Transactions. Schema for energy discovery, order lifecycle, and machine-verifiable settlement.  
<https://becknprotocol.io/core-specification/>

## **UK Flexibility Standards**

Elexon. (2024). P415 Facilitating Access to Wholesale Markets for Flexibility. Virtual Lead Party (VLP) activation framework for behind-the-meter assets.  
<https://www.elexon.co.uk/bsc/mod-proposal/p415/>

Ofgem. (2025). Balancing and Settlement Code P444: Compensation for VLP Actions. Settlement mechanism for flexibility services with OBP ID traceability.  
<https://www.ofgem.gov.uk/publications/p444-compensation-virtual-lead-party-actions>

## **Carbon-Aware Computing**

Hindustan Times. (2025). Digital Energy Grids: The UPI Moment for Electricity? Analysis of carbon-intensity-based workload scheduling and DEG identity layer applications.  
<https://www.hindustantimes.com/ht-insight/economy/digital-energy-grids-the-upi-moment-for-electricity-101747980569795.html>

Axle Energy. (2025). P415: How to Wholesale. Load shifting business models and wholesale market participation strategies.  
<https://www.axle.energy/blog/p415-how-to-wholesale>