Digital Energy Grid Hackathon — Idea Submission Template

1. Team Information

- **Team Name:** MURAT-AI
- **Institution / Organization:** Imperial College London
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2. Problem Focus

- **Problem 1: Utility Interface with Agentic Orchestration for Grid-Scale Demand Flexibility**

3. Solution Overview (max 150 words)

Our solution, the **Feeder-Level Flexibility Agent (FLFA)**, addresses the challenge of real-time feeder-level load management for Distribution System Operators (DSOs). As DERs proliferate, manual coordination is insufficient. FLFA acts as a co-pilot, using advanced forecasting to predict localized grid overloads (spikes) at the feeder/substation level. It then autonomously orchestrates subscribed Demand-Side Resources (DSRs) via Beckn Protocol workflows to mitigate the spike within a sub-5 second detection-to-dispatch SLA. This agentic approach ensures grid stability, enables verifiable P444 settlement through OBP IDs, and transforms demand flexibility into a reliable, first-class operational asset for the utility.

4. Technical Architecture (max 200 words or diagram)

The architecture comprises two main components: the **Forecasting Agent** and the **Dispatch Agent**.

- **Forecasting Agent:** Ingests real-time and historical SCADA/AMI data (load, voltage, temperature) to run a **Time-Series Forecasting Model (e.g., LSTM or Prophet)** to predict load spikes 15-60 minutes ahead at the feeder level.
- **Dispatch Agent:** Monitors the forecast and, upon prediction of an overload, queries the Beckn Sandbox for the beckn:Catalog of available, subscribed DERs (e.g., home batteries, EV chargers). It then uses a **Constraint Optimization Algorithm** to select the optimal mix of DERs to dispatch, minimizing cost while resolving the overload.

Data Sources / APIs / Models:

1. **SCADA/AMI Data (Simulated):** Real-time load, voltage, and temperature data for forecasting.
2. **Beckn Sandbox:** Used by the Dispatch Agent to discover DER flexibility (beckn:Catalog) and activate it (beckn:Order lifecycle).
3. **AI Model: A Long Short-Term Memory (LSTM) network** is used by the Forecasting Agent for high-accuracy, short-term load forecasting.

Orchestration Logic: The Forecasting Agent alerts the Dispatch Agent of a predicted overload. The Dispatch Agent initiates the Beckn workflow: Search for flexibility, Select the optimal set, and Order the dispatch, ensuring the P415 VLP activation and full audit logging for P444 settlement.

5. Agent Workflow (max 150 words)

4. **Sense & Predict:** The Forecasting Agent continuously ingests real-time feeder data. The LSTM model predicts a load spike exceeding the feeder's capacity 30 minutes in advance.
5. **Discover Flexibility:** The Dispatch Agent initiates a beckn:Search query to the Beckn network to discover the beckn:Catalog of available DER flexibility (e.g., 50kW of EV charging deferment).
6. **Optimize & Dispatch:** The optimization algorithm selects the necessary flexibility (e.g., 40kW) and the Dispatch Agent issues a beckn:Order to activate the load reduction (P415 VLP).
7. **Audit & Settle:** The entire transaction, including the OBP ID, is logged for full traceability, enabling verifiable P444 settlement and regulator review. The sub-5 second SLA is maintained by pre-qualifying DERs and optimizing the Beckn transaction flow.

6. Business Model & Impact (max 150 words)

The FLFA enables a **Transaction Fee Model** where the DSO pays a small fee per successful flexibility dispatch, tied to the value of the avoided infrastructure upgrade or grid event.

Stakeholders & Benefits:
- **DSOs (Utilities):** Enhanced grid stability, deferred capital expenditure on infrastructure, and compliance with flexibility reforms.
- **DER Owners (Consumers/Businesses):** New revenue stream for participating in Demand Flexibility Programs.
- **Regulators (Ofgem):** Full auditability and transparency of flexibility activation and settlement.

The solution is **scalable** as it is built on the open Beckn Protocol, allowing seamless integration of new DER aggregators and utility systems.

7. References / Inspiration (optional)

- Ofgem's Flexibility Reforms and P415/P444 Settlement Mechanisms.
- Beckn Protocol Documentation for Demand-Side Management.