DiceGrid: WATT WARS

Presented by 1D6 Foundation

One-Page Competitor Brief

Gameplay

Teams connect **NODES** to a shared **GRID** (24 V RMS, 50 Hz AC). Power flows *continuously*; there are no discrete matches or timed phases. Your objective: **maximise cumulative score** over the full event day.

- **Buy Energy**: Draw from the organiser-provided **SUPPLY NODES** (fixed cost) or the **GRID** (dynamic cost).
- **Sell Energy**: Export to the **GRID** and earn credits governed by the live **SPOT PRICE** coefficient.
- **Battery Arbitrage**: A **BATTERY NODE** (a special **SUPPLY NODE**) lets you purchase low and discharge high.
- **Reactive Support**: Teams earn points for supporting the grid with active/reactive power when its frequency and voltage deviate from their nominal values.

All **NODES** share identical hardware; **PROGRAMMABLE NODES** may be reflashed by teams, while **SUPPLY NODES** run organiser firmware.

Scoring Mechanism

Every tick ($\Delta T \approx 1\,\text{s}$) the **GAME COORDINATOR** integrates each team's average real power $\langle P_{\text{net}} \rangle_{\Delta T}$ and reactive power $\langle Q_{\text{net}} \rangle_{\Delta T}$. The instantaneous score increment is:

$$\Delta S = \alpha_{\text{spot}} \langle P \rangle_{\Delta T} + \Gamma_P + \Gamma_Q,$$

$$\Gamma_P = \alpha_P \left(f_{\text{nom}} - f_{\text{grid}} \right) \langle P \rangle_{\Delta T},$$

$$\Gamma_Q = \alpha_Q \left(V_{\text{nom}} - V_{\text{grid}} \right) \langle Q \rangle_{\Delta T}.$$

- **SPOT PRICE** (α_{spot}): baseline payout/charge per watt of net real power.
- **FREQ PRICE** (α_P): bonus/penalty for real power that corrects grid frequency.
- **VOLT PRICE** (α_Q): bonus/penalty for reactive power that corrects grid voltage.

Coefficients broadcast live; expect them to change with demand.

Hardware & Operating Constraints

- **Series Inductor**: A ($\approx 6\,\text{mH}$) series grid-coupling inductor is automatically enabled when a **NODE** is connected to the **GRID**. This allows the **NODE** to operate as a grid-forming inverter (see application note **1D6-2025-2**).
- **Grid Bus**: 24 V RMS at 50 Hz AC common to all teams.
- **Current Limit**: Max RMS current per **NODE** is 1.5 A.
- **Heat Dissipation**: Instantaneous difference $|P_{\text{in}} - P_{\text{out}}|$ must not exceed 2 W per **NODE**.
- **NODE Peripherals** Each **NODE** includes a 4-switch full-bridge synchronous converter between each port, along with voltage and current sensors. Controlling these MOSFETs is the primary role of the **NODE** firmware.

How to Succeed

1. Optimise conversion efficiency (e.g. MPPT, synchronous rectification).
2. Track the live α coefficients via UART and adapt in real time.
3. Exploit **BATTERY NODES** for strategic arbitrage.
4. Provide helpful Q support when V_{grid} deviates and P support when ω_{grid} deviates.
5. Honour current and power-imbalance limits—supervisors will instantly **NODES** disconnect any **NODES** that violate them.

Key Terms

NODE: Bidirectional power module (common HW).
PROGRAMMABLE NODE: Team-reflashable **NODE**.
SUPPLY NODE: Organiser-flashed source (includes **BATTERY**).
BATTERY NODE: Special **SUPPLY NODE** for storage & arbitrage.
GRID: Shared 24 V, 50 Hz AC bus.
GAME COORDINATOR: Central authority broadcasting prices & scores.