Energy Utopia Challenge: AI for a Smarter, Greener Future

IEEE PES Tunisia Section Chapter & IEEE YP Tunisia Section Affinity Group

TSYP13 TECHNICAL CHALLENGE

SCOPE & TOPIC:

The **Energy Utopia Challenge** invites participants to explore how Artificial Intelligence can improve the way we use and manage energy. The challenge covers four main topics: **optimizing energy consumption**, **managing energy storage**, **predicting and integrating renewable energy**, and **predictive maintenance of energy equipment**. Teams will use real or simulated datasets to build smart solutions, such as forecasting, anomaly detection, or decision support tools. The goal is to design innovative AI-driven ideas that make **energy systems smarter**, **greener**, and more **sustainable**.

Problem Statement:

Energy systems around the world are becoming more complex, with rising demand, the integration of renewable sources, and the need for more efficient and reliable operations. Traditional methods of managing consumption, storage, production, and maintenance are no longer enough to ensure stability and sustainability. At the same time, huge amounts of data are being generated every second by smart meters, sensors, and energy equipment. The challenge is how to use Artificial Intelligence to transform this data into actionable insights. By applying AI techniques, participants are expected to design solutions that can predict, optimize, and prevent issues across four key areas: energy consumption, energy storage, renewable energy integration, and predictive maintenance.
The goal is to create intelligent tools that not only improve efficiency and reduce costs but also support the transition towards a smarter and greener energy future.

Challenge Goal:

1. Optimizing Energy Consumption

The goal is to use AI to better understand and manage electricity usage in buildings, factories, and homes.

- Detect unusual consumption or anomalies.
- Predict future energy demand.
- Provide recommendations for shifting or reducing loads to save costs and energy.

2. Managing Energy Storage

Participants will explore how AI can improve the performance and lifetime of batteries or other storage systems.

- Forecast the remaining useful life of storage systems.
- Develop optimal charging and discharging strategies to reduce costs.
- Detect early signs of degradation, overheating, or abnormal behavior.

3. Forecasting & Integrating Renewable Energy

The challenge includes predicting and managing variable renewable sources such as solar and wind.

- Forecast renewable energy production based on weather data.
- Detect gaps between expected and actual production.
- Plan smart usage of storage and consumption according to weather forecasts.

4. Predictive Maintenance of Energy Equipment

AI can help ensure energy systems remain reliable by anticipating failures before they occur.

- Detect anomalies in sensor data (temperature, vibration, voltage, etc.).
- Predict the remaining useful life (RUL) of equipment.
- Provide decision support for technicians by linking past failures with current sensor signals.

Instructions and Delivrables:

i. Topic Selection

- Each team must choose one of the four proposed topics (energy consumption, storage, renewable integration, or predictive maintenance).
- The objective is to design an AI-based solution that addresses a real-world problem within the chosen domain.

ii. Datasets

Teams are responsible for collecting or generating the data they need for their chosen topic. Data can be obtained through public sources, APIs, web scraping, or by simulating realistic scenarios. They are encouraged to combine multiple sources and perform data cleaning, feature engineering, and preparation to build a dataset that supports their AI solution.

iii. Technical Insights & Hints

- Data preprocessing: Handle missing values, detect anomalies, normalize variables, and enrich data with external sources (e.g., weather or economic indicators).
- Feature engineering: Create meaningful features such as rolling averages, seasonal trends, or energy consumption patterns.
- Model selection: Consider time-series forecasting models (ARIMA, Prophet, LSTM, Transformers, etc.), anomaly detection models (Isolation Forest, Autoencoders, etc.), predictive maintenance models (classification or survival analysis), and maintenance assistance (AI agents and LLMs to analyze sensor data, detect potential failures, and provide actionable recommendations to technicians).
- Evaluation: Define clear KPIs (e.g., prediction accuracy, anomaly detection precision, cost savings potential).

iv. Challenge Phases

- **Phase 1: Ideation & Data Exploration**
  - **Deadline:** 20/10/2025
  - **Delivrables:**
    - A **project proposal report** that includes all key points: chosen topic, objectives, expected impact, data sources and preparation, and a preliminary AI model plan.
    - A **GitHub repository and/or Kaggle notebook** containing the dataset collected or generated, along with any code developed during this phase (data collection scripts, preprocessing, exploratory analysis, and initial modeling experiments).

- **Phase 2: Solution Development & Deployment**
  - **Deadline:** 19/12/2025
  - **Delivrables:**
    - **A full project report** documenting the complete workflow, including data preparation, model training, evaluation, deployment steps, and any additional features implemented.
    - **A GitHub repository** containing the full solution code, trained models, and application files.
    - A **demo video** showcasing the working solution and its key functionalities.
    - A **5-minute presentation** summarizing the project, results, and impact.

Submission:

Submit your solution via this link

Rules and criteria:

This challenge is for Student Branches (SBs) only, any SB can participate in this challenge represented by one team of **5** members (maximum).

=>Any deliverables submitted must remain anonymous, especially the videos and the github.

Pitching Duration:

5 minutes

Pitching Language:

English **Français**

Scoring:

Total Score: 100 Points

- **Phase One: Pre-selection [50 pts]**
  - Adherence to Challenge Requirements- **15 points**
  - Technical Approach- **19 points**
  - Quality & Clarity of Deliverables- **8 points**
  - Innovation and Creativity - **8 points**
- **Final Phase: [45 points]**
  - Technical Approach- **20 points**
  - Prototype Functionality & Features - **10 points**
  - Live Presentation Quality - **5 points**
  - Quality & Clarity of Deliverables - **10 points**
- **Bonus: [5 points]**
  - Having at least one PES member in the team- **1 point**
  - Having at least one YP member in the team - **1 point**
  - Having at least one YP having a PES membership in the team - **1 point**
  - Covering the business scope (budget: solution implementation, production, and continuous training, integration and deployment cost)- **2 point**

Winners:

- Number of winners: **3** teams
- Prizes will be announced later

Important Dates:

- Infosession date: **24/09/2025**
- First submission deadline: **20/10/2025** 23:59 GMT+1
- Final Submission deadline: **19/12/2025** 23:59 GMT+1

Please contact us through the following email address **pes@ieee.tn** or **yp@ieee.tn** for any inquires or clarifications.