ABSTRACT

Energy consumption is a significant concern for households and businesses, impacting both costs and sustainability. The **AI-Powered Smart Energy Consumption Tracker** is a web-based application designed to help users monitor their electricity usage and optimize energy consumption. By leveraging **AI-driven analytics**, the system predicts electricity usage trends, offers personalized energy-saving recommendations, and detects unusual energy spikes that may indicate faulty appliances or unnecessary usage.

The application is built using **React.js (Next.js) for the frontend**, ensuring a seamless and responsive user experience, while the backend is powered by **Django or FastAPI** with **PostgreSQL** for efficient data management. AI models, developed using **TensorFlow or Scikit-learn**, analyze historical consumption patterns to provide actionable insights.

Additionally, the system can integrate with **IoT devices (ESP32/Raspberry Pi)** for real-time energy tracking, enhancing accuracy and responsiveness. By combining advanced AI capabilities with user-friendly visualization tools, this tracker empowers individuals and businesses to **reduce electricity bills, enhance energy efficiency, and contribute to a more sustainable future**

**Users**

1.Residential Users (Homeowners/Tenants)

* Monitor personal electricity usage in real time.Receive alerts for unusual power consumption or faulty appliances.
* Compare current usage with past trends and set energy-saving goals.
* Integrate with smart home devices (smart meters, IoT-enabled appliances).
* Get bill predictions based on usage trends.

2. Commercial Users (Businesses & Enterprises)

* Track energy usage across multiple locations or departments.
* Optimize power consumption for cost savings.
* Schedule equipment usage based on AI-generated peak hour predictions.
* Receive sustainability and carbon footprint reports.
* Get maintenance alerts for high-energy-consuming equipment.

3. Utility Companies (Electricity Providers)

* Monitor overall electricity demand in real-time.
* Predict power load distribution and optimize supply.
* Detect anomalies, power theft, or outages.
* Provide dynamic pricing based on real-time usage trends.
* Send targeted energy efficiency programs to consumers.

4. Government & Policy Makers

* Analyze energy consumption trends at a city or regional level.
* Implement and monitor energy conservation policies.
* Provide incentives for users with energy-efficient behavior.
* Promote renewable energy adoption based on usage patterns.

5. Technicians & Energy Consultants

* Access detailed energy reports to suggest efficiency improvements.
* Monitor energy consumption of clients and offer consulting services.
* Detect and diagnose high energy consumption patterns remotely.

**FEATURES**

1. Real-Time Energy Monitoring – Displays live electricity usage through interactive graphs and dashboards.
2. AI-Powered Recommendations – Suggests energy-saving tips based on user consumption patterns.
3. Consumption History & Trends – Allows users to view past energy usage and compare trends over time.
4. Bill Estimation & Cost Forecasting – Predicts electricity bills based on current usage trends.
5. Smart Alerts & Notifications – Sends alerts for excessive energy usage, power surges, or unusual consumption.
6. Peak Hours Awareness – Shows when electricity demand is highest and suggests off-peak usage for savings.
7. Appliance-Level Tracking – Identifies energy consumption of individual devices and suggests optimizations.

**Sustainability & Smart Integrations**

1. **Renewable Energy Suggestions** – Recommends switching to solar/wind power or integrating with smart grids.
2. **Smart Home Integration** – Connects with IoT devices like smart plugs, thermostats, and energy-efficient appliances.
3. **Remote Appliance Control** – Lets users turn off/on appliances remotely to prevent unnecessary power use.
4. **Load Balancing & Scheduling** – Suggests when to use high-power appliances to reduce costs.

**User Management & Community Engagement**

1. **Multi-User Access** – Allows family members or employees to monitor and manage usage.
2. **Community Energy Challenges** – Encourages users to compete in energy-saving challenges.
3. **AI Chatbot Assistance** – Provides instant energy-saving tips and troubleshooting help.
4. **User Feedback & Support** – Lets users report issues, get help, or suggest new features.