

## Smart Home Energy Monitor - Codebase Overview

### 1. Client Architecture

- React 18 + Vite + Shadcn UI power the SPA; AuthProvider + EnergyProvider wrap routes \(\src/App.tsx:22\).
- ProtectedRoute enforces login plus onboarding before feature pages render \(\src/routes/ProtectedRoute.tsx:6\).
- Layout components \(\ConnectionStatus, BottomNav, Toaster\) keep a consistent mobile friendly shell \(\src/components/AppLayout.tsx:14\).

### 2. Realtime Data Flow

- EnergyProvider hydrates devices, alerts, home profile, and billing fields from localStorage \(\src/contexts/EnergyContext.tsx:43\).
- After onboarding it connects to MQTT, subscribes to power/energy/alert topics, and builds rolling history \(\src/contexts/EnergyContext.tsx:114,162\).
- Toggle/update/add/remove actions publish MQTT commands and sync with /api/devices \(\src/contexts/EnergyContext.tsx:304-375\).
- mqttService centralizes connects, wildcard subscriptions, publishing, and disconnect logic \(\src/services/mqttService.ts:53-268\).

### 3. Automations and Safeguards

- Background runner reloads saved rules, fires notify/turnOff/scene actions, and tracks essential devices \(\src/contexts/EnergyContext.tsx:418-518\).
- Standby Kill shuts devices off after sustained low usage and offline devices raise warnings after 5 minutes \(\src/contexts/EnergyContext.tsx:556-606\).
- A budget watcher converts monthly plus TOU settings into 75/90/100 percent toasts \(\src/contexts/EnergyContext.tsx:612-646\).

### 4. Feature Screens

- Dashboard aggregates watts, today's kWh, estimated cost, top consumers, and the All Off command \(\src/pages/Dashboard.tsx:11-174\).
- Devices and AddDevice manage the catalog with filtering, zod validation, and icons \(\src/pages/Devices.tsx:6-74, src/pages/AddDevice.tsx:2-180\).
- DeviceDetail streams per device charts, edits metadata, and clears retained MQTT on delete \(\src/pages/DeviceDetail.tsx:9-199\).
- Automations builds custom scenes and threshold rules; Insights renders charts; Settings centralizes broker, TOU, budget, export, import, and reset \(\src/pages/Automations.tsx:25-220, src/pages/Insights.tsx:1-200,) Tj 0 -14 Td (src/pages/Settings.tsx:1-14).

### 5. Backend Services

- Express 5 server layers Helmet, rate limiting, CORS allowlist, CSRF token endpoint, and /api routers \(\Backend/server.cjs:26-120\).
- SQLite tables \(\users, devices, settings\) plus auth middleware handle PBKDF2 hashing and signed cookies \(\Backend/db.cjs:9-34, Backend/middleware/auth.cjs:9-124\).
- Optional CSRF middleware pairs with the ensureCsrfToken helper on the client \(\Backend/middleware/csrf.cjs:8-27, src/api/client.ts:28-73\).

### 6. Developer Utilities

- test-simulator.cjs publishes power/energy/alert traffic and reacts to command topics \(\test-simulator.cjs:1-147\).
- scripts/clear-retained.cjs wipes retained MQTT topics so deleted devices stay deleted \(\scripts/clear-retained.cjs:1-82\).