# EM Tools – Full Project Requirements Document

## 🔄 Overview

EM Tools is a modular suite designed to support comprehensive energy modeling, lifecycle cost analysis (LCCA), standards compliance, and embodied carbon tracking. It integrates outputs from CBECC, EnergyPlus, and IESVE and delivers streamlined data processing, conversion, visualization, and cost evaluation.

The system is organized into **five interdependent tracks**, each composed of functional modules that interact through a shared data structure.

## 📆 TRACK 1: EM Core Tools

**Purpose**: Core engine for parsing, conversion, comparison, and reporting.

### Modules:

* **Model Viewer / Inspector**: View CBECC and IESVE inputs; XML & IDF visual comparison.
* **Model Conversion Engine**: Translates between CBECC, IESVE, and EnergyPlus (IDF).
* **CBECC Parser + Normalizer**: Converts input.xml to normalized JSON.
* **IDF Generator**: Produces EnergyPlus-ready files.
* **IESVE Exporter**: Outputs IES-compatible files from normalized models.
* **Comparison Engine**: Baseline vs. proposed energy use and system deltas.
* **Shared Lookup Modules**: Zip → Climate Zone, eGRID, Utility Rate.
* **Dashboard Generator**: Visualization interface for key metrics.

### Dependencies:

* Shared\_Data modules (ZIP, eGRID, Rate DB)
* EM Explorer for dashboard display
* LCCA for scenario cost evaluation

## 📑 TRACK 2: Reference Documents

**Purpose**: Developer and user guidance for modeling protocols, input standards, and compliance documentation.

### Modules:

* **CBECC Modeling Guide**: Inputs, use cases, system definitions.
* **IESVE Modeling Guide**: Input field mapping and system assumptions.
* **CBECC vs. IESVE Comparison**: Methodological notes, caveats, examples.
* **QA/QC Protocols**: For cross-model verification.
* **PDF + GitHub Wiki Integration**: Structured, navigable output.

### Dependencies:

* Aligned with EM Core Tool outputs and modules
* Informs QA modules and report generators

## 🔢 TRACK 3: EnergyPlus Tools

**Purpose**: Generate EnergyPlus-compliant IDF models, compliance analysis, and energy performance results.

### Modules:

* **Baseline Modeling Tool**: Converts CBECC building into ASHRAE 90.1 baseline.
* **IDF Generator**: Receives normalized JSON from EM Core and builds full IDF.
* **Compliance Validator**: Evaluates HVAC, envelope, and schedules for ASHRAE.
* **Performance Analysis Tool**: Produces consumption tables and LEED-ready summaries.
* **ECON-1 + EAP Report Generator**: Formal reporting for Title 24, LEED, incentives.

### Dependencies:

* EM Core for parser and conversion
* LCCA for cost feedback
* EM Explorer for QA report display

## 💸 TRACK 4: LCCA Tools

**Purpose**: Integrate lifecycle cost estimation with modeling results and scenarios.

### Modules:

* **LCCA Scenario Tool**: Supports multiple design/system proposals.
* **Construction Cost Database**: Costs for assemblies, systems, and escalation.
* **Cost Estimator (HVAC, PV, Battery)**: System-level pricing, includes CAPEX + O&M.
* **Emissions Estimator**: Integrates with eGRID to calculate carbon footprint.
* **Excel Dashboard Generator**: .xlsm report with scenario outputs.
* **Input Linker**: Connects normalized data to dashboard.

### Dependencies:

* EM Core and EnergyPlus for model data
* Shared\_Data/eGRID and rate DBs for GHG + utility cost
* EM Explorer for visual output (future)

## 🔍 TRACK 5: EM Explorer (QA + Visualization)

**Purpose**: QAQC, diagnostics, and multi-model visualization.

### Modules:

* **Geometry Mapper**: Compare zone/surface definitions across models.
* **Manual J Viewer**: Load breakdown by room/zone.
* **HVAC Explorer**: System and component explorer (per building type).
* **EUI + GHG Viewer**: Tracks consumption and emissions by zone/system.
* **QAQC Report Generator**: Differences in envelope, systems, load shapes.
* **XLSX Exporter**: Tabular outputs of comparisons and diagnostics.
* **Scenario Dashboard**: Interactive UI across CBECC, E+, and IES outputs.

### Dependencies:

* EM Core Tools for normalized data
* EnergyPlus and IES outputs
* LCCA results for GHG and $ overlays

## 💾 Shared Data Layer

**Purpose**: Common data sources accessed by all tracks

### Includes:

* **ZIP to eGRID Mapping** → Shared\_Data/eGRID/egrid\_regions.csv
* **Utility Rate Database** → Future module for cost estimation
* **Climate Zone Mappings** → ZIP → CZ → LCCA/Title 24 alignment
* **Material Lookup** → For EC3 and cost modules

## ✅ Project Completion Criteria (v1.0)

* Each module delivers testable output
* GitHub tagged with version + changelog
* .env variables wired and documented
* QA pipeline active for all translators
* All dashboards linked to outputs and updated
* Reference Docs and GitHub Wiki fully published

Let me know if you’d like this cross-linked to your milestone dashboard or exported to PDF/Markdown.