Product Requirements Document: Universal Carbon Emissions Tracking Platform

Based on my comprehensive analysis of the carbon accounting software market, competitive landscape, and regulatory requirements, I've created a detailed Product Requirements Document for your carbon emissions tracking platform.

Executive Summary

Product Vision: EcoConnect is an enterprise-grade carbon emissions calculator that revolutionizes how large companies track their carbon footprint through universal equipment integration - the first platform to connect directly to ALL laboratory and factory equipment for real-time emissions data instead of estimates.

Key Market Insights

The carbon accounting software market presents a significant opportunity:

- Market Size: $18B in 2024, projected to reach $76B by 2030-2032 (CAGR: 20%+)
- Competitive Gap: No existing platform offers comprehensive equipment integration across all sectors
- Target Market: Enterprise companies (200+ employees) in biotech, manufacturing, chemicals, and research

Unique Selling Proposition

"The first and only carbon tracking platform that connects to ALL your equipment - from lab instruments to factory machines - providing real-time emissions data instead of estimates."

Core Competitive Advantages

- Universal Equipment Integration - Direct connection to 1000+ equipment types
- Real-time IoT Monitoring - Equipment-level carbon tracking vs. estimates
- Industry-Specific Optimization - Domain expertise in biotech and manufacturing
- Predictive Analytics - AI-driven optimization recommendations
- Regulatory Compliance Suite - Built-in support for GHG Protocol, ISO 14064, CSRD, TCFD, SASB
- Enterprise-Grade Architecture - Scalable, secure, API-first design

Technical Architecture

The platform uses a modern, scalable tech stack:

- **Frontend**: React.js, TypeScript, Material-UI, D3.js/Plotly
- **Backend**: Node.js, Python microservices, GraphQL, RESTful APIs
- **Database**: PostgreSQL, InfluxDB (time-series), MongoDB
- **IoT Integration**: MQTT, WebSocket APIs, edge computing
- **Analytics**: TensorFlow, PyTorch, Apache Spark
- **Infrastructure**: Cloud-native (AWS/Azure), Docker, Kubernetes

Target Customer Segments

- Large Biotech/Pharmaceutical (25-51+ employees)
- Manufacturing Enterprises (500+ employees)
- Chemical/Materials Companies (200+ employees)
- Research Institutions (University/Government labs)

Business Model & Pricing

- Starter: $2,500/month (up to 50 equipment connections)
- Professional: $10,000/month (up to 500 connections)
- Enterprise: Custom pricing starting at $25,000/month (unlimited)

Implementation Roadmap

- Phase 1 (Months 1-6): Foundation - Core platform and initial integrations
- Phase 2 (Months 7-12): Expansion - Advanced features and 50+ equipment types
- Phase 3 (Months 13-18): Market Launch - 100+ integrations and commercial launch

Core Platform Features

1. Universal Equipment Integration Hub

- Equipment Discovery & Connection: Auto-detect and connect to 100+ equipment types (lab instruments, manufacturing machines, HVAC systems)
- IoT Sensor Integration: Deploy wireless sensors for legacy equipment without APIs
- Real-time Data Ingestion: Process 100,000+ data points/second from connected equipment
- API Gateway: Support REST, MQTT, OPC-UA, and Modbus protocols

2. Live Emissions Dashboard

- Real-time Monitoring: Live carbon emissions by equipment, facility, and scope (1, 2, 3)
- Interactive Visualizations: Heat maps, trend charts, emissions by category
- Equipment Performance Metrics: Energy consumption, efficiency scores, carbon intensity
- Alert System: Automated notifications for anomalies and threshold breaches

3. AI-Powered Analytics Engine

- Predictive Emissions Forecasting: Machine learning models for future emissions trends
- Optimization Recommendations: AI-generated suggestions for 10-73% emissions reduction
- Anomaly Detection: Identify unusual consumption patterns and equipment malfunctions
- Carbon Reduction ROI Calculator: Cost-benefit analysis of optimization projects

4. Regulatory Compliance Suite

- Multi-Framework Support: GHG Protocol, ISO 14064, CSRD, TCFD, SASB compliance
- Automated Reporting: One-click generation of regulatory reports
- Audit Trail: Complete data lineage and validation for compliance officers
- Third-party Verification: Export audit-ready data packages