**Functional Requirements**

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**Executive Summary**

This document defines the functional requirements for the AI-Powered Sustainability Regulatory Compliance Platform for Real Estate. The system automates EU sustainability regulation compliance (SFDR, EU Taxonomy, CSRD) for property companies and real estate asset managers while providing actionable environmental performance insights.

**User Personas**

**Primary Users**

**P1: Compliance Manager**

* Responsible for regulatory reporting and compliance
* Needs automated report generation and compliance tracking
* Technical proficiency: Intermediate

**P2: ESG Analyst**

* Analyzes sustainability performance and identifies improvements
* Needs detailed analytics and benchmarking tools
* Technical proficiency: Advanced

**P3: Portfolio Manager**

* Manages real estate investment portfolios
* Needs high-level dashboards and performance metrics
* Technical proficiency: Basic to Intermediate

**P4: Fund Manager**

* Oversees Article 8/9 funds requiring SFDR compliance
* Needs investor-ready reports and risk assessments
* Technical proficiency: Basic

**Core Functional Requirements**

**F1: Data Collection and Processing**

**F1.1 Multi-Source Data Ingestion**

**Priority:** High  
**User Stories:** P1, P2, P3

**Description:** The system shall automatically collect and process property-specific sustainability data from multiple sources.

**Acceptance Criteria:**

* Integrate with 20+ major property management systems (Yardi, MRI, Argus, etc.)
* Process utility bills in multiple formats (PDF, CSV, XML, EDI)
* Extract data from Energy Performance Certificates (EPCs)
* Import building management system (BMS) data via APIs
* Process tenant sustainability surveys and questionnaires
* Handle regulatory database feeds in real-time

**Data Sources:**

* Utility bills (electricity, gas, water, waste)
* Energy Performance Certificates
* Building management systems
* Tenant surveys and occupancy data
* Regulatory databases (EU Taxonomy updates, SFDR amendments)
* Third-party ESG data providers
* Property valuation and asset information

**F1.2 Document Processing via Computer Vision**

**Priority:** High  
**User Stories:** P1, P2

**Description:** The system shall use computer vision algorithms to automatically extract relevant data from property documents.

**Acceptance Criteria:**

* Extract utility consumption data from scanned bills with 95%+ accuracy
* Process EPC documents and extract key performance metrics
* Recognize and categorize building certification documents (BREEAM, LEED)
* Handle documents in multiple languages (English, German, French, Spanish)
* Validate extracted data against predefined ranges and flag anomalies

**F1.3 Data Quality and Validation**

**Priority:** High  
**User Stories:** P1, P2, P3

**Description:** The system shall ensure data quality through automated validation and cleansing processes.

**Acceptance Criteria:**

* Identify and flag missing data points required for compliance
* Detect outliers and anomalies in energy consumption data
* Validate data consistency across different sources
* Provide data quality scores for each property and metric
* Generate data gap reports with recommendations for improvement

**F2: EU Regulatory Compliance Analysis**

**F2.1 EU Taxonomy Alignment Assessment**

**Priority:** High  
**User Stories:** P1, P2, P4

**Description:** The system shall automatically assess property portfolio alignment with EU Taxonomy technical screening criteria.

**Acceptance Criteria:**

* Map property data against 6 environmental objectives
* Apply technical screening criteria for real estate activities (7.1-7.7)
* Assess "Do No Significant Harm" (DNSH) criteria compliance
* Verify minimum social safeguards requirements
* Calculate taxonomy-aligned percentage of portfolio value
* Generate detailed alignment reports with evidence documentation

**Covered Real Estate Activities:**

* 7.1 Construction of new buildings
* 7.2 Renovation of existing buildings
* 7.3 Installation of energy efficiency equipment
* 7.4 Installation of renewable energy technologies
* 7.5 Acquisition and ownership of buildings
* 7.6 Professional services related to energy efficiency
* 7.7 Development of real estate projects

**F2.2 SFDR Principal Adverse Impact (PAI) Calculation**

**Priority:** High  
**User Stories:** P1, P4

**Description:** The system shall automatically calculate and report Principal Adverse Impacts for real estate investments under SFDR.

**Acceptance Criteria:**

* Calculate mandatory PAI indicators for real estate:
  + Share of non-renewable energy consumption (PAI 5)
  + Energy consumption intensity per property type (PAI 6)
  + Activities negatively affecting biodiversity areas (PAI 7)
  + Exposure to fossil fuels through real estate assets (PAI 17)
  + Energy efficiency of buildings (PAI 18)
* Generate periodic adverse sustainability impact statements
* Provide improvement targets and trajectory planning
* Export PAI data in regulatory-compliant formats

**F2.3 CSRD Double Materiality Assessment**

**Priority:** Medium  
**User Stories:** P1, P2

**Description:** The system shall support Corporate Sustainability Reporting Directive (CSRD) compliance through double materiality analysis.

**Acceptance Criteria:**

* Assess environmental impact materiality for real estate portfolio
* Evaluate financial materiality of sustainability factors
* Generate CSRD-compliant sustainability statements
* Map disclosures against European Sustainability Reporting Standards (ESRS)
* Provide materiality assessment documentation and evidence

**F3: AI-Driven Analytics and Insights**

**F3.1 Energy Consumption Forecasting**

**Priority:** High  
**User Stories:** P2, P3

**Description:** The system shall predict future energy consumption and carbon emissions using time-series forecasting models.

**Acceptance Criteria:**

* Forecast energy consumption 12-24 months ahead with <10% error rate
* Predict carbon emissions based on consumption patterns and grid factors
* Account for seasonal variations, occupancy changes, and improvement measures
* Provide confidence intervals for all predictions
* Support scenario modeling for different improvement strategies

**F3.2 Performance Benchmarking**

**Priority:** Medium  
**User Stories:** P2, P3

**Description:** The system shall benchmark property performance against industry standards and peer groups.

**Acceptance Criteria:**

* Compare properties against GRESB benchmarks
* Benchmark against similar property types, locations, and sizes
* Track performance improvements over time
* Identify top and bottom performers in portfolio
* Generate benchmarking reports with improvement recommendations

**F3.3 Improvement Recommendations**

**Priority:** High  
**User Stories:** P2, P3

**Description:** The system shall provide AI-driven recommendations for improving environmental performance and regulatory alignment.

**Acceptance Criteria:**

* Identify specific improvement opportunities for each property
* Prioritize recommendations based on cost-benefit analysis
* Estimate investment requirements and payback periods
* Predict impact on regulatory compliance scores
* Generate actionable improvement plans with timelines

**F4: Real-Time Regulatory Monitoring**

**F4.1 Regulatory Change Detection**

**Priority:** High  
**User Stories:** P1, P4

**Description:** The system shall continuously monitor EU regulatory developments and automatically update compliance requirements.

**Acceptance Criteria:**

* Monitor official EU regulatory databases and publications
* Detect changes in technical screening criteria, PAI calculations, and reporting requirements
* Parse regulatory amendments using NLP algorithms
* Alert users to relevant changes within 24 hours of publication
* Update system calculations and compliance checks automatically

**F4.2 Compliance Alert System**

**Priority:** High  
**User Stories:** P1, P4

**Description:** The system shall provide proactive alerts for compliance deadlines and requirements.

**Acceptance Criteria:**

* Track all regulatory reporting deadlines for each fund/portfolio
* Alert users 90, 30, and 7 days before deadlines
* Notify users of new compliance requirements
* Flag potential compliance gaps or risks
* Provide escalation alerts for critical compliance issues

**F5: Reporting and Documentation**

**F5.1 Automated Report Generation**

**Priority:** High  
**User Stories:** P1, P4

**Description:** The system shall generate investor-ready compliance reports automatically.

**Acceptance Criteria:**

* Generate SFDR Article 8/9 fund disclosures
* Create EU Taxonomy alignment reports with supporting evidence
* Produce CSRD sustainability statements
* Export reports in multiple formats (PDF, Excel, XML)
* Include charts, graphs, and visualizations
* Maintain audit trails for all report data

**F5.2 Dashboard and Visualization**

**Priority:** Medium  
**User Stories:** P2, P3, P4

**Description:** The system shall provide interactive dashboards for monitoring sustainability performance and compliance status.

**Acceptance Criteria:**

* Real-time compliance status dashboard with traffic light indicators
* Interactive portfolio performance maps and charts
* Drill-down capability from portfolio to individual property level
* Customizable dashboard views for different user roles
* Mobile-responsive design for tablet and smartphone access

**F5.3 API Access**

**Priority:** Medium  
**User Stories:** P1, P2

**Description:** The system shall provide API access for integration with existing property management and investment systems.

**Acceptance Criteria:**

* RESTful API for data export and import
* Real-time data feeds for compliance metrics
* Webhook support for automated notifications
* API documentation with examples and SDKs
* Rate limiting and security controls

**Performance Requirements**

**Response Time**

* Data processing: <30 seconds for standard property portfolio (100 properties)
* Report generation: <2 minutes for comprehensive compliance report
* Dashboard loading: <3 seconds for main views
* API responses: <1 second for standard queries

**Accuracy Requirements**

* Data extraction from documents: 95%+ accuracy
* EU Taxonomy alignment calculations: 99%+ accuracy
* Energy consumption forecasting: <10% mean absolute error
* Regulatory change detection: 99%+ recall rate

**Scalability**

* Support portfolios up to 10,000 properties
* Handle 100+ concurrent users
* Process 1,000+ documents per hour
* Store 10+ years of historical data

**Security and Compliance Requirements**

**Data Security**

* End-to-end encryption for all data transmission
* AES-256 encryption for data at rest
* Multi-factor authentication for user access
* Role-based access control with audit logging

**Regulatory Compliance**

* GDPR compliance for EU personal data
* SOC 2 Type II compliance for data handling
* ISO 27001 information security standards
* Regular security assessments and penetration testing

**Integration Requirements**

**Property Management Systems**

* Yardi Voyager and Matrix
* MRI Software
* Argus Enterprise
* RealPage
* Buildium

**ESG Data Providers**

* MSCI ESG ratings
* Sustainalytics
* ISS ESG
* CDP (Carbon Disclosure Project)
* GRESB

**Regulatory Databases**

* European Banking Authority (EBA) technical standards
* European Securities and Markets Authority (ESMA) guidance
* EU Taxonomy Navigator
* National regulatory databases

**Future Enhancements**

**Phase 2 (6-12 months)**

* UK Sustainability Disclosure Requirements (SDR) support
* TCFD alignment analysis
* Scope 3 emissions calculation for real estate
* AI-powered greenwashing detection

**Phase 3 (12-18 months)**

* Global expansion (US SEC climate rules, Singapore green taxonomy)
* Integration with IoT sensors for real-time building data
* Blockchain-based sustainability credential verification
* Advanced portfolio optimization algorithms

**Acceptance Testing Criteria**

Each functional requirement will be tested against specific acceptance criteria with defined test cases, expected outcomes, and performance benchmarks. Testing will include:

* Unit testing for individual AI algorithms
* Integration testing for system components
* User acceptance testing with real estate professionals
* Regulatory compliance validation with legal experts
* Performance testing under realistic load conditions

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