Green enterprise architecture refers to the design and implementation of business systems and processes that prioritize environmental sustainability. It involves integrating environmentally responsible practices and technologies into a company's overall architecture, with the goal of reducing the organization's carbon footprint and promoting sustainable practices.

1.Explain the various types of green architectures within the enterprise, such as information architecture and solutions architecture .

Views of Green Enterprise Architecture

A comprehensive GEA encompasses an understanding of the various views of the organization and its interrelationships. Figure 6.1 shows these various architectural views together with the key functionality and the roles that hold primary responsibility within those views. Ā e Green information architecture (GIA), shown in upper half of Figure 6.1, primarily deals with the models of information capture and information provisioning to both external and internal parties in the business space. Ā e information architect and the business analyst work in this space identifying and modeling the information requirements. Ā e GIA describes the enterprise from a business perspective. Ā is architecture is developed based on the business requirements in the "problem space" and takes into account the strategies and policies of the organization (Unhelkar, 2003). Ā e GIA identifies the basic functional requirements that are modeled in the context of the Green IT strategies, processes, applications, and IT governance of the enterprise. Ā is would result in a prioritized suite of functional and operational requirements that become part of the green transformation program. Green solution architecture appearing in the lower half of the architectural spaces, deals with the design and development of systems from a technical perspective. Ā is solutions architecture primarily handles models and implementation of contents, networks, applications, their testing, and deployment.

Ā e solution architect predominantly works in this space supported by the systems analysts and developers. Finally, the all encompassing GEA, depicted in the background in Figure 6.1, provides the constraints across all the systems and applications. Ā e GEA also influences both the information and solution architecture models. Ā ese three form the basic enterprise architectural views of the organization. Ā ere are many other additional architectural views of the organization. Rosen et al. (2011, HRG) have described different architectural domains such as the business
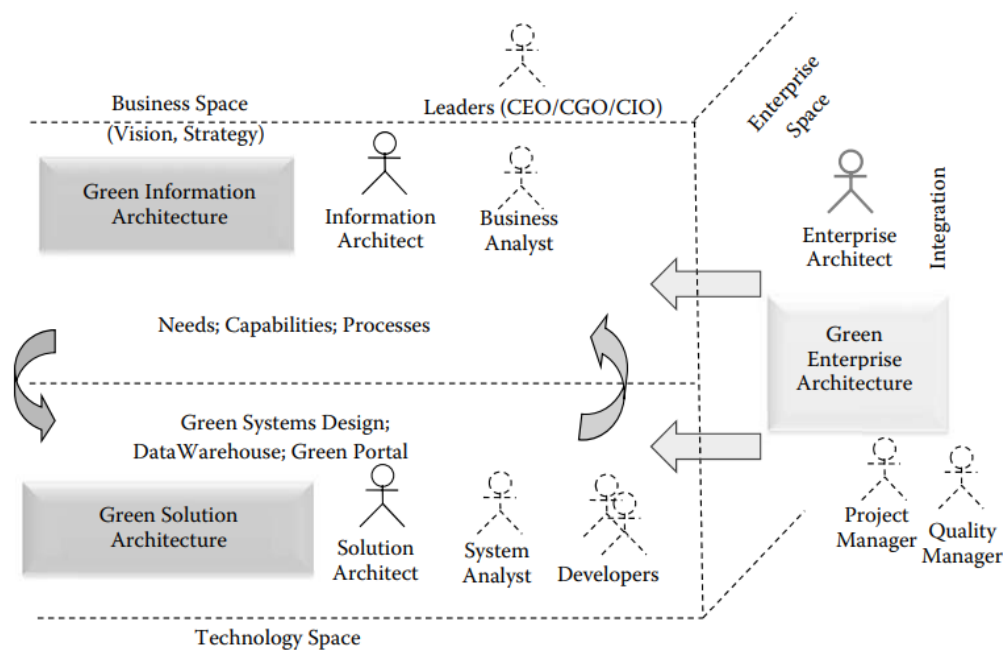
Information architecture is the process of organizing, structuring, and labeling content (e.g., web pages, documents, data) to support effective navigation, search, and retrieval by users. It involves designing the information ecosystem to ensure that the right information is available to the right people at the right time, and in the right format.

Solutions architecture, on the other hand, is the process of designing and implementing technology solutions to meet specific business needs. It involves defining the components of the solution, such as software, hardware, and networking, and how they will work together to achieve the desired outcome. Solutions architecture is focused on the technical aspects of the solution, while information architecture is focused on the organization and presentation of information within the solution.

2. Explain the role of supply chain management systems in the green enterprise architecture.

Green Supply Chain Management

Green supply chain systems, especially with mobile technologies incorporated in them, are a major component of GEA. They reduce inventories, costs, and carbon. However they require contract negotiations. SCM have evolved rapidly to automate and optimize the lifecycle of material procurement. Similarly, SCM are also integral to procurement and use of equipments and corresponding infrastructure. (Lan and Unhelkar 2005) Integration with supply chains has also been studied resulting in integrated SCM (ISCM). Unhelkar and Lan (2011) have extended the concept of ISCM to incorporate environmental considerations within them resulting in Green integrated supply chain management (GISCM) that brings together various stakeholders in the supply chain within and outside the organization.

Supply chain management (SCM) systems are an integral part of organization's systems, as was shown earlier in Figure 6.3. Ā erefore, they deserve specific attention when the GEA is discussed. Figure 6.10 highlights the results from the Trivedi and Unhelkar (2010) survey that depicts this importance of various aspects of a supplier relationship and their environmental responsibility. Ā e need to bring together the suppliers, customers, employees, and senior management in order to produce an integrated and efficient supply chain that will reduce carbon emissions cannot be overstated. Ā e SCM of an organization needs to be analyzed, planned, and optimized for sourcing and deliveries in an environmentally conscious manner. All modern-day supply chain systems are web-based. Undoubtedly, these electronic (Internet-based) systems deliver the enterprises with a competitive advantage by opening up opportunities to streamline processes, reduce costs, increase customer patronage, and enable thorough planning abilities. SCM thus includes geographical, relational, environmental considerations between buyer and supplier. Green issues require further attentions as different legislations apply to the integrated supply chain management (ISCM) across regional boundaries. Cross-borders logistics, culture, language, and economic and regulatory climate are additional considerations which can affect the integration of business processes between regional offices and external organizations. One ill-performing participant in the supply chain will affect the performance of the entire supply chain (Strausl, 2001).

Ā ese characteristics of a good ISCM now need to be converted to handle the environmental issues related to the supply chain. Following are the advantages of GISCM:

- Reduction in unwanted inventory through accurate identification of material requirements within the integrated process leads to reduced storage space and less materials resulting in corresponding carbon savings.

- Improved usage of infrastructure/equipment through sharing of resources reduces number of equipments and infrastructure needed.
- Reduction in carbon overhead relating to material transfer and storage.
- Optimize the number of people that need to handle material on their way to the end customer, thereby reducing the carbon content of that process.
- Eliminate business processes that do not add direct value to the most optimum movement of goods, thereby reducing carbon.
- "Buy-in" from customers by enabling them to provide input into the design and manufacturing of the goals or services that can be based on green initiatives.
- Real-time integration and improved logistics of distribution centers reduces carbon.
- Planning the demand and supply, management of infrastructure planning, and planning the production includes environmental consciousness and metrics.
- Sourcing of materials, services, maintenance of catalogs, collaborative supply management of electronic payments are integrated and measured to ensure reduction in carbon.
- Integration in supply chain enables optimum product lifecycle management, demand planning, production management, and event management. Ā ese activities are improved with reduced carbon as they are all integrated together with the production, quality assurance, packaging, and distribution.
- Disposal of electronic waste and consumed products is handled much better with integrated supply chains and systems.
- Improved and effective handling of returns from customers, especially as the organization that provides the material in the supply chain is in the best position to also accept returns from customers.

Supply chain management systems play a crucial role in a green enterprise architecture by enabling companies to reduce their environmental impact throughout their supply chain. These systems help companies track and monitor their supply chain operations to identify areas where they can reduce waste, improve energy efficiency, and minimize carbon emissions. By implementing green supply chain practices, companies can improve their sustainability, reduce costs, and enhance their reputation as environmentally responsible organizations. Additionally, supply chain management systems can help companies collaborate with suppliers to implement sustainable practices, promote transparency, and ensure compliance with environmental regulations. Overall, a well-designed supply chain management system is a critical component of a green enterprise architecture, as it enables companies to align their environmental goals with their business objectives and drive sustainable growth.
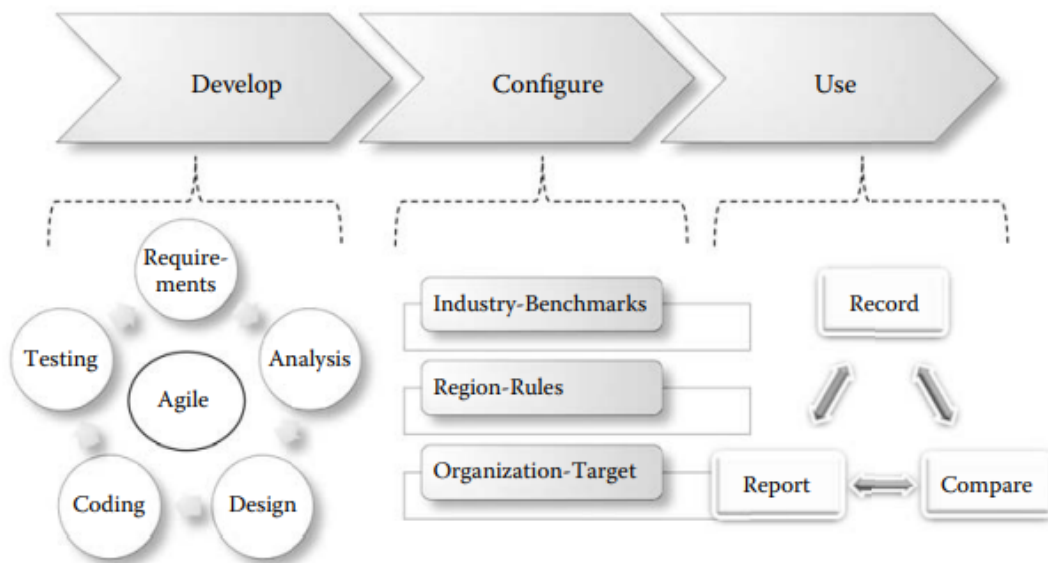
3.List and explain the phases of green information systems

Phases in a GIS Development and Deployment

Figure 7.1 depicts the major phases of any typical software development lifecycle. In terms of GIS, they apply as follows:

Develop—GIS needs to be developed by following agile practices and considering the important phases of a SDLC starting from requirements, analysis, design, and code to testing. Development has to consider issues of deployment, integration, and operations. Analysis and

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Develop | Configure | Use

Require-ments

Testing

Analysis

Agile

Coding

Design

Industry-Benchmarks

Region-Rules

Organization-Target

Record

Report ⇌ Compare

Figure 7.1   Major phases in GIS: development, configuration, and use.

design of the system is undertaken using the unified modeling language (UML) diagrams that helps in modeling the problem space and develop a solution in design space (model of solution space). CAMS provides this overall methodological approach.
Configure—Configuring GIS according to benchmarks and rules of organization. Ā is would be an activity specific to each organization within each industry sector.
Use—Use of GIS will lead to ongoing recording of carbon data creation of reports as well as comparisons.

Development Phase: In this phase, the GIS is developed by coding and integrating various hardware and software components. The development phase includes the implementation of

energy-efficient technologies, optimizing algorithms and processes, and implementing green data center practices.

Configuration Phase: In this phase, the GIS is configured according to the specific needs of the organization. This includes setting up the GIS for energy efficiency, such as configuring power management settings, optimizing hardware and software settings, and using virtualization technologies to consolidate servers.

Use Phase: In this phase, the GIS is put into operation. The use phase involves the day-to-day operation and management of the system. This includes monitoring and controlling energy consumption, managing the storage and disposal of electronic waste, and promoting green IT awareness and education among the staff.

Overall, the phases of green information systems aim to ensure that the system is designed, developed, configured, and used in a way that minimizes its environmental impact and promotes sustainable practices. By following these phases, organizations can reduce their carbon footprint, lower their energy consumption, and improve their overall sustainability.

4.Describe the features of green information system

Features of GIS

GIS are required to have all relevant features for supporting the organization in its green initiative. Ā ese include support for the routine, operations, and also strategic trends. GIS also includes enhancement of the business systems with green capabilities. Ā is would enable the organization to make use of its existing data and processes and extend them for carbon control.

GIS implementation needs to consider the integration issues—particularly as organizations have many existing ERP applications that will continue to be used irrespective of the environmental initiatives. Integration projects within ERBS will immensely benefit by the earlier discussion on technologies and EI. Ā e earlier mentioned metrics and the three scopes in carbon emissions are all implemented through GIS.

Ā e features of a GIS that play a significant role in enhancing this ability of business to coordinate its environmentally responsible approaches can be listed as follows:

- Collecting environment-related data in real time. Ā e GIS has to be geared to collect data such as number of devices in use and on standby. Mobility further enhances this data capture ability and makes it real time. GIS has to also relate this data to other business applications.

- Providing querying tools, key performance indicators (KPIs), and business analytics to field workers and decision makers in the area of EI. Availability of querying mechanisms can provide information that enables closing down of unused servers, desktops, and other equipments.
- Enhancing the decision-making capabilities of senior management by collating and computing up-to-date information from varied external sources (e.g., government regulatory bodies and weather information) and feeding that into GIS. As a result, knowledge management in the green domain of the organization is enhanced. Ā is service-oriented approach in GIS and the resultant real-time analytics goes a long way in enhancing the organization's green credentials.
- GIS substantiates the green effort of the organization through the metrics, thereby providing positive feedback and impact on the employees' job satisfaction.
- GIS can continuously identify and upgrade business processes and business practices in manufacturing, sales, and field support operations in order to make them environmentally responsible. GIS can help in optimizing the business processes (as was discussed in Chapter 5).
- GIS also provides feedback to customers and other external users of the business on its environmental performance—potentially resulting in increased customer service and satisfaction—especially for the environmentally sensitive and responsible customers.
- Aligning office and home activities through GIS can be a tremendous boost to the organizational effort in improving its green credentials. Ā is is so because GIS can identify the areas of work that are overlapping with each other due to their location-specific nature and make them location-independent as far as possible.
- GIS extends the tools and techniques of business management (such as KPIs, business analytics, and reporting) and applies them to the environmental aspect of business. Mobility further enhances the application of these management tools and techniques.
- GIS provides the business with the ability to sustain itself for a long time. An environmentally responsible business and a sustainable business are complimentary. GIS can bring together technologies and processes for environmental sustainability.
- GIS enables collaboration amongst businesses for the purpose of achieving environmental responsibilities. Ā is collaboration is achieved through the use of service orientation architecture (SOA) as discussed in Chapter 6.

Green information systems (GIS) are designed to be environmentally sustainable and energy-efficient. Some of the features of green information systems include:

Energy efficiency: GIS are designed to be highly energy-efficient, minimizing the amount of energy consumed during their operation. They achieve this through various energy-saving techniques, such as using energy-efficient hardware, optimizing software algorithms, and implementing power management features.

Virtualization: GIS often use virtualization technologies to consolidate servers and reduce the number of physical servers required. This reduces energy consumption, as fewer servers mean lower cooling and electricity costs.

Renewable energy sources: GIS can be powered by renewable energy sources, such as solar, wind, or hydro power. This reduces reliance on non-renewable sources of energy and lowers the carbon footprint of the system.

Green data center practices: GIS are often designed to support green data center practices, such as efficient cooling and heating systems, efficient power distribution, and use of recycled or reused materials.

Electronic waste management: GIS are designed with end-of-life considerations in mind, promoting environmentally friendly practices for the disposal and recycling of electronic waste.

Sustainable supply chain management: GIS can support sustainable supply chain management by enabling organizations to track and monitor their supply chain operations, identify areas for improvement, and collaborate with suppliers to promote sustainability.

Overall, the features of green information systems are designed to promote environmental sustainability and reduce the carbon footprint of information technology operations.

5. List the importance of green enterprise architecture in an organization and write the sequence diagram for emissions check.

Sequence Diagram for "Emissions Check"

Figure 7.10 shows an example of a sequence within the GOP that deals with emissions check.

Environmental manager calculates emissions and they are sent to an employee who captures the details and creates them in system under administrator's access. Administrator generates report out of system and sends the reports back to environmental manager. In addition to it, feedback on each pollutant and related emission values is sent to environmental manager.
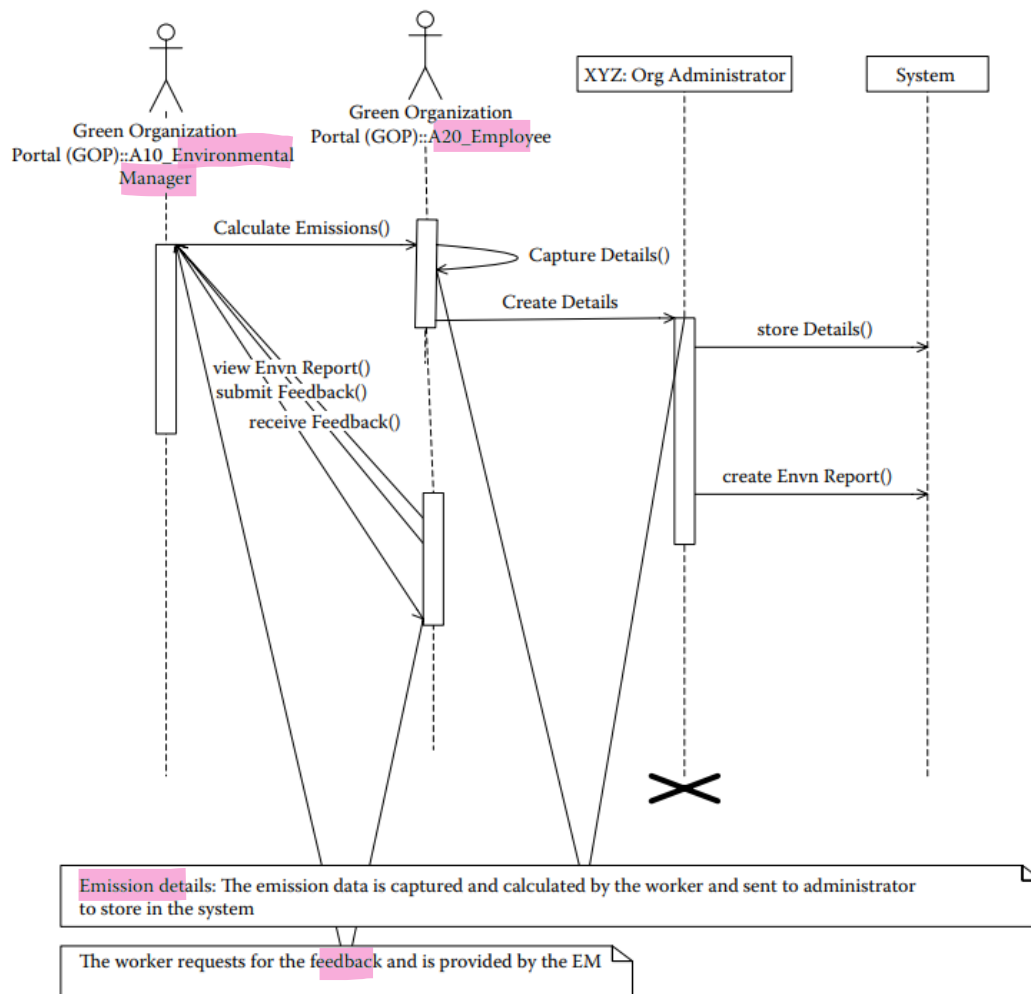
Green enterprise architecture is important for organizations in several ways, including:

Environmental sustainability: Green enterprise architecture promotes environmentally sustainable practices, helping organizations reduce their carbon footprint, conserve natural resources, and support sustainable development.

Cost savings: Implementing green enterprise architecture can result in cost savings, such as reduced energy consumption, lower waste disposal costs, and increased operational efficiency.

Competitive advantage: Organizations that adopt green enterprise architecture can gain a competitive advantage by demonstrating their commitment to sustainability, which can enhance their reputation and attract environmentally conscious customers, partners, and investors.
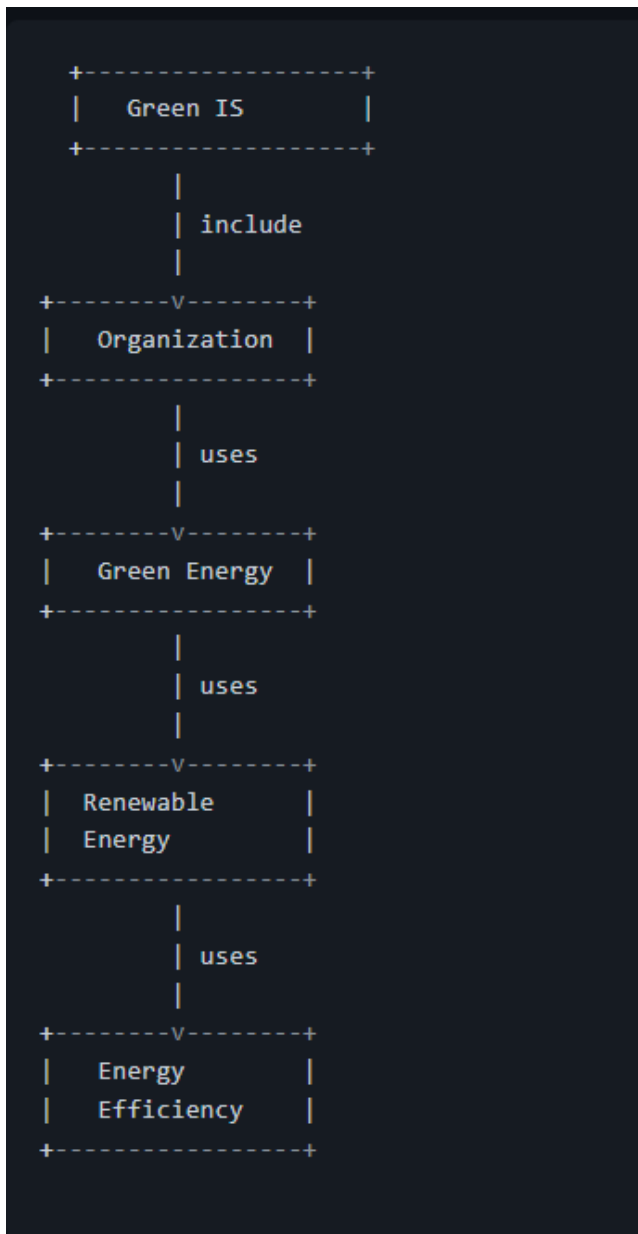
Compliance with regulations: Many countries have regulations in place to promote environmental sustainability, and green enterprise architecture can help organizations comply with these regulations and avoid penalties.

Improved stakeholder relationships: Adopting green enterprise architecture can improve stakeholder relationships, as it demonstrates an organization's commitment to sustainability and social responsibility. This can enhance relationships with customers, employees, suppliers, and communities.

Innovation: Green enterprise architecture encourages innovation in sustainable technologies, processes, and practices, which can lead to new business opportunities and revenue streams.

6.Create a use case diagram from major aspects of green information systems relevant to your working organization

```
+-----------------+
|   Green IS      |
+-----------------+
        |
        | include
        |
+--------V--------+
|  Organization   |
+-----------------+
        |
        | uses
        |
+--------V--------+
|  Green Energy   |
+-----------------+
        |
        | uses
        |
+--------V--------+
|  Renewable      |
|  Energy         |
+-----------------+
        |
        | uses
        |
+--------V--------+
|   Energy        |
|   Efficiency    |
+-----------------+
```

In this use case diagram, the "Green IS" system is the main component that is used by the organization. The organization uses the "Green IS" to implement different strategies and technologies to reduce their environmental impact. The "Green IS" system also uses "Green Energy" which includes "Renewable Energy" and "Energy Efficiency" to reduce the carbon footprint of the organization. The use of renewable energy sources and energy-efficient technologies are both important aspects of a green information system.

7.Write the use case diagram of a green organizational portal of any enterprise organization.
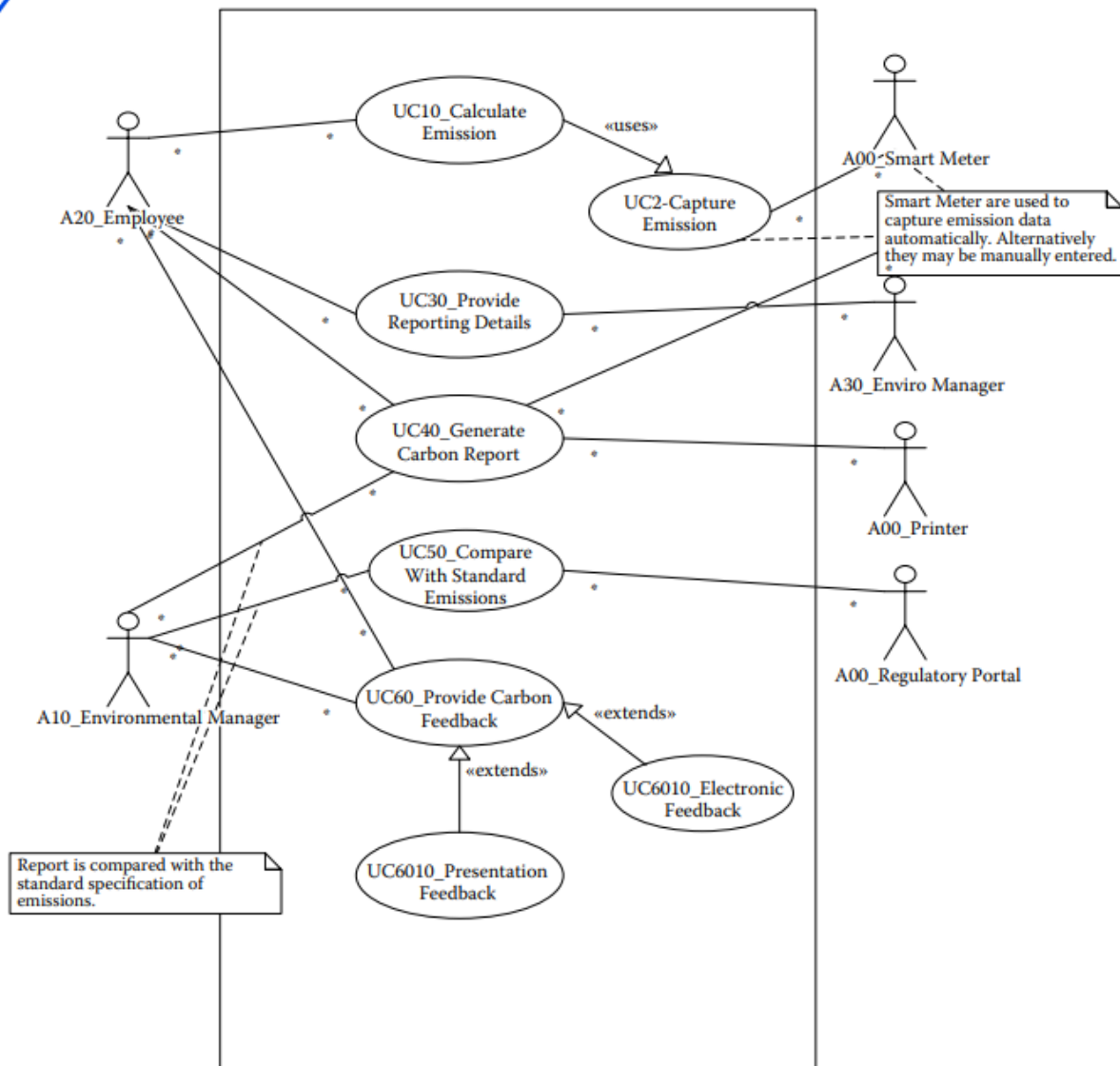
Figure 7.4   Use case diagram for "green organizational portal."

A green organizational portal of an enterprise organization typically provides a platform for employees to access resources and information related to sustainability practices, as well as to collaborate and communicate with others in the organization regarding sustainability initiatives. Employees can access training modules and educational resources related to sustainability practices, such as energy conservation, waste reduction, and responsible sourcing.

Employees can track their progress and contributions to sustainability initiatives, such as reducing carbon emissions or increasing the use of renewable energy sources.

Employees can collaborate with one another on sustainability-related projects, such as implementing a recycling program or promoting eco-friendly commuting options.

Employees can share success stories and best practices related to sustainability initiatives, providing inspiration and ideas for others in the organization.

Managers can track the overall progress of sustainability initiatives within the organization and identify areas for improvement.

The portal can provide access to external resources and tools related to sustainability, such as industry reports or carbon footprint calculators.