Carbon Accounting and Sustainable Designs in Product Lifecycle Management

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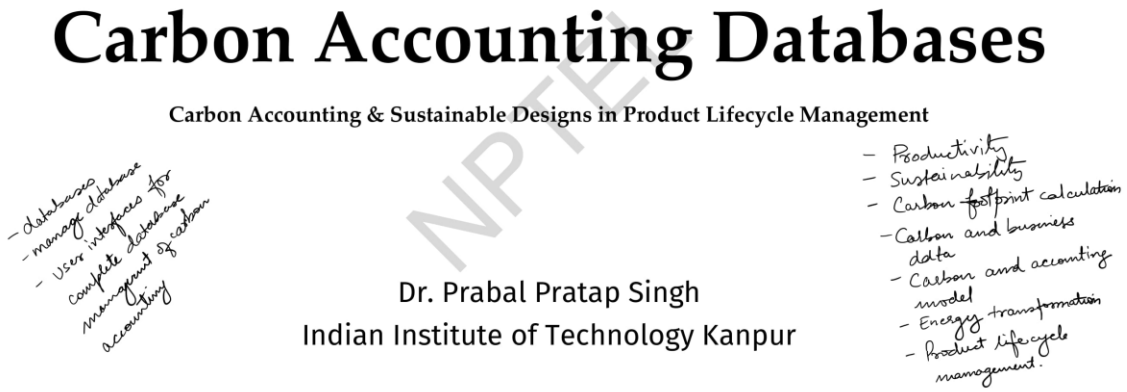
Week 09

Lecture 41

Carbon Accounting Databases (Part-1)

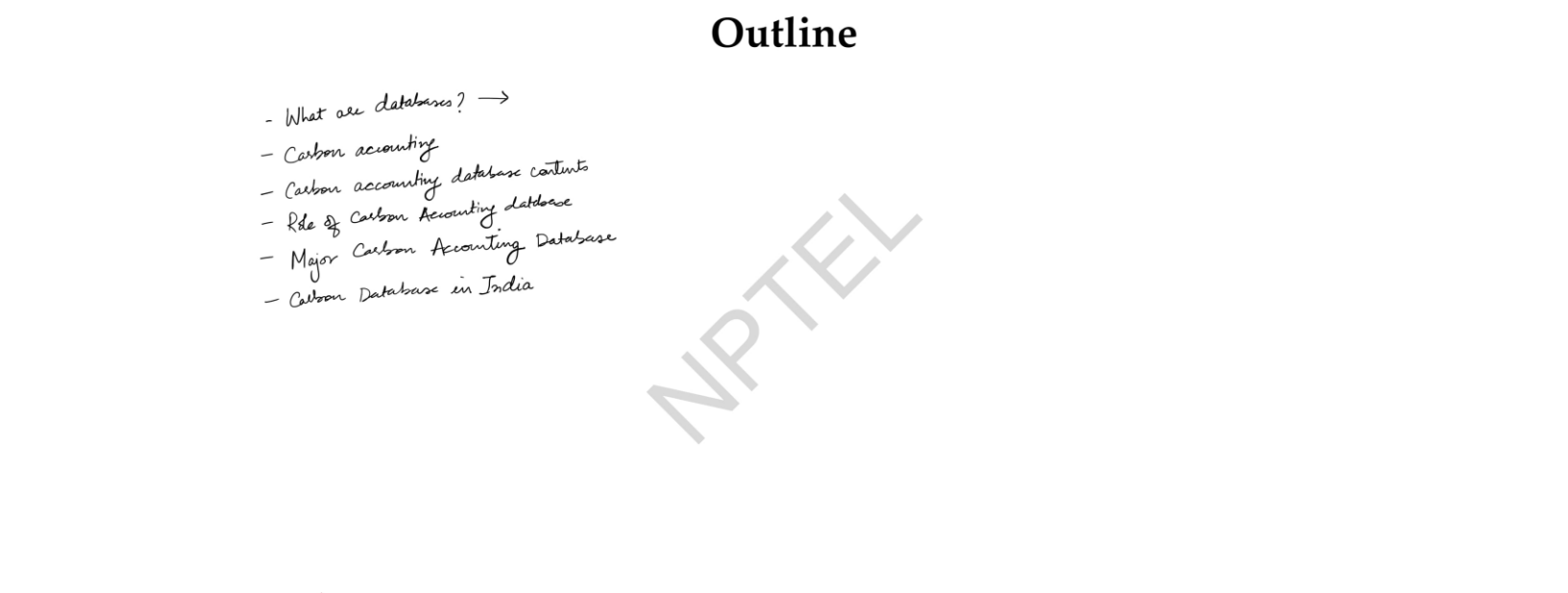
Hello, everyone. Welcome to the course on "Carbon Accounting and Sustainable Designs in Product Lifecycle Management". This course is currently hosted on SWAYAM NPTEL portal and is jointly conducted by Professor Deepu Philip, Dr. Amandeep Singh and myself, Dr. Prabal Pratap Singh.



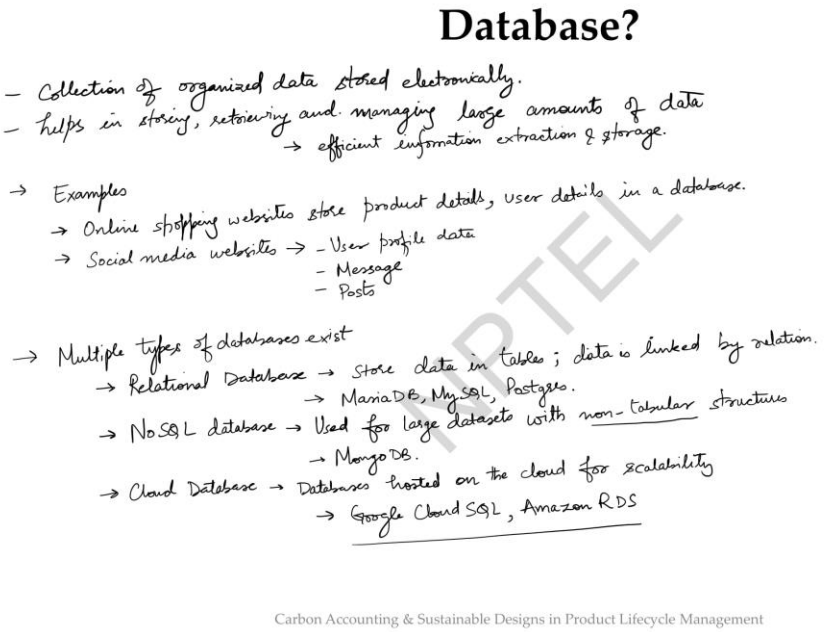
So, the major topics that are covered are Productivity, Sustainability, Carbon Footprint Calculation, Carbon and Business Data, Carbon and Accounting Model.

Various Kinds of Energy Transformation, and Product Life Cycle Management. so now, we will try to learn, What are the different kinds of databases, How to create databases, and Manage those databases, and finally, we will also look at - How to create user interfaces for complete Database Management of Carbon Accounting.

So first of all, we will need to understand, What are the Different Kinds of Carbon Accounting Databases that are existing today. And then, we will try to learn How to create these databases. And we will learn about, MariaDB and other technologies to create our own databases.



So, moving forward, outline for today is - What are databases? Next, we will talk about quick refresh on Carbon Accounting, then we will talk about the Contents of Carbon Accounting Databases. Then, we will understand the role of the Carbon Accounting Database, after that, we will see What are the major Carbon Accounting Database, and finally, we will look at What are the major carbon databases in India. There are various government and private agencies that are creating these databases.



So, we will look into that also so starting with, What are databases? Database is nothing but collection of organized data, which is stored electronically. What does it helps with? It helps in storing,

Retrieving and Managing Large Amounts of Data for efficient information, extraction and storage. These are the major roles why we use databases. Some of the examples are : we all use Amazon or Flipkart, e-commerce websites - like online shopping websites. These website store product details and user details, using a database.

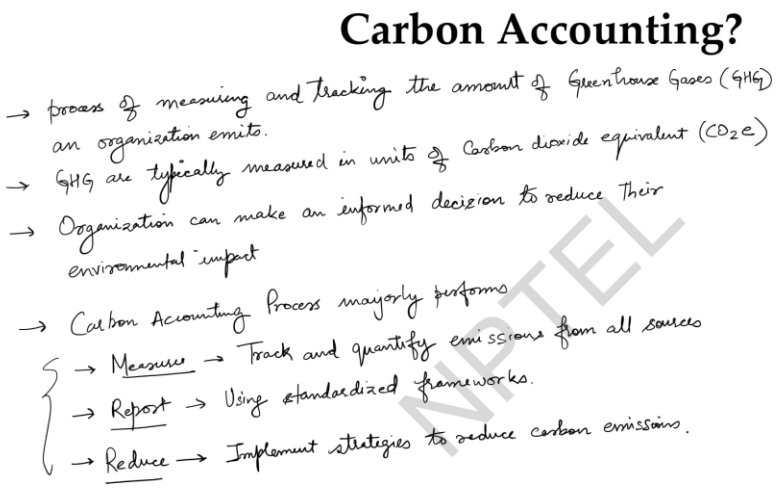
So, there are different kinds of database - we will talk about that also - but they are actually using database behind what we see on those websites. Also, famous example which we all use, is Social Media Websites. So, Why do they use they use it? For user profile data, also, They use it for storing messages, and for Storing or Editing post that their user creates. There are different kinds of databases. Multiple technologies or types of databases exist. So, what are the major kinds of databases?

First is Relational database. These kinds of database store data in tables, and the data is linked by relations. That is why they are called Relational Databases. Now, the major names of Relational Databases are MariaDB, MySQL or PostgreSQL. Another kind of database is NoSQL database.

So Relational Database was SQL based, another type of database is NoSQL database. Why they are used? They are used for storing large datasets with non tabular structures. So, this is the main identifying information between Relational and NoSQL databases. And an example is MongoDB.

Third kind of databases are, there are different kinds, but the major kinds of databases out of those. Third kind is cloud database. So, the background technology may remain same, but these kinds of databases are available in the cloud. The servers or the storage capacity is provided by different organizations, and their servers are located globally. So, these are databases hosted on the cloud for scalability.

And major kinds of these cloud databases are Google, Cloud SQL. They are using SQL, but they have added more features in their own Google Cloud SQL. Another major name is Amazon RDS. So, these are some kinds of databases that are available.



Next thing, we should look at is - What is Carbon Accounting? So, we have already talked about this, but let us just have a quick recap.

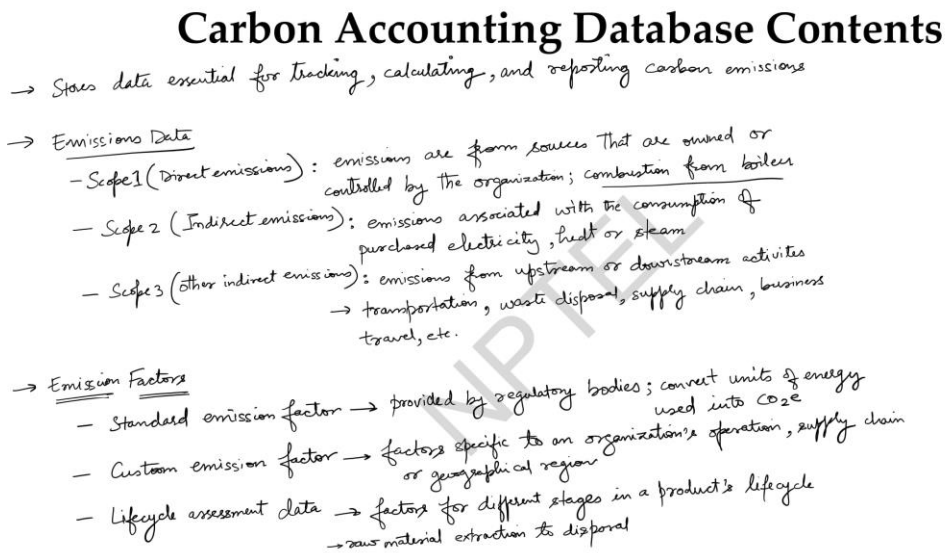
So that, we can understand What is Carbon Accounting and how we are going to use it in our databases. So what we are going to store in databases? We first need to know, What we are doing in Carbon Accounting. Carbon Accounting is a process of measuring and

tracking the amount of green house gases also known as GHG, that an organization emits. So, these GHGs are typically measured in units of Carbon Dioxide equivalent.

So, these things are already taught by professor Deepu Phillip in the course. we are just having a refresh of these. So, Carbon Dioxide equivalent is also known as CO2e. Organizations can make an informed decision by using this Carbon Accounting to reduce their environmental impact. What are the three major things in Carbon Accounting Process? These are Carbon Accounting process majorly performs three operations. First is measure; second is report; third is reduce. What do we measure?

We measure, we track and quantify emissions from all sources. What do we report? We report whatever we measured or tracked using standardized frameworks. So there are different kinds of frameworks like GHG protocol etc. We will talk about those also.

The last part is reduce. We need to reduce the carbon emission. So, how do we do that? We implement strategies to reduce carbon emissions. So, these are the three major things which we do in Carbon Accounting process. Now, we know, what is Carbon Accounting.



So, let us see, what are the contents of Carbon Accounting databases. Because, we are going to develop these databases and learn how to develop these databases. First, we should know, what are the contents of these databases, right? The Carbon Accounting

databases majorly store data essentials for tracking, calculating and reporting carbon emissions.

So, all the three processes, that we are doing in Carbon Accounting process, we can use these technologies or databases to track, calculate and report these carbon emissions. Now, majorly, these databases include Emissions data. What are these emissions data? There are three different kinds of emission data. The first is scope1.

These are also known as direct emissions. These direct emissions are from sources that are owned or controlled by the organizations. So, let us say, in a facility there are different kinds of boilers. So, the scope 1 or direct emissions of this facility could be the combustion from boilers, right? So, this is an example of scope 1 emission.

When we are creating a database for this facility, we need to identify and calculate the combustion from boiler and classify it as a scope 1 or direct emissions. The second kind of emission data is, scope 2 which is Indirect Emissions. These emissions are associated with the consumption of purchased electricity, heat or steam. Third kind of emissions data is, Scope 3.

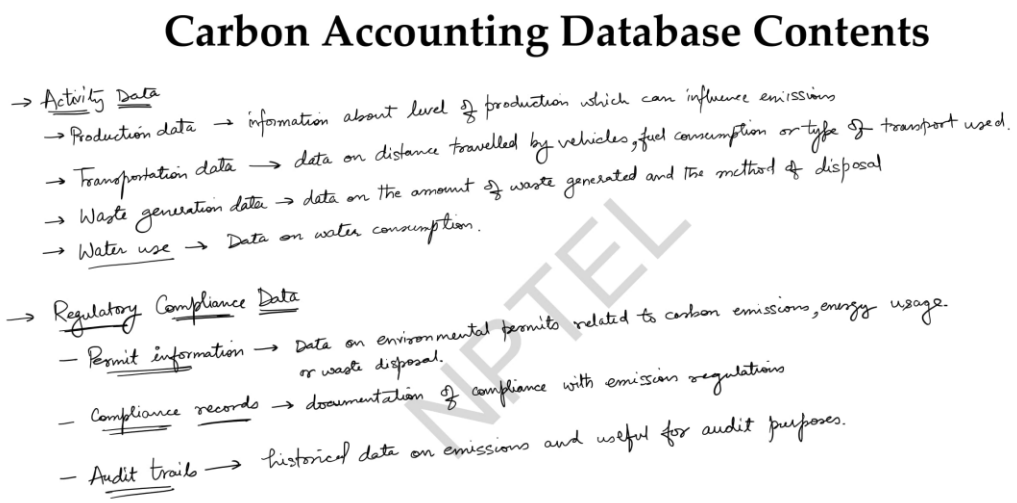
This is other identified Indirect Emissions. These emissions are from upstream or downstream activities of an organization. What are these upstream or downstream activities? These could be transportation waste disposal of the organization, supply chain or business travel - how you or your employees are traveling while performing a project activity, or project task.

So, the emissions emitting from those travels can also be included in Carbon Accounting process, for the organization. These are accounted under Scope 3. Now, this was Under Emissions Data. Another thing we can store in Carbon Accounting database is, Emissions Factor Data. So, there are different kinds of Emission Factors; first one is, Standard Emission Factor.

Another is, Custom Emission Factor. The last is, Lifecycle Assessment Data. So, under Standard Emissions Factor, What is included? They are provided by regulatory bodies. For example, they convert units of energy used, into CO2e under Customs Emission Factor. These are factors specific to organizations, operation, supply chain

or geographical region. Under this head, there are factors for different stages in a product's life cycle. So, this could be raw material extraction for disposal of the product.

So, these kinds of factors are also included while we are creating Carbon Accounting databases.

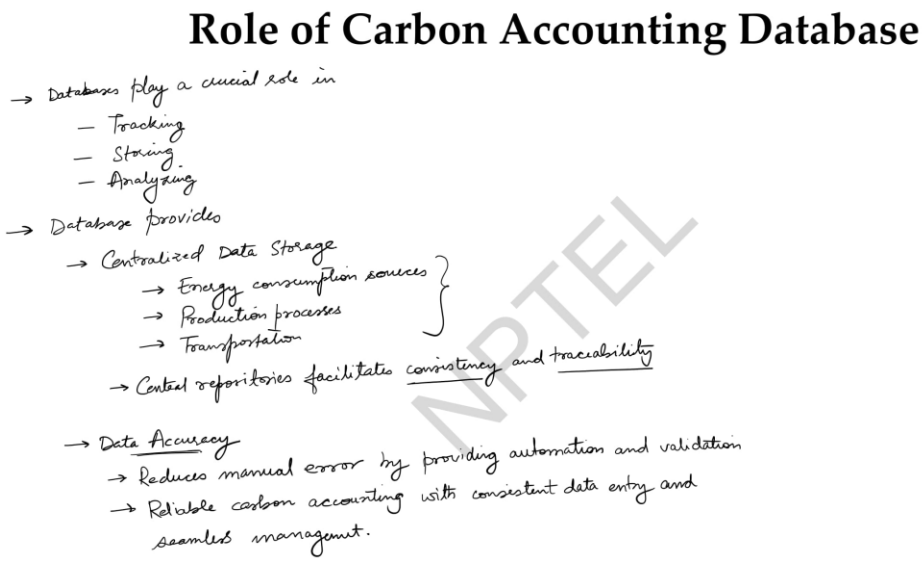


Another content offered for the database could be Activity Data. These could be production data or transportation data, waste generation data. Majorly, these are the kinds of things that organizations produce or do. So, under production data, information about - level of production which can influence emissions under transportation data on distance traveled by vehicles,

or the fuel consumption, or the type of transport used, waste generation data- could be data on the amount of waste generated, and the actual method of disposal of that waste. Finally, water use could be the data on Water Consumption. Another important content, of the Carbon Accounting database could be, Regulatory Compliance Data.

Under this, could be Permit Information, or Compliance Records or Audit Trails Under Permit Information, What can we include? Data on Environmental Permits for an organization, related to carbon emissions, energy usage or waste disposal. Compliance Records is the documentation of compliance with emission regulations. It is historical data on emissions. Why we are storing it? Because, It is useful for audit purposes.

Now, we know that there are different kinds of contents in a Carbon Accounting databases. Out of those, major are: Emissions data, Emission factors, Activity data, and Regulatory Compliance Data.

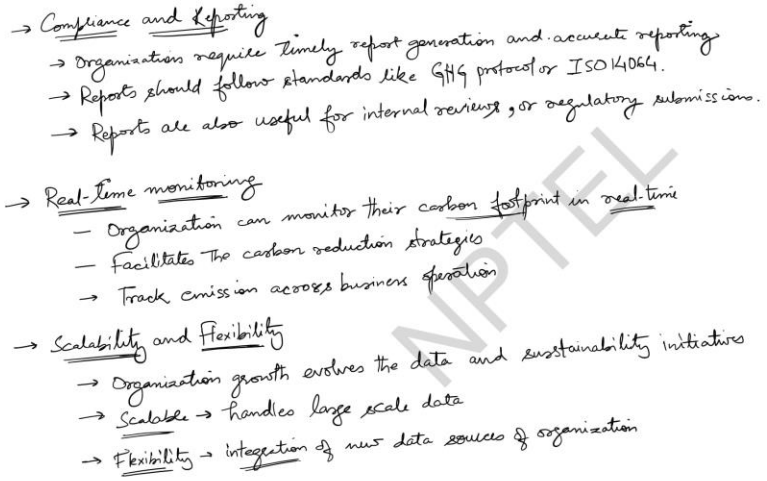


Now, let us understand, what are the role of these Carbon Accounting databases? These databases play a crucial role in tracking, storing, and analyzing. So, How are they doing it? These databases provides: Number one is, Centralized Data Storage Capabilities. So, these could be, carbon Accounting like Energy Consumption Sources, and Production process, or Transportation.

So, these are different kinds of processes. They are happening at different locations of the organization. These databases, what they do is; they try to combine all these sources and create a Centralized data storage. These central repositories facilitates consistency and traceability. So, maintaining the consistency, and traceability is very important while performing the process of Carbon Accounting.

And these databases are the major sources of providing these features of consistency and traceability. Another thing these database provides, are Data Accuracy. So, what happens with the data is, these databases reduce manual error by providing automation and validation. Further, they provide reliable Carbon Accounting with consistent data entry and seamless management, okay.

Role of Carbon Accounting Database



So another thing that database provides is the compliance and reporting So, the complete Carbon Accounting process is tied with the regulatory compliance. So, organizations require timely report generation and accurate reporting and these reports should follow standards like GHG protocol or ISO 14064.

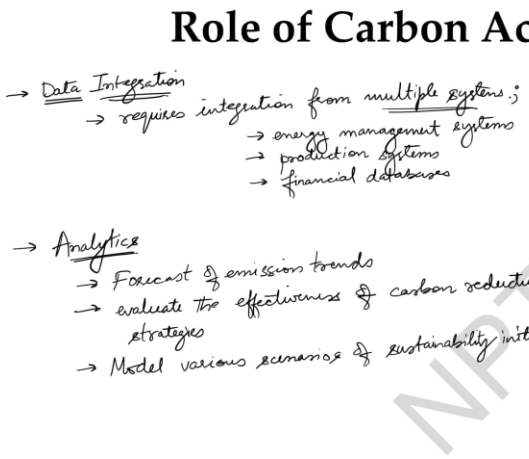
These reports are also useful for internal reviews or regulatory submissions now another major thing that these database provides is the real-time monitoring So, with this technology organizations if needed can monitor their carbon footprint in real time. Further, they facilitate the carbon reduction strategies. Also, they can track emissions across business operations in real time.

Based on the sustainability targets, we can perform these operations in real time. Some organizations are very dynamic in nature. Their production or other processes they are engaged in, are very dynamic. So, usually they need the complete carbon footprint calculations in real time. That is why, some kinds of databases that we use in Carbon Accounting are having the capability of real time monitoring.

Another thing these databases provide are, Scalability and Flexibility. So, with major corporations, the amount of data that is being generated, is increasing daily. So, the system should scale themselves. Therefore, organizations growth evolves the data and the

associated sustainability initiatives. So, they provide scalability, means scalable, means handles large scale data.

Based on these Carbon Accounting databases, Flexibility means integration of new data sources of organizations. So, as the organization grow they may include new products, development or new processes. So, the sources of Carbon Accounting process also increase. Therefore, the developed database should have the possibility of being flexible. So that, it can integrate new data sources.



Another thing is, Data Integration. So, this is also a feature provided by the Accounting databases. And when we develop our own database, we should decide whether they are having these kinds of features or not. So what is included in data integration? It includes;

To require integration from multiple systems. So, what are these multiple systems? These are energy management systems, production systems, or, the financial databases of the organizations. the last major thing that these databases provides is, the Analytics Capability of Analytics. So, these databases can facilitate forecast of emission trends for the organization.

They can evaluate the effectiveness of carbon reduction strategies. They can model or simulate various scenarios of sustainability initiatives. So, these are the different kinds of Carbon Accounting databases. And in the next lecture, we will continue with the Major

Carbon Accounting databases that are existing in the global world, where different organizations are using different kinds of Carbon Accounting databases. And finally, we will also talk about the Carbon Accounting databases that are prevalent in India, which are provided by different Indian government ministries and other private organizations.

Thank you.