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Global warming has resulted from rising average atmospheric temperatures, which has caused a series of changes in the Earth's climate and weather systems. As humans continue to release heat-trapping greenhouse gases (GHG) into the atmosphere, these changes continue to accelerate. Carbon dioxide (CO₂) is the most important anthropogenic greenhouse gas due to its abundance. This gas also has the ability to linger in the atmosphere for thousands of years.

CO₂ emissions can come from both natural and man-made sources. On the one hand, the exhalation by most multicellular living organisms under the animal kingdom (including humans) involves the release of CO₂ and leads to the natural source of CO₂ emissions. On the other hand many man–made activities contribute to CO₂ emissions such as transportation, mining, power generation, urbanization etc.

The building sector, encompasses all the processes from construction through operation of built environments, up to its occupancy and maintenance stage. The building sector’s boom in expansion has had a tremendous direct and indirect influence on the environment. The use of nonrenewable energy resources, poor building design, and a lack of sustainable thinking in urbanization have all stymied CO₂ emissions.

The construction industry utilizes a huge quantity of nonrenewable energy and emits a significant amount of CO₂ emission in the environment. Buildings account for around 39% of annual global CO₂ emissions. Also, according to reports, the building industry accounts for more than a third of overall energy consumption in both developed and developing countries. As a result, CO₂ emission reduction efforts are critical. To encourage CO₂ emission reduction, energy conservation planning and the execution of methods to decrease potential emissions should be highlighted.

Considering the impacts of climate change, world government has come together in recent years to try and mitigate the damages caused. Kyoto Protocol, the Paris Agreement and the recent COP 26 are examples of the efforts being put in by these governments.
As per the report by Climate Change Performance Index (CCPI), an independent monitoring tool that provides information on the Paris Agreement implementation phase, India has been ranked 10th amongst 65 nations due to its climate change policies and mitigating plans.

Source: Germanwatch, Climate Change Performance Index ranking 2022, https://ccpi.org/ranking/
This comes as a result of the vision set for India by the Honb’le Prime Minister, and the systematic implementation of steps taken to reduce emissions. India has pledged to be a Net Zero emission nation by the year 2070 in COP 26. The same is reflected in our NDC (Nationally Determined Contribution) goals as follows:

• First- India will take its non-fossil energy capacity to 500 GW by 2030.
• Second- India will meet 50 percent of its energy requirements from renewable energy by 2030.
• Third- India will reduce the total projected carbon emissions by one billion tonnes from now till 2030.
• Fourth- By 2030, India will reduce the carbon intensity of its economy by more than 45 percent.
• Fifth- by the year 2070, India will achieve the target of Net Zero

Currently, most of India’s states and union territories have submitted respective State Action Plans on Climate Change, which complement India’s National Action Plan on Climate Change (NAPCC).

One of the methods to accelerate incentives for carbon reduction globally is through Carbon markets, an effective and inexpensive instrument for climate change mitigation. They convert Carbon emissions reduction and removal into tradable assets. Together with other instruments for pricing greenhouse gas emissions, such as CO₂ taxes, they provide incentives for climate-friendly investment. Currently there are two types of Carbon markets, Compliance markets and voluntary markets. Compliance markets are mandatory set by the governments and hence have higher participation amongst the large companies compared to the voluntary markets. The Carbon market sector has seen a tremendous growth in the year 2021, with a market value of $851 Billion. Another empirical method to reverse the amount of CO₂ gasses present in the atmosphere is by Carbon sequencing. There are currently two methods of Carbon sequencing – Geologic and biological. Geologic carbon sequestration is the process of storing carbon dioxide (CO₂ ) in underground geologic formations. The CO₂ is usually pressurized until it becomes a liquid, and then it is injected into porous rock formations in geologic basins. This method of carbon storage is also sometimes a part of enhanced oil recovery, otherwise known as tertiary recovery, because it is typically used later in the life of a producing oil well. Biologic carbon sequestration refers to storage of atmospheric carbon in vegetation, soils, woody products, and aquatic environments.
For example, by encouraging the growth of plants—particularly larger plants like trees—advocates of biologic sequestration hope to help remove CO₂ from the atmosphere.

In order to quantify the efforts taken by different organisations and individuals to contribute to reduction in carbon emissions, Carbon calculation is carried out. The calculation of carbon footprint is the standard way of measuring and reporting the environmental impact that a person, building, land or a structure, has on the environment. The carbon footprint calculator function bases calculations on the three environmental scopes, including the following components:

• On-site energy production and other industrial activities
• Area of facilities and percent of occupancy
• Facility energy use such as electricity, gas, coal, oil, and renewable
• Travel such as plane, rail, vehicle
• Waste generated
• Personal habits related to food preference, shopping and individual awareness
The project can be registered by filing expression of interest (EOI) available on GRIHA website.

A handholding workshop will be conducted by GRIHA Council. The intent of this workshop shall be to address specific queries of project proponent on the GRIHA Decarbonization Habitat Programme.

- Survey form to be filled by the project proponent
- Simultaneously project team should initiate collating the data for assessment and reporting.
- Post data collection, project proponent should prepare the report indicating the various parameters and the measures taken by the project and calculated GHG emissions as per the GRIHA Decarbonization Habitat Programme.

Subsequent to the online submission of documents, a committee review meeting will be carried out by a team of experts from GRIHA Council and 3rd party evaluators. The documentation must be complete in all respects for all attempted parameters. Any attempted parameter with incomplete documentation shall not be evaluated.

An evaluation report consisting of the result, as per the carbon level achieved by the project shall be released by GRIHA Council.

The carbon level achieved will be documented in the form of a certificate, report and plaque which will be handed over to the project team.
The certification fee is calculated on two components
a) Built up area of the project and
b) Floating occupancy of the project

<table>
<thead>
<tr>
<th>Built-up Area</th>
<th>Certification Fee</th>
<th>(INR)</th>
<th>(USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up till 10,000 sqm</td>
<td>3 lakh</td>
<td></td>
<td>5000/-</td>
</tr>
<tr>
<td>For every sqm above 10,000 sqm</td>
<td>3.75/sqm</td>
<td>@1/sqm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Floating Occupancy</th>
<th>Certification Fee</th>
<th>(INR)</th>
<th>(USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 50,000</td>
<td>0.5 lakh</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>50,001 – 2,50,000</td>
<td>1 lakh</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>2,50,001 – 5,00,000</td>
<td>1.5 lakh</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>5,00,001 – 10,00,000</td>
<td>2 lakh</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Above 10,00,001</td>
<td>2.5 lakh</td>
<td>2500</td>
<td></td>
</tr>
</tbody>
</table>

Exclusive of government taxes

Note: All travel and accommodation of GRIHA Council professionals, is not included in the above cost and shall be arranged by the project proponent.
Net GHG emissions of the project would be assessed based on: **Reduction in carbon emissions and carbon sequestration**

The total emissions are calculated for six components: Energy – Water – Waste – Transport – Social - Lifestyle

- **Energy**
  - Energy consumed
  - Energy offset from clean energy sources

- **Water**
  - Water consumed
  - Water reused or recycled

- **Waste**
  - Waste generated
  - Waste to resource

- **Transport**
  - Transport emissions
  - Non-motorised transports and walking

- **Social factor**
  - Emissions through social aspects
  - Reduce
  - Reuse
  - Recycle
  - Upcycle

- **Daily Lifestyle**
  - Lifestyle related emissions
  - Recycle
  - Reuse
  - Reduce
  - Upcycle

**GHG emissions of the project t CO₂e**
GHG emissions negative $t\text{CO}_2\text{e}$

Total GHG emissions of the project $t\text{CO}_2\text{e}$

<table>
<thead>
<tr>
<th>Certification Level</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>high carbon emission</td>
</tr>
<tr>
<td>Orange</td>
<td>moderate carbon emission</td>
</tr>
<tr>
<td>Yellow</td>
<td>low carbon emission</td>
</tr>
<tr>
<td>Green</td>
<td>towards carbon reduction</td>
</tr>
<tr>
<td>Blue</td>
<td>near net zero</td>
</tr>
<tr>
<td>Indigo</td>
<td>net zero</td>
</tr>
<tr>
<td>Violet</td>
<td>net positive</td>
</tr>
</tbody>
</table>

Certification Scale
Components for GHG Emissions

Energy
Energy consumption in appliances and processes, DG sets

Water
Domestic, commercial and industrial water use

Waste
Solid waste consisting of dry and wet waste.

Transportation
Commuting methods

Social
Stationary (paper and printing), green policy, housekeeping products, tobacco control, furnishing, fertilizer and biodiversity.

Lifestyle
Clothing, food & beverages, Health, Cutlery and cosmetics
SECTION – 1

ENERGY

Energy Consumption of appliances and processes
The intent of this section is to understand the building energy demand/consumption and to set out method for the calculation & reporting of a set of carbon metrics for GHG emissions arising from the measured direct energy use during operation of a building.

**Assessment criterion:**
Total energy consumption/demand* of building is calculated taking into account the different energy sources such as municipal grid, from fuel source (DG, gas generator etc.) and renewable energy in order to drive an appropriate energy performance indicator.

* Note: In total energy consumption/demand calculation cooking fuel and energy consumption via transportation will not be included. Both the aforementioned parameters have been considered in other sections.
The carbon metric is a measure (a partial carbon footprint) that is based on energy consumption/demand data and related building information for an existing building in operation. It provides information related to the calculation of GHG emissions and can be used as an environmental indicator. Using bottom to top model approach, the metric and its protocol can be applied for all stakeholders in both commercial and residential building.

Methodology

Energy use

- Building system
- Energy use and production
- System losses and conversions

Delivered energy

- On-site renewable energy

Exported energy

- Building Needs
  - Heating
  - Cooling
  - Ventilation
  - DHW
  - Lighting
  - Plug loads
  - Process etc,

Site boundary of energy transformation, utilization and generation
To calculate the direct CO₂ emissions, the energy consumption can be translated to CO₂ emissions figures by using conversion factors (emission factors) for different energy forms.

- E₁ = E₂ + E₃
- G₁ = E₁ x conversion factor
- G₂ = E₄ x conversion factor
- G₃ = G₁ – G₂

Where:

- E₁ – Total energy demand/consumption
- E₂ – Energy consumption from renewable energy source
- E₃ – Energy consumption non renewable source
- E₄ – Energy generation from renewable energy system
- G₁ – GHG emission from total energy demand
- G₂ – Reduction in GHG emission via generation of energy from renewable energy source
- G₃ – Overall GHG emission

Bottom to top approach for assessment of GHG emission at building level
Compliance

- Inventory of various installed system
- Identification of primary and secondary energy source
- Annual energy consumption data from primary energy source
- Annual energy generation from installed renewable energy source.
- Reference of various conversion factor consider to calculate the GHG emission
<table>
<thead>
<tr>
<th>Commercial/residential sector</th>
<th>Gas (PNG, LPG)</th>
<th>Electricity</th>
<th>Diesel</th>
<th>Renewable energy</th>
<th>Any other source of energy supply</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Consumption of energy from primary source</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong> Conversion factor (TJ/unit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong> Carbon emission factor (t C/TJ)</td>
<td>C = (AxB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D</strong> Carbon emission (t C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E</strong> Carbon content</td>
<td>E = (CxD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F</strong> Carbon Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>G</strong> Fraction of carbon stored</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H</strong> Carbon Stored (Gg C)</td>
<td>H = (FxG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I</strong> Net Carbon Emission (Gg C)</td>
<td>I = (F- H)</td>
<td></td>
<td></td>
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SECTION - 2

WATER

Domestic, commercial and industrial water use
The intent of this section is to ascertain the GHG emissions of an entity with respect to its water consumption. Water is made available for consumption from different sources through various treatment and distribution systems. These treatment and distribution systems are a source of GHG emission, hence it is intended here to know the amount of GHG emitted in fulfilling the water demands.
The water-carbon calculator is a measure of amount of Green House Gases emitted in the extraction, distribution and treatment of water as all these processes. In non-domestic applications GHG emissions from a water supply system are in the form of,

- Carbon dioxode (CO\textsubscript{2}) - emitted from energy use in operations
- Methane (CH\textsubscript{4}) - produced during waste water treatment and discharge
- Nitrous Oxide (N\textsubscript{2}O) produced during waste water treatment and discharge.

### Methodology

<table>
<thead>
<tr>
<th>Gas</th>
<th>Source</th>
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<tbody>
<tr>
<td>Carbon Di Oxide</td>
<td>Energy consumed during water extraction</td>
</tr>
<tr>
<td></td>
<td>(Municipal supply pipelines, bore well and water tankers etc.)</td>
</tr>
<tr>
<td>Methane</td>
<td>Emissions from waste water treatment and discharge</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>Emissions from waste water treatment and discharge</td>
</tr>
</tbody>
</table>
For calculating equivalent carbon from water use, following calculations are made:

- **CO₂ emissions from the energy consumption** – This is achieved by multiplying total energy consumption with emission factors of energy generation per unit of energy produced.

- **CH₄ emissions from waste water treatment** – This is achieved by multiplying total waste water generated with emission factors from IPCC National Greenhouse Gas Inventories.

- **N₂O emissions from waste water treatment** – This is achieved by multiplying total waste water generated with emission factors from IPCC National Greenhouse Gas Inventories.
Compliance

- Inventory of installed electro mechanical plumbing systems.
- Identification of source of water.
- Identification of water treatment systems (fresh water, waste water).
- Total fresh water consumption and waste water generated data.
- Calculation of GHG emissions of all the processes.
SECTION - 3

WASTE
Solid waste consisting of dry and wet waste.
The intent of this section is to enable the project proponent in assessing the waste generated from the organization (by people and operations) and analyze its impact in terms of GHG emissions.

**Assessment Criteria:**

- Types of waste considered: Municipal solid waste which includes paper, textile, food waste, landscape waste etc.
- Type of treatment and disposal methods: Composting, incineration, landfill, recycle etc.
- Quantity of waste generated (in kgs)
- Types of GHG gasses: Methane and Nitrous Oxide emitted from waste disposal and treatment.
**Methodology**

**GHG emissions largely depend on:**
- **Onsite:** This would encompass the emissions generated from the types of treatment strategies adopted on site, for example, emissions from organic waste composter (OWC), composting pits etc.
- **Offsite disposal:** This includes indirect emissions from the waste diverted from site to landfill and other areas.
- **Offsite treatment:** This includes all other indirect emissions such as incineration, upcycling and segregation of waste etc.
**Calculation**

1. **Waste Generated**
   - Quantum of different types of waste generated

2. **GHG emitted per unit of waste (e.g. grams of CH₄ emitted from waste generated)**
   - Emission factors

3. **Emissions (t CO₂e)**
   - Global warming potential of respective gases

\[ \text{Emissions (t CO₂e)} = \text{Waste Generated} \times \text{GHG emitted per unit of waste} \times \text{Emission factors} \]

- GHG emissions in form of CH₄, N₂O, CO₂ etc. [Carbon dioxide equivalent (CO₂e) of emissions]
Compliance

- Identification of sources of different types waste.
- Inventory of installed treatment systems.
- Calculation of quantum of waste generated.
- Calculation of GHG emissions of all the processes.
SECTION - 4

Transportation
Commuting methods
The intent of this section is to help assess GHG emissions in terms of CO₂ equivalent (CO₂e) for the transportation demand of a project. The aim is to provide guidelines to calculate emissions on account of the movement of people and goods which catering to the day-to-day needs of the organization.

**Assessment criterion:**

Total energy consumption of organization is calculated taking into account the different modes of transport, their utilization, and fuel type.

**How to estimate:**

- **Consistency** in approaches, inventory boundary and calculation methodologies are important for comparison of data over time

- **Transparency** in assumptions, references and data sources

- **Accuracy** of data is important or use of ‘standardized guidelines’
**Methodology**

**Stages of GHG Calculation for the transport sector:**

1. **Identify operations to be covered**
2. **Identify GHG emission sources**
3. **Collect GHG activity data**
4. **Select GHG emission factors**
5. **Calculate GHG emissions**
6. **Reporting & Way Forward**

**Scope 1 Emissions**
- **Transportation of materials, products, waste, and employees**
  - Only company controlled/owned mobile sources (e.g. trucks, trains, cars, ships, busses, airplanes)

**Scope 2 Emissions**
- Indirect emissions from purchased electricity, steam, heating and cooling
- For office-based businesses Scope 2 usually most significant

**Scope 3 Emissions**
- All other indirect emissions. GHG Protocol defines Scope 3 emissions into 2 categories:
  - Upstream Scope 3 emissions
  - Downstream Scope 3 emissions
**Calculation**

Activity data

GHG emitted per unit of activity (e.g. kg of CO₂ per liter of fuel)

Global warming potential

Radioactive forcing impact of one unit of GHG (CO₂e)

Emissions (t CO₂e)

Carbon dioxide equivalent (CO₂e) of emissions

Examples of Activity Data:

- Modes of transport used
- Liters/units of fuel/energy consumed
- Kilograms of material consumed
- Kilometers of distance traveled
- Hours of time operated
Compliance

- Categorization under Scope 1, 2 and 3 emissions
- Documentation of various transport activities
- Annual energy/fuel consumption data
- Emissions calculation sheets
- Calculation and reporting of total GHG emissions on account of transport
SECTION - 5

Social

Cosmetics, stationary, green policy, housekeeping products, tobacco control, furnishing, fertiliser, biodiversity.
The intent of this section is to calculate the total GHG emission through social needs of the project and ways it has been suppressed.

**Assessment criterion:**
Total annual consumption of building occupants is reported, taking into account the following collective segments, in order to assesses the total GHG emissions under this section.

- Stationary
- Green Policy
- Housekeeping products
- Tobacco control
- Furnishing
- Fertilizer
- Biodiversity
Segments considered for GHG emission under social section.

**Intent**

- **Stationary**
  - Paper
  - Printing
  - Pen
  - Pencil
  - Files

- **Housekeeping**
  - Soaps
  - Toiletries
  - Floor cleaning agents
  - Cloth iron

- **Green Policy**
  - E-waste & batteries
  - Refrigerant
  - Cleaning agents
  - Products procurement

- **Tobacco control**
  - Tobacco use ban on site.
  - Smoking prohibited/dedicated smoking zone
  - Fire extinguisher

- **Fertilizer**
  - Use of manure on site
  - Use of fertilizers
  - Pest control agents

- **Biodiversity**
  - Enriching flora of the region
  - Enriching fauna of the region
  - Preserving water bodies

- **Furnishing**
  - Furniture
  - Blinds and curtains
  - Towels/napkins
  - Lamps/chandeliers
Methodology

Taking into account Scope 1; Scope 2 & Scope 3 Emissions accessed through survey form filled by the project team in compliance to the social segments.
**Calculation**

\[
\text{Activity} \times \text{Emission factor} \times \text{Global warming potential} - \text{carbon sequestration of GHG (CO}_2\text{e)} = \text{Emissions (t CO}_2\text{e) of emissions}
\]
Compliance

- Primary data collection with survey forms
- Photographic documentation of initiatives
- Invoices of procurements
- Emissions calculation sheets
- Environmental performance reports
SECTION - 6

**Lifestyle**
Clothing, food & beverages, Health, Cutlery
The intent of this section is to calculate the GHG emissions through lifestyle practices followed by the inhabitants of the project.

**Assessment criterion:**
Total annual consumption of building occupants is reported, taking into account the following collective segments, in order to assess the total GHG emissions under this section.

- Clothing
- Food & beverages
- Health care
- Cutlery
- Cosmetics
Clothing
- Winter
- Summer
- Monsoon

Food & beverages
- Vegetarian
- Vegan
- Non-Veg
- Water
- Drinks
- Tea/Coffee

Health care
- First Aid
- Health check-up
- Treatment

Cutlery
- Glass
- Plates
- Spoon

Cosmetics
- Shampoo
- Hair Oil
- Toothbrush
- Makeup
- Lotion
- Perfumes
- Razors
Methodology

Taking into account Scope 1; Scope 2 & Scope 3 Emissions accessed through survey form filled by the project team in compliance to the social segments.
**Calculation**

- **Activity data**
- **Emission factor**
- **Global warming potential**
- **Global warming potential annulled**
- **Carbon dioxide equivalent (CO₂e) of emissions**

Calculation:

1. Activity data
2. Activity data x Emission factor
3. Activity data x Emission factor x Global warming potential
4. Activity data x Emission factor x Global warming potential - carbon sequestration of GHG (CO₂e)
5. Activity data x Emission factor x Global warming potential - Carbon dioxide equivalent (CO₂e) of emissions
Compliance

- Primary data collection with survey forms
- Photographic documentation of initiatives
- Invoices of procurements
- Emissions calculation sheets
- Environmental performance reports