# BRSR Carbon Calculator - Methodology

## Overview

The BRSR Carbon Calculator automates the calculation of Greenhouse Gas (GHG) emissions for Indian companies to comply with SEBI's Business Responsibility and Sustainability Reporting (BRSR) framework.

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## Problem Statement

### The SEBI Mandate

- **Scope**: Top 1000 listed companies in India must disclose carbon footprint data
- **Additional Coverage**:
  - MSMEs supplying to large corporations (e.g., Tata, Reliance)
  - MSMEs exporting to international markets
- **Challenge**: Manual GHG calculation is complex, error-prone, and expensive

### Current Issues

1. **Complexity**: Understanding GHG Protocol and emission scopes
2. **Cost**: Hiring consultants costs ₹50,000 - ₹5,00,000+
3. **Time**: Manual calculations take weeks
4. **Accuracy**: High risk of errors in manual processes
5. **Compliance**: Audit-grade reports difficult to produce

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## Solution Approach

**Our Objective**

**Transform complex GHG emission calculations into simple, one-click, audit-ready outputs**

**Key Features**

- ✅ Automated calculations across all 3 scopes
- ✅ SEBI BRSR-compliant reporting
- ✅ Audit-grade accuracy
- ✅ Affordable for MSMEs, scalable for corporations
- ✅ One-click report generation

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## Calculation Methodology

### The GHG Protocol - Three Scopes

Our calculator follows the internationally recognized GHG Protocol standard:

#### Scope 1: Direct Emissions

- **Definition**: Emissions from sources owned or controlled by the company
- **Examples**:
  - Company vehicles (diesel, petrol, CNG)
  - On-site fuel combustion (generators, boilers)
  - Manufacturing processes
  - Refrigerant leakage

#### Scope 2: Indirect Emissions (Electricity)

- **Definition**: Emissions from purchased electricity, heat, steam, or cooling
- **Examples**:
  - Grid electricity consumption
  - Purchased heating/cooling
  - Office and facility electricity

#### Scope 3: Other Indirect Emissions

- **Definition**: All other indirect emissions in the value chain
- **Examples**:
  - Business travel (flights, trains, taxis)
  - Employee commuting

- Supply chain emissions
- Waste disposal
- Product transportation

**Core Calculation Formula**

$$\text{Total } CO_2e = \text{Activity Data} \times \text{Emission Factor}$$

Where:

- **Activity Data**: Quantity of activity (liters of fuel, kWh of electricity, km traveled)
- **Emission Factor**: $CO_2$ equivalent per unit of activity (kg $CO_2e$ per liter, per kWh, per km)
- **$CO_2e$**: Carbon Dioxide equivalent (includes $CO_2$, $CH_4$, $N_2O$, and other GHGs)

**Emission Intensity Calculation**

$$\text{Emission Intensity} = \text{Total Emissions} / \text{Metric}$$

Common metrics:

- Per unit of revenue (tonnes $CO_2e$ per ₹ Crore)
- Per employee (tonnes $CO_2e$ per employee)
- Per unit produced (tonnes $CO_2e$ per unit)

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## Step-by-Step Process

**Step 1: Company Information Input**

**User provides basic company details:**

1. Company name and registration number
2. Reporting period (fiscal year)
3. Industry sector
4. Number of employees
5. Annual revenue
6. Production units (if applicable)

**System Action:**

- Creates company profile
- Initializes data collection templates

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**Step 2: Scope 1 Data Collection**

**User inputs direct emission sources:**

### 2.1 Fuel Consumption

- Diesel (liters)
- Petrol (liters)
- Natural Gas (cubic meters)
- LPG (kg)
- Coal (tonnes)

### 2.2 Calculation Process

For each fuel type:
1. User enters: Quantity consumed
2. System retrieves: India-specific emission factor
3. System calculates: Quantity × Emission Factor = $CO_2e$
4. System aggregates: Total Scope 1 emissions

**Example:**

Diesel consumed: 10,000 liters
Emission factor: 2.68 kg $CO_2e$/liter (India standard)
Scope 1 (Diesel) = 10,000 × 2.68 = 26,800 kg $CO_2e$ = 26.8 tonnes $CO_2e$

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**Step 3: Scope 2 Data Collection**

**User inputs electricity consumption:**

### 3.1 Electricity Data

- Total kWh consumed (from electricity bills)
- State/region (for grid-specific emission factors)

### 3.2 Calculation Process

1. User enters: Total kWh consumed
2. System identifies: State-specific grid emission factor
3. System calculates: kWh × Grid Factor = $CO_2e$

**Example:**

Electricity consumed: 50,000 kWh

Grid emission factor: 0.82 kg $CO_2e$/kWh (Delhi grid)
Scope 2 = 50,000 × 0.82 = 41,000 kg $CO_2e$ = 41 tonnes $CO_2e$

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**Step 4: Scope 3 Data Collection**

**User inputs indirect emission sources:**

**4.1 Business Travel**

- Air travel (km by class)
- Rail travel (km)
- Taxi/hired vehicles (km)

**4.2 Employee Commuting**

- Number of employees
- Average commute distance
- Mode of transport distribution

**4.3 Supply Chain**

- Purchased goods and services
- Transportation and distribution

**4.4 Calculation Process**

For each category:
1. User enters: Activity data
2. System retrieves: Category-specific emission factor
3. System calculates: Activity × Factor = $CO_2e$
4. System aggregates: Total Scope 3 emissions

**Example (Air Travel):**

Domestic flights: 10,000 km (economy class)
Emission factor: 0.133 kg $CO_2e$/km
Scope 3 (Air) = 10,000 × 0.133 = 1,330 kg $CO_2e$ = 1.33 tonnes $CO_2e$

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**Step 5: Data Validation**

**System automatically validates:**

1. ✅ Check for missing mandatory fields
2. ✅ Validate numerical entries (no negative values)

3. ✅ Cross-check against industry benchmarks
4. ✅ Flag unusual values for review
5. ✅ Ensure completeness of data

**User Action:**

- Review flagged items
- Correct or confirm unusual values
- Add explanatory notes if needed

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**Step 6: Calculation & Aggregation**

**System performs calculations:**

```
Step 6.1: Calculate individual emission sources
Step 6.2: Aggregate by scope
  - Total Scope 1 = Σ (All direct emissions)
  - Total Scope 2 = Σ (All electricity emissions)
  - Total Scope 3 = Σ (All other indirect emissions)

Step 6.3: Calculate totals
  - Total Emissions = Scope 1 + Scope 2 + Scope 3

Step 6.4: Calculate intensity ratios
  - Emissions per revenue = Total / Annual Revenue
  - Emissions per employee = Total / Number of Employees
  - Emissions per unit = Total / Production Units
```

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**Step 7: Report Generation**

**System generates BRSR-compliant report:**

**7.1 Report Sections**

1. **Executive Summary**
   - Total emissions by scope
   - Year-over-year comparison (if available)
   - Key insights
2. **Detailed Emissions Breakdown**
   - Scope 1: By fuel type
   - Scope 2: By facility/location

- Scope 3: By category

3. **Emission Intensity Metrics**
   - Per unit revenue
   - Per employee
   - Per production unit
4. **Compliance Checklist**
   - ✅ Company information provided
   - ✅ Scope 1 emissions calculated
   - ✅ Scope 2 emissions calculated
   - ✅ Scope 3 emissions calculated
   - ✅ Emission intensity calculated
5. **Methodology & Assumptions**
   - Emission factors used
   - Data sources
   - Calculation approach
   - Limitations and exclusions

**7.2 Output Formats**

- PDF report (audit-ready)
- Excel spreadsheet (detailed data)
- Dashboard view (interactive)

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**Step 8: Review & Export**

**User actions:**

1. Review generated report
2. Verify all calculations
3. Add comments or notes
4. Export final report
5. Submit to auditors/SEBI as required

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## Technical Implementation

## System Architecture

```
Frontend (React + JSX)
    ↓
User Input Forms
    ↓
Data Validation Layer
    ↓
Calculation Engine (JavaScript)
    ↓
Emission Factor Database
    ↓
Report Generator
    ↓
Output (PDF/Excel/Dashboard)
```

## Technology Stack

- **Frontend**: React with JSX
- **Build Tool**: Vite
- **Package Manager**: npm
- **Styling**: CSS/Tailwind
- **State Management**: React Hooks
- **PDF Generation**: jsPDF / PDFKit
- **Excel Export**: SheetJS (xlsx)

## Key Components

### 1. Input Forms

```javascript
// Example: Scope 1 Fuel Input
<FuelCalculator>
  - Diesel input field
  - Petrol input field
  - Natural gas input field
  - Auto-calculation on change
</FuelCalculator>
```

### 2. Calculation Engine

```javascript
```

```javascript
// Example: Calculate Scope 1
function calculateScope1(fuelData) {
  const emissionFactors = {
    diesel: 2.68,  // kg CO₂e per liter
    petrol: 2.31,  // kg CO₂e per liter
    naturalGas: 2.03  // kg CO₂e per m³
  };

  let totalEmissions = 0;

  for (const [fuel, quantity] of Object.entries(fuelData)) {
    totalEmissions += quantity * emissionFactors[fuel];
  }

  return totalEmissions / 1000; // Convert to tonnes
}
```

### 3. Report Generator

```javascript
// Generate BRSR-compliant PDF report
function generateReport(companyData, emissionsData) {
  const report = {
    summary: calculateSummary(emissionsData),
    details: formatDetails(emissionsData),
    compliance: checkCompliance(companyData, emissionsData)
  };

  return createPDF(report);
}
```

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## Data Requirements

### Minimum Required Data

### Scope 1

- Fuel consumption records (monthly/yearly)
- Fuel types and quantities

### Scope 2

- Electricity bills (kWh consumed)
- Location/state information

**Scope 3**

- Travel records (km traveled by mode)

- Employee count and commute data
- Supplier/logistics data (if available)

**Data Sources**

1. **Utility Bills**: Electricity consumption
2. **Fuel Purchase Records**: Diesel, petrol, gas receipts
3. **Travel Records**: Employee travel logs
4. **HR Records**: Employee count, commute surveys
5. **Logistics Data**: Transportation records

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# Output Format

### BRSR Report Structure

```
1. Company Profile
   - Name, sector, reporting period

2. Emissions Summary
   - Total emissions: X tonnes CO₂e
   - Scope 1: Y tonnes CO₂e
   - Scope 2: Z tonnes CO₂e
   - Scope 3: W tonnes CO₂e

3. Emission Intensity
   - Per ₹ Crore revenue: A tonnes CO₂e
   - Per employee: B tonnes CO₂e

4. Detailed Breakdown
   - Tables and charts by scope

5. Methodology
   - Emission factors used
   - Calculation approach

6. Compliance Statement
   - Adherence to SEBI BRSR norms
```

### Sample Output

BRSR CARBON FOOTPRINT REPORT

Company: ABC Manufacturing Ltd.

Reporting Period: FY 2024-25
Sector: Manufacturing

EMISSIONS SUMMARY

Total Emissions: 150.00 tonnes $CO_2e$

Scope 1 (Direct): 45.00 tonnes $CO_2e$ (30%)
Scope 2 (Electricity): 75.00 tonnes $CO_2e$ (50%)
Scope 3 (Indirect): 30.00 tonnes $CO_2e$ (20%)

EMISSION INTENSITY

Per ₹ Crore Revenue: 15.00 tonnes $CO_2e$
Per Employee: 1.50 tonnes $CO_2e$
Per Unit Produced: 0.15 tonnes $CO_2e$

# Emission Factors Database

## India-Specific Factors (as per SEBI BRSR Guidelines)

### Fuels (Scope 1)

| Fuel Type | Emission Factor | Unit |
|---|---|---|
| Diesel | 2.68 | kg $CO_2e$/liter |
| Petrol | 2.31 | kg $CO_2e$/liter |
| Natural Gas | 2.03 | kg $CO_2e/m^3$ |
| LPG | 3.00 | kg $CO_2e$/kg |
| Coal | 2,419 | kg $CO_2e$/tonne |

### Electricity (Scope 2 - by State)

| State/Region | Grid Emission Factor | Unit |
|---|---|---|
| Delhi | 0.82 | kg $CO_2e$/kWh |

| | | |
|---|---|---|
| Maharashtra | 0.79 | kg $CO_2e$/kWh |
| Gujarat | 0.84 | kg $CO_2e$/kWh |
| Tamil Nadu | 0.71 | kg $CO_2e$/kWh |
| Karnataka | 0.73 | kg $CO_2e$/kWh |

**Transport (Scope 3)**

| Mode | Emission Factor | Unit |
|---|---|---|
| Air (Domestic, Economy) | 0.133 | kg $CO_2e$/km |
| Air (International, Economy) | 0.111 | kg $CO_2e$/km |
| Rail | 0.041 | kg $CO_2e$/km |
| Car (Petrol) | 0.171 | kg $CO_2e$/km |
| Bus | 0.089 | kg $CO_2e$/km |

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## Quality Assurance

### Validation Checks

1. **Data Completeness**: All mandatory fields filled
2. **Range Validation**: Values within expected ranges
3. **Consistency Checks**: Cross-verification of related data
4. **Benchmark Comparison**: Against industry averages
5. **Audit Trail**: Complete log of all inputs and calculations

### Accuracy Standards

- **Calculation Precision**: Up to 2 decimal places
- **Rounding**: Standard rounding rules applied
- **Factor Updates**: Emission factors updated annually
- **Compliance**: 100% adherence to SEBI BRSR norms

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## Benefits

### For Companies

✅ **Time Saving**: Minutes vs. weeks for manual calculation
✅ **Cost Reduction**: 90% cost savings vs. hiring consultants
✅ **Accuracy**: Eliminates human calculation errors
✅ **Compliance**: Audit-ready SEBI BRSR reports
✅ **Scalability**: Works for MSMEs to large corporations

### For Stakeholders

✅ **Transparency**: Clear, standardized reporting
✅ **Comparability**: Consistent methodology across companies
✅ **Reliability**: Verified emission factors
✅ **Accessibility**: Easy-to-understand outputs

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## Support & Resources

### Documentation

- User Guide (detailed step-by-step instructions)
- API Documentation (for integrations)
- FAQ (common questions and issues)

### Contact

- Email: support@brsrcalculator.com
- GitHub: github.com/yourproject/brsr-calculator

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## Version History

- **v1.0.0**: Initial release with Scope 1, 2, 3 calculations
- **v1.1.0**: Added state-specific grid emission factors
- **v1.2.0**: Enhanced Scope 3 categories
- **Current**: v1.2.0

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## License

This methodology follows SEBI BRSR guidelines and the GHG Protocol standards.

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**Last Updated**: November 2025
**Maintained By**: BRSR Calculator Team