A.4.4 CARBON FOOTPRINT OF INSTITUTIONS

Carbon Footprint Calculator

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The carbon footprint is a key indicator of an institution's environmental impact, as it encompasses all emissions of carbon dioxide (CO2) and other greenhouse gases that occur during various operational activities. Its measurement and analysis have become imperative in global efforts to reduce climate change, given that the increase in the planet's temperature is a direct consequence of the increased concentration of these gases in the atmosphere. Understanding the carbon footprint not only allows institutions to identify their environmental weaknesses, but also to develop strategies to improve energy efficiency, reduce costs, and build a more sustainable business model.

For institutions in Serbia, Slovenia and Macedonia, it is important to take into account the local circumstances that affect their carbon footprint. For example, in Serbia, a significant proportion of emissions is associated with reliance on fossil fuels for electricity generation, which can be improved by switching to renewable energy sources such as solar and wind energy. In Slovenia, where there is a greater focus on sustainability and green initiatives, institutions can turn to investing more in energy-efficient technologies and environmentally friendly practices. Macedonia, on the other hand, faces waste management challenges and the need to improve existing industrial practices, which often result in higher CO2 emissions.

The Carbon Footprint Calculator allows institutions to efficiently collect and analyze data on key emission factors. Participants enter information about the number of employees, electricity consumption, heating, as well as fuel consumption and the amount of waste generated. This tool uses specific emission factors that are adapted to local conditions and data, thus ensuring the accuracy of the calculation. Based on the data entered, the calculator generates total CO2 emissions, as well as detailed analyses that cover emissions by source and estimate the total carbon footprint of the institution.

The output reports, obtained through the calculator, play a key role in the process of reducing the carbon footprint. These reports not only provide an overview of the current situation, but also offer concrete recommendations for reducing emissions. For example, the report may indicate that switching to more energy-efficient appliances or greater use of renewables would significantly reduce the overall carbon footprint.

Data visualizations, such as graphs and diagrams, make it even easier to understand and analyze data. They allow institutions to quickly identify key sources of emissions and the extent of their contribution to the overall footprint. This not only helps to prioritize reduction strategies, but also

allows institutions to track their progress over time, thereby increasing accountability and transparency.

Finally, the carbon footprint calculator is a significant tool for all institutions striving for sustainability. Through accurate measurement and analysis, it enables them to identify opportunities for improvement, cost reduction and building a positive image in the market. In light of the growing global challenges related to climate change, the use of such tools becomes not only a responsibility, but also a strategic advantage for institutions that want to leave a positive mark on the planet.

The technology behind the carbon footprint calculator plays a key role in data collection, processing and analysis, allowing institutions to effectively assess their environmental impact. The calculator has been developed using modern web technologies, which provides an interactive user experience and quick data analysis. The front-end part of the calculator is based on JavaScript, which allows dynamic generation of graphical representations and visualization of data through libraries such as Chart.js. These libraries allow users to see clear and informative graphs showing their carbon footprint by different categories, making it even easier to understand and make decisions.

The digitalization of the carbon footprint calculation process is essential. Traditionally, data collection and analysis were often manual and time-consuming, making it difficult to make quick decisions. By using digital tools, institutions can automatically collect data from various sources (e.g. energy computers, waste monitoring systems), which reduces the possibility of errors and increases the accuracy of calculations. In addition, integration with data management systems allows institutions to track trends over time, which helps them identify opportunities to improve and reduce emissions.

In addition, digitalization makes it easy to share results with employees, partners and stakeholders, increasing transparency and accountability. Online platforms also facilitate the exchange of experiences and strategies for reducing footprint among different institutions, thus encouraging cooperation and joint work towards achieving sustainability goals.

Looking ahead, it is possible to consider several directions for the development of carbon footprint calculators. First, the integration of artificial intelligence (AI) and machine learning can be considered to improve the accuracy of emissions predictions based on the data entered. These technologies could help identify patterns and trends that may not be immediately apparent, allowing institutions to identify key factors contributing to their footprint and to develop more targeted reduction strategies.

Second, the development of mobile applications can make it easier to use calculators in the field, which would allow for faster data collection and access to real-time information. Also, the introduction of functionality to track the progress of emission reductions in real time can improve employee motivation and engagement.

Third, the future development of calculators may also include the implementation of blockchain technology to verify emissions data. This approach can allow for greater transparency and data security, thereby increasing trust among users and relevant institutions.

Finally, potential extensions to the calculator can include additional environmental aspects, such as impacts on biodiversity, water use and waste management, providing a more comprehensive picture of the environmental impact of institutions. These innovations and enhancements would not only increase the usefulness of the calculator, but would also contribute to raising awareness of the importance of reducing the carbon footprint and other environmental factors, which is essential for a sustainable future.

The results of the calculation of the carbon footprint of the Greenes consortium partner represent a significant step towards understanding and reducing the environmental impact of various institutions. This project, which is aimed at analysing and reducing the carbon footprint, includes a number of key steps that have enabled the in-depth analysis of environmental data.

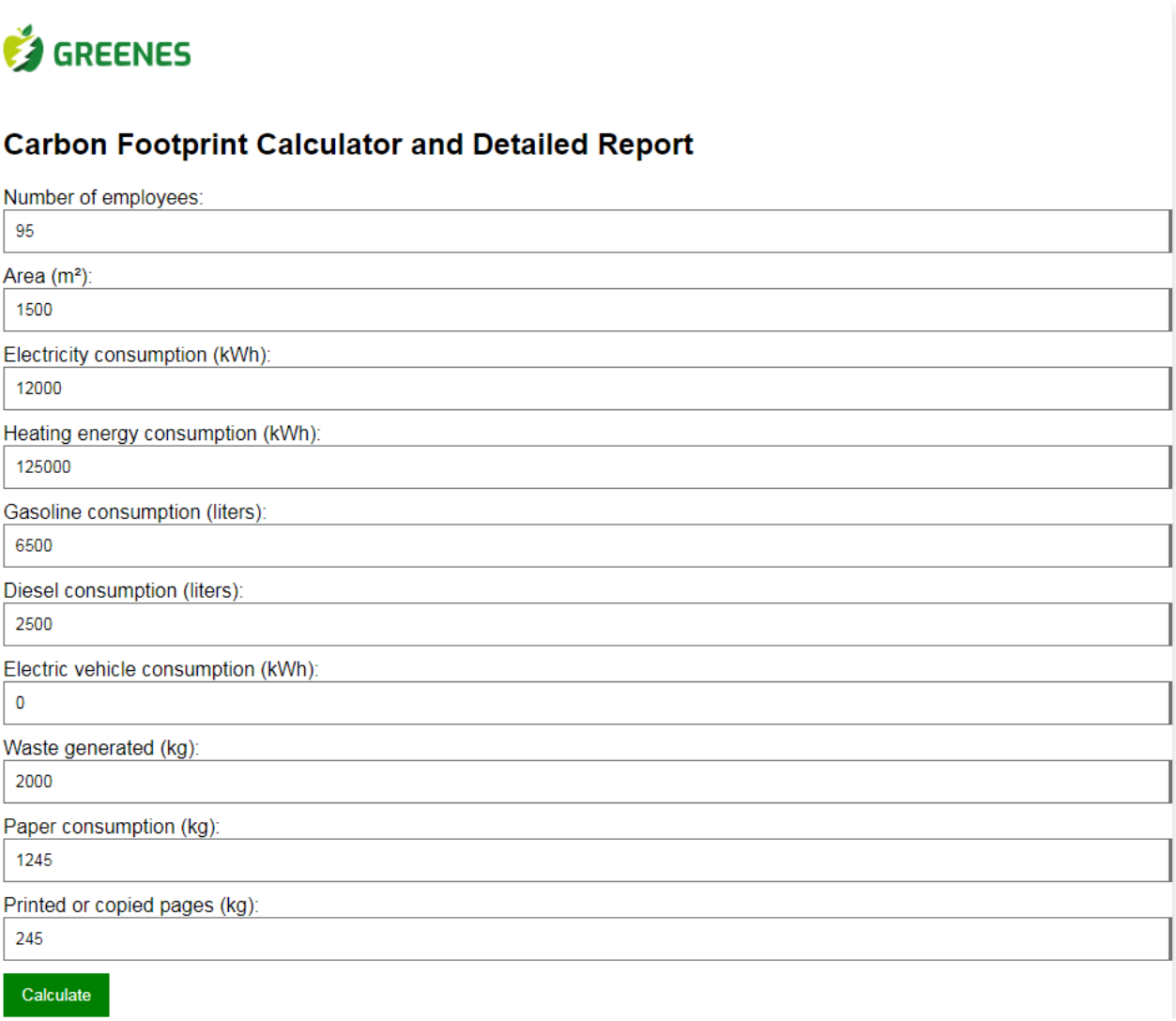
First, all project partners were required to collect relevant data on their consumption behavior, including information on electricity, heating, fuel, waste generation, as well as other factors contributing to their carbon footprint. Using a carbon footprint calculator, each institution was able to enter its own specific data, and the results showed not only total CO2 emissions, but also differences between institutions based on size, sector and geographical location.

Thanks to a careful analysis of the data collected, the Greenes consortium was able to identify key areas for improvement. For example, it has been shown that some institutions have significantly reduced their electricity consumption by using energy-efficient appliances and switching to renewable energy sources. These initiatives have resulted in a significant reduction in CO2 emissions, which has confirmed the importance of introducing sustainable practices into the business.

In addition, the analysis also revealed areas where further progress can be made. For example, certain institutions have generated higher amounts of waste, indicating the need to improve recycling practices and reduce waste. These findings have helped partners develop strategies and action plans aimed at reducing their carbon footprint and increasing sustainability.

As a result of the joint work and collaboration within the Greenes consortium, the partners received detailed reports showing their CO2 emissions by category, which allowed them to set concrete targets for reducing emissions in the future. The reports included recommendations and best practices that have proven successful with other partners, further motivating all participants to continue their efforts to reduce their environmental footprint.

The analysis and calculation of the carbon footprint of the project partners showed significant progress in understanding and managing the environmental impact. These results have not only provided useful insights for institutions, but have also contributed to the wider goal of reducing CO2 emissions in the region, thereby raising awareness of the importance of sustainable development and environmental responsibility.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Carbon Footprint Calculator and Detailed Report

Number of employees:
95

Area (m²):
1500

Electricity consumption (kWh):
12000

Heating energy consumption (kWh):
125000

Gasoline consumption (liters):
6500

Diesel consumption (liters):
2500

Electric vehicle consumption (kWh):
0

Waste generated (kg):
2000

Paper consumption (kg):
1245

Printed or copied pages (kg):
245

Calculate

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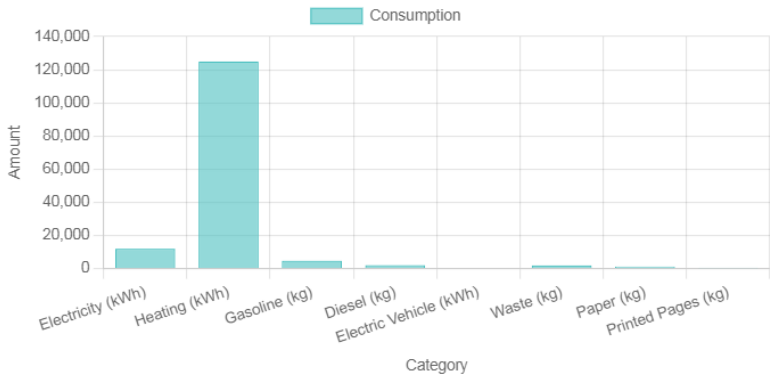
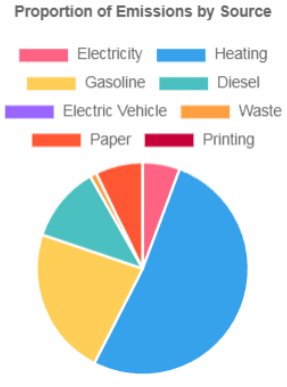
Institution Name: ATVSS Nis
Year: 2024
Total Carbon Footprint per Person: 0.5175 t CO2
Total Carbon Footprint (All Employees): 49.1625 t CO2
Carbon Footprint per m²: 0.0328 t CO2 per m²
Rating: Excellent
Emissions by Source:
- Electricity: 2.7960 t CO2 (5.69%)
- Heating: 25.5000 t CO2 (51.87%)
- Gasoline: 11.1111 t CO2 (22.60%)
- Diesel: 5.6950 t CO2 (11.58%)
- Electric Vehicle: 0.0000 t CO2 (0.00%)
- Waste: 0.5000 t CO2 (1.02%)
- Paper: 3.5607 t CO2 (7.24%)
- Printing: 0.0002 t CO2 (0.00%)
Additional Information:
Recommendations:
1. Increase the use of renewable energy sources.
2. Implement energy-saving practices.
3. Encourage carpooling and public transport.
4. Reduce waste generation and increase recycling efforts.





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HTML CODE

```
<! DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Carbon Footprint Calculator and Detailed Report</title>
  <script src="https://cdn.jsdelivr.net/npm/chart.js"></script>
  <script src="https://cdnjs.cloudflare.com/ajax/libs/jspdf/2.5.1/jspdf.umd.min.js"></script>
  <script
src="https://cdnjs.cloudflare.com/ajax/libs/html2canvas/1.4.1/html2canvas.min.js"></script>
  <style>
    body { font-family: Arial, sans-serif; }
    .container { width: 50%; margin: 0 auto; padding: 20px; background-color: rgba(255, 255, 255,
0.9); border-radius: 10px; box-shadow: 0 4px 8px rgba(0, 0, 0, 0.2); }
    img#logo { max-width: 150px; height: auto; margin-bottom: 20px; }
    input, textarea { margin-bottom: 10px; padding: 8px; width: 100%; }
    button { padding: 10px 15px; background-color: green; color: white; border: none; cursor: pointer;
}
    button:hover { background-color: darkgreen; }
    .result, .report { margin-top: 20px; padding: 15px; background-color: rgba(0, 0, 0, 0.5); color:
white; }
    textarea { height: 150px; }
    .chart-container { width: 100%; height: 300px; margin-top: 20px; }
    .pie-chart-container { height: 300px; display: flex; justify-content: center; }
    footer { margin-top: 20px; text-align: center; font-size: 12px; }
  </style>
</head>
<body>

  <div class="container">
    <img src="logo.png" alt="Company Logo" id="logo">
```

```
<h2>Carbon Footprint Calculator and Detailed Report</h2>
<form id="carbonForm">
  <label for="employees">Number of employees:</label>
  <input type="number" id="employees" placeholder="Enter number of employees" required>

  <label for="area">Area (m²):</label>
  <input type="number" id="area" placeholder="Enter total area in square meters" required>

  <label for="electricity">Electricity consumption (kWh):</label>
  <input type="number" id="electricity" placeholder="Enter electricity in kWh" required>

  <label for="heating">Heating energy consumption (kWh):</label>
  <input type="number" id="heating" placeholder="Enter heating energy in kWh" required>

  <label for="gasoline">Gasoline consumption (liters):</label>
  <input type="number" id="gasoline" placeholder="Enter gasoline in liters" required>

  <label for="diesel">Diesel consumption (liters):</label>
  <input type="number" id="diesel" placeholder="Enter diesel in liters" required>

  <label for="electric">Electric vehicle consumption (kWh):</label>
  <input type="number" id="electric" placeholder="Enter electric vehicle consumption in kWh" required>

  <label for="waste">Waste generated (kg):</label>
  <input type="number" id="waste" placeholder="Enter waste in kg" required>

  <label for="paper">Paper consumption (kg):</label>
  <input type="number" id="paper" placeholder="Enter paper consumption in kg" required>
```

```
    <label for="printing">Printed or copied pages (kg):</label>
    <input type="number" id="printing" placeholder="Enter the weight of printed/copied pages in kg" required>

    <button type="button" onclick="calculateCarbonFootprint()">Calculate</button>
  </form>

  <div class="result" id="result"></div>

  <h3>Generate Report</h3>
  <form id="reportForm">
    <label for="institutionName">Institution Name:</label>
    <input type="text" id="institutionName" placeholder="Enter the institution name" required>

    <label for="year">Year:</label>
    <input type="number" id="year" placeholder="Enter the year" required>

    <label for="additionalInfo">Additional Information:</label>
    <textarea id="additionalInfo" placeholder="Enter any additional information"></textarea>

    <button type="button" onclick="generateReport()">Generate Report</button>
    <button type="button" onclick="exportToPDF()">Export Report to PDF</button>
    <button type="button" onclick="exportChartToPDF()">Export Chart to PDF</button>
  </form>

  <div class="report" id="report"></div>

  <div class="chart-container">
    <canvas id="consumptionChart"></canvas>
  </div>
  <div class="pie-chart-container">
```

```
    <canvas id="emissionPieChart"></canvas>
  </div>
</div>

<footer>
  © 2024 Greenes. All rights reserved.
</footer>

<script>
  let chart, pieChart;

  function calculateCarbonFootprint() {
    const employees = document.getElementById("employees").value;
    const area = document.getElementById("area").value;
    const electricity = document.getElementById("electricity").value;
    const heating = document.getElementById("heating").value;
    const gasolineLiters = document.getElementById("gasoline").value;
    const dieselLiters = document.getElementById("diesel").value;
    const electric = document.getElementById("electric").value;
    const waste = document.getElementById("waste").value;
    const paper = document.getElementById("paper").value;
    const printing = document.getElementById("printing").value;

    const electricityEmissionFactor = 0.233;
    const heatingEmissionFactor = 0.204;
    const gasolineEmissionFactor = 2.31;
    const dieselEmissionFactor = 2.68;
    const electricEmissionFactor = 0.233;
    const wasteEmissionFactor = 0.25;
    const paperEmissionFactor = 2.86;
    const printingEmissionFactor = 0.001;
```

```
const gasolineKg = gasolineLiters * 0.74;
const dieselKg = dieselLiters * 0.85;

const electricityEmissions = electricity * electricityEmissionFactor / 1000;
const heatingEmissions = heating * heatingEmissionFactor / 1000;
const gasolineEmissions = gasolineKg * gasolineEmissionFactor / 1000;
const dieselEmissions = dieselKg * dieselEmissionFactor / 1000;
const electricEmissions = electric * electricEmissionFactor / 1000;
const wasteEmissions = waste * wasteEmissionFactor / 1000;
const paperEmissions = paper * paperEmissionFactor / 1000;
const printingEmissions = printing * printingEmissionFactor / 1000;

const totalEmissions = (
  electricityEmissions +
  heatingEmissions +
  gasolineEmissions +
  dieselEmissions +
  electricEmissions +
  wasteEmissions +
  paperEmissions +
  printingEmissions
);

const totalPeople = parseInt(employees);
const carbonFootprintPerPerson = totalEmissions / totalPeople;

const areaValue = parseFloat(area);
const carbonFootprintPerArea = totalEmissions / areaValue;

let rating = calculateRating(carbonFootprintPerPerson);
```

```
    document.getElementById("result").innerHTML = '
      <h3>Total Carbon Footprint per Person:</h3>
      <p>${carbonFootprintPerPerson.toFixed(4)} t CO2 per person</p>
      <p>Total Carbon Footprint (All Employees): ${totalEmissions.toFixed(4)} t CO2</p>
      <p>Carbon Footprint per m²: ${carbonFootprintPerArea.toFixed(4)} t CO2 per m²</p>
      <p>Rating: ${rating}</p>
    `;

    document.getElementById('report').dataset.carbonFootprint = carbonFootprintPerPerson.toFixed(4);
    document.getElementById('report').dataset.rating = rating;

    const consumptionData = [electricity, heating, gasolineKg, dieselKg, electric, waste, paper, printing];
    const labels = ["Electricity (kWh)", "Heating (kWh)", "Gasoline (kg)", "Diesel (kg)", "Electric Vehicle (kWh)", "Waste (kg)", "Paper (kg)", "Printed Pages (kg)"];
    createOrUpdateChart(consumptionData, labels);

    const emissions = [electricityEmissions, heatingEmissions, gasolineEmissions, dieselEmissions, electricEmissions, wasteEmissions, paperEmissions, printingEmissions];
    const totalEmission = emissions.reduce((acc, val) => acc + val, 0);
    const percentageData = emissions.map(emission => ((emission / totalEmission) * 100).toFixed(2));
    createOrUpdatePieChart(emissions, percentageData);
  }

  function calculateRating(carbonFootprintPerPerson) {
    if (carbonFootprintPerPerson < 2) return "Excellent";
    else if (carbonFootprintPerPerson < 5) return "Good";
    else if (carbonFootprintPerPerson < 10) return "Average";
```

```
  else return "Poor";
}

function createOrUpdateChart(data, labels) {
  const ctx = document.getElementById('consumptionChart').getContext('2d');

  if (chart) {
    chart.destroy();
  }

  chart = new Chart(ctx, {
    type: 'bar',
    data: {
      labels: labels,
      datasets: [{
        label: 'Consumption',
        data: data,
        backgroundColor: 'rgba(75, 192, 192, 0.6)',
        borderColor: 'rgba(75, 192, 192, 1)',
        borderWidth: 1
      }]
    },
    options: {
      scales: {
        y: {
          beginAtzero: true,
          title: {
            display: true,
            text: 'Amount'
          }
        },
```

```
        x: {
          title: {
            display: true,
            text: 'Category'
          }
        }
      }
    }
  });
}

function createOrUpdatePieChart(emissions, percentageData) {
  const ctx = document.getElementById('emissionPieChart').getContext('2d');

  if (pieChart) {
    pieChart.destroy();
  }

  pieChart = new Chart(ctx, {
    type: 'pie',
    data: {
      labels: [
        'Electricity',
        'Heating',
        'Gasoline',
        'Diesel',
        'Electric Vehicle',
        'Waste',
        'Paper',
        'Printing'
      ],
```

```
    datasets: [{
      data: emissions,
      backgroundColor: [
        '#FF6384',
        '#36A2EB',
        '#FFCE56',
        '#4BC0C0',
        '#9966FF',
        '#FF9F40',
        '#FF5733',
        '#C70039'
      ],
      borderWidth: 2,
      borderColor: '#ffffff',
    }]
  },
  options: {
    responsive: true,
    plugins: {
      title: {
        display: true,
        text: 'Proportion of Emissions by Source'
      },
      legend: {
        display: true,
        position: 'top'
      },
      tooltip: {
        callbacks: {
          label: function(tooltipItem) {
            const label = tooltipItem.label || '';
```

```
            const value = tooltipItem.raw || 0;
            const percentage = percentageData[tooltipItem.dataIndex] || 0;
            return `${label}: ${value.toFixed(4)} t CO2 (${percentage}%)`;
          }
        }
      },
      datalabels: {
        display: true,
        formatter: (value, context) => {
          const percentage = percentageData[context.dataIndex];
          return `${percentage}%`;
        },
        color: '#fff',
      }
    }
  }
});
}

function generateReport() {
  const institutionName = document.getElementById("institutionName").value;
  const year = document.getElementById("year").value;
  const additionalInfo = document.getElementById("additionalInfo").value;
  const carbonFootprint = document.getElementById('report').dataset.carbonFootprint;
  const rating = document.getElementById('report').dataset.rating;

  const totalCarbonFootprint = (parseFloat(carbonFootprint) * parseInt(document.getElementById("employees").value)).toFixed(4);

  const emissions = [
    document.getElementById("electricity").value * 0.233 / 1000,
```

```
    document.getElementById("heating").value * 0.204 / 1000,
    document.getElementById("gasoline").value * 0.74 * 2.31 / 1000,
    document.getElementById("diesel").value * 0.85 * 2.68 / 1000,
    document.getElementById("electric").value * 0.233 / 1000,
    document.getElementById("waste").value * 0.25 / 1000,
    document.getElementById("paper").value * 2.86 / 1000,
    document.getElementById("printing").value * 0.001 / 1000
  ];

  const totalEmission = emissions.reduce((acc, val) => acc + val, 0);
  const percentageData = emissions.map(emission => ((emission / totalEmission) * 100).toFixed(2));

  const areaValue = parseFloat(document.getElementById("area").value);
  const carbonFootprintPerArea = totalEmission / areaValue;

  const report = `
    Institution Name: ${institutionName}
    Year: ${year}
    Total Carbon Footprint per Person: ${carbonFootprint} t CO2
    Total Carbon Footprint (All Employees): ${totalCarbonFootprint} t CO2
    Carbon Footprint per m²: ${carbonFootprintPerArea.toFixed(4)} t CO2 per m²
    Rating: ${rating}
    Emissions by Source:
    - Electricity: ${emissions[0].toFixed(4)} t CO2 (${percentageData[0]}%)
    - Heating: ${emissions[1].toFixed(4)} t CO2 (${percentageData[1]}%)
    - Gasoline: ${emissions[2].toFixed(4)} t CO2 (${percentageData[2]}%)
    - Diesel: ${emissions[3].toFixed(4)} t CO2 (${percentageData[3]}%)
    - Electric Vehicle: ${emissions[4].toFixed(4)} t CO2 (${percentageData[4]}%)
    - Waste: ${emissions[5].toFixed(4)} t CO2 (${percentageData[5]}%)
    - Paper: ${emissions[6].toFixed(4)} t CO2 (${percentageData[6]}%)
```

```
      - Printing: ${emissions[7].toFixed(4)} t CO2 (${percentageData[7]}%)
      Additional Information: ${additionalInfo}
      Recommendations:
      1. Increase the use of renewable energy sources.
      2. Implement energy-saving practices.
      3. Encourage carpooling and public transport.
      4. Reduce waste generation and increase recycling efforts.
    `;

    document.getElementById("report").innerText = report;
  }

  function exportToPDF() {
    const { jsPDF } = window.jspdf;
    const doc = new jsPDF();
    const reportContent = document.getElementById("report").innerText;
    doc.text(reportContent, 10, 10);
    doc.save("carbon_footprint_report.pdf");
  }

  function exportChartToPDF() {
    const canvas = document.getElementById('consumptionChart');
    html2canvas(canvas).then(canvas => {
      const imgData = canvas.toDataURL('image/png');
      const pdf = new jsPDF();
      pdf.addImage(imgData, 'PNG', 10, 10);
      pdf.save("consumption_chart.pdf");
    });
  }
</script>
</body>
```

</html>