CARBON FOOTPRINT CALCULATOR

documentation

EVALUATOR :

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Introduction

Climate change is increasingly recognized as a major challenge. It is widely accepted that the greenhouse gas emissions caused by humans are having a negative impact on the environment. The most important greenhouse gas, arising from human activity, is carbon dioxide (CO2). Virtually all human activities cause the CO2 emissions that lead to climate change. By using electricity generated from fossil fuel power stations, burning gas for heating or driving a petrol or diesel car, every person is responsible for CO2 emissions. Furthermore every product or service that humans consume indirectly creates CO2 emissions; energy is required for their production, transport and disposal. These products and services may also cause emissions of other greenhouse gases. Understanding and addressing the full range of our impact is crucial for the effects of climate change to be minimized

The total set of greenhouse gas emissions caused directly and indirectly by an individual, organisation, event or product is commonly called their carbon footprint. Establishing the carbon footprint of an organization can be the first step in a program to reduce the emissions it causes.

What is Carbon Footprint?

A **carbon footprint** is the total greenhouse gases (GHG) emissions caused by an individual, event, organization, service, or product, expressed as carbon dioxide equivalent Greenhouse gases, including the carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, land clearance and the production and consumption of food, manufactured goods, materials, wood, roads, buildings, transportation and other services.

In most cases, the total carbon footprint cannot be calculated exactly because of inadequate knowledge of and data about the complex interactions between contributing processes, including the influence of natural processes that store or release carbon dioxide. For this reason, Wright, Kemp, and Williams proposed the following definition of a carbon footprint:

A measure of the total amount of carbon dioxide (CO_2) and methane (CH_4) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Calculated as carbon dioxide equivalent using the relevant 100-year global warming potential.

Sources of emissions

In order to produce a reliable footprint, it is important to follow a structured process and to classify all the possible sources of emissions thoroughly. A common classification is to group and report on emissions by the level of control which an organization has over them. On this basis, greenhouse gas emissions can be classified into three main types:

1. **Direct emissions that result from activities the organization controls**

   Most commonly, direct emissions will result from combustion of fuels which produce CO2 emissions, for example the gas used to provide hot water for the workspace. In addition, some organizations will directly emit other greenhouse gases. For example, the manufacture of some chemicals produces methane (CH4) and the use of fertilizer leads to nitrous oxide (N2O) emissions.

2. **Emissions from the use of electricity**

   Workplaces generally use electricity for lighting and equipment. Electricity generation comes from a range of sources, including nuclear and renewable. However, in the UK around 75% is produced through the combustion of fossil fuels.

Although the organization is not directly in control of the emissions, by purchasing the electricity it is indirectly responsible for the release of CO2.

3. **Indirect emissions from products and services**

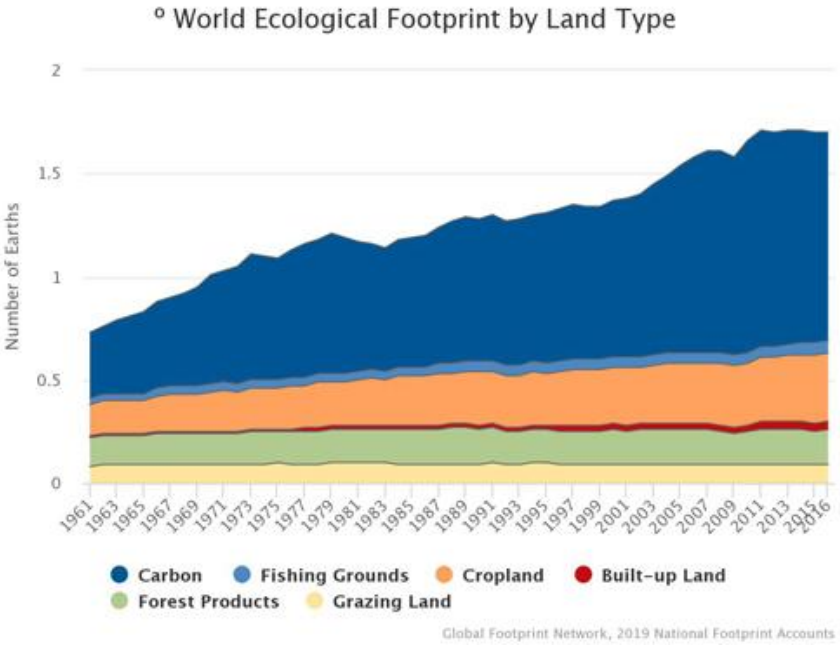
Each product or service that is purchased by an organisation is responsible for emissions. So the way the organisation uses products and services affects its carbon footprint. For example, a company that manufactures a product is indirectly responsible for the carbon that is emitted in the preparation and transport of the raw materials. Downstream emissions from the use and disposal of products can also be indirectly attributed to the organisation. It is clear, therefore, that producing a full footprint covering all three types of emissions can be quite a complex task. A further complexity in understanding published footprints is that they are rarely comparable for the following reasons:

• Despite emerging international standards not all organizations follow the same approach to calculating their footprint or classify their emissions in the same way

• Some footprints are expressed on a time period basis, such as the footprints of an individual or company which are typically measured annually. Others are expressed on a unit basis, such as per event or product purchased

• Carbon footprints are typically calculated to include all greenhouse gases and are expressed in tones of CO2 equivalent (tCO2e). However, others

calculate the footprint to include CO2 only and express the footprint in tCO2 (tones of CO2)



The reasons for needing a carbon footprint will determine which approach is most t appropriate. In some cases it may be possible to do a basic footprint – in others a much more rigorous process will be required.

Why to decrease Carbon Footprint?

Carbon Footprint and the Environment

Our increasing carbon footprint is having profound effects on the environment. Rising temperatures and shifting precipitation patterns are changing the growing patterns of plants and result in indigenous vegetation moving to increasingly cooler climates. Sea levels are rising as the temperature of our planet increases--warmer water occupies more space than cooler water. Rising seas will not only erode shorelines and destroy ecosystems, coastal cities and towns could be displaced by rising seas.

Carbon Footprint and Wildlife

As vegetation shifts climates because of increasing temperatures and shifting weather patterns, wildlife that depends on it will become threatened because it is unable to keep up with the rate at which the climate is changing. For example, migratory birds arrive at their destination to find that food sources such as plants bloomed too early or not at all and melting Arctic ice destroys hunting ground for polar bears. According to the Nature Conservancy, one quarter of the Earth's species will be headed for extinction in 40 years if climate change increases at its current rate.

Carbon Footprint and Human Health

Our increased carbon footprint has the capacity to harm our health. Most at risk are women in agricultural work and children. According to the World Health Organization, climate change is projected to increase the percentage of people in Mali suffering from hunger from 34 percent to at least 64 percent 40 years from now. An increase in malnutrition is caused by the result of climate change on food crops, such as drought that interferes with the growing season. Drought also causes diarrheal diseases as access to safe water is compromised. Vector-borne diseases such as malaria are increasing as the temperature increase allows malarias mosquitoes to survive in countries previously too cool for them.

Carbon Footprint and Economic Losses

The threat posed by our increasing carbon footprint on the economy is significant. Climate change will affect local economies dependent on land and natural resources the most, such as farms that fall victim to lowered crop yields. For example, according to the Nature Conservancy, economic losses due to our increasing carbon footprint and the resulting climate change has threatened the lobster industry in New England as catches have plummeted. In addition, the increase in ocean temperatures is threatening the survival of coral reefs, a $375 billion per year industry.

Ways to decrease your carbon

Here are some of the easiest ways you can start to shrink your carbon footprint.

Food

1. **Eat low on the food chain.** This means eating mostly fruits, veggies, grains, and beans. Livestock—meat and dairy—is responsible for 14.5 percent of manmade global greenhouse gas emissions, mainly from feed production and processing and the methane (25 times more potent than CO2 at trapping heat in the atmosphere over 100 years) that beef and sheep belch out

2. **Choose organic and local** foods that are in season. Transporting food from far away, whether by truck, ship, rail or plane, uses fossil fuels for fuel and for cooling to keep foods in transit from spoiling.

3. **Buy foodstuffs in bulk** when possible using your own reusable container.

4. **Reduce your food waste** by planning meals ahead of time, freezing the excess and reusing leftovers.

5. **Compost** your food waste if possible

Shopping

6. **Buy less stuff!** And buy used or recycled items whenever possible.

7. Bring your own **reusable bag** when you shop.

8. Try to avoid items with excess packaging.

9. If shopping for appliances, lighting, office equipment or electronics, look for **Energy Star** products, which are certified to be more energy efficient.

Home

10. **Do an energy audit** of your home. This will show how you use or waste energy and help identify ways to be more energy efficient.

11. **Change incandescent light bulbs** (which waste 90 percent of their energy as heat) to light emitting diodes (LEDs). Though LEDs cost more, they use a quarter of the energy and last up to 25 times longer.

12. **Switch lights off** when you leave the room and **unplug** your electronic devices when they are not in use.

13. Installing a **low-flow showerhead** to reduce hot water use can save 350 pounds of CO2. Taking shorter showers helps, too.

Transportation

14. **Drive less.** Walk, take public transportation, carpool, rideshare or bike to your destination when possible. This not only reduces CO2 emissions, it also lessens traffic congestion and the idling of engines that accompanies it.

15. If you must drive, **avoid unnecessary braking and acceleration.** Some studies found that aggressive driving can result in 40 percent more fuel consumption than consistent, calm driving.

16. **Take care of your car.** Keeping your tires properly inflated can increase your fuel efficiency by three percent; and ensuring that your car is properly maintained can increase it by four percent. Remove any extra weight from the car.

17. Use less air conditioning while you drive.

18. If you're shopping for a new car, **consider purchasing a hybrid or electric vehicle**.

19. If you fly for work or pleasure, air travel is probably responsible for the largest part of your carbon footprint. **Avoid flying if possible**; on shorter trips, driving may emit fewer greenhouse gases.

Why calculate a carbon footprint?

There are typically two main reasons for wanting to calculate a carbon footprint:

- To manage the footprint and reduce emissions over time
- To report the footprint accurately to a third party.

Footprinting for management of emissions

Calculating an organisation's carbon footprint can be an effective tool for ongoing energy and environmental management. If this is the main reason that an organisation requires a carbon footprint, it is generally enough to understand and quantify the key emissions sources through a basic process, typically including gas, electricity and transport. This approach is relatively quick and straightforward.

Having quantified the emissions, opportunities for reduction can be identified and prioritized, focusing on the areas of greatest savings potential.

Footprinting for accurate reporting

Organisations increasingly want to calculate their carbon footprint in detail for public disclosure in a variety of contexts:

- For CSR or marketing purposes
- To fulfill requests from business or retail customers, or from investors
- To ascertain what level of emissions they need to offset in order to become 'carbon neutral'. For these

purposes, a more robust approach is needed, covering the full range of emissions for which the organisation is responsible. It may also be appropriate for the calculation to be independently verified to ensure that the methodology has been correctly used and that the results are accurate.

Calculating a carbon footprint

A basic approach to carbon footprinting

For most organisations, calculation of a basic carbon footprint is a fairly quick exercise. A basic footprint is likely to cover direct emissions and emissions from electricity as these are the simplest to manage, but exclude some of the indirect emissions. There are usually a handful of major emissions sources that must be quantified, including:

- Onsite fuel usage
- Onsite electricity usage
- Use of transport which you own.

To get the key information to calculate a basic carbon footprint, collect data from all utility meters and record the distances travelled by the organisation's vehicles. Convert the fuel, electricity and transport consumption figures to CO2 by using the standard emissions factors, which are published by Defra and reproduced on the Carbon Trust website, together with advice on how to undertake the calculation.

When calculating a basic carbon footprint it is common to exclude sources of indirect emissions which your organisation does not control, for example emissions from waste, from the supply chain or from employee travel on public transport or airlines.

Once the basic carbon footprint has been established, it is then possible to take steps to manage the emissions:

- Set and agree efficiency or emissions reduction targets
- Identify likely opportunities for efficiency or emissions reduction
- Prioritise the opportunities, based on environmental or financial criteria
- Take action to implement the opportunities
- Monitor the performance of the actions taken and improve as necessary.

Producing a full carbon footprint

Accurate calculation of your carbon footprint requires a more detailed approach and may require specialist advice. The five steps below show a systematic approach, suitable for producing an accurate carbon footprint:

1. Define the methodology
2. Specify the boundary and scope of coverage
3. Collect emissions data and calculate the footprint
4. Verify results

Collect emissions data and calculate the footprint

The accuracy of the footprint relies on correct data and may include collecting information on:

- Onsite fuel consumption
- Owned transport utilization
- Emissions from chemical reactions in manufacturing processes or from land use or agricultural activities
- Electricity consumption
- Employee travel by air, rail and in vehicles not owned by the organization
- Suppliers' emissions.

For gas and electricity, collect consumption data in MWh or kWh. Data for other fuels can be collected in a variety of units, for example, kWh, MJ, Litres and so on. For transport emissions it may be necessary to estimate the total fuel consumption based on the mileage of the vehicles and fuel economy assumptions.

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Code for calculating Carbon Footprints

```
//Carbon Footprints
//Programmer: Mark Cravens
//Date: Created on 6 December 2016
#include <iostream>
#include <vector>
#include <list>
#include <iterator>
#include <typeinfo>
#include <algorithm>
#include <functional>
#include <cstdlib>
#include <cstring>
#include <fstream>

using namespace std;

class CarbonFootPrint
{
public:
	virtual double getCarbonFootPrint();
};

double CarbonFootPrint::getCarbonFootPrint()
{
	return 0;
}

class Building : public CarbonFootPrint
{
public:
	Building(double e = 0, int m = 12); //Constructor
	~Building(); //Destructor
	double setElectric();
	virtual double getCarbonFootPrint();

private:
	double electric;
	int months;
};

Building::Building(double e, int m)
{
	electric = e;
	months = m;
}

Building::~Building()
{

}

double Building::setElectric()
{
	cout << "Enter your monthly electric in kilowatts: " << endl;
	cin >> electric;
	return electric;
}
```

```
double Building::getCarbonFootPrint()
{

	cout << "The carbon footprint for this house is " << (electric * months) << endl;
	return(electric * months);
}


class Car : public CarbonFootPrint
{
public:
	Car(double = 0, double = 0); //Constructor
	~Car(); //Destructor
	double setYearlyMiles();
	double setAverageMPG();
	virtual double getCarbonFootPrint();

private:
	double yearlyMiles, averageMPG;
	int co2 = 19;
};

Car::Car(double ym, double mpg)
{
	yearlyMiles = ym;
	averageMPG = mpg;
}

Car::~Car()
{
}

double Car::setYearlyMiles()
{
	cout << "Enter in your yearly miles: " << endl;
	cin >> yearlyMiles;
	return yearlyMiles;
}

double Car::setAverageMPG()
{
	cout << "Enter in your average miles per gallon: " << endl;
	cin >> averageMPG;
	return averageMPG;
}

double Car::getCarbonFootPrint()
{

	cout << "The carbon footprint for this car is " << ((yearlyMiles / averageMPG) *
co2) << endl;
	return((yearlyMiles * averageMPG) * co2);
}

class Bicycle : public CarbonFootPrint
{
public:
	Bicycle(double = 0, int = 1); //Constructor
```

```
        ~Bicycle(); //Destructor
        double setMiles();
        virtual double getCarbonFootPrint();

private:
        int calories;
        double miles;
};

Bicycle::Bicycle(double m, int c)
{
        miles = m;
        calories = c;
}

Bicycle::~Bicycle()
{
}

double Bicycle::setMiles()
{
        cout << "Enter in number of miles: " << endl;
        cin >> miles;
        return miles;
}

double Bicycle::getCarbonFootPrint()
{

        cout << "The carbon footprint for this bicycle is " << (miles* calories) << endl;
        return (miles * calories);
}

int main()
{
        vector <CarbonFootPrint*> list; //A vector of CarbonFootPrint pointers.

        int answer;
        cout << endl;
        cout << "=========+-----------------------+=========\n";
        cout << "=========|Carbon Footprints       |=========\n";
        cout << "=========|Created by Mark Cravens |=========\n";
        cout << "=========|Due: 16 December 2016   |=========\n";
        cout << "=========+-----------------------+=========\n";
        cout << endl;
        cout << "Welcome to the Carbon Footprint Calculator!\n" << endl;

        bool finished = false;

        do
        {
                cout << "Main Menu" << endl << endl;
                cout << "1: Add house information." << endl;
                cout << "2: Add car information." << endl;
                cout << "3: Add bicycle information." << endl;
                cout << "4: Print carbon footprint for all items set." << endl <<endl;

                cin >> answer;
```

```
		switch (answer)
		{
		case 1:
		{
			cout << "\n" << endl;
			Building *anotherBuilding;
			anotherBuilding = new Building;
			anotherBuilding->setElectric();

			//Add the pointer to the list of pointers.
			list.push_back(anotherBuilding);
			cout << "\n" << endl;

			break;
		}

		case 2:
		{
			cout << "\n" << endl;
			Car *anotherCar;
			anotherCar = new Car;
			anotherCar->setYearlyMiles();
			anotherCar->setAverageMPG();

			//Add the pointer to the list of pointers.
			list.push_back(anotherCar);

			cout << "\n" << endl;

			break;
		}

		case 3:
		{
			cout << "\n" << endl;
			Bicycle *anotherbike;
			anotherbike = new Bicycle;
			anotherbike->setMiles();

			//Add the pointer to the list of pointers.
			list.push_back(anotherbike);

			cout << "\n" << endl;

			break;
		}

		case 4:
		{
			cout << "\n" << endl;

			//Have it iterate through the vector and print out each carbon
footprint.

			for (auto item : list)
			{
				item->getCarbonFootPrint();
```

```
                }

                cout << "Would you like to continue? (Y/N) " << endl;
                char continueFlag;
                cin >> continueFlag;
                if (continueFlag == 'N' || continueFlag == 'n')
                        finished = true;

                break;
        }

        default:
        {
                cout << answer << " is not a valid option" << endl;

                break;
        }
        }

    } while (!finished);

    system("PAUSE");
    return 0;
}
```