WOMEN GOING GREENER

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WomEn Going Greener

Reducing the environmental footprint of Female Entrepreneurship

MODULE 3

Footprint Minimization Magic

WEnCoop ENERGY COOPERATIVE

RINASCITA COOPERATIVA SOCIALE

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Introduction

The combined effects of intensive industrialization, transportation development, population growth, and urbanization undeniably contribute to global warming through greenhouse gas (GHG) emissions. This change in the GHG concentration (primarily carbon dioxide) led to the warming of the planet, which is currently, on average, 1.28°C warmer than in the second half of the nineteenth century (Copernicus Climate Data Store | Copernicus Climate Data Store, n.d.). A seemingly minor warming has unleashed a cascade of additional changes in the Earth's climate system, putting our society and the natural world around us in jeopardy. Risks are already and will continue to be, impediments to the orderly development of society and the normal operation of natural systems. Heat waves, floods, droughts, fires, degraded lands, and damaged ecosystems are becoming increasingly common and severe, indicating that we are not on track as a civilisation. That is why we should not be surprised that we are talking more about the climate crisis than climate change.

At the global scale, the key greenhouse gases emitted by human activities are:

- Carbon dioxide - CO_2
- Methane – CH_4
- Nitrous oxide - N_2O
- Fluorinated gases (F - gases: sulfur hexafluoride - SF_6, perfluorocarbons - PFCs, hydrocarbons - HFCs, nitrogen trifluoride - NF3).

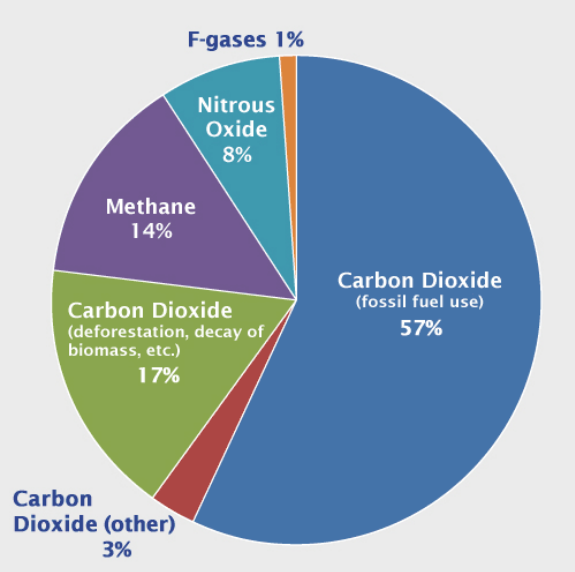

Figure 1 Global Greenhouse Gas Emissions by Gas (TrueValueMetrics ... Impact Accounting for the 21st Century, 2024)

Since carbon dioxide (CO_2) is the most emitted GHG, total emissions are usually expressed as carbon dioxide equivalent (CO_2eq). Global GHG emissions reached in 2022 the level of 53.8 Gt CO2eq (European Commission, 2023b). To curb global warming, world leaders have agreed on an international agreement on climate change that limits the increase in the global average temperature to a maximum of 2°C, with a target of 1.5°C compared to pre-industrial levels (Arora & Arora, 2023). To avert dangerous climate change, it is necessary to reduce greenhouse gas (GHG) emissions from every sector of the global economy.

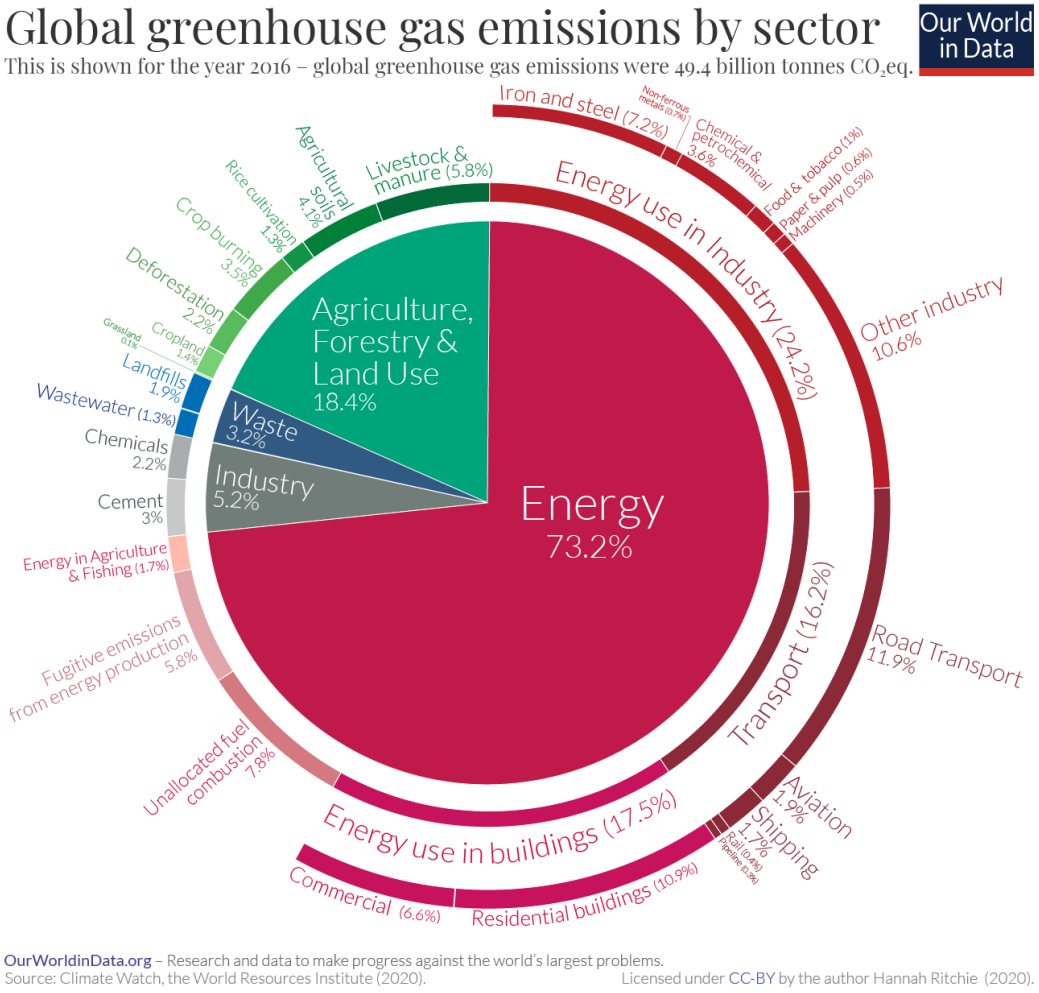

Figure 2 Global GHG emissions by sector

Figure 2 shows global GHG emissions by sector (Ritchie, 2020). Industry is a driver of economic growth and prosperity, generating about one quarter of global GDP. But that growth comes at a price – around 30% of global emissions are caused by the production of the goods we need in our daily lives. As a result, meeting environmental targets will be difficult unless the industrial sector is decarbonized.

GHG emissions in industry

Greenhouse gases emitted during industrial production are classified into two categories: direct emissions that are produced in the plant and indirect emissions that occur off-site but are associated with the company. The GHG Protocol Corporate Accounting and Reporting Standard is the most extensively used global GHG accounting standard (GHG Protocol, 2015). It includes three categories of industrial GHG emissions: Scope 1 includes direct emissions produced by the company's sources or those under its direct control. Scope 2 includes indirect emissions from the use of purchased heat, steam, and electricity. Scope 3 emissions include all additional indirect emissions from the company's value chain.

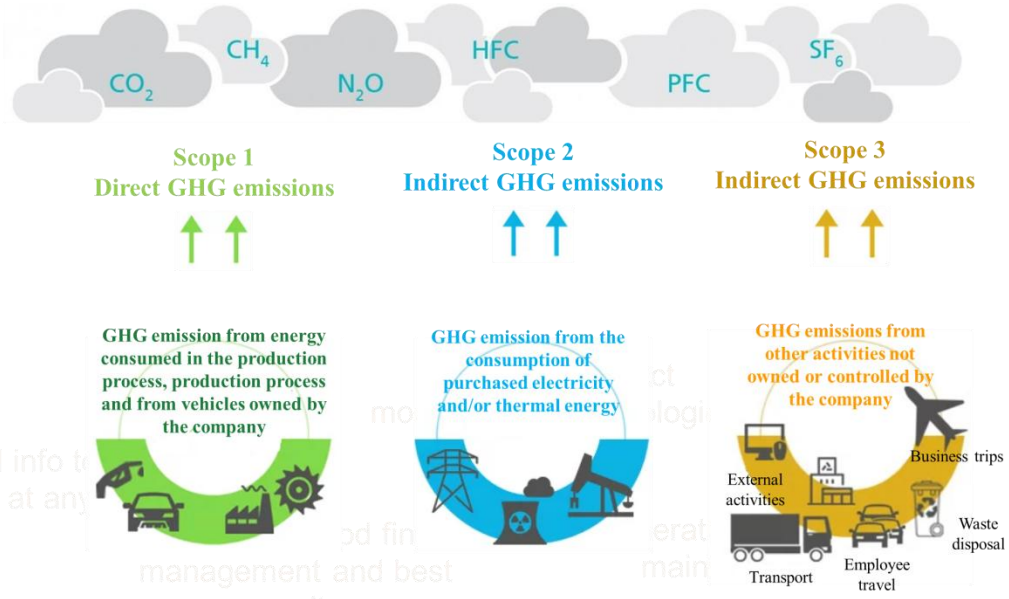

Figure 2 Industrial GHG emissions by scope

Carbon footprint

A carbon footprint (or greenhouse gas footprint) is a measure of the total amount of GHG emissions (in tCO_2eq) that occur directly or indirectly during production. Determining (measuring and calculating) corporate carbon footprint is the initial and crucial step in devising an effective strategy for reducing GHG emissions. This assessment not only identifies the key areas where emissions are highest but also provides a baseline from which improvement can be monitored.

Many well-known companies have conducted well-known studies of their carbon footprints to gain a deeper understanding of their environmental impact. These studies have revealed that the environmental impact of corporate activities is often more significant than previously thought. They highlight the urgency for companies to take action. By examining these cases and their reduction strategies, businesses can identify potential areas for improvement in their own sustainability practices. For calculating carbon footprint of a company, the following steps should be performed:

1. Identify the scope: The process begins with defining the scope of carbon footprint assessment (i.e. Scope, 1, 2 or 3).
2. Gather data: Data on energy use, travel records, supply chain operations, and resource consumption should be collected. Utility bills, fuel receipts, and purchasing records should be used to compile accurate and comprehensive data.
3. Carbon accounting: Based on the input data, the emissions are calculated. It is necessary to know the values of appropriate emission factors. An emission factor is a coefficient which enables converting activity data into GHG emissions. Besides, several software tools (so called carbon footprint calculators) that can help in quantifying carbon emissions are available for different counties. The examples are: Terrapass (https://terrapass.com/carbon-footprint-calculator/), ClimeCo (https://shop.climeco.com/business/business-emissions-calculator/), CarbonTrust SME Carbon Footprint Calculator (https://www.carbontrust.com/our-work-and-impact/guides-reports-and-tools/sme-carbon-footprint-calculator), Ecorand (https://ecorand.com/carbon-footprint-calculator-for-companies/), etc. These tools follow established protocols, ensuring that measurements are accurate and comparable to industry standards.

Industrial decarbonisation

Many developed societies understand the significance and need of reducing carbon footprint of their industrial facilities. To reduce carbon footprint of industrial facilities and accelerate the transition to climate neutrality in EU, the Net-Zero Industry Act (NZIA) creates a regulatory framework to boost the competitiveness of EU industry and technologies crucial for decarbonisation (European Commission, n.d.). The U.S. Department of Energy's (DOE) Industrial Decarbonization Roadmap identifies four key pathways to reduce industrial emissions through innovation in American manufacturing (DOE Industrial Decarbonization Roadmap, 2022):

1. Energy efficiency,
2. Electrification (with electricity produced from decarbonised sources),
3. Low-carbon fuels, feedstocks, and energy sources, and
4. Carbon capture, utilization, and storage (CCUS).

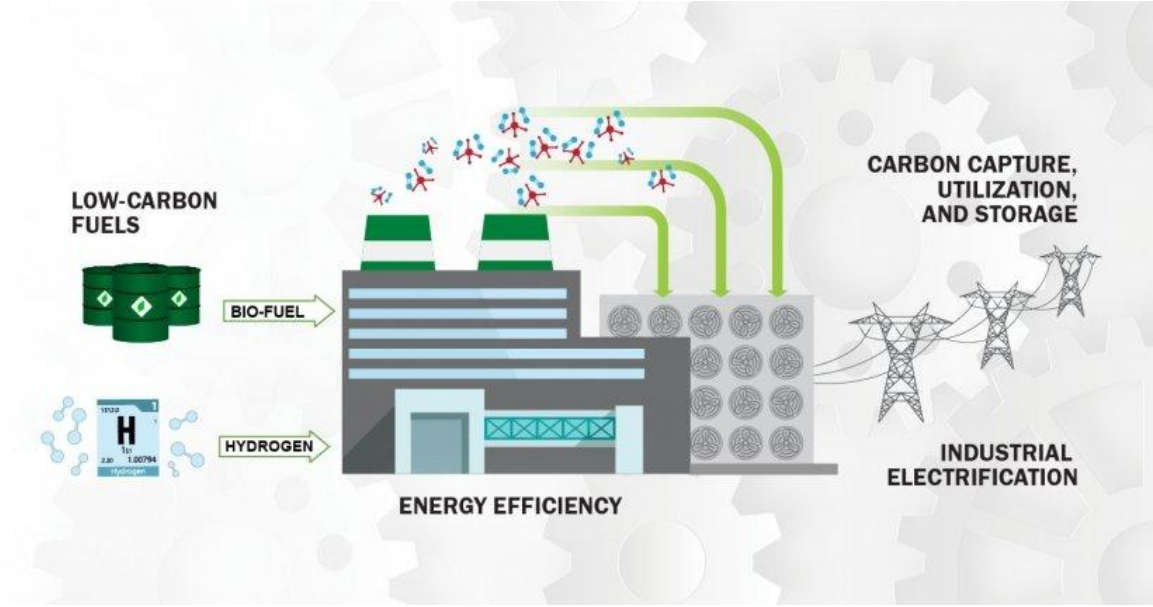

Figure 3 Strategies for industrial decarbonisation (taken from (DOE Industrial Decarbonization Roadmap, 2022)

Solutions for Industrial Decarbonisation

There are plenty of available, emerging, and experimental technical solution for decarbonising different industrial branches. A critical and systematic review of more than 250 decarbonising options for different industries is available in scientific literature:

- 86 commercially available, emerging, and experimental innovations for the iron and steel industry (Kim et al., 2022),
- 78 commercially available, emerging, and experimental innovations for the food and beverage industry (Sovacool et al., 2021),
- 32 emerging technologies for making ceramic manufacturing more sustainable (Furszyfer Del Rio et al., 2022a),
- 30 different innovations for making glass manufacturing more sustainable (Furszyfer Del Rio et al., 2022b),
- 40 decarbonisation interventions in oil refining plants (Griffiths et al., 2022),
- 71 potentially transformative technologies for the decarbonisation of the chemical industry (Chung et al., 2023).

Energy Efficiency Solutions

The fact that “every joule of energy that goes unwasted is the cleanest energy of all” signifies the importance of energy efficiency. The numerous energy efficiency solutions

for different industries exist and it is practically impossible to count them all. Nevertheless, energy efficiency solution can be systematised in following groups:

1. Optimizing the production system for energy efficiency
    - Installation of appropriate quality plants for energy generation/conversion (electricity, heating, cooling),
    - Waste heat recovery,
    - Switch to more efficient processes that achieve the same results,
2. Designing efficient energy distribution systems and their maintenance
    - Reduction of losses in distribution systems by appropriate dimensioning, distance reduction, pipe insulation, avoiding 90° bends in pipes and ducts, etc.
    - Management of leaks and uncontrolled use of steam, hot and cooling water and compressed air,
3. Proper selection of energy and process equipment
    - Work around the optimal load,
4. Installing efficient equipment (pumps and fans that provide sufficient flow with minimal energy consumption, boilers with the best available technology, use of highly efficient controllable electric motors - such as variable speed drives),
5. System management for efficient operation
    - Avoiding idling the equipment,
    - Correcting/reducing variability in the process and production flow,
6. Introduction of the energy management system
7. Demand side interventions:
    - Reduced use of materials: extended shelf life of products, greater intensity of product use and greater efficiency of materials,
    - Additive manufacturing (3D printing),
    - Substitution of low-carbon materials with high-carbon materials in products (construction materials industry),
    - Circular economy.

Energy Auditing

To Identify and prioritise energy efficiency and energy cost reduction opportunities in a company, energy auditing procedure in accordance with the ISO 50002 standard (ISO 50002:2014, 2017) should be perform. It includes the preparation for energy audit (defining the audit criteria and scope, selection of energy audit team, making an audit plan, preparing an audit checklist, conducting the initial walk-through visit, collecting energy bills and available data and information, conducting the preliminary analysis), data analysis, measurement of energy and process parameters, analysing energy use and production patterns, identifying and prioritising energy efficiency and energy cost reduction opportunities and energy audit reporting (Josijevic et al., 2020). The procedure is used to estimate the current energy performance of the company, to calculate the total

energy consumption and the share of the largest energy consumers. It also includes the calculation and benchmarking of appropriate energy performance indicators. The influence of production volume on both energy consumption and energy performance indicators should also be determined (Gordić et al., 2010),

Carbon offsetting

The implementation of energy efficiency measures and other actions that enable carbon footprint reduction results in a decrease in the carbon footprint compared to a business-as-usual situation (Figure 4). Since it is difficult to achieve net-zero production if only energy efficiency measures, electrification with decarbonised electricity, low-carbon fuels, feedstocks, and energy sources and CCUS are applied, it is necessary to compensate for the carbon footprint by carbon offsetting. The concept of carbon offsetting is illustrated in Figure 5. To neutralise their remaining GHG emissions, companies invest in environmental projects that reduce, remove or prevent the release of GHG into the atmosphere elsewhere. Companies purchase voluntary carbon offsets (VCOs), which are measurable, quantifiable, and trackable units of GHG emission reductions (Future Role for Voluntary Carbon Markets in the Paris Era Final Report, n.d.). The voluntary carbon offset is certified by governments or independent certifying agencies and reflects a one-tonne CO2eq emission reduction.

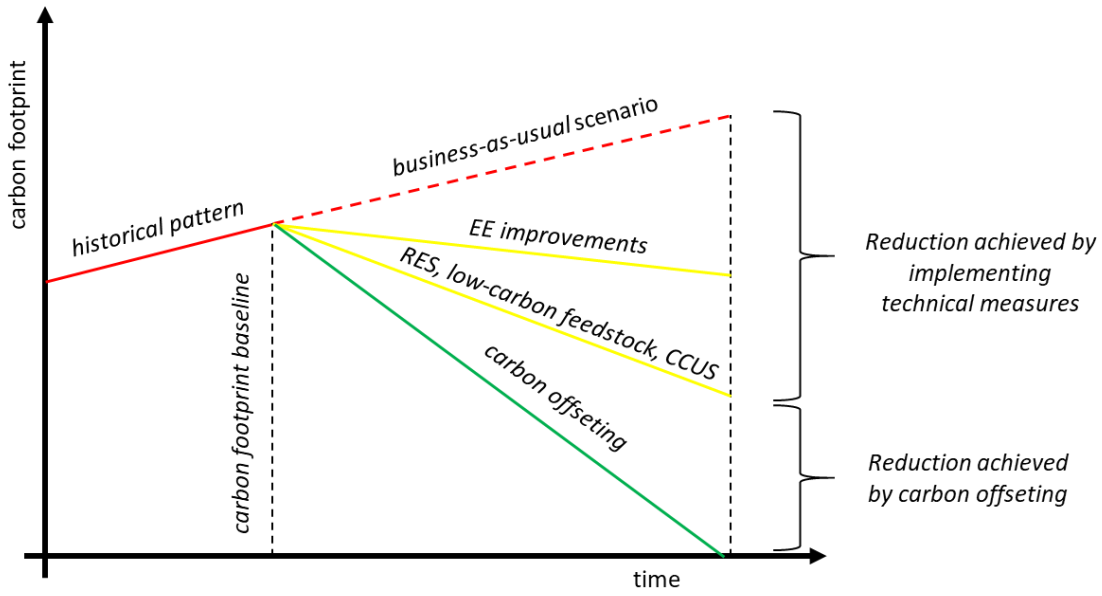

Figure 4 Carbon footprint reduction compared to a business-as-usual scenario

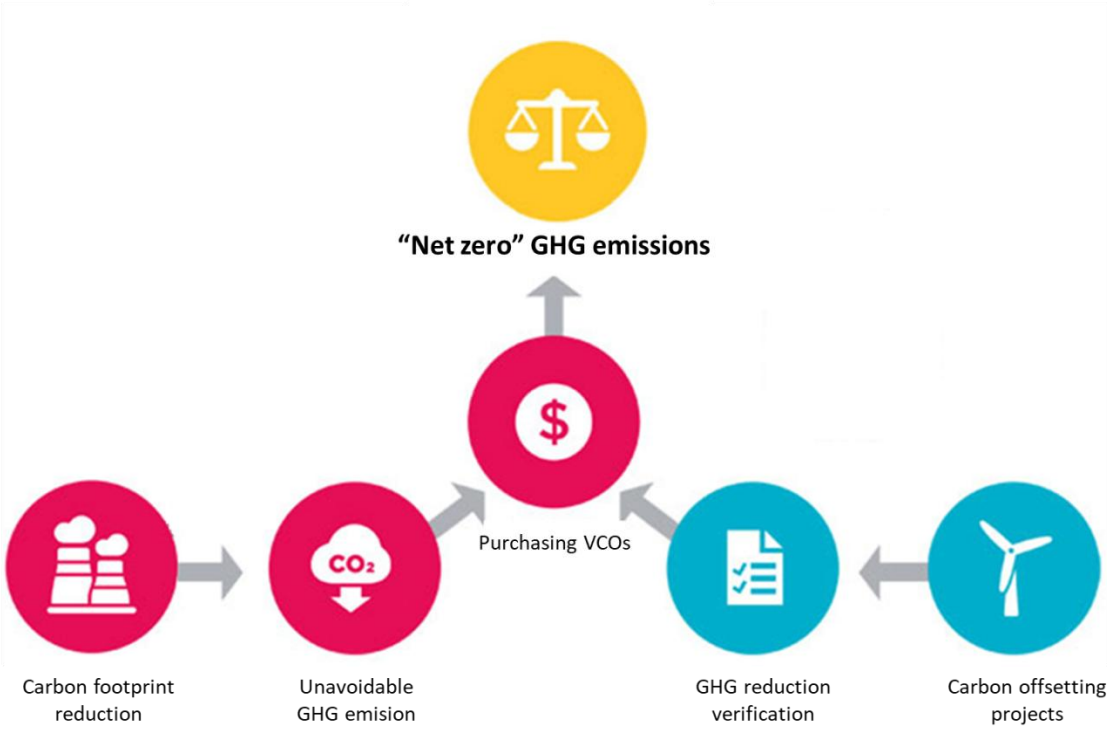

Figure 5 Carbon offsetting concept

Types of Offset Projects

Voluntary carbon markets were developed for companies or individuals to reduce their environmental footprint, demonstrate social responsibility, and enhance public image. The Verra, formerly Verified Carbon Standard (VCS), American Carbon Registry (ACR), Climate Action Reserve (CAR), Gold Standard (GS) and Plan Vivo are the major voluntary organizations that approve carbon offset methodologies, certify GHG reduction projects and register carbon offsets globally (Broekhoff et al., 2019). Most of these projects are in developing countries. In addition to reducing GHG emissions, they also improve the living conditions of local communities. Carbon offset projects refer to:

- Energy efficiency,
- Renewable energy sources (for displacing fossil-fuel emissions from conventional power plants),
- Afforestation, land use, and agriculture (carbon stored in plants, as well as absorbing additional carbon as trees grow),
- Waste disposal, (Gordic et al., 2023).

Benefits of Smaller Environmental Footprint

Businesses are becoming more conscious of the advantages of minimising their environmental impact in the modern world, where global concerns are paramount. Eco-friendly practices have significant benefits for the business in addition to being a step towards sustainability. Here is why businesses benefit from having a smaller environmental impact:

1. Enhanced brand image and corporate reputation
2. Regulatory compliance and reduced risks
3. Cost savings i.e. financial benefits through efficient practices
4. Building long-term sustainability

Enhanced brand image and corporate reputation

A dedication to decreasing the environmental impact boosts a company's brand image and reputation. Consumers, employees, and investors are increasingly valuing companies that prioritise environmental sustainability. By actively reducing carbon emissions, companies can improve their brand and public image, attracting environmentally conscious, loyal existing and new customers and workers. Furthermore, investors are more likely to fund companies that demonstrate a commitment to sustainability, which opens up chances for collaboration and growth.

Regulatory compliance and reduced risks

Reducing the environmental footprint can also help companies to stay ahead in terms of regulatory requirements. Environmental regulations are becoming stricter and companies that actively reduce their impact can avoid potential fines and legal issues.

Governments and regulatory bodies around the world have implemented regulations to reduce carbon emissions. These regulations differ in scope and target different industries. For example, the world's first carbon market, the EU ETS established in 2005 is a cap-and-trade system that sets an annual cap on the amount of GHG that companies in covered sectors may emit (European Commission, 2023c). The CBAM, designed to prevent carbon leakage to EU market, is a supplementary measure to the EU ETS. It operates by imposing a charge on the embedded carbon of certain imports, which is equal to the charge imposed on domestic goods under the ETS (European Commission, 2023a). By staying updated and adhering to these regulations, companies can avoid legal repercussions and position themselves as responsible corporate entities.

As the struggle against climate change intensifies, future legislation are likely to enforce increasingly higher carbon emission objectives. Anticipating prospective regulations and

adopting proactive actions to decrease emissions can help companies remain ahead of the curve. Furthermore, companies that practise environmental stewardship are frequently better positioned to influence future legislation and advocate for policies that are consistent with their own sustainability goals.

Cost savings i.e. financial benefits through efficient practices

Implementing energy efficiency measures and using renewable energy sources can result in significant cost reductions. Companies can reduce long-term operational costs by lowering energy use and utilising sustainable energy options. Furthermore, renewable energy systems typically have reduced maintenance costs and can provide a consistent long-term energy supply, decreasing exposure to market fluctuations in fossil fuel pricing. Companies can then reinvest their savings back into the business, stimulating further growth and innovation.

Building long-term sustainability

Working towards a decreased (or even zero) environmental footprint contributes to the company's future sustainability. Such approaches protect the business's longevity by making it more adaptive to a changing world and helping to save resources for future generations.

Conclusion

More sustainable practices help to create a healthier world while also driving business success, making them beneficial to both the environment and the company itself. Companies who recognize the need of addressing climate change and take decisive action not only contribute to a better future, but also establish themselves as responsible industry leaders.

Reducing a company's carbon footprint is a complex approach that goes beyond regulatory compliance to provide a competitive edge in the market. Companies may achieve significant environmental and economic benefits by accurately tracking emissions, investing in energy-efficient technology, optimizing supply chains, and supporting carbon offset programs. Such efforts promote a culture of sustainability throughout the organization, increasing stakeholder trust and securing a competitive advantage. Finally, these practices are critical to combat climate change and guaranteeing a company's long-term viability and success in a rapidly changing global landscape.

The journey to carbon neutrality may be a challenging one, but the benefits are immense.

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