Net-Zero Emissions Primer

for Pharmaceutical Manufacturing Companies

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canada

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Glossary

Active Pharmaceutical Ingredient (API): The component in a tablet, injection or other type of medicine that produces the therapeutic effect, such as curing, treating, or preventing a disease, or affecting the body's structure or function.

Base Year: A year in history against which a company's emissions are tracked over time to compare it with future emissions. It must be a consecutive twelve months, either as a full calendar year or consecutive over two calendar years.

Biologics: A broad category of complex drugs derived from living organisms or their components, including proteins, sugars, and nucleic acids. Biologics can be extracted from living sources such as yeast or bacteria or chemically synthesized.

Biosimilars: A biosimilar is a 'generic' version of a currently marketed biologic drug or 'reference product'. Biosimilars are rarely, if ever, identical to the reference product but instead are 'highly similar' in structure and function. Biosimilars must have no clinically meaningful differences in terms of safety, purity, and potency versus the reference product and must be just as safe and effective.

Carbon dioxide equivalent (CO_2 eq): A unit of measure for comparison between greenhouse gases (GHGs) that have different global warming potentials (GWPs). This unit of measure allows other GHGs to be expressed in terms of the GWP of one unit of CO_2. To express GHG emissions in units of CO_2 eq, the quantity of a given GHG is multiplied by its GWP.

Cleanroom: An enclosed area in which ambient conditions—including airborne particles, temperature, noise, humidity, air pressure, air motion, vibration, and lighting—are strictly controlled to avoid contamination of a drug during its manufacturing.

Contract Development and Manufacturing Organization (CDMO): A company that provides manufacturing services to other pharmaceutical companies on a contract basis, producing products according to client specifications.

Contract Research Organization (CRO): A company that provides research and clinical trial services to the pharmaceutical, biotechnology, and medical device industries.

Cold chain: A cold chain is a temperature-controlled supply chain for perishable goods like pharmaceuticals, vaccines, and certain foods.

Decarbonization: The process of reducing carbon dioxide emissions from a product, process, facility, or sector.

Direct emissions: Emissions from sources that are owned or controlled by a company (GHG Protocol 2004: 97).

Downstream emissions: Emissions from downstream activities associated with the operations of a company, including processing of sold products, use of sold products, investments, franchises, downstream transportation and distribution, end-of-life treatment of sold products, and downstream leased assets.

Emission factor: A value that quantifies an average amount of emissions associated with an activity. For more details on Canada-specific emission factors, see the latest National Inventory Report for Canada.

Emissions: The release of greenhouse gases into the atmosphere.

Emissions inventory: A quantified list of a company's greenhouse gas emissions and sources.

Energy Efficiency: A measure of how effectively energy is used for a given purpose. It is a ratio or other quantitative relationship between an output of performance, service, goods, commodities, or energy, and an input of energy.

Excipient: An inactive substance that serves as the vehicle or medium for a drug or other active substance. Excipients are mixed with API's to generate the final 'drug product' (medicine) administered to the patient.

Generic drug: A generic drug is a copy of a brand name small molecule drug, also known as the 'reference product'. Generic drugs contain the same API as the brand name drug and are considered bioequivalent (i.e. to have the identical efficacy and safety) to the reference product. There may be many generic versions of the same reference product.

Global Warming Potential (GWP): Allows the comparison of the global warming impacts of different gases or particles (such as black carbon). It is a measure of how much energy the emissions of 1 tonne of a gas or particle will absorb over a given period of time, compared to the emissions of 1 tonne of carbon dioxide. For the purposes of net-zero planning, use of 100-year GWP is recommended.

Greenhouse gas (GHG): A gas that absorbs and re-emits radiation, resulting in the greenhouse effect, which contributes to a warming climate. For the purposes of this guidance and for the Net-Zero Challenge, GHGs include all of those that are subject to reporting for the Greenhouse Gas Reporting Program. As of 2021, this includes carbon dioxide (CO2), methane (CH4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), 13 different hydrofluorocarbons (HFCs), and 7 different perfluorocarbons (PFCs).

Indirect emissions: Emissions that are a consequence of the activities of a company but occur at sources owned or controlled by another company (GHG Protocol 2004: 99).

Inventory boundary: Allows a participant to determine what sources of emissions are the result of their activities and accordingly, what emissions will need to be addressed in order to reach net-zero

emissions by 2050. Generally, the inventory boundary includes geographical boundaries and organizational boundaries.

Metered Dose Inhaler (MDI): A common medical device used to deliver a specific, pre-measured amount of aerosolized medication directly to the lungs, typically for treating chronic respiratory conditions like asthma and chronic obstructive pulmonary disease.

Mitigation strategy: A practice, process, or technology that contributes to mitigation, e.g., enhancing energy efficiency and adopting renewable energy sources.

Net-Zero Challenge: A voluntary Government of Canada program that encourages businesses to develop and implement credible and effective plans to transition their facilities and operations to net-zero emissions by 2050.

Net-zero emissions: Achieving net-zero emissions means that anthropogenic emissions of greenhouse gases into the atmosphere are balanced by anthropogenic removals of greenhouse gases from the atmosphere over a specified period; for organizations, net zero GHG emissions is commonly considered as the condition in which emissions have been reduced such that only residual emissions remain, and offsetting is restricted to removal credits only (ISO 14068).

Net-zero plan: A net-zero plan includes an emissions inventory and base year, interim targets, descriptions of the considered scenarios, pathways and mitigation strategies, and an outline of how net-zero planning will be incorporated into a company's governance and disclosures.

New chemical entity (NCE): A drug with an active chemical molecule not previously approved by regulatory agencies, representing a novel treatment option rather than a reformulation or new use of an existing drug.

Offset credits: Represent GHG emissions reductions or removals generated from activities that are additional to what would have occurred in the absence of the offset project (i.e., generated from activities that go beyond legal requirements and a business-as-usual standard). Each offset credit generated by an offset project represents one tonne of carbon dioxide equivalent (CO2 eq) reduced or removed from the atmosphere.

Organizational boundaries: The boundaries that determine the operations owned or controlled by a company, depending on the consolidation approach taken (equity share, operational control, or financial control).

Scope: Defines the operational boundaries in relation to direct and indirect emissions (GHG Protocol 2004: 101).

Scope 1 emissions: A company's direct emissions, principally the generation of electricity, heat, or steam, physical or chemical processing, transportation, and fugitive emissions (GHG Protocol 2004: 101).

Scope 2 emissions: A company's indirect emissions associated with the purchase of electricity, heating/cooling, and steam for own consumption (GHG Protocol 2004: 101).

Scope 3 emissions: A company's indirect emissions excluding those covered in scope 2. Also known as value chain emissions (GHG Protocol 2004: 101).

Small molecule drug: Low-molecular-weight APIs that are chemically synthesized. These drugs are commonly administered orally in tablets or capsules but are also available in injections, inhaled medicines, creams and ointments.

Upstream emissions: Emissions from upstream activities associated with the operations of a company, including purchased goods and services, capital goods, fuel- and energy-related activities, upstream transportation and distribution, waste generated in operations, business travel, and employee commuting.

Value chain: All business processes or activities involved in the production of a good or service for market, from conception to end use and beyond. A simplified value chain would include corporate services (e.g., marketing, logistics), research and development, inputs, assembly, distribution, sales, and after-sales service.

Value chain emissions: These are indirect emissions that may exist upstream or downstream of a company's direct operations. "Value chain emissions" are also known as scope 3 emissions.

Abbreviations

API: Active Pharmaceutical Ingredient

CH_4: Chemical formula for methane

CO_2: Chemical formula for carbon dioxide

CO_2 eq: Carbon dioxide equivalent

DAC: Direct air capture

DPI: Dry Pressure Inhaler

EV: Electric vehicle

GDP: Gross domestic product

GHG(s): Greenhouse gas(es)

HGV: Heavy Ground Vehicles

HVAC: Heating, ventilation and air conditioning

ICE: Internal combustion engine

GWP: Global Warming Potential

HFC: Shorthand for a group of chemicals called hydrofluorocarbons

ISO: International Organization for Standardization

kt: Kilotonne(s)

MDI: Metered Dose Inhalers

Mt: Megatonne(s)

NAICS: North American Industry Classification System

N_2O: Chemical formula for nitrous oxide

PFC: Shorthand for a group of chemicals called perfluorocarbons

PPA: Power Purchase Agreements

REC: Renewable Energy Credit

SAF: Sustainable aviation fuel

SF_6: Chemical formula for sulfur hexafluoride

SMI: Soft Mist Inhaler

ZEV: Zero emission vehicle

Section 1 Introduction

1.1 Purpose of this Primer

The purpose of this Net-Zero Emissions Primer is to help companies and organizations in the pharmaceutical manufacturing industry group in Canada:

a) Improve their understanding of the importance of net-zero, and what the transition to net-zero could look like for their subsector and globally; and,
b) Develop a net-zero strategy and plan for their organization.

1.2 Who is This Primer For?

The objective of this primer is to help companies and organizations in the **pharmaceutical manufacturing industry** reach net-zero emissions by 2050. This industry group can include bio-pharmaceutical companies, biotech company, biologics companies, animal health companies and vaccine manufacturers among others.

It can be used by either companies and organizations who are just starting out on their journey towards net-zero emissions, or those who are further along in the process and are looking for more concrete advice on what steps they can take.

1.2.1 Overview of the industry

The pharmaceutical industry consists of companies that design, discover, develop, test and sell medicines and related products to improve the health of humans or animals. The pharmaceutical manufacturing industry in Canada concentrates on producing medicines in large volumes for sale to hospitals, pharmacies and the public. See **Error! Reference source not found.** for an industry overview.

The North American Industry Classification System (NAICS) code for this industry is 3254 - Pharmaceutical and medicine manufacturing. This Net-Zero Primer may also be relevant for pharmaceutical research and development facilities classified under the NAICS code 541710 - Research and development in the physical, engineering and life sciences.

Examples of substances produced by the pharmaceutical manufacturing industry include:

- Anesthetic preparations (general and local)
- Blood derivatives
- Botanical and herb grinding and milling (i.e., for medicinal use)
- Contact lens solutions
- Medicinal chemicals, uncompounded
- Topical pharmaceutical agents (e.g., antiseptics, antipruritics like corticosteroids and demulcents)
- Vaccines (i.e., bacterial, viral)
- Veterinary medicinal preparations
- Vitamin preparations

- Nutraceuticals, botanical based
- Water decontamination or purification tablets

In Canada, there were 771 establishments in this industry in 2024, most of which were "micro", small and medium establishments with less than 500 employees. There were 16 pharmaceutical manufacturing establishments with 500 employees or more. The sector employed over 35,000 people in 2024 [2], [3]. Pharmaceutical manufacturing in Canada is concentrated in Quebec, Ontario and British Columbia, however, establishments in this sector operate in every province and territory.

The main types of pharmaceutical manufacturing companies in Canada include:

1. **In-house facilities** – These facilities are owned by large pharmaceutical companies to make medicines they have developed and sell themselves. These companies may perform all the steps needed to make the finished product for sale, or out-source steps such as packaging and product testing to contract organizations.
2. **Contract services companies** – This includes contract development and manufacturing organizations (CDMOs), companies that support pharmaceutical firms by providing outsourced services across the drug development and manufacturing lifecycle.

The types of pharmaceutical manufacturing include:

1. **Formulation & finished dosage manufacturing** – Manufacturing the final products, which can include creams and ointments, liquids, tablets, injectables, inhaled products and more. This accounts for most of the pharmaceutical manufacturing in Canada.
2. **Active pharmaceutical ingredient (API) or Biologics manufacturing** – Manufacturing the active ingredients in a drug, including small molecules and biologics. There is very little API manufacturing in Canada, and most pharmaceutical companies purchase APIs from other countries.

The processes undertaken by pharmaceutical companies include chemical synthesis, fermentation, distillation and solvent extraction; grading, grinding and milling; and packaging products into tablets, vials, ampoules or ointments [1].

Most pharmaceutical manufacturing companies in Canada do not have high direct emissions, since the most emissions intensive part of the supply chain is API manufacturing and that is usually done in other countries. The estimated direct GHG emissions from this industry in Canada were estimated to be 251 kt CO_2 eq in 2022 [4]. Although the direct emissions from individual facilities in this sector are generally small, the indirect emissions are typically much higher, especially from purchased goods. The aggregate emissions of the pharmaceutical industry are significant and must be addressed if Canada is to meet its net-zero target; doing so will also help position pharmaceutical companies to operate in Canada to operate in a decarbonized economy.

1.3 How to Use This Primer

This primer is separated into two main sections:

0: Section 2 The Shift to Net-Zero Emissions; and,

0: Section 3 Net-Zero Strategy and Planning for Pharmaceutical Manufacturing Companies

The purpose of Section 2 is to provide information on what net-zero is, why it is important, and what the shift to net-zero could look like both for the pharmaceutical manufacturing industry and globally. This section provides important background and context that companies should be aware of before developing their net-zero strategy and plan.

The purpose of Section 3 is to provide companies with guidance on how they can develop a net-zero strategy and a concrete plan for implementation. Note that this primer is based on the typical activities of a firm in the pharmaceutical manufacturing sector. While it provides a general guide to simplify and support the process of net-zero planning, the information in the primer should be applied to the specific circumstances of each company to develop a path forward.

The following steps in net-zero planning will be covered in Section 3:

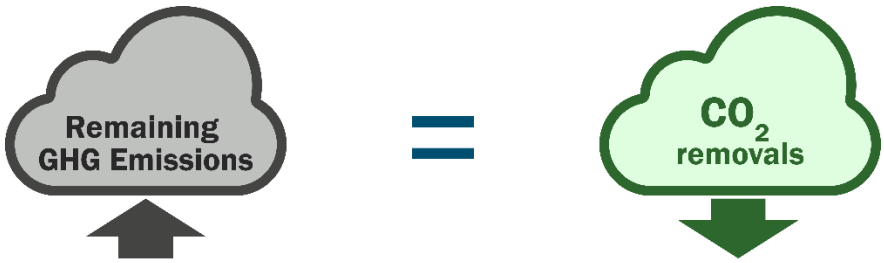
Section 2 The Shift to Net-Zero Emissions

The purpose of this section is to provide relevant background and context on the shift to net-zero emissions, to help pharmaceutical manufacturing companies understand their role in the transition and prepare to develop their net-zero strategy and plan.

This section describes what net-zero is, why it is important, and what the shift to net-zero could look like for companies and organizations in the pharmaceutical manufacturing industry in Canada and globally. It also gives an introduction on how to measure emissions using internationally recognized GHG emissions accounting practices.

2.1 What is Net-Zero?

Net-zero emissions are achieved when anthropogenic greenhouse gas (GHG) emissions to the atmosphere are balanced by anthropogenic removals over a specified period [5].



Net Zero means emissions are balanced by removal

GHGs are gases emitted from both human and natural sources, that once in the atmosphere, absorb and release heat. Rising concentrations of GHGs in the atmosphere contribute to climate change. GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. A commonly used unit of measurement for GHGs is CO_2e, which stands for carbon dioxide equivalent, and takes into account the global warming potential of all of the GHGs.

2.2 Why is Planning for Net-Zero Emissions by 2050 Important?

The world is moving toward net-zero emissions because the science is clear: to avoid the worst impacts of climate change, we must ultimately eliminate all net addition of GHGs to the atmosphere. Achieving the Paris Agreement goal of limiting warming to 1.5°C requires immediate action across all sectors of the economy. Delaying action will increase risks to health, ecosystems, and economic stability and make future transitions more difficult and costly. That's why governments, businesses, and communities are accelerating efforts to cut emissions and build a climate-resilient future.

For the pharmaceutical manufacturing industry, reaching net-zero emissions is important, since the aggregate emissions from the sub-sector are significant, even if those from individual firms are usually small. The sector as a whole has a role to play in the global transition to net-zero.

For individual companies in the pharmaceutical manufacturing industry, planning for net-zero emissions is also important, as it allows firms to prepare for the future and increase their resilience to climate risk. Net zero planning can also help identify business opportunities, secure a competitive advantage, build their reputation with clients and investors and be better positioned for trade and export opportunities. Net-zero planning can also be useful for ensuring compliance with evolving regulatory standards and meeting conditions for participation in voluntary emissions accounting programs (such as the Government of Canada's Net-Zero Challenge).

2.3 The Global Shift to Net-Zero

Globally, the main sources of GHG emissions come from the burning of fossil fuels (oil, natural gas, propane, and coal) for energy production, industry, transportation, and buildings. Other significant sources of GHGs come from agriculture, forestry, and land use changes [6].

Broadly speaking, the main actions required to reach net-zero emissions in Canada include:

- **Decarbonize and expand the electricity grid** using technologies such as wind, solar, and nuclear, to electrify end-uses (such as light duty vehicles, building heating, and industry) that currently rely on fossil fuels
- **Increase the production and use of low-carbon fuels** – such as hydrogen and advanced biofuels to address end-uses that are not easily electrified, for example, high temperature industrial processes and certain types of transportation
- **Promote energy efficiency** to reduce costs and minimize the scale of the new clean energy infrastructure that must be built over the coming years
- **Address non-energy related emissions** from industrial processes (such as the production of cement or steel), waste management practices, and agriculture
- **Deploy carbon removal approaches** – including nature-based solutions (such as tree planting) and direct air capture (DAC)- to trap GHG emissions that cannot be eliminated and permanently remove them from the atmosphere

Getting to net-zero will require efforts from every economic sector. Economies are intertwined: products from one firm are used by others; goods and services flow across borders and production chains link many disparate activities. Change on this scale will be spread over decades, with some countries and sectors able to move more quickly than others. Canada has committed to achieving net-zero emissions by 2050 through the Canadian Net-Zero Emissions Accountability Act, which became law in June 2021 [7].

2.4 The Shift to Net-Zero for the Pharmaceutical Manufacturing Industry in Canada

This section describes what the shift to net-zero could look like for the pharmaceutical manufacturing industry as a whole in Canada (what this could look like for your company specifically is addressed in 0).

2.4.1 Where do Emissions in the Pharmaceutical Manufacturing Industry Come From?

Direct emissions from pharmaceutical companies come from on-site energy use and transportation. Heating, ventilation, air conditioning and refrigeration (HVAC/R) systems are the largest consumers of on-site energy (typically about 70% of energy use), given that facilities have strict requirements for temperature, humidity, pressure and air purity to ensure product integrity [8]. Other categories of emissions include plug loads, processes, employee and product transportation, emissions from the manufacturing of raw materials, and packaging.

Details on where these emissions typically come from are provided below in Table 1.

Table 1 - Main sources of emissions in the pharmaceutical manufacturing industry

Category	Description	Explanation	Relative magnitude of emissions	Degree of company control
Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R)	Ventilation required for clean rooms and fume hoods, make-up air (MUA) units, chilled water, hot water and steam for manufacturing processes, space heating and cooling, refrigeration.	Direct emissions from the burning of fossil fuels onsite, or indirect emissions from purchased electricity. Direct emissions from high Global Warming Potential (GWP) refrigerants.	Medium	High
Plug loads and processes	Lighting, mixers, centrifuges, microscopes, sterilization, office equipment, water heating, dryers, forklifts etc.	Direct emissions from the burning of fossil fuels onsite, or indirect emissions from purchased electricity.	Low to medium	High
Raw materials	Manufacturing of raw materials, including active pharmaceutical ingredients (APIs), excipients (non-active ingredients), bulk	Emissions from manufacturing raw materials depend on the feedstocks used, energy	Low to High	Low to medium

Category	Description	Explanation	Relative magnitude of emissions	Degree of company control
	chemicals and biological products [9].	sources and chemical synthesis processes.		
Downstream use of Metered Dose Inhalers (MDIs)	Patient's downstream use of MDIs, which are used to treat chronic respiratory diseases, such as chronic obstructive pulmonary disease (COPD) and asthma.	MDIs use hydrofluorocarbon (HFC) propellants, which are potent GHGs [10]	Medium to High	Medium to High
Product/Material Transportation	Common modes of transportation include refrigerated heavy ground vehicles (HGVs), small, refrigerated vehicles (last mile delivery), temperature-controlled vans, cargo aircraft with cold chain containers and refrigerated shipping containers.	Direct emissions from the burning of fossil fuels in each of these modes of transportation	Medium to High	Low to High
Employee Transportation	Employee commuting and business travel.	Emissions from employee vehicles commuting and company-related travel for meetings, sales or logistics purposes.	Medium to High	Medium to High
Packaging	Plastics (syringes, vials, IV bags, etc.), aluminum (blister foils, tubes), glass (vials, bottles) or paper.	Emissions come from energy use in the manufacturing of materials, sterilization processes, and end-of-life disposal (incineration, landfill methane, hazardous waste treatment).	Low to Medium	Low to Medium

2.4.2 How to Reduce Emissions in the Pharmaceutical manufacturing industry

There are several actions that can be taken to reduce emissions in the pharmaceutical manufacturing industry. Some actions are under the control of the company, whereas others are actions that need to occur across the broader economy. Table 2 summarizes the main mitigation actions that need to happen, in order for the pharmaceutical manufacturing industry to reach net-zero emissions.

Table 2 – Main emissions mitigation actions in the pharmaceutical manufacturing industry

Category	Actions Companies Could Take	Actions Across the Broader Economy
Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R)	• Electrify fossil fuel space and water heating equipment, by installing electric heat pumps. • Transition natural-gas powered absorption chillers to electric systems. • Optimize air-change rates for clean rooms, as these are often overly conservative and have a very high energy demand [8]. • Implement heat recovery systems, capturing waste heat to reduce the demand on heating systems. • Replace refrigerants used in building HVAC/R system with a lower Global Warming Potential (GWP) alternative.	• Decarbonize electricity grids. • Decarbonize building construction (heavy equipment, generators, etc.) and materials (steel, concrete, plastics, etc.) used for new-build offices and the retrofit of existing buildings.
Plug loads and processes	• Electrify steam and heat processes (i.e. sterilization) by switching to electric steam boilers or heat pumps. • Reduce energy demand by switching to high efficiency equipment, such as high efficiency chillers, variable speed drives (VSD) for motors and variable air volume (VAV) systems [8]. • Reduce energy use by switching to energy efficient motors, office equipment, lighting, dryers, etc.	• Grid decarbonization and expansion of clean power generation. • Investment in local grid capacity to support load increases from electrification. • Continued innovation in efficient, low-carbon manufacturing equipment.

Category	Actions Companies Could Take	Actions Across the Broader Economy
Manufacturing of Raw materials[1]	• Purchase raw materials from low-carbon providers. • If manufacturing raw materials on-site, implement emissions reductions measures, including adoption of renewable energy, green chemistry, sustainable feedstock and solvent procurement and process efficiency improvements [10].	• Companies manufacturing the raw materials implement emissions reductions measures, including adoption of renewable energy, green chemistry, sustainable feedstock and solvent procurement and process efficiency improvements [10]. • Improve supply chain transparency, including guidance for companies on how to determine emissions factors for purchased materials. • Updates to standards and regulations to encourage or require pharmaceutical companies to consider the emissions impact of raw materials manufacturing.
Downstream use of Metered Dose Inhalers (MDIs)	• Provide MDI alternatives, when possible, such as dry powder inhalers (DPIs) or soft mist inhalers (SMIs) [12]. • When MDIs are necessary, choose smaller volume relievers that emit less propellant at each use [12].	• Patient education on MDI alternatives and proper inhaler use, to minimize unnecessary emissions of propellant [12]. • Patient education on proper disposal of MDIs (recycling and incineration) to reduce residual release of HFCs after disposal [12].
Product/Material Transportation	• Switch short-haul and last mile HGVs to electric vehicles. • Optimize logistics to reduce unnecessary travel. • For refrigerated transport, switch to refrigerants with a lower Global Warming Potential (GWP).	• Expand charging infrastructure for electric vehicles and increase availability of ZEVs. • Increase availability of zero-emission refrigerated HGVs for long-haul transportation. • Replace jet fuel with sustainable aviation fuel (SAF), hydrogen, synthetic fuels or electric propulsion.

[1] Incudes active pharmaceutical ingredients (APIs), excipients (non-active ingredients), bulk chemicals and biological products

Category	Actions Companies Could Take	Actions Across the Broader Economy
Employee Transportation	• Switch from internal combustion engines (ICE) to zero emission vehicles (ZEV) for road transport. • Install electric vehicle (EV) chargers on-site. • Adopt active transport (biking, walking, etc.) for commuting. • Choose rail travel instead of air travel for short journeys. • Avoid travel where possible and encourage remote work when possible.	• Build-out urban mass transit systems and either electrify or shift to low-carbon fuels. • Expand charging infrastructure for electric vehicles and increase availability of ZEVs. • Expand and upgrade passenger rail travel networks, and switch to electric or hydrogen fuel-cell powered locomotives. • Replace jet fuel with sustainable aviation fuel (SAF), hydrogen, synthetic fuels or electric propulsion.
Packaging	• Reduce unnecessary packaging • Transition to packaging that can be re-used or recycled • Seek out packaging from low-carbon providers. • Replace petroleum plastics with bio-degradable or compostable plastics, or if possible, cardboard, aluminum or glass.	• Decarbonize production chains involved in the manufacture and transport of packaging. • Continued innovation in low-carbon plastics.

The emissions mitigation actions in Table 2 cover emissions sources that can be quantified using internationally recognized accounting practices, such as the GHG Protocol and ISO 14064.

Pharmaceutical manufacturing companies can also reduce emissions indirectly through:

- **Supply Chain Pressure –** If a company considers emissions when purchasing raw materials and packaging, it increases the motivation for companies up the supply chain to reduce their emissions.
- **Knowledge Sharing –** ensuring staff receive ongoing training about climate change mitigation in the areas in which they provide advice and services, and can act as thought leaders, publicly sharing their achievements.
- **Branding –** A company can market themselves as a net-zero leader, highlighting their ability to deliver low-carbon design or service solutions as part of their publicity. This can normalize net-zero planning and inspire others in the sector to take action.

2.5 Measuring GHG Emissions

Accurately measuring a firm's emissions profile is critical to identify where to direct the mitigation actions. There are several widely accepted international resources that can be used to measure a company's GHG emissions. Two widely used resources are explained below, the international GHG Protocol and the International Organization for Standardization (ISO) 14064 standards.

2.5.1 International GHG Accounting Protocol

The GHG Protocol is the most widely used framework for GHG accounting and identifies, explains, and provides options for GHG emissions inventory best practices. It is used widely across many voluntary GHG initiatives including the Government of Canada's Net-Zero Challenge and the Science Based Targets initiative.

The GHG Protocol adopts standard accounting categories companies can use to effectively communicate their emissions data with stakeholders, investors, and regulatory bodies. The GHG Protocol's categorization provides a holistic view of a company's entire value chain, offering deeper insights into emission sources and potential areas for cost and carbon reductions. These emissions categories will also be referred to throughout this primer, and are as follows:

- **Scope 1 emissions**: Direct emissions from owned or controlled sources, such as company-owned facilities and vehicles.
- **Scope 2 emissions:** Indirect emissions from purchased electricity, steam, heating, and cooling.
- **Scope 3 emissions:** All other indirect emissions that occur throughout the supply chain, from raw material extraction to transportation, product use, distribution and disposal.

Scope 3 emissions

In the GHG Protocol there are fifteen categories for Scope 3 emissions:

Category 1: Purchased goods and services

Category 2: Capital goods

Category 3: Fuel- and energy-related activities

Category 4: Upstream transportation and distribution

Category 5: Waste generated in operations

Category 6: Business travel

Category 7: Employee commuting

Category 8: Upstream leased assets

Category 9: Downstream transportation and distribution

Category 10: Processing of sold products

Category 11: Use of sold products

Category 12: End-of-life treatment of sold products

Category 13: Downstream leased assets

Category 14: Franchises

Category 15: Investments

2.5.2 International Organization for Standardization

The International Organization for Standardization 14064 standards can be used to quantify, monitor, report, and verify GHG emissions. Relevant standards include:

- ISO 14064-1 (GHG emissions and removals for organizations – corporate level), and
- ISO 14064-3 (validation and verification of GHG statements).

The ISO 14064 series is complementary to the GHG Protocol and companies could benefit from using both sets of guidance. Specifically, if a company wishes to have their GHG emissions inventory verified by an accredited third-party, it is recommended that they use the ISO 14064-1 standard to ensure that their GHG emissions inventory is developed in a way that can be easily verified and compared to the inventories of other organizations.

Section 3 Net-Zero Strategy and Planning for Pharmaceutical Manufacturing Companies

The purpose of this section is to help pharmaceutical manufacturing companies make a strategy and a plan to reach net-zero emissions by 2050 or earlier and position their company competitively in a net-zero world. This section is for companies who understand the background and context provided in 0 and are ready to take action.

Note that this primer is based on the typical activities of a firm in the pharmaceutical manufacturing sector. While it provides a guide to simplify the process of net-zero planning, your company or organization must apply it to its own specific circumstances to develop a path forward.

3.1 Corporate Strategy in a Net-Zero World

Before creating a detailed net-zero plan, your company should create a corporate strategy that determines broadly how your company wants to position itself in a net-zero emissions world. Your company should research and evaluate both the external competitive landscape and the company's internal strengths and weaknesses, to determine the best path forward for the company.

Some of the questions you could ask are:

- What could the pharmaceutical manufacturing industry look like in Canada in 2050? What is our company's position in this environment?
- What aspects of our business may be the most exposed to change and risk —and where could we find strategic advantages in the transition to net zero?
- What key risks should we mitigate to ensure our company's success as we eliminate our emissions over the coming years?
- Are there any new business opportunities that our company could pursue in the transition to net-zero?
- Does our company have any weaknesses that expose it to risk due to climate change and a changing economy?

3.1.1 Net-Zero Business Model

Next, you should reflect on whether your company should make any changes to its business model.

For many companies in the pharmaceutical manufacturing industry, reaching net-zero emissions and operating in a net-zero world will not result in a significant change to their business models or everyday working practices. There will be changes in how facilities are heated and powered and how products and employees move from place to place, but the drug manufacturing processes is not likely to be affected.

3.1.2 The Competitive Advantage of Net-Zero

Moving to net-zero isn't just about managing risk—it also presents real opportunities.

Businesses that take early action in moving towards net-zero may be able to gain a competitive edge, reduce costs, attract and retain talent, build stronger relationships with clients and investors and be better positioned for trade and export opportunities. Operational costs can be reduced by prioritizing cost-saving mitigation actions and taking advantage of available funding, grants or incentives.

In the pharmaceutical sector, being ahead of the curve on climate action is quickly becoming a marker of leadership and credibility. For example, in the Canadian pharmaceutical industry, many major companies have already made emissions reductions commitments, through the Net-Zero Challenge or the Science-Based Targets Initiative (SBTi). There are also several industry specific sustainability initiatives, such as:

- The Pharmaceutical Supply Chain Initiative, driving responsible value chains,
- The Activate Program, part of Manufacture 2030, where global pharmaceutical companies are working to decarbonize API supply chains, and
- The Canadian Association of Pharmacy for the Environment (CAPhE), pharmacy professionals dedicated to improving the profession's impact on climate change

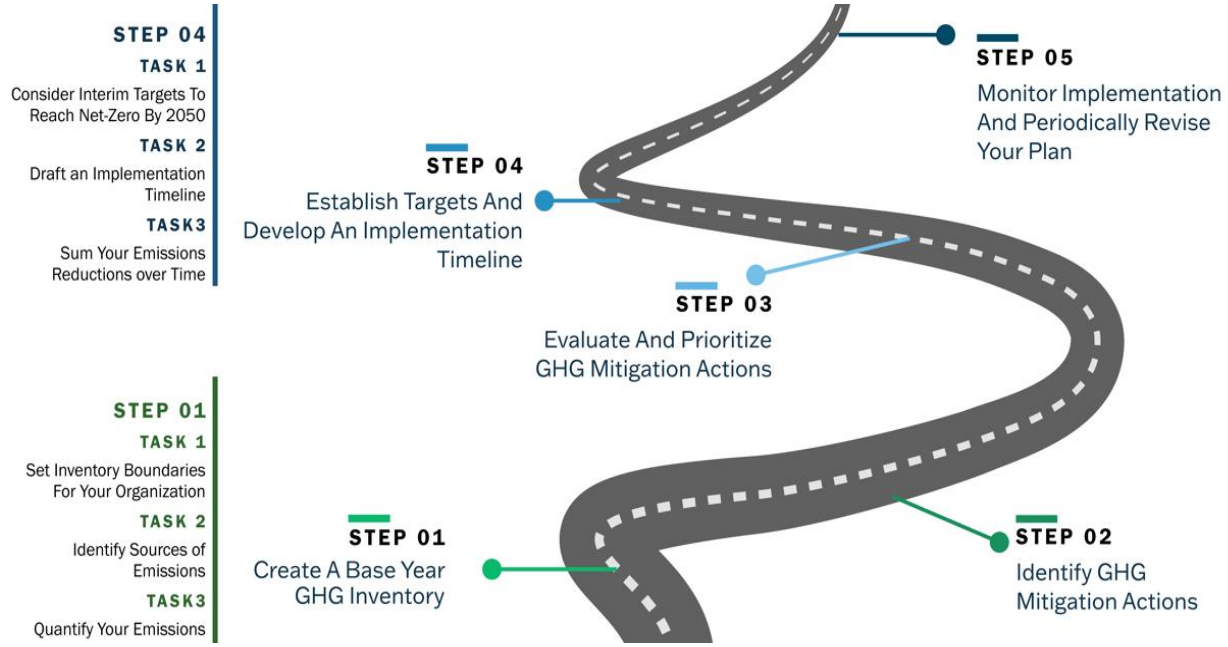
Internationally, the World Health Organization (WHO) is calling for pharmaceutical companies to take action on climate change, recognizing that the effects of climate change and human health are interlinked. The WHO is urging global regulatory bodies and stakeholders to reduce the environmental impact of the pharmaceutical and healthcare sectors, through changes to standards, guidance, and regulations.

Planning for net-zero can help companies stay ahead of future changes to regulations, codes and standards, as well as understanding upcoming technological advances.

3.2 Net-Zero Planning for Pharmaceutical Manufacturing Companies

Once you have an understanding of what the net-zero transition could look like globally, and for your sector, and you have considered your company's strategy in a net-zero world, you are ready to create a net-zero plan, that will outline the tangible actions you can take.

This section goes over the steps your company will need to complete a credible and achievable net-zero plan. The steps you will need to take are:



Details on how to complete each of these steps are given in the sections below.

For some pharmaceutical manufacturing companies, doing a simple net-zero plan in house is possible. However, many companies may have more complex facilities and operations or lack the internal resources to create a credible net-zero plan. In these cases, companies may wish to seek out external expertise on clean technology, the energy transition, energy and climate policy and finance.

3.2.1 Step 1 - Create a Base Year GHG Inventory

The first step in creating a net-zero plan is creating an inventory of your GHG emissions for a one-year period, that will be the base year. To create the base-year inventory you will need to set inventory boundaries for your organization, identify your sources of emissions, and quantify the emissions over 12 consecutive months.

Set inventory boundaries for your organization

Setting the inventory boundary allows you to determine what sources of emissions are the result of their activities and accordingly, what emissions will need to be addressed in order to reach net-zero emissions.

Generally, inventory boundaries can be set through three criteria: equity share, financial and operational boundaries. Please refer to ECCC's Net-Zero Challenge Technical Guide 2.0 and the GHG Protocol Corporate Standard for details on how to set inventory boundaries for your organization.

Identify sources of emissions

Table 3 shows common sources of emissions for pharmaceutical manufacturing companies. Identify which of these sources apply to your organization.

Table 3 - Common sources of emissions for pharmaceutical manufacturing companies

Category	Description
Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R)	• Boilers and other space and water heating equipment • Ventilation required for fume hoods, clean rooms, etc. • Air conditioners or chillers used for space cooling • Refrigeration required in warehouses or other storage areas
Plug loads and processes	• Electrical operation of lab and bulk manufacturing equipment including mixers, centrifuges, microscopes , other analysis equipment and motors • Other miscellaneous plug loads including lighting, office equipment • Steam and heat processes such as sterilization and drying
Manufacturing of Raw materials[2]	• Emissions from manufacturing raw materials, which will vary widely depending on the feedstocks used, energy sources and chemical synthesis processes
Downstream use of Metered Dose Inhalers (MDIs)	• Emissions from HFC propellants, which are released when the patient uses the device
Product/Material Transportation	• Diesel fueled refrigerated heavy ground vehicles (HGVs) trucks used for transporting raw materials and finished products that require temperature control • Small, refrigerated vehicles (last mile delivery) or temperature-controlled vans that are gasoline or diesel powered • Transport of cold chain containers through marine, air or rail freight

[2] Incudes active pharmaceutical ingredients (APIs), excipients (non-active ingredients), bulk chemicals and biological products

Category	Description
Employee Transportation	• Daily commuting by employees in gasoline or diesel vehicles. • Business travel by car or plane for supplier meetings, trade shows, sales etc.
Packaging	• Emissions produced during the manufacturing or end-of life disposal of plastic, glass aluminum or paper packaging

Once you have identified the sources of emissions, you will need to identify which category each emissions source falls into (Scope 1, 2 or 3), as described in the International GHG Accounting Protocol.

While the table above identifies the most common sources of emissions for pharmaceutical manufacturing companies, the full list of Scope 3 emissions should be reviewed, to determine if there are any other sources that could be relevant to your business.

Quantify your emissions

Once emissions sources have been identified, you must quantify your emissions. This is done by gathering activity data and emission factors that quantify the GHG emissions associated with each type of activity.

Activity data are quantitative measures of activities that result in GHG emissions. Examples of activity data could include:

- Cubic meters of natural gas used to heat a building
- Liters of gasoline used by vehicles
- Kilowatt hours of electricity consumed
- Kilometers travelled by airplane
- Dollar amount of office supplies purchased

Emissions factors are calculated ratios, that specify the amount of GHGs that are emitted per unit of activity. Multiplying the activity data by the correct emissions factor will produce an estimate of total emissions associated with this activity.

There are several reputable organizations that provide publicly available emissions factors. Environment and Climate Change Canada publishes the following resources to find emissions factors:

- For electricity: National Inventory Report, Part 3, Annex 13
- For other activities: National Inventory Report, Part 2, Annexes 3 and 6

Other helpful resources to create your GHG Inventory include:

- ECCC's Net-Zero Challenge Technical Guide 2.0
- ECCC's Net-Zero Challenge Emissions Calculator
- GHG Protocol Corporate Standard

3.2.2 Step 2 - Identify GHG Mitigation Actions

Once the base year GHG inventory is complete, the second step is to identify possible actions your company could take to mitigate those emissions. Possible mitigation actions for each category of emissions are given in the sections below. It should be noted that while these mitigation actions are all technically feasible, many of them will not be possible in the short term due to financial, regulatory, and supply chain constraints. Step 3 – Evaluate and Prioritize GHG Mitigation Actions will explain how to identify these constraints and prioritize mitigation actions for the short, medium and long term.

In many cases, the recommendation is to electrify fossil fuel equipment. Once that is complete, you will also need to address your Emissions from Purchased ElectricityEmissions from Purchased Electricity, which are addressed at the end of this section.

If none of these mitigation actions are feasible for your company, the recommendation is to purchase Carbon Offset Credits.

Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R)

Table 4 presents the top mitigation actions for GHG emissions from HVAC/R systems.

These possible mitigation actions are presented roughly in order of what will be the most impactful and practical, to the least. Several examples of energy efficiency improvements are presented below, however the best choices to prioritize for your specific facilities will depend on several different factors, therefore it is recommended to conduct an energy audit of your facilities prior to making a decision. Additional tools and information resources related to energy efficiency are available from Natural Resources Canada's Office of Energy Efficiency.

Table 4 - Practical actions to reduce GHG emissions for HVAC/R systems

Source of Emissions	Possible mitigation actions
Process Heat (Hot Water or Steam)	• Electrify hot water and steam generation using electric industrial heat pumps or electric boilers. • Reduce energy demand by implementing energy efficiency improvements, for example: waste heat recovery, boiler and pipe insulation, and improved maintenance [8][3].
Space or Water Heating	• Replace fossil-fuel space and water heating with low-carbon alternatives, such as air or ground source electric heat pumps or connection to a low carbon district heating system. • Reduce demand for space heating by making upgrades to the building (windows, air sealing, improved insulation, smart thermostats, etc.).
Ventilation	• Optimize recirculation air change rates in cleanrooms. Cleanrooms may be classified at a higher air change rate than necessary due to conservative design [8], [11]. • Implement energy savings actions for fume hoods including improved maintenance, restriction of sash openings, or installing variable air volume (VAV) hoods [8].
Air Conditioning and Chillers	• Transition natural-gas powered absorption chillers to electric systems. • Upgrade your AC to a more efficient cooling system, like a heat pump (this should be coordinated with replacement of your space heating).
Refrigerants used in air conditioners, heat pumps, chillers	• Ensure proper disposal of old equipment to prevent refrigerant leakage. • Prioritize replacement HVAC equipment using low-GWP refrigerants (such as R-32, R-454B, CO_2, ammonia) to minimize emissions from leaks.

[3] An energy audit should be conducted to identify the improvements that will result in the greatest cost and energy savings.

Plug loads and processes (non-HVAC)

Table 5 presents the top mitigation actions for GHG emissions from plug loads and non-HVAC heating processes.

These possible mitigation actions are presented roughly in order of what will be the most impactful and practical, to the least. Several examples of energy efficiency improvements are presented below, however the best choices to prioritize for your specific facilities will depend on several different factors, therefore it is recommended to conduct an energy audit of your facilities prior to making a decision.

Table 5 - Practical actions to reduce GHG emissions for plug loads and processes

Source of Emissions	Possible mitigation actions
Steam and heat processes	• Electrify steam and heat processes (e.g. sterilization, drying) by switching to electric steam boilers or heat pumps. • Reduce energy demand by implementing energy efficiency improvements, for example: waste heat recovery,

Electric plug loads	• Reduce energy use by switching to energy efficient equipment or improving operation of existing equipment. Examples include:
	  ○ Upgrade any remaining halogen or fluorescent lighting to LEDs, and install smart-sensors to minimize energy use
	  ○ Improve efficiency of motor systems, compressors and pumps through improved maintenance, monitoring and implementation of energy management systems

Raw materials

Table 6 presents the top mitigation actions for GHG emissions from the manufacturing of raw materials, including active pharmaceutical ingredients (APIs), excipients (non-active ingredients), bulk chemicals and biological products [9]. These are often indirect emissions, as most Canadian companies do not manufacture raw materials on-site.

Table 6 - Practical actions to reduce GHG emissions for raw materials

Source of Emissions	Possible mitigation actions
Manufacturing of Raw Materials	• When manufacturing raw materials on-site, implement emissions reductions measures, including:

Source of Emissions	Possible mitigation actions
	○ Implementation of green chemistry principles[4]. This could include solvent waste recovery, continuous manufacturing and process redesign [10] ○ Implementation of process efficiency improvements in manufacturing such as waste heat recovery, energy efficiency upgrades [10] ○ Considering the emissions reductions targets of suppliers of feedstock and solvents when making procurement decisions (suppliers often include oil and gas or petrochemical companies) [10] ○ Decarbonizing remaining Emissions from Purchased Electricity • When making decisions about suppliers, consider the carbon footprint of their manufacturing process and, if possible, procure raw materials from a supplier with emissions reductions targets

Downstream use of Metered Dose Inhalers (MDIs)

Table 7 presents the top mitigation actions for GHG emissions from product and material transportation. These possible mitigation actions are presented roughly in order of what will be the most impactful and practical, to the least.

Table 7 - Practical actions to reduce GHG emissions from downstream use of MDIs

Source of Emissions	Possible mitigation actions
Downstream use of Metered Dose Inhalers (MDIs)	• Provide MDI alternatives, when possible, such as: • Dry powder inhalers (DPIs), which do not use propellants ○ Soft mist inhalers (SMIs) [12] • When MDIs are necessary, provide smaller volume relievers that emit less propellant at each use [12]. • Collaborate with downstream suppliers of MDIs (i.e. physicians and pharmacists) to improve patient education on proper use and disposal of MDIs, including:

[4] Note that making changes to the chemical processes involved in product manufacturing may require regulatory approvals

Source of Emissions	Possible mitigation actions
	○ Patient education on MDI alternatives and proper inhaler use, to minimize unnecessary emissions of propellant [12] ○ Patient education on proper disposal of MDIs (recycling and incineration) to reduce residual release of HFCs after disposal [12]

Product/Material Transportation

Table 88 presents the top mitigation actions for GHG emissions from product and material transportation. These possible mitigation actions are presented roughly in order of what will be the most impactful and practical, to the least.

Table 8 - Practical actions to reduce GHG emissions for product and material transportation

Source of Emissions	Possible mitigation actions
Refrigerated ground vehicles	• Refrigerated HGVs: ○ Switch short-haul and last mile HGVs to electric heavy ground vehicles (eHGVs) as they become available in the medium/long-term ○ If eHGVs are not feasible in the short-term, switch out diesel in existing vehicles to renewable diesel or a biodiesel blend • Small refrigerated or temperature-controlled vehicles: ○ Switch to electric or plug-in-hybrid vehicles ○ If refrigeration is required, choose a vehicle with electric transport refrigeration units (eTRUs) • Optimize routes and shipment loads to reduce unnecessary fuel consumption, minimize empty trips, and consolidate deliveries • Switch to refrigerants with a lower Global Warming Potential (GWP) such as R-452A, CO_2 or ammonia • Ensure regular maintenance of and efficient operations of vehicles to reduce fuel consumption • Decarbonize remaining Emissions from Purchased Electricity

Source of Emissions	Possible mitigation actions
Transport of cold chain containers though air, rail or marine freight	• Prioritize transport of cold chain containers by rail first, then marine, then cargo aircraft. • If possible, when working with third party transportation and logistics companies, select a company that has plans for emissions reductions • Optimize routes to reduce unnecessary fuel consumption, minimize empty trips, and consolidate deliveries • Improve energy performance of cold chain containers through improved insultation, sealing • Switch to refrigerants with a lower Global Warming Potential (GWP) such as R-452A, CO_2 or ammonia • Decarbonize remaining Emissions from Purchased Electricity**Error! Reference source not found.**

Employee Travel and Commuting

Table 9 presents the top mitigation actions for GHG emissions from employee travel and commuting. These possible mitigation actions are presented roughly in order of what will be the most impactful and practical, to the least.

Table 9 - Practical actions to reduce GHG emissions for employee travel and commuting

Source of Emissions	Possible mitigation actions
Daily commuting by employees in gasoline or diesel vehicles	• Promote commuting via public transit where available, including subsidizing transit passes or offering incentives. • Encourage active transport methods such as biking and walking, supported by on-site facilities. • Facilitate and incentivize the adoption of zero emission vehicles (ZEVs), including installation of charging stations and/or providing financial assistance for ZEV purchases. • Enable remote or hybrid work arrangements where feasible, significantly reducing commuting emissions.
Business travel by car or plane for supplier meetings, sales, trade shows, etc.	• Eliminate unnecessary travel by optimizing virtual meeting use and consolidating trips when travel is essential. • Prioritize rail or other low-emission transport modes over air travel for short to medium-distance trips.

Source of Emissions	Possible mitigation actions
	• Prioritize direct flights when air travel is unavoidable. • Establish clear corporate travel policies specifying electric vehicles for car rentals unless a conventional vehicle is explicitly necessary. • Consider switching company provided vehicle fleet (e.g. used for sales fleet) to ZEVs

Packaging

Table 10 presents the top mitigation actions for GHG emissions from product packaging. These possible mitigation actions are presented roughly in order of what will be the most impactful and practical, to the least.

Table 10 - Practical actions to reduce GHG emissions for packaging

Source of Emissions	Possible mitigation actions
Product Packaging	• Reduce unnecessary packaging • Transition to packaging that can be re-used or recycled • Plastic packaging is typically the most emissions intensive, followed by glass, aluminum, and paper. Where possible, switch out plastic packaging for one of these alternatives. If no alternative is available replace petroleum plastics with biodegradable or compostable plastics

Emissions from Purchased Electricity

Many of the actions presented above require electrification of activities that are currently powered by fossil fuels. In most cases, this is the most effective action a company can take to transition to net-zero. However, even if your facilities are fully electrified, there may be remaining emissions if your facilities are located in a province with a high emitting grid (e.g. Alberta, Saskatchewan or Nova Scotia [12]). Emissions from remaining electricity consumption can be addressed by either:

- Supplying your own renewable electricity, for example through roof-top solar panels
- Using Power Purchase Agreements (PPAs)
- Purchasing Renewable Energy Certificates (RECs)

- Waiting until the provincial grid is decarbonized[5]

Carbon Offset Credits

Purchasing carbon offset credits is a mitigation action that can be taken when no other option is feasible.

Carbon offset credits represent GHG emissions reductions or removals generated from activities that are additional to what would have occurred in the absence of the offset project (i.e., generated from activities that go beyond legal requirements and a business-as-usual scenario). Each offset credit generated by an offset project represents one tonne of CO_2e reduced or removed from the atmosphere.

Today, most offsets are emissions reductions. But as the economy approaches net-zero, emission reduction offset opportunities will decline, as emissions fall across all sectors of the economy. Companies that do rely on offsets should therefore over time increase the proportion of offsets that come from carbon removals.

3.2.3 Step 3 – Evaluate and Prioritize GHG Mitigation Actions

Now that several possible mitigation actions have been identified, companies will need to evaluate and prioritize them. Each company will have a different evaluation framework depending on various factors including their level of ambition, financial position, resourcing and management support.

Table 11 shows common factors that companies should consider when evaluating and prioritizing emissions mitigation actions.

Table 11 – Factors you should consider when selecting which mitigation actions to prioritize

	Possible Pros	Possible Cons
Emissions Impact	• The mitigation action will have a significant impact on reducing the firm's emissions	• The mitigation action will have a small impact on the firm's emissions
Technology Maturity	• The mitigation action has been successfully used in real life conditions	• The mitigation action has not yet been commercially deployed

[5] All provincial governments have committed to a non-GHG emitting grid by 2050. For detailed carbon accounting, estimates provided by provincial electricity regulators can be used to forecast these levels.

	Possible Pros	Possible Cons
	• The mitigation action is a non-technical solution (e.g. walking to work)	
Capital Cost	• The capital cost is similar to or lower than the high-emitting option • There are funding, grants or incentives available to help reduce the capital cost	• The capital cost is much higher than the existing option • There are limited funding options available
Operation and Maintenance (O&M) Costs	• The O&M costs are lower than the existing option (e.g. high efficiency equipment will have lower energy costs) • Government policy can lower the ongoing O&M cost (e.g. a price on carbon can make electrification more cost effective)	• The O&M costs are higher than the existing option (e.g. switching to electricity may be more expensive than natural gas)
Regulatory Barriers	• There are no regulations that could impede the implementation of the mitigation action	• There are regulations in place that make this mitigation action difficult (e.g. changing a chemical process or ingredient in pharmaceutical manufacturing would require significant regulatory approval process)
Availability	• The mitigation action is readily available • Enabling infrastructure is available (e.g. charging stations for EVs)	• There are supply chain constraints, making the solution less readily available • The enabling infrastructure is not yet in place
Timing	• The timing of implementing the mitigation action is logical (e.g. equipment is reaching the end of its lifetime and will need to be replaced anyways)	• The timing of implementing the mitigation action is not ideal (e.g. equipment was recently replaced, and it would not make sense to replace it again in the short term)
Lifestyle Considerations	• Mitigation action increases quality of life, is more convenient (e.g. no more	• Mitigation action decreases quality of life, is more inconvenient (e.g. a longer commute)

	Possible Pros	Possible Cons
	pumping gas when you own an EV)	

Completing this analysis of the mitigation actions, along with understanding your company's available resources, can help identify the top mitigation actions that your company would like to pursue. You will complete this exercise based on the situation today but note that all of these factors are constantly changing, and this exercise will need to be repeated regularly as the landscape changes.

3.2.4 Step 4 - Establish Targets and Develop an Implementation Timeline

Now that you have identified your main emissions sources and potential actions to decarbonize your activities it is time to bring it all together, to assess what is possible within specific time horizons, and to formulate or adjust targets.

Task 1: Consider Interim Targets to Reach Net-Zero by 2050

Targets provide crucial grounding for decarbonization efforts. They communicate a company's ambition, allow the organization to coordinate its response, and provide a benchmark against which progress can be measured. Many voluntary initiatives, including the Government of Canada's Net-Zero Challenge, requires member companies to set interim targets as part of a plan to reach net-zero emissions by 2050 or earlier. This aligns with Canada's legislative commitments to net-zero and the recommendation of the Science Based Targets initiative.

Interim targets are important to focus attention on what can be done in the short term and to ensure progress. Some companies have adopted shorter term targets based on an aspiration to be a leader in their sector and/or to harmonize with Canada's national goal of a 40% emissions reduction by 2030. Nevertheless, interim targets are more likely to be achieved when they are grounded in a solid analysis of the costs, timing, and effectiveness of proposed mitigation measures.

Task 2: Draft an Implementation Timeline

The mitigation actions should be placed on a timeline to establish and/or confirm interim targets and to form the basis for a phased decarbonization plan.

In Step 3 – Evaluate and Prioritize GHG Mitigation Actions, you evaluated several possible emissions mitigation actions, and this evaluation can help you determine a realistic implementation timeline.

Factors that influence the implementation timeline will include:

- Availability of equipment and enabling infrastructure (e.g. low carbon grid, EV charging infrastructure)
- Technology life cycle (e.g. end of life of HVAC equipment, average vehicle lifetime).
- Upfront cost and financing options

Task 3: Sum Your Emissions Reductions Over Time

Each of the actions you have decided to take can be included in your plan together with the anticipated reductions over time. Summing up the proposed reductions at key interim dates (2030, 2035, etc.) can then allow you to validate (or establish) appropriate interim targets.

It is important to remember at this point, that you can only fully decarbonize your company if other firms up and down multiple intersecting value chains are also decarbonizing their activities, and if broader decarbonization efforts beyond your control are also occurring (e.g. the decarbonization of the electricity grid). Therefore, the pathway to net-zero emissions may seem rather opaque.

But over time, as manufacturing, transport, and energy production are increasingly decarbonized the carbon intensity of these goods needed by your business will fall and net-zero will become achievable.

3.2.5 Step 5 - Monitor Implementation and Periodically Revise Your Plan

Full decarbonization of the economy will take time. It is hard to anticipate developments five years from now, let alone in thirty years. Net-zero planning will necessarily be an iterative process, with plans adjusted periodically to reflect changing circumstances.

Net-zero plans will need to be periodically revised and updated as your company and the whole economy moves towards net-zero emissions. Technological, economic, social and geo-political circumstances will evolve, shifting the environment within which your company operates, and presenting new challenges and opportunities.

You should establish a regular process for monitoring the implementation of your plan, such as:

- **At least once a year:** Formally review progress, assessing whether the assumptions on which the plan was based have shifted, whether the proposed actions have been taken, and the extent to which they are attaining the desired objectives.
- **Every five years:** A new plan can be developed that draws on the lessons learned and charts the rest of the journey towards net-zero.

Section 4 Conclusion

Reaching net-zero emissions is a long-term journey, but every business has a role to play—and every step matters. Whether your company is just starting to think about climate action or already exploring emission reductions measures, the most important thing is to begin with what you can control and put a plan in place.

This primer has laid out how to:

- Reflect on how your firm fits into a net-zero economy,
- Understand where your emissions come from,
- Identify practical actions across your operations and value chain,
- Set short- and long-term goals,
- And adapt your plan as the world changes.

Remember: this isn't about perfection. Your first plan doesn't need to solve everything all at once. Focus on taking meaningful action in the next 1–3 years. Talk to your employees, clients, and suppliers. Learn as you go. Use this plan to guide decision-making, communicate your direction, and build momentum.

As markets, technologies, and regulations evolve, so will your opportunities to reduce emissions. Revisit your plan regularly and update it as new solutions become available. As you reduce your own footprint, look for ways to amplify your impact.

Net-zero is a collective effort. Pharmaceutical manufacturing firms like yours are critical to shaping the path forward—for your clients, your sector, and your community. Start where you are, aim high, and keep going.

If you are ready to take the next step, learn more about how to join the Government of Canada's Net-Zero Challenge.

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Annex 1 Technology Descriptions

Table 12 – Descriptions of technologies commonly used to decarbonize the pharmaceutical manufacturing industry

Technology	Description	Applications	Considerations	Additional Resources
Electric Heat Pump	An electric heat pump is a device that extracts heat from a low temperature place and delivers it to a higher temperature place. The two most common types of heat pumps are: • **Air-source heat pumps** – The heat source or sink is the outside air. • **Ground-source heat pumps:** The heat source or sink comes from the ground.	Heat pumps can be used for space heating, water heating and space cooling, replacing traditional HVAC technology (i.e. furnaces, boilers, ACs).	Heat pumps are very efficient, often over three times more efficient than furnaces or boilers. Heat pumps have a higher upfront cost than traditional HVAC equipment.	Heating and Cooling with a Heat Pump - Natural Resources Canada
District Heating	District heating involves distributing heat generated from a central plant to residences, businesses or industries in a local area. The central heat source can be generated from either from clean energy or fossil fuels.	District heating is used to heat multiple buildings in close proximity. Common applications include college and university campuses hospitals and densely populated residential or commercial settings.	District heating has the potential to be a low-cost and efficient way to implement clean energy. Requires coordination and a large upfront investment.	Combined Heat and Power Technology Fact Sheet Series: District Energy District Heating - Energy System - IEA
Building Envelope Improvements	**Upgrading windows and doors** to higher efficiency options can reduce heat loss from the building. **Controlling air leakage** can greatly reduce heart loss from a building. A systematic	Residential and commercial buildings.	It helps reduce heating and air conditioning bills while maintaining a comfortable temperature inside the building.	Keeping the heat in - Natural Resources Canada

Technology	Description	Applications	Considerations	Additional Resources
	identification of air leaks should be followed by sealing leaks through weatherstripping and caulking and by applying gaskets and tapes. **Adding insultation** to a building's walls, roof, attic, basement reduces the amount of energy required for heating and cooling. There are many different types of insulation materials, with different applications, efficiency and costs.			
Smart Thermostats	A smart thermostat reduces the amount of energy required to heat or cool a building by learning the temperatures the occupants prefer and establishing a schedule that automatically adjusts to energy-saving temperatures while occupants are away or sleeping to help reduce energy usage.	Residential and commercial buildings.	Saves money on heating and cooling bills, while keeping building at a comfortable temperature.	Smart Thermostats - Natural Resources Canada
Zero Emission Vehicle (ZEV)	A ZEV is a vehicle that has the potential to produce no tailpipe emissions. They can have a conventional internal combustion engine (ICE) but must also be able to operate without using it. There are three types of ZEVs: • **Battery-electric vehicle (BEV)** – Run on electric motors, with rechargeable batteries. No tailpipe emissions.	ZEVs can be used to replace traditional ICE vehicles.	The upfront costs of ZEVs are typically higher than and ICE vehicles, while fuels costs are lower. When choosing what type of ZEV to select, one should consider available charging infrastructure, and the range of the vehicle required.	Types of zero-emission vehicles - Natural Resources Canada

Technology	Description	Applications	Considerations	Additional Resources
	• **Plug-in hybrid electric vehicle (PHEV)** – Have rechargeable batteries and a gas engine and can run in either mode. No tailpipe emissions when run in electric mode. • **Fuel cell vehicle (FCVs)** – Use hydrogen to power an electric motor. No tailpipe emissions.			