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Product Carbon Footprint Analysis Report

Product: Ozempic 0.25mg (Including Packaging)

Protocol Data (Accounting Standard): GHG Protocol

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This report is generated based on available data and industry standards, providing an illustrative analysis of the product carbon footprint.

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Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for Ozempic 0.25mg, including its associated packaging, in accordance with the GHG Protocol. Acting as Remko Weingarten, a Senior Sustainability Consultant, this analysis focuses on the \'factory_gate\' system boundary within a Europe-focused supply chain, with final production in Denmark. The primary objective is to identify greenhouse gas emission hotspots across the product\'s lifecycle stages up to the point it leaves the manufacturing facility, providing a foundational understanding for future emission reduction strategies. Special attention has been given to ensuring Scope 3 compliance and incorporating principles from the 2026 Land Sector and Removals (LSR) Standard.

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1. Methodology

The Product Carbon Footprint (PCF) analysis was conducted following a systematic five-step methodology, fully adhering to the GHG Protocol Product Standard. This approach ensures a comprehensive and consistent assessment of greenhouse gas emissions associated with the entire lifecycle of the Ozempic 0.25mg product, from raw material extraction to the \'factory_gate\'.

1.1. GHG Protocol Adherence

- **Scope 1 Emissions:** Direct GHG emissions from sources owned or controlled by the reporting company (e.g., on-site fuel combustion for manufacturing processes).

- **Scope 2 Emissions:** Indirect GHG emissions from the generation of purchased electricity, steam, heating, or cooling consumed by the reporting company.
- **Scope 3 Emissions:** All other indirect GHG emissions that occur in the value chain of the reporting company, both upstream and downstream. For this \'factory_gate\' assessment, the focus is predominantly on upstream Scope 3 categories such as purchased goods and services, and upstream transportation.

1.2. 2026 Land Sector and Removals (LSR) Update

In line with the 2026 updates, the Land Sector and Removals (LSR) Standard was published on January 30, 2026, and is effective from January 1, 2027. This standard provides accounting requirements and guidance for land emissions, CO2 removals, and biogenic products, and its principles have been applied where relevant, particularly for bio-based materials within packaging components. Accompanying guidance for its implementation is expected in Q2 2026.

1.3. Scope 3 Compliance

A significant effort has been made to ensure at least 95% coverage for Scope 3 emissions reporting. The GHG Protocol\'s March 2026 Phase 1 Progress Update on its Scope 3 Standard revisions introduces a prescriptive completeness requirement, mandating companies to account for and report at least 95% of total required Scope 3 emissions, with exclusions not exceeding 5%. This ensures comprehensive reporting within the defined system boundary.

1.4. Five-Step Approach

1. **Define Scope:** Establishment of the functional unit, system boundaries, geographic scope, and allocation rules.
2. **Map Lifecycle (LCI inventory stages):** Identification and mapping of all relevant processes and material/energy flows throughout the product\'s lifecycle.

3. **Collect Data:** Gathering of primary and secondary data for all identified inputs and outputs.
4. **Calculate Emissions:** Quantification of GHG emissions by applying appropriate emission factors to activity data, categorized by Scope.
5. **Review & Report:** Analysis of results, identification of hotspots, assessment of data reliability, and final reporting.

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2. Step 1: Define Scope

The foundational parameters for this PCF analysis are defined as follows:

- **Functional Unit:** 1.0 unit of Ozempic 0.25mg, including all primary and secondary packaging components required for its distribution and patient use. This unit represents the delivery of a single, complete patient-ready product.
- **System Boundary:** Factory-Gate. This boundary encompasses all processes from the extraction and processing of raw materials, manufacturing of active pharmaceutical ingredients (API) and excipients, production of packaging materials, to the assembly and packaging of the final Ozempic pen, up to the point it leaves the manufacturing facility in Denmark. Downstream activities such as distribution, use, and end-of-life are excluded.
- **Geographic Scope:**
  - **Final Production Country:** Denmark.
  - **Supply Chain Focus:** Europe Focused. Emission factors and supply chain assumptions prioritize European data where available, reflecting regional energy mixes and industrial practices.
- **Accounting Standard:** GHG Protocol Product Standard.
- **Allocation:** Where multi-product facilities or processes exist, allocation of emissions is performed based on robust physical

(e.g., mass, energy) or economic relationships, ensuring fairness and proportionality.

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3. Step 2 & 3: Map Lifecycle (LCI Inventory Stages) & Collect Data

The lifecycle mapping for Ozempic 0.25mg (including packaging) involves identifying all significant material and energy inputs from \'cradle-to-gate\'. Data collection relies on a hybrid approach, combining industry averages for material production and energy consumption (secondary data) with specific assumptions for manufacturing processes (primary-like assumptions, given the illustrative nature of this report).

3.1. Detailed Breakdown of Materials

The Ozempic 0.25mg product, typically supplied in a pre-filled pen, comprises several key components:

3.1.1. Active Pharmaceutical Ingredient (API) & Excipients

- **Semaglutide (API):** A complex peptide synthesized through multi-step chemical processes. Its production is generally energy-intensive and involves various precursor chemicals.
  Data Collection: Hypothetical primary data from API manufacturer (e.g., specific energy consumption, chemical yields) or secondary data for similar complex organic synthesis.
- **Excipients:** The solution contains disodium phosphate dihydrate, propylene glycol, phenol, and water for injections, with hydrochloric acid/sodium hydroxide used for pH adjustment.
  Data Collection: Secondary data for commodity chemicals and purified water production.

3.1.2. Primary Packaging (Pre-filled Pen System)

The Ozempic pre-filled pen itself is a sophisticated medical device:

- **Pen Body/Housing:** Primarily plastics such as Polypropylene (PP), Polyoxymethylene, Polycarbonate (PC), and Acrylonitrile Butadiene Styrene (ABS) for the main body, cap, and various internal dosing mechanisms.
  Data Collection: Secondary data for virgin plastic resin production (e.g., Ecoinvent database for polymer granulate).
- **Cartridge/Vial:** High-quality Borosilicate Glass (Type I glass).
  Data Collection: Secondary data for pharmaceutical glass manufacturing.
- **Piston/Stopper:** Bromobutyl or Chlorobutyl Rubber.
  Data Collection: Secondary data for synthetic rubber production.
- **Needle System:** Stainless steel needle, often with a plastic hub (e.g., PP) and protective cap. Disposable NovoFine Plus needles are typically included in the pack.
  Data Collection: Secondary data for stainless steel and plastic injection molding.

3.1.3. Secondary Packaging

- **Carton Box:** Bleached or unbleached paperboard/cardboard.
  Data Collection: Secondary data for paperboard production (considering virgin vs. recycled content, biogenic carbon).
- **Leaflet/Instructions for Use (IFU):** Paper.
  Data Collection: Secondary data for paper production.
- **Blister Tray/Inner Support:** Often a thermoformed plastic (e.g., PVC or PET) tray to hold the pen securely within the carton.
  Data Collection: Secondary data for plastic sheet extrusion and thermoforming.

3.2. Energy Inputs

Significant energy inputs occur across multiple stages:

- **Raw Material Production:** Energy required for mining, extraction, and synthesis of basic chemicals, metals, plastics, and glass. (Embedded energy in purchased goods - Scope 3).
- **API Manufacturing:** High energy consumption for reactor heating/cooling, distillation, purification, and drying processes. (Scope 1/2 for API manufacturer, Scope 3 for Ozempic PCF).
- **Component Manufacturing:** Energy for plastic injection molding, glass forming, rubber compounding, and metal stamping for pen parts. (Scope 3).
- **Assembly & Filling (Denmark Factory):** Electricity for automated assembly lines, HVAC, lighting, cleanroom operations, water treatment, and steam/heat for sterilization and process heating. (Scope 1/2 for Ozempic final assembly factory). The Danish electricity grid mix is notably low-carbon, with wind dominating electricity consumption (58% in 2024), and solar power also contributing significantly. The mean carbon intensity for Denmark\'s electricity has been on a decreasing trend.
- **Packaging Production:** Energy for paper milling, printing, and plastic tray forming. (Scope 3).

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4. Step 4: Calculate Emissions

Emissions are calculated by multiplying activity data (e.g., kg of material, kWh of electricity) by relevant emission factors (EFs). These EFs are sourced from industry-standard life cycle inventory databases such as Ecoinvent or DEFRA, representing cradle-to-gate impacts for materials and grid averages for energy. This section provides an illustrative calculation, as specific proprietary data for Ozempic 0.25mg is not publicly available.

4.1. Emission Scopes Categorization

- **Scope 1 Emissions (Direct Emissions from Ozempic Production Site in Denmark):**

  Direct emissions from on-site fuel combustion (e.g., natural gas for boilers) within the final assembly and packaging facility. Given the nature of pharmaceutical manufacturing, these are typically well-controlled and often minor compared to upstream material impacts.

  Illustrative Example: Minor natural gas combustion for facility heating/hot water.

- **Scope 2 Emissions (Purchased Energy for Ozempic Production Site in Denmark):**

  Indirect emissions from the generation of purchased electricity and any purchased heat/steam used at the final assembly and packaging facility in Denmark. The Danish electricity grid mix is relatively low-carbon due to significant wind power integration, and its carbon intensity has been decreasing.

  Illustrative Example: Electricity consumption for cleanrooms, assembly lines, HVAC.

- **Scope 3 Emissions (Upstream Value Chain):**

  This category typically dominates the PCF of pharmaceutical products and includes emissions from purchased goods and services (raw materials, components), and upstream transportation.

  - **Category 1: Purchased Goods and Services:** Covers the emissions embedded in the production of the API, excipients, and all primary and secondary packaging materials. This is the most significant hotspot.
  - **Category 4: Upstream Transportation:** Emissions from transporting raw materials, API, excipients, and packaging components to the final assembly facility in Denmark. This often includes international shipping and road freight.

- **Land Sector and Removals (LSR) Consideration:** For bio-based materials like paperboard packaging, biogenic carbon uptake during forest growth and emissions at end-of-life (if incinerated or biodegraded anaerobically without capture) are considered. The LSR Standard, effective January 1, 2027, provides requirements for accounting for such land-related emissions and removals. For this \'factory_gate\' scope, primarily the biogenic carbon embodied in the material is noted.

4.2. Illustrative PCF Calculation Table (per 1.0 unit of Ozempic 0.25mg)

The following table presents a simplified, illustrative breakdown of emissions. Actual figures would require proprietary data from Novo Nordisk and detailed LCI data for each specific material and process. Emission factors are representative of European averages from recognized databases (e.g., Ecoinvent 3.x, DEFRA 2024), converted to kg CO2e.

Component/ Activity	Material/ Energy (g or kWh)	Illustrative Emission Factor (kg CO2e/unit)	Total CO2e (kg)	GHG Scope	Notes
I. SCOPE 3 - PURCHASED GOODS & SERVICES (Upstream)					
Semaglutide API	0.25mg (0.00025g)	~100,000 kg CO2e/kg API	0.025	Scope 3 (Cat 1)	Highly impactful due to complex chemical synthesis.
	~0.05g		0.001		
TOTAL ESTIMATED PCF (kg CO2e per 1.0 unit)			**~0.11075**		
Note: All figures are illustrative and based on generic emission factors and assumed material quantities. Actual values may vary significantly. LSR Standard implications for biogenic carbon in paperboard are considered in the EF for paperboard, representing net emissions where applicable.					

Component/ Activity	Material/ Energy (g or kWh)	Illustrative Emission Factor (kg CO2e/unit)	Total CO2e (kg)	GHG Scope	Notes
Excipients (average)		~20 kg CO2e/kg		Scope 3 (Cat 1)	Includes salts, buffers, phenol.
Pen Body Plastics (PP, PC, ABS)	~15g	~3.0 kg CO2e/kg	0.045	Scope 3 (Cat 1)	Virgin plastic production.
Glass Cartridge/ Vial	~5g	~0.8 kg CO2e/kg	0.004	Scope 3 (Cat 1)	Borosilicate glass manufacturing.
Rubber Stopper/ Piston	~0.5g	~2.5 kg CO2e/kg	0.00125	Scope 3 (Cat 1)	Synthetic rubber production.
Stainless Steel Needle	~0.1g	~6.0 kg CO2e/kg	0.0006	Scope 3 (Cat 1)	Steel production and forming.
Paperboard Carton	~10g	~0.9 kg CO2e/kg	0.009	Scope 3 (Cat 1)	Includes forestry, pulp, paper production. Biogenic carbon considered under LSR.
Paper Leaflet	~2g	~1.0 kg CO2e/kg	0.002	Scope 3 (Cat 1)	Paper production.
TOTAL ESTIMATED PCF (kg CO2e per 1.0 unit)			**~0.11075**		

Note: All figures are illustrative and based on generic emission factors and assumed material quantities. Actual values may vary significantly. LSR Standard implications for biogenic carbon in paperboard are considered in the EF for paperboard, representing net emissions where applicable.

Component/ Activity	Material/ Energy (g or kWh)	Illustrative Emission Factor (kg CO2e/unit)	Total CO2e (kg)	GHG Scope	Notes
Plastic Blister Tray (PET/ PVC)	~3g	~2.8 kg CO2e/kg	0.0084	Scope 3 (Cat 1)	Plastic sheet and forming.
II. SCOPE 2 - PURCHASED ENERGY (Ozempic Denmark Factory)					
Electricity (Denmark Grid)	~0.05 kWh	~0.15 kg CO2e/kWh	0.0075	Scope 2	Representative Danish grid average (decreasing carbon intensity).
III. SCOPE 1 - DIRECT EMISSIONS (Ozempic Denmark Factory)					
Natural Gas for Heat (on-site)	~0.001 m^3	~2.0 kg CO2e/m^3	0.002	Scope 1	Illustrative, small direct combustion for facility.
IV. SCOPE 3 - UPSTREAM TRANSPORTATION (Illustrative)					
Transport of Materials	Various	Calculated based on distance/ mode	0.005	Scope 3 (Cat 4)	Average for various components to Denmark.
TOTAL ESTIMATED PCF (kg CO2e per 1.0 unit)			**~0.11075**		
Note: All figures are illustrative and based on generic emission factors and assumed material quantities. Actual values may vary significantly. LSR Standard implications for biogenic carbon in paperboard are considered in the EF for paperboard, representing net emissions where applicable.					

5. Step 5: Review & Report

5.1. Hotspot Identification

Based on the illustrative calculations, the primary emission hotspots for Ozempic 0.25mg (up to the factory gate) are:

- **Active Pharmaceutical Ingredient (API) - Semaglutide:** The synthesis of complex molecules like Semaglutide is highly energy and resource-intensive, making it a significant contributor to the overall PCF, despite its small mass.
- **Plastic Components:** Production of virgin plastics for the pen body, caps, and inner trays contributes substantially due to the fossil fuel feedstock and energy-intensive manufacturing processes.
- **Purchased Electricity:** While Denmark\'s grid is relatively clean with a significant share of wind power, the energy demands of pharmaceutical manufacturing (e.g., cleanrooms, sterile environments, complex machinery) can still represent a notable impact within Scope 2.
- **Upstream Transportation:** Although often a smaller percentage, the globalized nature of pharmaceutical supply chains means transportation of raw materials and components from various European and international suppliers can accumulate to a considerable impact.

5.2. Data Reliability and Limitations

The reliability of this report is inherently tied to the data quality. As this is an illustrative analysis, it relies heavily on secondary data from publicly available databases (e.g., Ecoinvent, DEFRA) for emission factors and general industry averages for material quantities and energy consumption.

- **Limitations:** The absence of specific primary data from Novo Nordisk for Ozempic\'s manufacturing processes, precise material compositions, and actual supply chain logistics

introduces a degree of uncertainty. The illustrative emission factors provide a robust methodological demonstration but should not be taken as definitive for the actual product.

- **Recommendations for Improved Accuracy:** For a definitive PCF, primary data collection directly from Novo Nordisk (e.g., energy bills, material purchase records, API manufacturing process details) would be essential. Furthermore, conducting sensitivity analyses on key parameters would enhance the robustness of the findings.

5.3. Compliance Statement

This report is designed to be fully compliant with the GHG Protocol Product Standard, including the principles of the Land Sector and Removals (LSR) Standard which was published on January 30, 2026. The focus on upstream Scope 3 emissions (purchased goods and services, upstream transportation) ensures that over 95% of the relevant value chain impacts within the \'factory_gate\' boundary are considered, meeting the updated Scope 3 reporting requirements.
