

Supplementary materials

S1. Significance analysis

All the source of emissions was evaluated by the following criteria:

Magnitude: it measures the quantitative importance of the elements flows (mass or energy) associated with different impact categories. The magnitude determination is assessed by a scale of 6 values: very low (0 pt.), low (1 pt.), medium-low (2 pt.), medium (3 pt.), medium-high (4 pt.) and high (5 pt.).

Influence: it is referred to the possibility to monitor and define reduction plans of the emissions flows. When the organization has influence on the emission source it is assigned 1 pt, otherwise 0 pt.

Importance: it consider the interest of the organization to analyse the emissions of a specific activity. This parameter is ranged between 0 and 2 pt.

Availability: it is referred to the availability of data related to a specific activity. This parameter is evaluated by a scale of 3 values: available data (2 pt), easy-to-find data (1 pt), hard-to-find data (0 pt).

When the sum of all parameters was ≥ 3 , that emission was considered significant for the analysis.

Activity flow	Magnitude	Influence	Importance	Availability	Total	Significant
<u>Upstream - Farm stage</u>						
Electricity consumption, milking parlour	4	0	1	1	6	Yes
Electricity consumption, well	2	0	1	1	4	Yes
Electricity consumption, cooling system	1	0	1	0	2	No
Electricity consumption, lightening	0	0	0	1	1	No
Electricity consumption, slurry separator and anaerobic digester	1	0	0	1	2	No
Electricity consumption, tank for milk storage	2	0	1	1	4	Yes
Lackage of refrigerant gas, tank for milk storage	1	0	1	1	3	Yes
Water consumption, milking parlour	1	0	1	0	2	No
Water consumption, well	1	0	1	0	2	No
Drinking water, animals	1	0	1	0	2	No
Water consumption, cooling system	1	1	0	0	2	No
Fuel consumption, agricultural machinery	2	0	1	2	5	Yes
Transport, extra-farm feed	2	0	1	1	4	Yes
Transport, animals	1	0	0	1	2	No
Transport, animals' medicines and vaccines	1	0	0	1	2	No
Transport, herbicides and mineral fertilizers	1	0	1	0	2	No
Transport, cleaners	1	0	0	1	2	No
Transport, fuel	0	0	0	2	2	No
Production, extra-farm feed	2	0	1	1	4	Yes
Production, animals' medicines and vaccines	1	0	1	0	2	No
Production, herbicides and mineral fertilizers	0	0	1	1	2	No
Production, cleaners	1	0	1	0	2	No
Enteric fermentation	4	1	2	1	8	Yes
Manure management	2	1	1	1	5	Yes

<i>Carbon sink</i>	2	1	1	1	5	Yes
<i>Soil emissions</i>	2	1	1	1	5	Yes
<i>Buildings</i>	2	0	0	0	2	No
<i>Waste disposal</i>	1	0	1	0	2	No
<u>Core - Dairy plant</u>						
<i>Energy consumption, machinery and refrigerated cells</i>	3	0	1	1	5	Yes
<i>Energy consumption, hot water</i>	2	0	0	0	2	No
<i>Energy consumption, lightening</i>	1	0	0	1	2	No
<i>Energy consumption, air-conditioner</i>	1	0	0	1	2	No
<i>Lackage of refrigerant gas, refrigerated cells</i>	2	0	0	1	3	Yes
<i>Transport, raw milk from farm to dairy plant</i>	3	0	1	2	6	Yes
<i>Transport, dairy products from dairy plant to market</i>	2	0	1	1	4	Yes
<i>Transport, packaging</i>	3	0	1	1	5	Yes
<i>Transport, cleaners</i>	1	0	0	1	2	No
<i>Transport, ingredients (salt, citric acid)</i>	0	0	0	1	1	No
<i>Transport, fuel</i>	1	0	1	0	2	No
<i>Production, packaging</i>	4	0	1	1	6	Yes
<i>Production, ingredients (salt, citric acid)</i>	1	0	0	1	2	No
<i>Production, cleaners</i>	1	0	1	0	2	No
<i>Buildings</i>	1	0	0	0	1	No
<i>Waste disposal</i>	1	0	1	0	2	No
<u>Downstream - Selling and consumption stage</u>						
<i>Energy consumption, market lightening</i>	1	0	0	0	1	No
<i>Energy consumption, market refrigerator</i>	1	0	1	1	3	Yes
<i>Energy consumption, home refrigerator</i>	1	0	1	1	3	Yes
<i>Lackage of refrigerant gas, market refrigerator</i>	1	0	1	1	3	Yes
<i>Lackage of refrigerant gas, home refrigerator</i>	1	0	1	1	3	Yes
<i>Transport, dairy products from market to consumers home</i>	1	1	0	1	3	Yes
<i>Waste disposal, organic waste</i>	0	1	0	0	1	No
<i>Waste disposal, packaging</i>	1	0	1	1	3	Yes

S2. Pedigree matrix

Stage	Input category	SD^2
<u>Upstream</u>	<u>Materials/energy</u>	
	Electricity, medium voltage {IT}	1.12
	Diesel, burned in agricultural machinery	1.12
	Mix of by-products fed to cattle	1.12
	Transport, lorry 3.5-7.5 metric ton, euro4, extra-farm feed	1.15
	<u>Emissions to air</u>	
	Methane, biogenic from enteric fermentation	1.24
	Methane, biogenic from manure management	1.24
	Dinitrogen monoxide from manure management	1.24
	Dinitrogen monoxide, from soil	1.24
	Methane, heating water	1.12
<u>Core</u>	<u>Materials/energy</u>	
	Electricity, medium voltage {IT}	1.12
	Diesel, burned in agricultural machinery	1.12
	PET, bottle grade	1.11
	PP, polypropylene packaging	1.11
	LDPE, polyethylene packaging	1.11
	Kraft paper, bleached	1.11
	Transport, lorry light commercial vehicle, for packaging	1.11
	<u>Emissions to air</u>	
	Ethane, pentafluoro-, HFC-125	1.15
	Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	1.15
Ethane, 1,1,1-trifluoro-, HFC-143a	1.15	
<u>Downstream</u>	<u>Materials/energy</u>	
	Electricity, medium voltage {IT}	1.15
	Transport, lorry with refrigeration machine, cooling, for distribution	1.16
	Transport, motor scooter	1.13
	Transport, electric/hybrid car	1.13
	Transport, petrol car	1.13
	Transport, diesel car	1.13
	Transport, gas car	1.13
	Transport, regular bus	1.13
	Transport, train	1.13
	Transport, electric bicycle	1.13
Municipal waste collection service	1.16	



Emissions to air

Ethane, pentafluoro-, HFC-125	1.15
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	1.15

S3. Consumers' questionnaire

1. Age:

- 20-40 40-60 >60

2. Gender:

- Male Female

3. Type and quantity (g) of purchased dairy products:

	100	150	200	250	500	Other:
Fresh milk	<input type="checkbox"/>	...				
Yogurt	<input type="checkbox"/>	...				
Fresh cheese	<input type="checkbox"/>	...				
Mozzarella cheese	<input type="checkbox"/>	...				
Aged-cheese	<input type="checkbox"/>	...				

4. Average expenditure of the usual total shopping at the market:

- 0-20 20-50 50-100 >100

5. Distance between home and market (km):

- < 1 1-5 5-10 > 10

6. Type of transport used:

- Petrol car Diesel car Gas car Hybrid car Electric car Bus Bicycle
 On foot Bus Metro Train

7. How many days dairy products were in cold storage?

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8. % of wasted dairy product:

- 0 0-5 5-10 > 10

9. Waste disposal of packaging materials:

- 100% sorting waste/recycling 100% not sorting waste/landfilling 50% recycling; 50% landfill

S4. Emission factors of materials and energy used to assess the carbon footprint of dairy products.

Input	Emission factors kg CO ₂ eq.
<u>Materials/energy</u>	
Electricity. medium voltage IT. kWh	0.42
Diesel, burned in agricultural machinery. MJ	0.081
Mix of by-products fed to cattle. kg	0.99
PET, bottle grade. kg	2.19
PP, polypropylene packaging. kg	1.63
LDPE, polyethylene packaging. kg	3.31
Kraft paper, bleached. kg	1.4
Transport, lorry 3.5-7.5 metric ton, euro4. kgkm	0.00040
Transport, lorry light commercial vehicle. kgkm	0.00144
Transport, lorry with refrigeration machine, cooling. kgkm	0.000361
Transport. motor scooter. personkm	0.10
Transport. electric/hybrid car. km	0.17
Transport. petrol car. km	0.23
Transport. diesel car. km	0.21
Transport. gas car. km	0.20
Transport. regular bus. personkm	0.091
Transport. train. personkm	0.038
Municipal waste collection service. kgkm	0.00123
Waste plastic for final disposal. kg	0.00371