SEARCHING FOR THE SUSTAINABILITY OF THE FOOD AND DRINK INDUSTRY

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Aims

1. A few words about the anthropogenic environmental impact
2. LCA tool
3. Main environmental impacts of the food & drink industry
4. A few case studies (lager beer, espresso coffee).

HUMAN IMPACT
on the ENVIRONMENT

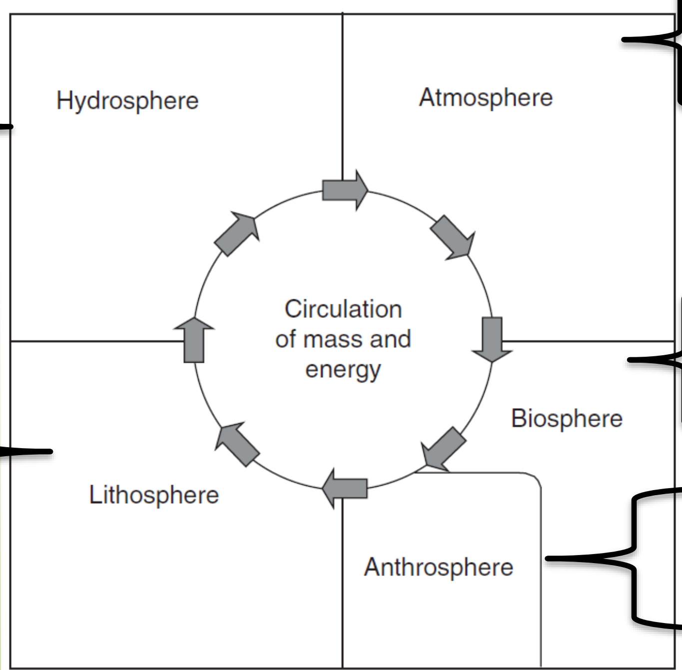
For all practical purposes, the planet Earth can be considered:

- a ***closed system*** in terms of **mass,** with boundaries located at the outer edges of the atmosphere, excluding rare meteors and artificial satellites.
- an ***open system*** from an **energetic** point of view, as it receives solar radiation during the day and disperses energy towards outer space at night.

Four strictly interdependent planetary subsystems can be identified

It includes liquid, solid and gaseous water.

Gaseous layer surrounding the Earth (thickness ~10,000 km)



It includes the crust and uppermost layer of the mantle (which is of irregular shape & depth with an average thickness of ~100 km).

It includes all living organisma and the dead ones not decomposed yet.

It includes humans & their structures: buildings, dams, bridges, roads, etc.

These subsystems exchange mass and energy through the so-called **biogeochemical cycle**s,

The most important of which are those of **C, N, O, P, S & H_2O.**

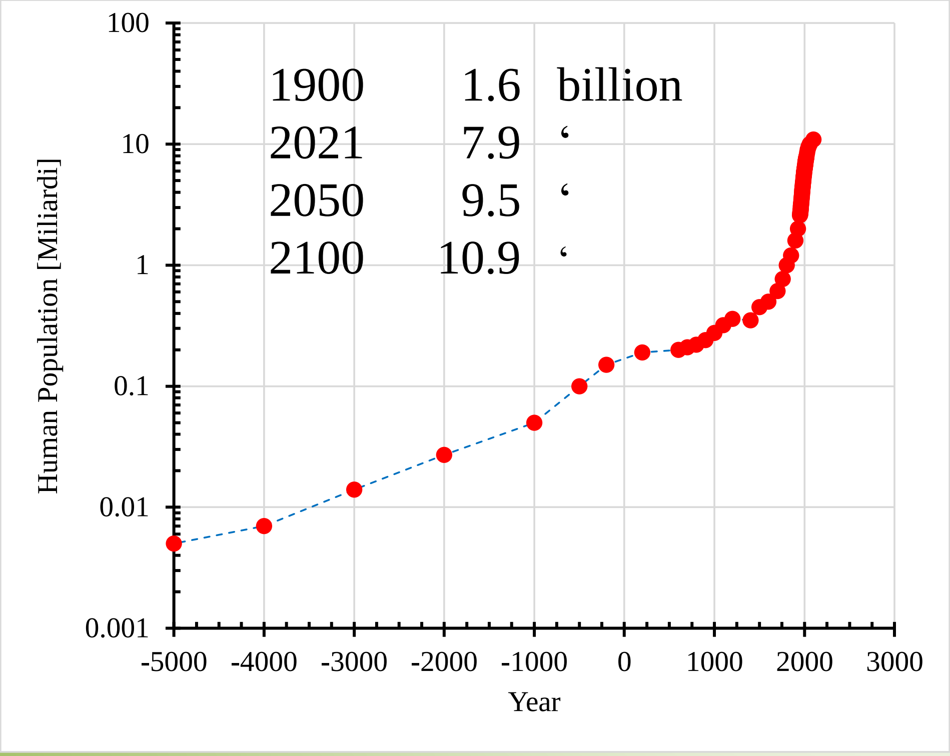
The reaction rates of these cycles were by far slower than those observed today as humans can accelerate them by resorting to:

1) **N-rich fertilizers** assimilable by plants.
2) **Water supply** if booster agricultural production in low moisture conditions.

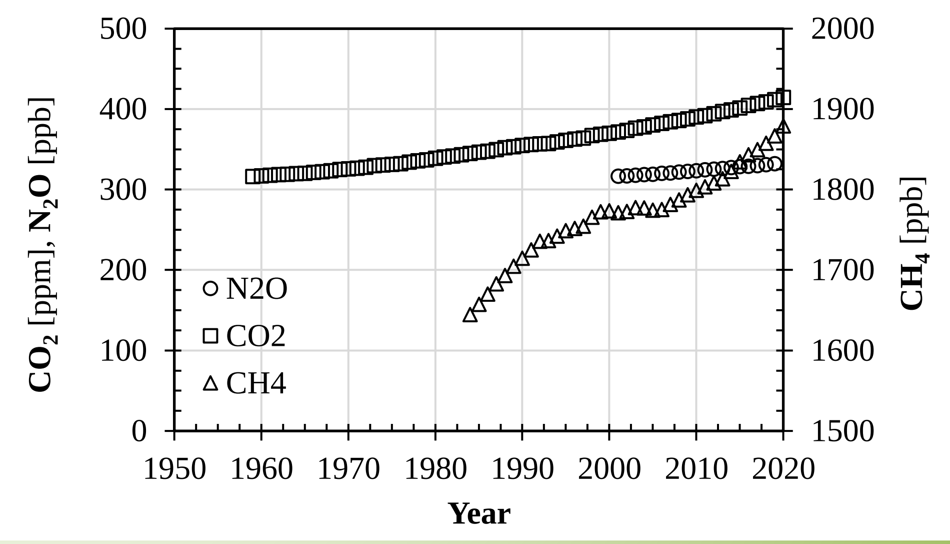
By accelerating such cycles, **the increase in food prod**uction has promoted **human population growth** at the expense of other ecosystems (i.e., grasslands and forests).

The higher consumption of mineral and water resources favors their depletion and leads to the release of **C** as **CO_2** into the atmosphere.

Human population growth since the year 5000 BC to 2100 AD (Worldometer, 2021).



The main GHG levels have been measured at the **Mauna Loa Observatory** (Hawaii, USA) since 1958. A clear increasing trend in the atmospheric CO_2, CH_4 & N_2O levels has been detected.



PRESSURE CATEGORIES & PROTECTION AREAS

Any change in human production & consumption activities exerts complex **environmental effects** or **pressures** on the 4 subsystems, which can be classified into four different categories:

1. **Materials**
   - *renewable*(***biotic***) *resources*: agro-food, fishery&forestry prod.s
   - *non-renewable* (***abiotic***) *resources*: fossil fuels, metallic minerals, & industrial and building materials.

2. **Water** abstracted and consumed to support any human activity.

3. **Land**
   - agricultural, forest, and grazing areas
   - surfaces used for raw material extraction, infrastructures, manufacturing, or private housing. Land use changes owing to the urbanization of agricultural/forest land are also included.

4. **GHG emissions in air** (CO_2, CH_4, N_2O, HCFC, PF, SF_6), yearly listed in the national inventory report (NIR) and published on the United Nations Climate Change website (https://unfccc.int/ghg-inventories-annex-i-parties/2022).

The human production and consumption activities involve several inter-linkages between such **pressure categories**, and their overall **environmental consequences** may be somewhere assessed by accounting for a series of different **environmental impact categories**.

According to Finnveden et al. (2009), such impacts are generally attributed to three **areas of protection**:

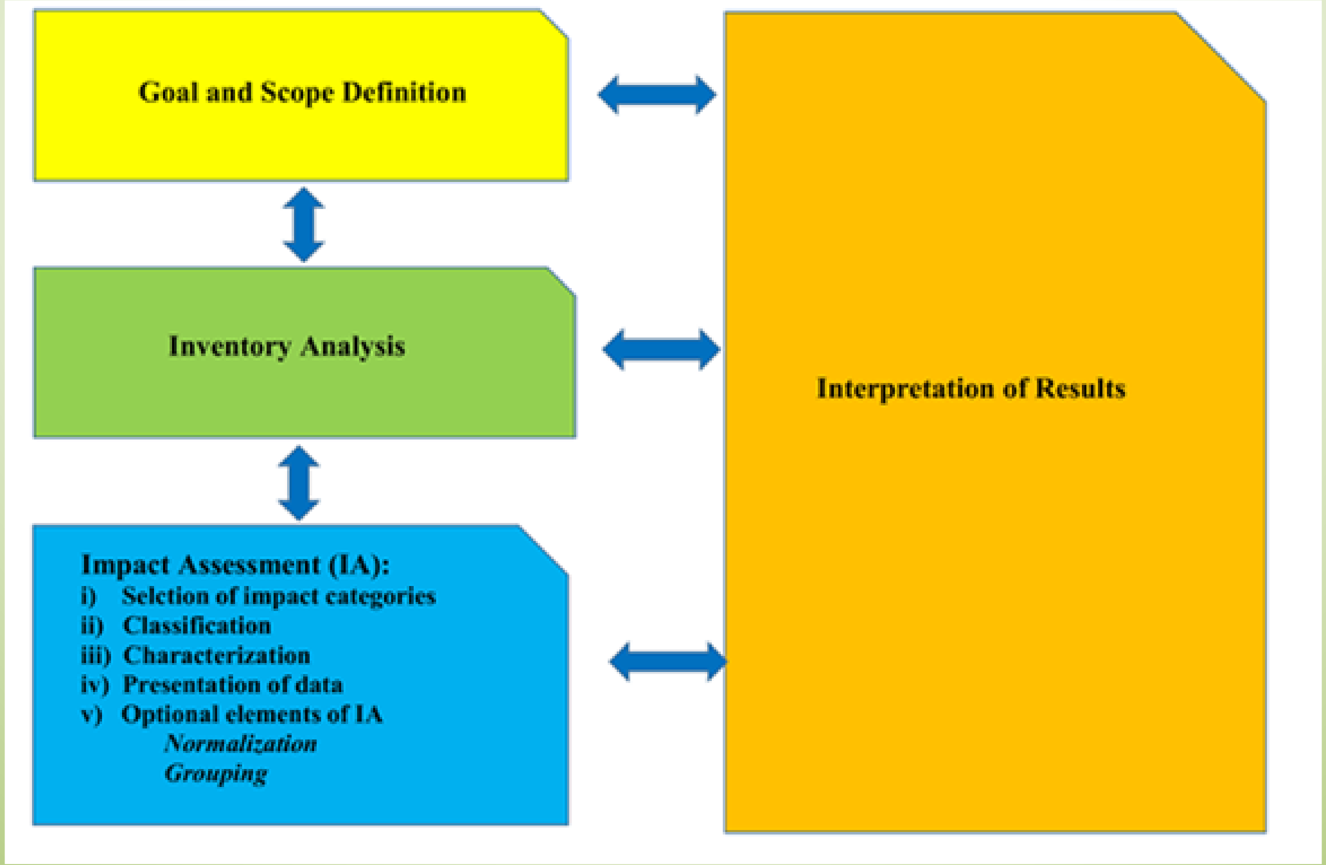
- **Ecosystem Quality (EQ),**
- **Human Health (HH)**
- **Natural resources (NR),**

These are generally evaluated using the best relationships currently available.

LIFE CYCLE ASSESSMENT (LCA)

The working procedure of the norm ISO 14040 entails the following 4 phases:

1. **Goal and scope definition**
2. **Life cycle inventory analysis (LCI)**
3. **Life cycle impact assessment (LCIA)**
4. **Life cycle interpretation.**



The standardization of the LCA methodology has not given rise to a worldwide accepted LCIA method yet.
All methods currently available are ISO compatible, but they provide different results in consequence of various factors, namely:

- the no. of impact categories accounted for;
- the no. of compounds included;
- the criteria and models required for the characterization, normalization and weighting steps;
- the regional, continental or global validity;
- the temporal validity of the data used in the modeling.

Any attempt to identify a recommended best practice has been so far unsuccessful.

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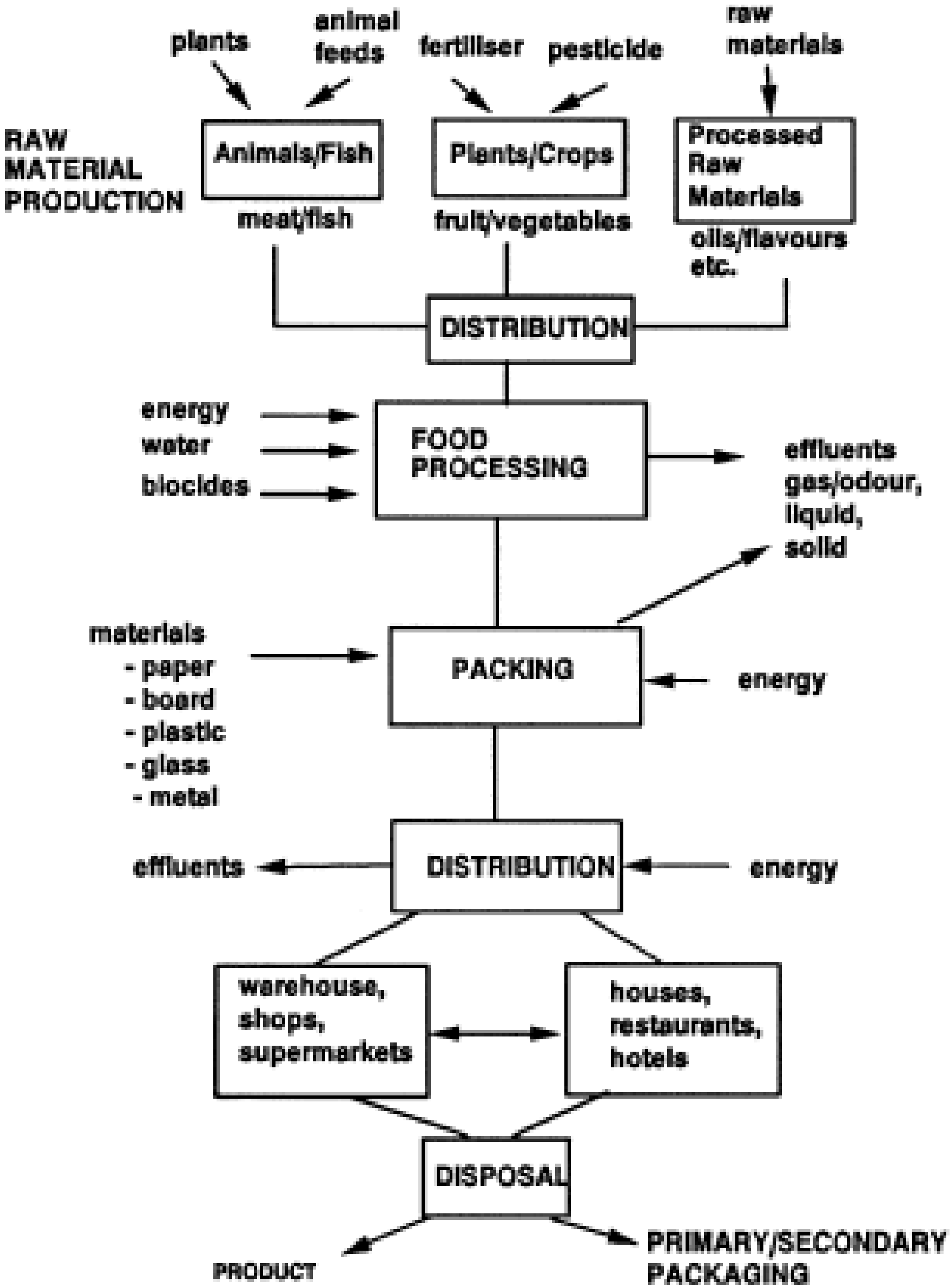


The complete supply chain of the food industry

from the production of raw materials

via food processing

to the consumption & disposal by the consumer

is quite complex.

One of the major materials supplied to the food processing industry is the **packaging** which is used

- ✓ to protect the processed food from deterioration and/or contamination (*primary packaging*) &
- ✓ to provide physical protection through the distribution & retailing operations (*secondary & tertiary packaging*).

Packaging Material	**Consumption**	**Recycling**		**Energy recovery**	
	Gg	Gg	%	Gg	%
Iron	465.2	371	79.8	0	0.0
Aluminum	69	47.4	68.7	4.5	6.5
Paper&Cardboard	4258.1	4047.5	95.1	347	8.2
Wood	2998.7	1873.1	62.5	67.1	2.2
Plastic	1863	1076	57.8	986	52.9
Glass	2520.1	2143.2	85.0	0	0.0
Total 2020	**12174.1**	**9558.2**	**78.5**	**1405**	**11.5**

ISPRA – Rapporto Rifiuti Urbani 355/2021

The food industry, of all the manufacturing industries, makes the **largest demand on packaging** (i.e., paper- & card-board, plastics, glass, metal), about **2/3** of the total industrial usage.

The **main direct impacts of food processing** are from

1. **waste generation**,
2. **water use** &
3. **energy use**.

Food waste is significant through the supply chain.

Food waste
- in the farm due to spoilage is ~ 21% of supply
- from processing is ~ 7% of supply.

The main types of **processing wastes** takes the form of

1. Solids (inedible materials, fine particulates, bones, fats),
2. Liquids (wastewaters, oils, flavours) &
3. Emissions (dust, volatile organic compounds, & odors).

If food wastes had to be just **treated** some years ago, now they are considered within the broader management perspective of **Circular Economy** to eliminate waste & pollution, keep products & materials in use & regenerating natural systems.

According to the waste hierarchy set out in Art. 4 of the revised waste framework (Directive 2008/98/EC), **any waste must be handled to avoid any negative impact on the environment or human health.**

Water use

In the food-processing industry great amounts of water are used as:

1. a major ingredient **in products for the drink&fermentation sector**,
2. an initial and intermediate cleaning source,
3. an efficient transportation conveyor of raw materials, &
4. the principal agent used in sanitizing plant areas & machinery (dairies).

Water use gives rise to wastewaters,

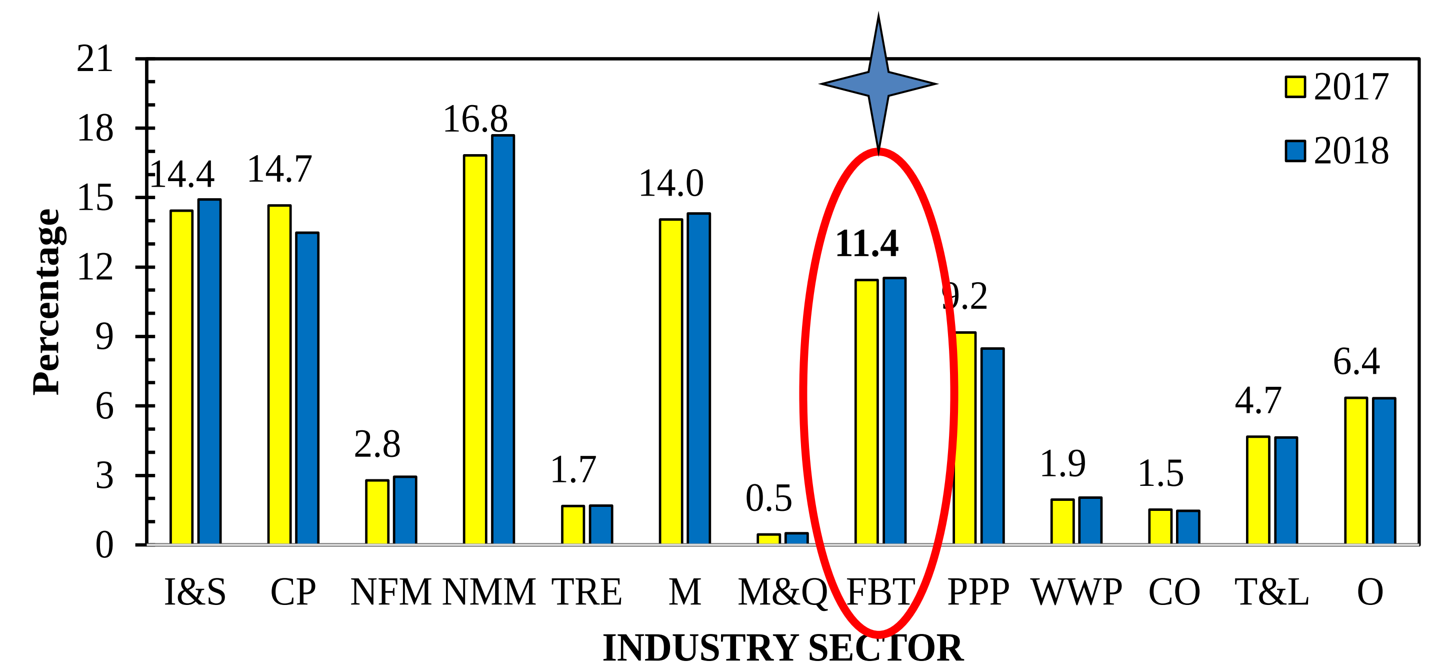
their environmental impact being due to the high content of

- **organic materials,**
- **suspended solids,**
- **organic nitrogen,**
- **oils & fats,**
- **pesticide residues from raw material treatments.**

ENERGY USE

The food industry is generally regarded as a light industry, its energy needs being of **low or medium intensity**.

Percentage energy consumption of the Italian industrial sector in 2017 & 2018.

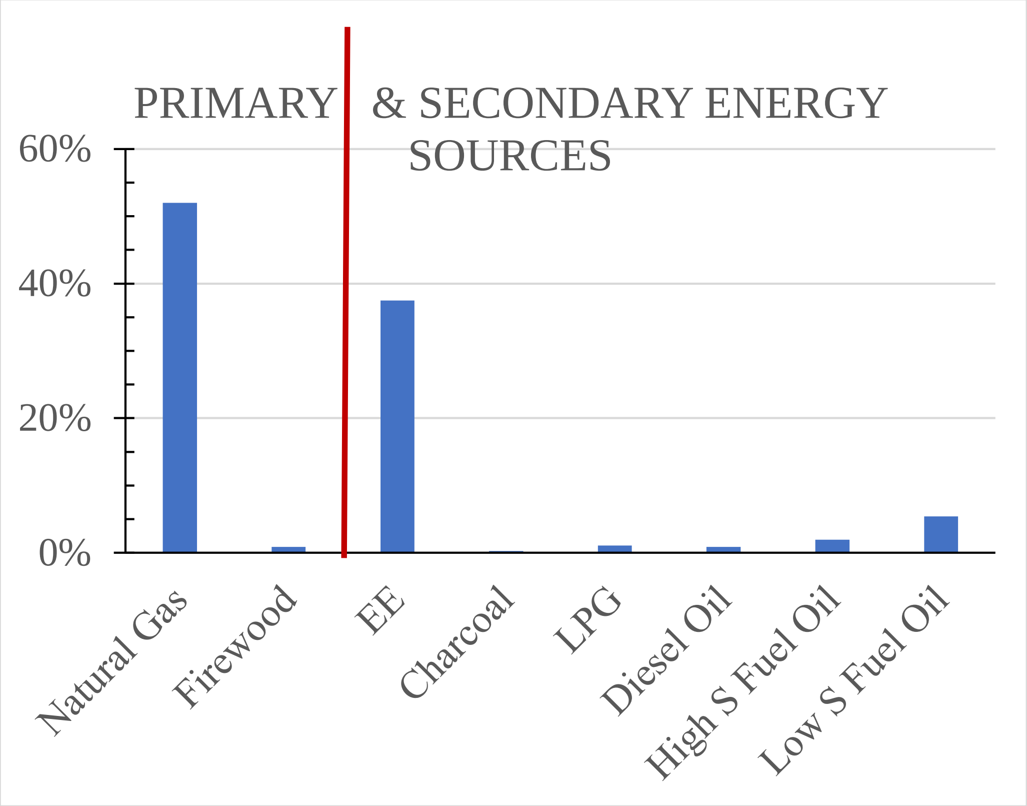


Iron & steel	I&S
Chemical & petrochemical	CP
Non-ferrous metals	NFM
Non-metallic minerals	NMM
Transport equipment	TRE
Machinery	M
Mining & quarrying	M&Q
Food, beverages & tobacco	**FBT**
Paper, pulp & printing	PPP
Wood & wood products	WWP
Construction	CO
Textile & leather	T&L
Other industries	O

The energy consumption of the FBT sector is ~11.4% of that of the Italian industrial sector(~27 Mtoe).

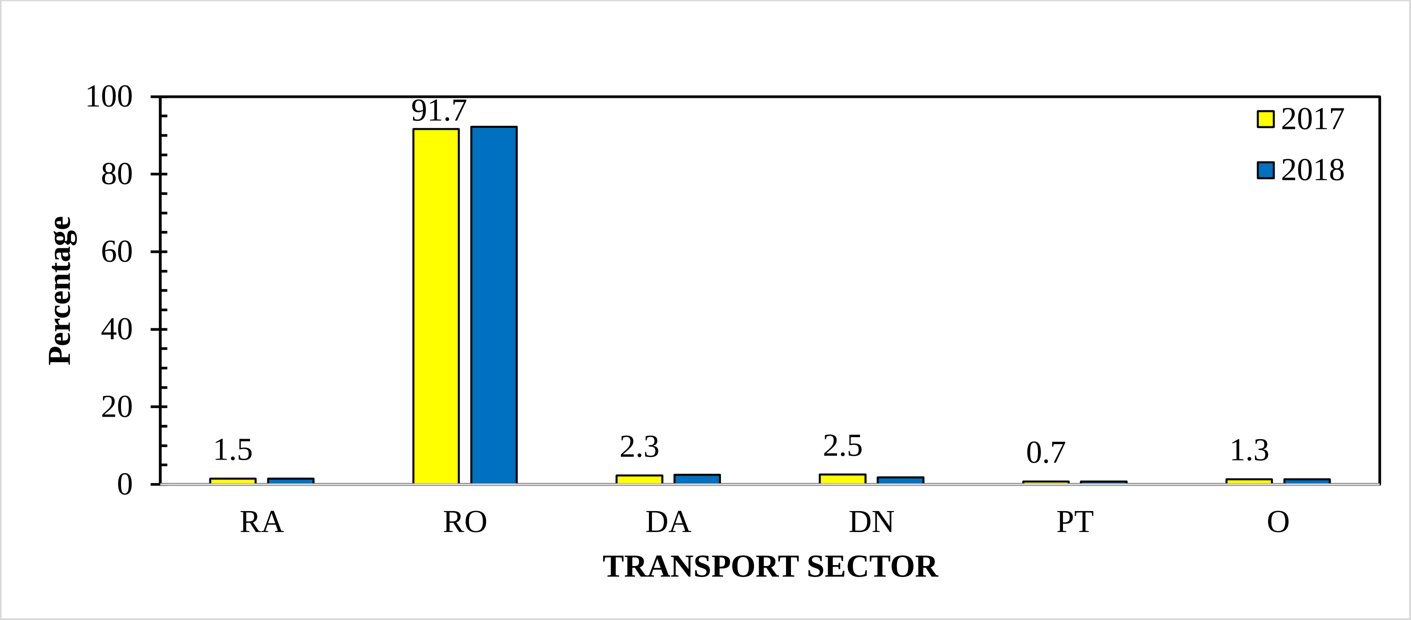
ENERGY CONSUMPTION (Tcal)	Primary Energy Sources	Secondary Energy Sources	TOTAL
AGRICULTURE & FISHERIES	1,713	27,934	**29,647**
AGRO-FOOD INDUSTRY	15,063	13,420	**28,483**

Percentage breakdown of the primary and secondary energy sources used by the Italian Agro-food sector in 2017



Process and Ancillary Equipment	%
Electrical Equipment	37.5
Heat Equipment	62.5

Percentage Transport Energy Consumption



Rail	RA
Road	RO
Domestic aviation	DA
Domestic navigation	DN
Pipeline transport	PT
Not elsewhere specified (transport)	O

In Italy, **road transport** covers over **90%** of the overall transport energy consumption

What

should a sustainable food company do

to limit its GHG emissions?

A sustainable food industry should (Morawicki, 2012):

1) rely exclusively on *renewable energy*;
2) depend on raw materials and ingredients made from renewable resources with renewable energy;
3) be *water neutral*;
4) have net-zero air emission;
5) produce fully biodegradable liquid and solid wastes at rates and levels easily degradable by nature.

Although 100% sustainability is just utopic,
any food & drink industry should improve its
sustainability by adopting a virtuous process
to riduce the GHG emissions/environmental impact
especially from its most impacting life cycle steps.

1) Some food business leaders see the growing interest toward food sustainability as a trend that **will end soon**.

2) Most of them are quickly catching up with the topic of sustainability as a response to stakeholders' pressure with the final aim of expanding their business.

Thus, some food industry has started to calculate the environmental impact of their products via any life cycle assessment procedures (i.e., *Environmental Product Declaration, EPD*®; *Carbon Footprint* logo; *Bilan Carbone*®).

Quite a number of food & drink companies intentionally take up ***greenwashing*** communication strategies to persuade the public that their products, aims and policies are environmentally friendly.

In 42% of the cases the **green claims** in various sectors (clothing, cosmetics, household appliances) might **be false or misleading** & potentially regarded as an **unfair trading practice** under the Unfair Commercial Practices Directive (Bruxelles, 28 January 2021).

To empower consumers against greenwashing, **EC Commission elaborated a new consumer agenda** (13 November 2020: https://tuttoconsumatori.mise.gov.it/44-approfondimenti/396-focus-sulla-nuova-agenda-dei-consumatori-new-consumer-agenda)

Video on the ***Environmental Sustainability Report***

(https://www.youtube.com/watch?v=14esBIpaQtk)

by Dr. **Franco AMELIO** (Deloitte Italia: https://www2.deloitte.com/it/it.html)

at **CIBUS 2022** (Parma, I)

Climate change & Circular Economy

Greenwashing

Ecologic Transition

Italian sounding

WHAT ABOUT
THE CONSUMER’S RESPONSE ?

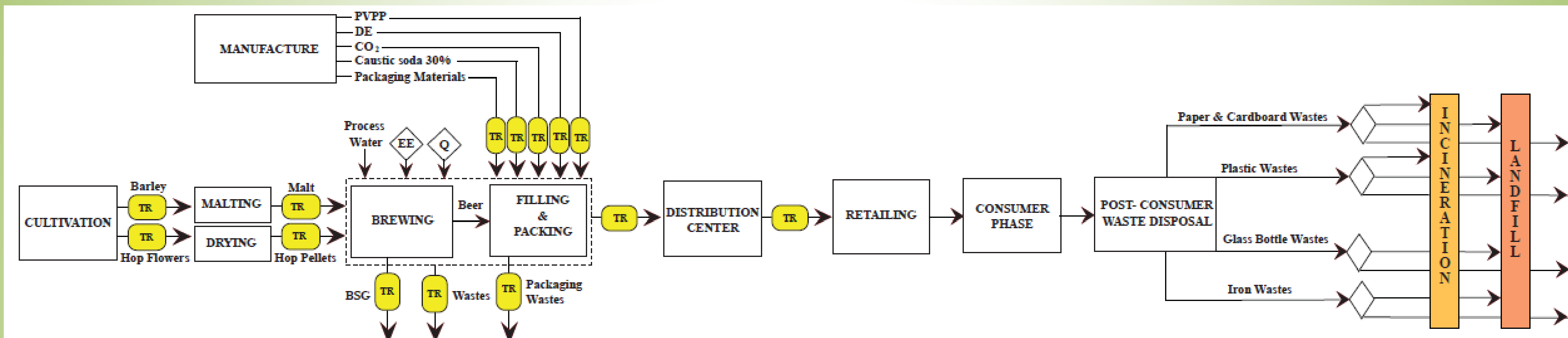
- Even if the **consumer** is aware of the sustainability concept, he/she is **unable to define it precisely.**
- What's more, the well-informed consumer is some way **reluctant towards the introduction of sustainable practices** in his/her every-day life.

- This is quite alarming & probably the main cause that led TESCO to phase out the 2007 programme of putting the CF logo on 50,000 own-brand products (https://www.ft.com/content/96fd9478-4b71-11e1-a325-00144feabdc0#axzz2hWsKTdpp).

A few case studies

to show
how the results of a B2C LCA study
might help manufacturers
to improve their sustainability

Case Study no. 1: Lager Beer



Cradle-to-grave boundary system (B2C)

Journal of Cleaner Production 112 (2016) 4196–4213

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

ELSEVIER

Carbon footprint of a pale lager packed in different formats: assessment and sensitivity analysis based on transparent data

CrossMark

Alessio Cimini, Mauro Moresi*

Mass of the main packaging materials used to pack 1 hL of lager beer in different formats (Cimini e Moresi, 2016):

- 66- & 33-cL Amber glass bottles (GB);
- 66-cL PET bottles (PB);
- 33-cL Aluminum cans (AC);
- 30-L stainless-steel kegs (SSK).

Packaging format Packaging materials	66-cL GB	33-cL GB	66-cL PB	33-cL AC	30-L SSK	Unit
Glass	43.9	56.1	0.0	0.0	0.0	kg/hL
Paper & cardboard	3.0	3.4	3.0	1.2	0.0	kg/hL
Plastic	0.1	0.1	4.4	0.3	0.0	kg/hL
Steel	0.3	0.6	0.0	0.0	32.0	kg/hL
Aluminum	0.0	0.0	0.0	4.9	0.0	kg/hL
Wood	2.8	3.2	3.0	1.9	2.5	kg/hL
Adhesive materials	0.2	0.2	0.2	0.2	0.0	kg/hL
Overall	50.3	63.6	10.6	8.5	34.5	kg/hL

Contribution of the diverse life cycle phases to the GHG emissions associated to the production & distribution of 1 hL of lager beer packaged in different formats

different formats (Cimini e Moresi, 2016), excluding the GHG credits deriving from the beer byproducts use as cattle feed **(~ 12 kg CO_{2e}/hL beer)**.

Beer primary packaging type	GB		AC	SSK
Volume (L)/Mass (kg)	0.66/0.290	0.33/0.185	0.33/00123	30.00/9.6
Life cycle phases	**GHG emissions (kg CO_{2e} hL^{-1})**			
Raw materials & processing aids	16.88	16.88	16.88	16.88
Brewing processing & packaging	8.41	8.4	8.33	8.41
Packaging materials	33.33	42.19	47.55	1.86
Transportation	9.71	10.67	8.09	9.26
Waste disposal	0.58	0.58	0.57	0.61
Beer production and distribution	**68.91**	**78.71**	**81.42**	**37.02**

GHG: greenhouse gas; GB: glass bottles; AC: aluminum cans; SSK: stainless steel kegs.

Since each keg is averagely reused 72 times, the contribution of packaging was only 5% of CF, while that of GBs and ACs was 48 and 58%.
Transport contributed up to 25% in the case of kegs (9.6 kg) but decreased to 14% or 10% if GBs or ACs were used.

To reduce
the contribution of packaging materials
to the beer CF,
it would be necessary to resort to: :

1) Lighter bottles or kegs.

2) Bottles with a higher percentage of recycled materials

3) Containers reusable as many times as possible.

If the **GB mass were reduced by 10%,** the beer CF would reduce by 2.5 to 5% (Amienyo and Azapagic, 2016) for the lower impact of packaging materials and their transport.

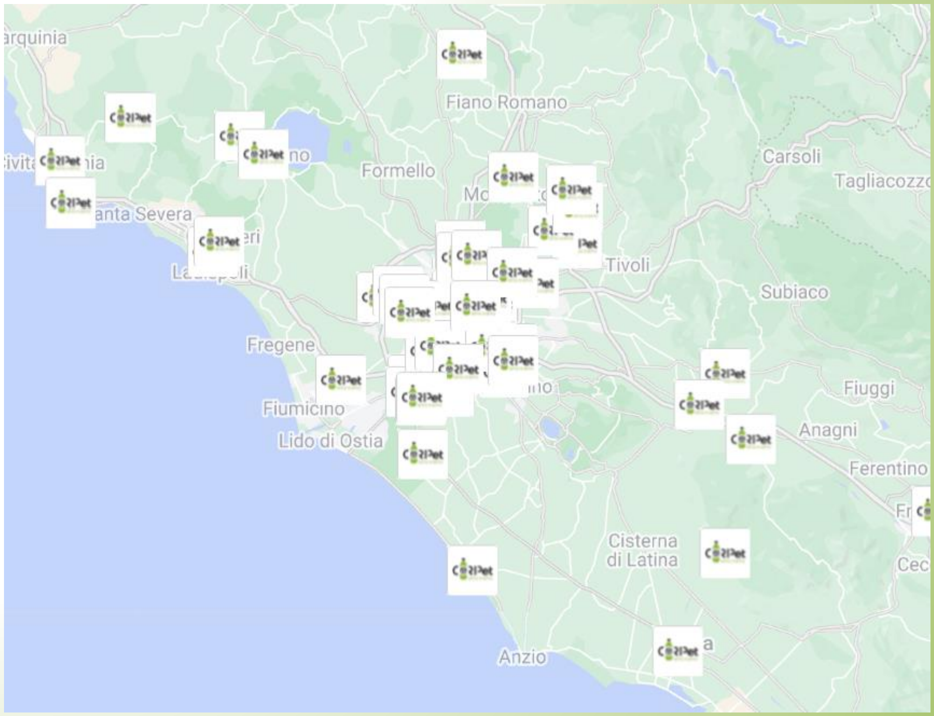
For Tuborg® beer packaged in **20-L plastic kegs** (each weighing 290 g) , a **70% reduction in GHG emissions** was estimated (EPD, 2011a).

The idea of increasing the recycling rate has proliferated in several countries.

- In France, mineral water in recycled PET (R-PET) bottles has been on the market since 2019.
- In Italy, the use of R-PET for the production of food bottles and trays has been approved by the ***2021 Budget Law*** provided that it derives from bottles used only for food purposes.
- In Germany, the legislation on container deposits (in force since 1 January 2003) provides that any ***empty plastic or glass bottle*** returned to shops or supermarkets receives a credit to be discounted at the cash desk of c€ 8-25/btg. Thus, 99% of reusable bottles and 97% of disposable bottles are thus returned to supermarkets and grocery stores.

To avoid any contamination problems, recycling companies currently subject plastic bottles to a thermal decontamination process at 280 °C or with a caustic detergent.

Such a decontamination process was approved for the management of PET packaging of liquid foods by the Italian Ministry of the Environment (***Decree no. 44 of 28 July 2021***) and is adopted by the **CORIPET consortium** (https://coripet.it/) to achieve 25% PET recycling by 2025.



CORIPET ECO-COMPACTORS IN LATIUM

Strictly speaking, sustainable waste management would only require the use of reusable bottles.

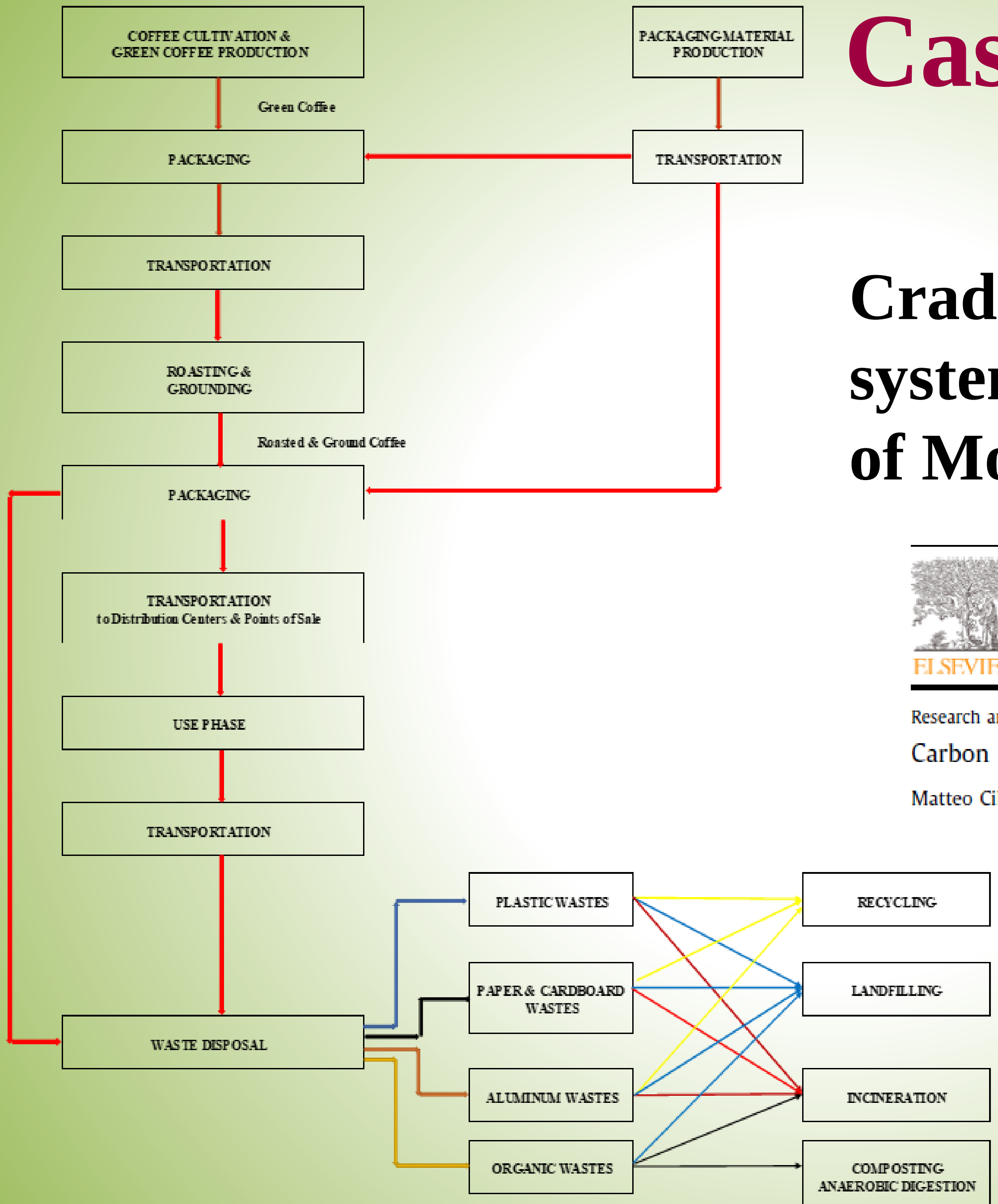
64% of Italian beer is consumed at home (Assobirra, 2020).

The environmental impact of beer consumption might be mitigated
by replacing GBs & ACs with
10- to 30-L returnable R-PET kegs
(such as the Keykeg type: https://www.keykeg.com).

This could emulate the success of 3- to 15-L bag-in-boxes for red and white wines also available online.

Case Study no. 2: Coffee cup

Cradle-to-grave boundary system (B2C) of 40-mL cup of Moka or espresso coffee.



Sustainable Production and Consumption 27 (2021) 1614–1625

Contents lists available at ScienceDirect

Sustainable Production and Consumption

journal homepage: www.elsevier.com/locate/spc

ELSEVIER

Research article

Carbon footprint of different methods of coffee preparation

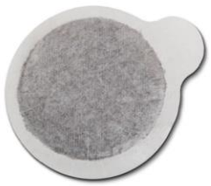
Matteo Cibelli[a], Alessio Cimini[a], Gabriella Cerchiara[b], Mauro Moresi[a,*]

ROASTED & GROUND COFFEE FORMATS

1) 250-g multilayer bags

2) Coffee Pads

a) 44-mm Easy Serving Espresso pods



b) Polylaminated pouch

c) 20-pod corrugated paperboard box

3) Coffee Capsules

3.1) Nespresso®-type capsules

3.2) 10-capsule corrugated paperboard box

A FEW COFFEE MACHINES

1) 3-cup induction Moka pot

2) Espresso machine Gaggia Viva RI8433/11

3) Pod coffee machine
Didì Borbone Blue Pod

4) Capsule coffee machine
Nespresso D40 Inissia Black

Contribution of the different life cycle phases to the carbon footprint of a functional unit of one 40-mL cup of coffee obtained using different coffee machines.

Coffee Maker	Induction Moka pot	LPG-heated Moka pot	Espresso Coffee Machine	Pod Coffee Machine	Capsule Coffee Machine
LCA Phase	**[g CO_{2e}/cup]**	**[g CO_{2e}/cup]**	**[g CO_{2e}/cup]**	**[g CO_{2e}/cup]**	**[g CO_{2e} cc^{-1}]**
Farming and GC Production	33.49	33.43	56.45	45.35	36.07
Packaging Material Production	0.86	0.86	1.45	9.20	7.37
Roasting, Grinding & Packaging	1.16	1.16	1.95	1.57	1.25
Transportation	1.50	1.51	2.56	3.19	2.08
Use Phase – Coffee Brewing	2.98	4.90	6.95	5.27	3.74
Use Phase – Cup Washing	4.26	4.26	4.26	4.26	4.26
Post-consumer	4.10	4.25	7.31	7.12	6.23
Carbon Footprint	**48.36**	**50.36**	**80.94**	**75.96**	**61.00**

Coffee brewing tests using different coffee machines: amounts of RGC and energy consumed & specific post-consumer wastes formed.

Format	**250-g RGC Pack**		**Coffee Pad**	**Coffee Capsule**	**Unit**
	Moka pot	**Espr. C. Machine**			
RGC	5.3	9	7.2	5.8	g/cup
n_c	3	1	1	1	-
E_{cc}	6.8±0.2	15.9±0.4	12.0±0.6	8.5±0.2	Wh/cup
t_c	88±2	19±3	30±5	25±4	s
Wood Wastes	0.003	0.005	0.027	0.008	g/cup
Paper&Cardboard Waste	0.34	0.58	4.79	1.82	g/cup
Plastic Waste	0.006	0.01	0.059	0.018	g/cup
Polylaminated bag waste	0.17	0.29	1.52	1.17	g/cup
Organic Waste	11.42	19.26	15.71	12.31	g/cup
Overall wastes formed	11.94	20.14	22.11	15.33	g/cup
Packaging Mat/RGC	**0.1**	**0.1**	**0.89**	**0.53**	g/g RGC

The problem of the **huge packaging waste formation** per cup of coffee brewed is challenging the main coffee makers.

1) The ***reusable Keurig® K-cups***

& ***refillable stainless-steel coffee capsules*** have been introduced in the USA and France.

2) Coffee balls (*CoffeeB*, Migros, Zürich, CH) currently available in Switzerland.

3 ***Paper-based home compostable Nespresso® coffee capsules coated with a thin compostable biopolymer film*** as a protective barrier were prepared by Nestlé Nespresso SA and their consumer acceptance will be tested in France and Switzerland not later than spring 2023.

Amounts of RGC used and post-consumer wastes formed per each cup of coffee brewed using refillable capsules or Coffee balls as compared to conventional Moka pot and Nespresso®-type coffee capsules.

Format	**250-g RGC Pack**		**Coffee Capsule**	**Coffee Balls**	**Unit**
	Moka pot	**Refillable Caps**			
RGC	**5.3**	**5.0**	**5.8**	**5.6**	g/cup
Wood Wastes	0.003	0.003	0.008	0.012	g/cup
Paper&Cardboard Waste	0.34	0.47	1.82	2.20	g/cup
Plastic Waste	0.006	0.006	0.018	0.026	g/cup
Polylaminated bag waste	0.17	0.16	1.17	0.0	g/cup
Organic Waste	11.42	10.94	12.31	12.21	g/cup
Iron waste		0.0006			g/cup
Silicone Waste		0.0002			g/cup
Overall wastes formed	**11.94**	**11.58**	**15.33**	**14.45**	g/cup
Packaging Mat/RGC	**0.10**	**0.13**	**0.53**	**0.40**	g/g RGC

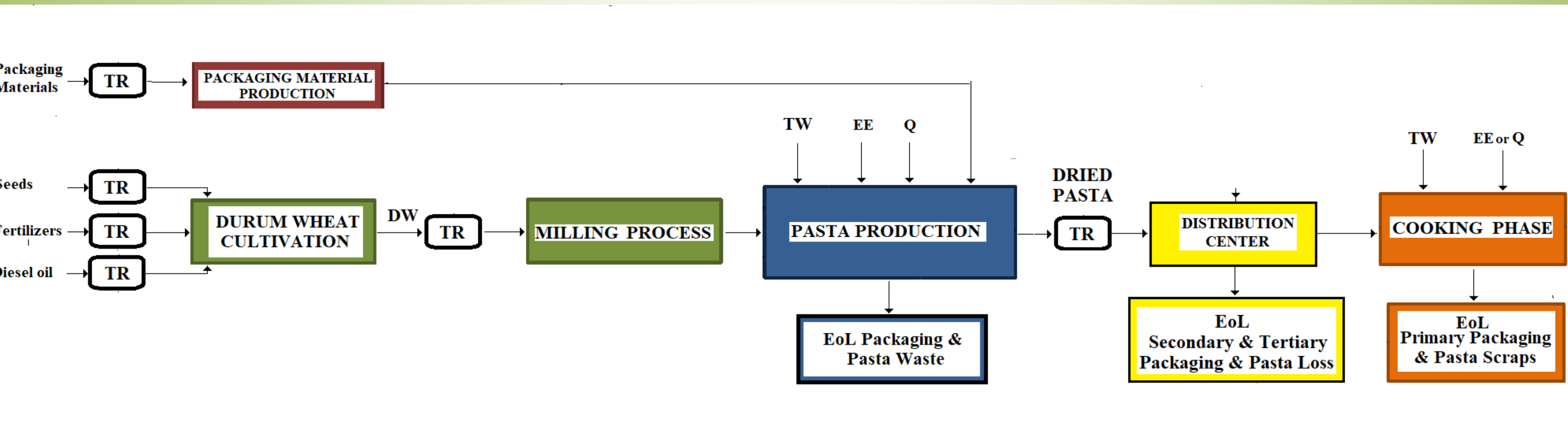
The alternatives recently introduced in the coffee market (*Coffee balls* or *paper-based Nespresso® coffee capsules)* **allow the disposal of spent capsules in the organic waste bin & reduce the packaging material-to-ground coffee ratio**.

The **eco-responsible consumer should be aware** that
the preparation of a coffee cup with the induction Moka pot
would be ***more labor-intensive***

but **would avoid**

~28 g CO_{2e} with respect to that brewed with a **coffee pod**
or
~13 g CO_{2e} with respect to that prepared with a **coffee capsule**.

Case Study no. 3: Dry pasta



Cradle-to-grave boundary system (B2C).

Chapter 5

Environmental impact of dry pasta using different standard methods

Alessio Cimini, Matteo Cibelli and Mauro Moresi

EE, electric energy; EoL, end of life; TW, process or cooking water; Q, thermal energy; TR, transport.

Dry Pasta Packaging

I II III

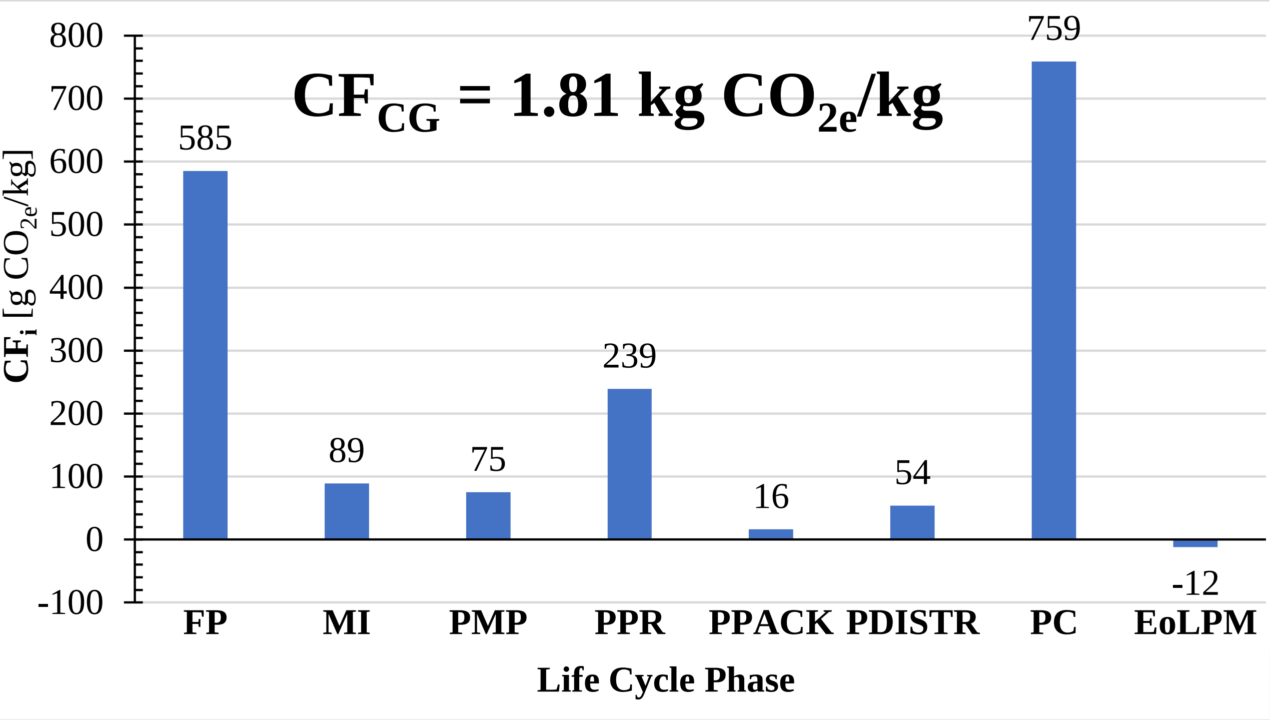
Primary packaging was a PP bag (6.6±0.3 g) containing 500 g of dry pasta.

The **secondary packaging** consisted of

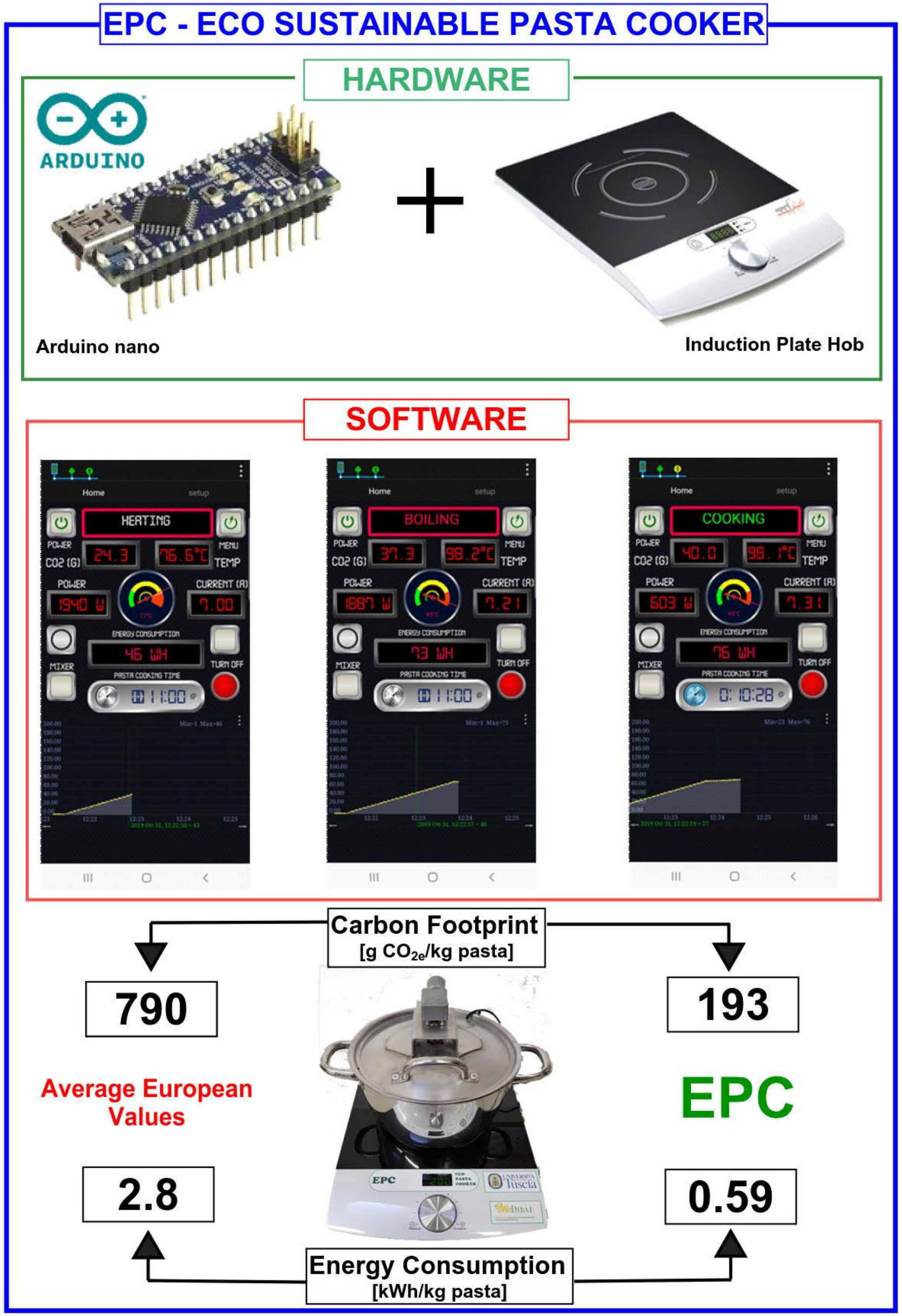
a carton (296.2±0.7 g), containing 12 bags.

The **tertiary packaging** included 95% reusable EPAL wood pallet (25 kg), stretch-and-shrink PE film (85±4 g) and 2 paper labels (2.52±0.04 g each), consisting of **10 cartons per layer** and **4 layer per pallet**.

Contribution of the different life cycle phases to the cradle-to-grave Carbon Footprint (CF_{CG}) of a functional unit (1 kg) of dried pasta packed in 0.5-kg PP bags in a medium-sized pasta factory.



FP,	field phase;
MI,	milling;
PMP,	packaging material manufacture;
PPR,	pasta production;
PPACK,	pasta packaging;
PDISTR,	transport of dry pasta;
PC,	pasta cooking;
EoLPM,	end of life of packaging material wastes.



Food and Bioproducts Processing 122 (2020) 291–302

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Development and assessment of a home eco-sustainable pasta cooker

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Case study	UNIT	RC	RAP	ε	EPC	e	EPC-RAP	e
Standard Method				%		%		%
EPD® (2018)								
GW_{100}	kg CO_{2e} kg^{-1}	1.80	1.44	-20.2	1.31	-27.5	0.94	-47.7
Acidification	kg SO_{2e} kg^{-1}	5.28×10^{-3}	3.64×10^{-3}	-31.1	6.63×10^{-3}	25.5	4.99×10^{-3}	-5.6
Eutrophication	kg PO_{4e}^{-3} kg^{-1}	2.31×10^{-3}	1.72×10^{-3}	-25.6	2.65×10^{-3}	14.9	2.06×10^{-3}	-10.7
Photochem. oxidation	kg NMVOC kg^{-1}	4.08×10^{-3}	2.83×10^{-3}	-30.7	3.97×10^{-3}	-2.6	2.72×10^{-3}	-33.3
Abiotic depletion, elements	kg Sb_e kg^{-1}	3.48×10^{-6}	1.39×10^{-6}	-60.0	3.28×10^{-6}	-5.7	1.19×10^{-6}	-65.7
Abiotic depletion, fossil fuels	MJ kg^{-1}	20.8	18.5	-11.2	13.1	-37.2	10.7	-48.4
Water scarcity	m^3_e kg^{-1}	3.36×10^{-1}	2.31×10^{-1}	-31.3	5.20×10^{-1}	54.8	4.15×10^{-1}	23.4
PEF								
OWS_P	(mPt) kg^{-1}	141.3	115.1	-18.6	108.8	-23.0	82.5	-41.6

Effect of a few mitigation options

1) reduced agricultural practice (RAP),
2) Use of an eco-sustainable pasta cooker (EPC),
3) EPC & RAP options

on the B2C environmental impact of 1 kg of dry pasta in 0.5 kg PP bags using the **EPD® 201**8 and **PEF standard methods** as referred to the reference case (RC).

If the current *Care* and *Sustainable* drivers were correctly used to mitigate the environmental impact of dry pasta,
its commercialization should be associated with any smart eco-sustainable pasta cooker

This would reduce the CF by 48% & **EI** by **42%**
with no increase in the packaging material wastes formed,
this being unfortunately not the case for coffee pads/capsules.

CONCLUSIONS

The agro-food system

is currently feeding a world population of ~8 billion,

but it is **ecologically unsustainable**,

since it makes use of non-renewable natural resources.

Even if the responses
from consumers & food companies
to the environmental safety
are still **unpredictable**
& highly dependent on political and economic issues,
the wellbeing of our descendants
in a closed system with limited resources, such as the Earth,
asks for serious initiatives.

Although *obtorto collo*,
all the present PhD students
will be inevitably involved.

Thanks for your attention

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