ENOUGH

EUROPEAN FOOD CHAIN SUPPLY
TO REDUCE GHG EMISSIONS BY 2050

ENOUGH methodology to estimate 2050 emissions from the European food supply chain

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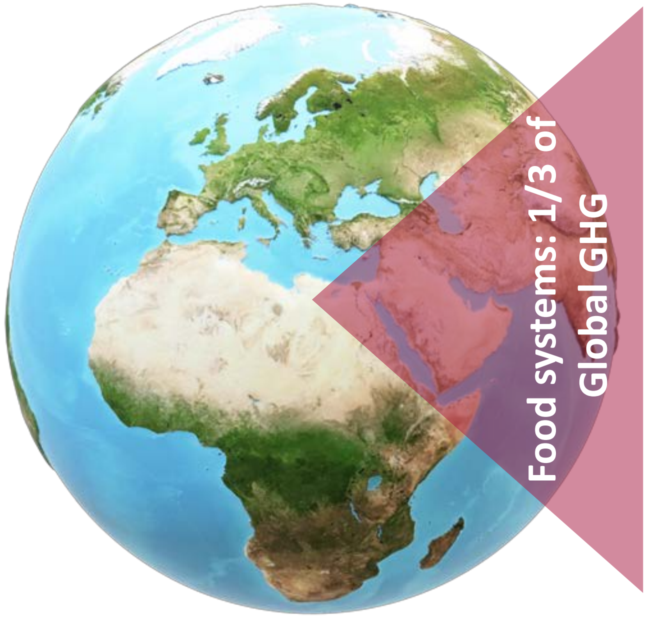
ENOUGH webinar on results and highlights

01/12/2022

THE EUROPEAN FOOD SUPPLY CHAIN EMISSIONS: WHERE TO ACT?

Emissions Background – Few numbers but huge emissions



- Share in **Total emissions** decreased from 38% (2000) to 31% (2020).
- **2020 Global level**

agrifood systems GHG emissions **16 Gt CO_2eq** (+9% (2000)):

~$^1/_2$ from farm gate, gate and $^1/_5$ LULUC

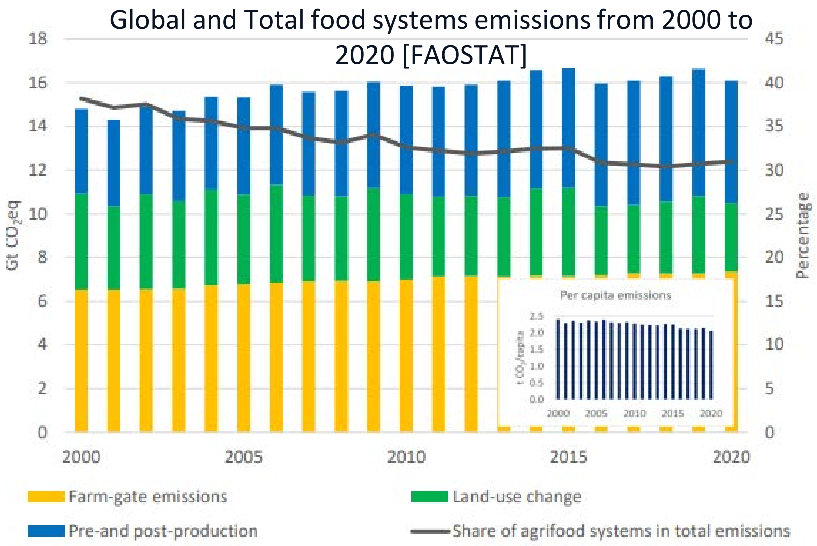
$^1/_3$ from post-farm

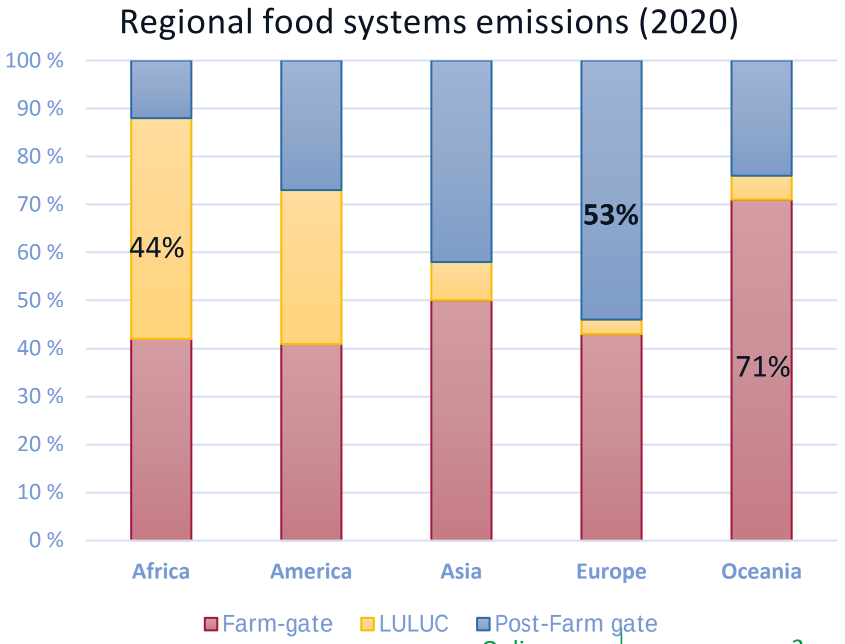
- **2020 Regional level**

LULUC largest contributor in Africa (44%)

Farm gate dominating in Oceania (71%)

Post-Farm gate largest contributor in Europe (53 %)





Data , Regional and Global emissions graph Source: GHG emissions from agrifood systems: Global, regional and country trends. FAOSTAT Analytical Brief 50

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EUROPEAN FOOD CHAIN SUPPLY TO REDUCE GHG EMISSIONS BY 2050

Innovative Technologies and solutions for the **food supply chain** to help **decarbonizing** the **2050 food sector.**

IN EUROPE: FOCUS TO REDUCE TEH EMISSIONS FROM TEH FOOD SUPPLY CHAIN

- WP1: baseline (1990), Current (2020) and Future (2030 and 2050) carbon emissions of the European Food supply chain
- Mapping emissions from different supply chain sectors for perishable

and non-perishable food in EU.

- 2020 Baseline is available for Europe

BUT

- Different approaches/ terminology/boundaries may be used.
- Availability of data/ Data is lacking in some countries.
- Some databases suffer from high degree of uncertainty.
- Checking consistency to establish harmonised standards to estimate GHG emissions.

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+ Establish a robust 1990 database (1990-2020 emissions evolution will help understanding

the main drivers influencing the future emissions)

+ Establish a detailed 2020 database : **Top-down** (gov. compiled data) and **bottom-up** (own generated data) approaches sense checked + uncertainty calculation IPCCC guidelines.
+ Predict emissions for 2030 and 2050 for accurate estimates

Horizon scanning: How the future food chain will look like? **What are the disruptive changes?**

Climate change, global population, energy source and generation, consumer trends…

(identifying the main drivers and sub-drivers)

Food supply chain sectors and their associated emissions

EMISSIONS SOURCES AND TERMINOLOGY IN TEH FOOD SECTOR

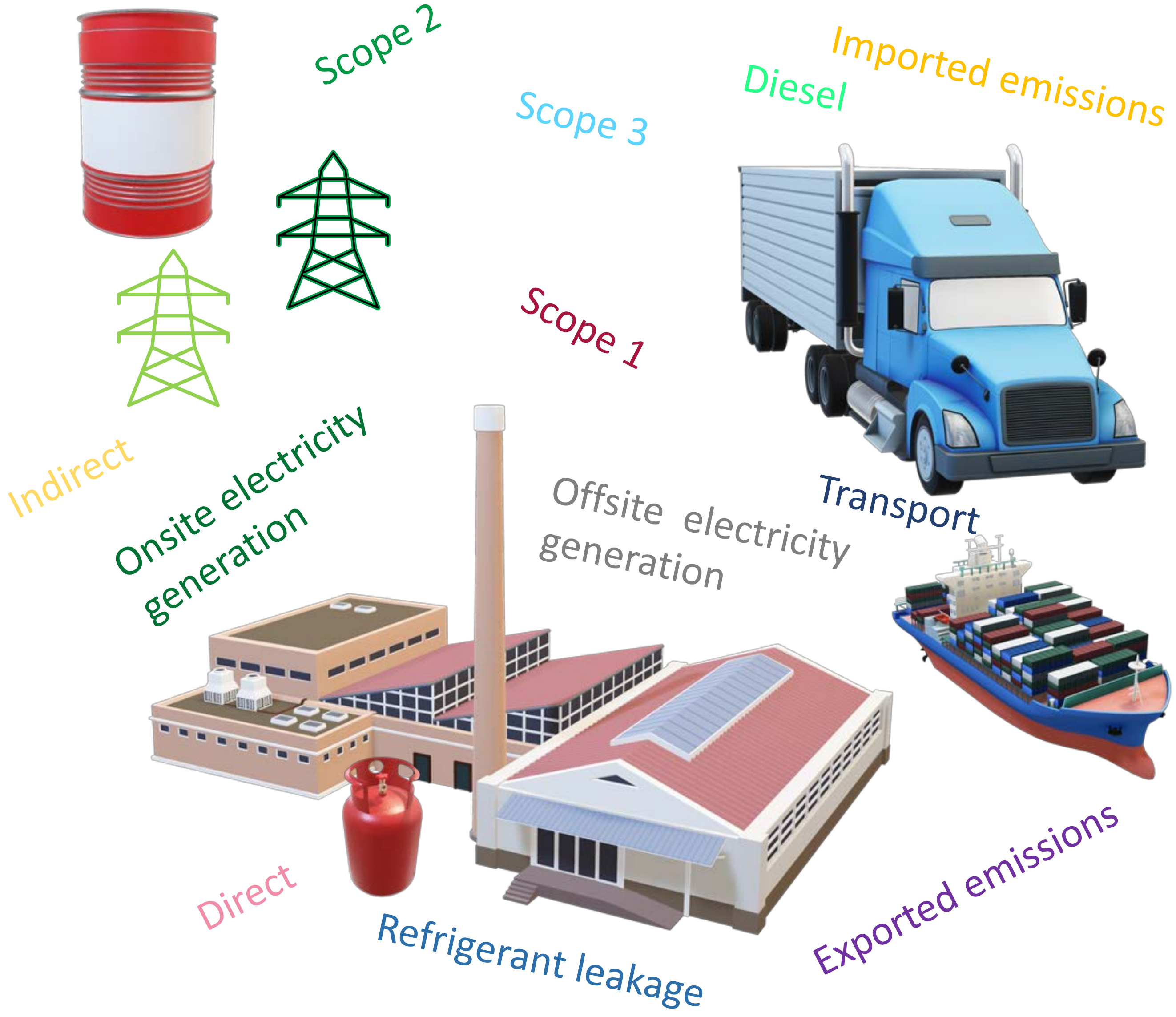
Refrigeration standard EN378, FAOSTAT, IEA …
Direct GHG **emissions** are emissions from refrigerant leaks during operation, maintenance and end-of-life. Others even include refrigerant manufacturing and transport.

Indirect GHG **emissions** are emissions are those associated to energy consumption of the refrigeration equipment. Others even include energy associated with production and transport of system components.

→ No clear boundaries → confusion → difficult to compare results.

+ In ENOUGH we are looking at the full supply chain including the cold chain, but not only.

→ The concept of "Scope" (Scope 1, Scope 2 and Scope 3 by the GHG Protocol)



EMISSIONS SOURCES AND TERMINOLOGY IN TEH FOOD SECTOR

Scope 1 (direct): Entities report GHG emissions from sources they own or control (General definition)

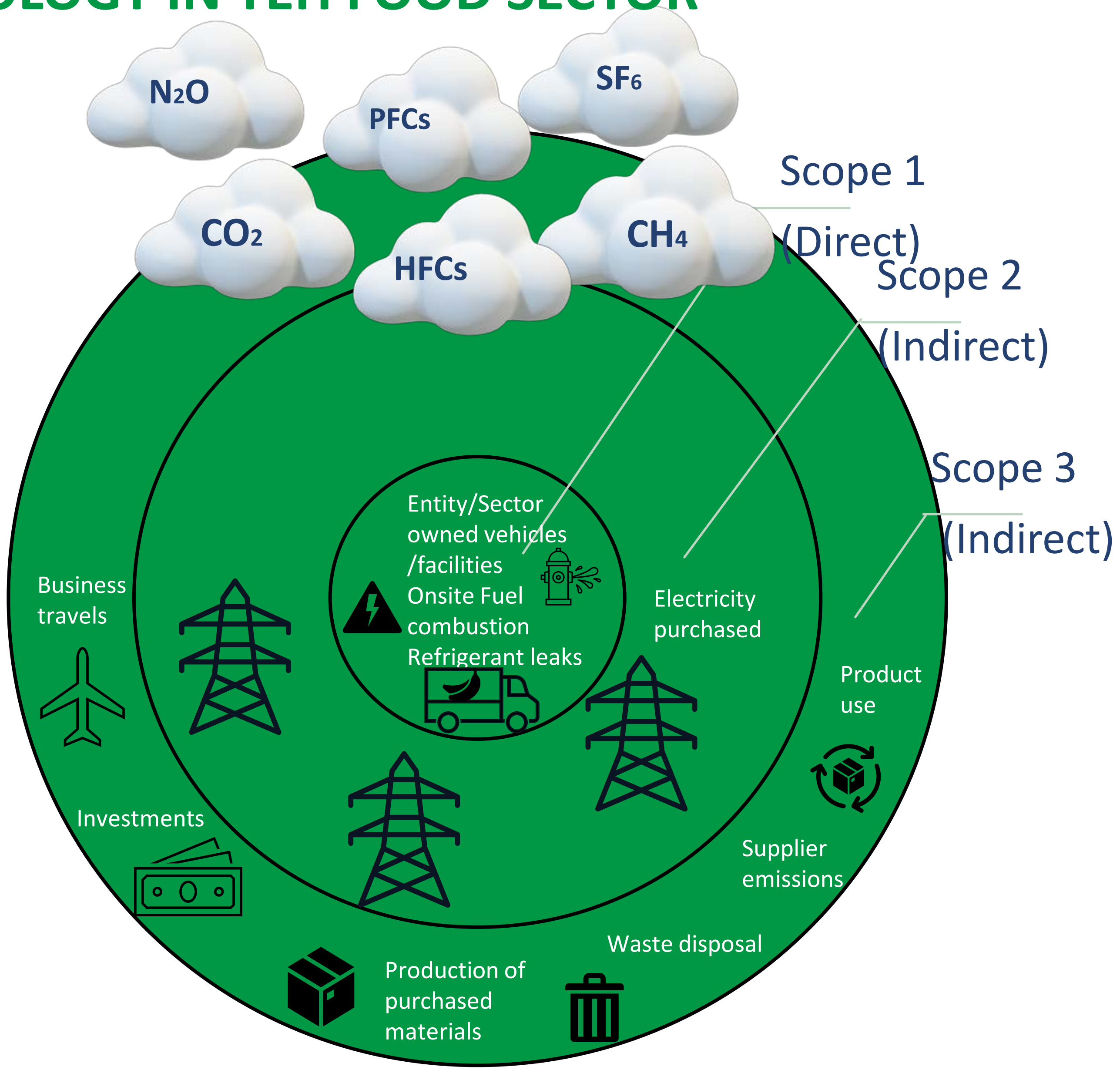
- Generation of electricity, heat, or steam from stationary combustion of fuels, e.g., boilers, furnaces, turbines… (e.g. For food processing)
- manufacture or processing of chemicals and materials, and waste processing (e.g. food packaging)
- Combustion of fuels in company owned/controlled mobile for the transportation of materials, products, waste, and employees. (e.g. food transport)
  (e.g., trucks, trains, ships, airplanes, buses, and cars)
- Fugitive emissions due to equipment leaks e.g. HFC emissions in refrigeration and AC equipment. (e.g refrigerant leakage)

Scope 2 (indirect): Emissions from the generation of purchased electricity consumed by the entity.

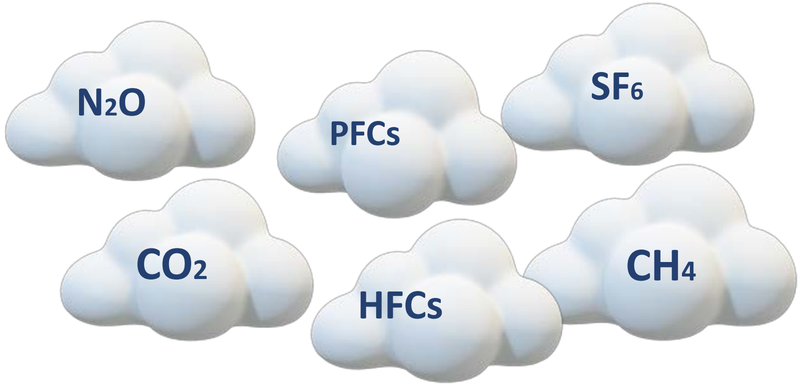
Scope 3 (indirect): consequence of the activities of the entity, but occur from non owned/controlled sources (Food loss and waste)

→ Precise description and boundaries for direct and indirect emissions

→ Help with climate policies and business goals



OUR BOUNDARIES IN ENOUGH



Emissions boundaries

Scope 1 , Scope 2 and Scope 3 emissions :

Scope 1 → Onsite fuel combustion for generation of electricity and heat

Fuel combustion for food transport

Refrigerant leaks

Scope 2 → Primary energy consumption (based on measured consumption)

Scope 3 → Emissions from food loss and food waste

- Excluding manufacture and end of life of food chain components
- Include all emissions also including SOx, NOx and PMs for full environmental impact

Geographical boundaries

- Area: EU boundary from farm to fork, imported emissions from outside EU
- Transport within an intermediate (transient) country locates between exported and imported countries.

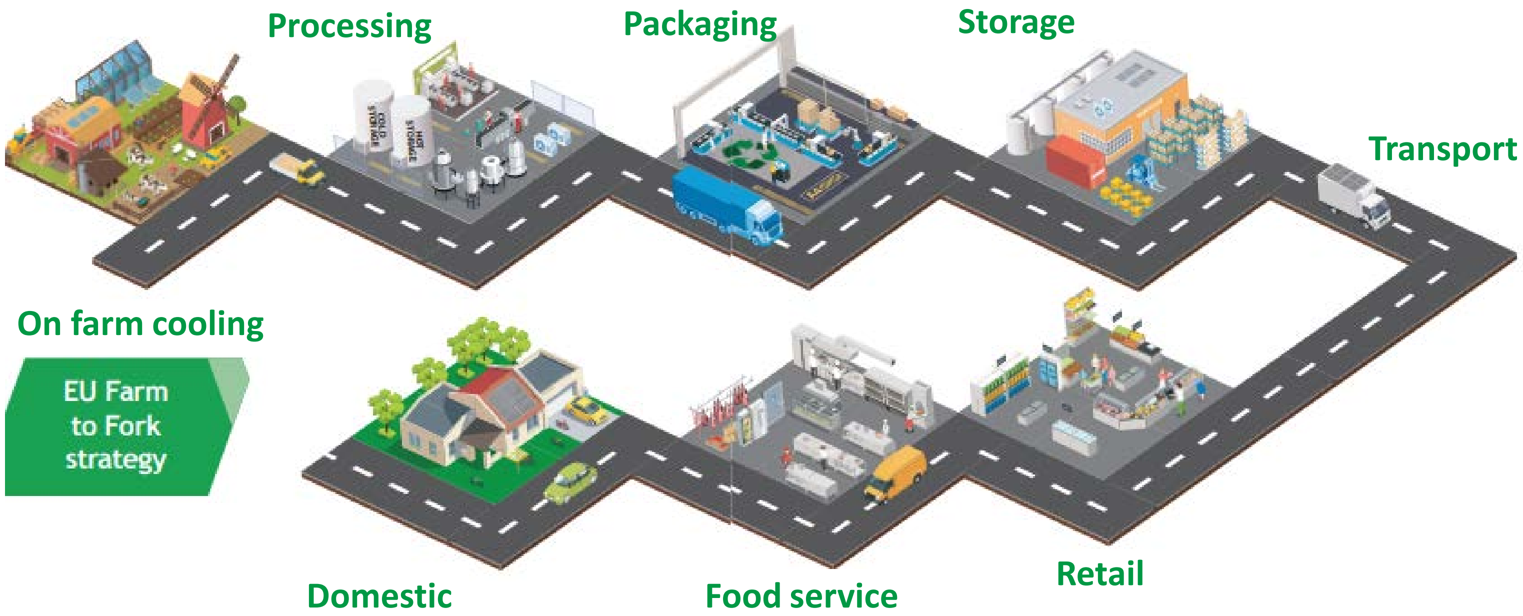
OUR BOUNDARIES IN ENOUGH

Sectors and commodities

- Perishable (needs refrigeration e.g., meat, fish, dairy, fruits and veggies)

and non-perishable food and beverages (canned food, baking, confectionary…) for human consumption.

- Post farm gate sectors: On farm cooling, processing, packaging (emissions from raw materials glass, paper, plastic.. and processing of packaging), storage, transport (refrigerated and non refrigerated, air, maritime, domestic), retail and food services, consumer



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OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Our approach

- Understand what the food/food cold-chain might **look like / need to look like in 2050**
- Identify **drivers** of change for GHG emissions in the food/food cold-chain supply chain
- Understand the **impact** of drivers and the **likelihood** of changes
- Develop the model for emissions estimation, with scenarios to achieve **resilience**

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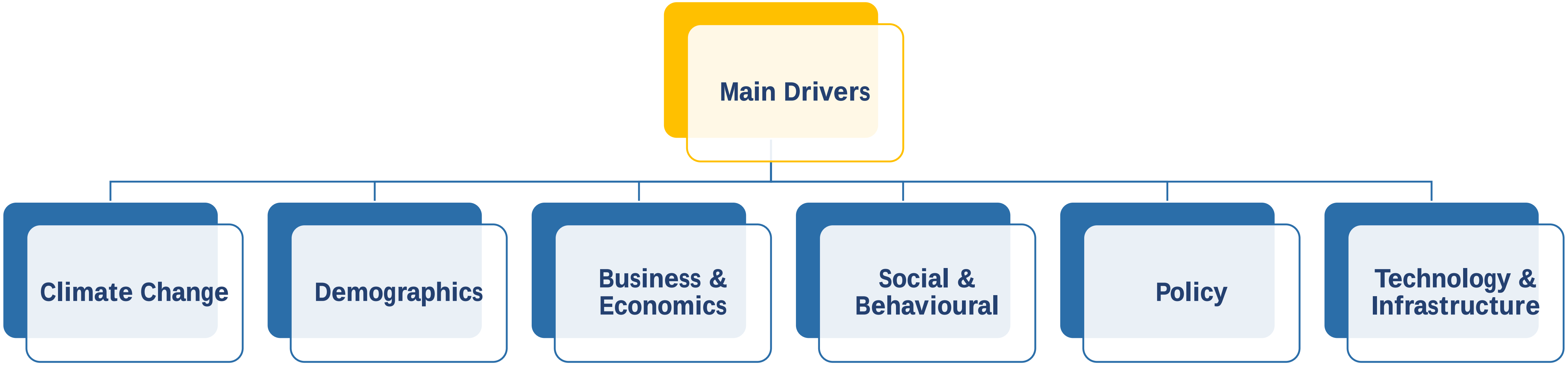
OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Step 1 Identify Key Categories - Main Drivers

Six main categories or drivers have been identified as follows:



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OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Sub - Drivers

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Note: the sub-drivers that are highlighted with yellow were further split into sub-sub-drivers

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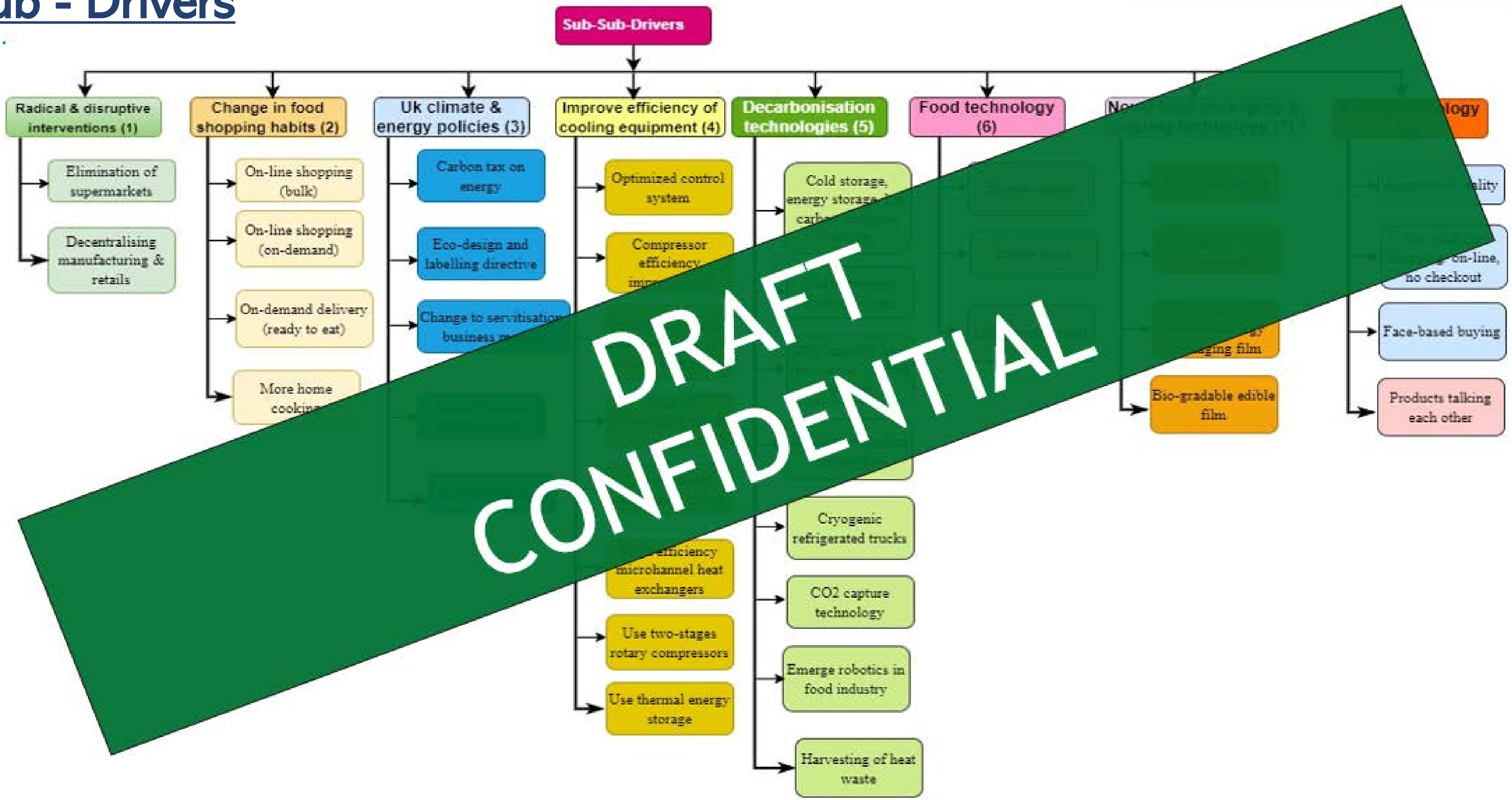
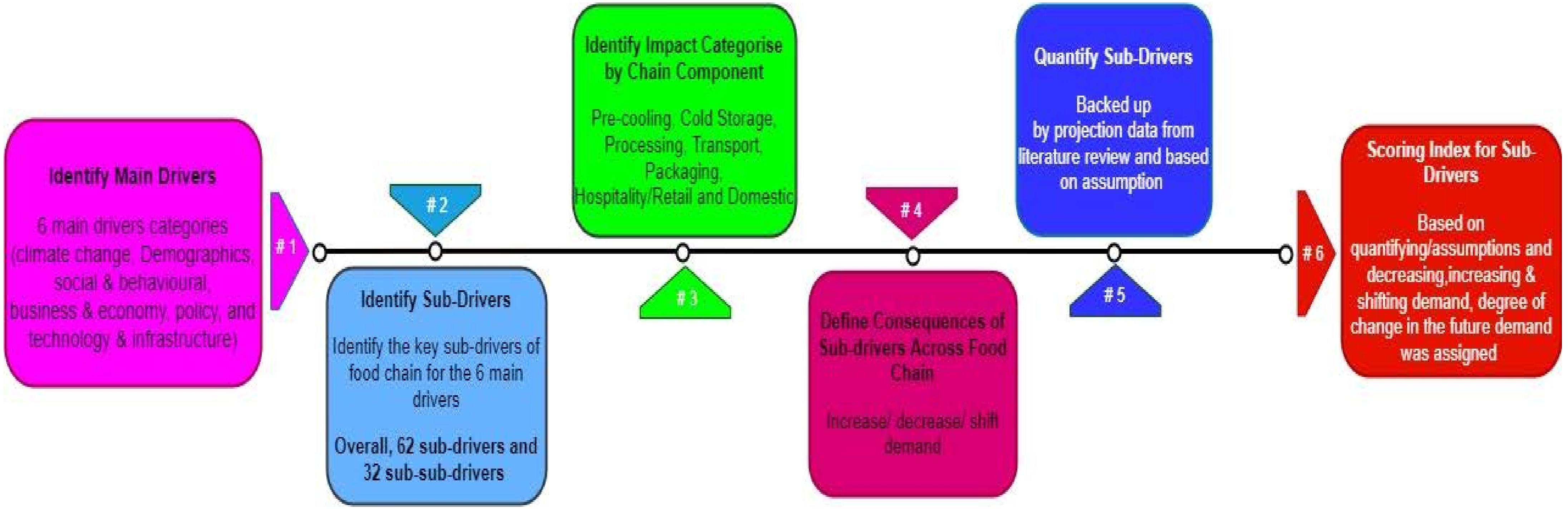
Sub- Sub - Drivers



OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Step 2 Develop the Primary Scoring Index:

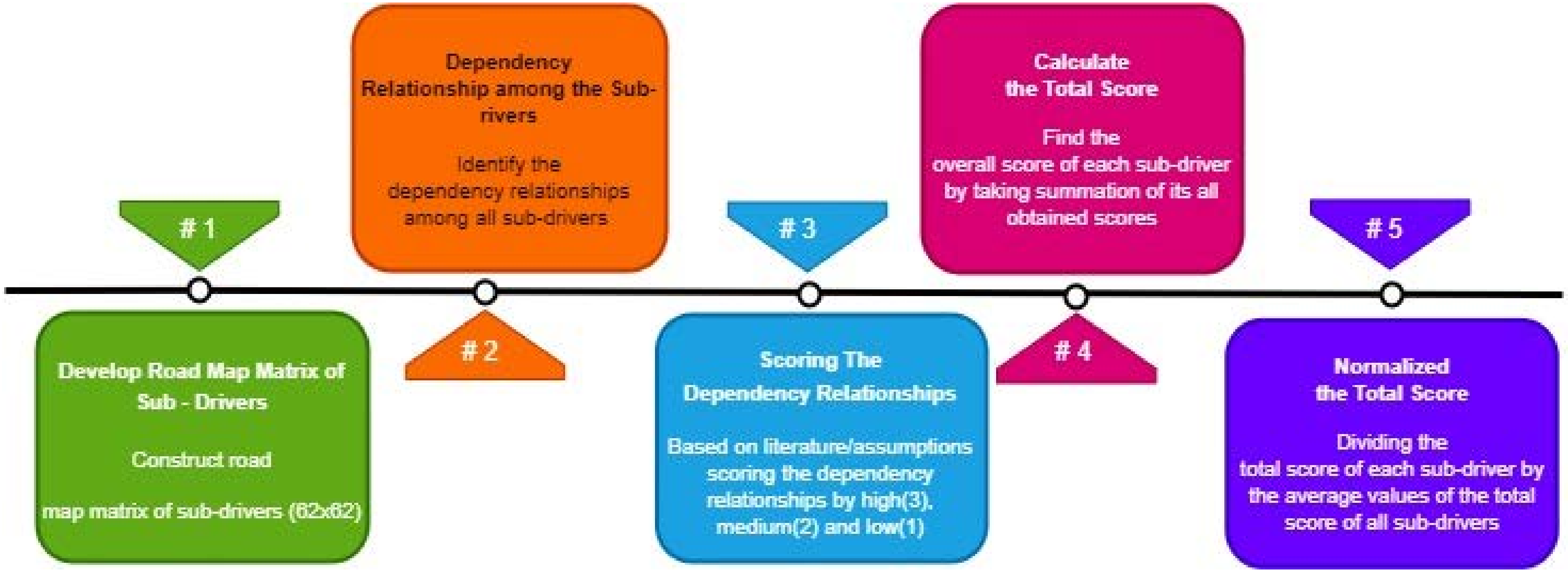
To quantify the level of impact of the sub-drivers, a primary scoring index was developed as outlined below. The quantification was made based on data gathered from data sources and academic literature, and expert knowledge.



OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Step 3 Develop of Road Map Matrix (Dependency Matrix)

This is developed to take into account the hidden impacts that arise due to dependency relationships among the sub-drivers which can not be captured by the primary scoring index. The relationships were identified based on data gathered from data sources and academic literature, and expert knowledge.



Road Map Matrix

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Main Drivers:

Climate Change

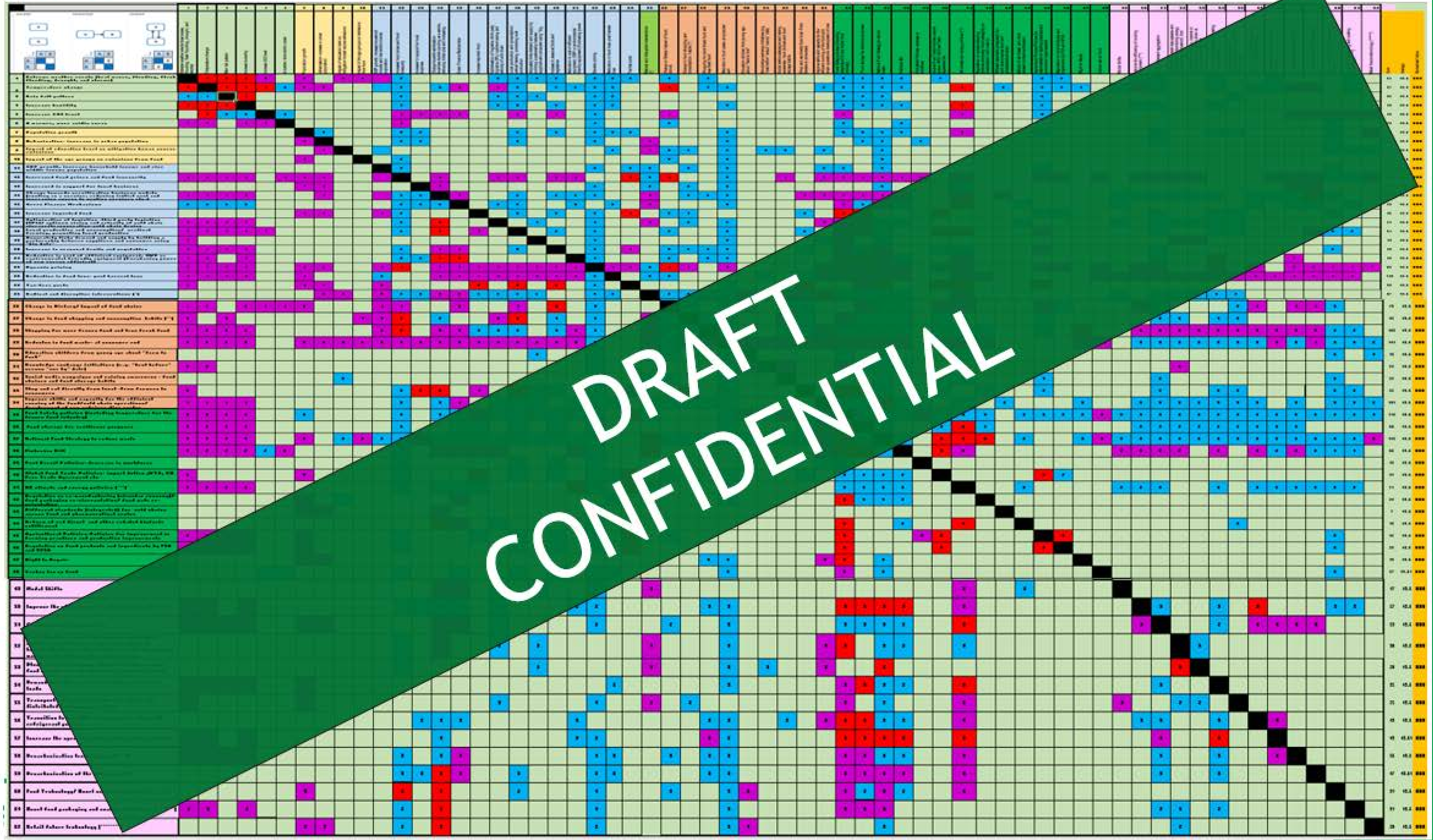
Demographics

Business & Economics

Social & Behavioural

Policy

Technology & Infrastructure



OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Win & Risk Sub-Drivers

Final Score of Sub-Driver = 0.75*Scoring Index + 0.25*Score of Dependency Relationship (Road Map Matrix)

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List Risk Sub-drivers

	#	Sub -Driver Number	Sub - Driver	Score
Risks	1	2	Temperature change	7.24
	2	7	Population growth	7.02
	3	4	Increase humidity	5.39
	4	1	Extreme weather events (heat waves, flooding, flash flooding, drought, and storms)	3.93
	5	27	Changes in food shopping and consumption habits (**)	3.24
	6	16	Increase imported food	3.23
	7	13	Increased in support for local business	2.67

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OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

List Win Sub-drivers

Wins	8	29	Reducton in food waste- at consumer end	-5.21
	9	34	Improve skills and capacity for the efficient running of the food/cold chain operations/ development of new refrigeration cycles	-5.01
	10	25	Radical and disruptive intervention[illegible]	-4.94
	11	26	Change in [illegible] choice	-4.87
	12	18	Local production and con[illegible], promoting local production	-4.81
	13	50	Improve efficiency of cooling equipment (****)	-4.79
	14	58	Decarbonisation technologies (*****)	-4.78
	15	37	National Food Strategy to reduce waste	-4.78
	16	56	Transition to low GWP refrigerants in line with refrigerant policies	-4.75
	17	59	Decarbonisation of the national grid	-4.74
	18	57	Increase the [illegible] temperature of frozen [illegible]	-4.72
	19	52	Digitalisation [illegible] and control systems/ monitoring energy [illegible] household, firm levels; Businesses adopting energy management softwares to reduce energy consumption; Warehouse management systems	-4.65
	20	28	Shopping for more frozen food and less fresh food	-4.58

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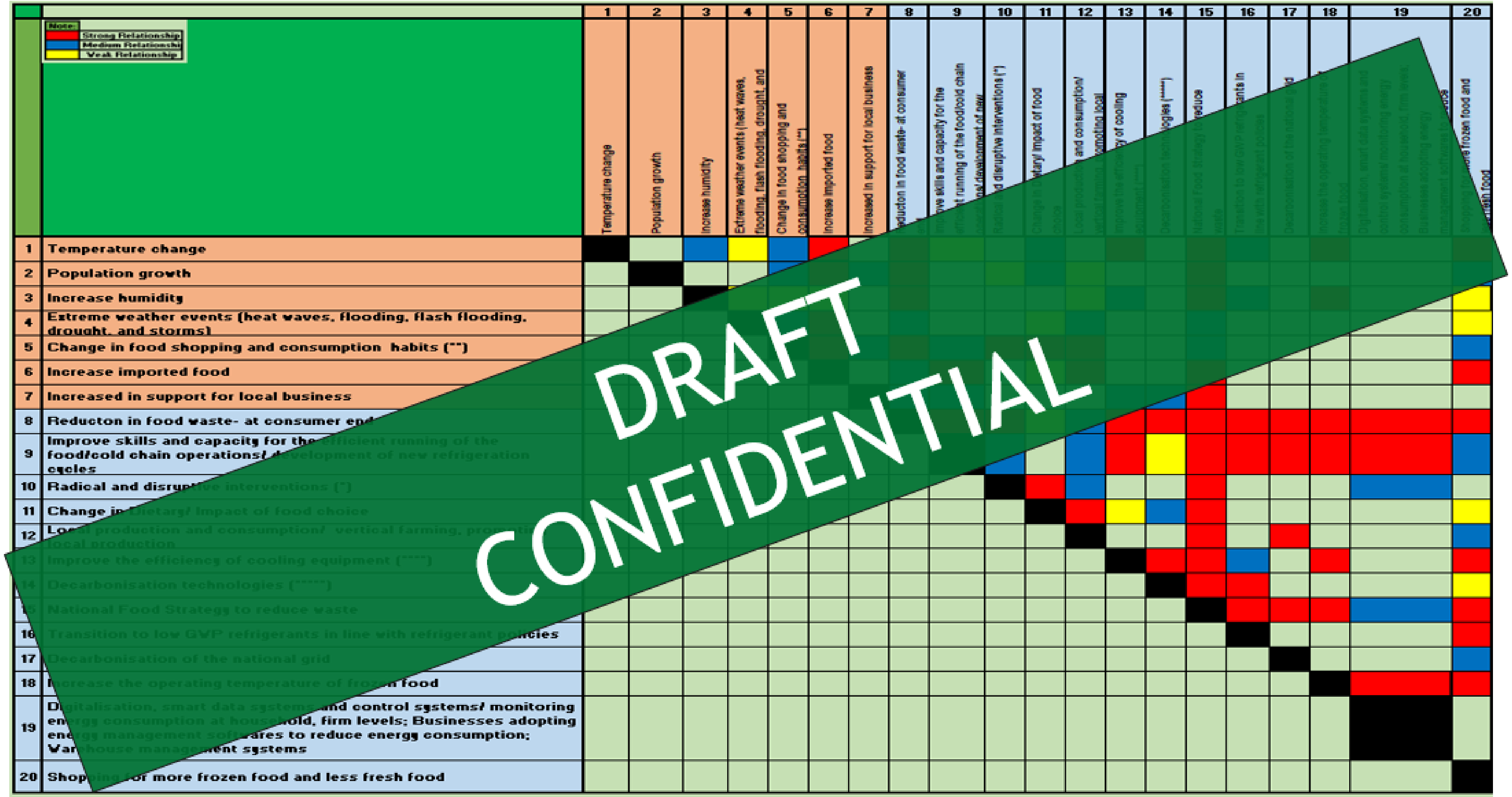
Final List Dependency Relationship



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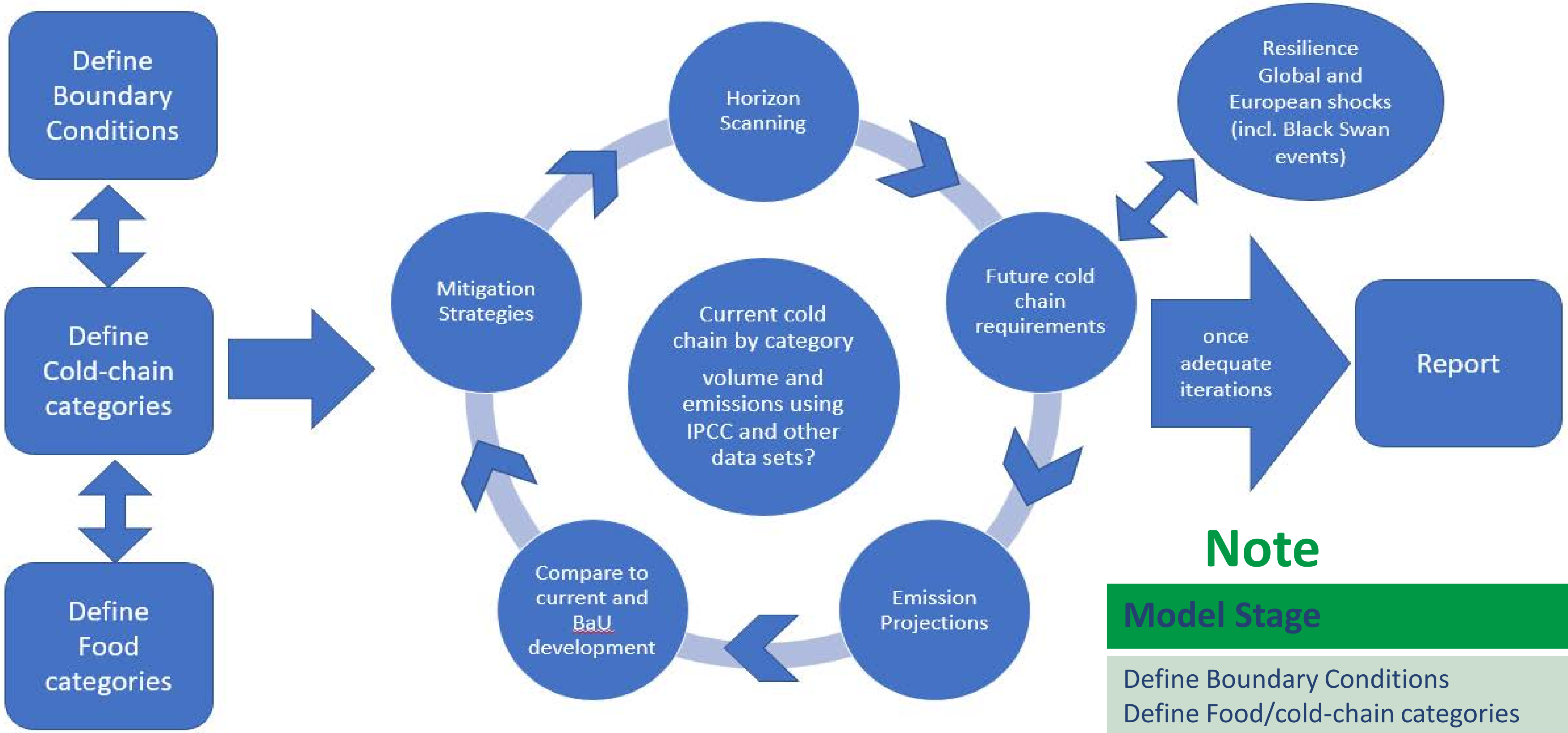
OUR METHODOLOGY: SUBDRIVERS SELECTION, QUANTIFICATION & THEIR IMPACT ON FUTURE FOOD EMISSIONS (2050)

Summary: Model Framework/ Future Quantifying Impact



Note

Model Stage	Status
Define Boundary Conditions	Done
Define Food/cold-chain categories	Done
Define food categories	Done
Horizon scanning	Done

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OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

Approaches

GHG emissions are generally estimated via two main approaches:

The Top–Down approach

- Using a top-down approach, it is not possible to allocate GHG amounts to particular sources.
- The estimation depends on the final figure of energy consumption/ emission processes.
- Can give an accurate snapshot of emissions which might be missed by incorrect assumptions in a bottom-up approach.
- Inappropriate to estimate the future emission and the potential of emission reduction through the deployment of different technologies.

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OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

The Bottom-Up approach

- Using a bottom-up approach allows for the allocation of GHG amounts to particular sources.
- The reliability of this approach depends on the availability of detailed data on energy consumption/ emission processes.
- Provides significant insight into the specific source of emissions and importantly what specific actions can be taken to reduce emissions.
- Appropriate to estimate the future emission and the potential of emission reduction through the deployment of different technologies.

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OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

The way we are proceeding:

- Develop baseline year database (2019) “Bottom-Up Approach”
- Understand the **business-as-usual** emissions
- Identify **drivers** of change for GHG emissions of the food supply chain
- Understand the **impact** of drivers and the **likelihood** of changes
- Develop the model for emissions estimation, with scenarios to achieve **resilience**

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OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

Purpose

- Estimate the energy demand, cooling demand, and GHG emissions from the UK food chain (from farm gate to fork.
- The model is based on a bottom-up approach.
- Food considered - meat, poultry, fish, milk, fruits, and vegetables (Chilled and frozen food)
- The food cold chain stages: pre-cooling, cold storage, processing, packaging, transportation, service (retail and hospitality), and household consumption.
- So far, we have only estimated energy and cooling demand. The GHG emissions will be estimated later.

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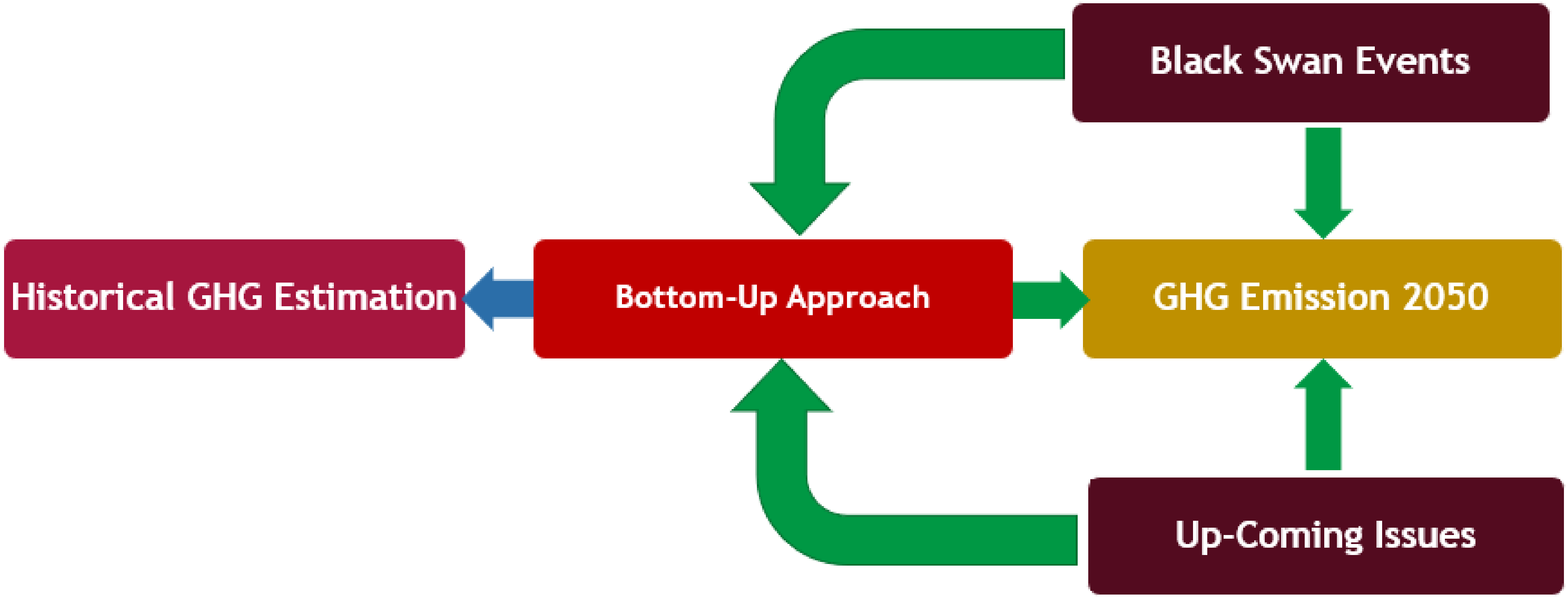
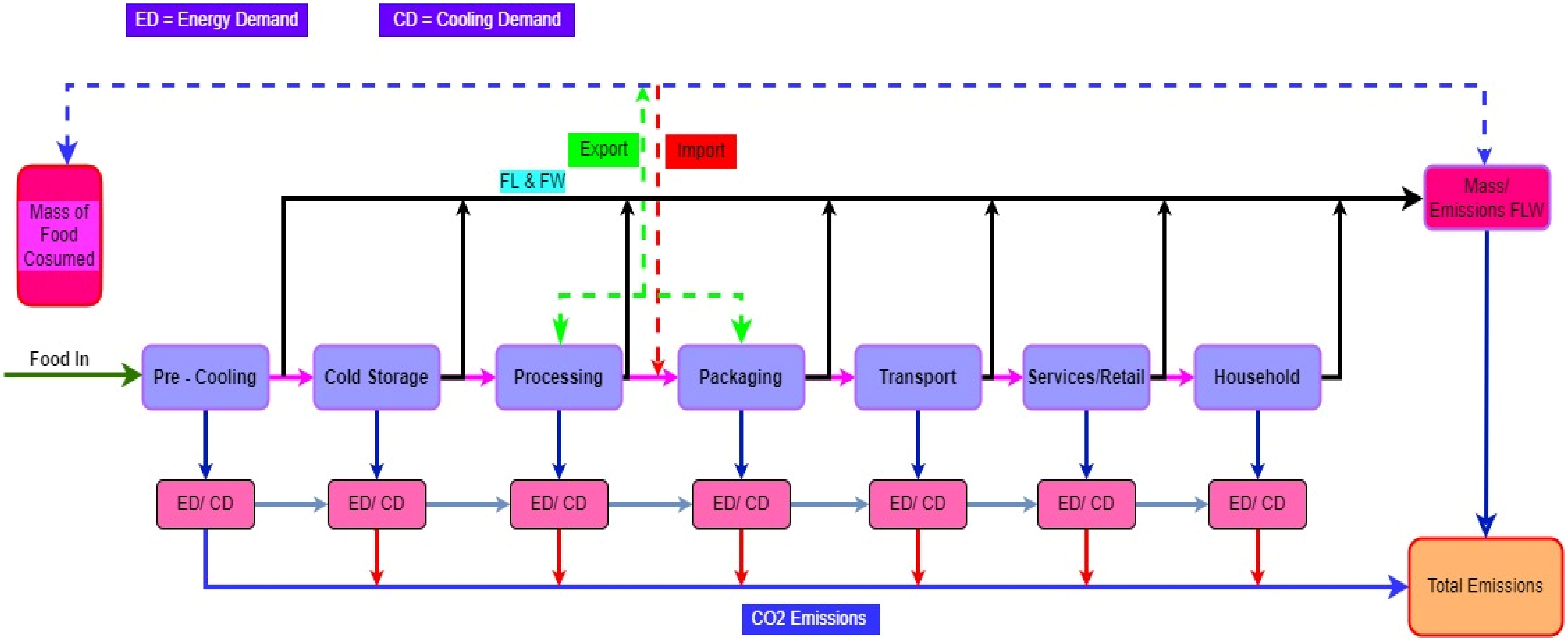
OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

Model Structure



OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

Bottom – Up Approach



OUR MODEL: TOP-DOWN AND BOTTOM-UP APPROACHES AND FIRST FIGURES

First figures for UK

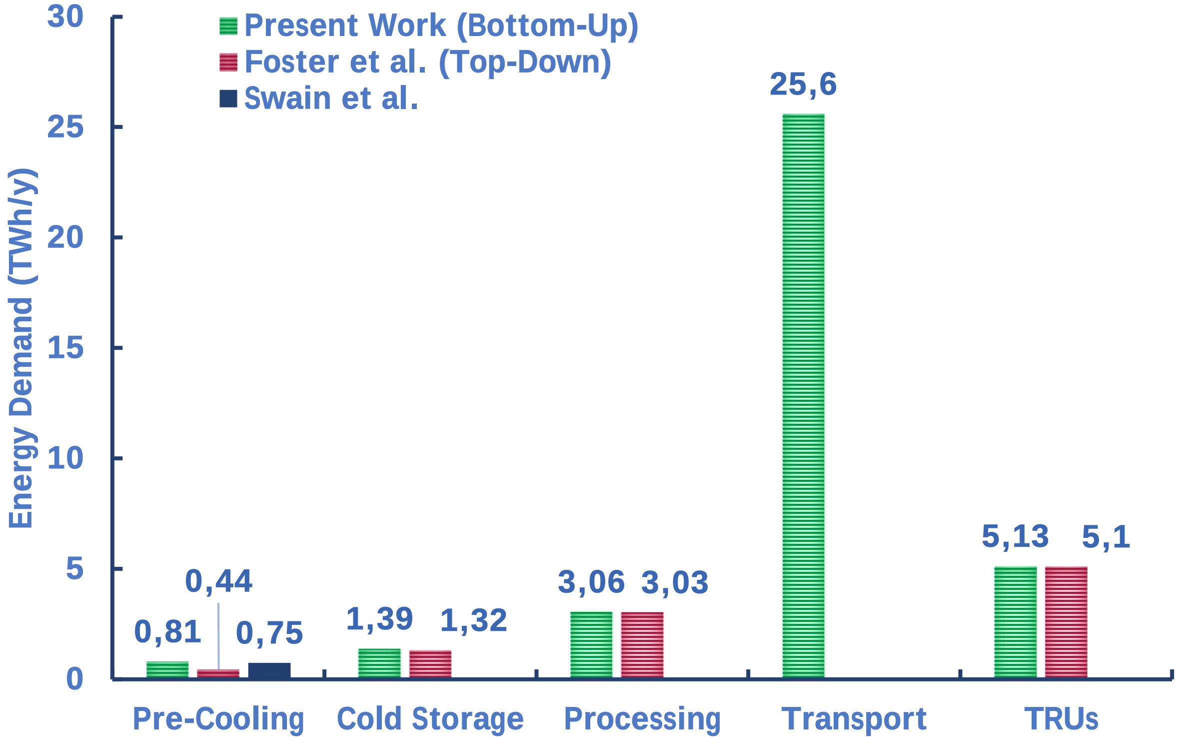


Fig.1: The estimated energy demand for different stages of the UK food cold chain in the baseline year 2019. The figure includes the comparison of the results of the present work (the baseline year 2019) and of Foster et al. (2022). Only pre-cooling is compared with Foster et al. (2022) and Swain et al. (2008).

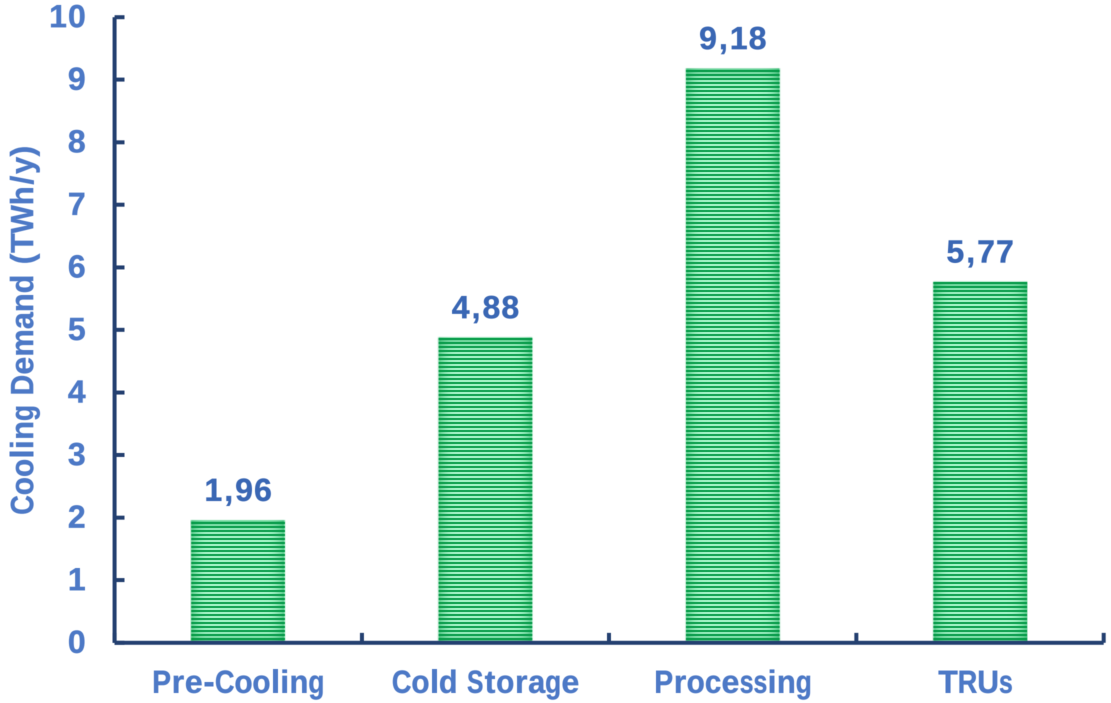


Fig.2: The estimated cooling demand for different stages of the UK food cold chain of the present work in the baseline year 2019.

CONCLUSIONS AND FUTURE STEPS

- Boundaries and horizon scanning performed → main drivers and subdrivers → model set up (Bottom- up)
- 2020 emissions database for food supply chain sector for the consortium members countries using the Top-down approach.
- 2020 emissions database for food supply chain sector for the consortium members countries using the Bottom-up approach.
- Sense checking both approaches and compare data with other inventories- detect and understand the deviations – will help with boundaries standard to estimate emissions from the sector.
- Predict the 2030 and 2050 emissions on an annual basis applying the BAU (no technology change but accounting for the defined drivers and sub drivers).
- Perform uncertainty analysis.
- Estimations to show the level of challenge to achieve the sector net zero in 2050 and what can be achieved by 2030.
- This work will help to set new policies and legislations towards zero carbon.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101036588

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EUROPEAN FOOD CHAIN SUPPLY TO REDUCE GHG EMISSIONS BY 2050

THANK YOU !

Also possible to write us:


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enough-emissions.eu