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A model-based assessment of the Greek National Energy and Climate Plan under a water-energy-food-emissions nexus context

Ljubljana, September 2025

Koundouri P., Alamanos A., Arampatzidis I., Devves S., Dellis K., Deranian C.,

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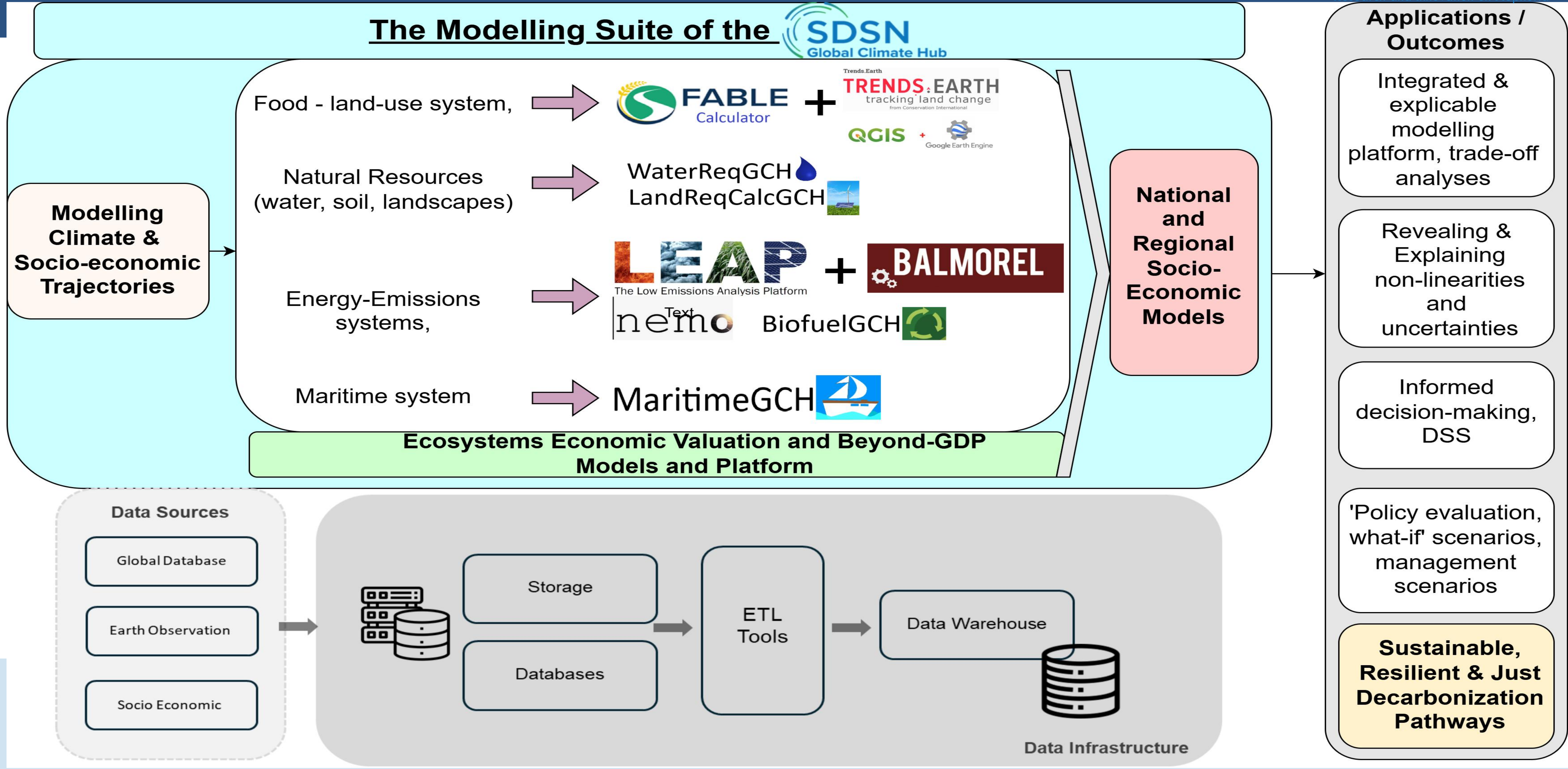
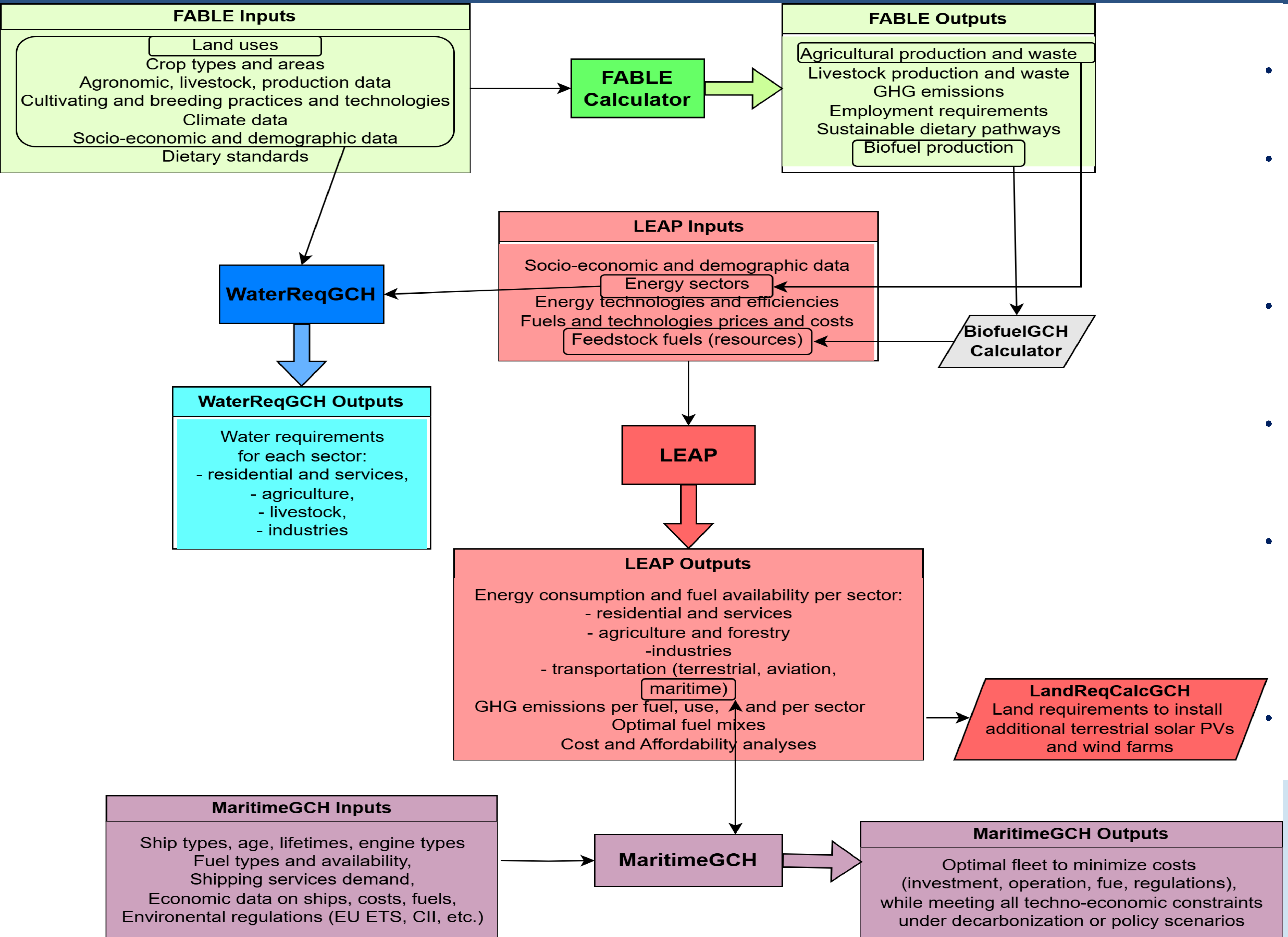
A novel integrated modelling system



Model integration



- FABLE Calculator (Mosnier et al., 2020) for the potential evolution of food and land-use systems;
- the Low Emissions Analysis Platform (LEAP) (Heaps, 2022) for the simulation of the energy consumption and the associated GHG emissions of multiple pollutants;
- MaritimeGCH for the simulation of the shipping sector's climate-neutrality (Alamanos, Koundouri, et al., 2024)
- WaterRequirements accounting tool (Alamanos & Koundouri, 2024) for the estimation of the water requirements of the studied sectors
- LandReqCalcGCH model to estimate the land requirements for any potentially additional renewable energy production units.

- All the models run under a common simulation period, 2020 to 2050, at an annual time-step.

Simulated scenarios for Greece

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The simulation considers two scenarios:

(a) the do-nothing scenario (business-as-usual - **BAU**) which assumes that the current trends will continue applying until 2050;

(b) the **NCNC** (National Climate Neutrality Commitments) scenario which assumes that the main sector climate-neutrality policies are jointly implemented. [e.g. cleaner fuels & increased energy efficiency]

The main policy instrument was simulated for each sector.

Other policies that are not considered in this study concern mostly economic measures, which were not simulated because this example does not include economic models. Ecosystems Economic Valuation & Beyond-GDP models, and General Computable Equilibrium (GCE) models are included in our future research plans.

Sectors	Main policy instruments simulated for the NCNC scenario
Residential, Industry, Transportation, Services	The **Greek National Energy and Climate Plan (NECP),** as defined by the Greek Ministry of Energy and Environment (2024), assumes certain interventions per sector. These refer to improvements of energy use efficiencies and cleaner energy mixes.
Food-land system, Agricultural production-based and energy-based systems	The **Greek CAP,** aligned with the broader EU CAP framework, clearly acknowledges the need to boost agricultural productivity, promote sustainable diets (reducing meat) within the constraints of limited land, and enhance energy efficiency in agriculture. To model such a trajectory, considering land-use, GHG emissions and costs, we developed a high crop and livestock productivity scenario within FABLE Calculator, corresponding to the NECP (and CAP) requirements by 2050.
Shipping sector	The NCNC assumes energy use efficiencies' improvements and cleaner energy mixes; however, there are no specific interventions, and still no Greek plan on shipping, aligned with the 2024 EU regulation. A moderate transition scenario to cleaner fuels was simulated, along with a combination of on-ship emission-reduction technologies was simulated to reflect the NCPC scenario, reflecting both the **NECP and the IMO's and EU ETS regulation targets.**
Water consumption	The European Union's Water Framework Directive (WFD) 2000/60/EC establishes a comprehensive framework for water policy, implemented through **the River Basin Management Plans (RBMPs), which outline Programmes of Measures (PoMs)** to address identified issues. While the RBMPs focus on protecting and managing water resources, they do not set explicit sector-specific water consumption reduction targets or measures. In this scenario, we assumed an improvement of water use efficiency by reducing water losses (LC).

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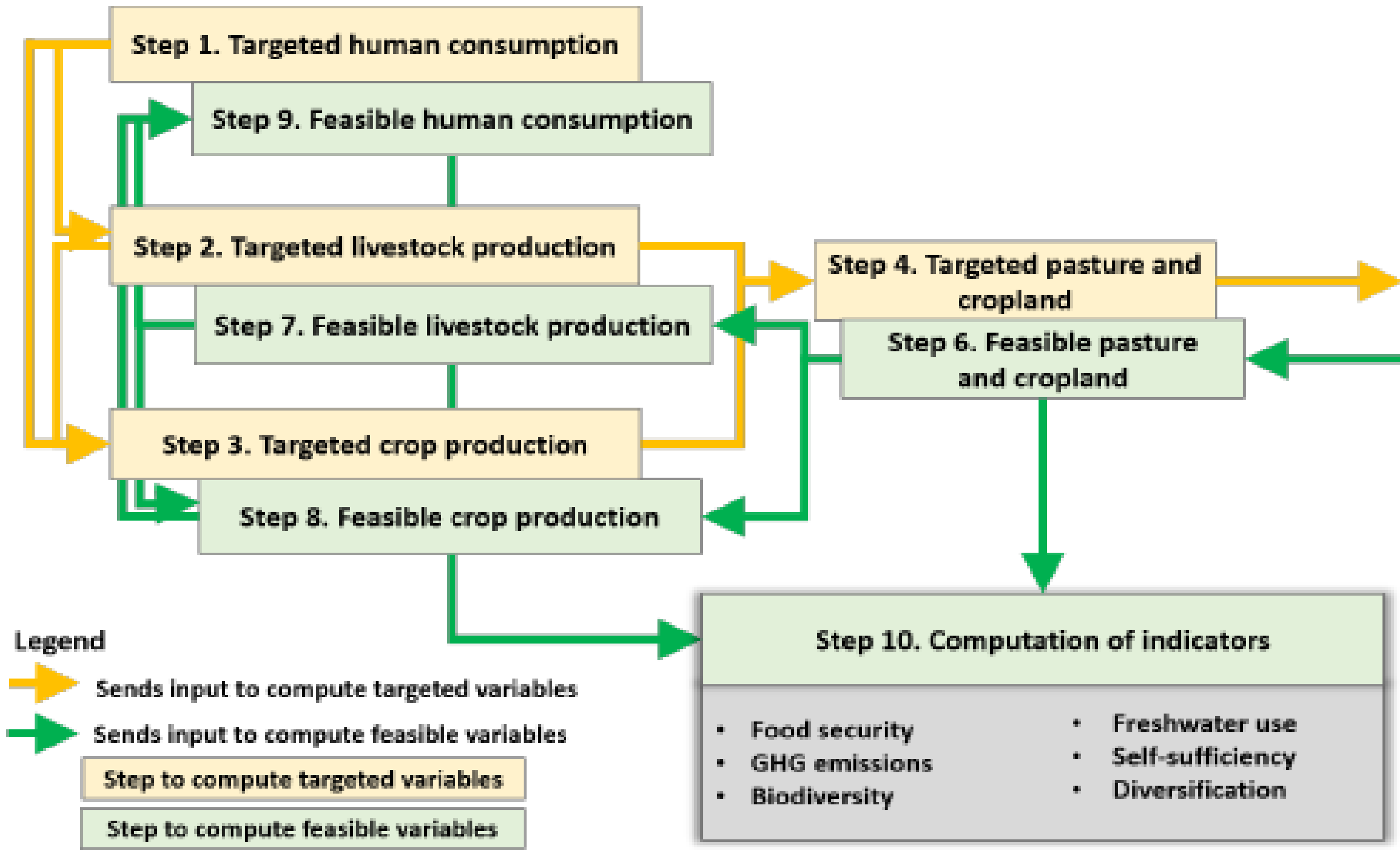
Food-Land system

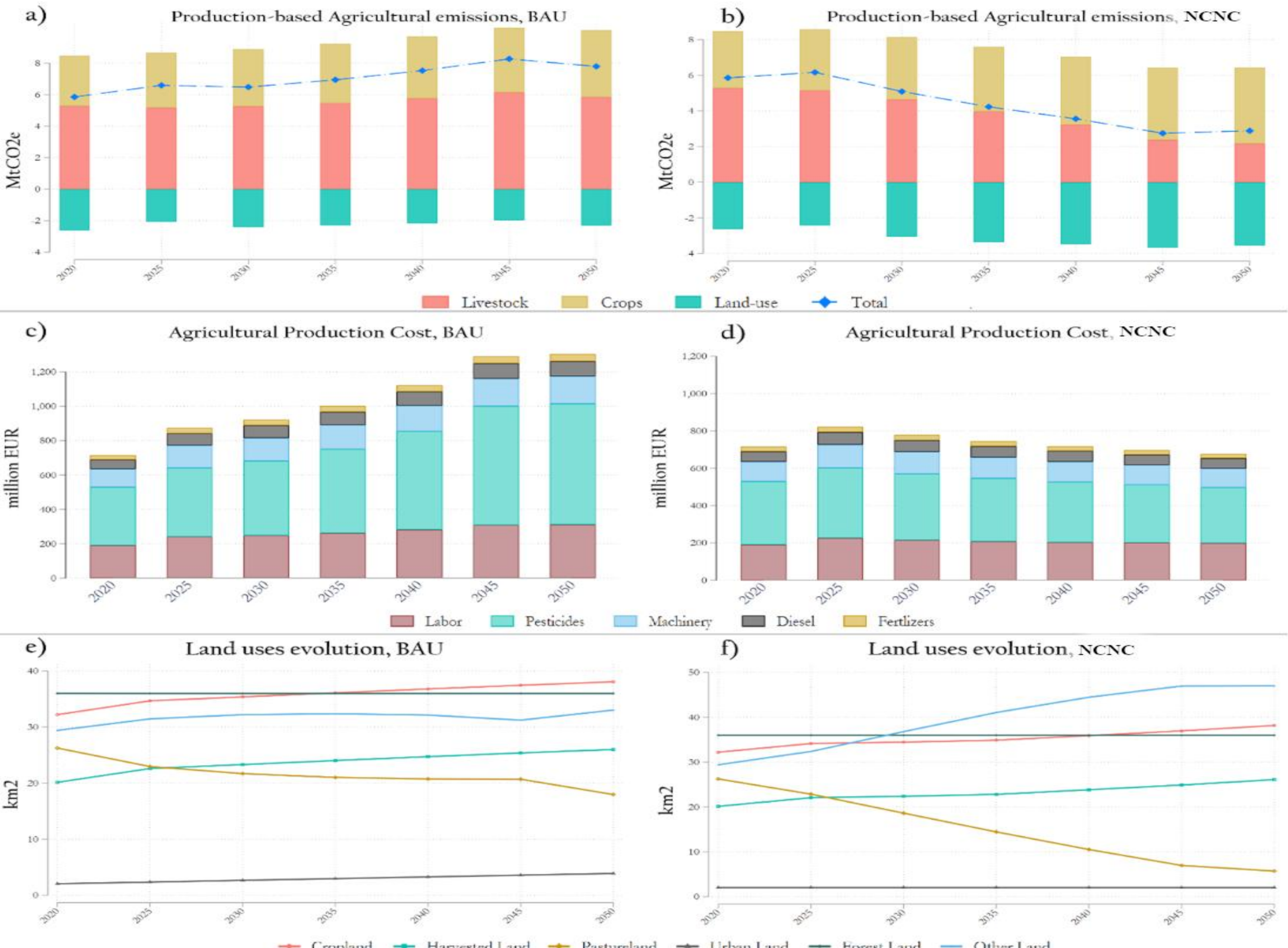


FABLE Calculator

- FABLE Calculator is a simulation tool for land use, agriculture, and food system scenarios.
- Excel-based Accounting Tool to project sustainable pathways including 88 raw and processed agri-food indicators
- Demand-based approach based on targeted human consumption.

- Uses FAOSTAT and CORINE data on crops, livestock, climate, and socio-economics.
- Models land allocation for agriculture, livestock, forestry, and bioenergy under constraints [Crop & Livestock targeted Production constrained by land availability and regulatory restrictions].
- Offers 1.5 billion scenario pathways by adjusting climate, policy, and demographic assumptions.
- Calculates GHG emissions from agriculture, including fertilizer use, livestock, and manure management.

Food-Land system Results



- **GHG Emissions:** The NCNC scenario cuts agricultural GHG emissions by 50% (3MtCO2e) by 2050 compared to BAU, mainly through reduced livestock emissions and increased land-based carbon withdrawals.

- **Production:** Higher agricultural productivity in NCNC improves climate mitigation and competitiveness, with a clear divergence from BAU after 2035, especially in crop-related emissions.

- **Costs:** Total agricultural costs drop from €828M (2025) to <€630M (2050) in NCNC, mainly due to a 27.5% reduction in pesticide expenses and a 14.8% decline in fertilizer costs.

- **Land Use:** Pastureland shrinks by 78% from 2020 to 2050 in NCNC due to diet shifts and productivity gains, leading to a surge in land categorized as "Other" in the FABLE Calculator.

Cross-sectoral Energy-Emissions Analysis

Energy Demand		
Sectors	Activity Level (AL)	Energy uses (and energy intensity, EI)
Residential	Population (distinguished between urban and rural)	Lighting, cooking, space heating, space cooling, water heating, and other appliances
Industry	Value Added of each industry product, or tons of product	Food and tobacco, textiles and leather, wood products, paper pulp and printing, chemicals and chemical products, rubber and plastic, non-metallic minerals, basic metals, machinery, transport equipment, other manufacturing, mining, cement and steel production
Agricultural energy use	Agricultural products (FABLE Calculator's output)	Energy used for the agricultural and livestock products
Transportation	Passengers and freight in passenger/km or tons/km	Cars, light trucks, motorcycles, buses, trains, domestic airplanes, shipping, freight trucks and trains
Services	Number of public buildings	Tertiary sector services
Energy Supply (fuels' production processes to cover the demand)		
Primary Resources	Solar, crude oil, coal lignite, hydropower, wind, coal, municipal solid waste, biofuels	
Secondary Resources	Diesel, petroleum coke, refinery feedstocks, residual fuel oil, kerosene, CNG, LPG, gasoline, Hydrogen, biogas, oil, heat, electricity, synthetic fuels	
Transformation processes	Transmission and distribution, synthetic fuel production, generation of hydrogen, electricity, heat, oil refining – with the associated losses	
GHG emissions		
Types of pollutants	CO_2, CH_4, N_2O, PM2.5, Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur Hexafluoride (SF_6), Black Carbon (BC), Organic Carbon (OC)	

LEAP (Low Emissions Analysis Platform)

•Detailed representation of all sectors' energy uses.

The energy demand (D) has been calculated as the product of an activity level (AL) and an annual energy intensity (EI, energy use per unit of activity), according to LEAP's Final Energy Demand Analysis method

$$D_{sector,scenario} = AL_{sector,scenario} \cdot EI_{sector,scenario}$$

•Detailed representation of all primary feedstock fuels, secondary fuels & their transformation processes to feed the demand.

•The GHG emissions are then estimated automatically, based on the emission coefficients of the IPCC's Fifth Assessment Report (IPCC, 2014) per sector, per use and per fuel type for the demand side, and per process for the supply side.

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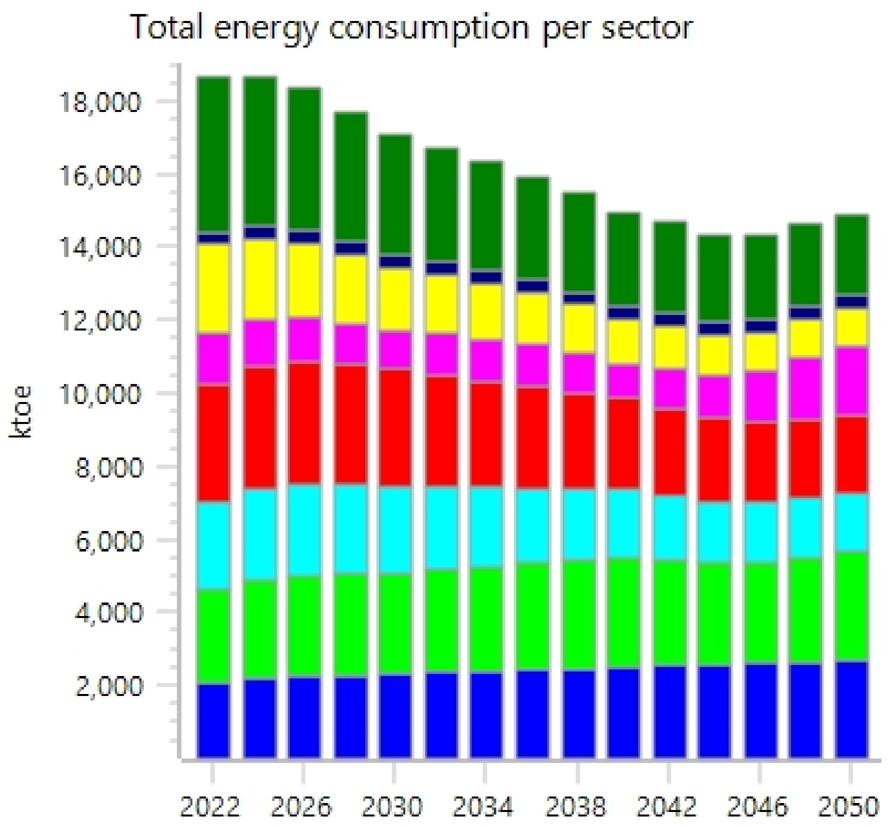
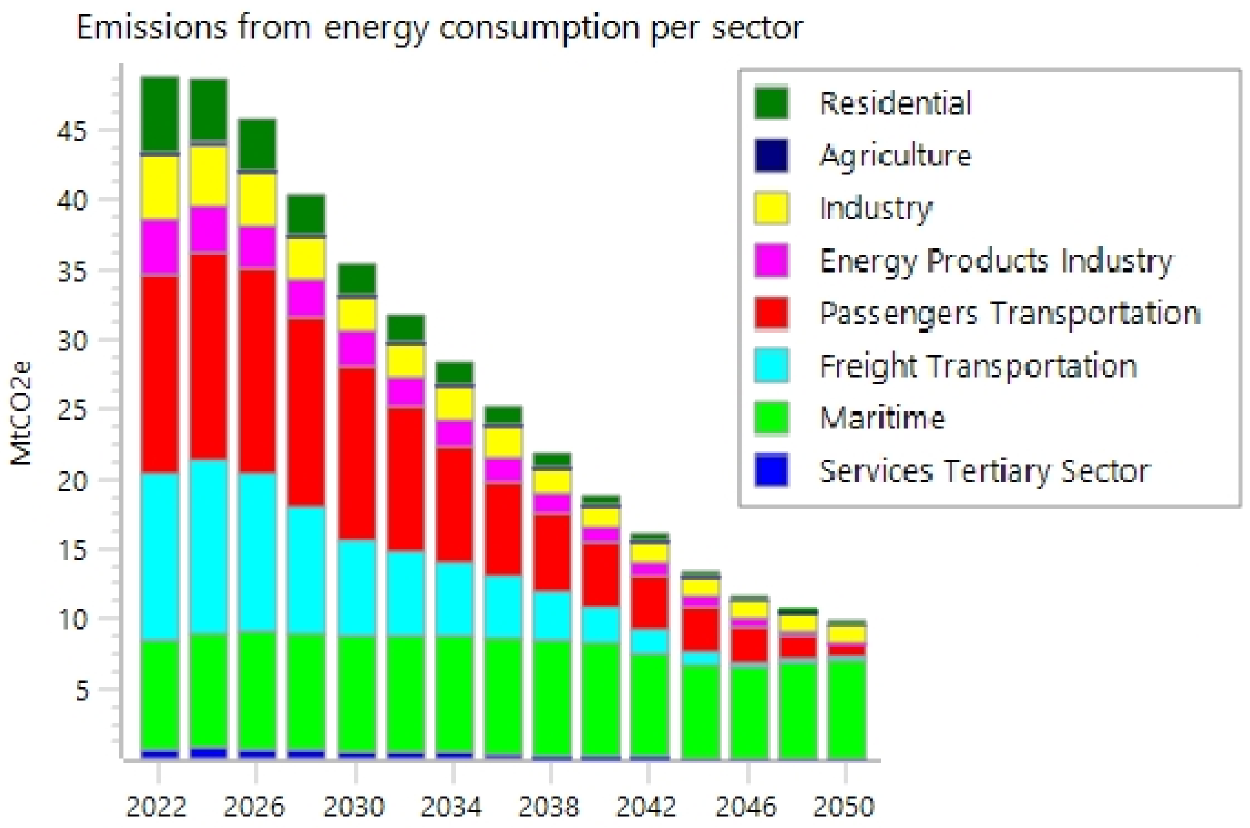
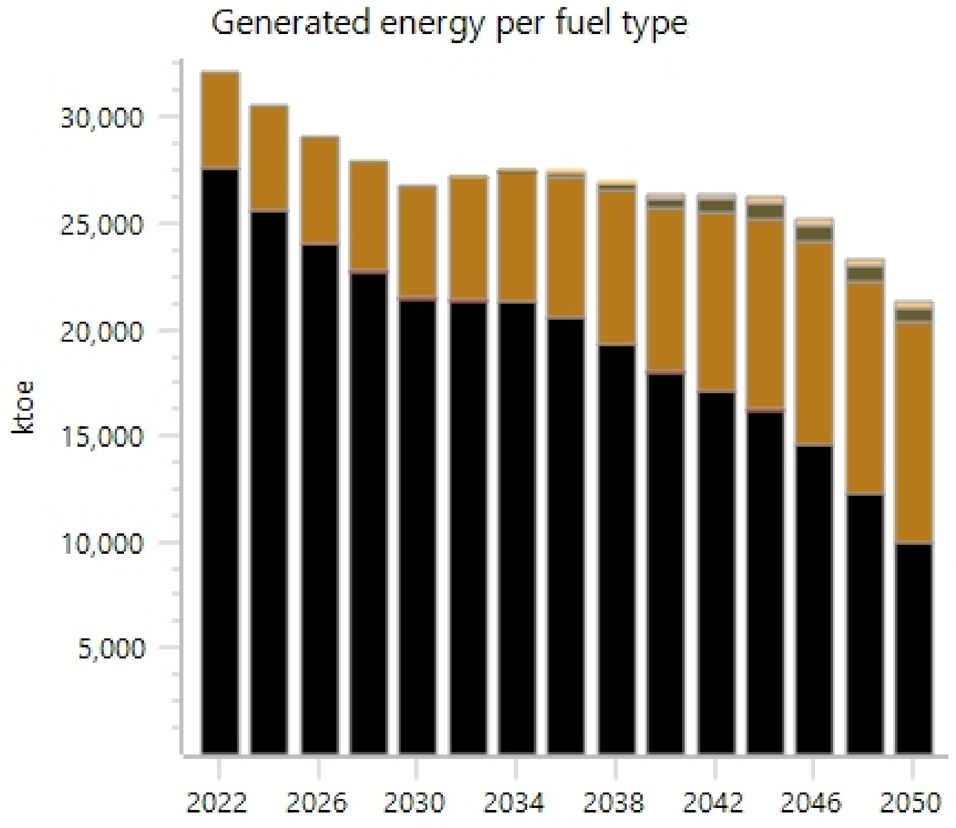
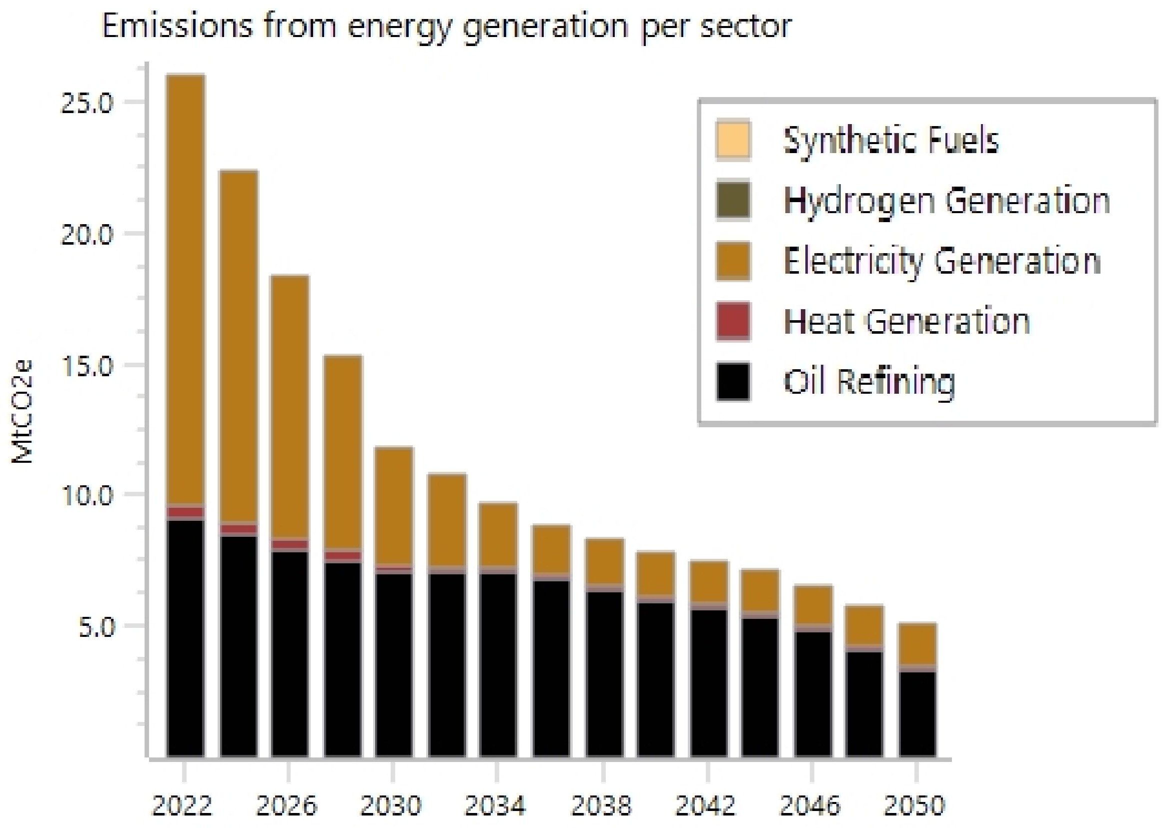
Cross-sectoral Energy-Emissions Results









- **Energy Consumption & Emissions:** The NCNC scenario reduces total energy demand by 23%, with industry (-58%) and transport (-34%) seeing the largest drops. Residential energy use declines due to population shrinkage & improved efficiencies, while services (+28%) and agriculture (+15%) increase.

- **Energy Supply Shift:** Oil refining drops 3x, while electricity production rises by 6.5 Mtoe in 2050. Hydrogen and synthetic fuels contribute 1.1 Mtoe and 571 ktoe, reducing reliance on fossil fuels and cutting GHG emissions from 26MtCO_2eq (2022) to 5.2MtCO_2eq (2050).

- **Renewable Expansion:** NCNC projections lead to 77% less natural gas use, complete lignite phase-out, and a 540% increase in wind/solar by 2050. Hydropower grows 120%, accelerating the clean energy transition.

- **GHG Emissions (100-Year GWP) Reduction:** NCNC achieves a 91.7% cut in emissions by 2050, reaching near total decarbonization, while BAU trends upward.

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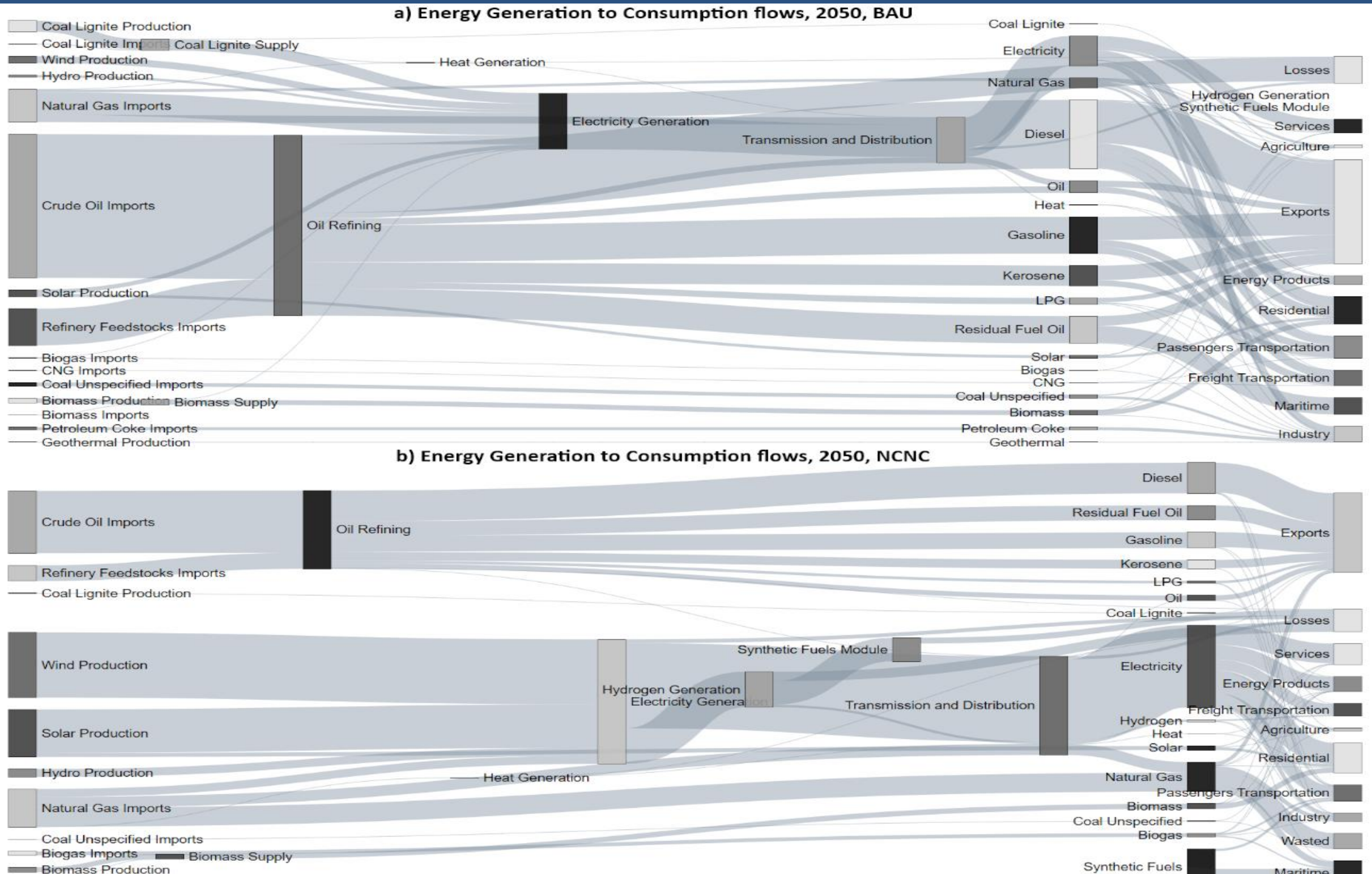
Cross-sectoral Energy-Emissions Results



Energy generation to consumption flows:

- We achieved a great level of modelling detail & granularity
- Significant decrease in fossil fuel use across the residential, industrial, and transportation sectors, one of the core recommendations of the NCNC.
- Adoption of renewable energy sources in electricity production – coupled with the introduction of hydrogen and synthetic fuels, particularly in the transportation sector – further contributes to these reductions.

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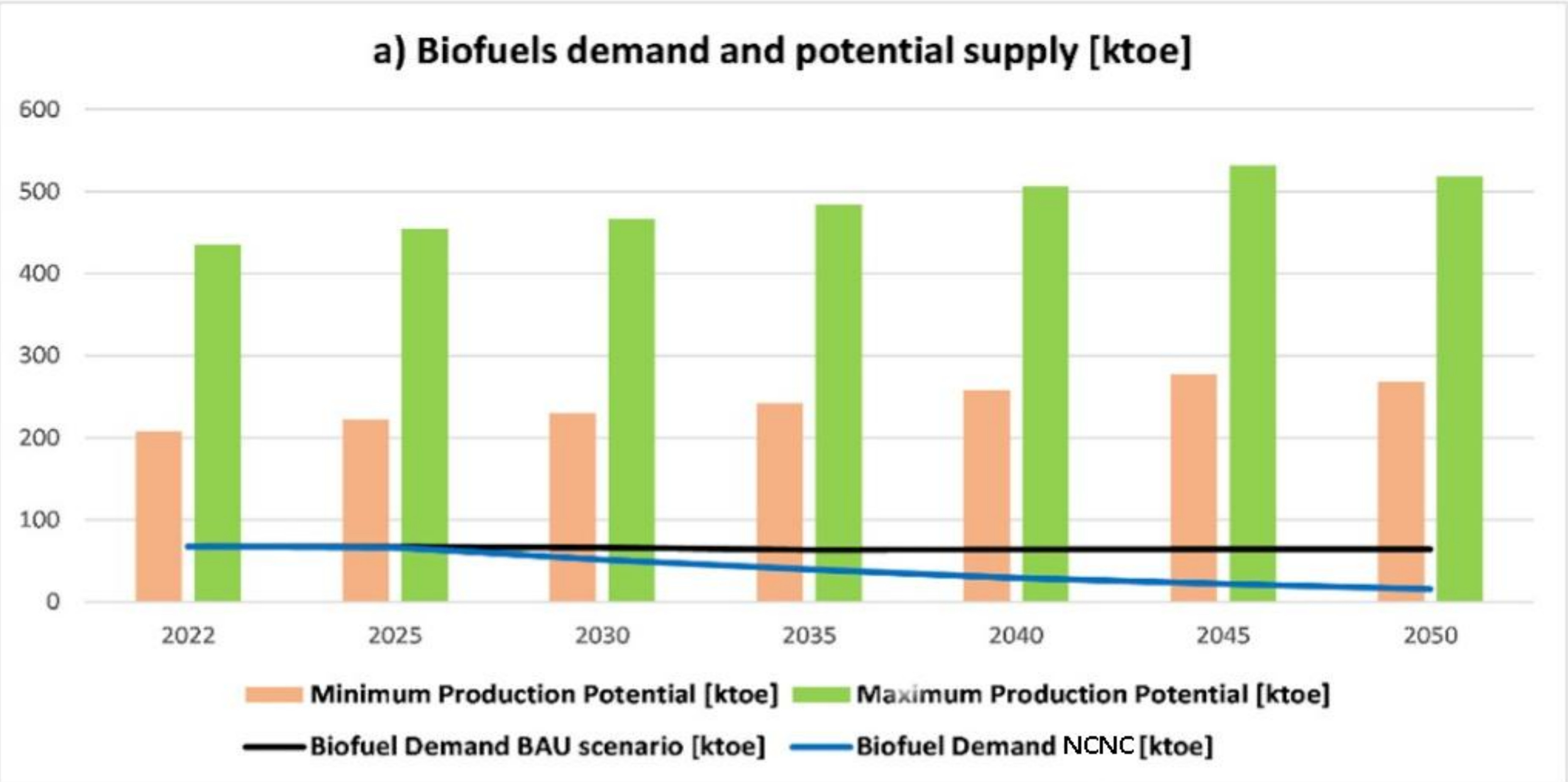
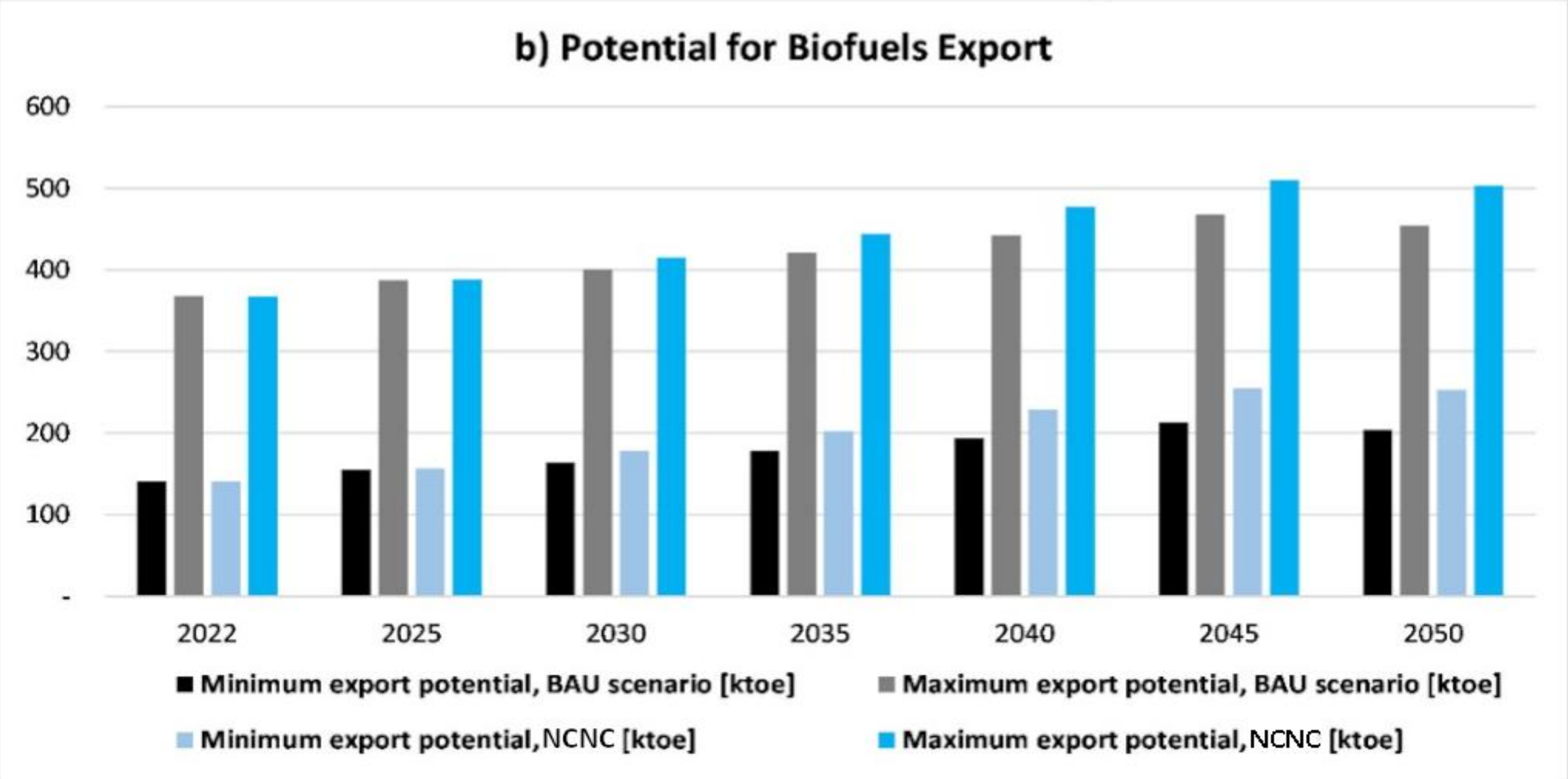
Biofuel production potential





The BiofuelGCH Calculator uses FABLE Calculator's outputs (crop & livestock products' residues) that are eligible & available for biofuels production (e.g. bioethanol & biodiesel)

$$Biofuel\ production\ potential_{\text{biofuel type}} = Residual\ Availability_{\text{selected crop}} \cdot Biofuel\ Production\ Coefficients_{\text{biofuel,crop}}$$

- The results indicate that there is a significant potential to produce biofuels domestically, ranging from 208-435ktoe in 2022 to 268-519ktoe in 2050.
- This production can fully cover the biofuel demand from uses such as agriculture, energy production and transformation processes, and the excess amount can be used for exports.
- This is an important finding for Greece, which currently imports biofuels & has no plan so far to utilize them for other sectors such as shipping (despite the recommendations of the recent IMO's FuelEU Maritime regulation).

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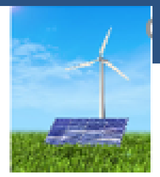
Needs for additional renewable energy infrastructure

LandReqCalcGCH



The LandReqCalcGCH model receives inputs from LEAP regarding the future energy mix, and estimates the land requirements for additional solar panels and onshore wind farms installation:
The implementation of the NCNC, requires in total 35051MW of solar energy, and 24780MW of wind power in 2050. This corresponds to an additional capacity of 28051MW and 16280MW respectively, compared to the current (2025) solar and wind power. Moreover, the NCNC projects that 52.46% of the wind power will be onshore, while the rest should be offshore. So, this results in 8541MW.

- The LandReqGCH model, based on these figures, uses typical values from the literature to convert these additional required capacities in solar and wind power into land requirements (km2) for the installation of additional solar panels and wind farms (onshore). These values from the literature are used as land conversion coefficients (km2/MW), taking into account the types of land uses, and the types of projects, and considering a range of options, according to Denholm et al. (2009) and Ong et al. (2013).

$$Land\ Requirements_{\text{renewable source}} = (Required\ production\ capacity_{\text{renewable source,onshore}} - Current\ production\ capacity_{\text{renewable source,onshore}}) \cdot Area\ Conversion\ Coefficient_{\text{renewable source,land use type,project type}}$$

- So, for solar panels that would range from 670km2 (min) to 846km2 (average) and to 1022km2 (max). The onshore wind farms would require from 19km2 (min) to 25km2 (average) and to 35km2 (max).

- Regarding the solar panels, the cost would range (min-average-max) from 1005million€ to 1269million€ and to 1533million€. The respective costs for the wind farms would range from 18.8 million€ to 25.3million€ and to 35million€.

Further focus on shipping, a pillar of the Greek economy

MaritimeGCH

- The MaritimeGCH model is an Investment Decision Support Tool (IDST), based on dynamic linear programming optimization (Alamanos & Koundouri, 2024; Alamanos, 2025).

- It minimizes the total cost of fleet operations over a user-defined planning horizon (in years, from 2020 to 2050 in this case). The total cost includes investments for new-build ships, operational costs of the fleet, fuels costs, and any allowance that must be purchased in the case of excess emissions, according to the EU's Emissions Trading System (ETS).

$$min \sum_{y=2020}^{2050} (total\_cost_y), \text{ where}$$

$$total\_cost_y = \sum_s (new\_ship_{y,s} \times invest\_cost_s) + \sum_s (stock\_ship_{y,s} \times op\_cost_s) + \sum_s (fuel\_demand_{y,f} \times fuel\_cost_f) + (excess\_emissions_y \times ETS\_price_y)$$

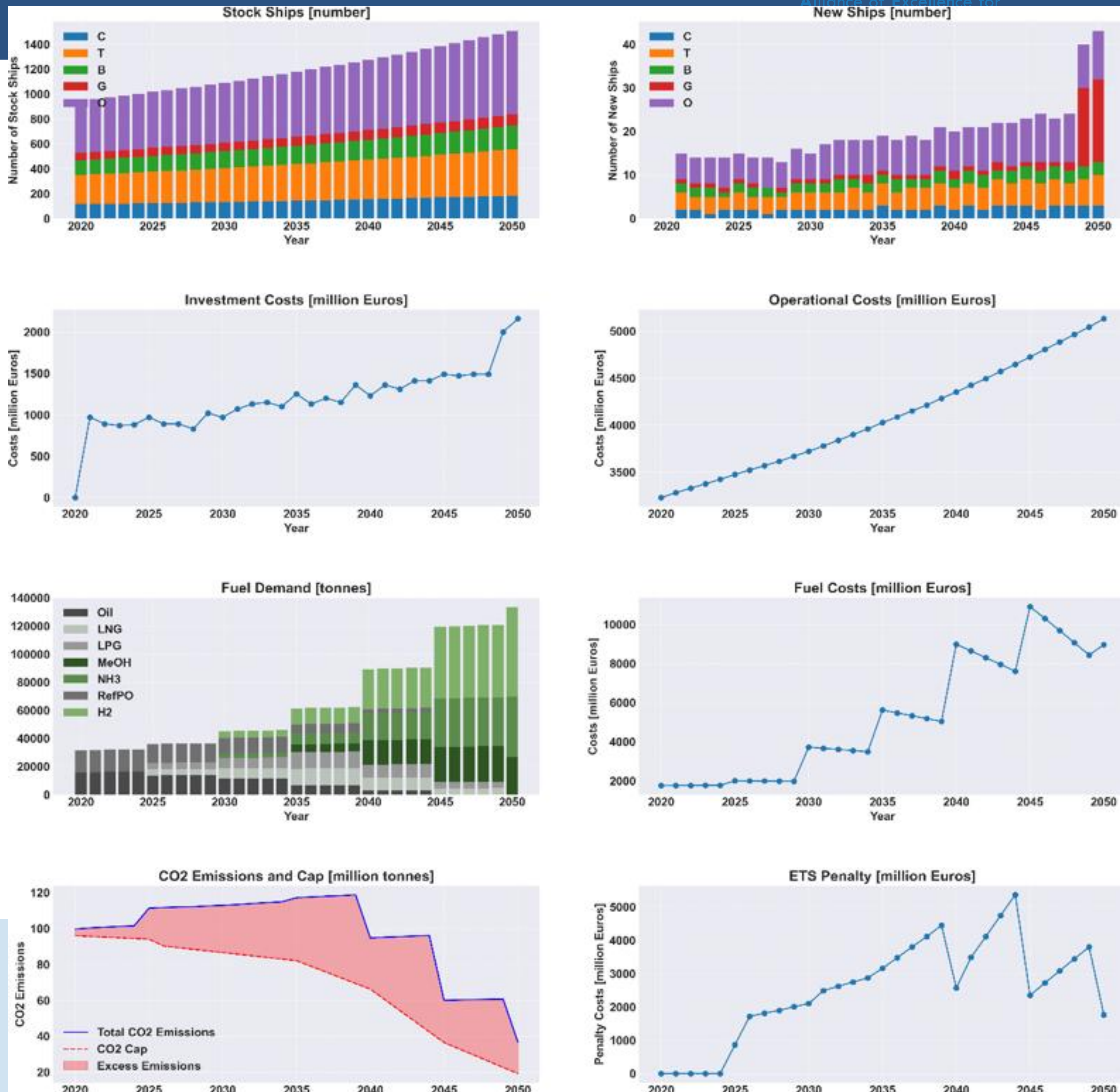
The model's constraints include:

- a fleet capacity constraint, where the total stock of ships each year must be sufficient to meet the demand for shipping services;
- a ship production constraint;
- a fleet stock update constraint where the total stock for a given year is the sum of surviving ships for the year and new ships built,
- fuel demand constraints subject to fuel availability;
- an emissions constraint, dictated by emissions factors for each fuel,
- the ETS emissions threshold where excess emissions are penalized;
- the fleet should also not exceed a performance metric as defined by the Carbon Intensity Indicator (CII) constraint, according to the IMO targets.

Shipping sector: Results

The simulated NCNC involves:
a) combination of emission-reduction technologies (Engine power optimization; Route Optimizer technology, Port-call technology, Energy-efficient propulsion system; Hull cleaning and maintenance; On board carbon capture)
b) moderate fuel-transition projection, assuming that oil fuels will gradually phase out (Oil and Refined Petroleum products), being replaced by the transition fuels (LNG and LPG), while by 2050 they will be replaced by clean fuels such as MeOH, NH3 and H2.

Fleet Growth: Steady increase in shipping demand drives fleet expansion, surpassing 1,400 vessels by 2050, with notable growth in container and passenger ships.
Investment Trends: Costs remain stable until 2045 (€1-1.5B) but rise sharply near 2050 (€2B) due to new vessel demand.
Fuel Transition: Shift from oil to LNG & LPG (mid-term) and NH3, MeOH & H2 (long-term), reducing emissions but raising fuel costs.
Emissions & ETS Impact: Emissions exceed the cap by 6MT in 2050; ETS penalties begin in the late 2030s, increasing costs for shipowners.
Decarbonization Challenges: Full decarbonization by 2050 is unlikely without subsidies, technology advancements, and stronger commitments.
Policy & Infrastructure Needs: Coordinated regulatory support, fuel-saving technologies, and alternative fuel bunkering infrastructure are essential for a smooth green transition.



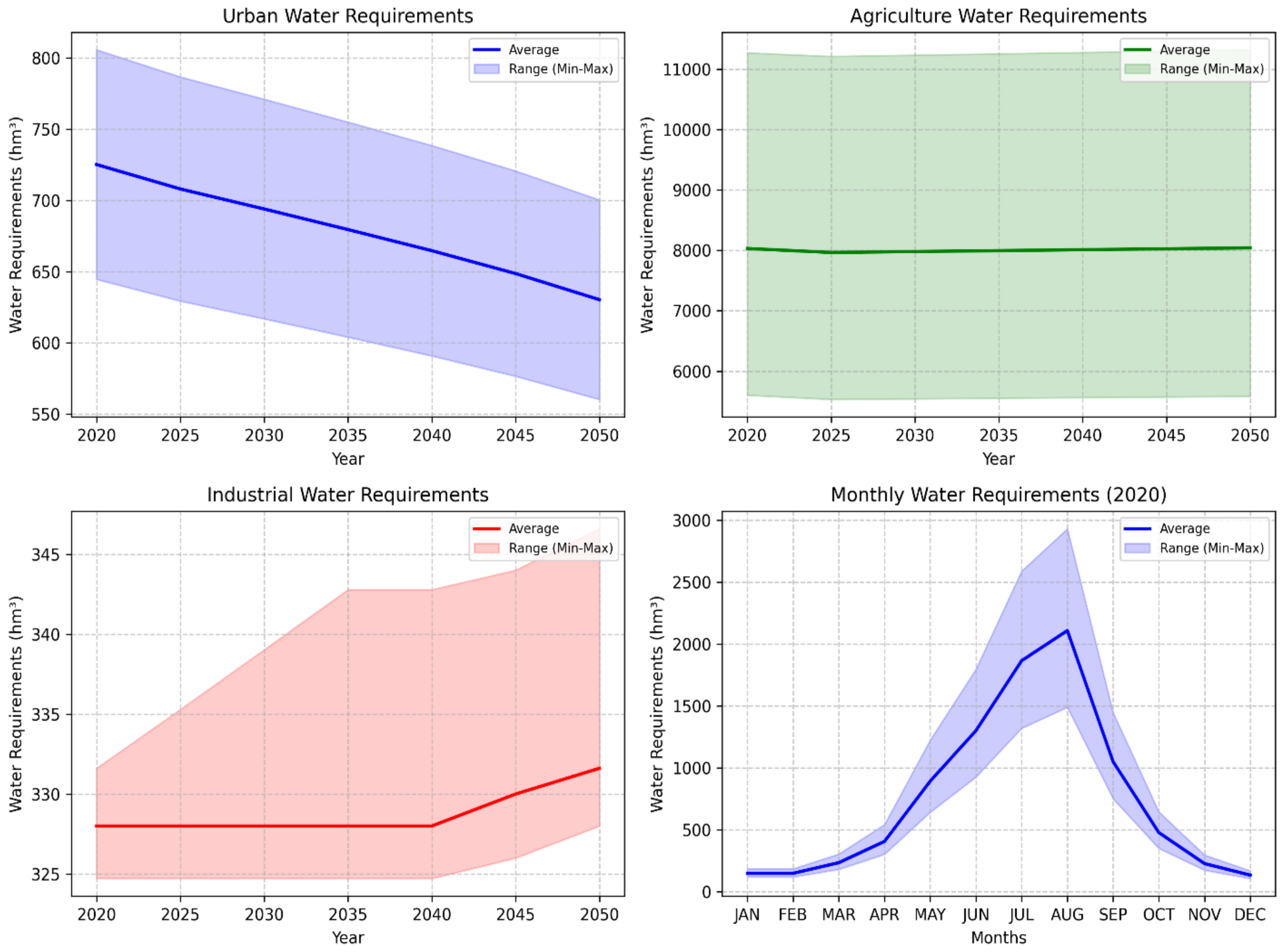
Water Requirements

The water requirements of all sectors studied in LEAP, are calculated by the WaterReqGCH accounting tool (Alamanos & Koundouri, 2024).
The estimation of water requirements followed the same approach with the energy demand, assuming an Activity Level (AL), typical water consumption rates (CR), and losses coefficients (LC), per sector and use.

$$W_{sector} = AL_{sector} \cdot CR_{sector} \cdot LC_{sector}$$

- **High Uncertainty in Water Sector**: Influenced by socio-economic, infrastructure, and hydro-climatological factors; no sector-specific demand management in Greek RBMPs.
- **Urban Water Use**: Represents 7–8% of total consumption; decreases from 725.19hm³ (2020) to 630.31hm³ (2050) due to population decline; network loss reduction could lower it further to 578hm³.
- **Agricultural Water Use** : Dominates at 88–89%; increases slightly after 2025, reaching 8041.12hm³ by 2050; assumes stable livestock and irrigation areas.
- **Industrial Water Use**: Smallest share (3–4%); remains stable with a slight increase from 328hm³ (2020) to 331.61hm³ (2050); no specific measures for industry in NCNC scenario.
- **Seasonal Water Demand:** Peaks during summer (May–October) due to irrigation and tourism; July demand (1866.6hm³) is over 8× higher than December (134.55hm³), stressing the need for storage and distribution.

WaterReqGCH



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Implications & Recommendations

- Robust & novel, integrated modelling system - potential replication for other countries.

- Although specific sectoral plans under the NCNC scenario have the potential to achieve multiple co-benefits, the absence of a unified framework can lead to inefficiencies and missed opportunities for synergies and unintended conflicts among objectives.

- A key point in transitioning to unified and more integrated approaches is the realization that the climate crisis cannot treated merely as an emissions reduction effort. It requires a broader sustainability context, involving the improvement of all interconnected systems and sectors.
- This research further highlights that national policies can (and should) play a pivotal role in triggering such policy evolutions, considering multiple sectors under more unified and coordinated frameworks.

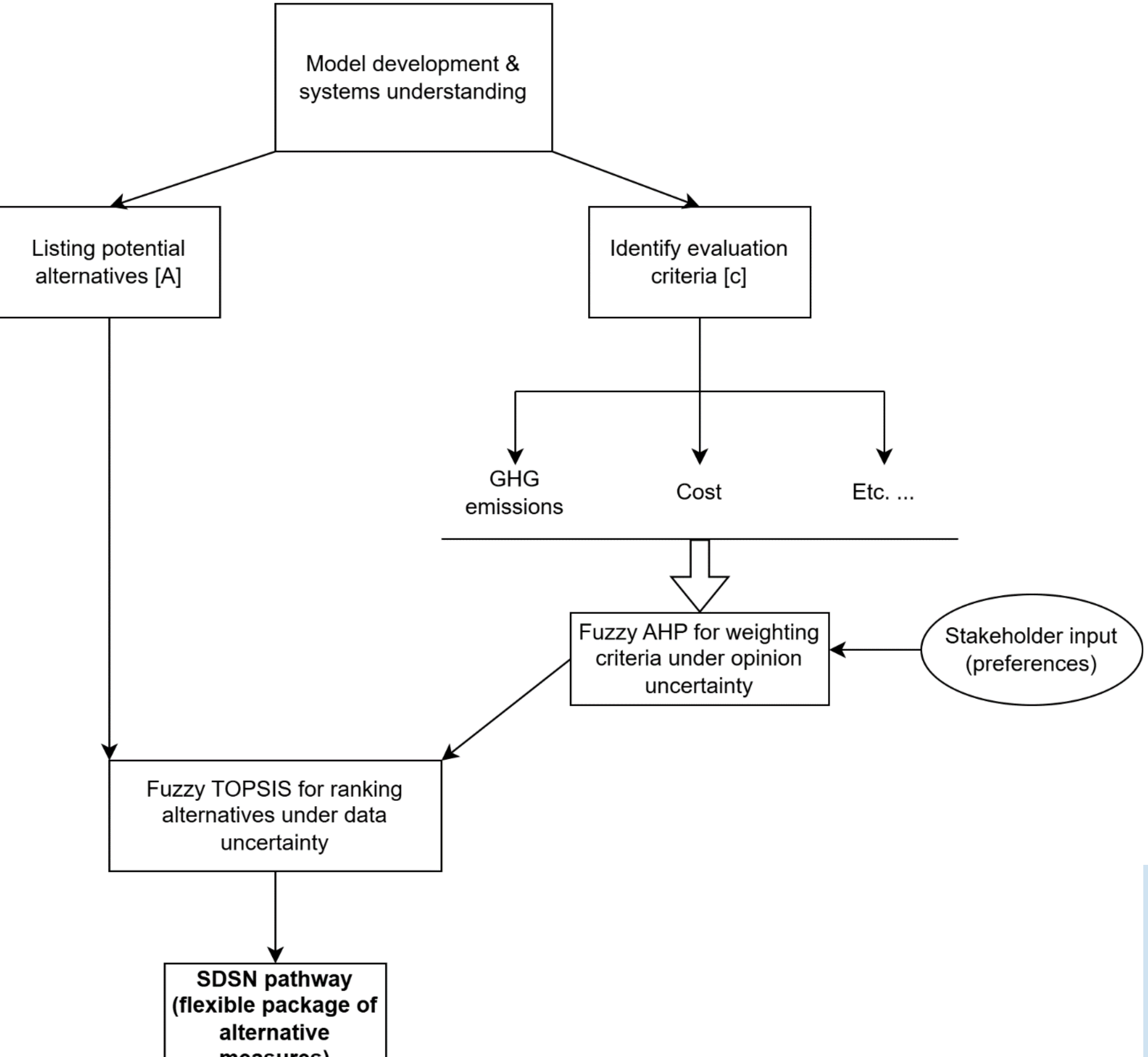
- Greece could benefit from the European Commission's guidance on the establishment of an inter-ministerial coordination mechanism, creating a dedicated body to align the implementation of NECP, CAP (Common Agriculture Policy, and RBMPs (River Basin Management Plans), establishing common planning horizons, developing thus more coherent long-term strategies that would consider multiple trade-offs.

- Integrated modelling approaches can serve as central tools in these efforts. Therefore, the development of robust national integrated modelling systems of fine resolution is also recommended.

The creation of a unified platform for simulating complex systems, monitoring policy interactions, and tracking progress across all related policies can facilitate better decision-making, resource allocation, and long-term sustainability planning.

The SDSN decarbonization pathway:
A Decision Support approach under Uncertainty

SDNS Sucess Pathway - Providing a Decision Framework



- Model building process → identification of parameters that can be modified, reflecting real-word measures.

- Legally binding framework (National Commitments) → refining by modifying key parameters (alternative measures).

- Implementing the 'refined' strategy: Prioritization of measures, using a novel MCA combinative approach, under uncertainty:
- Fuzzy AHP + Fuzzy TOPSIS

- Fuzzy AHP = preferences, weights of importance for the selected criteria (under "opinion uncertainty")

\+

- Fuzzy TOPSIS = Ranking the alternatives under the criteria, accounting for data/modelling/implementation uncertainty

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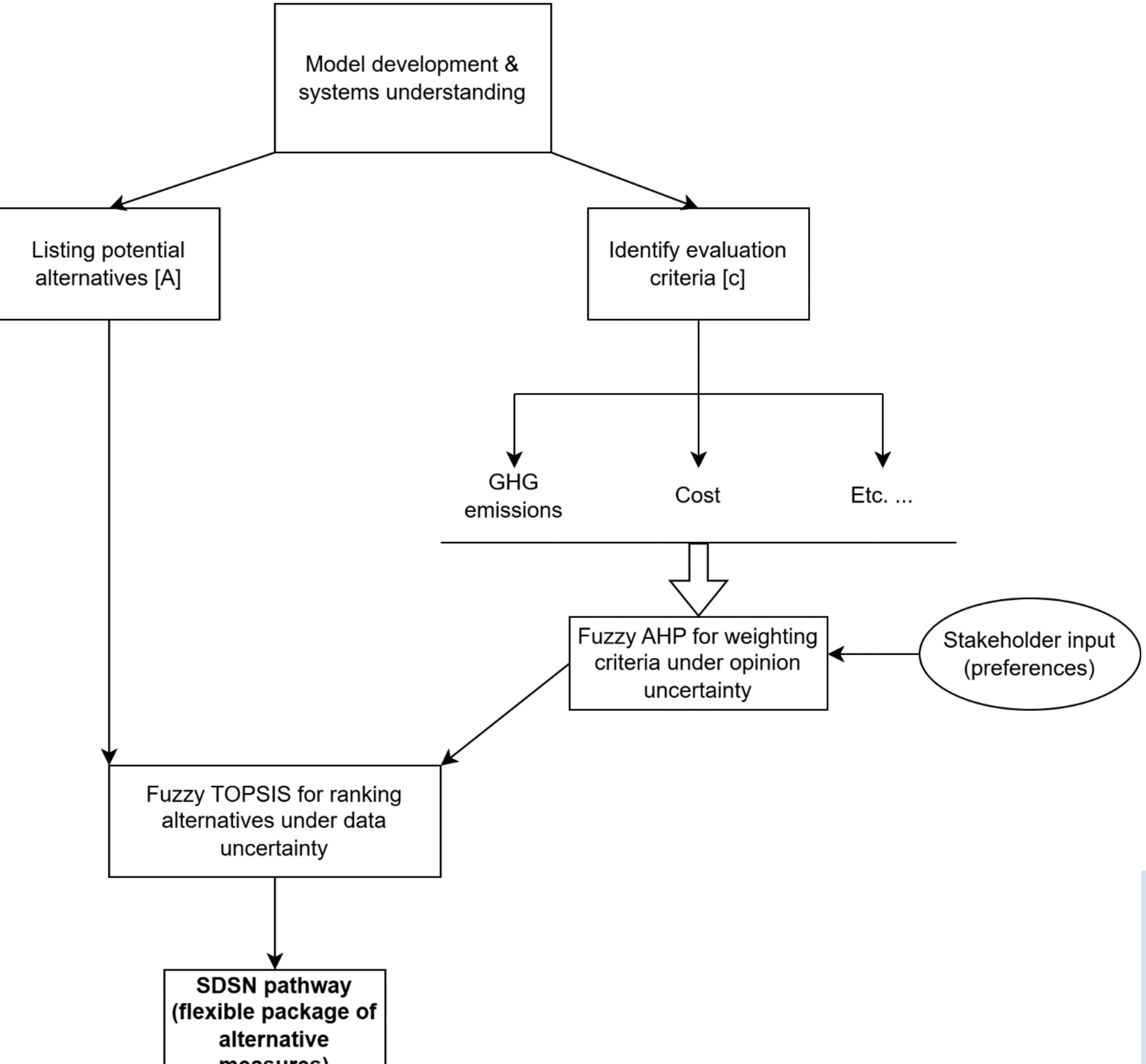
The SDSN decarbonization pathway:
A Decision Support approach under Uncertainty

SDNS Sucess Pathway - Providing a Decision Framework



Indicative Criteria for the Greek case example:

- C1 – Cumulative GHG emissions: net-zero goal - a direct outcome of LEAP. The 'cumulative' aspect means that we look at the total emissions of the planning, to account for the decarbonization speed of each alternative examined.
[we have also the target-year 2050 emissions].

- C2 - Cost: This criterion can be estimated by accounting for the expected implementation cost of each alternative (investment cost to apply each alternative).

- C3 - Energy supply dependency: Most countries might want to be energy autonomous by minimizing their energy import dependency. We estimate this as the ratio of the cumulative primary fuels' imports to the total supply (total primary fuels plus the imports, minus the exports).

- C4 – Cumulative energy consumption: Several policies might aim to a demand management, so the knowledge of the total consumption is an essential information.

SDSN scenario results

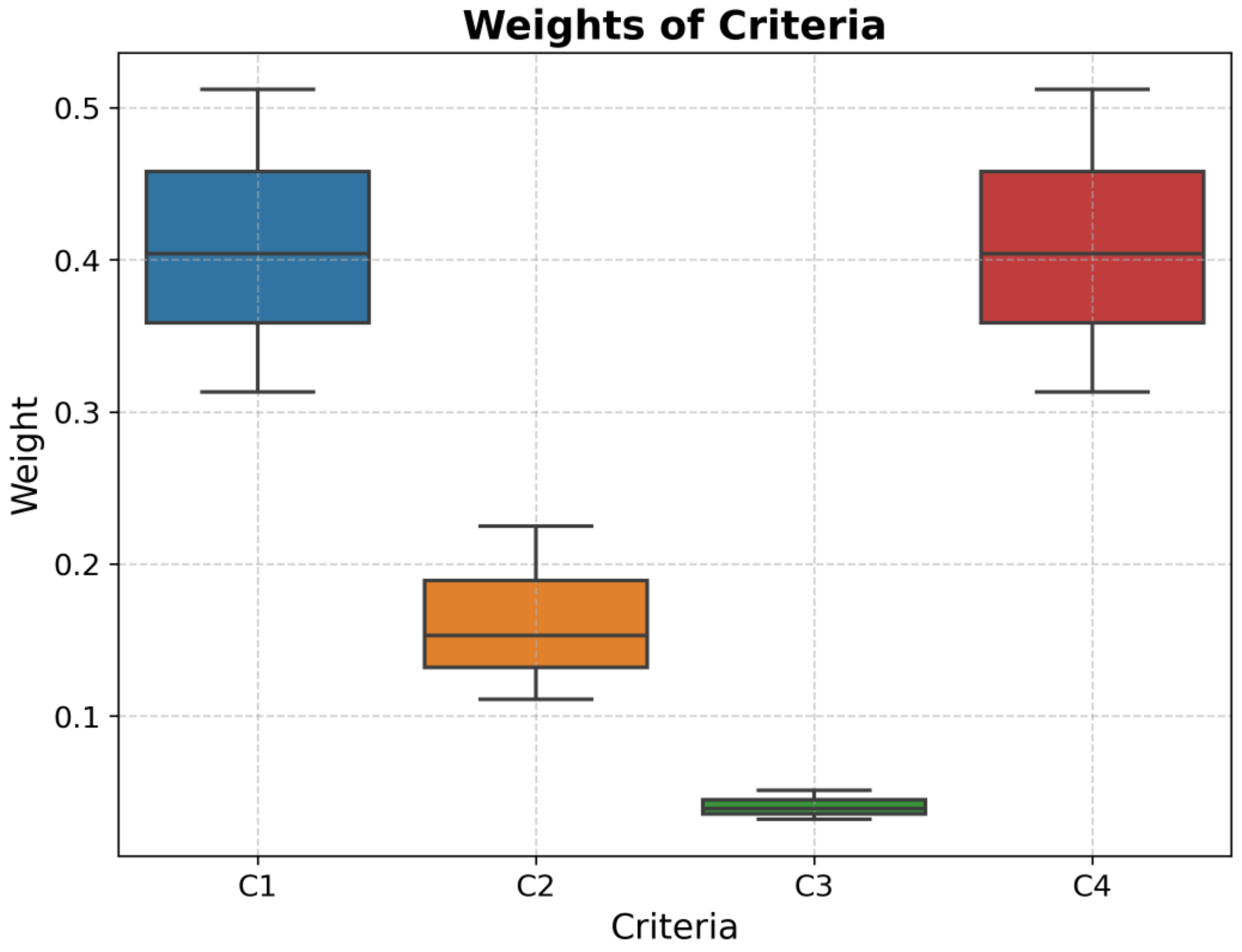
Fuzzy AHP

- Pairwise Comparison & Fuzzification: We (team of modelers) compare the criteria using linguistic terms (e.g., "slightly more important"), which are then converted into fuzzy numbers (typically triangular) – in this case, a lower 'pessimistic', a modal 'medium' and a high 'optimistic' judgment.

- Weight Calculation via Fuzzy Synthesis: Fuzzy comparison matrices are synthesized to derive priority weights for criteria, using a fuzzy extension of the eigenvector method.

- Defuzzification & Normalization: The fuzzy weights are defuzzified (with the centroid method) and normalized to obtain crisp priority values, which determine the final ranking of criteria and alternatives.

- The Fuzzy AHP technique offers also a consistency test, to ensure that the pairwise comparisons are aligned, and in case of not consistent weights, the users need to revisit their comparisons.



Result:

Preference in emissions reduction over the entire planning horizon, and the energy consumption, - as a direct driver of cutting emissions with potentially cheaper and smarter interventions) - over the implementation (or investment) costs.

SDSN scenario results

Fuzzy TOPSIS

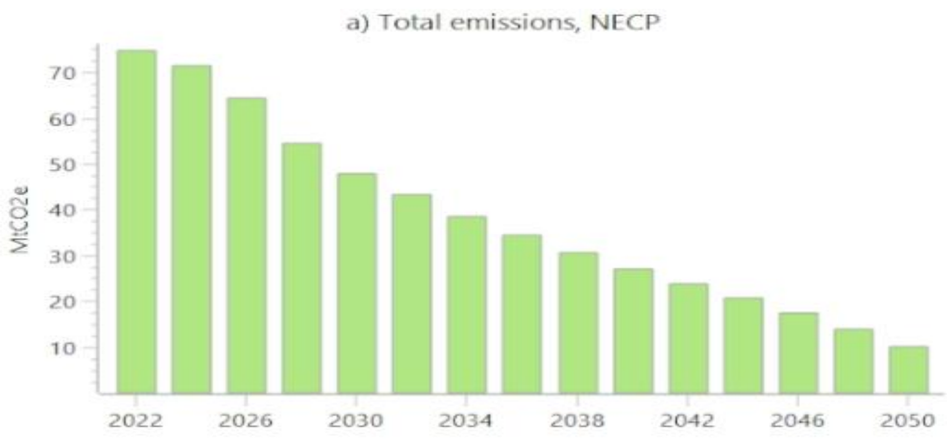
- Performance of the alternatives under each criterion (fuzzy)
- Determining Ideal & Anti-Ideal Solutions: The best (positive ideal) and worst (negative ideal) solutions are identified by selecting the highest and lowest fuzzy values for each criterion. [depending if optimal is the maximization or minimization of the criterion].
- Relative Closeness Calculation & Ranking: The Euclidean distance of each alternative from the ideal and anti-ideal solutions is computed, and alternatives are ranked based on their relative closeness to the ideal solution.
- The result is the ranking of the 'best – performing' alternatives.

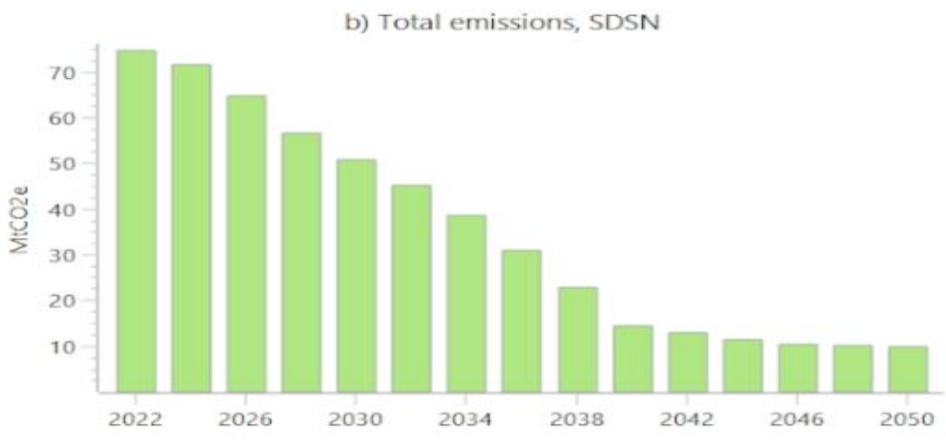
Alternatives	Energy consumption-side measures
Ad,r,1	**Residential sector**: Replace diesel and natural gas with heat pumps in space heating by 2040.
Ad,r,4	**Residential sector**: Replace wood (biomass) with heat pumps in space heating by 2040.
Ad,r,5	**Residential sector**: Replace diesel and biomass with electricity in cooking by 2040.
Ad,r,6	**Residential sector**: Accelerate energy savings -> Achieve the 2050 NECP goals by 2040.
Ad,a,1	**Agricultural sector**: Replace fossil fuels with electricity by 2040.
Ad,a,2	**Agricultural sector**: Accelerate energy savings -> Achieve the 2050 NECP goals by 2040.
Ad,m,1	**Maritime sector**: Transition to cleaner fuels based on the medium decarbonization scenario of the **MaritimeGCH** model.
Ad,s,1	**Services sector**: Replace fossil fuels with heat pumps by 2040
Ad,in,1	**All industries**: Accelerate energy savings -> Achieve the 2050 NECP goals by 2040.
Ad,in,2	**Several industries**: Use of electrode boilers -> 100% electrification for steam and hot water production.
Ad,in,6	**Steel and cement industries**: Duplicate the share of electricity by 2040 by reducing the "clinker to cement" ratio & 100% electrification of kilns.
Ad,tr,1	**Passenger transportation: Cars, light trucks & motorcycles**: Replace petroleum products with electricity & biofuels by 2040.
Ad,tr,2	**Passenger transportation: Buses & trains**: Replace petroleum products with electricity & green hydrogen by 2040.
Ad,tr,5	**Freight transportation: Freight trucks**: Replace petroleum products with electricity & green hydrogen by 2040.
	Energy production-side measures
Ad,elec,2	**Electricity generation**: Phase out of fossil fuels by 2040.
Ad,oil,1	**Oil refining**: Accelerate the substitution between petroleum products and synthetic fuels. Reach the projected NECP levels by 2040.
Ad,oil,2	**Oil refining**: Terminate the operation of all oil refineries 2045.
Ad,synth,1	**Synthetic fuels**: Linearly increase capacity to reach 40000 thousand BBL of oil equivalent per year by 2040.
Ad,hy,1	**Hydrogen**: Linearly increase capacity to reach 5500 MW by 2040.

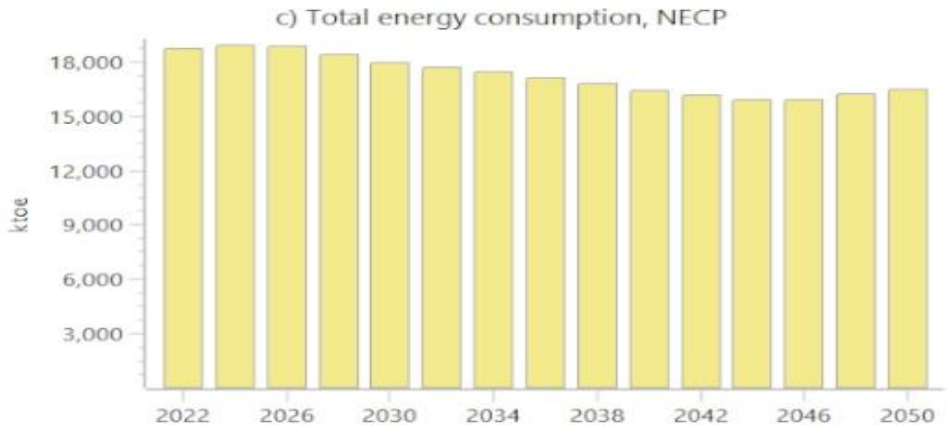
SDSN scenario

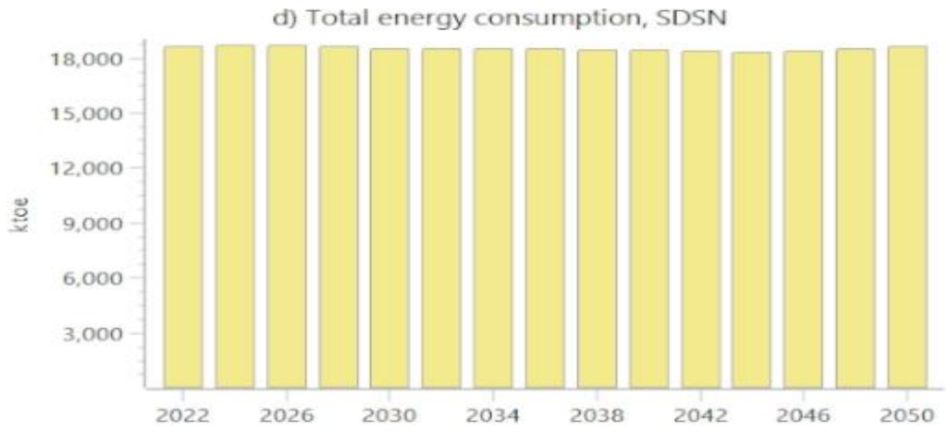
Application of the prioritized measures/ alternatives, up to the point they can achieve the same decarbonization level with the NECP.

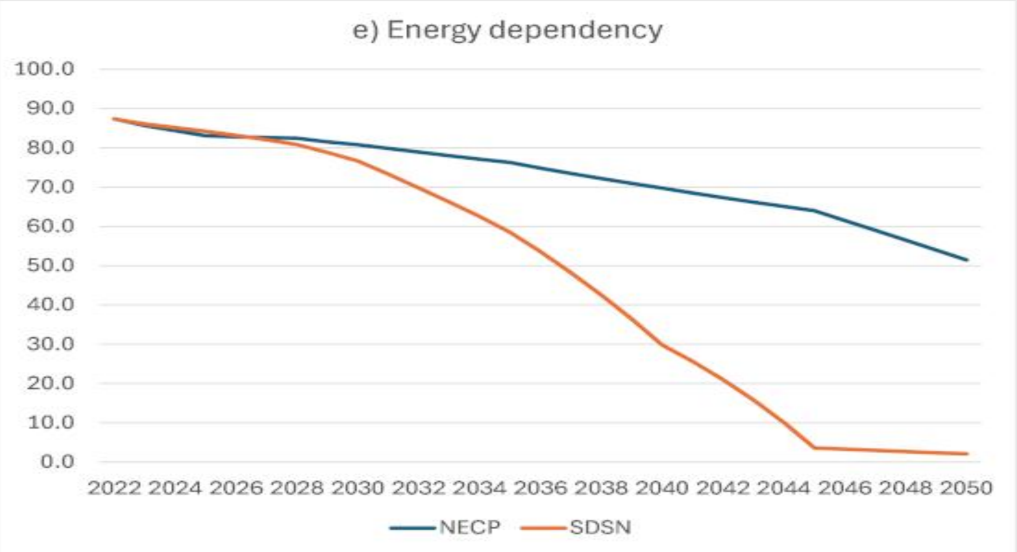
- **Lower emissions & faster**
- **Lower costs**
- **Lower dependency on imports [– compared to the standard NECP!]**

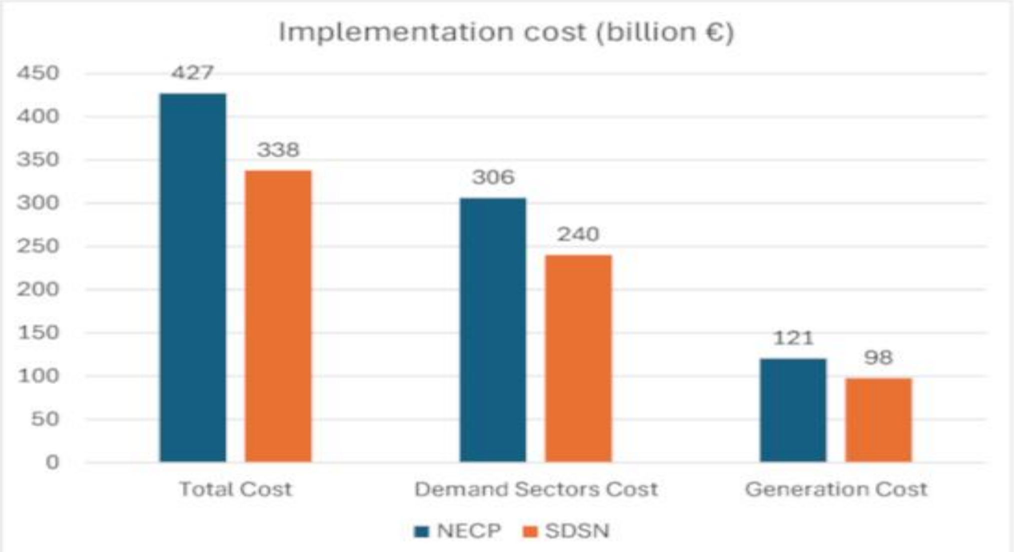












Ranking	Alternatives	Score	GHG emissions in 2050 (MtCO2e)	Cumulative GHG emissions (MtCO2e)	Total Implementation Cost (billion €)	Average Energy Dependency (in %)	Cumulative Energy Consumption (ktoe)
-	BAU	-	77.3	2230.0	0	87.0	543436.3
1	Ad,in,1	0.3740	75.3	2189.5	7.50	87.1	531340.5
2	Ad,tr,5	0.3740	45.8	1598.7	16.61	81.7	531340.5
3	Ad,a,2	0.2147	45.8	1597.4	16.61	81.8	529637.0
4	As,oil,2	0.2147	36.7	1442.4	16.61	67.3	529637.0
5	As,oil,1	0.0374	36.7	1444.6	33.56	66.5	529637.0
6	Ad,tr,1	0.0012	25.8	1244.6	80.55	63.1	529637.0
7	Ad,r,6	0.0002	25.1	1230.9	184.37	63.7	519783.3
8	Ad,m,1	0.0002	17.3	1137.8	188.39	58.8	527286.7
9	Ad,r,1	0.0001	13.5	1071.2	210.59	56.5	527270.2
10	Ad,r,4	0.0001	13.4	1071.9	232.80	56.6	527270.2
11	Ad,r,5	0.0001	13.2	1068.6	232.84	56.8	523690.7
12	Ad,a,1	0.0001	13.1	1065.4	242.44	56.7	523690.7
13	Ad,s,1	0.0001	12.4	1056.1	247.99	55.6	523690.7
14	Ad,in,2	0.0001	11.4	1037.4	248.11	55.0	523690.7
15	Ad,in,4	0.0001	11.4	1037.4	248.11	55.0	523690.7
16	Ad,in,5	0.0001	11.4	1037.4	248.11	55.0	523690.7
17	Ad,in,6	0.0001	11.3	1035.7	248.12	55.0	532830.8
18	Ad,tr,2	0.0001	10.0	1011.3	257.22	54.6	532830.8
19	Ad,tr,3	0.0001	-	-	-		
20	Ad,tr,4	0.0001	-	-	-		
21	Ad,tr,6	0.0001	-	-	-		
22	Ad,tr,7	0.0001	-	-	-		
23	As,elec,2	0.0001	-	-	317.22		
24	As,synth,1	0.0001	-	-	-		
25	As,hy,1	0.0001	-	-	318.12		
26	Ad,r,2	0	-	-	-		
27	Ad,r,3	0	-	-	-		
28	Ad,a,3	0	-	-	-		
29	Ad,in,3	0	-	-	-		
30	As,elec,1	0	-	-	-		

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Next Steps

Energy-Emissions modelling

- Development of a LEAP model version that will be significantly more time-efficient, data-handling efficient, with increased accuracy, and easily expandable & replicable, to ensure a fast simulation of the other European countries.
- Comparison of the two model versions to benchmark them, and build a strong case for a robust and time-efficient modelling approach for Europe.
- Simulation of all European+ countries: current accounts, National Commitments, and subsequently, elaboration of a unique SDSN scenario.

Food-Land systems modelling

- Get access to more FABLE Calculators, for more European countries.
- Develop ways (potentially AI-assisted) to work on the land-agriculture system of countries with no available Calculators.

Economic modelling

- Development of a Computable General Equilibrium (CGE) model, to enrich and complement the above modelling system with economic insights.
- Expand the CGE model for all European countries.

SDSN scenario

- Consideration of additional criteria, relevant to the socio-economic and policymaking angles of the broader decarbonization problem. These will come from the CGE and might include the impact on employment, or the total welfare cost and benefit of alternative measures, etc.
- Apply the SDSN scenario approach for the European case study, considering potentially cooperative solutions.

THANK YOU

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