



HAL
open science

Biomass from the carbon dioxide removal and carbon neutrality perspective: a long term assessment using TIAM-FR

Sophie Chlela, Sandrine Selsosse

► **To cite this version:**

Sophie Chlela, Sandrine Selsosse. Biomass from the carbon dioxide removal and carbon neutrality perspective: a long term assessment using TIAM-FR. 30th European Biomass Conference and Exhibition (EUBCE), May 2022, Marseille, France. hal-03941133

HAL Id: hal-03941133

<https://hal.science/hal-03941133v1>

Submitted on 16 Jan 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Sophie CHLELA, Sandrine SELOSSE
Mines Paris, PSL University, Centre for Applied Mathematics (CMA)

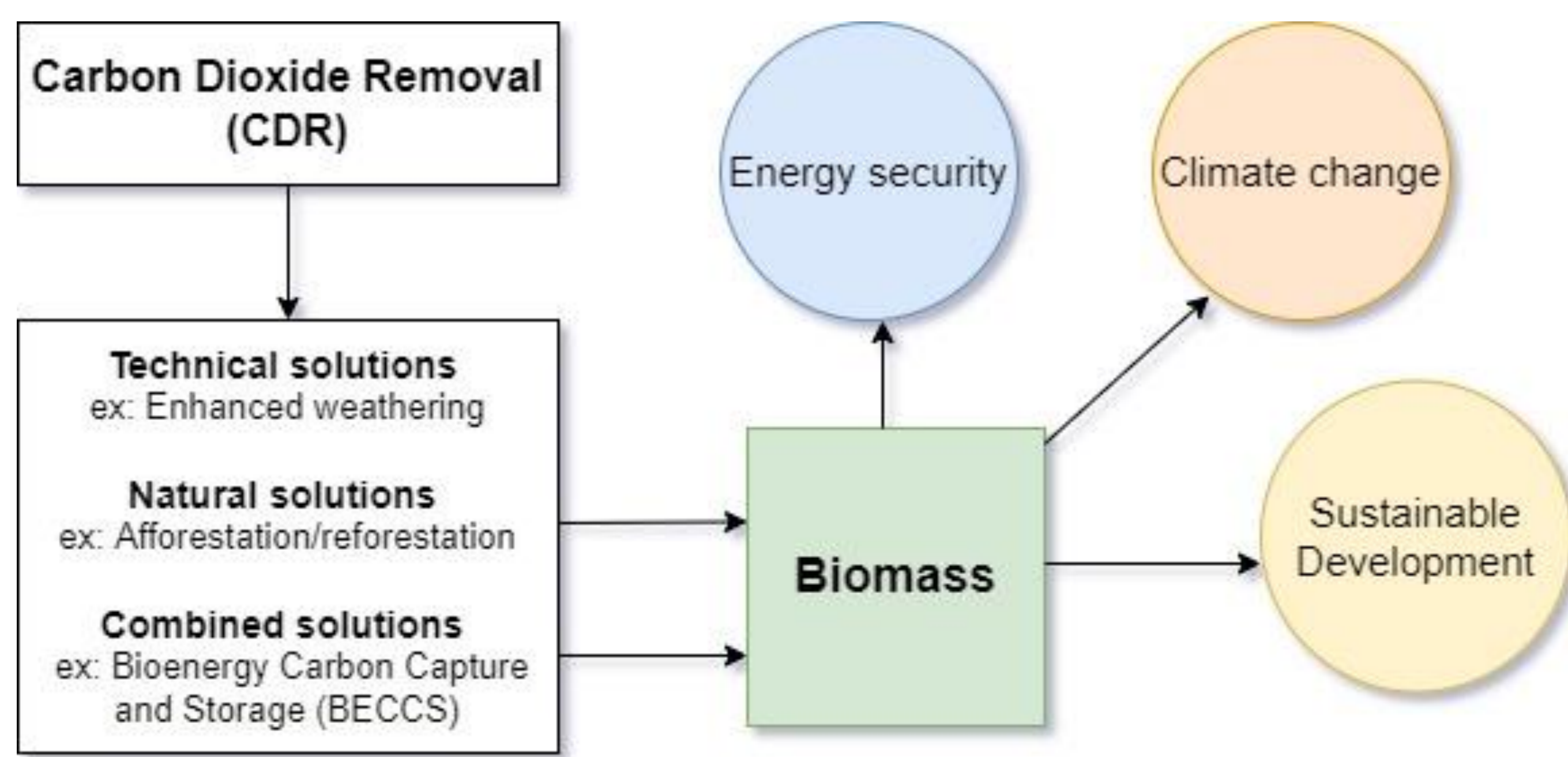
Introduction

Net zero emissions targets are henceforth, for the most part, implemented in the updated Nationally Determined Contributions (NDCs) to meet the Paris Agreement with their timeline ranging between 2050 and 2070. In addition to reducing anthropogenic emissions, carbon dioxide removal (CDR) solutions increasingly appear in prospective studies to limit the global temperature increase to 1.5°C [1]. We present land-based removal, i.e the use of biomass and bioenergy carbon capture and storage (BECCS) as CDR, showcasing how biomass can play multiple roles in climate change mitigation and sustainable development. We also present the relevant constraints in the long-term energy system analysis.

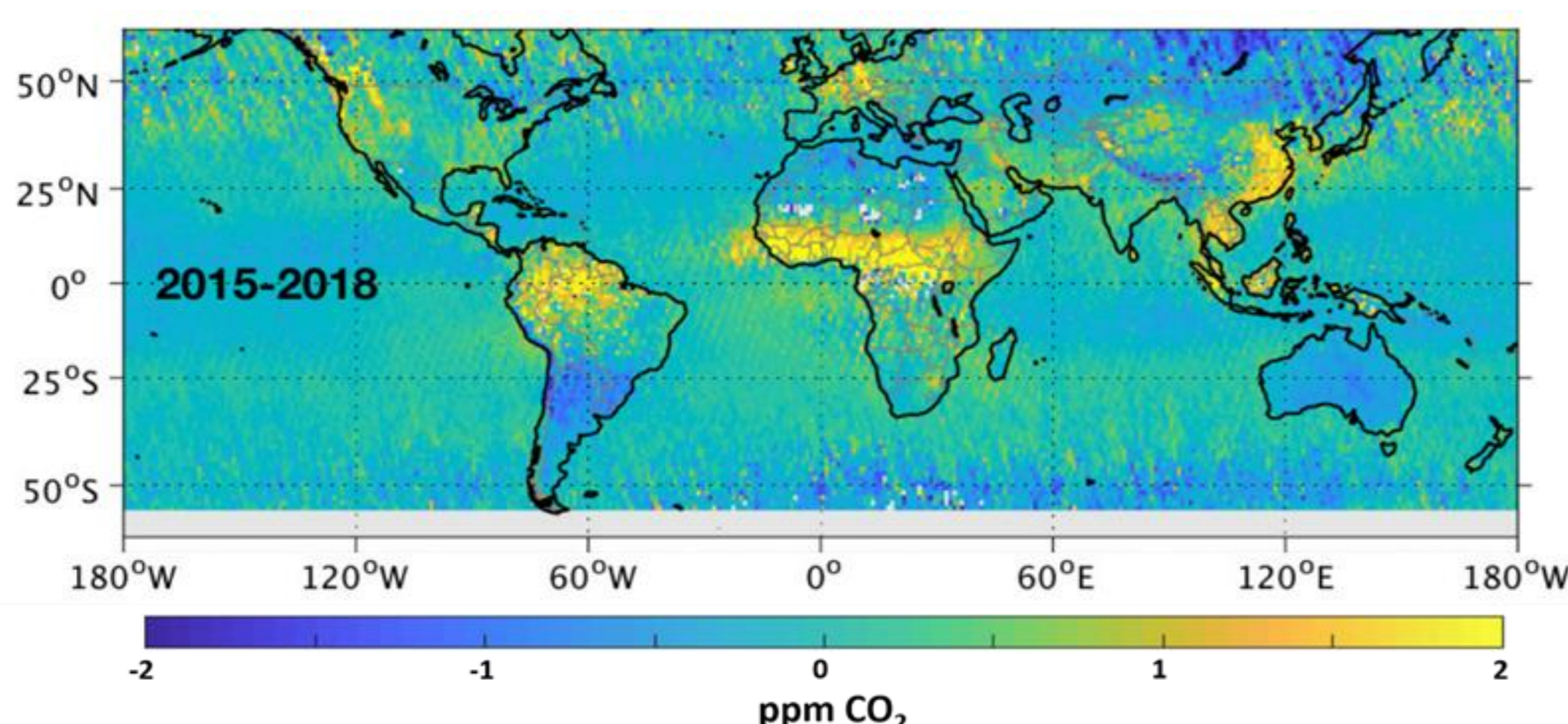
Biomass and CDR

- ✓ Biomass provides a source of heat, electricity and fuel for transportation and can provide negative emissions when BECCS is used in the power sector.
- ✓ Bioenergy represents the highest share of renewable energy (11% of the Total Final Energy Consumption) while modern bioenergy accounts for its half.
- ✓ Being a source of renewable energy supply, it contributes to the UN Sustainable Development Goals (SDGs).
- ✓ Biomass is capable of stabilization of carbon in vegetation and soils. For instance, forests constitute an important sink for the CO₂ removal.

How does biomass relate to the carbon neutrality targets?



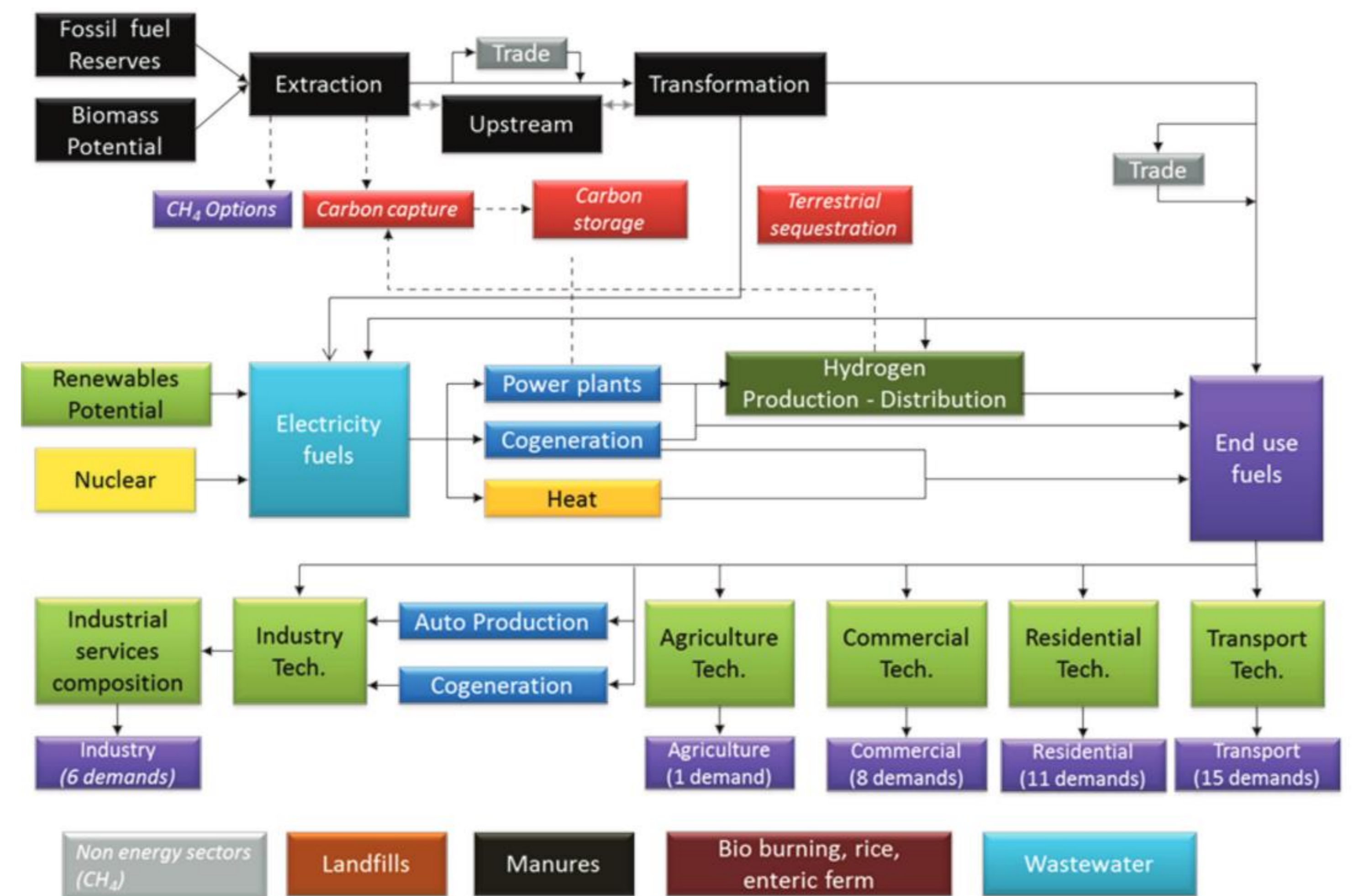
Hence, enhancing land-based sinks and using their potential in electricity generation would contribute to climate change mitigation.



Positive and negative anomalies representing sources and sinks of carbon dioxide. Source: NASA/JPL Caltech

Approach: TIAM-FR

- ✓ The French version of the TIMES Integrated Assessment Model of the IEA-Energy Systems Analysis Program (ETSAP) representing the world energy model in 15 regions
- ✓ Bottom-up optimization model based on linear programming and giving a detailed description of technologies and end-uses



The discounted global energy system cost over the entire model horizon until 2100:

$$\min(NPV) = \min\left(\sum_{r \in R} \sum_{y \in Y} (1 + d_{r,y})^{T_0-y} \cdot ANNCOST(r, y)\right)$$

Biomass in the model and the relevant constraints

- ✓ Several energy crops are available alongside the technologies of bioenergy production and trade
- ✓ Biomass potential with respect to the food and no deforestation for bioenergy production
- ✓ Carbon capture and storage potential
- ✓ Climate change (concentration, radiative forcing, temperature)
- ✓ NDCs including the Net zero CO₂ pledges by 2050-2070

References

- [1] IPCC, 2018a. Chapter 2 — Global Warming of 1.5°C. URL <https://www.ipcc.ch/sr15/chapter/chapter-2/> (accessed 5.04.22)
- [2] REN21, 2021. Renewables Global Status Report. REN21. URL <https://www.ren21.net/reports/global-status-report/> (accessed 5.04.22)
- [3] NASA, JPL, 2019. The Atmosphere: Getting a Handle on Carbon Dioxide [WWW Document]. Climate Change: Vital Signs of the Planet. URL <https://climate.nasa.gov/news/2915/the-atmosphere-getting-a-handle-on-carbon-dioxide> (accessed 5.4.22).
- [4] Kang, S., 2017. La place de la bioénergie dans un monde sobre en carbone: Analyse prospective et développement de la filière biomasse dans le modèle TIAM-FR (PhD thesis). Université Paris sciences et lettres.