The Economics of Carbon Management

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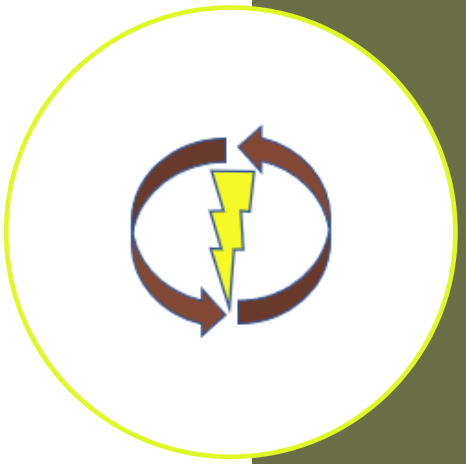
Introduction: Carbon Stocks and Flows

The role of a Carbon Takeback Obligation

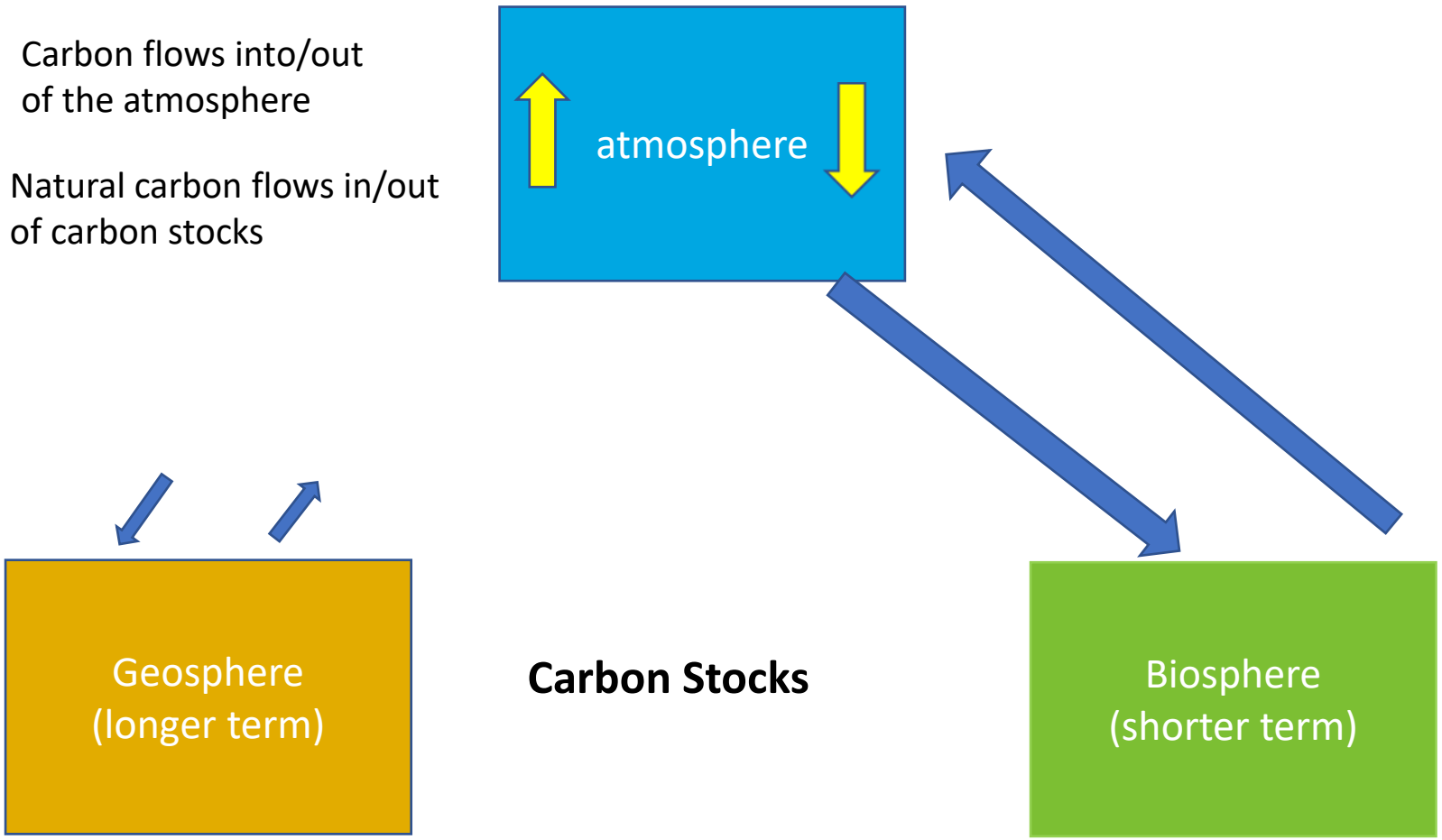
Economics of Carbon Management

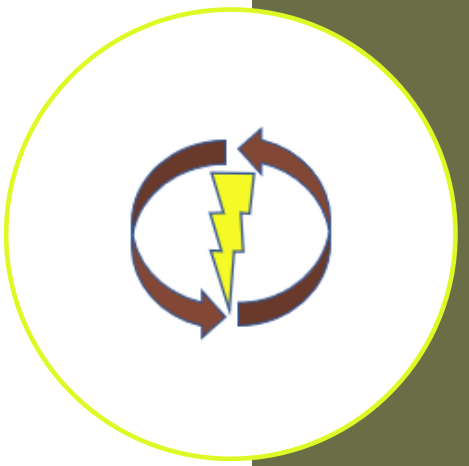


Carbon Stocks & Flows: Past

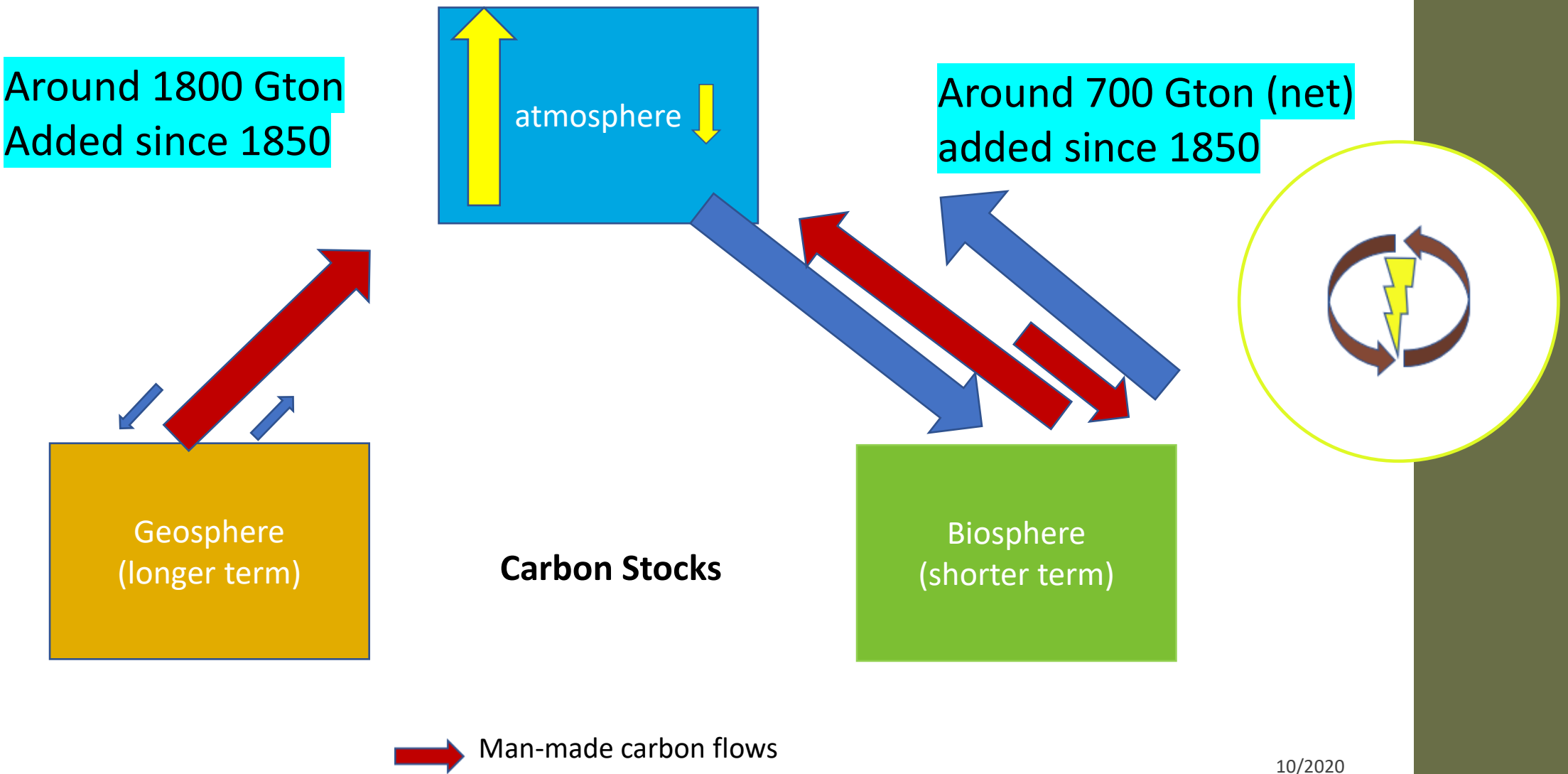
Carbon flows into/out of the atmosphere

Natural carbon flows in/out of carbon stocks



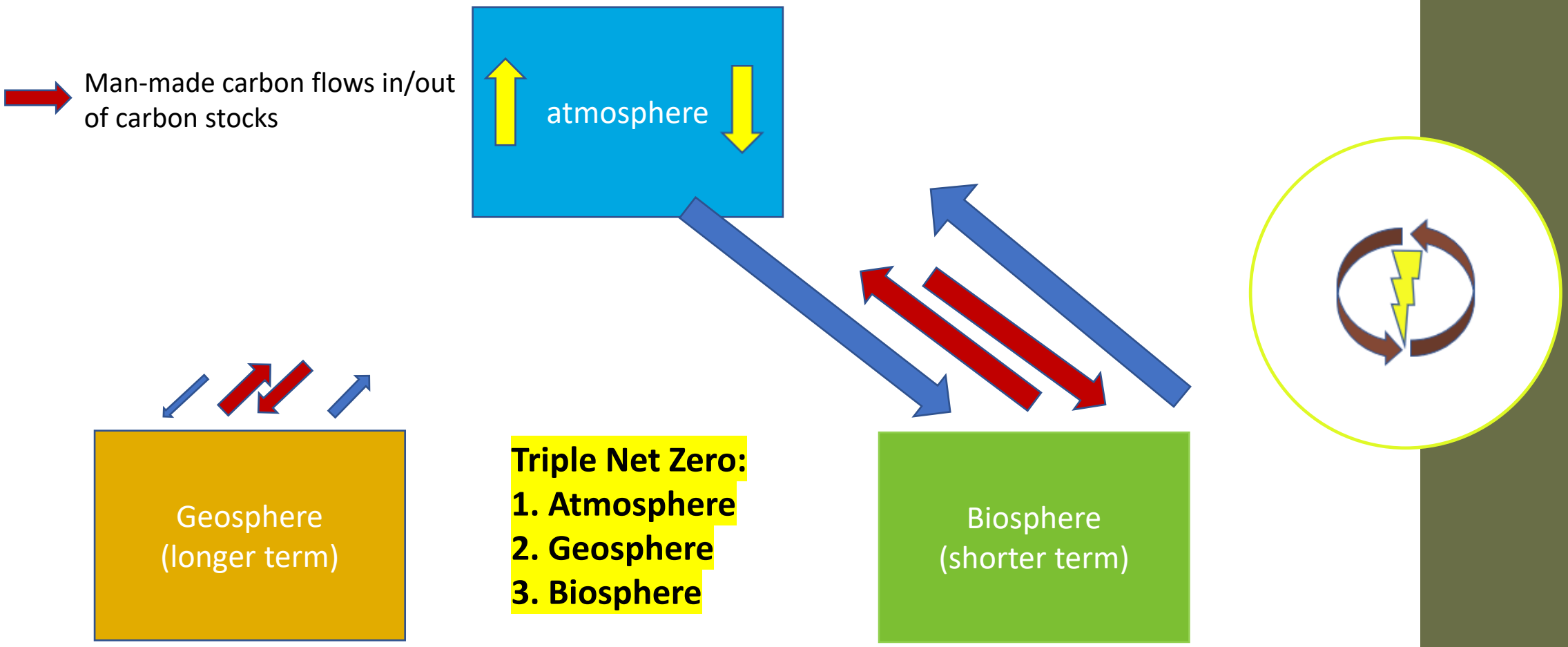


Carbon Stocks & Flows: Present



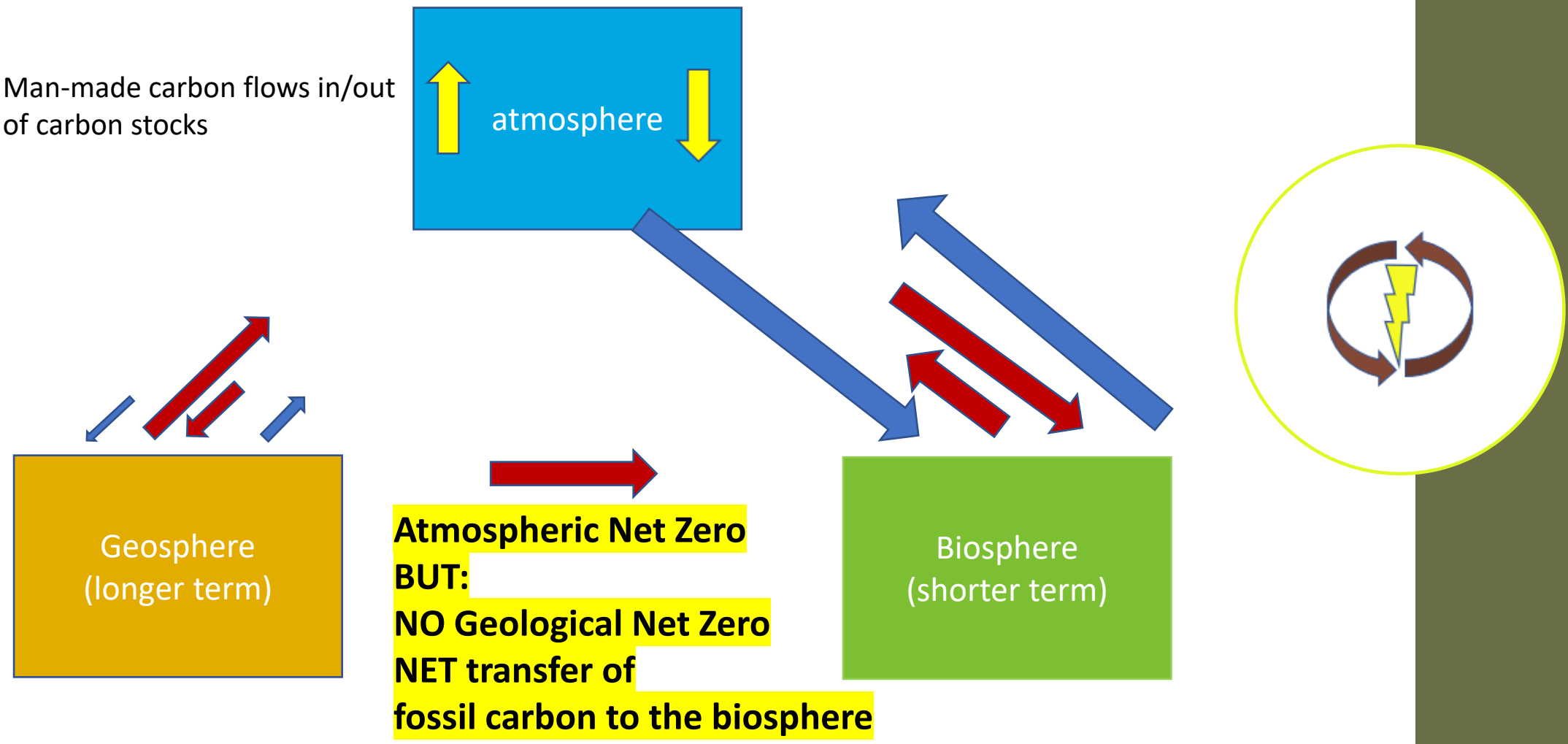
Carbon Stocks & Flows: Net Zero (1)

Man-made carbon flows in/out of carbon stocks



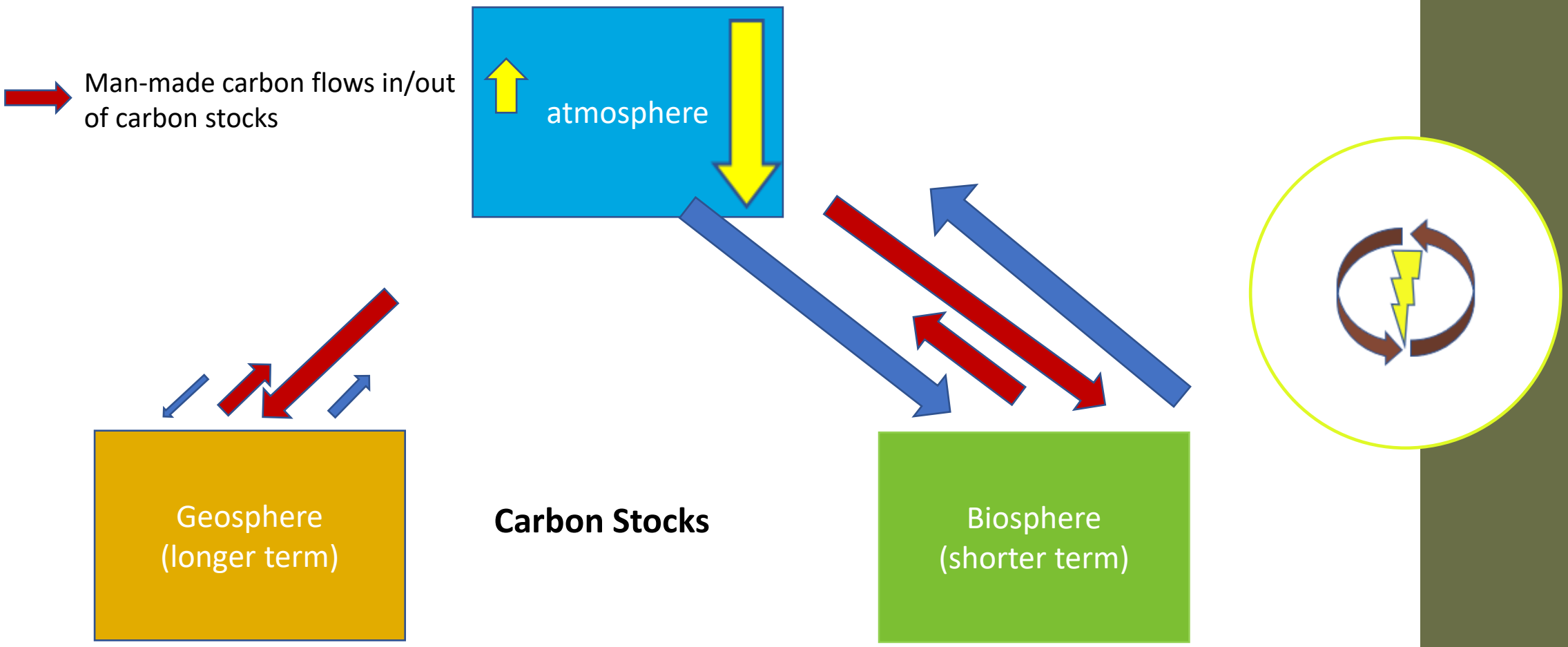
Carbon Stocks & Flows: Net Zero (2)

Man-made carbon flows in/out of carbon stocks

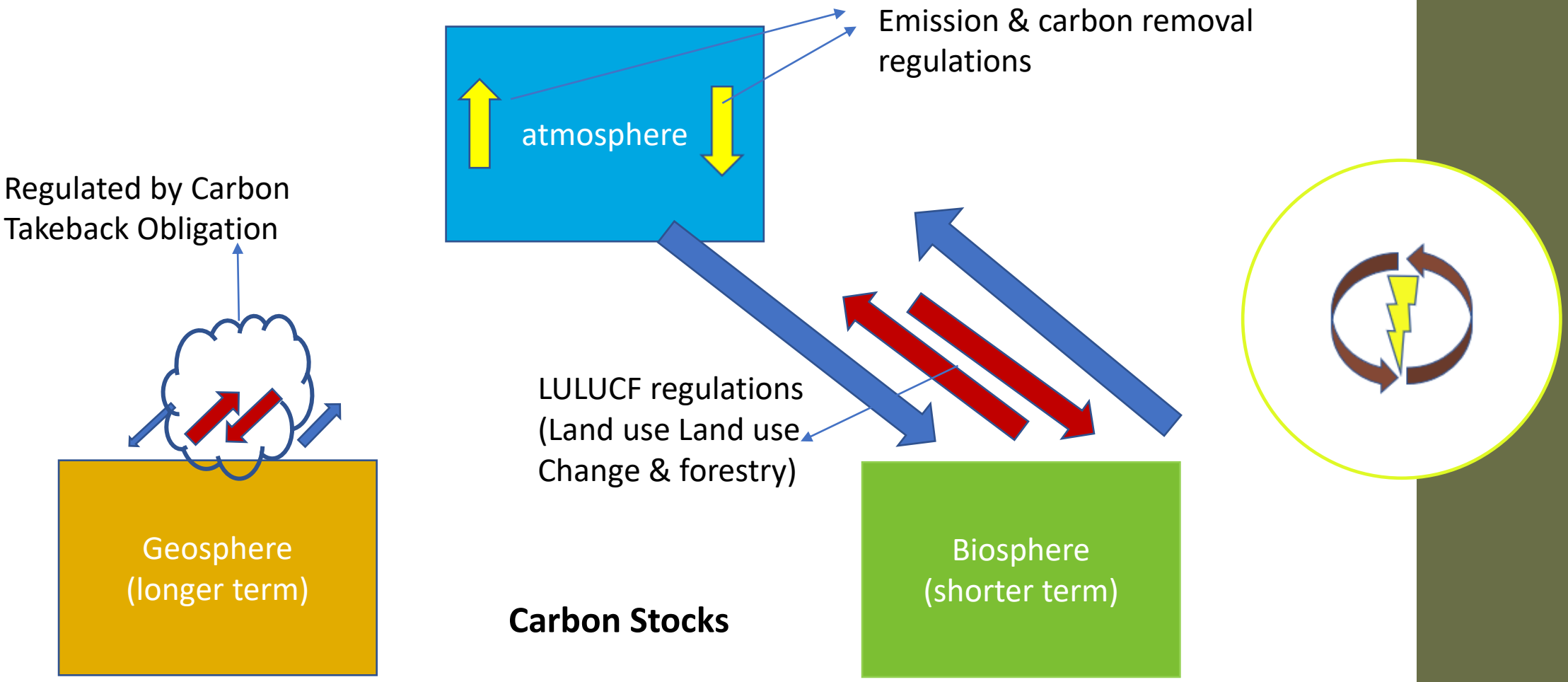


Carbon Stocks & Flows: Net Negative

Man-made carbon flows in/out of carbon stocks



Carbon Stocks & Flows: Net Zero Again

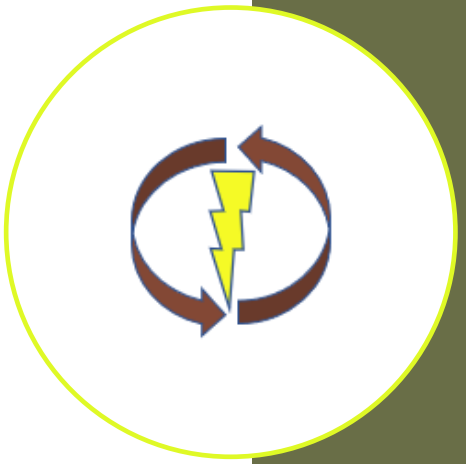


Conclusions Stocks & Flows

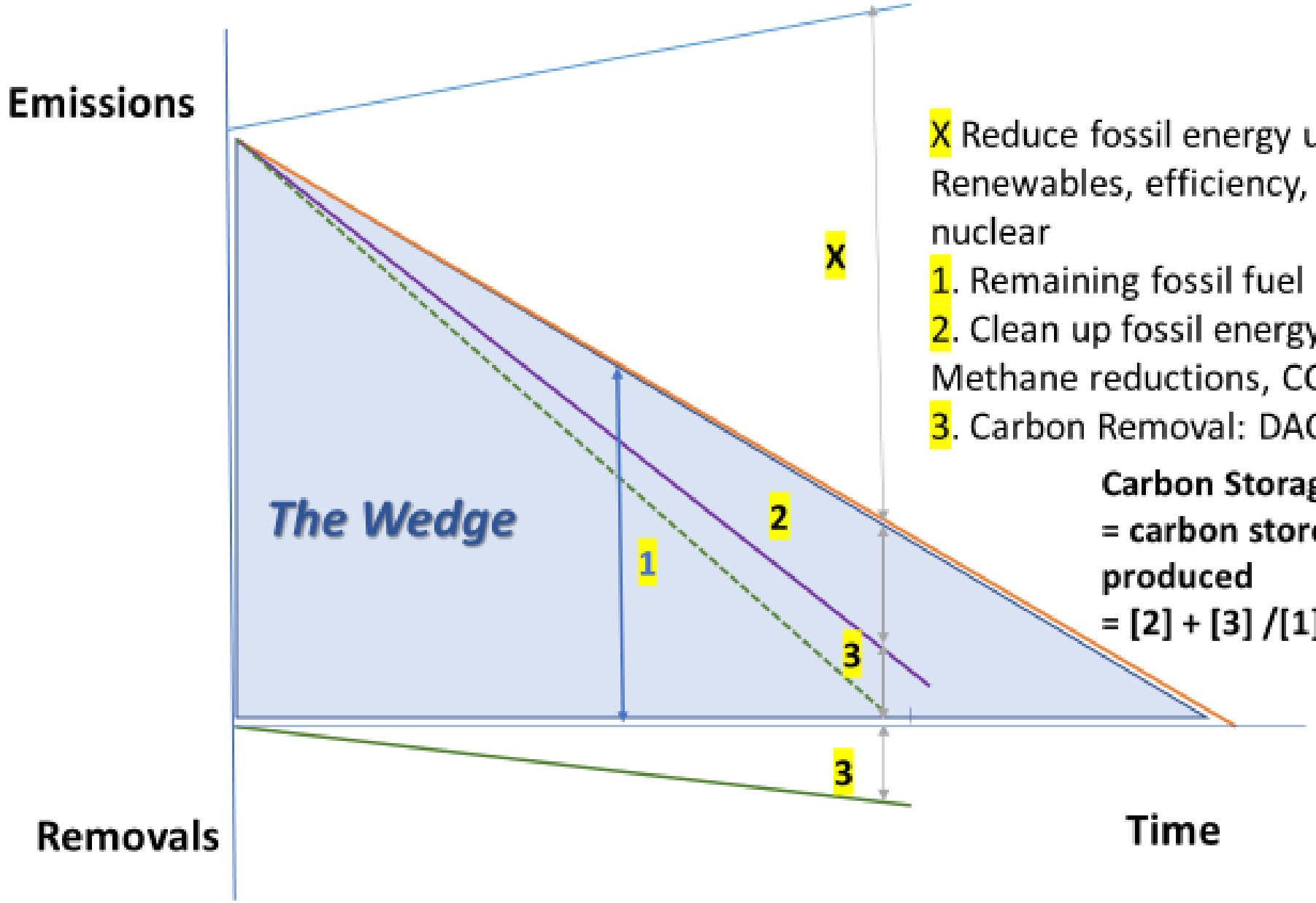
- We have **'super-charged' the short carbon cycle** over the last century → we need to stop adding fossil carbon

- It is **a myth** that our economies will be 'decarbonised' soon or ever

- More **accurate, consistent and future-proof** accounting of carbon stocks and flows is needed, including regulations for responsible management of these stocks



Stopping fossil fuels causing global warming



X Reduce fossil energy use: Renewables, efficiency, behavior, nuclear

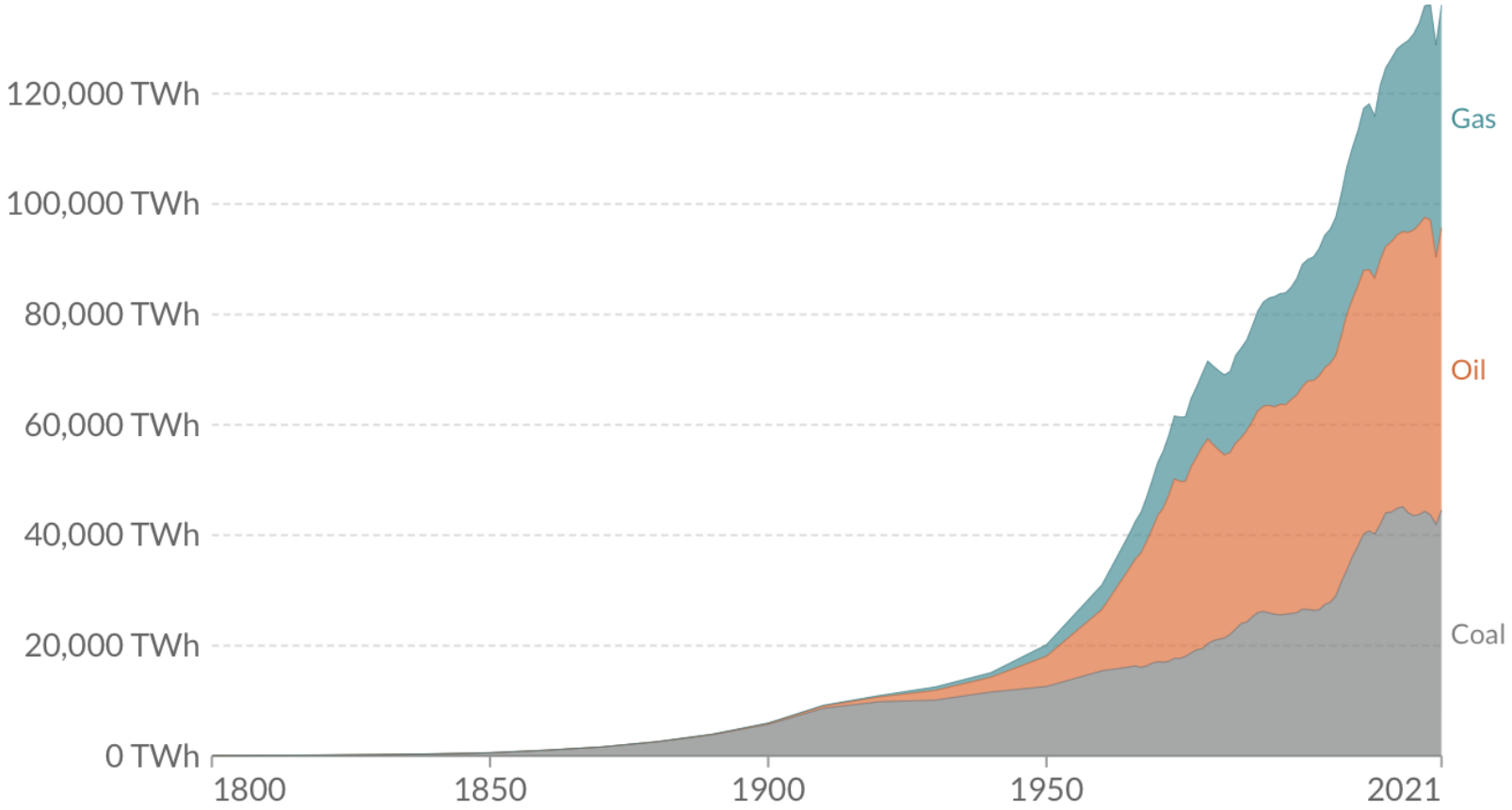
1. Remaining fossil fuel use

2. Clean up fossil energy use: Methane reductions, CCS, coal->gas

3. Carbon Removal: DACS, BiCRS

Carbon Storage %
= carbon stored/carbon produced
= [2] + [3] /[1]

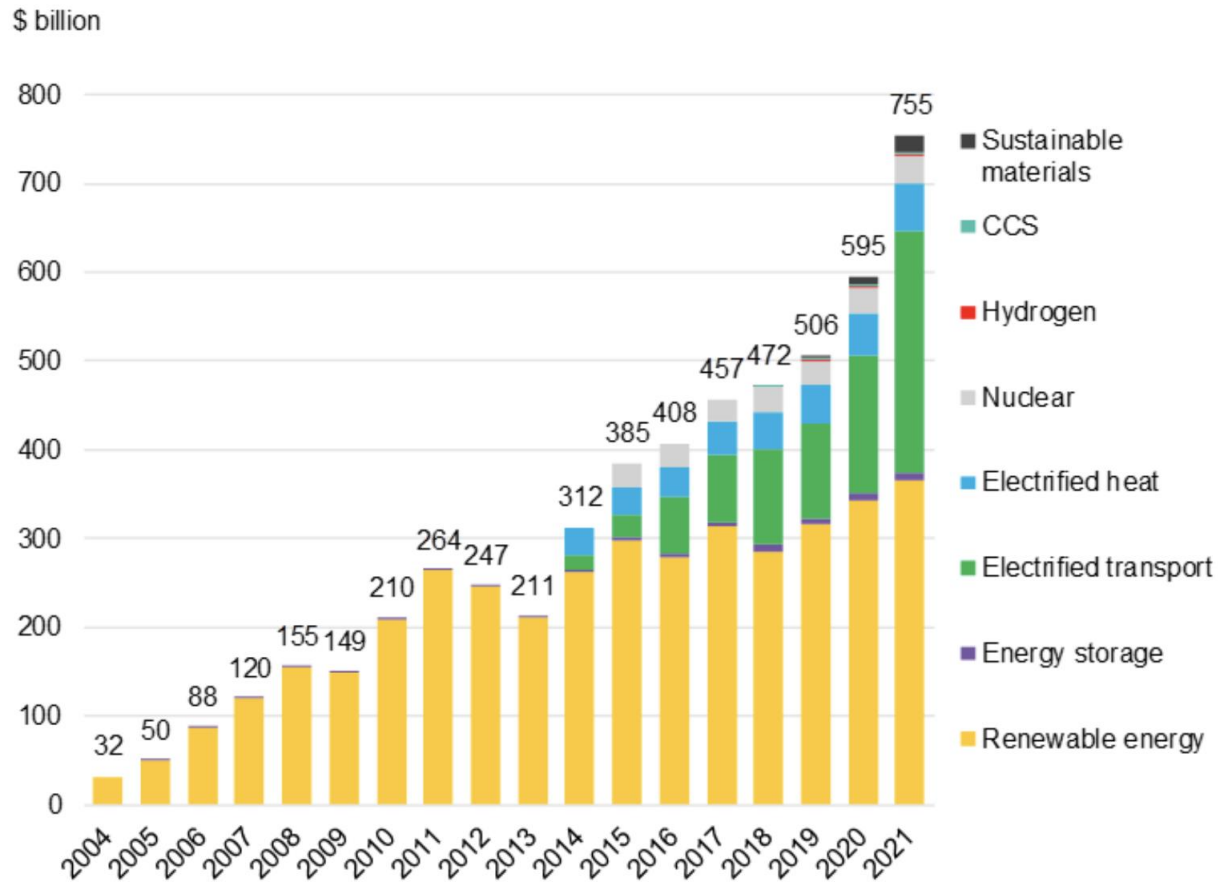
Burn Less?



Source: Our World in Data & BP Statistical Review of World Energy

Only 0.3% of energy transition investment in 2021 was in CCS technology

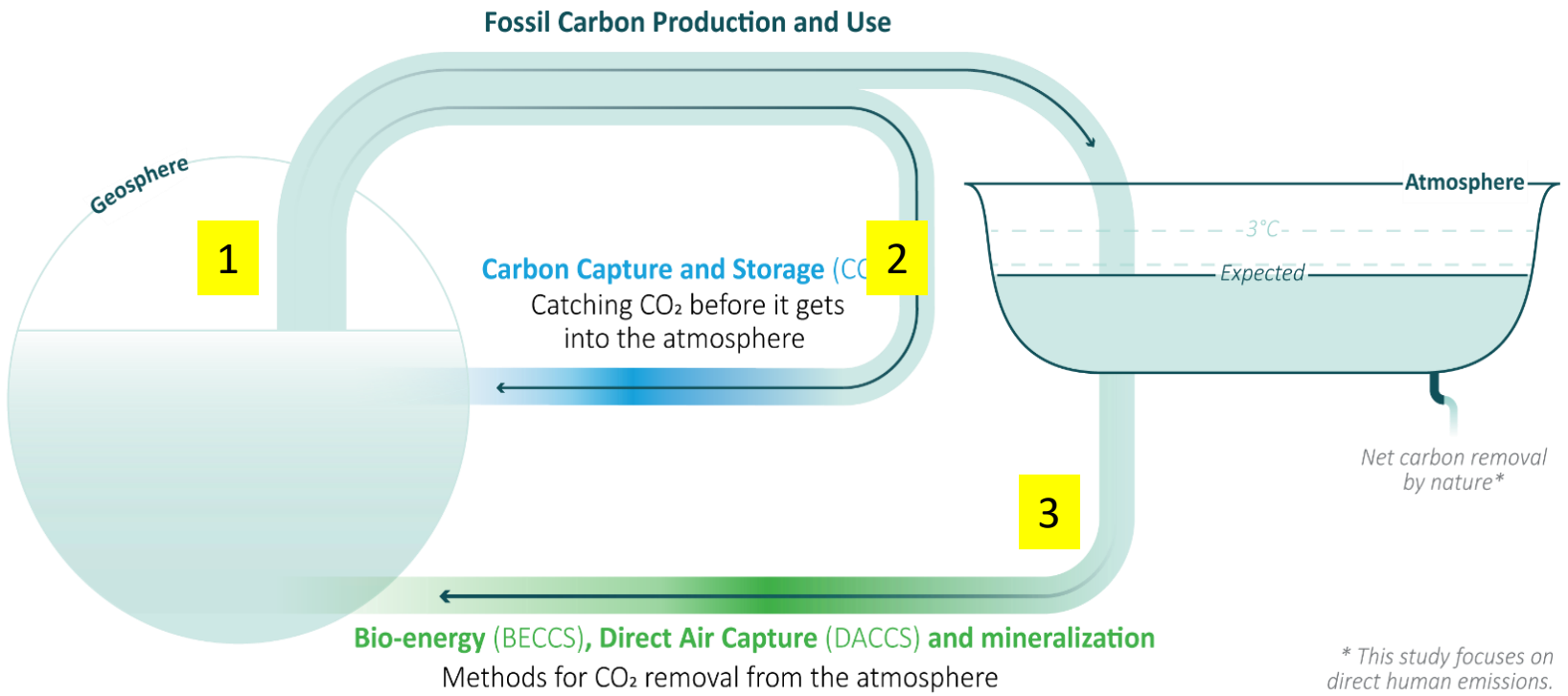
Around 40 Mton was stored. Roughly 0.1% of total fossil carbon produced.

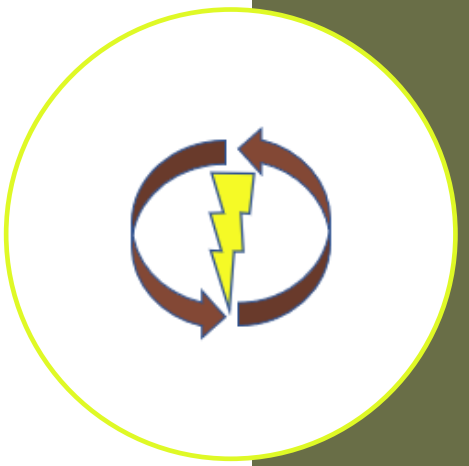


Source: Bloomberg, 2022. Energy Transition Investment Trends.

CTBO: a producer obligation

Making producers responsible for reaching Geological Net Zero on time





CTBO: core elements

1. **Storage Obligation:** an obligation to permanently store carbon for producers/suppliers of fossil carbon products;
2. **Stored Fraction**: **carbon stored** divided by **carbon produced**

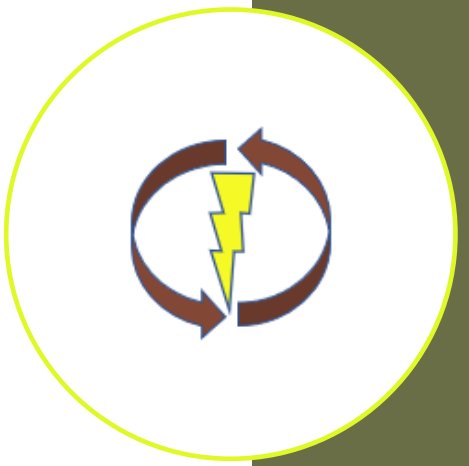
   scaling up in line with requirements in Net Zero scenario's:

   2030: 10% 2040: 50% 2050: 100%
3. **Carbon Storage Unit (CSU):**

   a CSU is awarded for each verified unit of carbon permanently stored

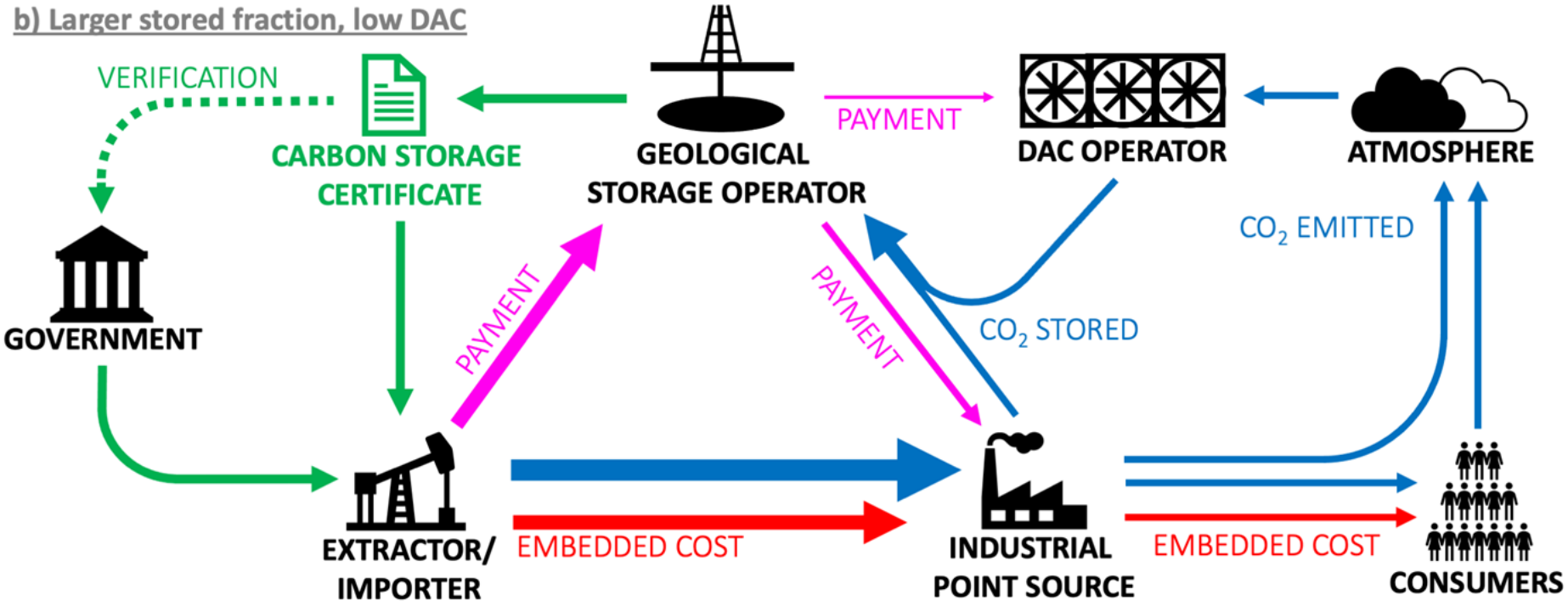
   They can only be used to demonstrate compliance with CTBO!
4. **Carbon Storage Surcharge (CSS)**

   Producers include (most of) the additional cost for CTBO compliance in product price



How a Carbon Takeback Obligation works

Scaling up the stored fraction

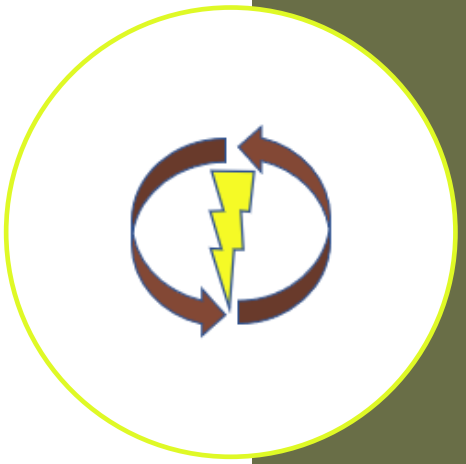


NET ZERO

UNIVERSITY OF OXFORD

NL CTBO studies

- Sponsors: Min Economic Affairs & Climate Change, Equinor, BP, EBN, NOGEPA
- Project team: De Gemeynt, RoyalHaskoningDHV, Margriet Kuijper Consultancy, Penrose, CE Delft
- Working Group: ngo's, investors, scientists, companies, financial experts, etc.



Phase 1: Report January 2021

Objective: shared understanding of objectives, boundary conditions and design choices for a CTBO policy in NL

Phase 2: Report June 2022

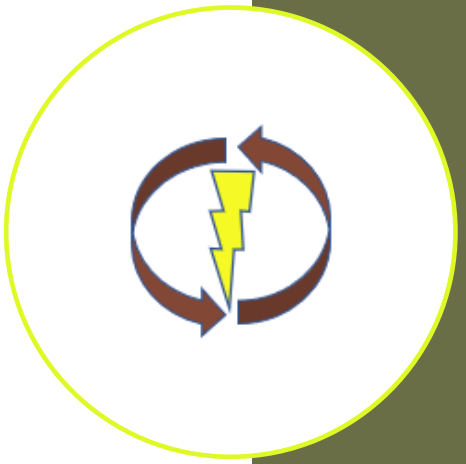
Objective: feasibility check on regulatory issues and broader economic impacts

Plus: activities in USA, Canada, UK, France, Norway

Shared objectives

Objectives:

1. A mechanism to ensure that the emissions from any remaining fossil carbon use are net zero by 2050
2. A simple and transparent mechanism to ensure that new decisions that involve fossil carbon (new production, use, investments) include the necessary conditions to be Paris-compliant
3. A mechanism that will provide a sustainable and broadly supported business model for CCS



Boundary conditions:

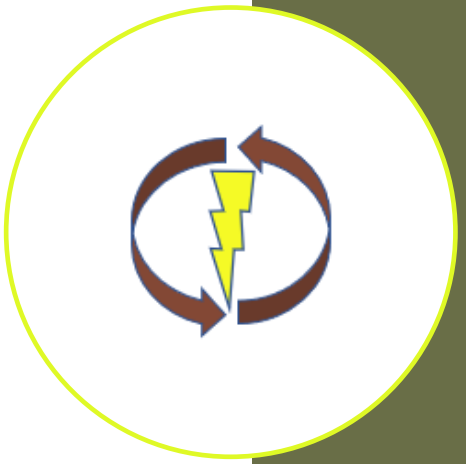
a) should not slow down the transition (lock-in fossil energy, delay renewables)

b) should not make NL less attractive for investments

Economics of Carbon Management

How does a CTBO impact the economics of carbon management?

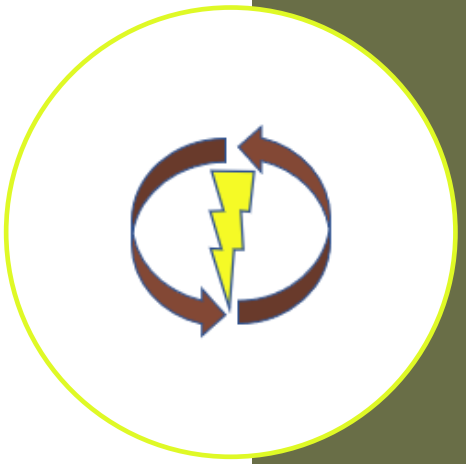
1. Existing point sources: CTBO acts a Contract for Difference
   ETS price high → CSU price low; ETS price low → CSU price high
2. Natural gas conversion to blue H2 or electricity (with CCS)
   as long as there is insufficient green electricity and H2
3. Investments in permanent Carbon Dioxide Removal (CDR):
   Biomass & CCS, DACS, mineralisation, use in concrete, etc



Concluding

The Carbon Takeback Obligation will provide a stable and predictable investment climate for both fossil energy investments and carbon capture and storage investments.

It can ensure that no new ‘unabated’ projects will be approved.



It will gradually ‘internalize’ the climate costs of fossil fuels in the product price, thereby encouraging customers to switch to cheaper and more sustainable alternatives.

This will greatly improve our chances of meeting the combined Challenge of Energy Security, Affordability and Climate targets.

Back-up

Carbon Dioxide Removal (CDR)

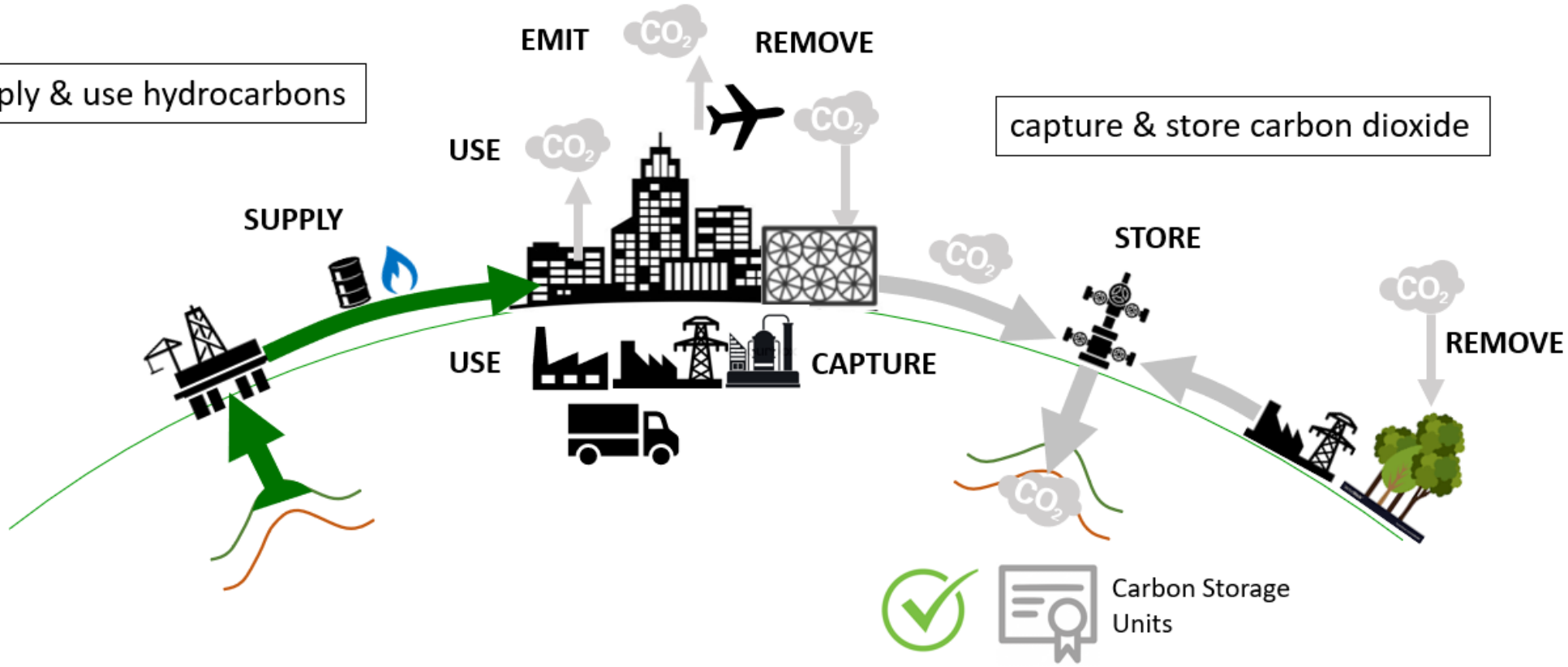
IPCC report, 3 purposes:

1) To reduce net emissions as soon as possible (new), avoid tipping points, etc
2) To offset difficult to mitigate fossil emissions
3) To remove historic emissions and overshoot, thereby delivering net negative emissions after reaching net zero

A CTBO ensures that:

- Costs of ‘2’ are paid for by fossil energy producers and users,
- Only permanent removal technologies are used

Carbon Takeback Obligation



Scaling up

CTBO as alternative supply-side policy to phase-out fossil energy use:

1. Leading countries introduce CTBO-policy (North Sea countries, EU, North America, Net Zero Producers Forum)
2. Countries start including CTBO-requirements for import AND export agreements
3. Worldwide CTBO policies and increasing % start to increase FE prices, reduce demand and restrict and slow-down new production
4. Net Zero is achieved, Fossil energy is still being used
5. Further increase above 100% can be considered (removal of historical emissions and overshoot)
6. Fossil energy phase-out is achieved