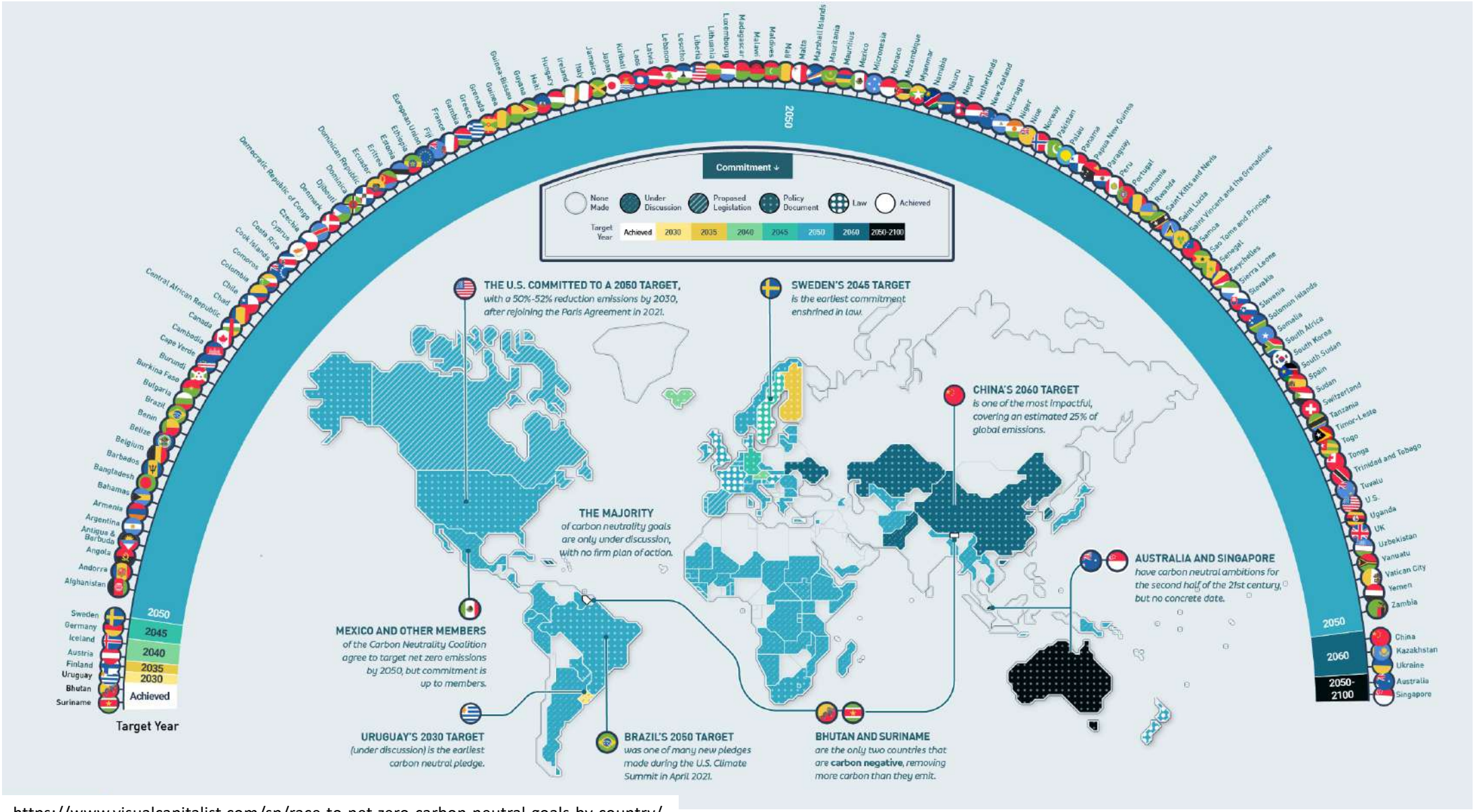
Towards net-zero sediment management of inland waterways – comparing embedded and embodied carbon emissions for dredging and reuse scenarios

Richard Lord & Keith Torrance — University of Strathclyde

Alasdair Hamilton & Paul Berry — Scottish Canals

Peter Berry — Canal & Rivers Trust

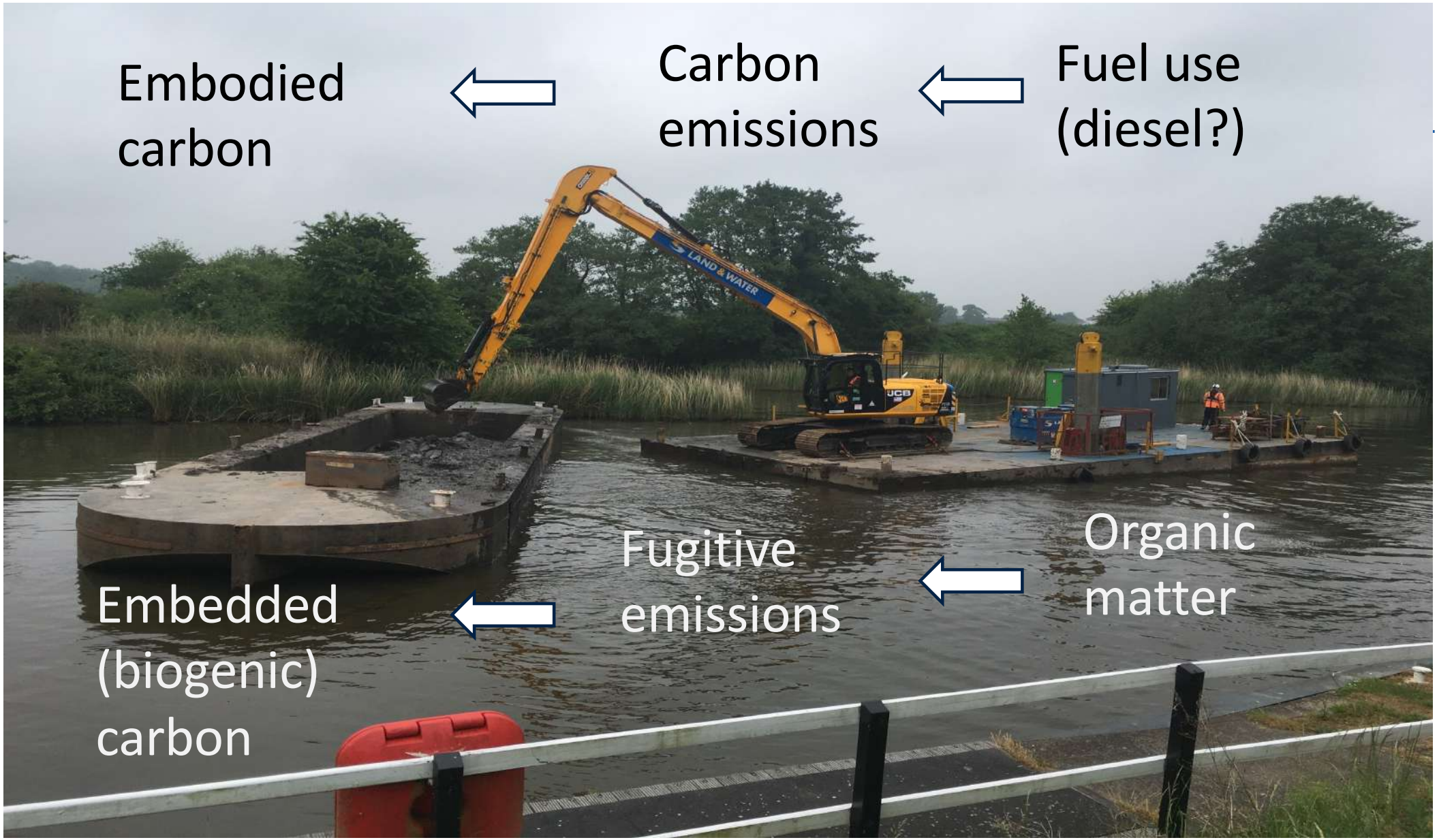
13th International SedNet Conference, Lisbon, 6-8 Sept 2023



https://www.visualcapitalist.com/sp/race-to-net-zero-carbon-neutral-goals-by-country/

Typical inland dredging

Typically transported for disposal


Embodied carbon
Carbon emissions
Fuel use (diesel?)
Organic matter
Fugitive emissions
Embedded (biogenic) carbon
LAND & WATER
JCB

Fuel use emissions – embodied C

- Example from CRT – up to 100,000 tonnes dredged every year (exc. Water Injection Dredging type works);

Annual Carbon Emissions for NDT contract (2019/20)			GHG emissions (Tonnes CO2 equivalent)	
on-site generators and plant				
total red diesel purchased	151,668	litres	418.30	31%
mobilisation				
estimated mobilisation distance	7,000	miles		
CO2 emissions	4,043.884	gCO2/mile	28.31	2%
personnel transport				
petrol	9,579.2	litres	21.04	2%
diesel	69,754.8	litres	178.57	13%
Disposal haulage				
estimated mileage	1,299,126	miles	693.82	52%
	(c. 55,000 tonnes of waste)			
total annual carbon budget of NDT Team			**1340.04**	

Organic matter in sediments -embedded (biogenic) C

- Example from CRT – up to 100,000 tonnes dredged every year (exc. Water Injection Dredging type works);
- Total GHG fuel emissions 1340 (T CO_2 equivalent)

Total dredged sediment	**100,000 Tonnes**
Total on dry basis (@ 38% dry matter)	38,000
Total organic matter (@ 12% SOM)	4560
Total C (assuming SOM = 58% SOC)	2645
Equivalent CO_2 (assuming 1 T C = 3.67 T CO_2)	9706

So embedded (biogenic) C in dredged sediment is 7 x embodied C from operational fuel emissions of dredging & transport for disposal/reuse

So need to consider fuel use AND potential release of C from dredging method & fate

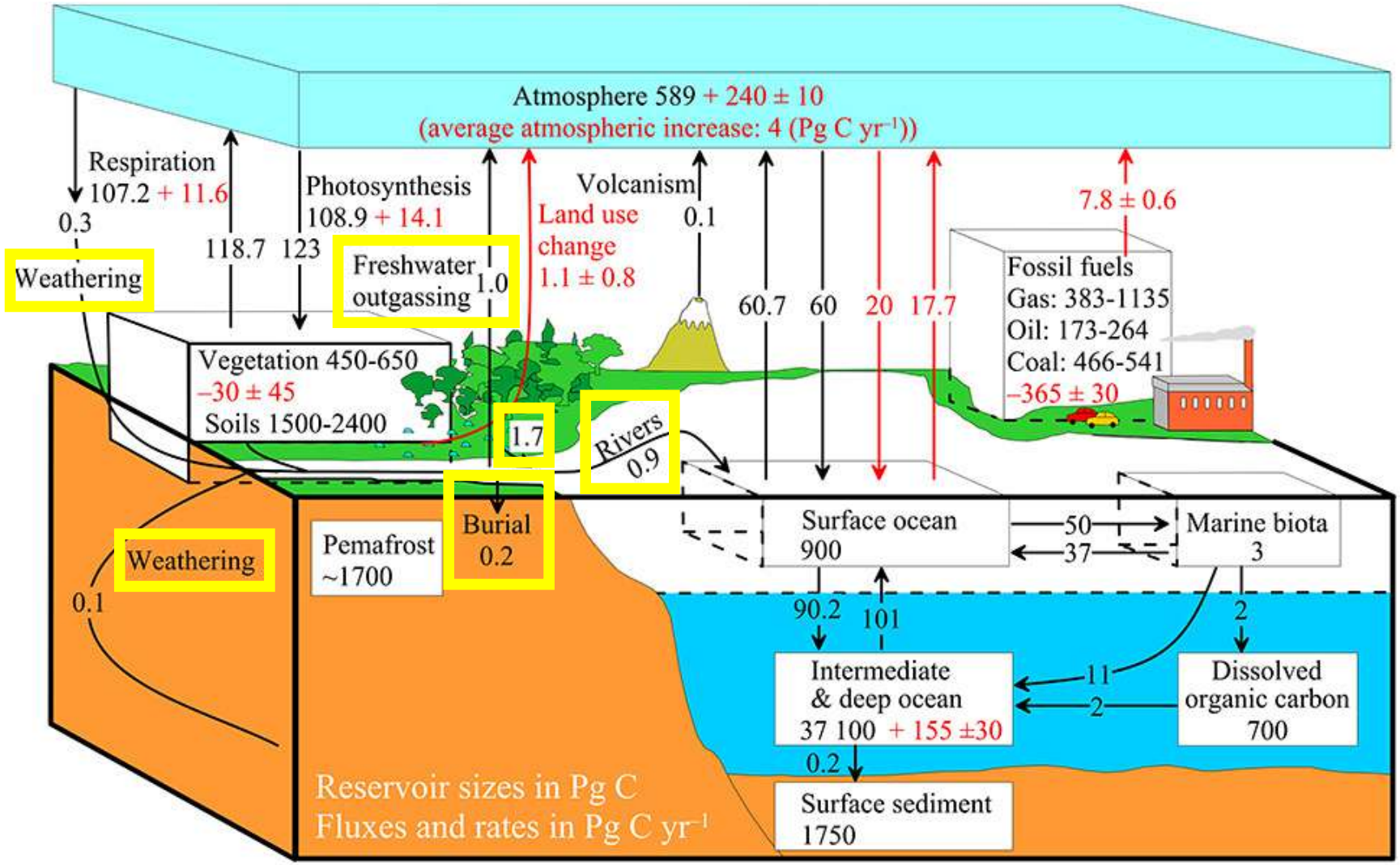
Disturbance by dredging and impact on the carbon cycle

- Are in situ sediments a source of GHG emissions or a future carbon sink (blue carbon)?

- If navigational disturbance and dredging releases GHGs is sediment removal beneficial?

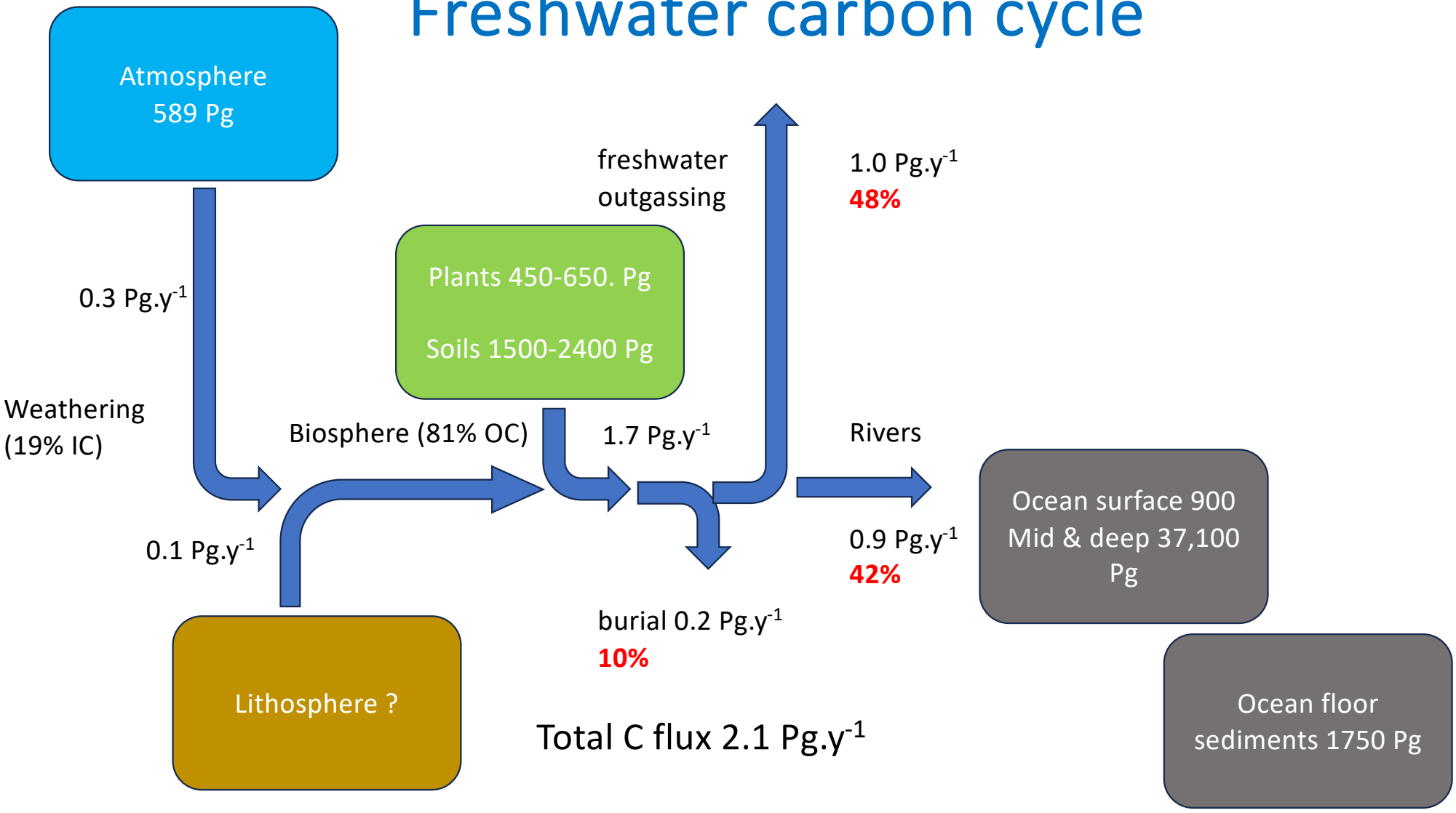
- What are the GHG impacts of different dredging and disposal methods

Global carbon cycle



Kandasamy & Nath (2016), Front. Mar. Sci 15 (3), 259 https://doi.org/10.3389/fmars.2016.00259

Freshwater carbon cycle



GHG Impacts of dredging methods / disposal options (and C storage potential?)

1. Ploughing and similar methods (reallocation & suppletion)

1. Fuel use – low
2. Disturbance of sediment - minimal
3. Future GHG emissions - as before?

Interreg
North-West Europe
SURICATES

2. Standard UK canal dredging method, hydraulic excavator into barge, or occasionally direct to bank

2. (cont.). Most commonly, excavated into barge, so double-handling to bank or road transport for disposal/reuse

1. Fuel use (plant, haulage, staff, site) –high
2. Disturbance of sediment – moderate to high
3. Future GHG emissions – highly variable/site-specific
    1. high (cement addition, landfill)
    2. low (topsoil use)
    3. negative (energy crops, nature-based carbon capture)

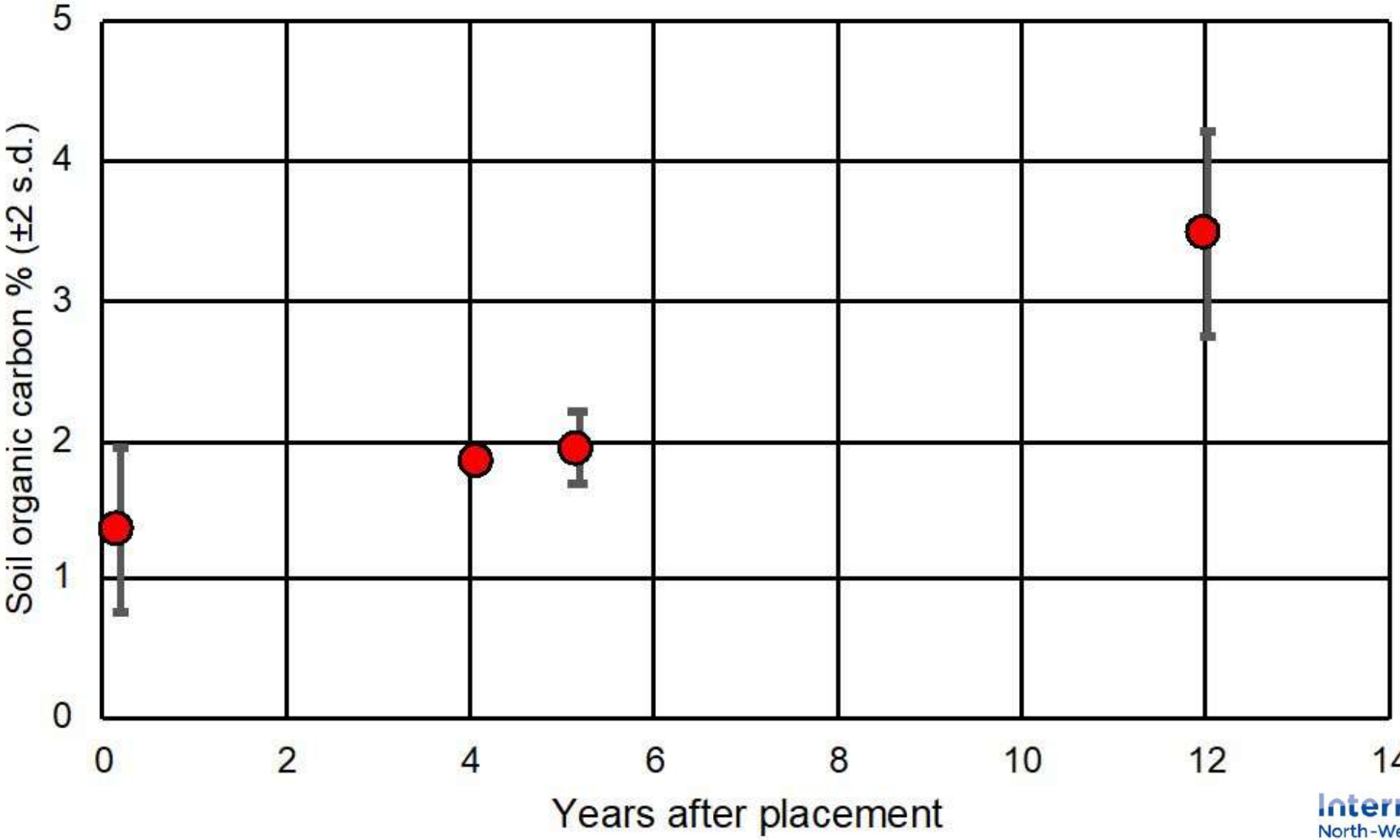
3. Novel cutter suction dredging, hydraulic transport of sediment & lagoon dewatering

1. Fuel use – lower (especially transport)
2. Disturbance of sediment - high
3. Future GHG emissions – low or negative if reused for soil & substituting primary aggregates


HIGHWAY MAINTENANCE

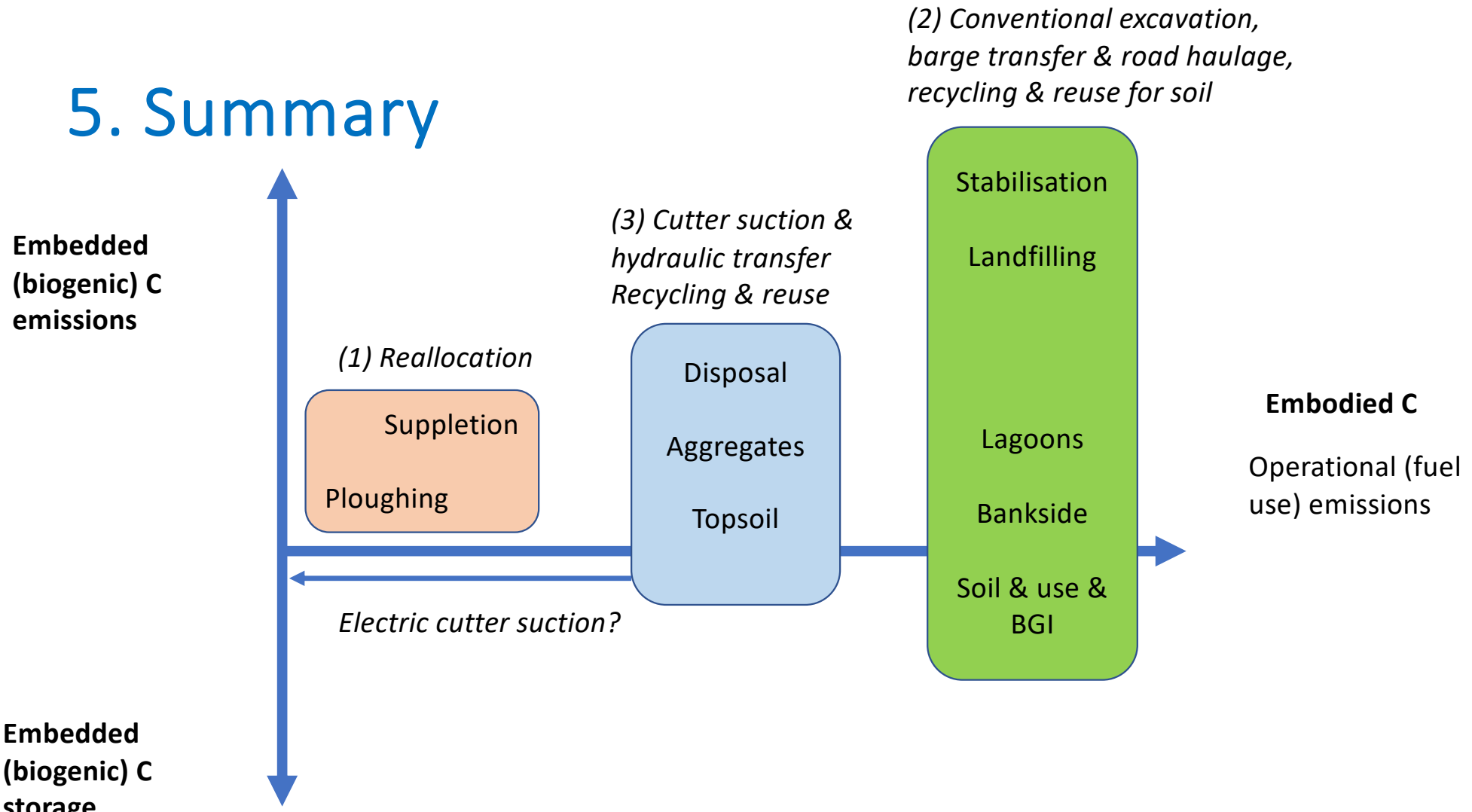
Interreg
North-West Europe
SURICATES

Interreg
North-West Europe
SURICATES



Interreg
North-West Europe
SURICATES

5. Summary


(2) Conventional excavation, barge transfer & road haulage, recycling & reuse for soil
Stabilisation
Landfilling
Lagoons
Bankside
Soil & use & BGI
(3) Cutter suction & hydraulic transfer Recycling & reuse
Disposal
Aggregates
Topsoil
(1) Reallocation
Suppletion
Ploughing
Electric cutter suction?
Embedded (biogenic) C emissions
Embedded (biogenic) C storage
Embodied C
Operational (fuel use) emissions

UK rejoins EU science research scheme Horizon

12 minutes ago

The UK is to rejoin the EU's flagship scientific research scheme, Horizon, the government has announced.

UK-based scientists and institutions will be able to apply for money from the £85bn fund from today.

Top Stories

US to arm Ukraine with controversial tank shells
42 minutes ago

Palestinians set out terms for Saudi-Israeli deal
7 hours ago

Court decriminalises abortion across Mexico
6 hours ago