Forum of Experts on SEEA Experimental Ecosystem Accounting
27 June 2019 Session 5c: Carbon stocks and flows

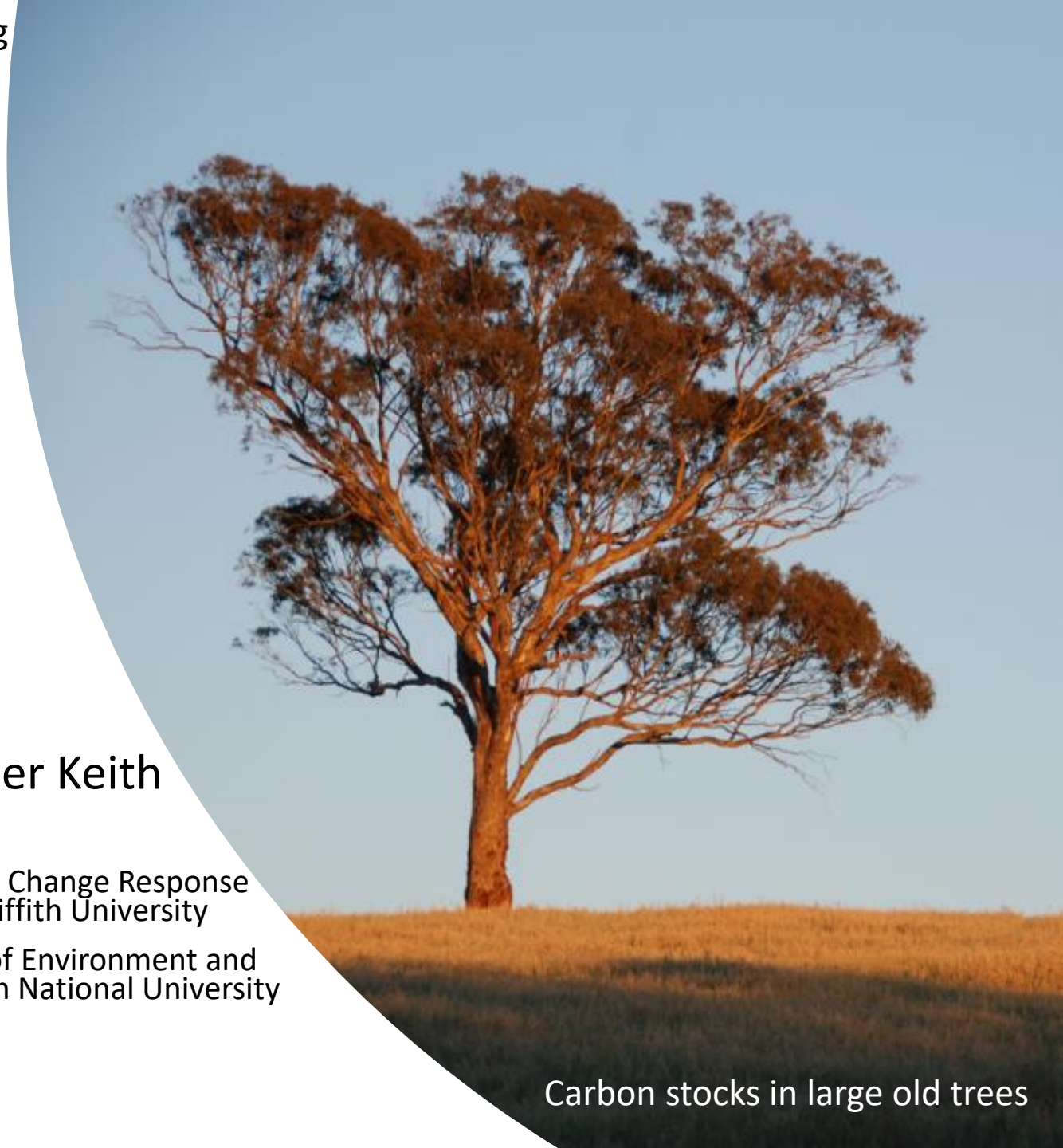
Policy demands for accounting for carbon related services

Carbon stocks in peatlands

Heather Keith

Griffith Climate Change Response Program, Griffith University

Fenner School of Environment and Society, Australian National University



Carbon stocks in large old trees

Policy demands for ecosystem accounting in general

Reasons for developing ecosystem accounts:

1) inform policy, public debate and scientific understanding about interactions between the environment and human activities
2) provide information about the comprehensive system to allow a macro-environmental approach to policy
3) comprehensive information to support multiple objectives, some of which may become apparent in the future
4) provide specific tools for on-ground management activities

Recognising the tension between the objectivity of accounts and the relevance of the information

Potential solution by separation of organisations for:

1) Data collection and reporting in the accounts is independent *(principles of comprehensiveness and objectivity)*
2) Analysis and interpretation of the information is directed by policy *(selection of relevant information)*

- different policy purposes require different types of information
- policy should not drive the data collection and reporting

Policy demands for carbon accounting

1. Climate change mitigation policy

- Identify global goals eg maintaining the atmospheric CO_2 concentration to below 450ppm to maintain temperature increase to below 2˚C *(carbon stock)*
- Allow fair and equitable ways of sharing the task through national responsibilities eg for emissions reduction *(carbon flows)*
- Identify relative benefits of different mitigation activities and prioritisation *(comparing carbon stocks and flows)*
- Need to coordinate with carbon accounting for the UNFCCC and Nationally Determined Contributions *(mostly carbon flows)*
- Support specific mitigation programs eg REDD+ *(carbon stocks)*

2. Land use and land management policy

- Quantify carbon storage and sequestration in ecosystems, eg forests, peatlands
- Identify synergies and trade-offs between the benefits of carbon storage and sequestration with other ecosystem services, eg timber provisioning, recreation, agricultural production
- Provide information to assess cost-effective solutions
- Monitoring and evaluation of environmental expenditure

3. Unified comprehensive carbon accounting system for application across international conventions

eg UNFCCC, CBD, SDGs.

- Define system ecosystem integrity and global tasks to achieve sustainability
- Efficiency of data collection and reporting
- Sharing of information across conventions eg ecosystem services from carbon and biodiversity, and well-being
- Allow macro-environmental approach to national and international problems

International environmental policies needing information from carbon accounts

Policy framework	Policy goal	Data needs
UNFCCC Kyoto Protocol Paris Agreement REDD+	Maintain the stock of CO_2 in the atmosphere below 450 ppm	Carbon stocks and change in stocks, by activity, land unit, country
OECD Green Growth Indicators demand-based indicators of carbon productivity	Decoupling carbon emissions from economic growth	• Combined economic and environmental data • Change in natural assets (carbon stocks)
Sustainable Development Goals 13. Action on Climate Change 15. Sustainable use of terrestrial ecosystems	• National policies to achieve low GHG emissions development • Foster resilience to climate change impacts • Define and demonstrate sustainable use of ecosystems	• Combined economic, carbon stock and flow data • Factors and interactions contributing to ecosystem resilience • Monitor all ecosystem services and change over time
Convention on Biological Diversity Aichi Targets IPBES Intergovernmental Science Policy Platform of Biodiversity and Ecosystem Services	• Safeguard ecological limits • Sustainable production and consumption • Reduce habitat loss • Sustainable land management in terms of supply of ecosystem services • Restoration of degraded ecosystems	Ecosystem services of carbon storage and sequestration defined by ecosystem and management types, and interactions with other ecosystem services
Natural Capital Protocol (coalition of > 300 organisations)	• Enable organisations to identify, measure and value direct and indirect impacts and dependencies on natural capital • Benefits for business, communities and economy	Co-benefits for ecosystems of management for adaptation and mitigation

Carbon accounting under the UNFCCC

Kyoto Protocol

- Accounting rules based on the IPCC (2006) guidelines
- Anthropogenic net annual emissions against a reference year *(gross emissions are not transparent and reference can vary)*
- No differentiation of forest types *(transfers of carbon stocks between qualities of different reservoirs not recorded)*
- Accounts only for managed land *(there is no definite distinction between managed and unmanaged lands)*
- Emissions from natural disturbance is included in the reference level *(differentiating natural and human-induced disturbance is difficult)*

Paris Agreement

- Political compromise with aspirations
- Concept introduced of maintaining ecological integrity as a criteria for mitigation activities

Katowice Climate Change Package

- Defines the rules to achieve the Paris Agreement goals
- Includes reference year(s) and reference indicators of emissions reductions
- Requires a global stocktake every 5 years
- Nationally-decided accounting methods to determine NDCs
- Refinement of IPCC guidelines in 2019, but maintaining the basis of the Kyoto Protocol rules and definitions

Emissions trading - carbon markets under both compliance schemes and as voluntary programs

- Kyoto Protocol mechanisms under CDM – only reforestation and afforestation (very few projects)
- national and regional regulated compliance schemes based on tradable carbon offsets for emissions reduction activities

REDD+

UNFCCC program for developing countries:

"reducing emissions from deforestation, forest degradation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks"

- aims to offer incentives to avoid deforestation and reduce emissions from forested lands.
- mitigation activities based on quantifying carbon stocks that are maintained in forests
- mitigation activities for which payments can be made (= ecosystem services)
- payment is by a results basis with the funding donated by other countries.
- project of nationally based
- monitoring includes anthropogenic forest-related GHG emissions by sources and removals by sinks, forest carbon stocks and forest area changes.
- accounting methods based on IPCC (2006) guidelines but 2019 refinement in process.

REDD+ projects in Laos

REDD+ demonstrates:

- linkages of carbon storage as an ecosystem service with other components of ecosystem accounts (drivers, reference levels, monitoring systems, land tenure, governance, safeguards of other ecosystem services)
- a financial value is created for the carbon stored in forests
- forest-related activities that lead to climate change mitigation are benefits to humans

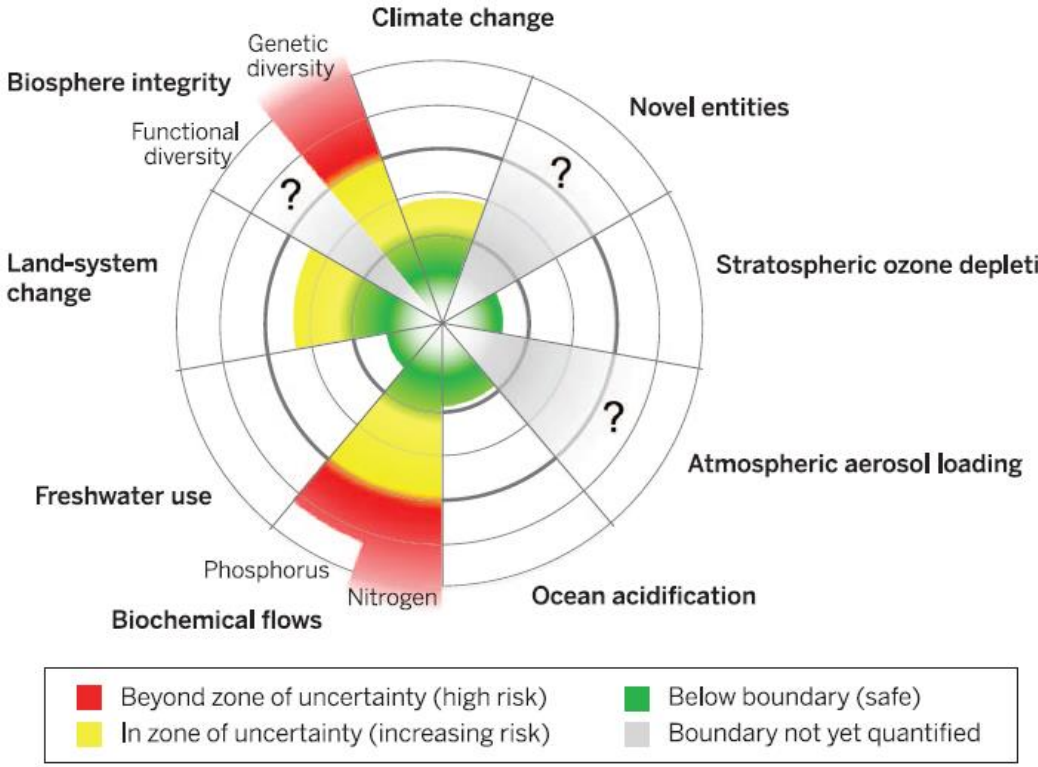
SEEA carbon accounts should support programs like REDD+:

- provide comprehensive and cost-effective monitoring of carbon stocks and changes in stocks
- show interactions between ecosystem services and links to human benefits

➢ Current problems with implementation include monitoring costs, forest governance, timber certification, leakage or displacement of emissions, positive and negative interactions with other conservation values.

Goal of comprehensive ecosystem accounts

- The theoretical framework for ecosystem accounting should be comprehensive and inclusive of all stocks and flows and show their potential link to benefits for humans.
- Selection of specific stocks and flows to be reported can be decided depending on the purpose of the accounts, eg based on relevance to policy questions or users.
- Prioritisation for reporting of accounts can be based on variables that control the planetary boundaries eg carbon stocks in the atmosphere, nitrogen in soil and water.
- The accounting framework as a statistical standard should be sufficiently flexible to allow any future policy relevant use (and not all can be conceived currently), but should be sufficiently rigorous to prevent manipulation of the information by users.



[Source: Steffen et al. 2015 Science 347:1259855]

Components of the carbon account linked to benefits for humans:

1. Carbon storage *(stock)*
2. Carbon sequestration *(flow)*
3. Carbon dioxide emissions *(flow)*

influencing the planetary boundaries

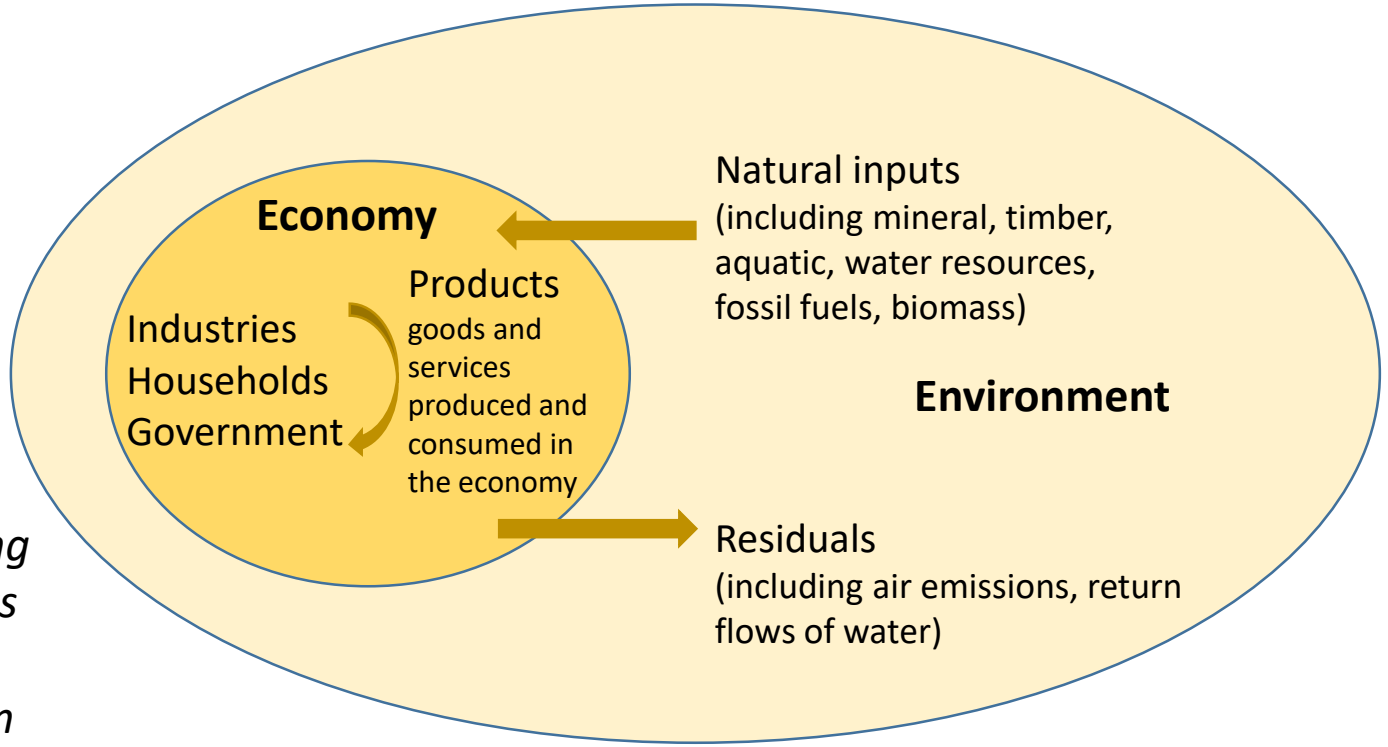
- Climate change
- Biosphere integrity
- Land-system change
- Biochemical flows
- Ocean acidification

Carbon accounts in the SEEA Central Framework

Natural inputs – physical flows of materials, water and energy moved from the environment as part of economic production processes or used in production, eg fossil fuels, biomass.

Residuals – flows of material and energy that are discarded to the environment through production, consumption and accumulation, eg air emissions.

Environmental assets – *"naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment, that may provide benefits to humanity" [SEEA CF 2.17]*
Selection of component to develop accounts is based on resources for use in economic activity and meaningful for analytical purposes.

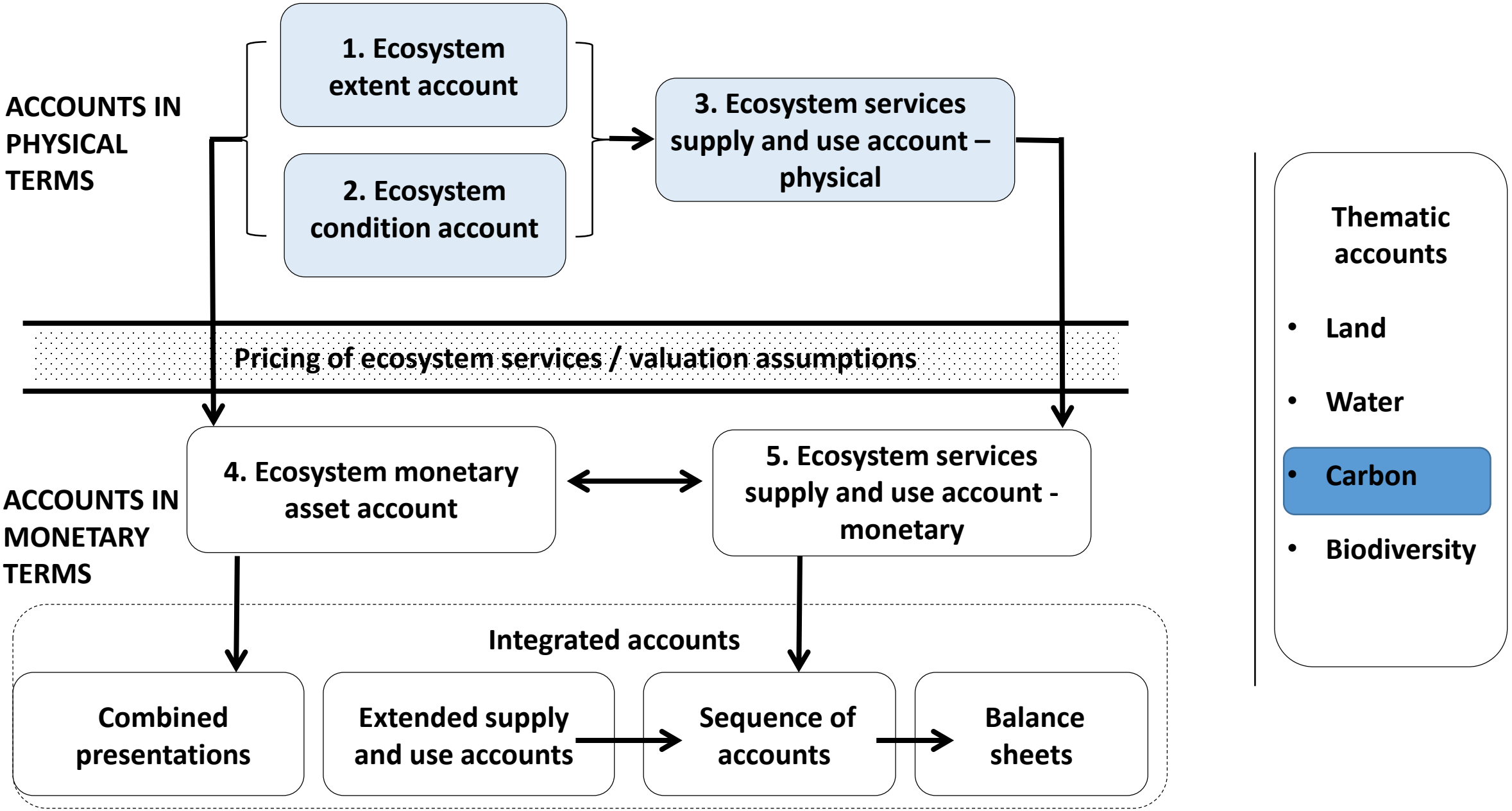


Physical flows within the economic – environmental system

Air emissions account – a physical flow account recorded as:

- flows from the economy to the environment as a result of production, consumption or accumulation processes
- generation and accumulation of emissions from industries and households by type of substance
- release of residuals as flows to the environment.
- production boundary of resident economic units
- gross anthropogenic emissions (does not record removals by environmental sinks like forests and soils)

Carbon in the SEEA Experimental Ecosystem Accounting framework



Carbon in the SEEA Experimental Ecosystem Accounting framework

Thematic account for carbon

- data on stocks and flows
- ➢ How does this translate to the ecosystem accounting framework?

Ecosystem asset accounts

"ecosystem assets are environmental assets viewed from a systems perspective with biophysical components operating within a functional unit. Ecosystem assets are defined for spatial areas covered by a specific ecosystem type" [SEEA EEA 2.130]

1. Carbon stock in the biosphere
   - extent (quantity as tC in each reservoir)
   - condition (quality of the reservoir eg natural, semi-natural, plantation forests)
2. Carbon stock in the atmosphere (the atmosphere should be considered an asset for this purpose)

- ➢ Exchange of carbon between assets as emissions and removals from biosphere to atmosphere.

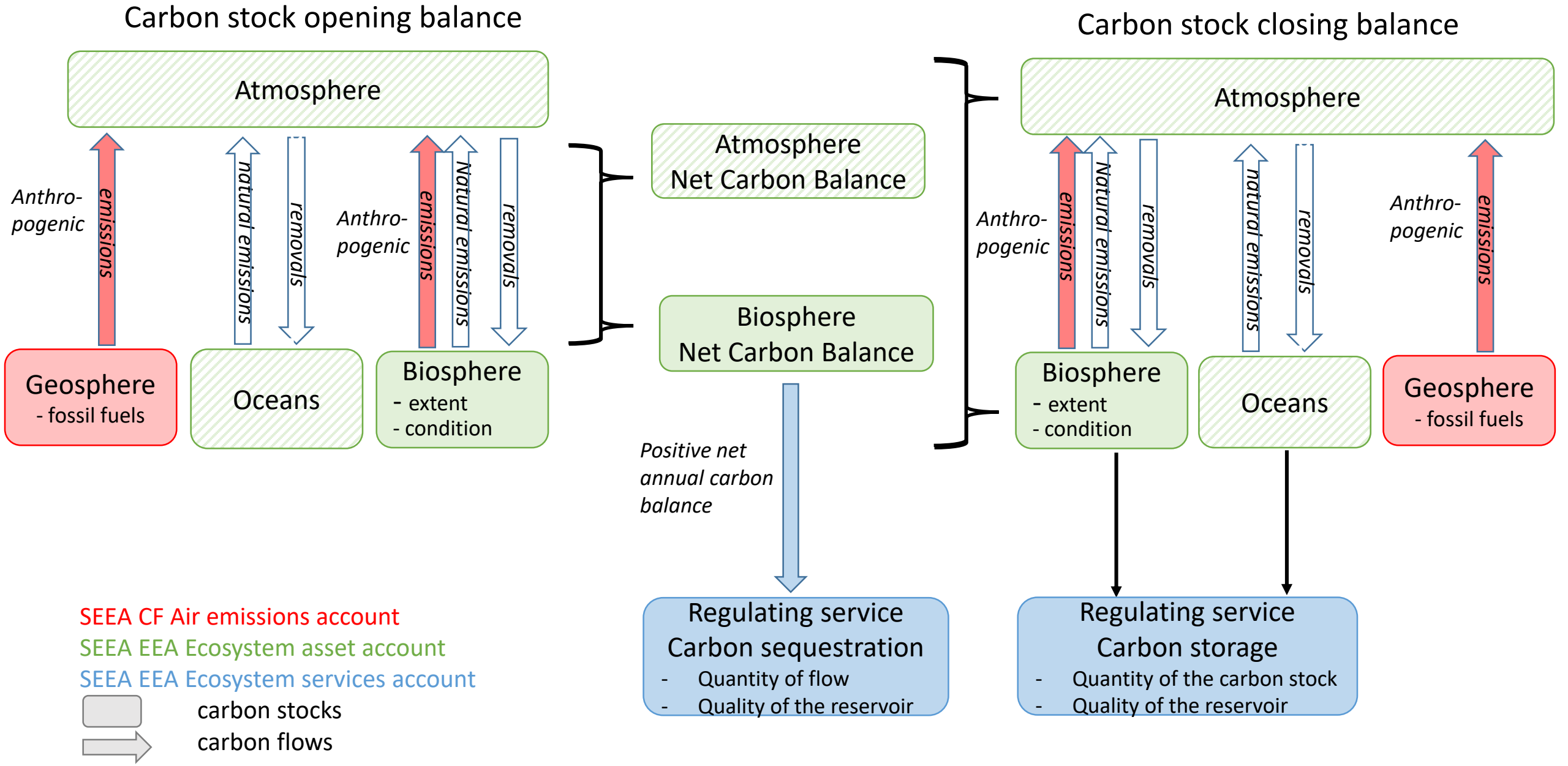
Ecosystem service accounts in physical units

1. Carbon sequestration – a flow as the removal of carbon from the atmosphere and uptake by the biosphere (units: tC/ha/yr)
2. Carbon storage – the benefit of the reservoir that stores carbon (units: tC/ha)

Ecosystem service accounts in monetary units as payments for ecosystem services

1. Carbon sequestration – market value for carbon credits
2. Carbon storage – avoided emissions could be valued as polluter pays or beneficiary pays
   eg replacement cost for a different reservoir

Carbon stocks and flows within the ecosystem accounting framework

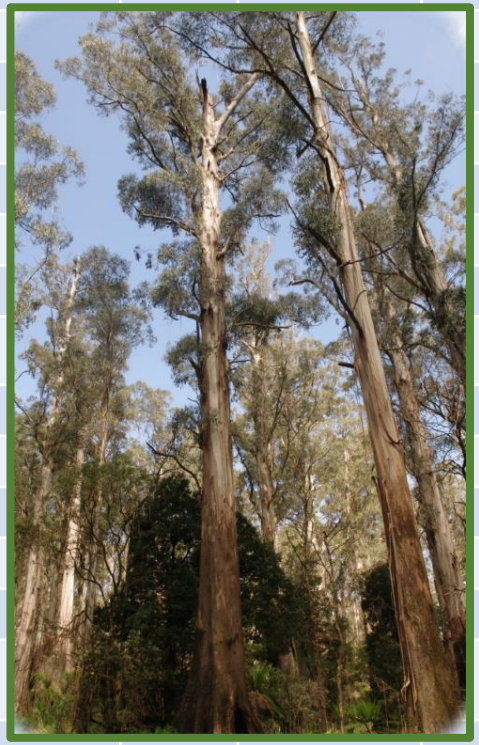


Qualities of carbon stocks in primary reservoirs

Reservoir		Criteria			Rank
		Stability	**Restoration time**	**Carbon density**	
Geocarbon		High	Geological	High	A. High
Biocarbon	Natural ecosystems	High – moderate	Decades to millennia	High	A. High
	Semi-natural ecosystems	Moderate	Years to centuries	Moderate	B. Moderate
	Agricultural systems	Low	Annual to decades	Low - moderate	C. Low-moderate
Oceans	Coastal biotic systems	Moderate	Years to centuries	Moderate	B. Moderate
	Marine sediments	High	Geological	Moderate	A. High

Carbon stock account for biocarbon in terrestrial ecosystems showing the quality of the carbon stocks

	Outside the economy				Accounted within the economy								
	Natural ecosystems				Semi-natural ecosystems				Plantations			Agriculture	
	Rainforest	Forest	Woodland	Peatlands	Selectively logged rainforest	Regrowth forest	Grazed woodland	Drained peatland	Softwood sawlog	Hardwood sawlog	S/H wood pulplogs	Annual	Perennial
Opening stock of carbon													
Additions to stock													
Natural expansion													
Managed expansion													
Discoveries													
Upward reappraisals													
Reclassifications													
Total additions to stock													
Reductions in stock													
Natural contraction													
Managed contraction													
Downward reappraisals													
Reclassifications													
Total reductions in stocks													
Imports and exports													
Imports													
Exports													
Closing stock of carbon													



Why carbon storage and carbon sequestration should both be accounted as ecosystem services

1. Carbon stock and flow data is reported in thematic accounts, but information relevant for policy needs to be transferred to ecosystem asset and ecosystem service accounts to demonstrate the links to benefits and use by humans, and leading to valuation.

2. The benefits of carbon storage depend on the qualities of carbon stocks (longevity, stability and resilience) to benefits to humans and links to the economy

3. The accounting framework should allow for all reservoirs to be included, but selection for development of accounts may be influenced by relevance for policy. Information about carbon storage is useful for current policy decisions.

4. Including the links between all stocks and flows of carbon with the economy allows a greater range of trade-offs and policy options to be investigated.

5. The services of carbon sequestration and carbon storage can be recorded separately in physical accounts.

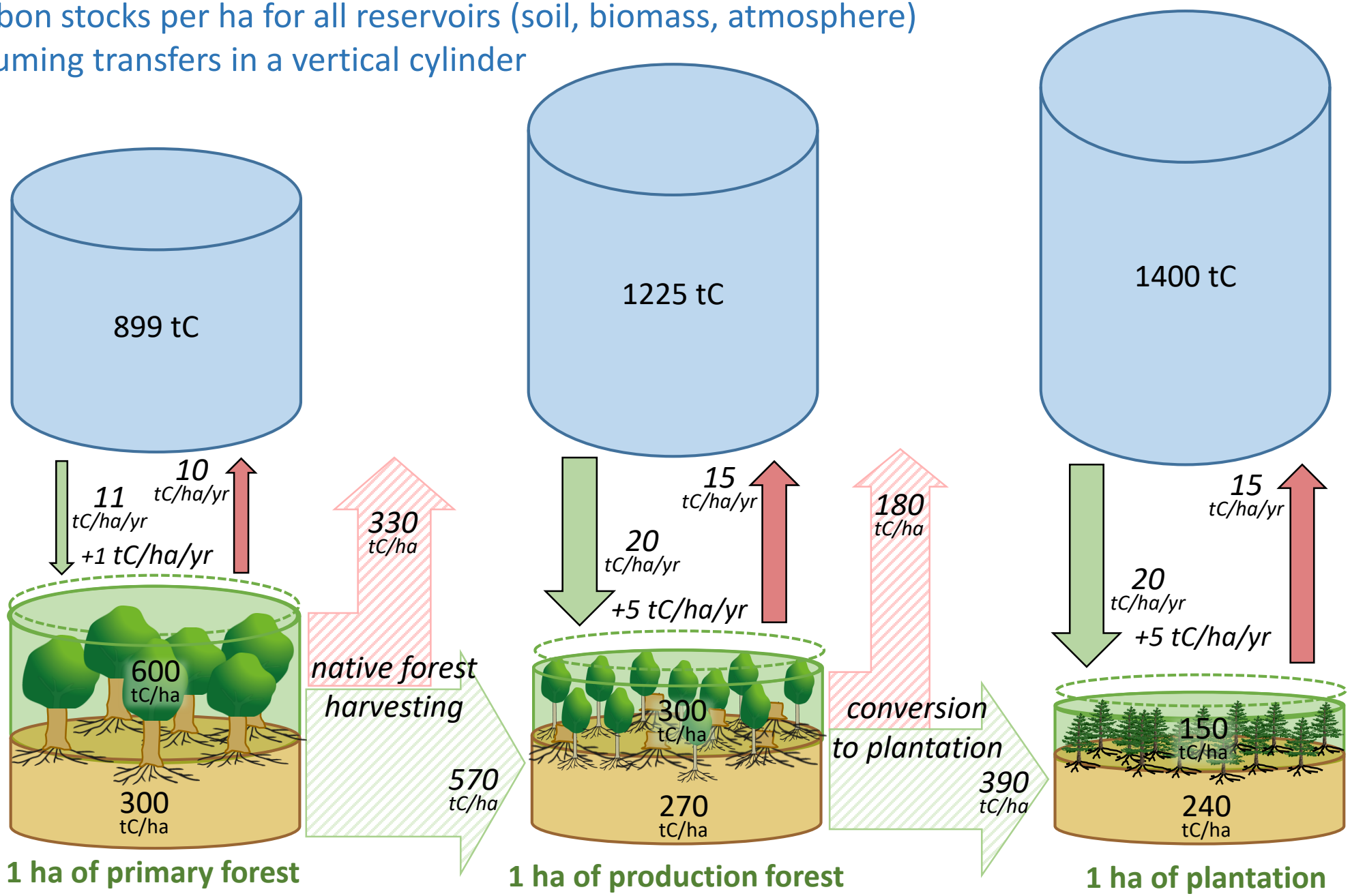
6. Valuation of a unit of carbon may be different for the services of carbon sequestration and carbon storage.

7. Linking carbon stocks and flows to assets and services provides information to policy allowing targeting of industries, policy instruments, and cost-effective solutions to climate mitigation

8. Reporting information on carbon storage and sequestration as ecosystem services enhances policy options for climate change mitigation, including national responsibility for reducing emissions and protecting and enhancing stocks.

Example of carbon stocks and flows

Carbon stocks per ha for all reservoirs (soil, biomass, atmosphere) assuming transfers in a vertical cylinder



Data for a wet, temperate eucalypt forest in SE Australia

Flows in italics
Stocks in roman

Long-term carbon dynamics in harvested temperate eucalypt forest