Vision, Structure, Scope, and Applicability of the National Ecosystem Services Classification System (NESCS) For UNSD SEEA-EEA

UNSD Expert Group Meeting
Towards a standard international classification
on ecosystem services
June 20, 2016

Charles Rhodes   ORISE (participating at EPA)

With contributions from:

Dixon Landers   *EPA*   *Joel Corona*   *EPA*

Paramita Sinha   *RTI*   *George van Houtven* *RTI*

Amanda Nahlik   *Kenyon College (cooperating with EPA)*

rhodes.charlesr@epa.gov

SEEA EEA Suggested Outline Elements

Expert Group Meeting Agenda proposed Six elements:

- **Purpose** and nature of the classification

- **Scope and coverage** of the classification

- **Principles** used in constructing the classification

- **Concepts** of "ecosystem services" used in the classification

- **Structure** of the classification

- **Applicability** for ecosystem accounting

Actual Outline Elements

The proposed Six elements will find address here in this order:

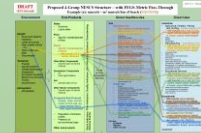1. **Concepts** of "ecosystem services" used in the classification

   - *ecosystem services classification system* (**ES-CS**)

2. **Principles** used in constructing the classification/ES-CS

3. **Purpose** and nature of the classification/ES-CS

4. **Structure** of the classification/ES-CS

5. **Scope and coverage** of the classification/ES-CS

   - Including how NESCS and FEGS-CS differ

6. **Applicability** of the ES-CS for ecosystem accounting

Growing ES literature since Daily et al. (1997), as ecologists, researchers, and policy makers try to apply *ES* concept:

*De Groot et al (2002); **MA (2005)**; Boyd and Banzhaf (2007);*

Wallace (2007); Fisher and Turner (2009); Staub et al (2011);

Haines-Young and Potschin (2012); Landers and Nahlik (2013) …

Where and what ecosystem services occur along the continuum between ecosystems and human well-being?

How should we distinguish ecosystem services relevant to any focused analysis?

Millennium Ecosystem Assessment (*MA, 2005)*

Supporting Services, Provisioning Services, Regulating Services, Cultural Services

1. Concept of ES

Millennium Ecosystem Assessment Types of Ecosystem Services and their Links to Human Well-Being

Source: Millennium Ecosystem Assessment, 2003. Ecosystems and human well-being: a framework for assessment.
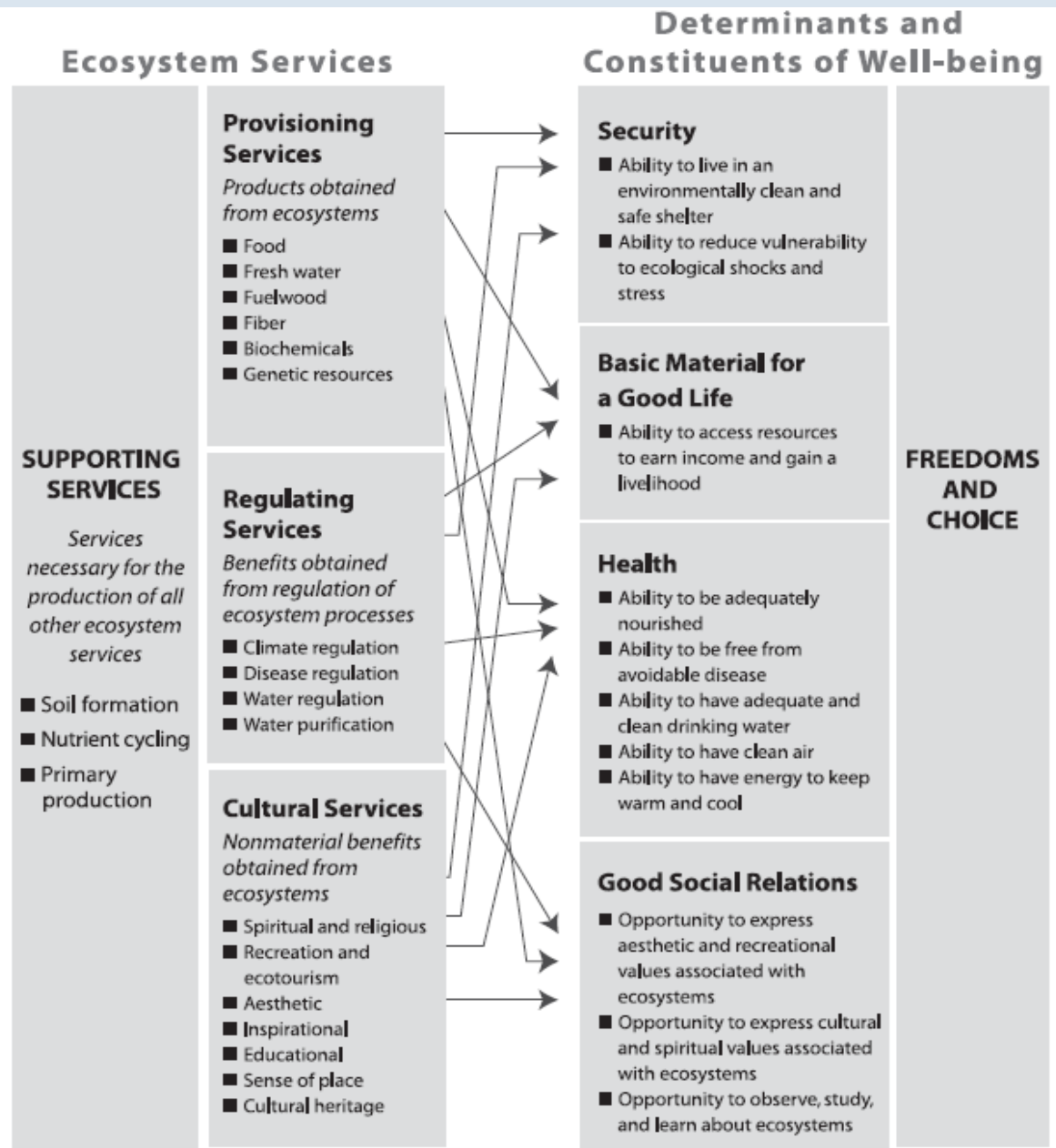
"These categories overlap extensively, and the purpose is not to establish a taxonomy but rather to ensure that the analysis addresses the entire range of services" (p. 38, emphasis added).

- **Porous categories**
- **Double Counting**

US EPA

- Benefit-Cost Analyses (BCA)

- Adding more ES *cannot* be allowed to bring poorly identified metrics or double counting into BCA or policy analyses

EPA's ORD, OW, OAR: within constraints of MA's four groups, can researchers derive a set of clear, unique, unduplicated ecological and economic *measures for ES that matter to people and policy*?

Boyd and Banzhaf (2007) indicate a potential way forward: **count only those ES that directly enter the human economy, at the point they do –** *Final Ecosystem Services*

Final Ecosystem Services

At the point they enter human systems "ecological endpoints" have no price – no human pays nature for birdsong, seashells, or soil productivity

Ecosystem Services Perspective and Economics

Final ES are *defined* as not having prices:

- A key information signal between providers (supply) and consumers (demand) in markets is *missing*

- The ES perspective *may,* and Environmental Economic Accounts *do* attempt to model/*mimic*/approximate a Price-Quantity relationship (equilibrium) for ES

The result must be awkward and clunky

2. Principles for ES-CS

Knowing this:

1) careful identification of supply- and demand-*like* elements becomes critical to "modeling success"

2) data may be judged relevant as it informs identified supply- and demand-*like* elements

"Supply" *from* a specific environment   "Demand" *from* specific humans

Approaches to definition and identification of ES seem to split between:

Those seeking formalization and standardization of ES definitions and identification

- bound to formal analysis
  - marginal/scenario/cost-benefit analyses
- seek long-term tool development
  - "full-spectrum" *identification*
  - precise, reproducible, and specific field *metrics*
  - precise final ES for known users/beneficiaries to *value*
  - common tracking of relevant ES metrics with the *goal* of "allowable" benefits transfer

Ad-hoc pragmatists

- frustrated with slowness of adoption of ES perspective
- focused on limitations of full-scale ES assessment for very few ES
  - 1 to 6 "ecosystem services"
- question the efficacy of formalizing classification

Core Features for a Desirable _Final_ Ecosystem Services Classification System

Exhaustive and Mutually Exclusive
uniquely identifies all structures, processes, functions, and products of natural systems (separate from human-driven systems) that humans use or appreciate

Non-Duplicative
focuses attention and measurement on those ecosystem services that humans use or appreciate directly (*final* versus intermediate *ecosystem services*), *to avoid double-counting*

Practical for Users
groups or separates candidate elements in a way easy to conceive and use, with clear definitions, and rules for classifying that appeal across disciplines and users – *avoiding overwhelming complexity, confusion, fuzzy classification boundaries, and thus avoiding divergent choices for similar cases by similar users*

Helpful for Selecting Appropriate Metrics
uniquely identifying the environment, the precise flows of ecosystem services, the users, and how they use the ES, all *help to determine what ecologists and economists should measure*

Wish List:

Modular
a "bonus" for practical use, if system interfaces with other standard classification systems or ecosystem service tools without extensive exceptions and patching

Appropriate to be a Standard
a "bonus" for practical use, if system is stable, its rules for use are well-explained, and it is practical enough to serve as the standard for many types of applications

Pathway Linking Policy Changes to Human Well-Being
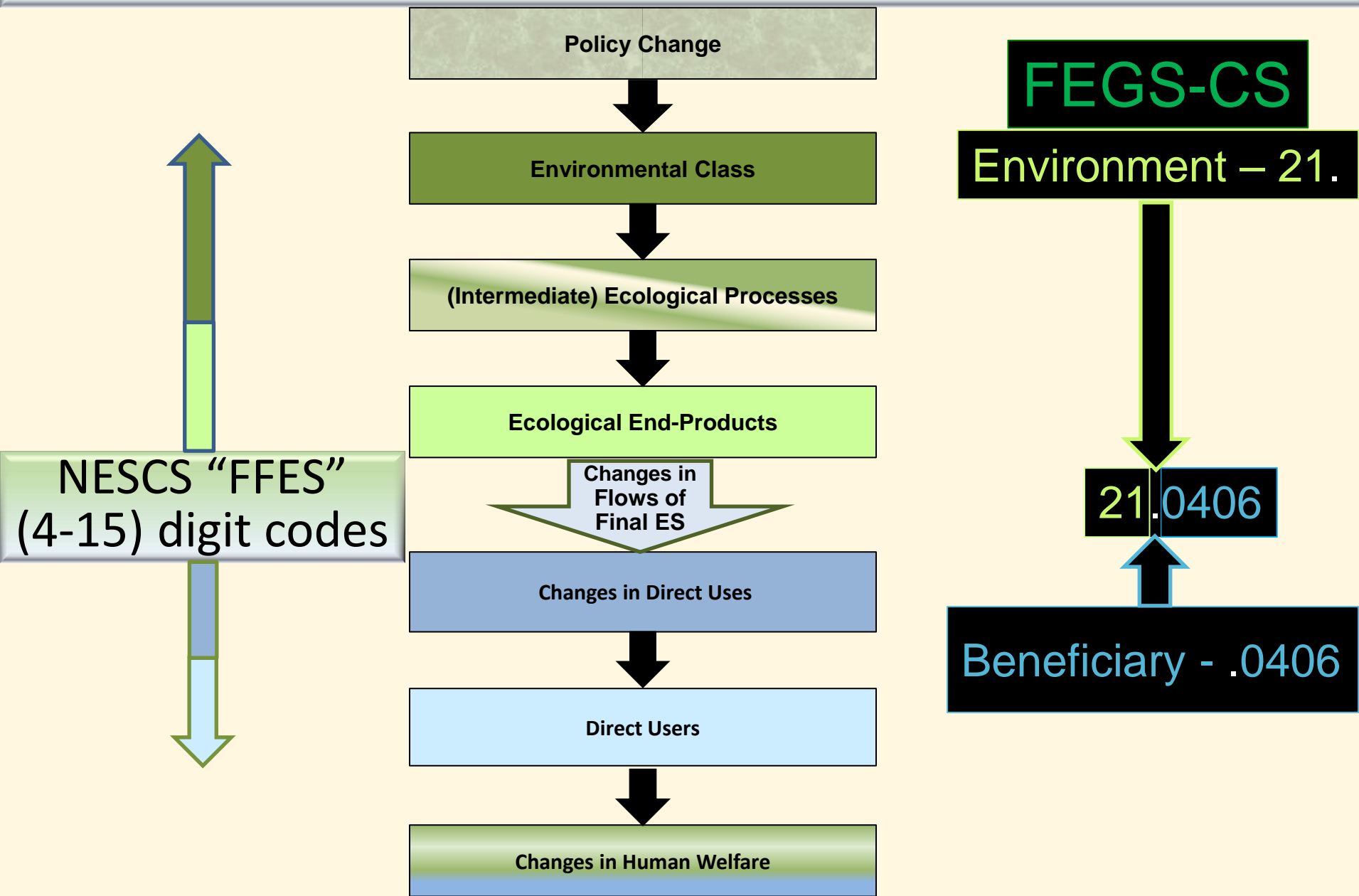
Policy Change

↓

Environmental Class

↓

(Intermediate) Ecological Processes

↓

Ecological End-Products

Changes in Flows of Final ES

Changes in Direct Uses

↓

Direct Users

↓

Changes in Human Welfare

NESCS "FFES" (4-15) digit codes

FEGS-CS

Environment – 21.

↓

21.0406

↑

Beneficiary - .0406

The National Ecosystem Services Classification System (NESCS)

United States Environmental Protection Agency

Office of Water
Office of Research and Development

September 2015
EPA-800-R-15-002

National Ecosystem Services Classification System (NESCS): Framework Design and Policy Application

Final Report

NESCS Four-Group Classification

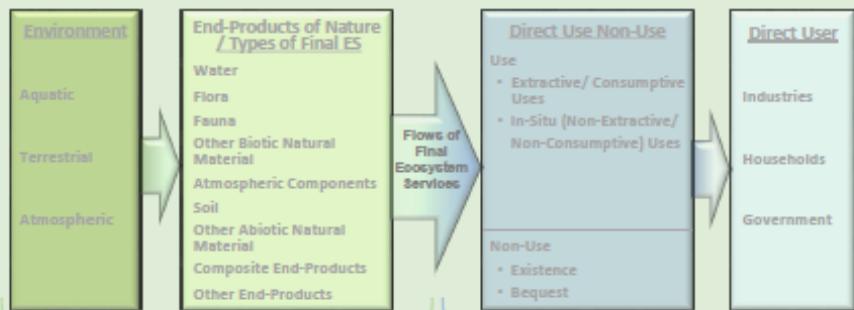| Environment	End-Products of Nature / Types of Final ES	Direct Use Non-Use	Direct User
Aquatic	Water	Use	Industries
Terrestrial	Flora	• Extractive/ Consumptive Uses	Households
Atmospheric	Fauna	• In-Situ (Non-Extractive/ Non-Consumptive) Uses	Government
	Other Biotic Natural Material		
	Atmospheric Components		
	Soil		
	Other Abiotic Natural Material	Non-Use	
	Composite End-Products	• Existence	
	Other End-Products	• Bequest	

- **Identification/Classification**

- **Quantification and Measures**
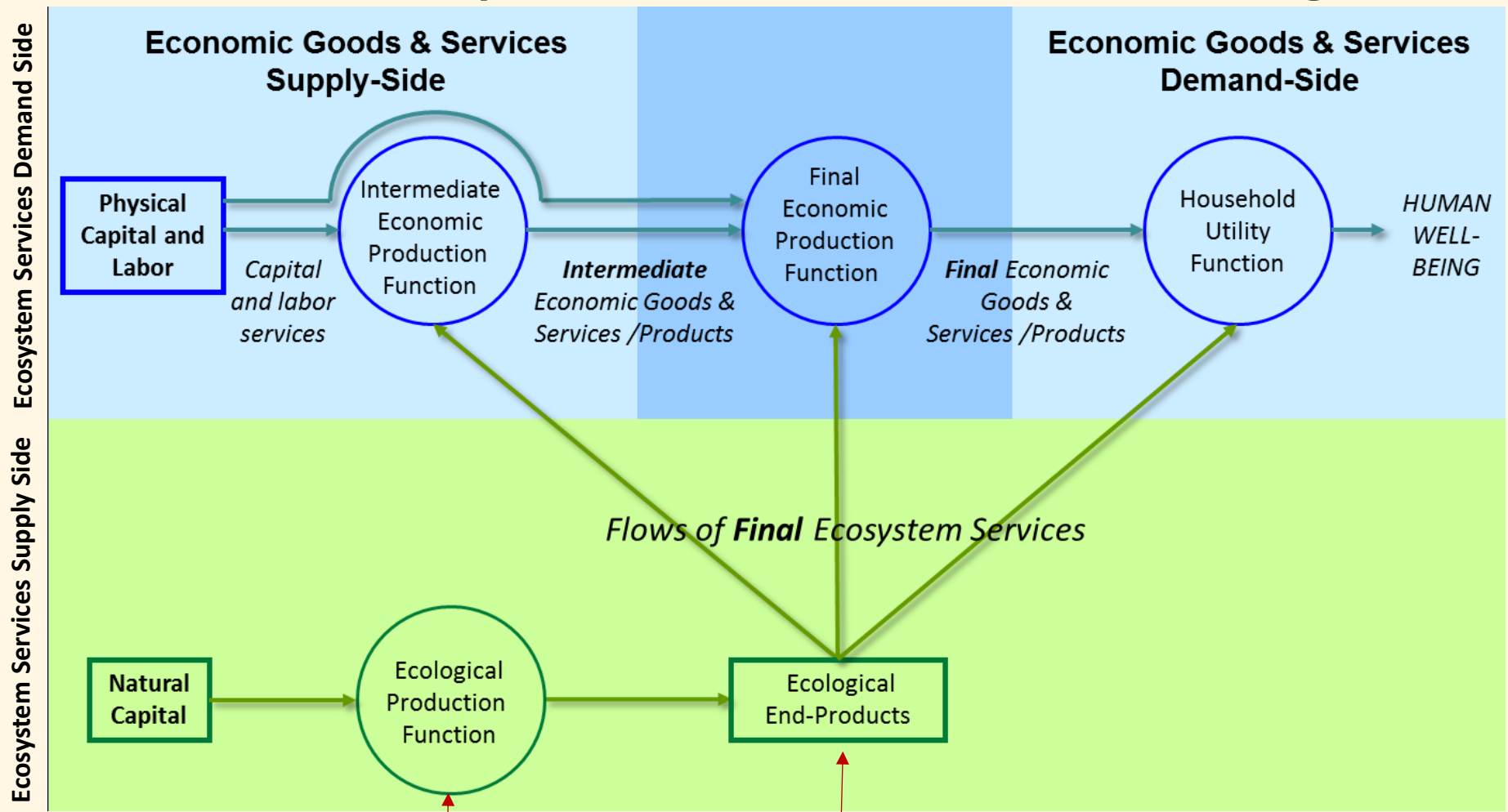
- **Valuation and Monetization**

United States Environmental Protection Agency. 2015. *National Ecosystem Services Classification System (NESCS): Framework Design and Policy Application*. EPA-800-R-15-002. United States Environmental Protection Agency, Washington, DC.

http://www.epa.gov/eco-research/ecosystems-services

NESCS Report generated under contract with RTI, International

The NESCS Conceptual Framework – The "Blue-Green Diagram"

Ecosystem Services Demand Side

Ecosystem Services Supply Side

Economic Goods & Services Supply-Side

Economic Goods & Services Demand-Side

Physical Capital and Labor

Intermediate Economic Production Function

Final Economic Production Function

Household Utility Function

HUMAN WELL-BEING

Capital and labor services

Intermediate *Economic Goods & Services /Products*

Final *Economic Goods & Services /Products*

*Flows of **Final** Ecosystem Services*

Natural Capital

Ecological Production Function

Ecological End-Products

(EPFs)

"Stocks of FEGS" is a good proxy for these

NESCS Four-Group Classification Structure (condensed)

Environment

Aquatic

Terrestrial

Atmospheric

End-Products of Nature / Types of Final ES

Water

Flora

Fauna

Other Biotic Natural Material

Atmospheric Components

Soil

Other Abiotic Natural Material

Composite End-Products

Other End-Products

Flows of Final Ecosystem Services

Direct Use/Non-Use

Use
- Extractive/ Consumptive Uses
- In-Situ (Non-Extractive/ Non-Consumptive) Uses

Non-Use
- Existence
- Bequest

Direct User

Industries

Households

Government

NESCS-S (Supply)

NESCS-D (Demand)

4. Structure of NESCS

National Ecosystem Services Classification System, Four-Group Structure

Environment

Aquatic
- Rivers and streams
- Wetlands
- Lakes and ponds
- Near coastal marine
- Open ocean and seas
- Groundwater

Terrestrial
- Forests
- Agroecosystems
- Created greenspace
- Grasslands
- Scrubland/shrubland
- Barren/rock and sand
- Tundra
- Ice and snow

Atmospheric
- Atmosphere

End-Products

Water
- Snow/ice
- Liquid water

Flora
- Specific species of flora

Fauna
- Specific species of fauna

Other Biotic Natural Material
- Specific types of natural material

Atmospheric Components
- Air
- Solar light/radiation

Soil
- Specific types of soil

Other Abiotic Natural Material
- Specific types of natural material

Combined End-Products
- -Scapes: views, sounds and scents of land, sea, sky
- Regulation of extreme events
- Natural phenomena
- Presence of environmental class

Other End-Products

Stock Indicators, Flow Indicators, Quality Indicators, Site Indicators, Indicators Characterizing Extreme Events

Flows of Final Ecosystem Services

Direct Use/Non-Use

Use
- **Extractive Use**
  - Raw material for transformation
  - Fuel/energy
  - Industrial processing
  - Distribution to other users
  - Support of plant or animal cultivation
  - Support of human health and life or subsistence
  - Recreation/tourism
  - Cultural/spiritual activities
  - Information, science, education, and research
  - Other extractive use
- **In-Situ Use**
  - Energy
  - Transportation medium
  - Support of plant or animal cultivation
  - Waste disposal/assimilation
  - Protection or support of human health and life
  - Protection of human property
  - Recreation/tourism
  - Cultural/spiritual activities
  - Aesthetic appreciation
  - Information, science, education, and research
  - Other in-situ use

Non-Use
- **Existence**
- **Bequest**

Direct User

Industries
- Agriculture, forestry, fishing and hunting
- Mining
- Utilities
- Construction
- Manufacturing
- Wholesale and retail trade
- Transportation and warehousing
- Information
- Finance and insurance
- Real estate rental and leasing
- Professional, scientific, and technical services
- Management of companies and enterprises
- Administrative support and waste management and remediation services
- Educational services
- Health care and social assistance
- Arts, entertainment, and recreation
- Accommodation and food services
- Other services

Households

Government

NESCS-S

NESCS-D

4. Structure of NESCS

NESCS Classification Structure and Hierarchical Coding System

	NESCS–S		NESCS–D	
Group	**Environment**	**End-product**	**Direct Use/Non-use**	**Direct User**
Definition	Ecosystems where end-products spatially occur, or producers of "end-products"	Biophysical components of nature that are directly used or appreciated by humans	Different ways in which end-products are used or appreciated by humans	Sectors that directly use or appreciate the end-products
Hierarchy and Coding System NESCS Category Representation*: WW.XX.YYYY.ZZZZZZZ				
Class	W	WW.X	WW.XX.Y	WW.XX.YYYY.Z
Sub-Class	WW	WW.XX	WW.XX.YY	WW.XX.YYYY.ZZZ
Detail			WW.XX.YYYY	WW.XX.YYYY.ZZZZZZZ
Example 1 – ocean water used as a medium to haul freight NESCS Code = 15.12.1202.1483111				
Class	Aquatic: **1**	Water: 1	Direct Use: **1**	Industry: **1**
Sub-Class	Open Ocean and Seas: **15**	Liquid Water: **12**	In-Situ Use: **12**	Transportation and Warehousing: **148**
Detail			Transportation medium: **1202**	Deep Sea Freight Transportation: **1483111**
Example 2 – direct fresh water intake used for home gardening NESCS Code = 11.12.1105.201				
Class	Aquatic: **1**	Water: 1	Direct Use: **1**	Households: **2**
Sub-Class	Rivers and Streams: **11**	Liquid Water: **12**	Extractive Use: **11**	Households: **201**
Detail			Support of plant or animal cultivation: **1105**	

Note that this 15-digit code is the most disaggregated level of representation. Different levels of aggregation can be used depending on the context.

Proposed 4-Group NESCS Structure – "Wiring Diagram" with Proposed Metrics By Group
Example: (a) lake, river, or stream water for drinking – m³ fresh water (m3frshw)
(b) same water in composite viewing environment – degree natural/unbuilt

Environment

Aquatic
- Rivers and streams (11.)
- Wetlands
- Lakes and ponds (13.)
- Near coastal marine
- Open ocean and seas
- Groundwater

Terrestrial
- Forests
- Agroecosystems
- Created greenspace
- Grasslands
- Scrubland/ shrubland
- Barren/rock and sand
- Tundra
- Ice and snow

Atmospheric
- Atmosphere

End-Products

Water
- Snow/ice
- Liquid water
  - fresh water (13.12.) (11.12.)
  - metric: m3frshw

Flora
- Specific classes/species of flora

Fauna
- Specific classes/species of fauna

Other Biotic Components
- Specific types of natural material

Atmospheric Components
- Air
- Solar light/radiation

Soil
- Specific types of soil

Other Abiotic Components
- Specific types of natural material

Composite End-Products
- -Scapes: views, sounds, scents of land, sea, sky
- beach envrnmt (13.81.)
  - metric: degree natural/unbuilt
- Regulation of extreme events
- Presence of environmental class

Other End-Products

Stock indicators, Flow Indicators, Quality Indicators, Site Indicators, Indicators Characterizing Extreme Events

Flows of Final Ecosystem Services

(a)

(b)

Direct Use/Non-Use

Use
- **Extractive Use**
  - Raw material for transformation
  - Fuel/energy
  - Industrial processing
  - Distribution to other users
  - Support of plant or animal cultivation
  - Support of human health and life or subsistence
  - freshwater (13.12.1106.) (11.12.1106.)
    - metric: m3frshw
  - Recreation/tourism
  - Cultural/spiritual activities
  - Information, science, education, and research
  - Other extractive use

- **In-Situ Use**
  - Energy
  - Transportation medium
  - Support of plant or animal cultivation
  - Waste disposal/assimilation
  - Protection or support of human health and life
  - Protection of human property
  - Recreation/tourism
  - Cultural/spiritual activities
  - Aesthetic appreciation beach environment (13.81.1209.)
    - metric: degree natural/unbuilt
  - Information, science, education, and research
  - Other in-situ use

Non-Use
- **Existence**
- **Bequest**
- **Other non-use**

Direct User

Industries
- Agriculture, Forestry, Fishing and Hunting
- Mining
- Utilities
- Construction
- Manufacturing
- Wholesale Trade
- Retail Trade
- Transportation and Warehousing
- Information
- Finance and Insurance
- Real Estate Rental and Leasing
- Professional, Scientific, and Technical Services
- Management of Companies and Enterprises
- Administrative Support and Waste Management and Remediation Services
- Educational Services
- Health Care and Social Assistance
- Arts, Entertainment, & Recreation
- Accommodation & Food Services
- Other Services

Households
- freshwater (13.12.1106.201) (11.12.1106.201)
  - metric: m3frshw / effort
  → satisfaction / $-equiv. source at intake
  - freshwater (13.81.1209.201)
  - metric: degree natural/unbuilt/access
  → satisfaction / $-equiv. source at intake

Government

NESCS-S

NESCS-D

DRAFT (EPA internal)

Proposed 4-Group NESCS Structure – with FEGS-Metric Pass-Through
Example (a): mussels – m² mussels/km of beach (m2m/kmb)

082514   Rhodes

Environment

End-Products

Direct Use/Non-Use

Direct User

Environment

Aquatic
- Rivers and streams
- Wetlands
- Lakes and ponds
- Near coastal marine (14.)
- Open ocean and seas
- Groundwater

Terrestrial
- Forests
- Agroecosystems
- Created greenspace
- Grasslands
- Scrubland/ shrubland
- Barren/rock and sand
- Tundra
- Ice and snow

Atmospheric
- Atmosphere

End-Products

Water
- Snow/ice
- Liquid water

Flora
- Specific classes/species of flora

Fauna
- Specific classes/species of fauna
  - wild mussels (14.3.)
    - metric: m2m/kmb

Other Biotic Components
- Specific types of natural material

Atmospheric Components
- Air
- Solar light/radiation

Soil
- Specific types of soil

Other Abiotic Components
- Specific types of natural material

Composite End-Products
- Scapes: views, sounds, scents of land, sea, sky
  - beach envrnmt (14.81.)
    - metric: degree natural/unbuilt
- Regulation of extreme events
- Presence of environmental class

Other end-products

Stock indicators, Flow Indicators, Quality Indicators, Site Indicators, Indicators Characterizing Extreme Events

Flows of Final Ecosystem Services

Direct Use/Non-Use

Use
- Extractive Use
  - Raw material for transformation
    - wild mussels (14.3.1101.)
      - metric: harvested volume
      - Fuel/energy
      - Industrial processing
  - Distribution to other users
    - wild mussels (14.3.1104.)
      - metric: harvested volume
      - Support of plant or animal cultivation
  - Support of human health and life or subsistence
    - wild mussels (14.3.1106.)
      - metric: harvested volume
  - Recreation/tourism
    - wild mussels (14.3.1107.)
      - metric: harvested volume
  - Cultural/spiritual activities
    - wild mussels (14.3.1101.)
      - metric: harvested volume
  - Information, science, education, and research
    - wild mussels (14.3.1109.)
      - metric: harvested volume
      - Other extractive use
- In-situ Use
  - Energy
  - Transportation medium
  - Support of plant or animal cultivation
  - Waste disposal/assimilation
  - Protection or support of human health and life
  - Protection of human property
  - Recreation/tourism
  - Cultural/spiritual activities
  - Aesthetic appreciation
    - beach envrnmt (14.81.1209.)
      - metric: degree natural/unbuilt
  - Information, science, education, and research
    - wild mussels (14.3.1209.)
      - metrics: degree natural, m2m/kmb
  - Other in-situ use

Non-Use
- Existence
- Bequest
- Other non-use

Direct User

Industries
- Agriculture, Forestry, Fishing and Hunting - Fishing Trapping (114)
  - wild mussels (14.3.1104.111412)
    - metric: harvest [(volume) / (effort)]
    - → $-equiv. source/ "brand integrity"
  - Mining
  - Utilities
  - Construction
- Manufacturing - Food Manuf. (311.)
  - wild mussels (14.3.1101.1311710)
    - metric: harvest [(volume) / (effort)]
    - → $-equiv. source/ "brand integrity"
  - Wholesale Trade
  - Retail Trade
  - Transportation and Warehousing
  - Information
  - Finance and Insurance
  - Real Estate Rental and Leasing
  - Professional, Scientific, and Technical Services
  - Management of Companies and Enterprises
  - Administrative Support and Waste Management and Remediation Services
- Educational Services
  - wild mussels (14.3.1109.1611310)
    - metric: harvest [(volume) / (effort)]
    - → $-equiv. source/"field train.g quality"
  - wild mussels (14.3.1209.1611310)
    - metrics: degree natural, m2m/kmb
    - → $-equiv. source/"field train.g quality"
  - Health Care and Social Assistance
  - Arts, Entertainment, & Recreation
  - Accommodation & Food Services
  - Other Services

Households
- wild mussels (14.3.1106.201)
  - metric: harvest [(volume) / (effort)]
  - → satisfaction / $-equiv. source-bundle
- wild mussels (14.3.1108.201)
  - metric: harvest [(volume) / (effort)]
  - → satisfaction / (alienable value of cultural identity?)
- wild mussels (14.3.1107.201)
  - metric: harvest [(volume) / (effort)]
  - → satisfaction / $-equiv. source-bundle
- wild mussels (14.81.1209.201)
  - metric: degree natural/unbuilt/access
  - → satisfaction / $-equiv. source-bundle
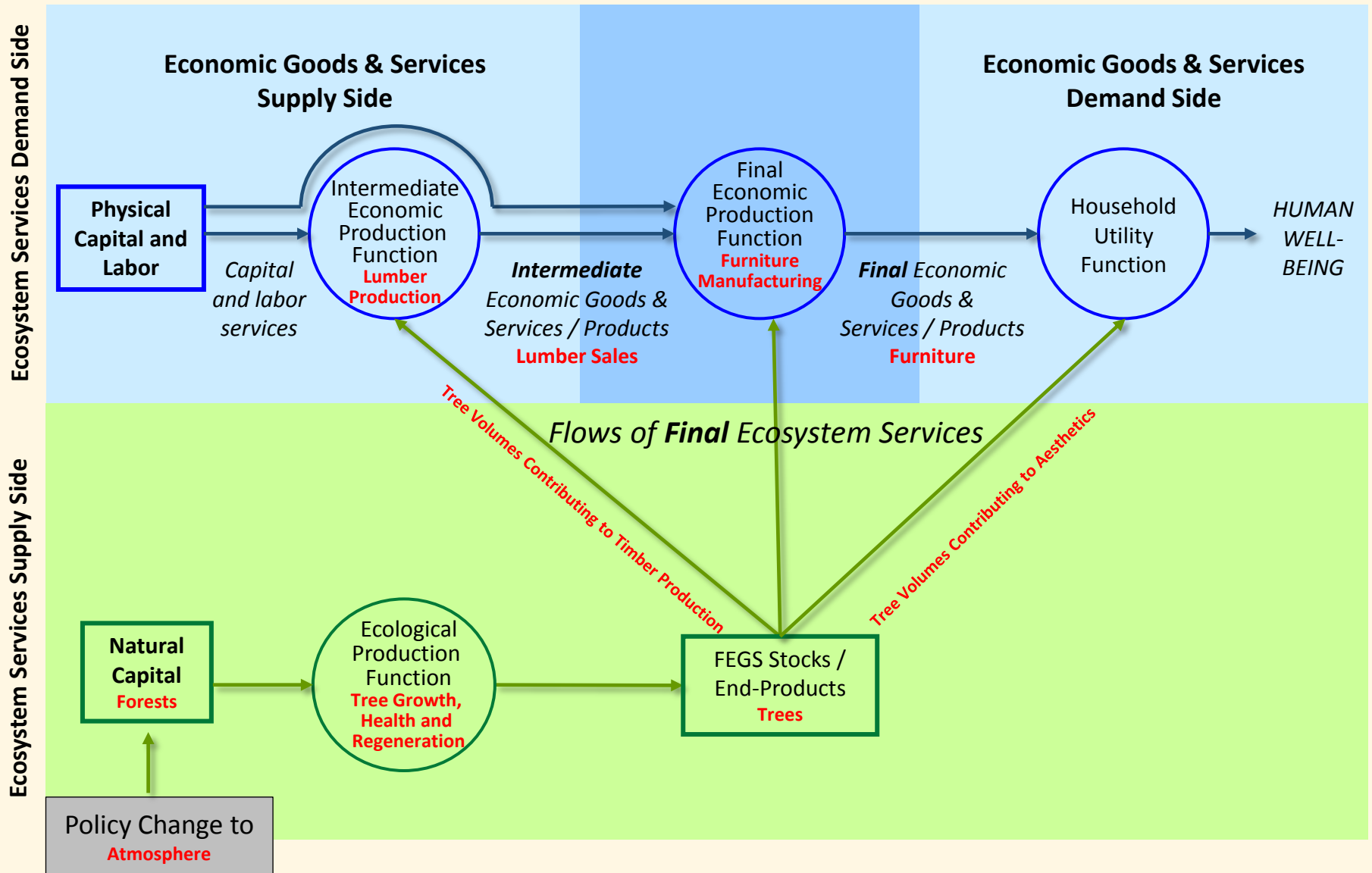
Government

NESCS-S

NESCS-D

FEGS-CS – NESCS Pass-Through Example:
7 times "wild mussels", 1 times "beach-scape" at the wild mussel site

FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS—FEGS-CS

Envrnm Class	Envrnm Sub-Class	Examples of FEGS	Beneficiary Category	Beneficiary Sub-Category	…if corp./food-processing, raw material for transformation →	FEGS-CS 6-Digit Code
Aquatic	Near-Coastal Marine	*wild mussels*: "type 10" of 21 types of FEGS is "fish," but thousands of FEGS, so no #	Commercial/Industrial	Food Extractors		XX.XXXX
(1)	14.		02	01		14.0201
			beneficiaries are a "use-user" combination ——————————→			b: FoodExtractors

NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS—NESCS

Envrnm Class	Envrnm Sub-Class	End-Product Class	End-Product Sub-Class	Use/Non-Use Class	Use/Non-Use Sub-Class	Use/Non-Use Detail (*Example*)	User Class	User Sub-Class / Detail	User Detail Example	NESCS 15-Digit Code WW.XX.YYY.ZZZZZZZ	FEGS-CS 6-Digit Code XX.XXXX
Aquatic	Near-Coastal Marine	fauna	*Ex.: wild mussels*	Use	extractn/ consump	raw material	Indus	Food Manuf	Seafood Prod. Prep & Packgg		
(1)	14.	(3)	3.	(1)	(11)	1101.	(1)	(311)	1311710	14.3.1101.1311710	14.0201
			(Thousands of species, so no #)	…if corp./food-processing, raw material for transformation				(UseClass+NAICS)			b: FoodExtractors
						distrib to others		Fishing Trapping	Shellfish fishing		
(1)	14.	(3)	3.	(1)	(11)	1104.	(1)	(114)	1114112	14.3.1104.1114112	14.0201
						OR …if self-employed harvester bags and sells wild mussels to passing cars					b: FoodExtractors
						info/educ/research		Educ Services			
(1)	14.	(3)	3.	(1)	(11)	1109.	(1)	(611)	1611310	14.3.1109.1611310	14.0801
						OR …if OSU class/research: where/how to harvest, with example harvest					b: Educs&Stdnts
					non-extractn/c..						
(1)	14.	(3)	3.	(1)	(12)	1209.	(1)	(611)	1611310	14.3.1209.1611310	14.0802
						OR …if OSU class/research: direct check species (mussel) condition without harvest					b: Researchers
				extractn/ consump		support human health subsistence		Households			
(1)	14.	(3)	3.	(1)	(11)	1106.	(2)	201	-	14.3.1106.201	14.0502
						OR …if mussels eaten by harvester					b: RecrPickGath
						cultural/spiritual activities					
(1)	14.	(3)	3.	(1)	(11)	1108.	(2)	201	-	14.3.1108.201	14.0701
						AND/OR also …if eating native seafood=spirit/culture (as PacNWTribal?)					b: SpiritCrmyPrtcp
						recreation/tourism					
(1)	14.	(3)	3.	(1)	(11)	1107.	(2)	201	-	14.3.1107.201	14.0602
						OR also …if tourist tries hand at mussel-ing					b: RecrPickGath
		combined end-products	-scapes, views, sounds, scents		non-extractn/c..	aesthetic appreciatn					14.0601
(1)	14.	(8)	81.	(1)	(12)	1209.	(2)	201	-	14.81.1209.201	
		AND …if "beach experience" is part of "ES" of mussel harvest, then a *separate* Non-Use ES "use" for *any* User, "combined end-product" here, not "fauna"									b: 06=non-extrct viewer
						…let's pick Household, not Industry for this example					

The NESCS Conceptual Framework – Specialized to a Terrestrial Acidification Example

Applying NESCS: Policies Impacting Terrestrial Acidification – Two-species example table, with NESCS numeric coding pieces

NESCS-S				NESCS-D							
Env. Class	Env. Sub-Class	End-product Class	End-product Sub-Class or Example	Direct Use/ Non-Use Class	Direct Use/ Non-Use Sub-Class	Direct Use/ Non-Use Detail	Examples of Direct Uses/ Non-Use	Direct User Class	Direct User Sub-Class	User Detail
2. Terrestrial	21. Forests	2. Flora	Sugar maple trees	1. Direct Use	11. Extractive Use	1101. Raw material for transformation	Input for maple syrup, furniture, construction	1. Industry	111. Agriculture, Forestry, Fishing and Hunting	1113. Forestry and Logging (e.g., **21.2.1101.1113**)
									123. Construction	123. Construction
									131–33. Manufacturing (Manufg.)	1311. Food Manufg. 1321. Wood Product Manufg. 1337. Furniture and Related Product Manufg.
					12. In-situ Use	1207. Recreation/tourism	Fall color viewing	1. Industry	148–49. Transportation and Warehousing	1487. Scenic and Sightseeing Transportation
									172. Accommodation and Food Services	1721. Accommodation 1722. Food Services and Drinking Places
								2. Households	201. Households	
						1209. Aesthetic appreciation	Scenic views for commuters	2. Households	201. Households	(e.g., **21.2.1209.201**)
				2. Non-Use	21. Existence	2101. Existence	Existence use	2. Households	201. Households	
					22. Bequest	2201. Bequest	Bequest use	2. Households	201. Households	
			Red spruce trees	1. Direct Use	11. Extractive Use	1101. Raw material for transformation	Input for musical instruments, furniture, construction	1. Industry	111. Agriculture, Forestry, Fishing and Hunting	1113. Forestry and Logging
									131–33. Manufacturing (Manufg.)	1321. Wood Product Manufg. 1337. Furniture and Related Product Manufg. 1339992. Musical Instrument Manufg.
				2. Non-Use	21. Existence	2101. Existence	Existence use	2. Households	201. Households	
					22. Bequest	2201. Bequest	Bequest use	2. Households	201. Households	(e.g., **21.2.2201.201**)

Inland (Freshwater) Wetland

General <u>Wetland</u> Characteristics for "Common List"	Examples	NESCS 4-Group Designation relevant combinations: environment—end-product—use—user
Wildlife	Birds, fish, insects for harvest, catch-and-release, research, or viewing	Wetland-fauna-extractive/in-situ-households
Vegetation	Wetland plants for harvest, research, or viewing	Wetland-flora-extractive/in-situ-households
Characteristic Open Space/ "-scape"	Wetland as enjoyable or inspirational landscape	Wetland-compositeendproduct-in-situ-households
Water quality	Extraction, distribution, scenic amenity	Wetland-liquidwater-extractive/in-situ-(any)
Flood surge (reduction)	Protect or support human health or life (1205), protect human property (1206)	Wetland-compositeendproduct-in-situ-(any)
Existence/bequest for each of previous five		Wetland-fauna-nonuse-households, Wetland-flora-nonuse-households, Wetland-compositeendproduct-nonuse-households, Wetland-liquidwater-nonuse-households, Wetland-compositeendproduct-nonuse-households
Groundwater (quantity)	recharge/flow from wetland absorption is *intermediate* ecological process	Groundwater-liquidwater-extractiveraw material-(any)
Freshwater (surface flow volume)	recharge/flow from wetland absorption is *intermediate* ecological process	River/stream-liquidwater-extractiveraw material-(any)
Existence/bequest for each of previous two		Groundwater-liquidwater-nonuse-households, River/stream-liquidwater-nonuse-households

Formal List of Potential Wetland FFES

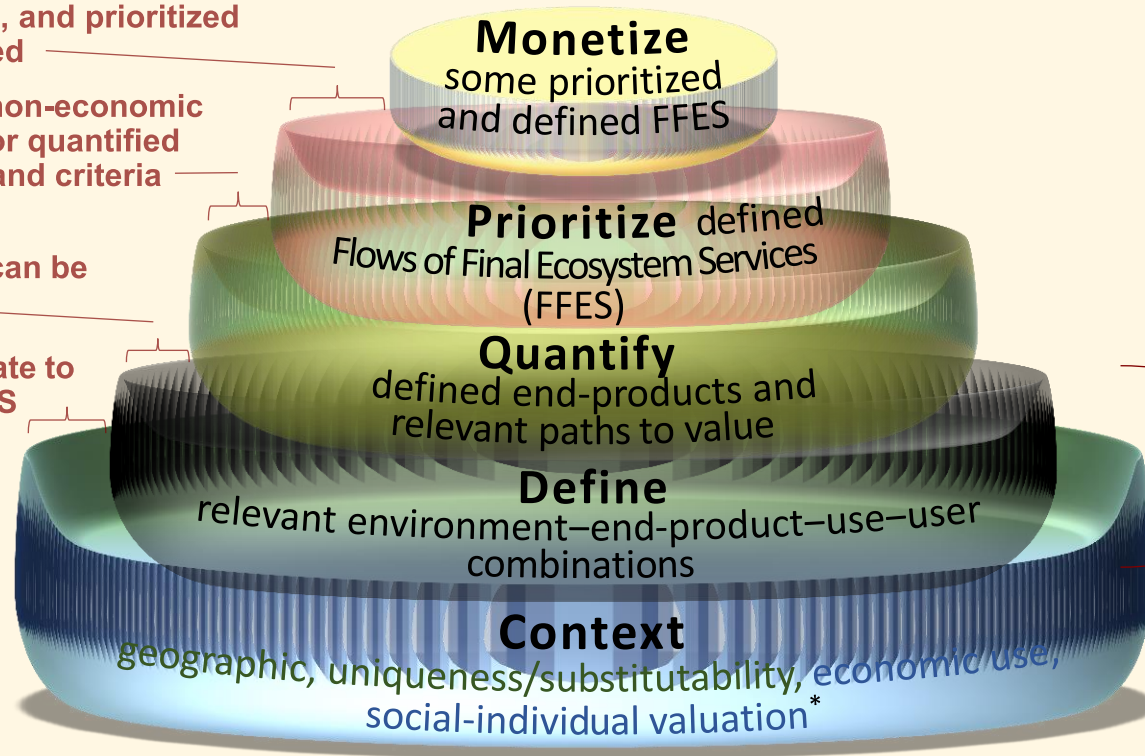| NESCS 4-Group Designation relevant combinations: environment—end-product—use—user	NESCS User Codes and Combinations ww.xx.yyyy.zzzzzzz
Wetland-fauna-extractive/in-situ-households	12.31.1yyy.201, 12.31.1yyy.1zzzzzz
Wetland-flora-extractive/in-situ-households	12.21.1yyy.201, 12.21.1yyy.1zzzzzz
Wetland-compositeendproduct-in-situ-households	12.81.1207(/08/09).201
Wetland-liquidwater-extractive/in-situ-(any)	12.12.1yyy.1zzzzzz, 12.12.1yyy.201
Wetland-compositeendproduct-in-situ-(any)	12.82.1205(/6).1zzzzzz
Wetland-fauna-nonuse-households, Wetland-flora-nonuse-households, Wetland-compositeendproduct-nonuse-households, Wetland-liquidwater-nonuse-households, Wetland-compositeendproduct-nonuse-households	12.31.21(/2).201, 12.21.21(/2).201, 12.81.21(/2).201, 12.12.21(/2).201, 12.82.21(/2).201
Groundwater-liquidwater-extractiverawmaterial-(any)	16.12.11yy.1zzzzzz, 16.12.1106.201
River/stream-liquidwater-extractiverawmaterial-(any)	11.12.11yy.1zzzzzz, 11.12.1106.201
Groundwater-liquidwater-nonuse-households, River/stream-liquidwater-nonuse-households	16.12.21(/2).201, 11.12.21(/2).201

Not all defined, quantified, and prioritized elements can be monetized

Including economic and non-economic methods, not all defined or quantified elements can be ranked, and criteria or ranking may vary
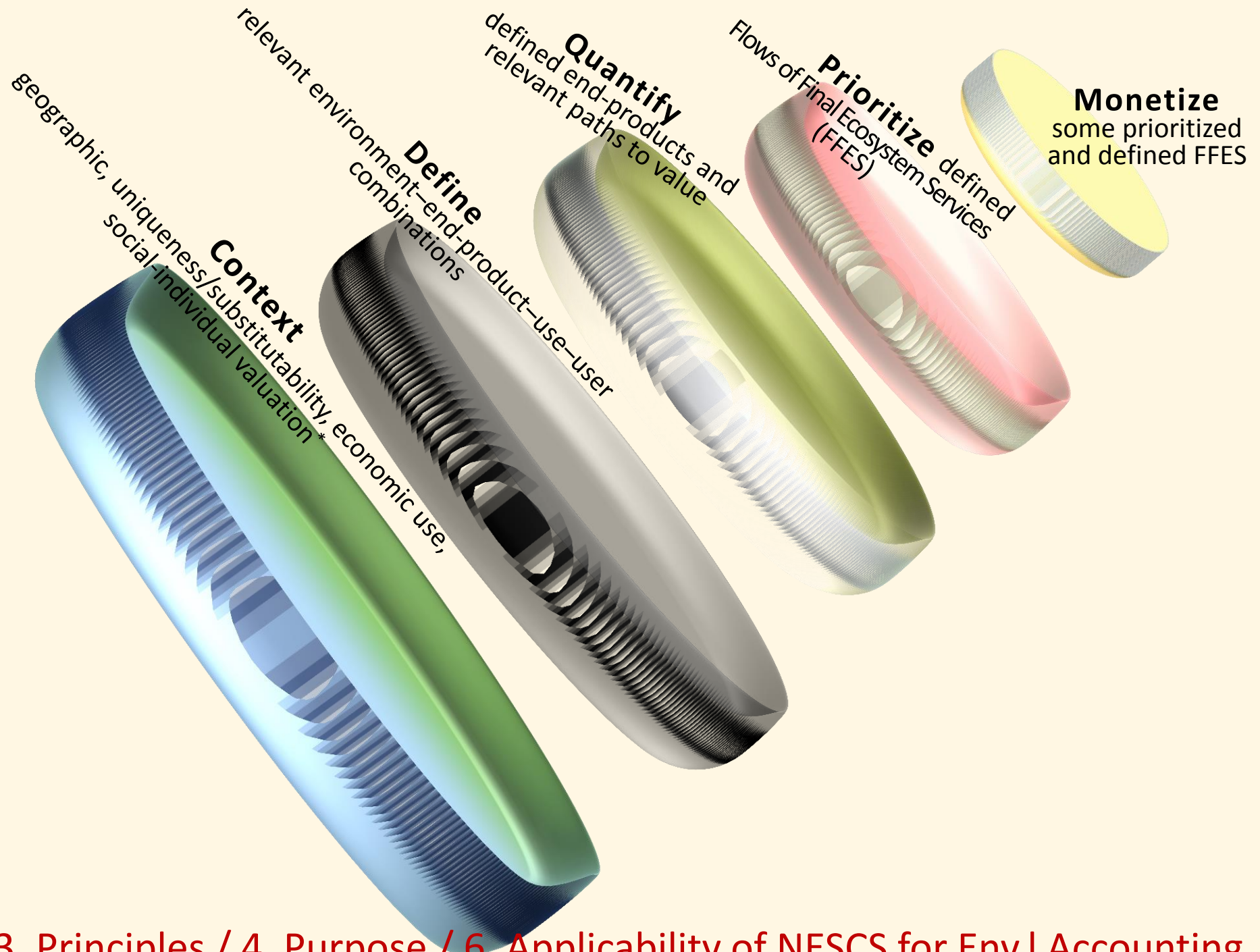
Not all defined elements can be quantified

Not all context can translate to definitions useful for FFES

Monetize
some prioritized and defined FFES

Prioritize defined
Flows of Final Ecosystem Services
(FFES)

Quantify
defined end-products and relevant paths to value

Define
relevant environment–end-product–use–user combinations

Context
geographic, uniqueness/substitutability, economic use, social-individual valuation *

NESCS

Careful definition identifies exactly what we seek to (or cannot yet) quantify, prioritize, or monetize

* Relative scarcity or abundance, absolute and at geographic scale of production and accessibility; degree to which characteristics are unique or substitutable; economic use of characteristics; cultural and individual influences on how contextual value is assigned
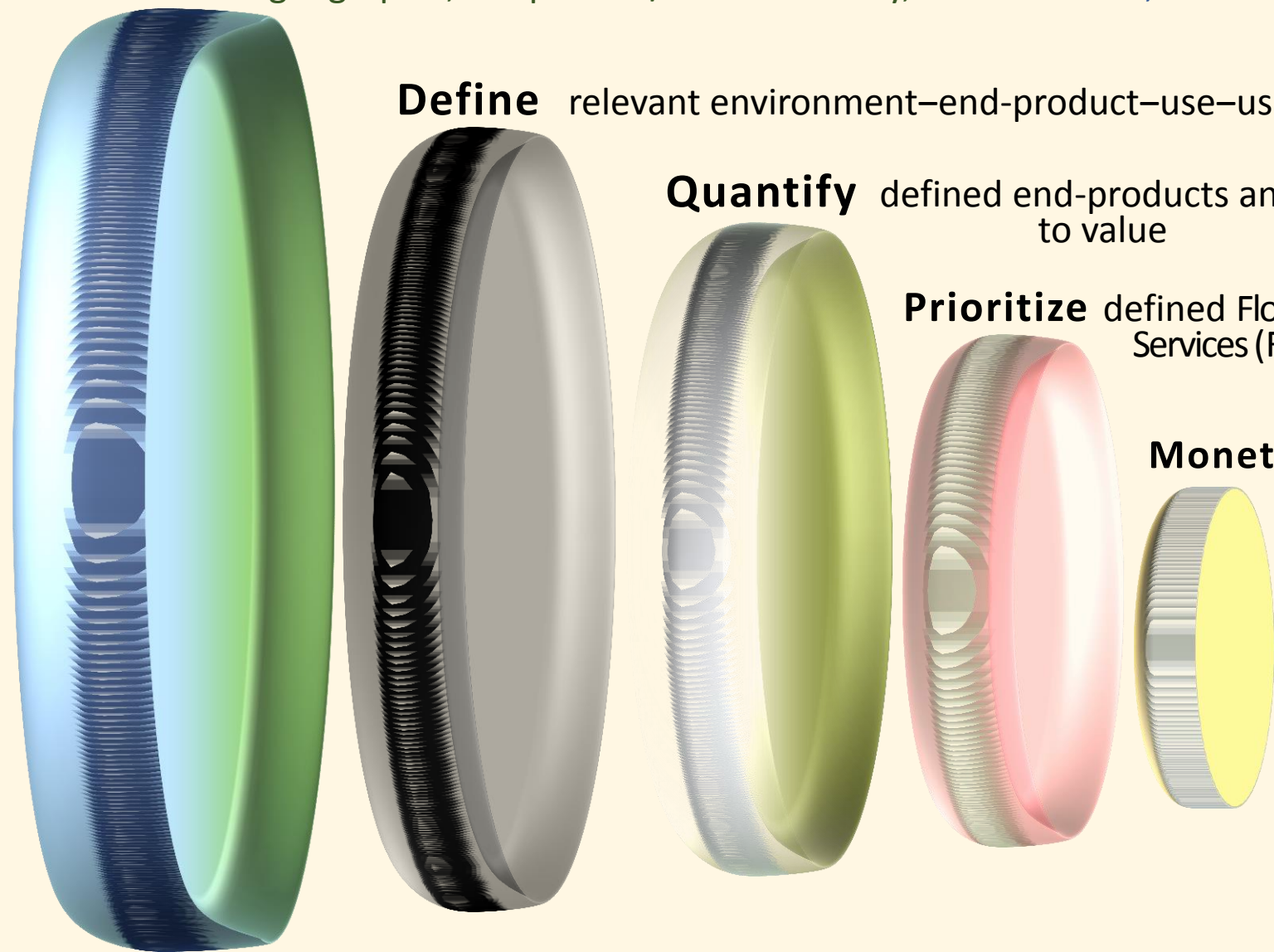
Context
geographic, uniqueness/substitutability, social-individual valuation *

Define
relevant environment–end-product–use–user combinations

Quantify
defined end-products and relevant paths to value

Prioritize
defined Flows of Final Ecosystem Services (FFES)
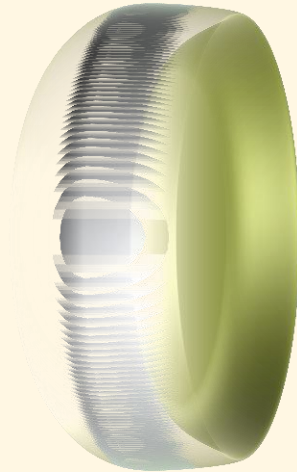
Monetize
some prioritized and defined FFES

3. Principles / 4. Purpose / 6. Applicability of NESCS for Env.l Accounting
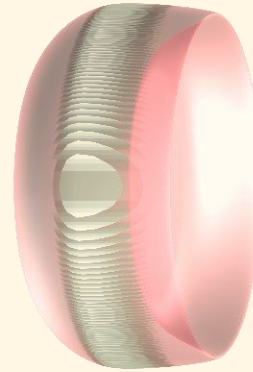
Context geographic, uniqueness/substitutability, economic use, social-individual valuation

Define relevant environment–end-product–use–user combinations

Quantify defined end-products and relevant paths to value

Prioritize defined Flows of Final Ecosystem Services (FFES)

Monetize some prioritized and defined FFES
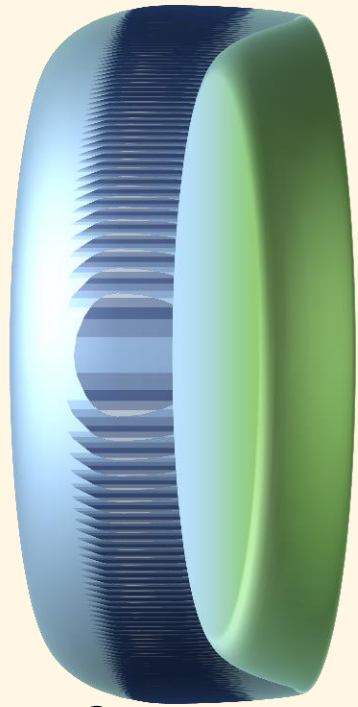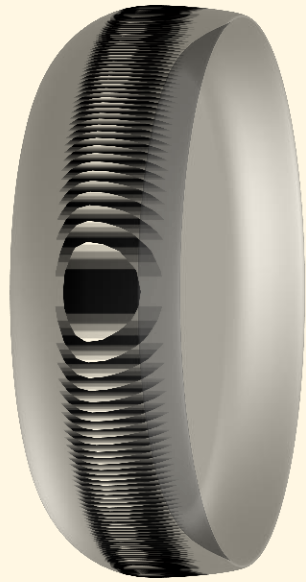
Context

Define

Quantify

Prioritize
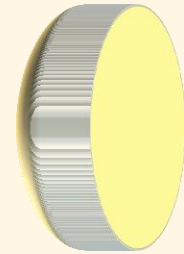
Monetize

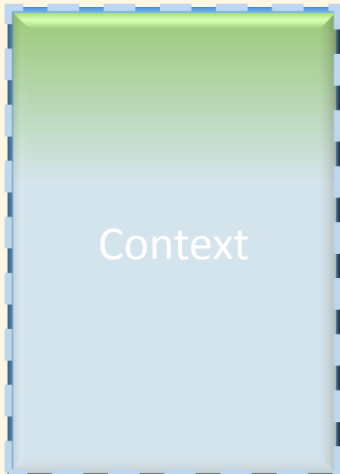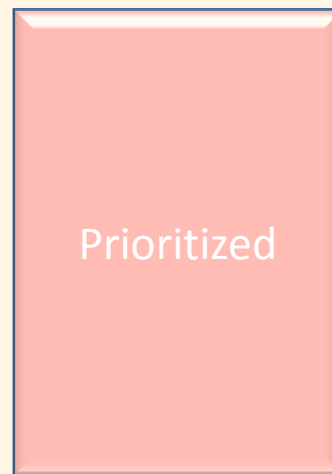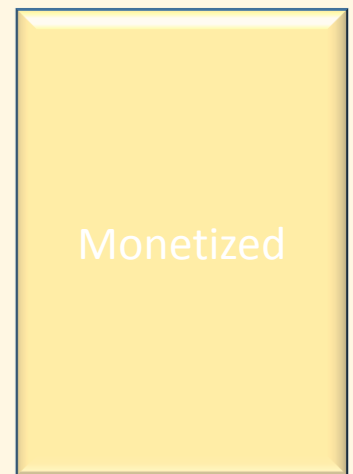| Context | Identified-Defined (Qualified) | Quantified | Prioritized | Monetized |

Identified-Defined
(Qualified)

Quantified

Prioritized

Monetized

number

90
Identified-
Defined
(Qualified)

40
Quantified

15
Prioritized

06
Monetized

Identified-Defined (Qualified)

Wetland-fauna-extractive/in-situ-**households,**
Wetland-fauna-extractive/in-situ-**(any)**

Wetland-flora-extractive/in-situ-**households,**
Wetland-flora-extractive/in-situ-**(any)**

Wetland-compositeendproduct-in-situ-**households**

Wetland-compositeendproduct-in-situ-**(any)**

Wetland-fauna-nonuse-**households,**
Wetland-flora-nonuse-**households,**
Wetland-compositeendproduct-nonuse-**households,**
Wetland-liquidwater-nonuse-**households,**
Wetland-compositeendproduct-nonuse-**households**

Groundwater-**liquidwater**-extractiverawmaterial-(any)

River/stream-**liquidwater**-extractiverawmaterial-(any)
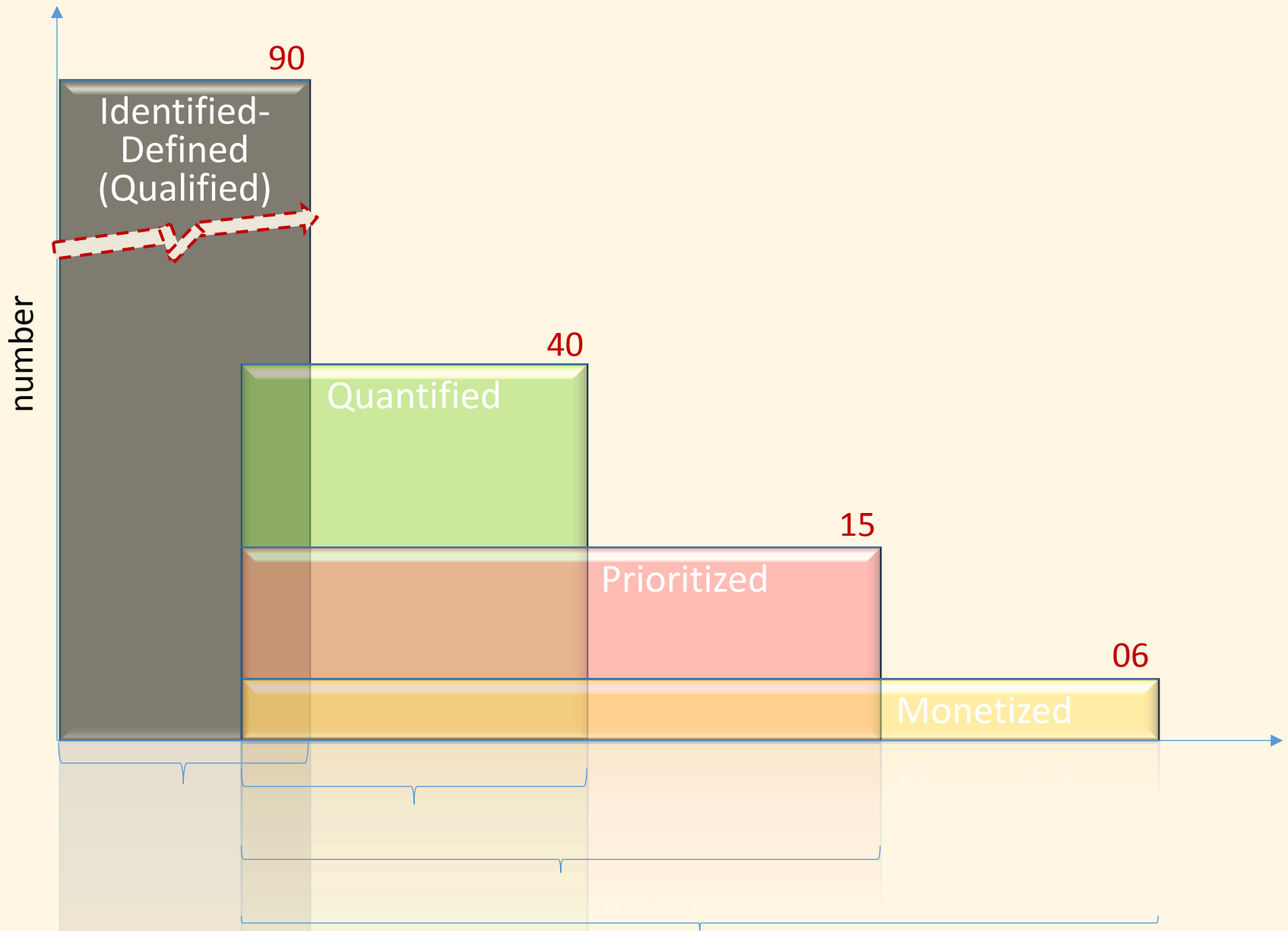
Groundwater-**liquidwater**-nonuse-**households,**
River/stream-**liquidwater**-nonuse-**households**

Quantified
(best metrics achieved to fill identified FFES and NESCS codes)

Prioritized

Monetized
(value estimates)

Identified-Defined (Qualified)

**Wetland-fauna-extractive/in-situ-households,
Wetland-fauna-extractive/in-situ-(any)**

12.31.1yyy.201, 12.31.1yyy.1zzzzzz, 12.31.1yyy.301

**Wetland-flora-extractive/in-situ-households,
Wetland-flora-extractive/in-situ-(any)**

12.21.1yyy.201, 12.21.1yyy.1zzzzzz, 12.21.1yyy.301

Wetland-compositeendproduct-in-situ-households

12.81.1207(/08/09).201
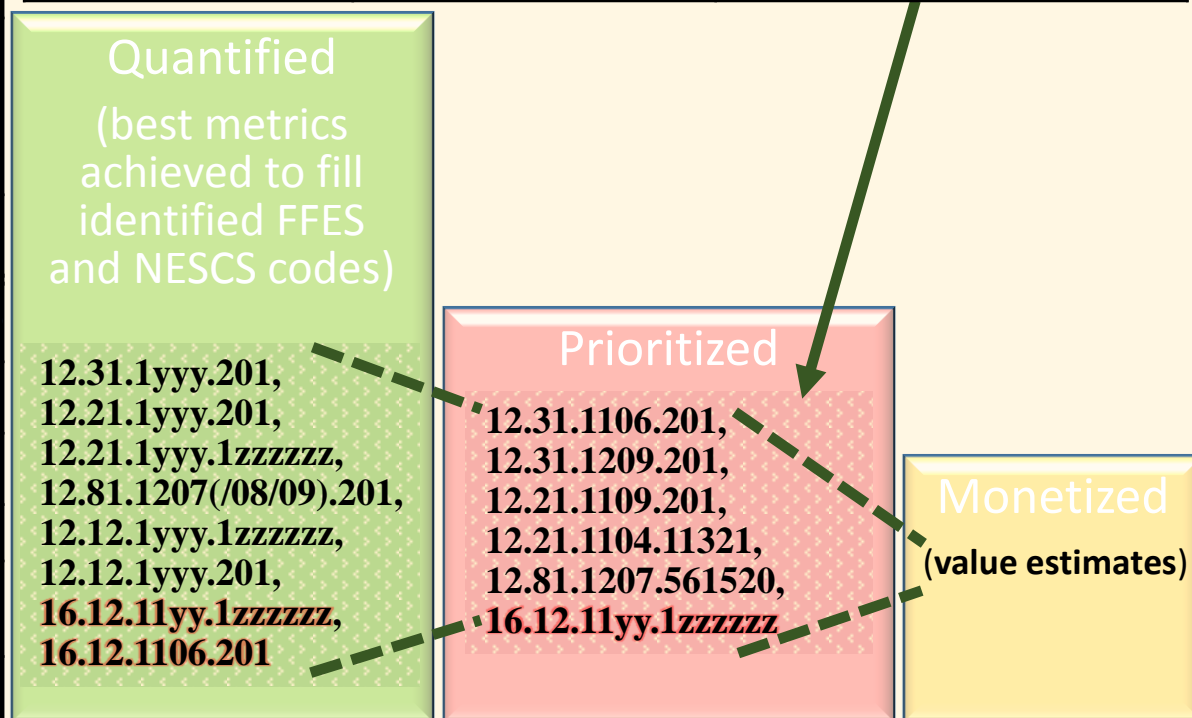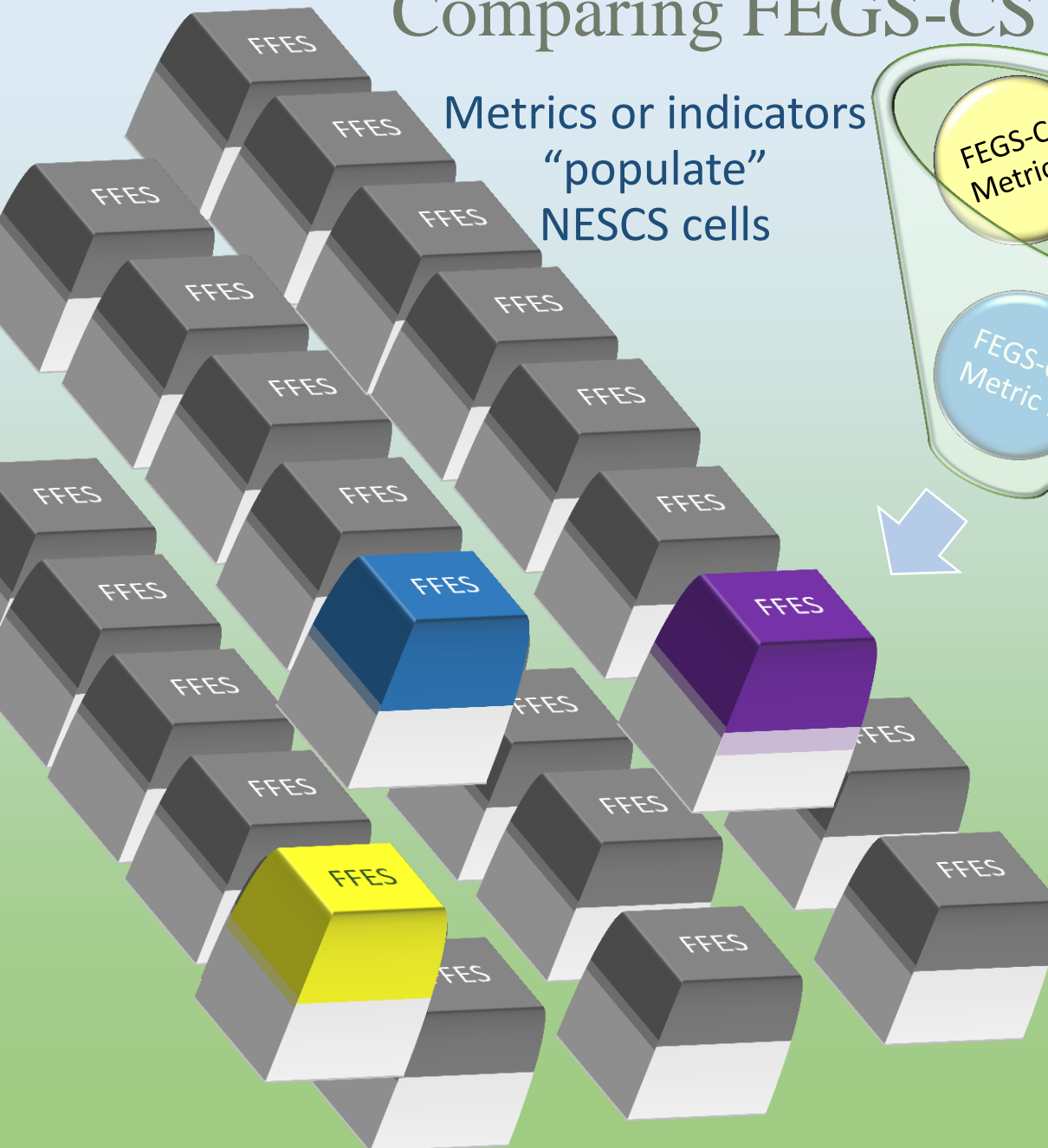
Wetland-liquidwater-extractive/in-situ-(any)

12.12.1yyy.1zzzzzz, 12.12.1yyy.201

Wetland-compositeendproduct-in-situ-(any)

**12.82.1205(/6).201, 12.82.1205(/6).301,
12.82.1205(/6).1zzzzzz**

**Wetland-fauna-nonuse-households,
Wetland-flora-nonuse-households,
Wetland-compositeendproduct-nonuse-households,
Wetland-liquidwater-nonuse-households,
Wetland-compositeendproduct-nonuse-households**

12.31.21(/2).201, 12.21.21(/2).201, 12.81.21(/2).201,
12.12.21(/2).201, 12.82.21(/2).201

Groundwater-liquidwater-extractiverawmaterial-(any)

16.12.11yy.1zzzzzz, 16.12.1106.201

River/stream-liquidwater-extractiverawmaterial-(any)

11.12.11yy.1zzzzzz, 11.12.1106.201

**Groundwater-liquidwater-nonuse-households,
River/stream-liquidwater-nonuse-households**

16.12.21(/2).201, 11.12.21(/2).201

NESCS Code	Use Type	Possible Metrics
12.31.**1106**.201	Duck hunting	Duck pop. density "in season"; # of hunting visits /yr.
12.31.**1209**.201	Bird/Moose watching	Target pop. density; # of visits to purpose /yr.
12.31.**1109**.201	Pictures or plants taken for school project	# of visits to purpose /yr.
12.21.**1104.11321**	gathering forest products for commercial use	Quantity (/Input value) to garden/ landscaping/nursery operations
12.81.**1207.561520**	Wetland ecotours	# of paid tours/season
16.12.11yy.1zzzzzz (proxy measure of intermediate ES role)	Groundwater % purified through wetlands, extracted for industrial use or public treatment	Quantity (at quality level?) of groundwater *purified by wetlands* used commercially or in public water treatment

Quantified

(best metrics achieved to fill identified FFES and NESCS codes)

12.31.1yyy.201,
12.21.1yyy.201,
12.21.1yyy.1zzzzzz,
12.81.1207(/08/09).201,
12.12.1yyy.1zzzzzz,
12.12.1yyy.201,
16.12.11yy.1zzzzzz,
16.12.1106.201

Prioritized

12.31.1106.201,
12.31.1209.201,
12.21.1109.201,
12.21.1104.11321,
12.81.1207.561520,
16.12.11yy.1zzzzzz

Monetized

(value estimates)

Comparing FEGS-CS and NESCS

Metrics or indicators "populate" NESCS cells

FFES (repeated on blocks)

FEGS-CS Metric 3
FEGS-CS Metric 2
FEGS-CS Metric 1

Needs:
- EPFs
- Data

Tool developers and practitioners within EPA expect *FEGS-CS* to be used to vet appropriate metrics for final ES, and the *EcoService Models Library* to aid in identifying ecological production functions

ORD Contact for FES Metrics and Indicators: Dr. Paul Ringold/ Ringold.paul@epa.gov; 541-754-4565

ORD Contact for EcoService Models Library: Randy Bruins/ bruins.randy@epa.gov
https://esml.epa.gov/epf_l/public/signup

The NESCS focuses users on the final ES of interest:

- By demanding identification of environment and user, it helps users discover which metrics best may best match ecosystem supply with human demand

- It embeds ecosystem structures processes and functions within the EPFs that characterize dynamics affecting the supply of ecological endpoints

- Modular structure offers appeal to non-US users, and standardized definitions should accommodate "results" database construction and use

The NESCS is a conceptual framework and a structure, with guidelines for use:

- applies at fine or coarse levels of numeric coding
- offers great flexibility in geographic and temporal scale of application
- does not provide metrics or conduct valuation, but should assist by identifying elements directly relevant to both later steps in ESA work
- will use EPFs, when applied in a sophisticated way
- is an accessible ES classification tool that offers a path to standardization of terms and many metrics

One "trace," or table row, is a potential FFES.

Existence, Magnitude, and Value of the FFES are empirical questions.

6. Applicability of NESCS for Environmental Accounting

National Ecosystem Services Classification System, Four-Group Structure

Environment	End-Products	Direct Use/Non-Use	Direct User

Environment

...ams

...e
...s

UNSD-selected ENVIRONMENT classes must be exhaustive, exclusive, and easy-to-use

End-Products

Water
• Snow/ice
• Liquid water

Flora
• Specific species of flora

Fauna
• Specific species of fauna

Other Biotic Natural Material
• Specific types of natural material

Atmospheric Components
• Air
• Solar light/radiation

Soil
• Specific types of soil

Other Abiotic Natural Material
• Specific types of natural material

Combined End-Products
• -Scapes: views, sounds and scents of land, sea, sky
• Regulation of extreme events
• Natural phenomena
• Presence of environmental class

Other End-Products

Stock Indicators, Flow Indicators, Quality Indicators, Site Indicators, Indicators Characterizing Extreme Events

Flows of Final Ecosystem Services

Direct Use/Non-Use

Use
• **Extractive Use**
  – Raw material for transformation
  – Fuel/energy
  – Industrial processing
  – Distribution to other users
  – Support of plant or animal cultivation
  – Support of human health and life or subsistence
  – Recreation/tourism
  – Cultural/spiritual activities
  – Information, science, education, and research
  – Other extractive use
• **In-Situ Use**
  – Energy
  – Transportation medium
  – Support of plant or animal cultivation
  – Waste disposal/assimilation
  – Protection or support of human health and life
  – Protection of human property
  – Recreation/tourism
  – Cultural/spiritual activities
  – Aesthetic appreciation
  – Information, science, education, and research
  – Other in-situ use

Non-Use
• **Existence**
• **Bequest**

Direct User

Industries
• A... forestry, ...unting

May substitute out NAICS for ISIC or other system, so long as exhaustive, exclusive, and easy-to-use

•
• ...
  a...
• Ar...
  and...
• Acco...
  food s...
• Other se...

Households

Government

NESCS-S

NESCS-D

Challenge Slide!!

Can you suggest a flow of "final" ES that we cannot trace from left to right?!

Understanding NESCS
in contrast to other Tools and Approaches

- **The NESCS is *NOT* a list –**
  - the 4-Group Structure and Guidelines for Use (under construction) provide a framework, operators, and general rules
  - can be used to make a list for any application, but there is little use for a comprehensive list (which could include *thousands* of potential FFES)

- **Final ES are *NOT* in any of the 4-Group Structure columns or tables**

- **The NESCS does *NOT* – do any economic valuation**

Understanding NESCS
in contrast to other Tools and Approaches

- **The NESCS is a *modular* (final) ES identification tool**
- **The NESCS looks *outside* of its own framework, structure, and rules for:**
  - *Ecological Production Functions* –
    to describe/project dynamics of *FFES* from an area, over time, and in response to exogenous influences

  - **all *final* selection of metrics, indicators, and qualitative or quantitative measures;**
    proper use of NESCS can guide choices, not make them

  - **stakeholders vet the *appropriate set* of identifiable FFES** and the appropriate subsets for environmental measurement and for valuation

  - *choosing which* **research and methodology gaps –**
    to improve future ES assessment efforts