NCA Natural Capital Accounting

Accounting for Nature: Natural Capital Accounting and the Department of the Interior

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Office of Policy Analysis Seminar
U.S. Department of the Interior
Tuesday, April 18, 2023

Presenters:

Ken Bagstad, Research Economist, U.S. Geological Survey
Robert Richardson, Chief Economist, Office of Policy Analysis, DOI

NCA Natural Capital Accounting

Welcome & Overview

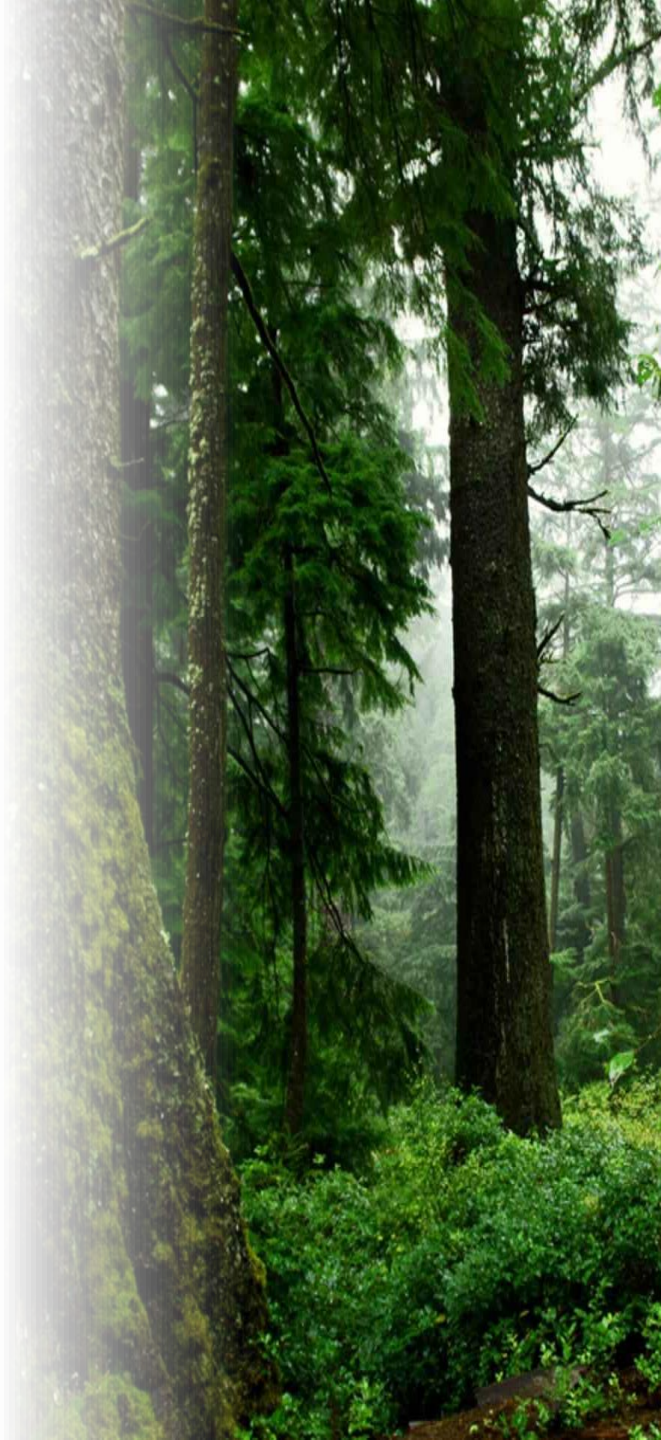
1. Earth Day 2023: “Investing in Nature”

2. Natural Capital Accounting (NCA) background

3. UN System of Environmental Economic Accounting (SEEA)

4. Accounts examples
    - Water
    - Ecosystem Accounts
    - Land
    - Urban

5. DOI applications
    - North Carolina and urban NWR case studies
    - Next steps



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System of National Accounts

- Early 1930s – Great Depression
  - Congress lacked data to help guide recovery
  - Sen. LaFollette (R-Wisconsin) introduced resolution to require Commerce Department to develop a “spreadsheet” of the economy and its components
  - Simon Kuznets (Bureau of Economic Research) constructed the national accounts to measure gross national product – first published in 1941
  - Warned Congress how the accounts should not be used – as a measure of living standards
    - Which is exactly how they have come to be used

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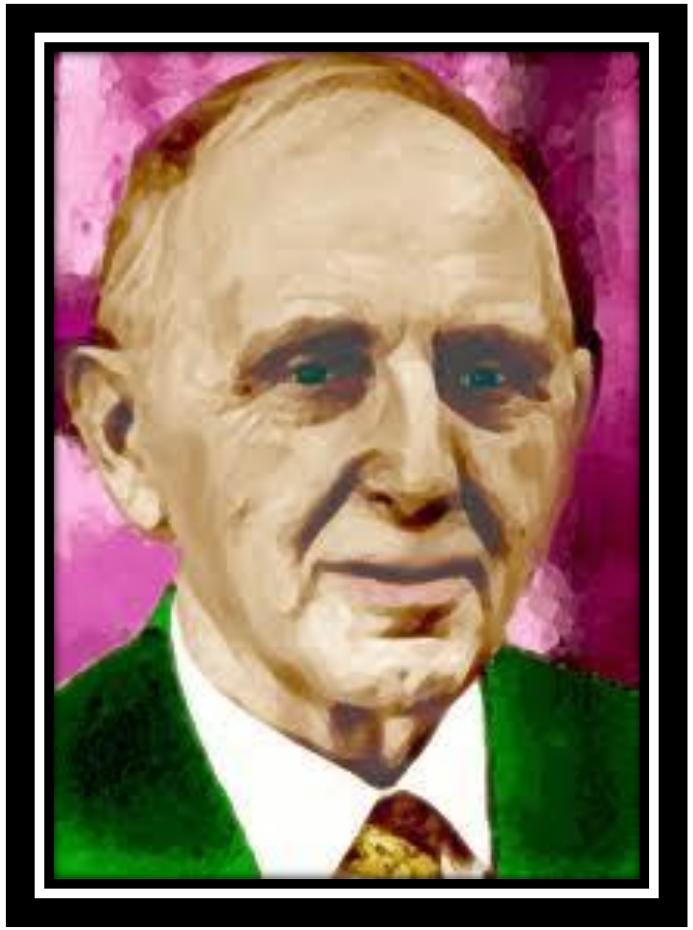
Kuznets on gross national product

In *evaluating* growth, "distinctions must be kept in mind between quantity and quality of growth, between its costs and return, and between the short and the long run…Goals for 'more' growth should specify more growth of what and for what." (1962, *The New Republic*)



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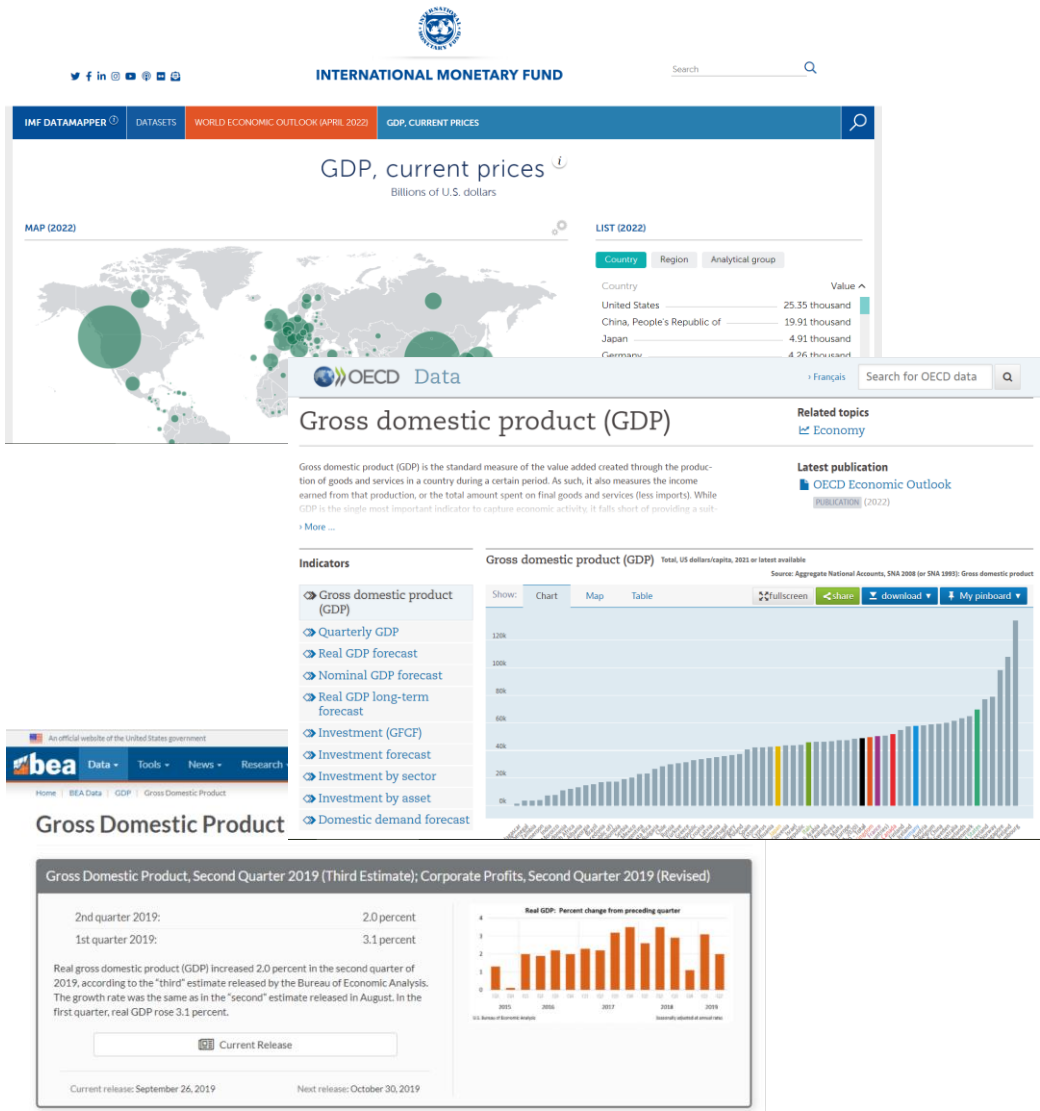
Economic accounts

- An “institutional miracle”?
  - Complex system
  - Regularly produced and updated
    - Over time
    - Across industries
    - Multiple geographies (national-state-MSA-county)
  - Independent and trusted
  - High policy relevance
    - Support economic prediction (effects of new policy on GDP, employment, trade…)



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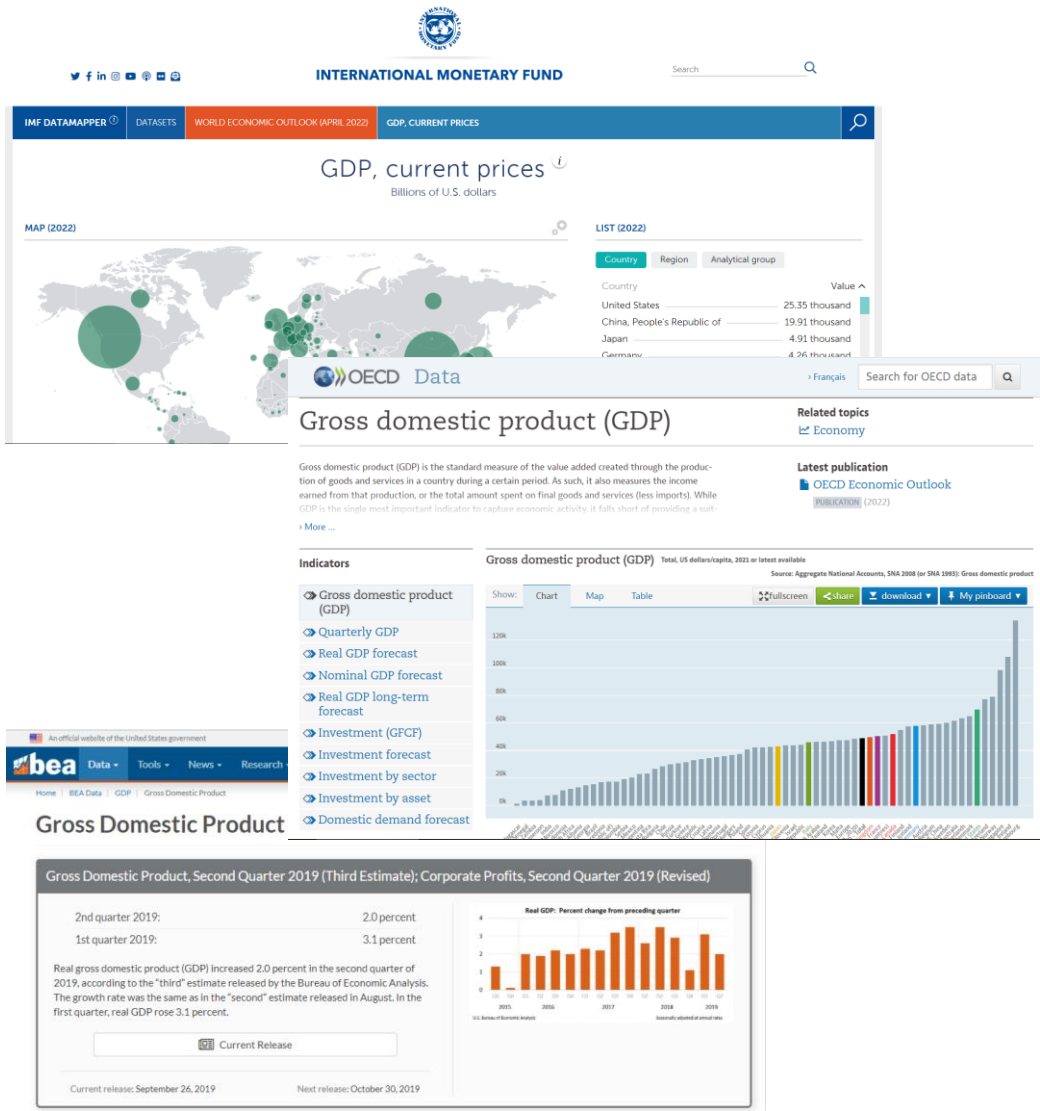
Economic accounts & natural resources

- BUT some key limitations
  - Includes the role of labor and capital in generating prosperity, but *not natural resources*
  - Does not account for *depletion/damage* (or protection/restoration) of the environment that impact current and future prosperity



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We do the same for our natural resources

- DOI/PPA has been estimating economic contributions of activities on DOI lands & waters since FY 2008 (part of the economic story, due to limitations)
- Opportunity to be more comprehensive
- DOI agencies including USGS have much of the data and scientific knowledge

Viewpoint

The Natural Capital Accounting Opportunity: Let's Really Do the Numbers

JAMES W. BOYD, KENNETH J. BAGSTAD, JANE CARTER INGRAM, CARL D. SHAPIRO, JEFFERY E. ADKINS, C. FRANK CASEY, CLIFFORD S. DUKE, PIERRE D. GLYNN, ERICA GOLDMAN, MONICA GRASSO, JULIE L. HASS, JUSTIN A. JOHNSON, GLENN-MARIE LANGE, JOHN MATUSZAK, ANN MILLER, KIRSTEN L. L. OLESON, STEPHEN M. POSNER, CHARLES RHODES, FRANÇOIS SOULARD, MICHAEL VARDON, FERDINANDO VILLA, BRIAN VOIGT, AND SCOTT WENTLAND

The nation's economic accounts provide objective, regular, and standardized information routinely relied generate consistent time series data across decades. Those data allow us to document what has happened in the (EGSA) accounts for the United States would allow diverse environmental, social, and economic data to be trans-

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Driver: EO 14072(4)(b)

Executive Order 14072 of April 22, 2022

Strengthening the Nation's Forests, Communities, and Local Economies

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

...

(b) The Director of the Office of Management and Budget shall issue guidance related to the valuation of ecosystem and environmental services and natural assets in Federal regulatory decision-making, consistent with the efforts to modernize regulatory review required by my Presidential Memorandum of January 20, 2021 (Modernizing Regulatory Review).

https://www.govinfo.gov/content/pkg/FR-2022-04-27/pdf/2022-09138.pdf

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Driver: M-22-15

EXECUTIVE OFFICE OF THE PRESIDENT

WASHINGTON, D.C. 20503

July 22, 2022

M-22-15

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

...

Nature-based climate solutions:

integrate traditional and nature-based approaches. Agencies should promote R&D efforts to include ecosystem services in cost-effectiveness and benefit-cost analyses; track natural assets through the emerging national system of natural capital accounts and associated environmental-economic statistics; and synthesize knowledge of these and other connections between nature, climate, economy, and society through the National Nature Assessment.

https://www.whitehouse.gov/wp-content/uploads/2022/07/M-22-15.pdf

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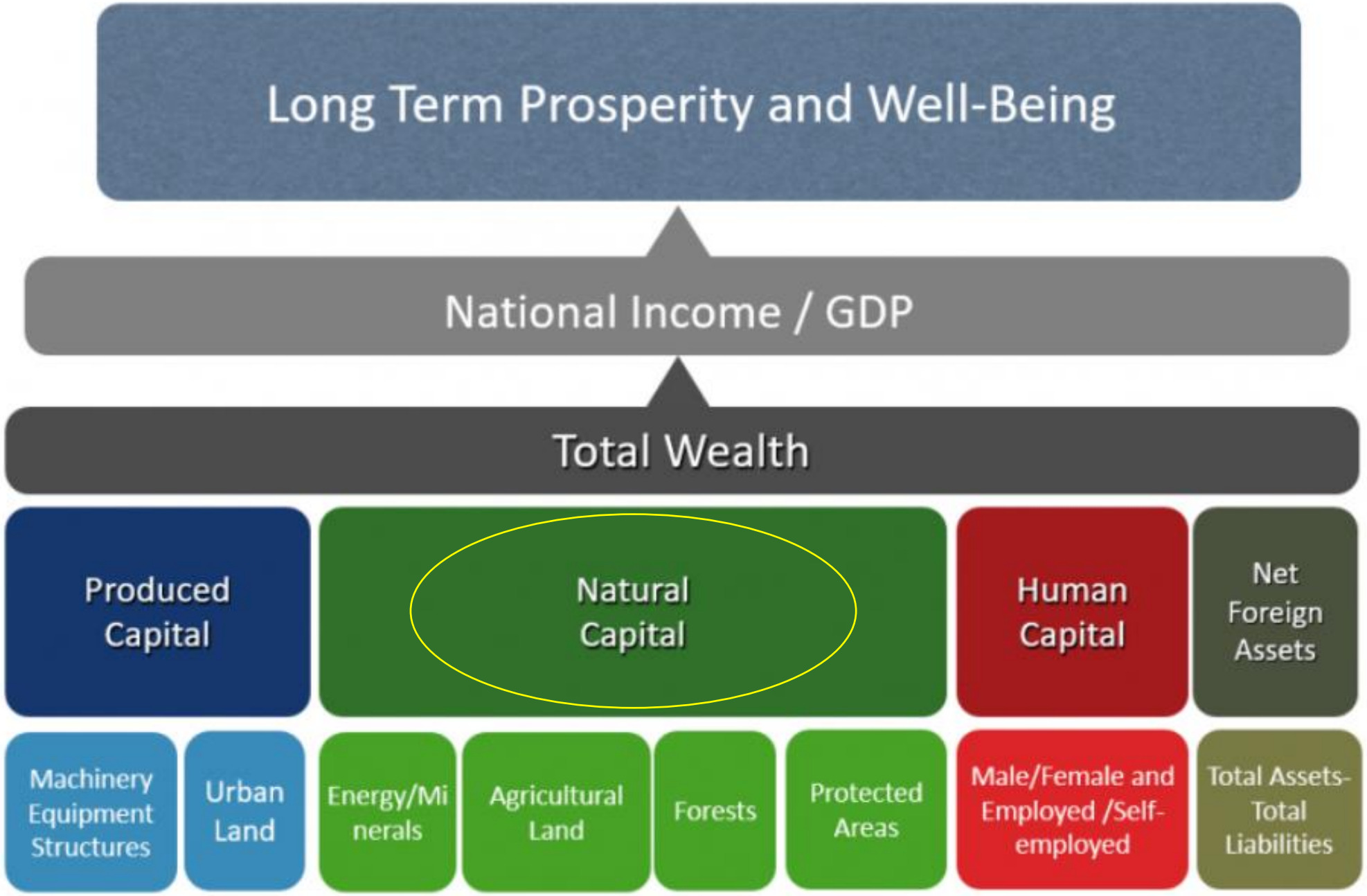

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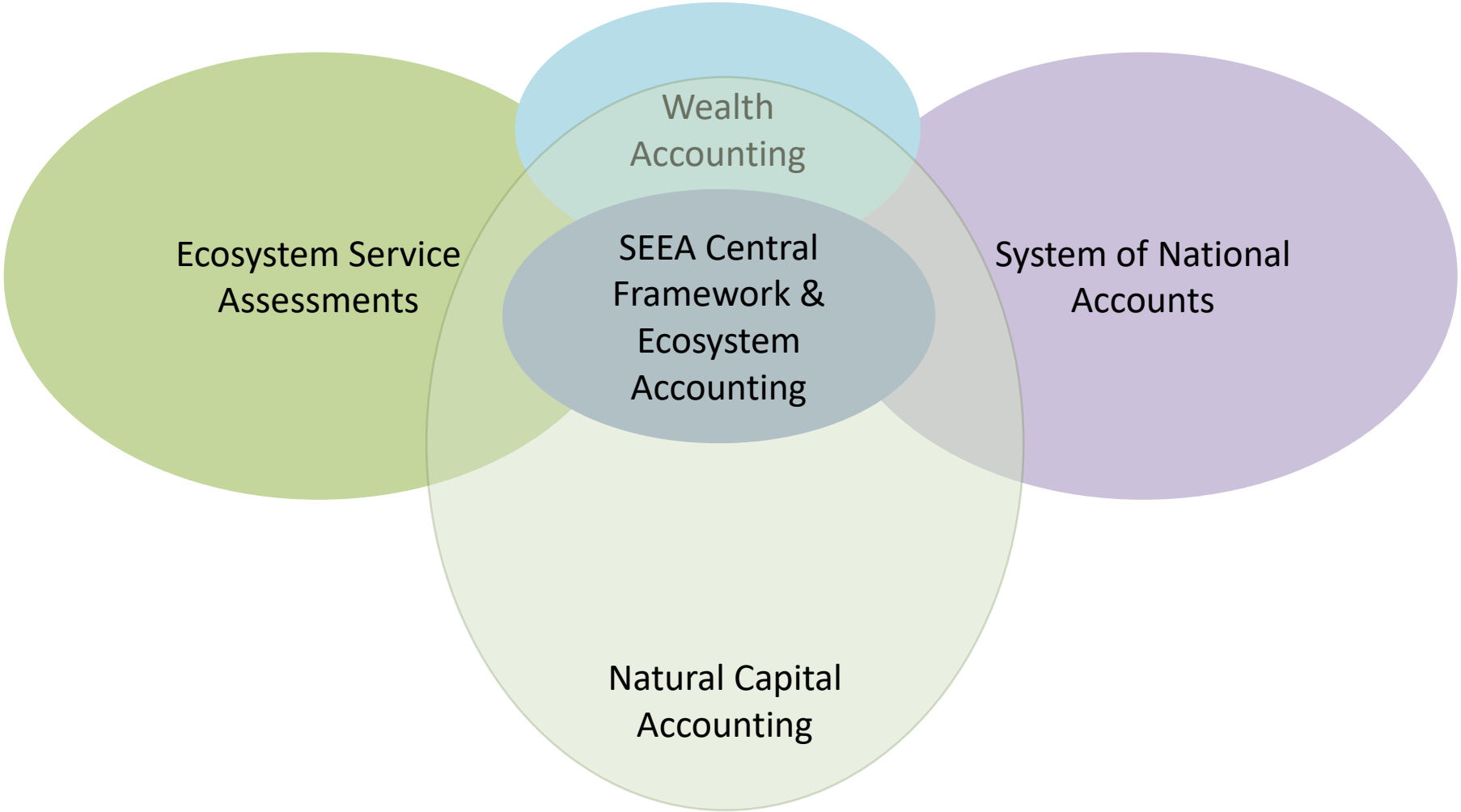
The why: NCA links systems

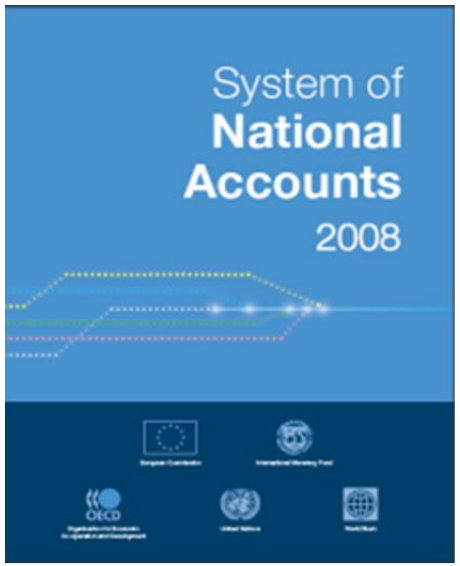


Bagstad et al., 2021

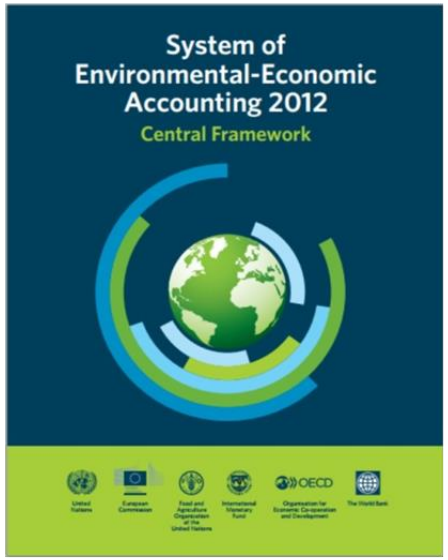
NCA Natural Capital Accounting

The how: NCA System of Environmental-Economic Accounting

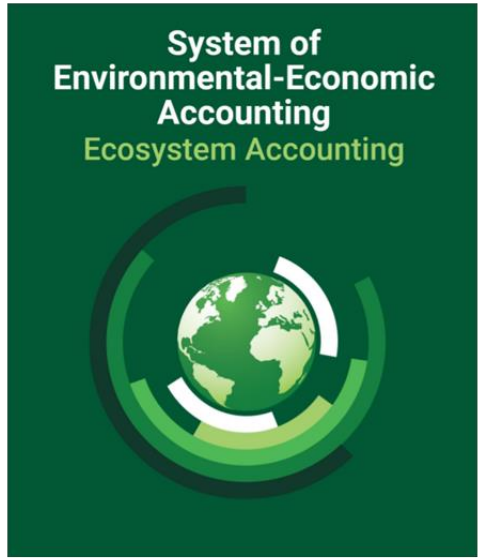
System of National Accounts



SEEA – Central Framework



SEEA - Ecosystem Accounting



Track natural resources:

- Over time
- At multiple spatial scales
- Compatible with economic accounts data

2012 2021

https://seea.un.org/

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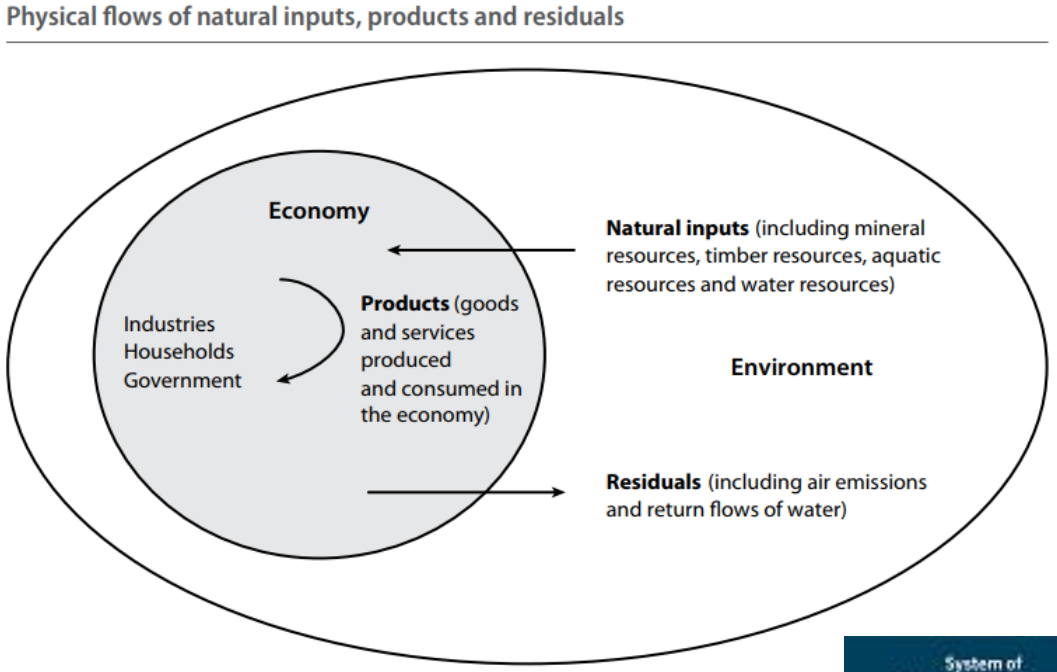
The how: SEEA Central Framework

- "an international statistical standard for measuring the environment and its relationship with the economy," covering:
  1. Environmental flows (energy, water, materials, air emissions, solid waste, etc.)
  2. Stocks of environmental assets (mineral and energy, land, soil, timber, aquatic/water resources, etc.)
  3. Economic activity related to the environment (environmental protection expenditures, environmental goods and services sector, tax and subsidy accounts)



https://seea.un.org/content/seea-central-framework

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The how: SEEA Ecosystem Accounting

Coherent, comprehensive view of ecosystem services:

- Ecosystem extent
- Ecosystem condition
- Ecosystem services
  - ❑ Physical
  - ❑ Monetary

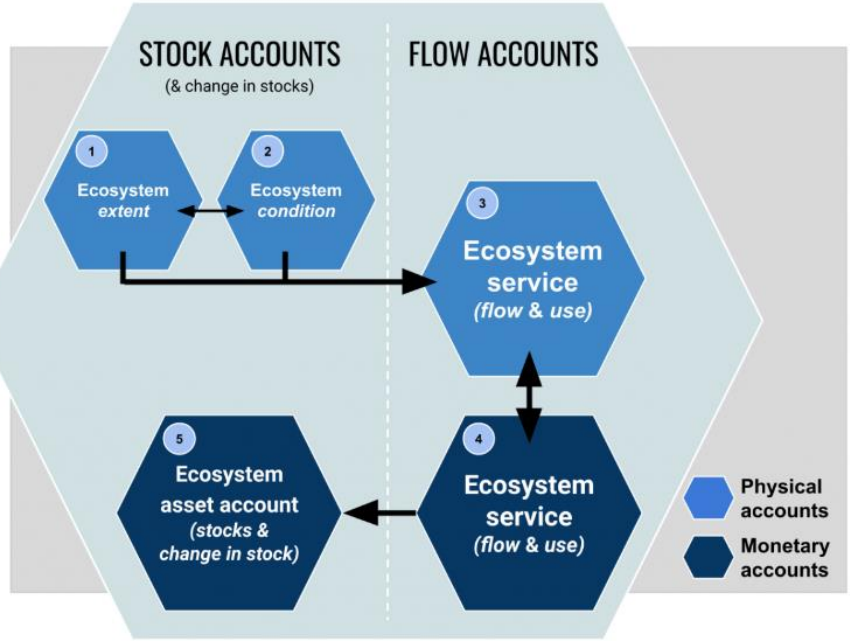
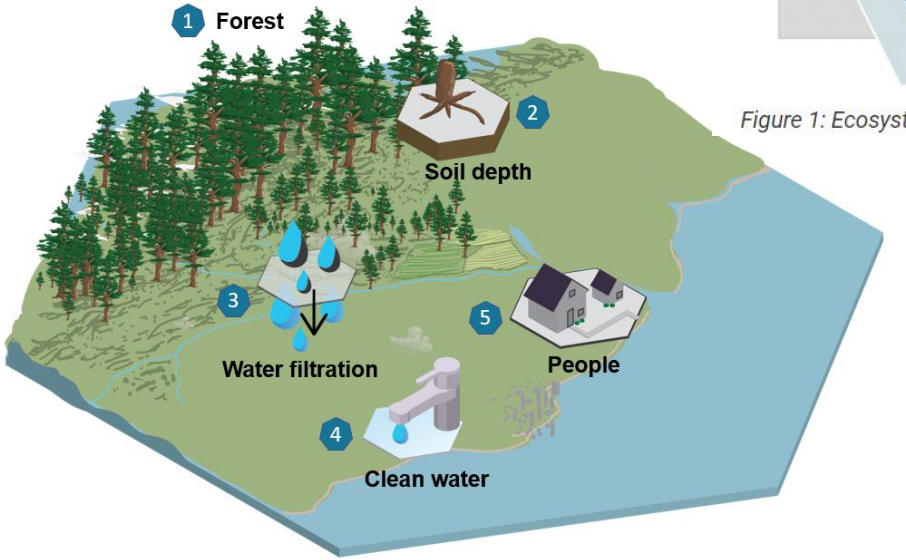


Figure 1: Ecosystem accounts and how they relate to each other

System of Environmental-Economic Accounting
Ecosystem Accounting



https://seea.un.org/ecosystem-accounting

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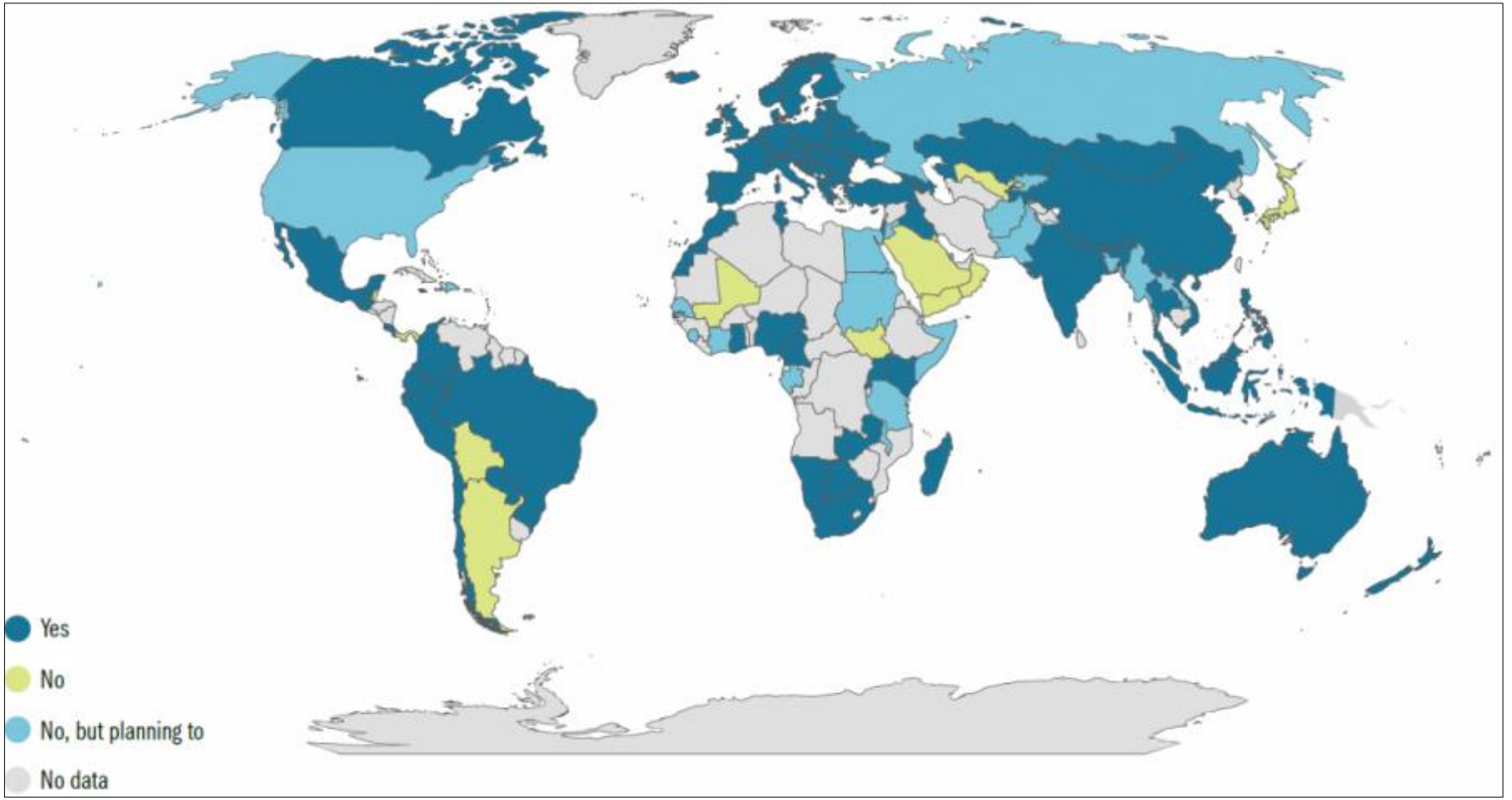
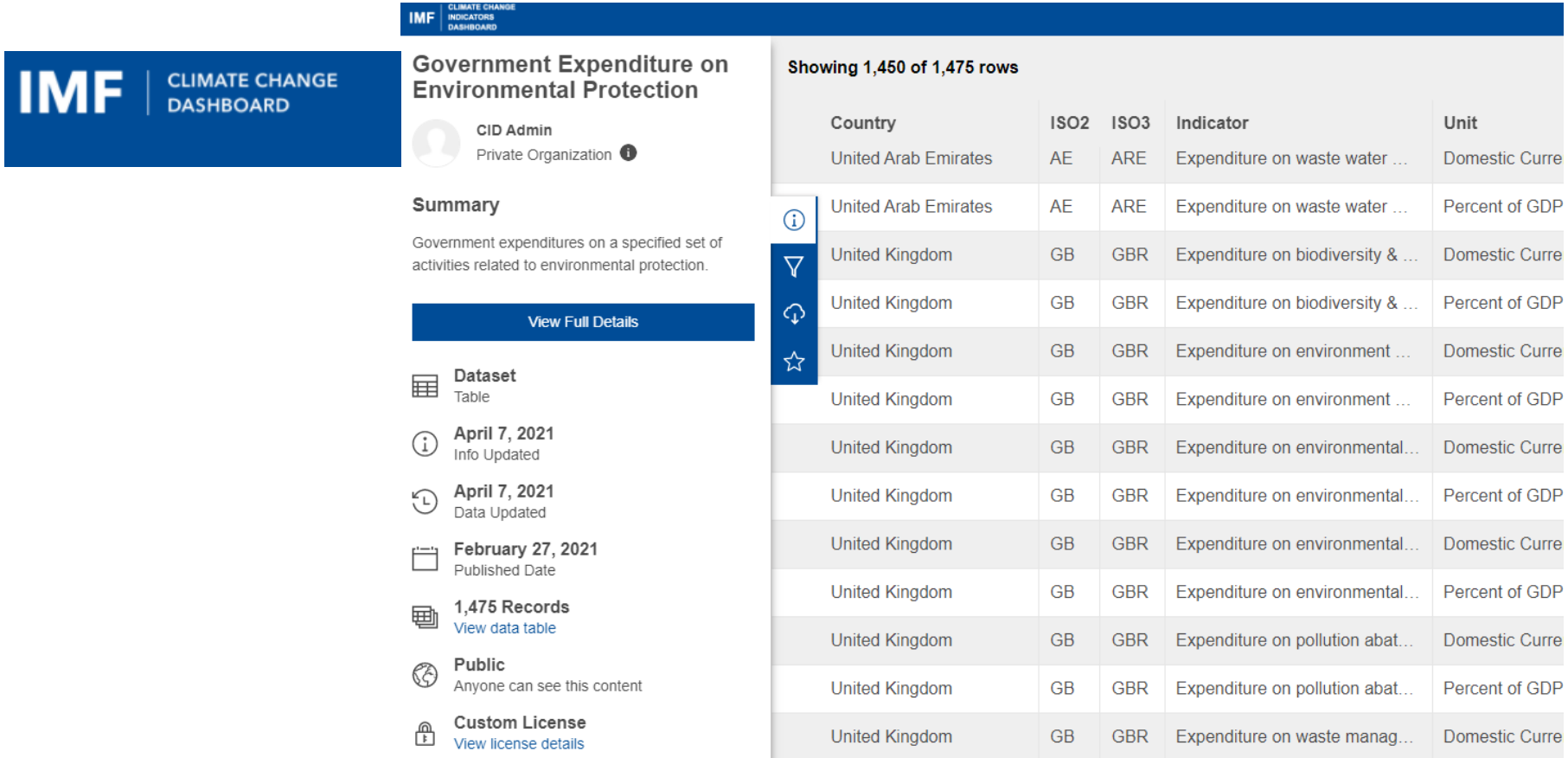
Over 90 countries have SEEA accounts



https://seea.un.org/

Where is the United States??



https://climatedata.imf.org/datasets/d22a6decd9b147fd9040f793082b219b_0/explore

?

"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, and not impaired, in value" **– Theodore Roosevelt, August 1910**

"This is a historic step forward towards transforming how we view and value nature. We will no longer be heedlessly allowing environmental destruction and degradation to be considered economic progress."
– **António Guterres, March 2021**

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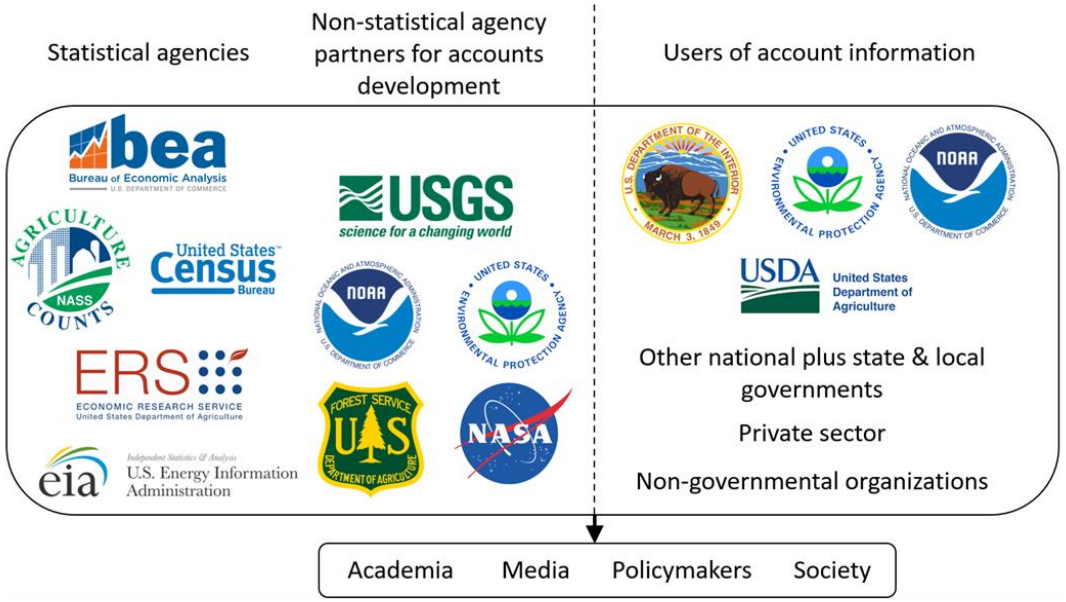
Piloting NCA in the U.S. (2016-present)

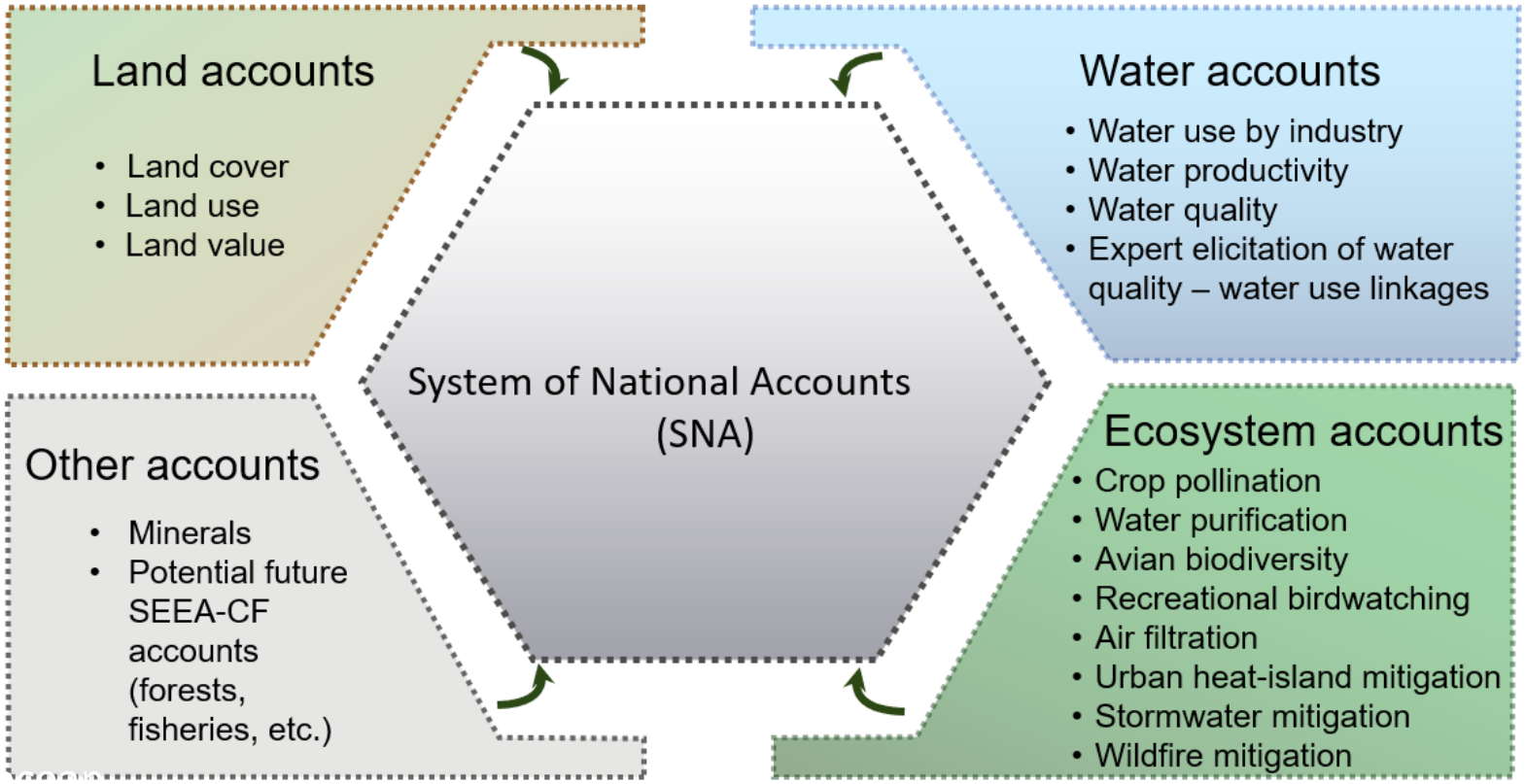


https://www.sciencedirect.com/journal/ecosystem-services/special-issue/10RZK17R0JP

Piloting NCA in the U.S.

Wentland et al. 2020 (Ecosystem Services)

BEA et al. (in prep)



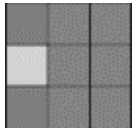
Bagstad et al. 2020 (Ecosystem Services)

Warnell et al. 2020, Heris et al. 2021 (Ecosystem Services)

https://www.sciencedirect.com/journal/ecosystem-services/special-issue/10RZK17R0JP

Data considerations:

Data should be publicly available on a national scale



Accounts summarized geographically and by ecosystem type

Analyses should be updateable – tracking over time is essential

Avoid proprietary tools and models when possible

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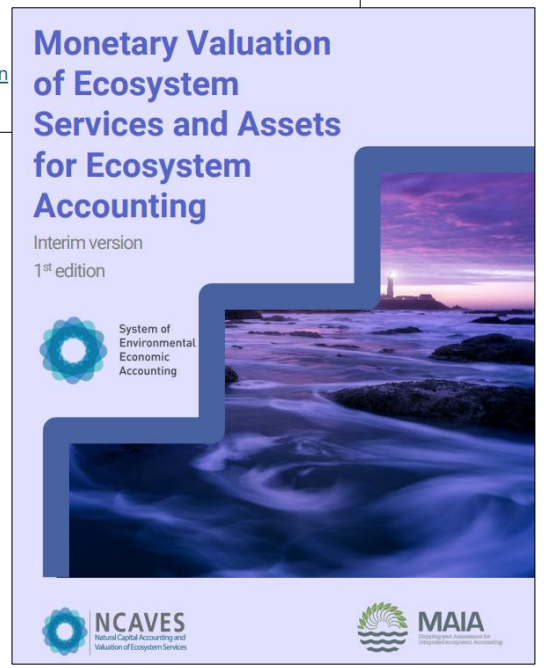
Valuation: Challenges

- National scale
- Without oversimplifying (ecological, hydrologic, socioeconomic heterogeneity)
- Consistent with SNA (i.e., exchange values vs. welfare)



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Implementation (2022-present)

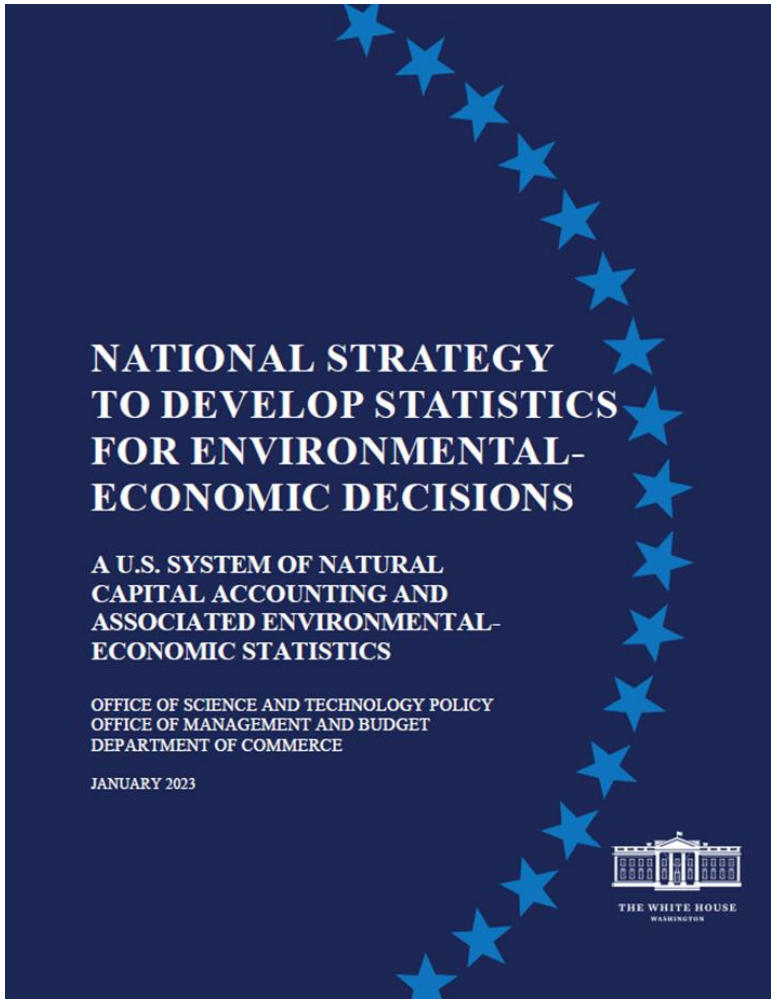
Administration Priorities

JANUARY 19, 2023

Fact Sheet: Biden-Harris Administration Releases National Strategy to Put Nature on the Nation's Balance Sheet

OSTP › BRIEFING ROOM › PRESS RELEASES

Today, the Biden-Harris Administration released the final *National Strategy to Develop Statistics for Environmental-Economic Decisions*, a historic roadmap that will kick off a multi-year effort to put nature on the nation's



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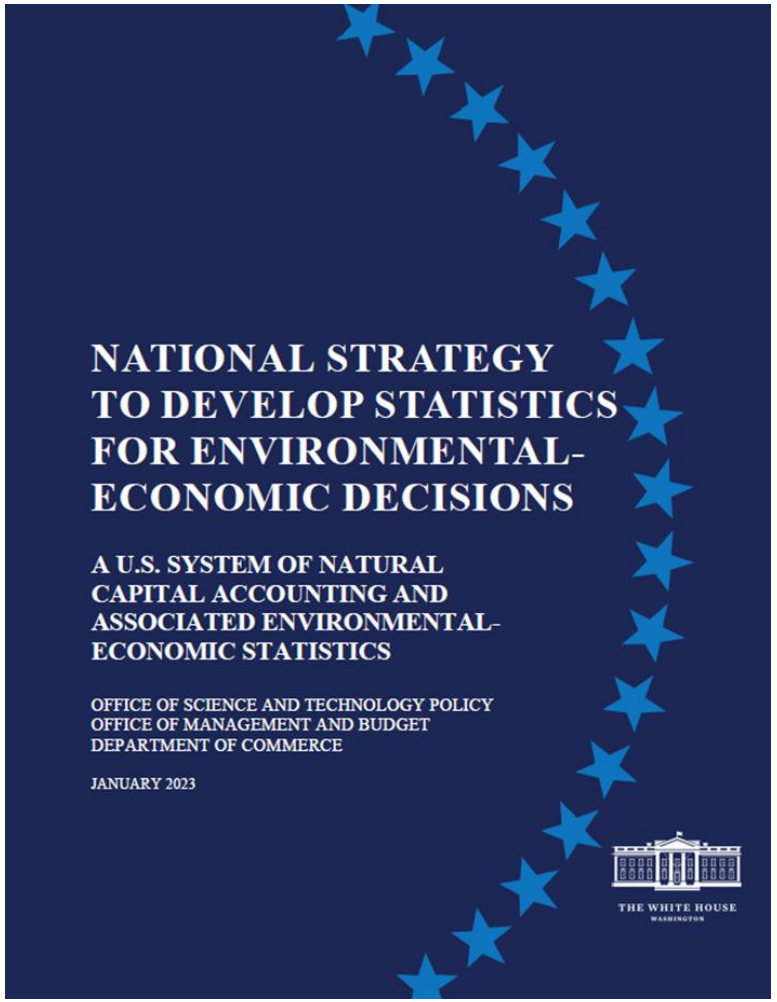
National Strategy

- Released January 2023
- Coordination across Federal Gov.
  - Data sharing
  - Interoperability (e.g., ARIES for SEEA)
- 15-year phased approach
  1. Research
  2. Experimental stats/pilots
  3. Core Statistical Product
- Headline Summaries
  - Changes in Natural Capital Wealth
  - Net Domestic Product incl. Natural Capital



https://www.whitehouse.gov/wp-content/uploads/2022/08/Natural-Capital-Accounting-Strategy.pdf

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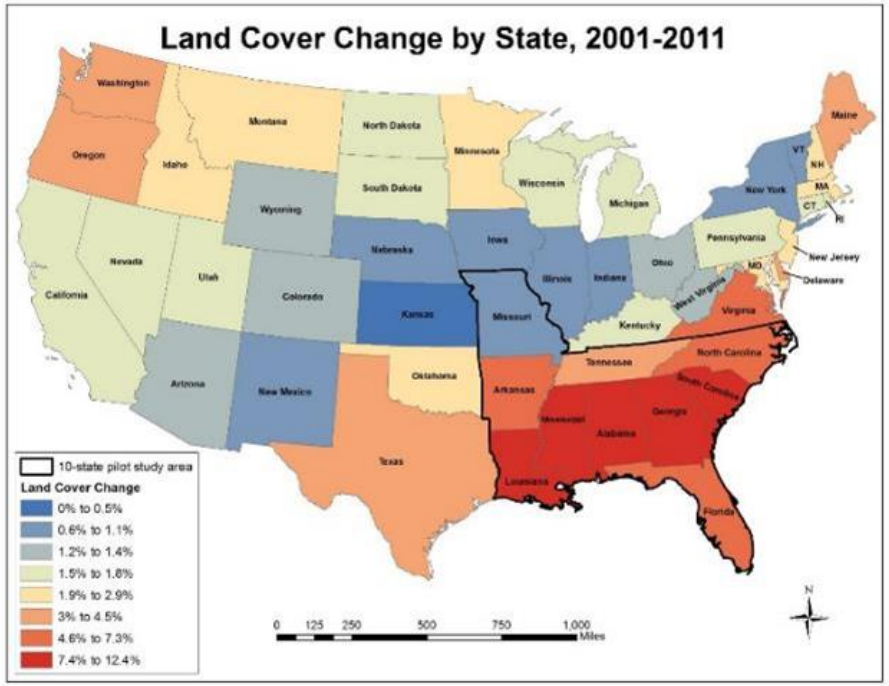
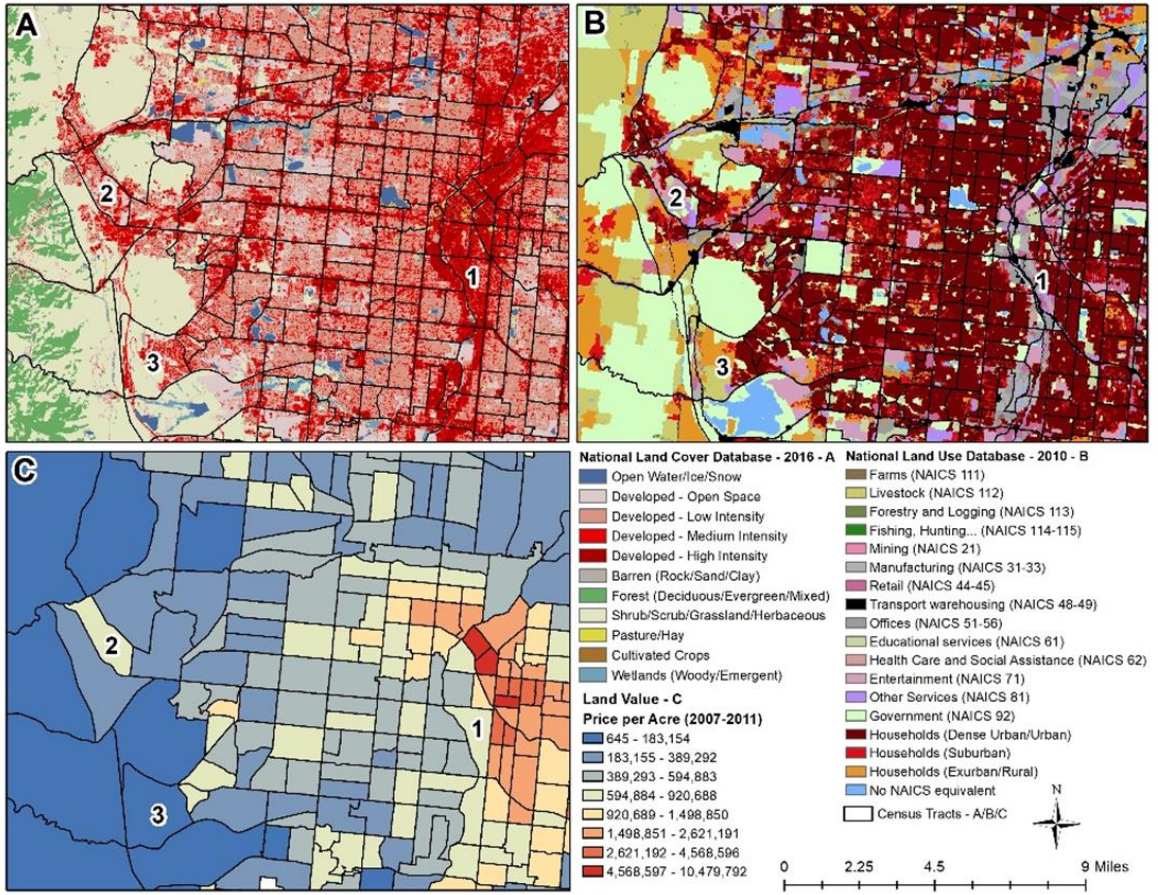
Examples: Land accounts



Land cover, use, value



Wentland et al. 2020

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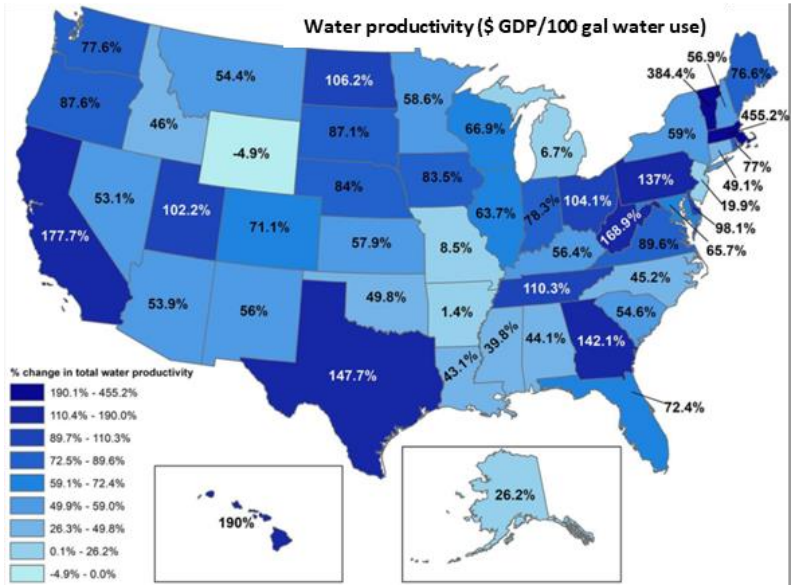
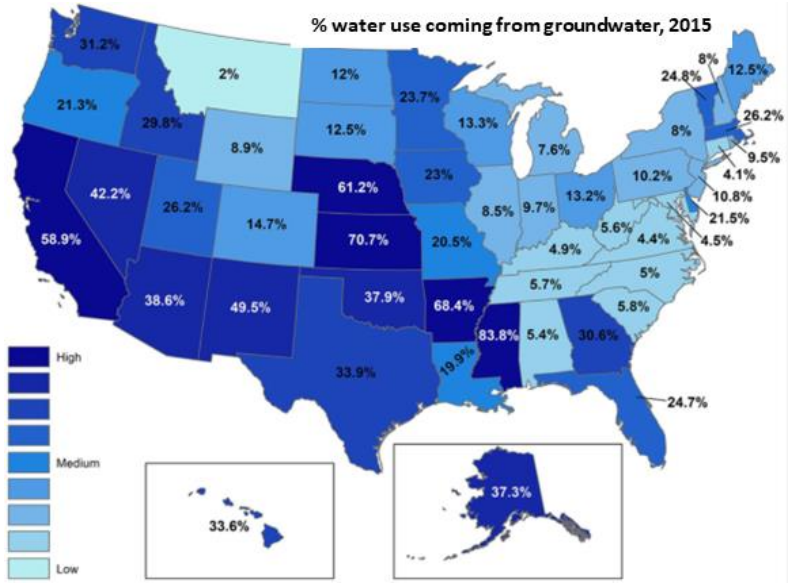
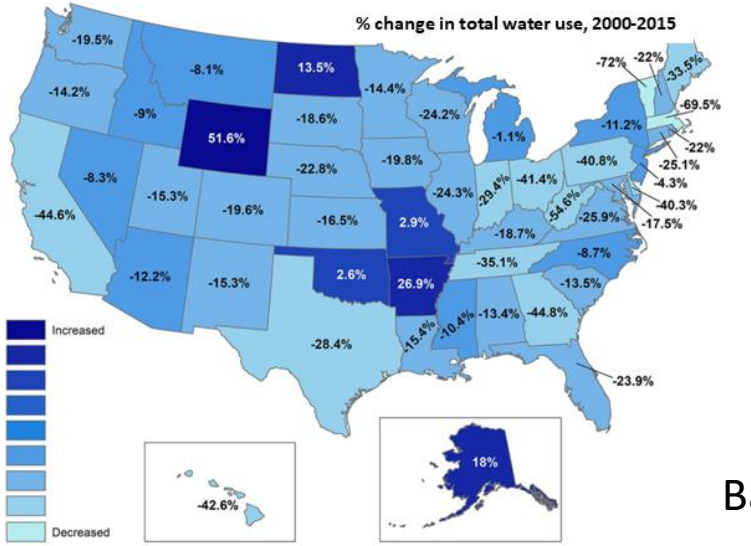
Examples: Water accounts





Water use, productivity, quality, emissions



Bagstad et al. 2020

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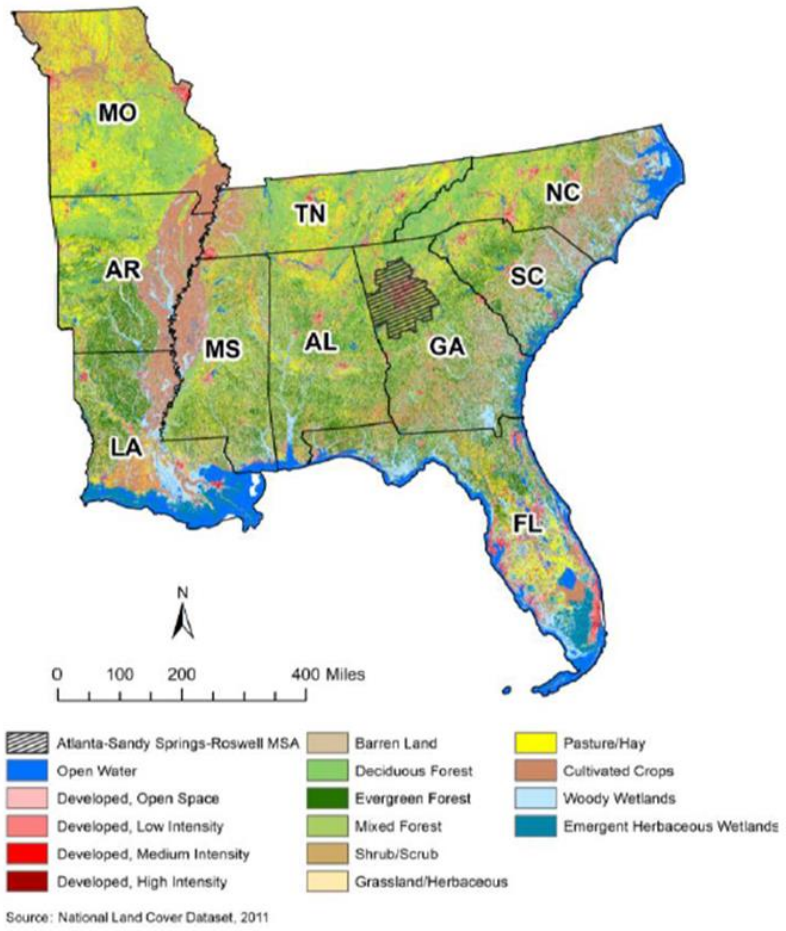
Examples: Ecosystem accounts



Warnell et al. 2020

			Ecosystem Types (Land Cover)																
			Offshore	Open Water - non-freshwater	Open Water - freshwater	Developed - Open	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland/Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands
Wild pollination*	Area of pollinator habitat in flight range of pollinator-dependent crops (sq km)	2001									5,471	2,516	1,336	1,290	165			7,061	172
		2006									4,152	2,125	1,459	2,191	423			11,539	371
		2011									53,679	30,441	6,670	18,388	9,314			43,104	3,354
	Area of pollinator-dependent crops in flight range of pollinator habitat (sq km)	2001															11,182		
		2006															21,581		
		2011															65,818		
	Ratio of pollinator habitat to pollinator dependent crops	2001															1.66		
		2006															1.05		
		2011															2.55		
Water purification	Area of purifying land cover types between NPS sources and waterways (sq km)	2001									31,542	20,238	6,959		5,385			25,463	3,379
		2006									31,453	19,780	6,678		5,997			25,427	3,504
		2011									31,005	19,330	6,353		6,192			25,151	3,789
	% of flowpath between NPS sources and waterways in purifying land cover types	2001			30.6%														
		2006			30.4%														
		2011			29.9%														
Bird biodiversity	Bird species richness (out of 160 species modeled)	2001	158	157		156	149				160	160				160	160	158	148
		2006	158	157		156	150				160	160		145		160	160	159	150
		2011	158	157		156	150				160	160		144		160	160	159	147
Air purification	Wind Speed (m/s)	2010	2.42																
		2015	2.54																
	Temperature (°C)	2010	17.06																
		2015	17.38																
	Precipitation (mm/yr)	2010	962																
		2015	1344																
	Pollution removal (tonnes/year) CO	2010	98,690																
		2015	92,583																
	Pollution removal (tonnes/year) NO_2	2010	438,139																
		2015	494,268																
	Pollution removal (tonnes/year) O_3	2010	4,531,927																
		2015	4,258,878																
	Pollution removal (tonnes/year) PM_{10}	2010	1,327,037																
		2015	1,205,268																
	Pollution removal (tonnes/year) $PM_{2.5}$	2010	220,218																
		2015	257,912																
	Pollution removal (tonnes/year) SO_2	2010	329,580																
		2015	176,681																

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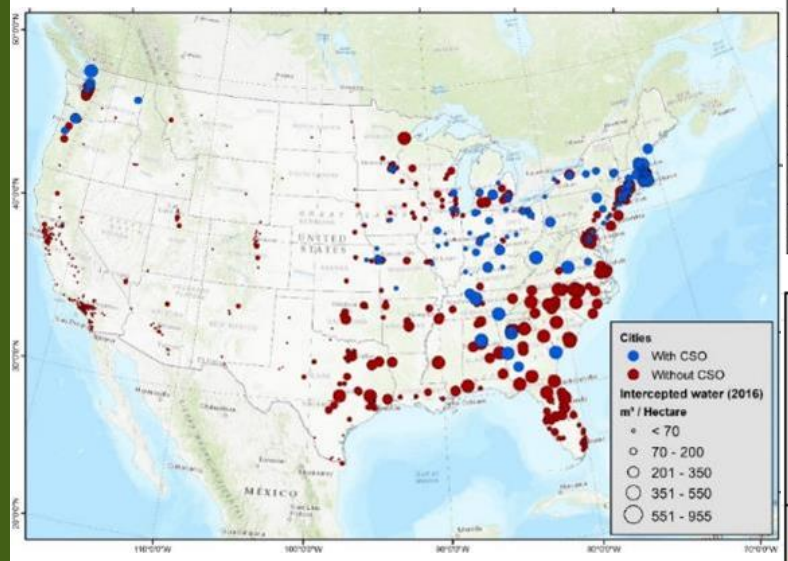
Examples: Urban ecosystem accounts

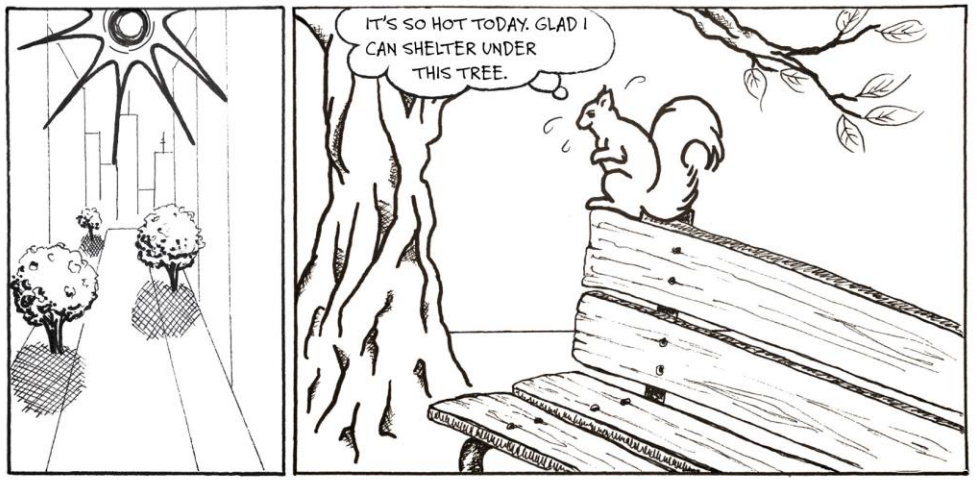


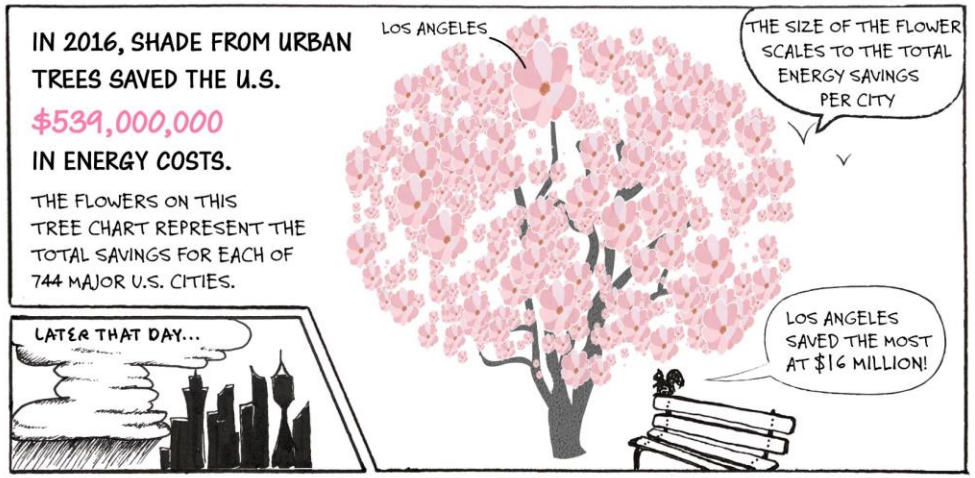
Ecosystem Accounting Area	Service Type	Year	Ecosystem Types (Land cover)															
			Open Water	Developed - Open	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Scrub/Shrub	Grassland/Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Total
736 cities with population >=50k and valid regression results	Energy Savings (Million $)	2011	0.0	150.2	238.4	87.0	6.3	0.1	14.8	12.4	3.0	3.2	2.4	1.2	0.4	3.1	0.3	522.7
		2016	0.0	150.5	247.7	91.8	6.5	0.2	12.4	12.2	7.5	2.8	1.7	1.7	0.5	2.9	0.4	538.6
Cities of Colorado (17 with population >=50k)		2011	0.0	2.9	12.5	3.9	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	20.0
		2016	0.0	2.9	12.7	3.9	0.1	0.0	0.1	0.2	0.0	0.3	0.0	0.0	0.0	0.1	0.0	20.3
Denver, CO		2011	0.0	1.0	3.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1
		2016	0.0	0.9	3.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
130 cities with CSOs with population >=50k	Avoided Runoff Value (Million $)	2011	0.7	85.6	59.7	16.9	1.2	0.4	155.7	29.1	47.4	2.8	2.2	8.7	0.9	20.7	1.6	433.6
		2016	0.6	83.7	59.0	17.4	1.2	0.4	149.4	30.2	46.6	1.9	2.1	8.2	0.9	21.6	1.6	424.7

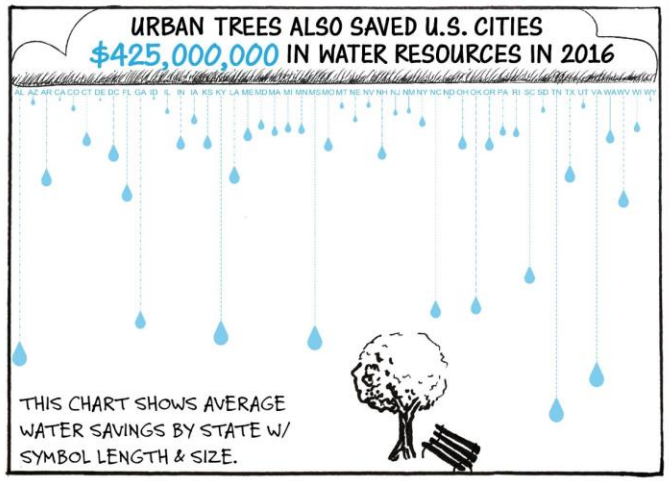
Ecosystem Accounting Area	Service Type	Year	Economic units												
			NAICS 11 Livestock	Wastewater treatment 221320	NAICS 31-33 Manufacturing	NAICS 44-45 Retail	NAICS 48-49 Transport warehousing	NAICS 51-56 Offices	NAICS 61 Educational services	NAICS 62 Health care & social assistance	NAICS 71 Entertainment	NAICS 92 Government	Households (No NAICS Code)	No NAICS equivalent	Total
736 cities with population >=50k and valid regression results	Energy Savings (Million $)	2011	0.0	0.0	1.3	2.1	11.3	2.9	3.5	0.9	0.2	0.9	497.7	1.8	522.7
		2016	0.0	0.0	1.3	2.1	11.2	2.9	3.5	1.0	0.2	0.9	513.7	1.8	538.6
Cities of Colorado (17 with population >=50k)		2011	0.0	0.0	0.0	0.1	0.0	1.7	0.1	0.0	0.0	0.1	17.6	0.3	20.0
		2016	0.0	0.0	0.0	0.1	0.0	1.7	0.1	0.0	0.0	0.1	17.9	0.3	20.3
Denver, CO		2011	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.1	4.3	0.1	5.1
		2016	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.1	4.3	0.1	5.0
130 cities with CSOs with population >=50k	Avoided Runoff Value (Million $)	2011	0.0	433.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	433.6
		2016	0.0	421.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	424.7

Heris et al. 2021

NCA Natural Capital Accounting







LEARN MORE ABOUT HOW URBAN TREES REDUCE ENERGY COSTS AND INCREASE RAIN INFILTRATION IN CITIES ACROSS THE UNITED STATES!

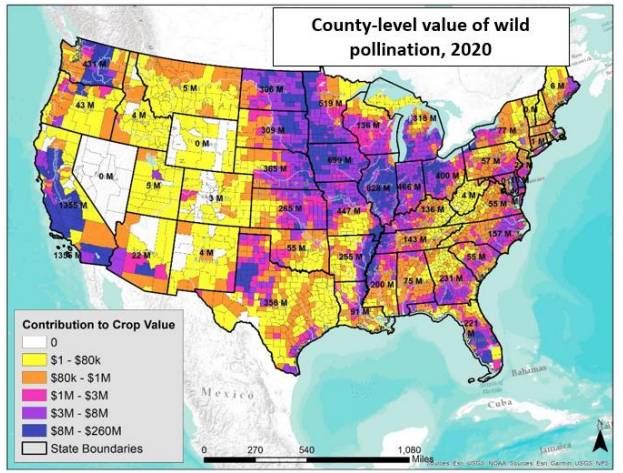
USGS science for a changing world

Data from: doi.org/10.5066/P9QV182X
Illustrations by Althea A. Archer

NCA Natural Capital Accounting

Examples: National pollination account

Year	Ecosystem Types (Land cover)												
	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Scrub/Shrub	Grassland/Herbaceous	Agriculture	Woody Wetlands	Emergent Herbaceous Wetlands	TOTAL
2008	$140.4	$17.7	$1.2	$4.1	$243.7	$44.0	$50.7	$136.9	$552.1	$5,909.1	$101.2	$71.8	$7,273.0
2011	$160.7	$21.2	$1.5	$7.0	$286.8	$61.7	$61.2	$227.1	$531.3	$7,435.5	$119.8	$98.8	$9,012.7
2014	$223.9	$34.9	$2.7	$12.0	$399.7	$60.0	$74.5	$183.9	$791.9	$9,591.9	$145.6	$138.2	$11,659.1
2017	$210.5	$34.3	$2.7	$8.9	$431.9	$61.3	$77.8	$189.4	$506.1	$9,352.3	$149.1	$141.3	$11,165.6
2020	$171.9	$32.7	$2.7	$8.2	$432.2	$60.8	$90.6	$167.4	$381.5	$7,624.0	$121.6	$121.2	$9,215.0



Year	Economic Units													
	111110 Soybean farming	111120 Oilseed (except soybean) farming[1]	111219 Other vegetable (except potato) and melon farming[2]	111310 Orange groves	111320 Citrus (except orange)	111331 Apple orchards	111332 Grape vineyards	111333 Strawberry farming	111334 Berry (except strawberry) farming[3]	111335 Tree nut farming[4]	111339 Other noncitrus fruit farming[5]	111920 Cotton farming	111992 Peanut farming	TOTAL
2008	$4,311.2	$66.2	$66.7	$563.7	$57.5	$347.5	$506.5	$93.9	$45.1	$246.9	$264.7	$556.6	$146.3	$7,273.0
2011	$4,791.3	$64.2	$41.2	$576.5	$59.9	$342.7	$433.9	$107.9	$40.8	$364.7	$225.5	$1,798.4	$165.7	$9,012.7
2014	$7,415.7	$63.8	$47.4	$547.2	$86.3	$362.7	$868.0	$295.3	$81.2	$710.0	$220.4	$794.4	$166.9	$11,659.1
2017	$7,232.1	$65.6	$80.3	$368.4	$45.5	$328.5	$879.9	$137.8	$70.1	$528.5	$250.4	$998.6	$179.9	$11,165.6
2020	$5,848.8	$85.5	$43.3	$152.0	$94.3	$363.8	$654.2	$33.1	$94.1	$570.8	$351.8	$764.3	$159.1	$9,215.0

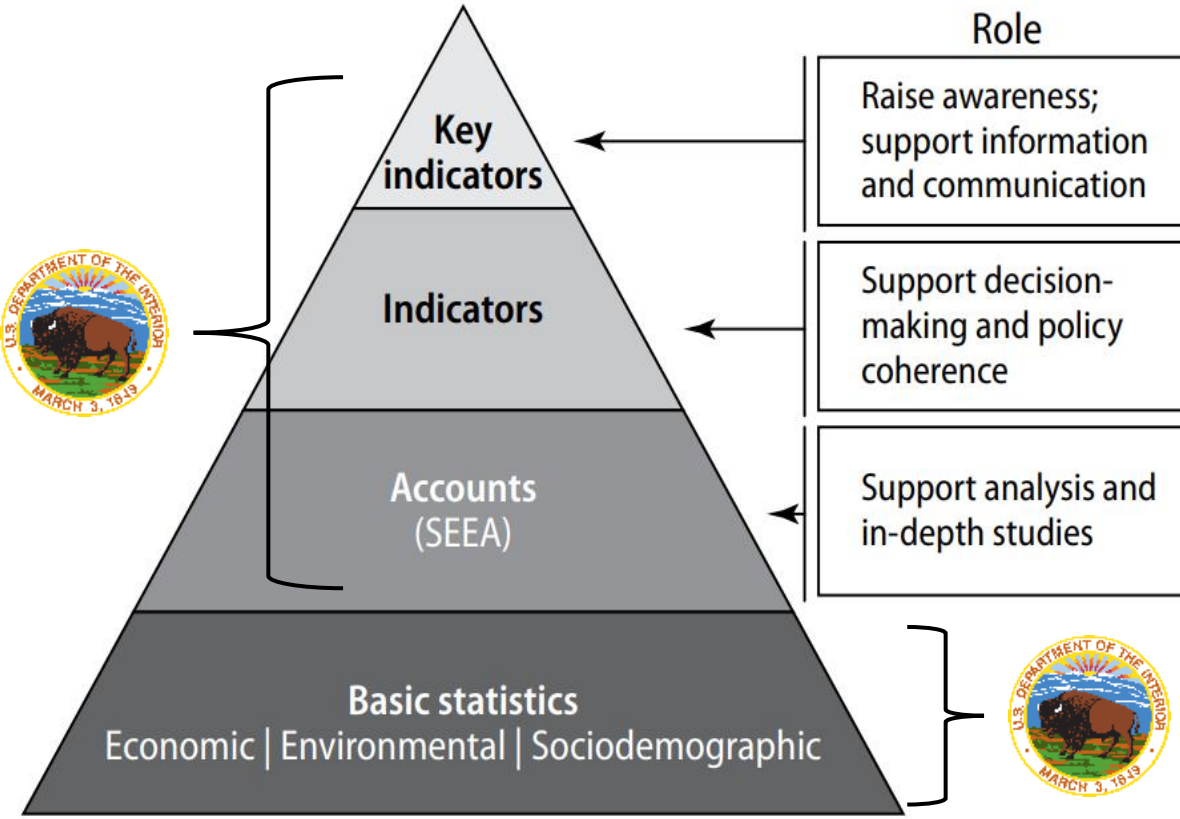
All values in million 2019 USD

NCA Natural Capital Accounting

DOI's Involvement

NCA Natural Capital Accounting

NCA Information Pyramid & DOI



	Role	Audience	Properties
Key indicators	Raise awareness; support information and communication	General public, journalist, high-level policymakers and managers, lawmakers	Aggregated and/or weighted indices; small sets of indicators
Indicators	Support decision-making and policy coherence	Government officials, policy analysts, managers, stakeholders	Large sets of indicators
Accounts (SEEA)	Support analysis and in-depth studies	Policy analysts, researchers, statisticians	Detailed and/or comprehensive statistical basis; multipurpose

Source: SEEA Applications and Extensions, 2012

NCA Natural Capital Accounting

DOI is an NCA information *provider*

- DOI bureaus provide critical data – land, water, energy & minerals, ecosystems – for accounts
- Partnerships with non-traditional partners (e.g., Depts. of Commerce, Treasury; Office of the Chief Statistician)

USGS science for a changing world

U.S. FISH & WILDLIFE SERVICE

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

BUREAU OF RECLAMATION

NATIONAL PARK SERVICE

BOEM
Bureau of Ocean Energy Management

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

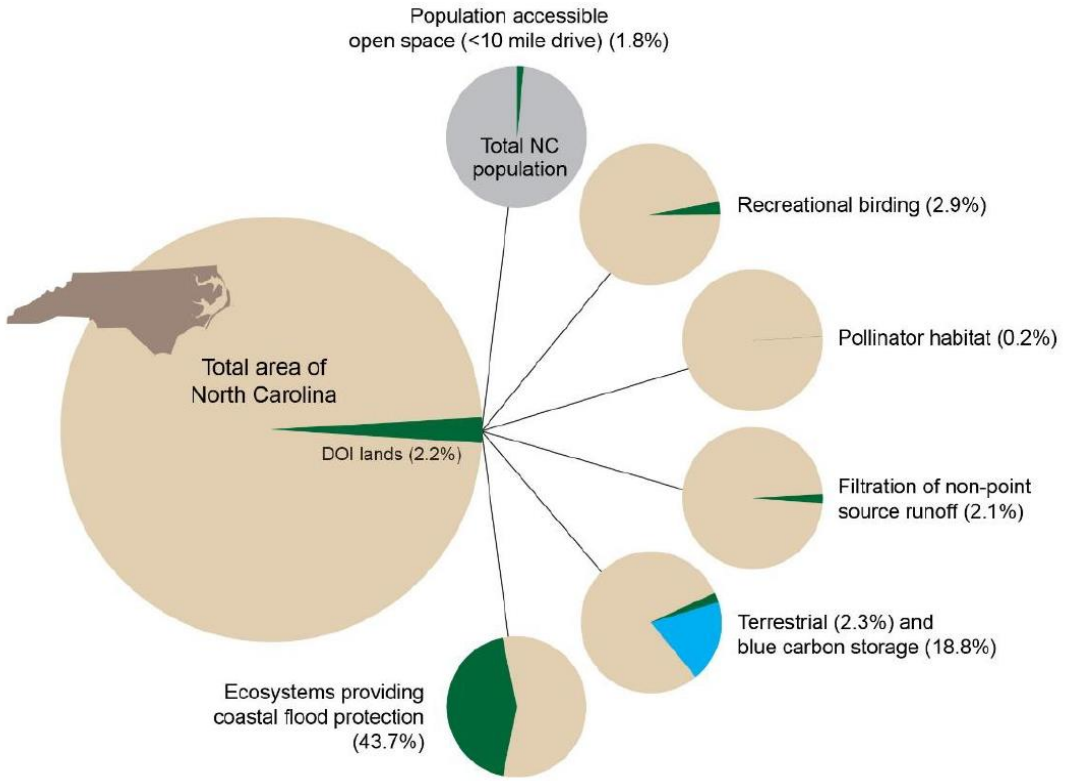
NCA Natural Capital Accounting

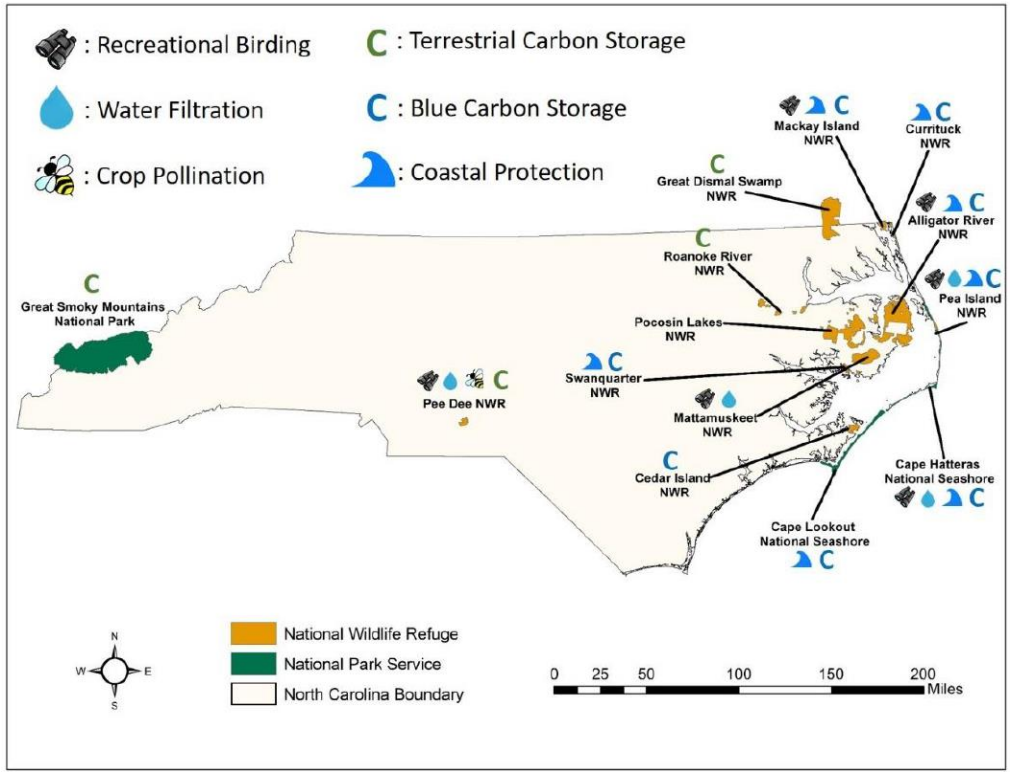
DOI is an NCA information *user*

- Values for resources impacted by DOI decisions
- Improve consistency in ecosystem services metrics
- NEPA compliance and other statutory requirements
- Policy priorities
- Community benefits from nature

NCA Natural Capital Accounting

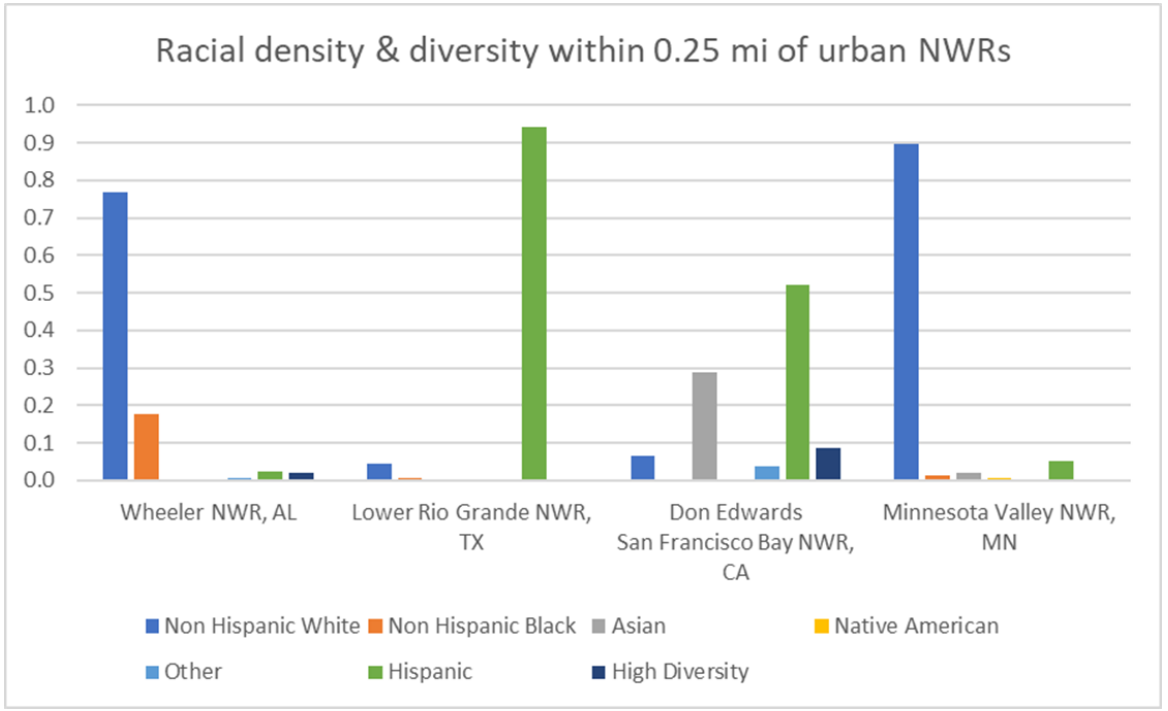
NCA, Interior mission, priorities: DOI as an information user

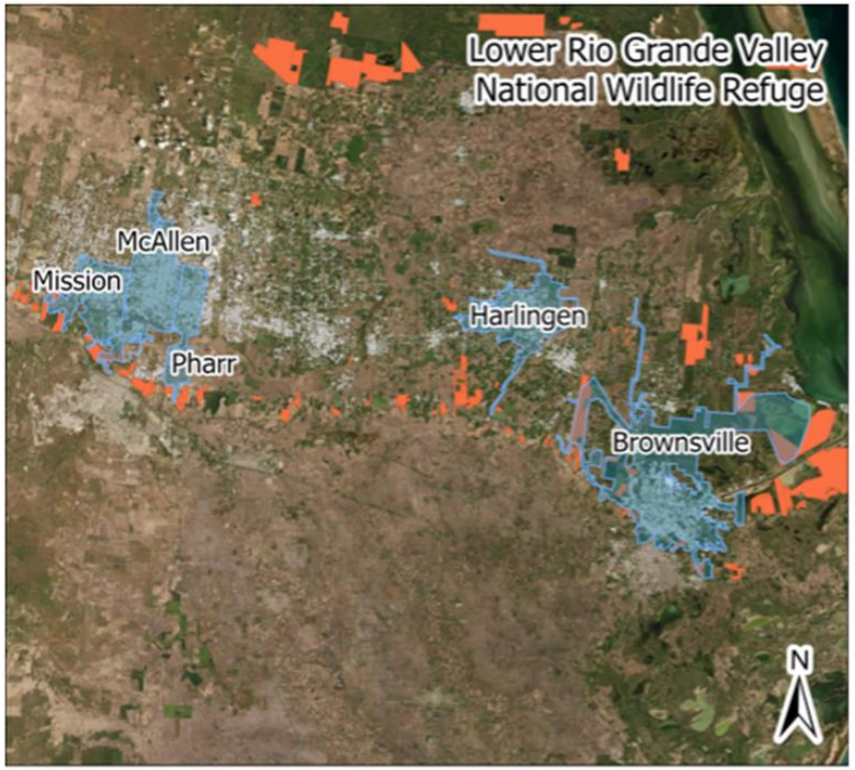




NCA Natural Capital Accounting

NCA, Interior mission, priorities: DOI as an information user





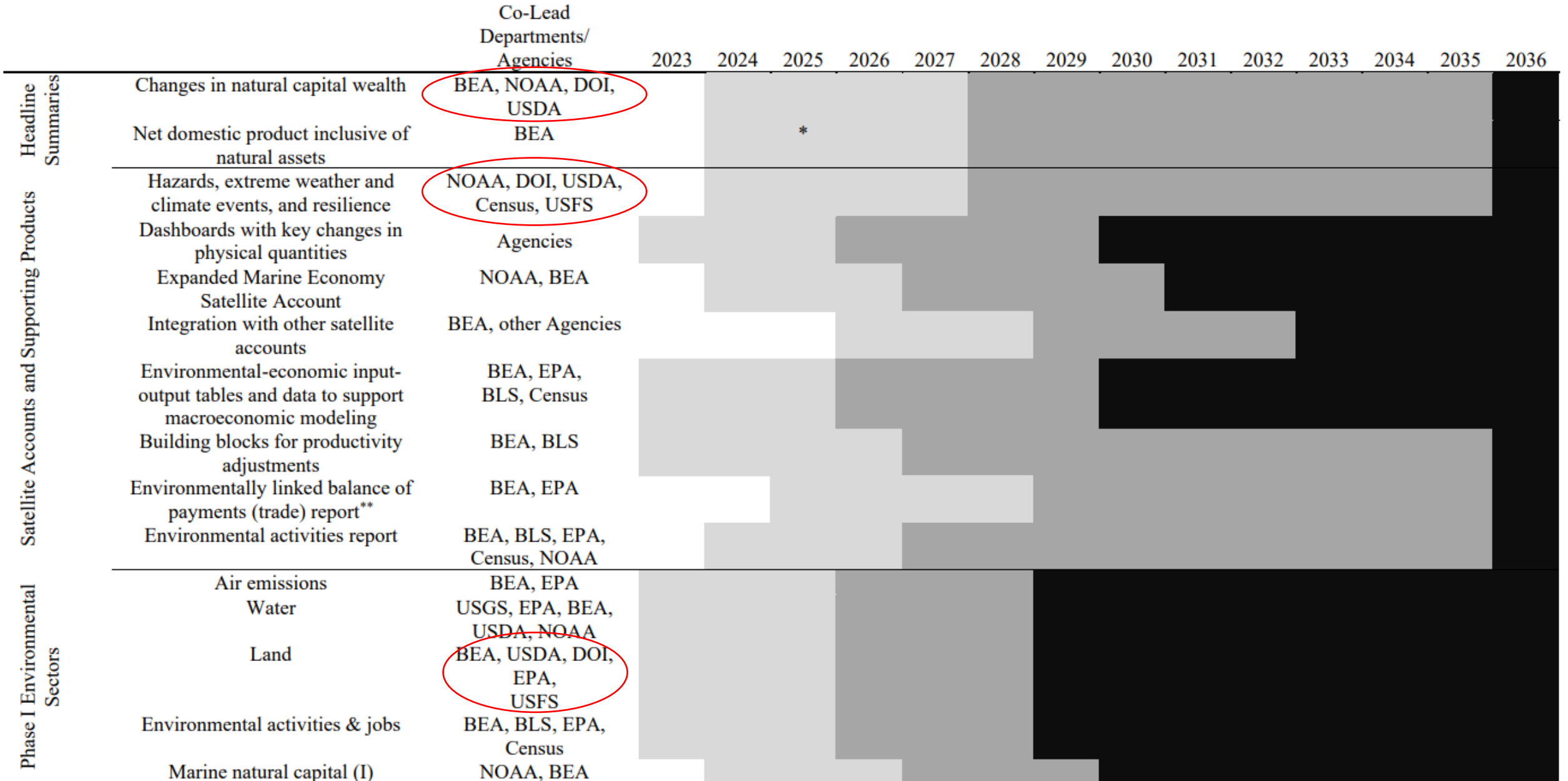
City	Energy Savings (2016, USD)	Rainfall Interception (m^3)
Brownsville, TX	$ 104,246 ± 16,835	3,184,089 ± 292,618
Harlingen, TX	$ 4 ± 0	5,700 ± 520
McAllen, TX	$ N/A ± N/A	0 ± 0
Mission, TX	$ 287 ± 15	27,830 ± 2,661
Pharr, TX	$ N/A ± N/A	0 ± 0

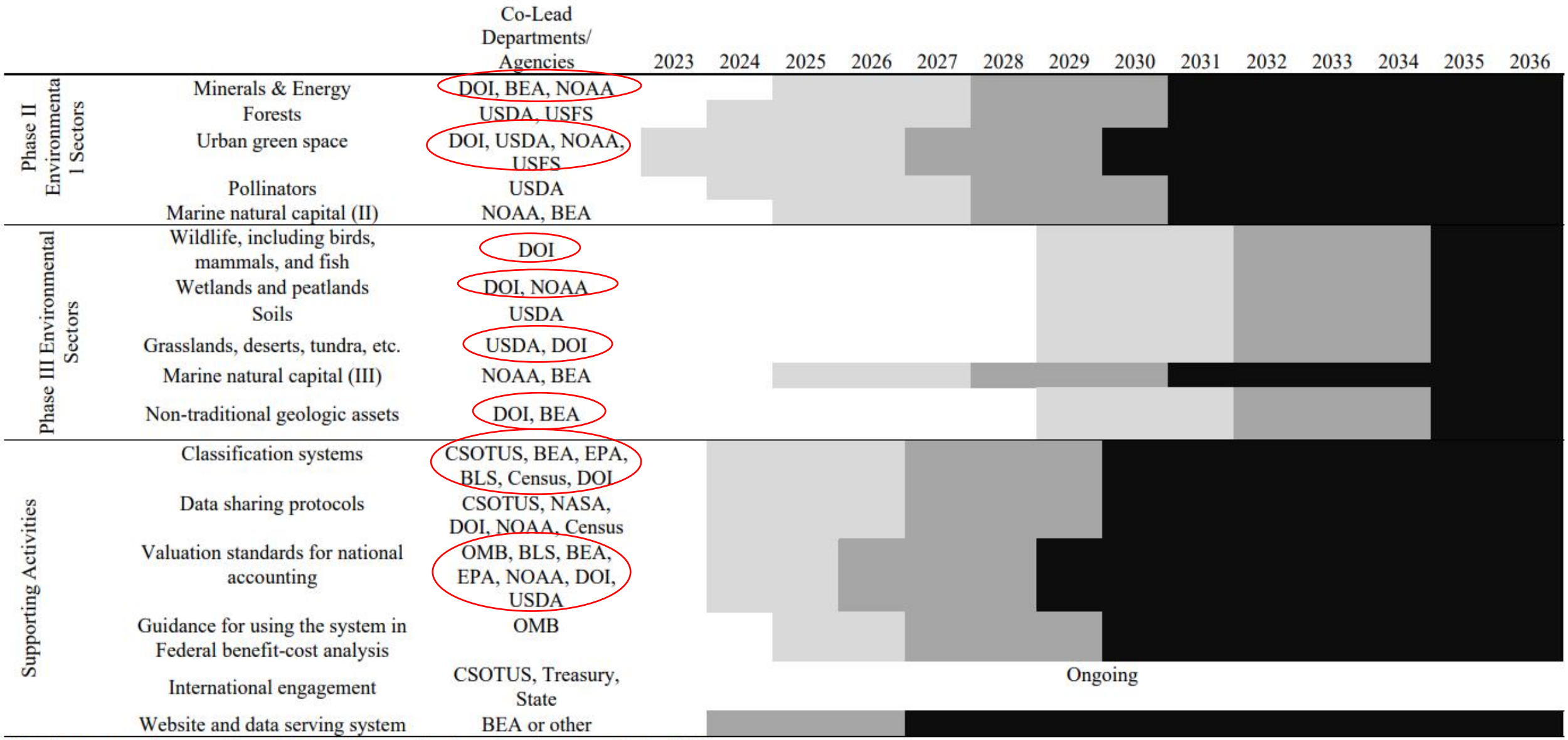
National Wildlife Refuge
Buildings
0 5 10 20 Miles

NCA Natural Capital Accounting

NCA and Interior priorities

- ✓ Climate change
- ✓ DEIA & EJ
- ✓ Energy
- ✓ Water
- ✓ America the Beautiful
- ✓ National Nature Assessment


Co-Lead Departments/ Agencies
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
Headline Summaries
Changes in natural capital wealth
BEA, NOAA, DOI, USDA
Net domestic product inclusive of natural assets
BEA
*
Satellite Accounts and Supporting Products
Hazards, extreme weather and climate events, and resilience
NOAA, DOI, USDA, Census, USFS
Dashboards with key changes in physical quantities
Agencies
Expanded Marine Economy Satellite Account
NOAA, BEA
Integration with other satellite accounts
BEA, other Agencies
Environmental-economic input-output tables and data to support macroeconomic modeling
BEA, EPA, BLS, Census
Building blocks for productivity adjustments
BEA, BLS
Environmentally linked balance of payments (trade) report**
BEA, EPA
Environmental activities report
BEA, BLS, EPA, Census, NOAA
Phase I Environmental Sectors
Air emissions
BEA, EPA
Water
USGS, EPA, BEA, USDA, NOAA
Land
BEA, USDA, DOI, EPA, USFS
Environmental activities & jobs
BEA, BLS, EPA, Census
Marine natural capital (I)
NOAA, BEA



*Pending expected new guidance from the international statistical community in 2025.
**May articulate to the G20 data gaps initiatives.

NCA Natural Capital Accounting

Implementation for each account will involve multiple DOI bureaus

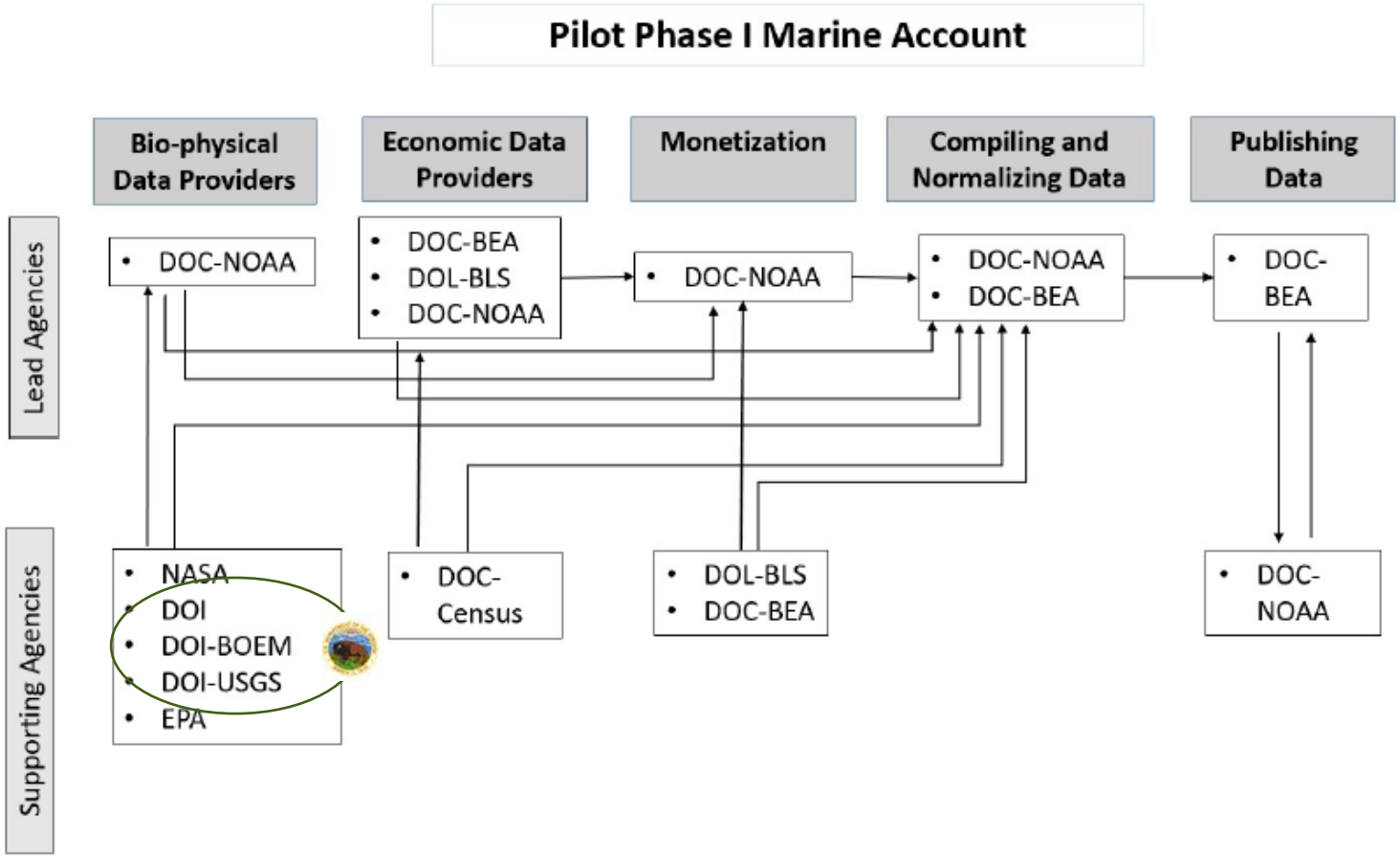


Figure 3. Agencies involved in producing the Marine account.

NCA Natural Capital Accounting

Implementation for each account can involve multiple DOI bureaus

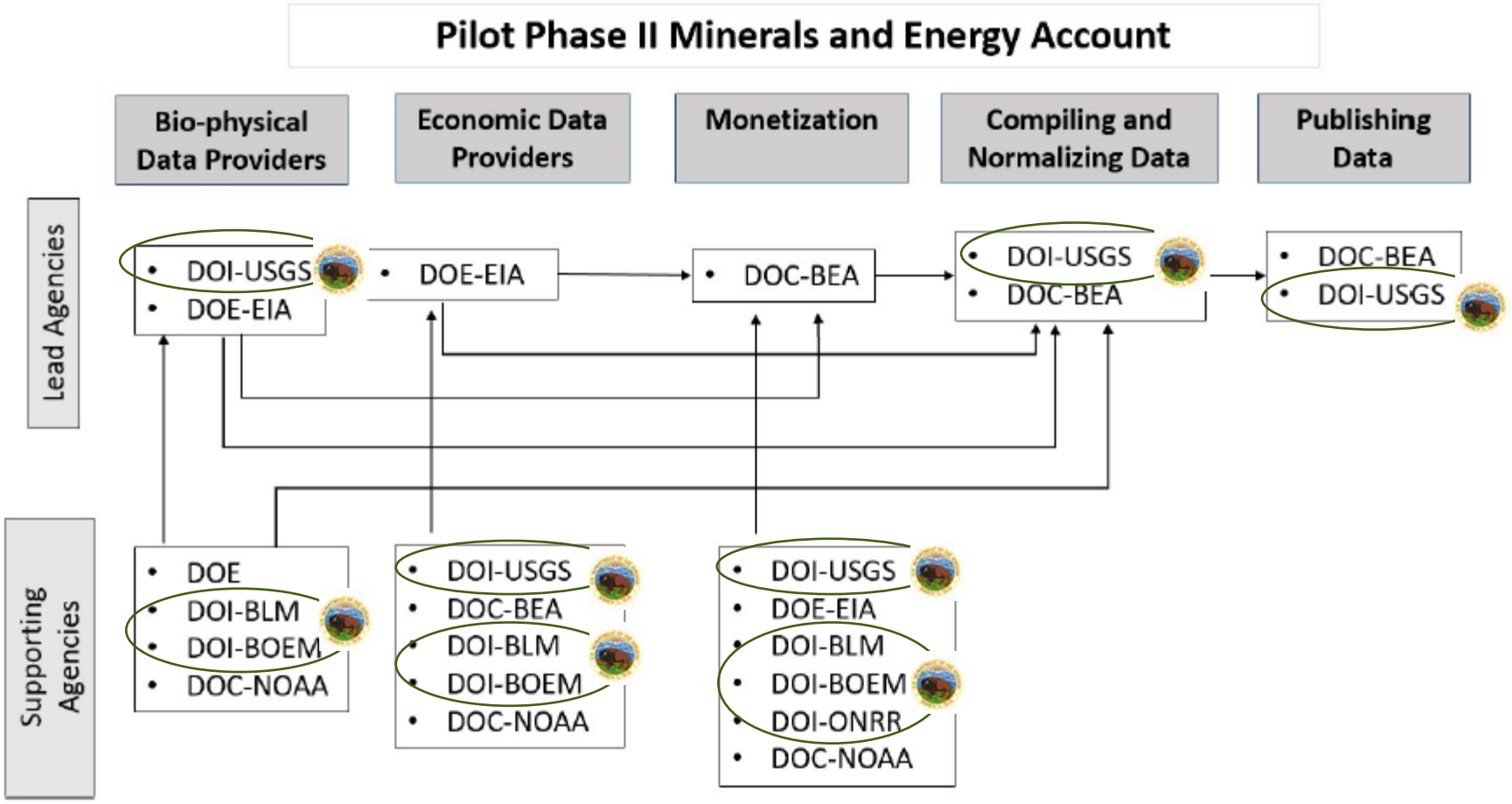


Figure 8. Agencies involved in the Minerals and Energy account.

NCA Natural Capital Accounting

APRIL 24, 2022

Accounting for Nature on Earth Day 2022

OSTP › NEWS & UPDATES › OSTP BLOG

By Jane Lubchenco, Deputy Director for Climate and the Environment; Heather Tallis, Assistant Director for Biodiversity and Conservation Science; and Eli Fenichel, Assistant Director for Natural Resource Economics and Accounting

"As we reflect on Earth Day 2022, we invite everyone to look around – truly look around – and see how nature supports our lives. Next Earth Day, we hope to see more nature thriving in its own glory and securing a prosperous future for all of America. We need nature to build a better future for everyone, and we look forward to building that future with you."

NCA Natural Capital Accounting

Questions, comments?