9TH IMF Statistical Forum

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MEASURING CLIMATE CHANGE

THE ECONOMIC AND FINANCIAL DIMENSIONS

Accounting for Climate Change and Environmental Activity: Implementation Challenges in the US

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November 17, 2021

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*Disclaimer: Any views expressed here are those of the authors and not necessarily those of the Bureau of Economic Analysis or the U.S. Department of Commerce.

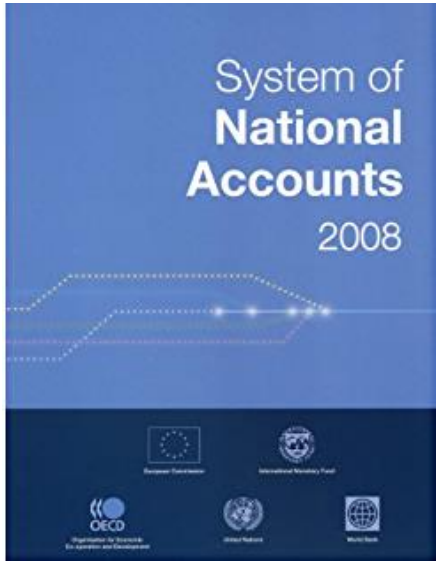
Core Questions

- How does the world measure economic and financial dimensions of climate change and the environment?
  - A *very brief* introduction to environmental economic accounts:
    - What do other countries (or their national statistical offices) measure?
    - What does the U.S. government measure currently?
- What impediments do the U.S. and other countries face when measuring environmental economic activity accounts?
  - Lessons and challenges from the U.S. public and private sectors:
    - Can "Big Data" solve our problems?
    - Or, does it have to start from the **accounting**? How might government and firm accounting change to harmonize classifications and definitions for the world to better measure environmental economic accounts in the 21st century?

National Accounts & Environmental-Economic Accounts

System of Environmental Economic Accounting (SEEA)

(SNA)



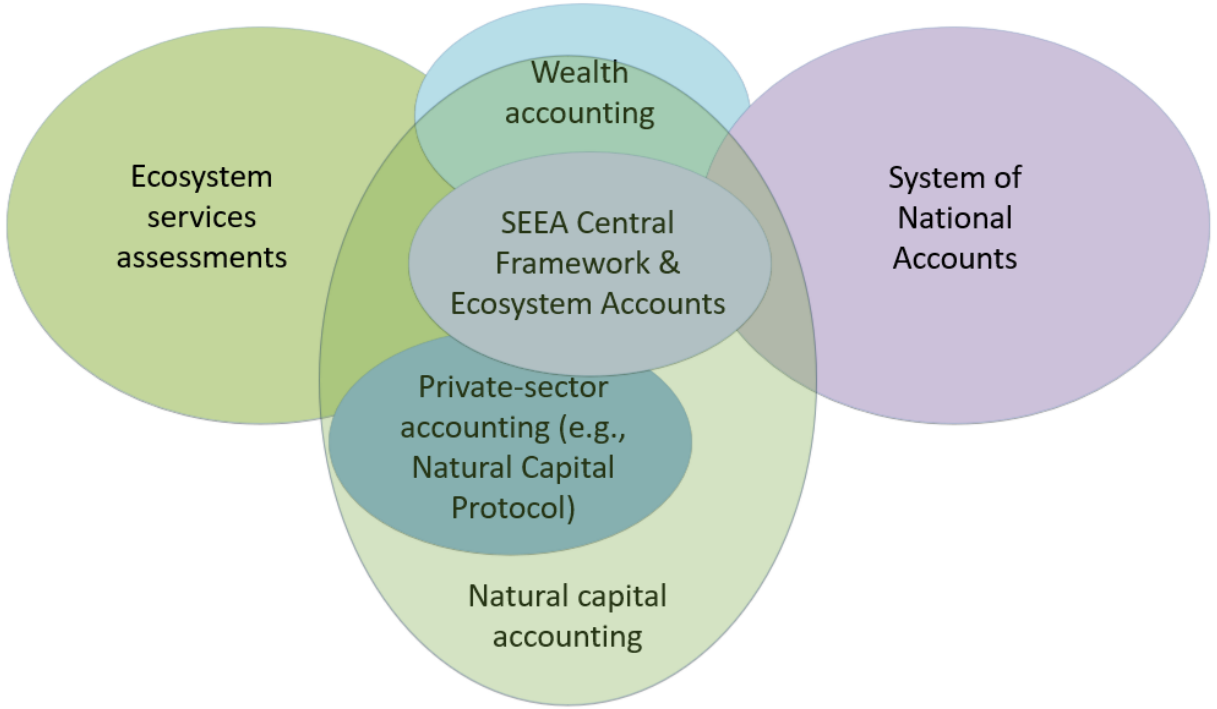


Figure 1 from Bagstad et al. (2021)

System of Environmental-Economic Accounts

- SEEA Central Framework includes:
  - Physical flow accounts (Ch. 3)
  - **Environmental Activity Accounts (Ch. 4)**
    - **e.g. environmental protection expenditures, environmental goods and services sector (EGSS), tax and subsidy accounts**
  - Environmental Asset Accounts (Ch. 5)
    - e.g. mineral and energy, land, soil, timber, aquatic/water resources, etc.
- Information from these accounts is used by policymakers, researchers, and the private sector. They also help countries with international reporting for:
  - According to the UN Statistics Division (UNSD), 90 countries around the world have compiled these accounts
  - Sustainable Development Goals (SDGs), U.N. Framework Convention on Climate Change, and for organizations like the OECD and the IMF tracking climate change indicators and disseminating environmental-economic data

Where is the United States??

IMF | CLIMATE CHANGE DASHBOARD

IMF | CLIMATE CHANGE INDICATORS DASHBOARD

Government Expenditure on Environmental Protection

CID Admin
Private Organization

Summary

Government expenditures on a specified set of activities related to environmental protection.

View Full Details

Dataset
Table

April 7, 2021
Info Updated

April 7, 2021
Data Updated

February 27, 2021
Published Date

1,475 Records
View data table

Public
Anyone can see this content

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?

Showing 1,450 of 1,475 rows

Country	ISO2	ISO3	Indicator	Unit
United Arab Emirates	AE	ARE	Expenditure on waste water ...	Domestic Curre
United Arab Emirates	AE	ARE	Expenditure on waste water ...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on biodiversity & ...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on biodiversity & ...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on environment ...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on environment ...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on environmental...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on environmental...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on environmental...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on environmental...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on pollution abat...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on pollution abat...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on waste manag...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on waste manag...	Percent of GDP
United Kingdom	GB	GBR	Expenditure on waste water ...	Domestic Curre
United Kingdom	GB	GBR	Expenditure on waste water ...	Percent of GDP
Uruguay	UY	URY	Expenditure on environment ...	Domestic Curre
Uruguay	UY	URY	Expenditure on environment ...	Percent of GDP

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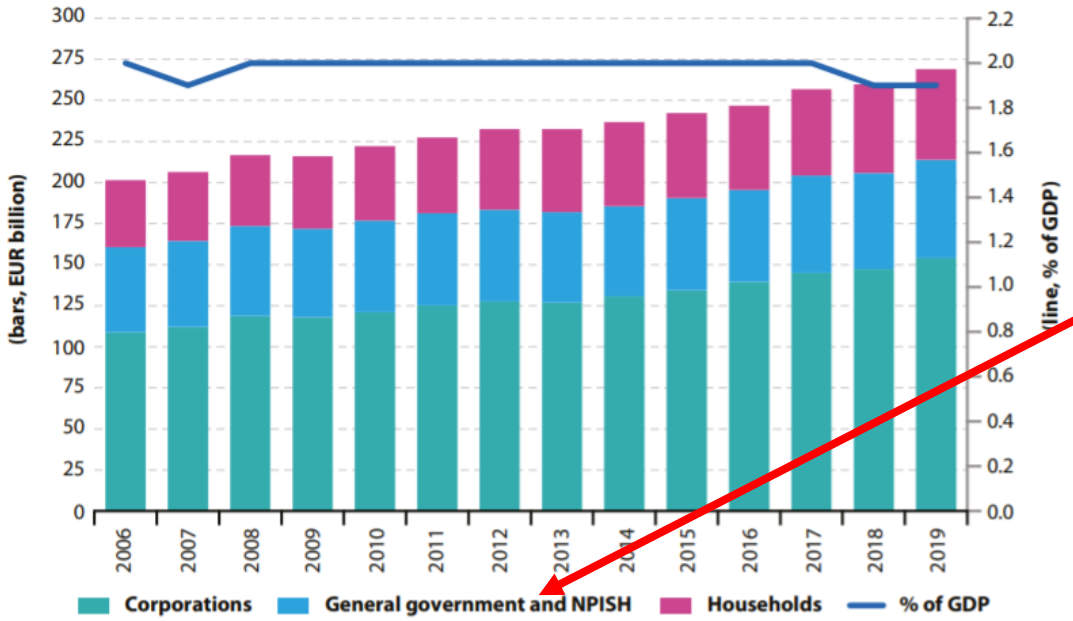
MEASURING CLIMATE CHANGE
THE ECONOMIC AND FINANCIAL DIMENSIONS

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

I. Starting point: Government expenditures

- Identify – by separating out – the environmental expenditures by various economic actors (institutional units)
  - Start with Government (Federal, State, Local)

Figure 3.11.1: National expenditure on environmental protection by institutional sector, EU-27, 2006–2019
(EUR billion and % of GDP)

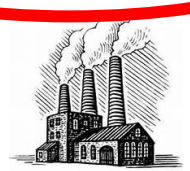


Note: Data are estimated by Eurostat. NPISH: non-profit institutions serving households.

Source: Eurostat (online data codes: env_ac_epneis and nama_10_gdp)

Households

Government (EU example)



Non-financial corporations

source: https://ec.europa.eu/eurostat/documents/3217494/11478276/KS-DK-20-001-EN-N.pdf/06ddaf8d-1745-76b5-838e-013524781340?t=1605526083000 Energy, transport and environment publication, page 137

What does the U.S. do currently?

- The U.S. does not currently produce formal environmental-economic accounts, but…
  - Related satellite accounts produced by BEA
    - Outdoor Recreation Satellite Account
    - Marine Economy Satellite Account
  - Interagency research producing pilot accounts as proof-of-concept work:
    - Land (Wentland et al 2020)
    - Water (Bagstad et al 2020)
    - Ecosystem services (Warnell et al 2020)
    - Urban ecosystems (Heris et al 2021)
  - Environmental activity accounts (this paper)

Outdoor Recreation

Table 1. U.S. Classifications used with respect to government expenditures

Classification of Functions of Government (COFOG)	National Income & Product Accounts (NIPA) used by BEA	Office of Management and Budget (OMB)	Census Bureau	House (Congressional) Budget* and White House Budget Tables**
01 General Public Services	General Public Services	General Government plus International Affairs plus net interest plus allowances	Government Administration Plus interest on general debt Plus general expenditures not elsewhere classified	800 General Government 150 International Affairs 900 Net interest 920 Allowances
02 Defense	National Defense	National Defense	National Defense and international relations	050 National Defense
03 Public order and safety	Public order and safety	Administration of Justice	Public safety	750 Administration of Justice
04 Economic Affairs	Economic Affairs	Agriculture plus Energy plus Natural Resources and Environment plus Transportation plus Commerce and housing credit plus General science, space and technology	Transportation plus Utility expenditure plus Liquor store expenditure	350 Agriculture 270 Energy (partial) 300 Natural Resources and Environment (partial) 400 Transport 370 Commerce and housing credit 250 General Science, Space, and Technology
05 Environmental Protection	(1)	(2)	(3)	270 Energy (partial) 300 Natural Resources & Environment (partial)
06 Housing and Community amenities	Housing and Community services	Community and regional development	Environment and housing	450 Community and regional development
07 Health	Health	Health plus Medicare plus Veterans benefits and services	(4)	550 Health 570 Medicare 700 Veterans benefits and services
08 Recreation, culture and religion	Recreation and culture	(5)	(3)	(6)
09 Education	Education	Education, training, employment, and social services	Education services	500 Education, training, employment, and social services
10 Social protection	Income security	Income security plus social security plus Undistributed offsetting receipts	Social services and income maintenance plus Insurance trust expenditure	600 Income security 650 Social Security 950 Undistributed offsetting receipts

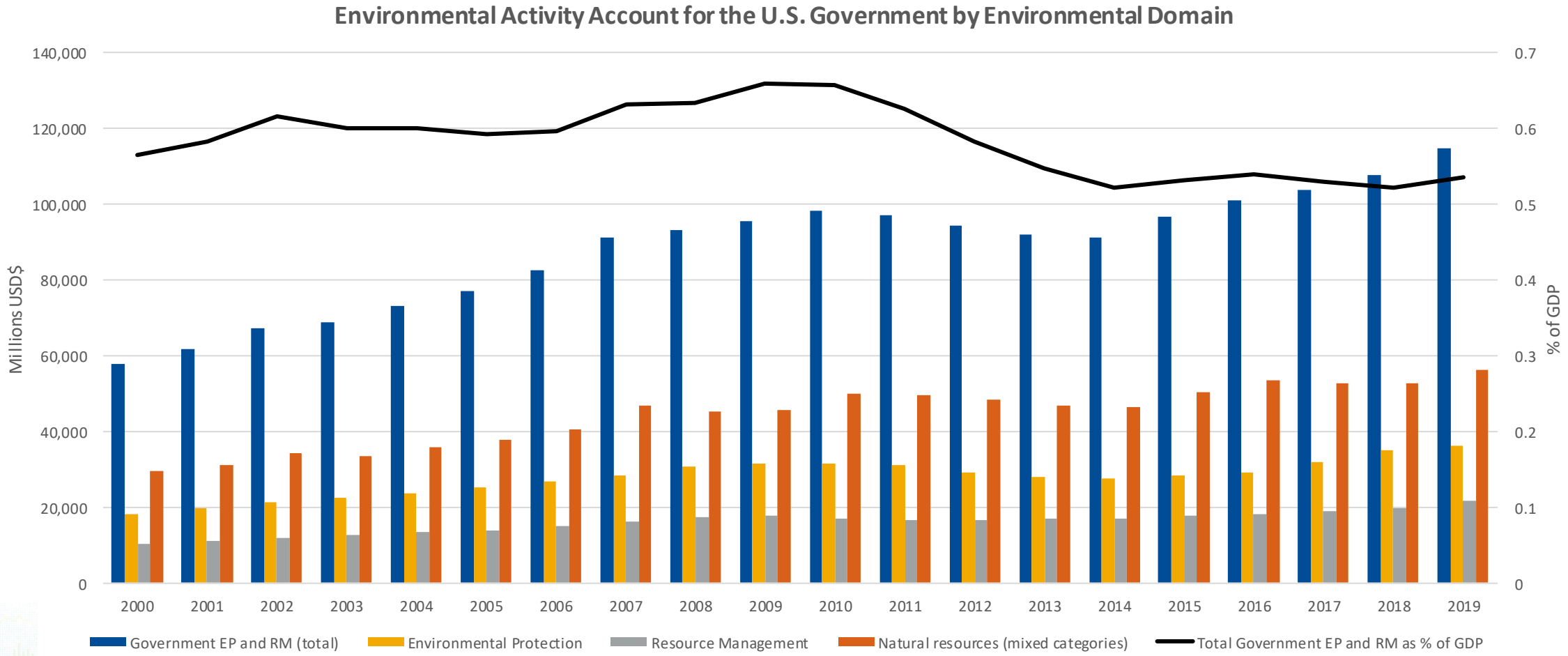
1. Contained largely in the housing and community services and economic affairs function.
2. Contained largely in the natural resources and environment function and community and regional development function.
3. Contained largely in the environment and housing function.
4. Contained largely in the social services and maintenance function.
5. Contained largely in the natural resources and environment function.
6. Recreation is included in 300 Natural resources and environment; Culture is included in 500 Education, training, employment, and social services.

Assembling accounts from existing NIPA data

Table 4 - Environmental Activity Account for the U.S. Government by Environmental Domain – nominal estimates (millions USD$)

	Line*	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Government Environmental Protection (EP) & Resource Management (RM) Expenditure		-	98,471	97,231	94,405	91,874	91,421	96,928	101,217	103,748	107,708	114,630
I. Environmental Protection (EP)		-	31,452	31,082	29,299	28,014	27,565	28,498	29,337	31,885	35,050	36,412
2 Wastewater management	102		20,980	20,602	18,868	17,931	17,931	18,744	19,411	20,089	21,388	22,598
3 Waste management	103		10,472	10,480	10,431	10,083	9,634	9,754	9,926	11,796	13,662	13,814
II. Resource Management (RM)	-		17,167	16,567	16,511	17,039	17,196	17,833	18,379	18,941	19,880	21,753
14 Management of water resources	101		17,167	16,567	16,511	17,039	17,196	17,833	18,379	18,941	19,880	21,753
Natural resources – mixed categories	23		49,852	49,582	48,595	46,821	46,660	50,597	53,501	52,922	52,778	56,465

*Line refer to the corresponding lines in the National Income and Product Accounts (NIPA) Table 3.15.5 - Government Consumption Expenditures and Gross Investment by Function, while the categories underlying Environmental Protection (2 & 3) and Resource Management (14) correspond to CEA categories.

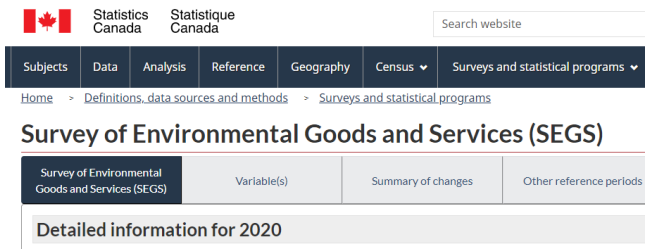

Environmental Activity Account for the U.S. Government by Environmental Domain
Millions USD$
% of GDP
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Government EP and RM (total)
Environmental Protection
Resource Management
Natural resources (mixed categories)
Total Government EP and RM as % of GDP

Lessons and Takeaways from Govt. Accounts

- Govt. environmental protection expenditures and resource management data
  - What can we do? → Begin with coarse estimates from the NIPA tables
    - Some functions encompass too much (e.g., energy) and need to be pared down
    - Some functions are missing or lumped in elsewhere (i.e., other environmental protection expenditures, mitigation, and adaptation expenditures).
    - In both cases above, finer detailed data is required for better estimates
  - What should we do? → Align classifications and definitions in government accounting with SEEA and use supplemental surveys to fill gaps
    - Adopting a consistent system across the US government (USG) more aligned with COFOG and SEEA
    - Obtaining finer detailed data in the collection process (e.g., census of state and local governments reporting categories) or in government budgeting
  - What did we learn? → Accounting definitions and classifications matter.
    - e.g. Water, Sewerage, and Sanitation are a massive part of the U.S. resource management expenditures → How much of these coarse categories are "primarily environmental"? Climate?

II. Private Sector Environmental Activities: Data?

- United States
  - EPA & Census Bureau used to conduct annual surveys of enterprises collecting data on pollution abatement and control expenditures (PACE) from 1973-1994, 1999 and 2005
    - No longer collected
  - BEA Annual Survey of US Direct Investment Abroad
    - Do not ask about environmental activity specifically
  - Census surveys (e.g., Economic Census, Annual Business Survey, etc.) collect sector-specific data, including some data useful for environmental activity accounts
    - Not designed with SEEA in mind - more on this later
- Other countries have extensive surveys and data collection efforts
  - Canada: Annual Survey of Environmental Goods and Services
  - E.U.: Environmental Goods and Services Sector Questionnaire



- In the 21st century, national statistical offices are increasingly figuring out ways to be less reliant on long, costly surveys
  - Big Data, proprietary data, administrative data, "blended data"

Data – What do firms disclose publicly?

- 21st century corporate trend toward reporting on sustainability (Environmental, Social, and Governance (ESG) reports and disclosures based on KPMG report)
  - 96% of the largest companies (Top 250 by market cap)
  - 80% of large and mid-cap companies (5,200 companies, top 100 in 52 countries)

- ESG ratings/scores are increasingly commonplace
  - MSCI, Sustainalytics, Bloomberg, Thomson Reuters Refinitiv, and RobecoSAM
    - Refinitiv has distilled public information from these disclosures and reports into a single database that includes both ratings and underlying data

ESG reports and related sustainability/climate disclosures

Exceeded 2020 reduction goals; progressing further greenhouse gas reductions

By the end of 2020, ExxonMobil delivered on its goal to significantly reduce methane emissions and flaring versus 2016 levels. The Company's goals included a 15 percent reduction in methane and a 25 percent reduction in flaring. Both goals were achieved through targeted improvements at facilities in the United States, Equatorial Guinea, Angola and Nigeria, eliminating approximately 6 million tonnes of CO_2 equivalent emissions (CO_2e).

Since 2000, ExxonMobil has invested over $10 billion in projects to research, develop and deploy lower-emission energy solutions. ExxonMobil also continues to expand collaborative efforts with other companies and academic institutions. See pages 22 to 29 for more information on these collaborations.

MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

ENVIRONMENTAL MATTERS

Environmental Expenditures

	2020	2019
	(millions of dollars)	
Capital expenditures	1,087	1,276
Other expenditures	3,389	3,969
Total	4,476	5,245

Throughout ExxonMobil's businesses, new and ongoing measures are taken to prevent and minimize the impact of our operations on air, water and ground. These include a significant investment in refining infrastructure and technology to manufacture clean fuels, as well as projects to monitor and reduce nitrogen oxide, sulfur oxide and greenhouse gas emissions, and expenditures for asset retirement obligations. Using definitions and guidelines established by the American Petroleum Institute, ExxonMobil's 2020 worldwide environmental expenditures for all such preventative and remediation steps, including ExxonMobil's share of equity company expenditures, were $4.5 billion, of which $3.4 billion were expensed in expenses with the remainder in capital expenditures. The total cost for such activities is expected to increase to approximately $4.9 billion in 2021 and 2022. Capital expenditures are expected to account for approximately 25 percent of the total.

Environmental Liabilities

Annual Reports (10K) Example: ExxonMobil

Examples of Environmental R&D and environmental investment disclosures

lower-carbon capital allocation

$2B	$750M	$300M
by 2028 in carbon-reduction projects	by 2028 in investments in renewables and offsets	committed to the Future Energy Fund II
page 41	pages 44–46	page 47

carbon footprinting
page 42

- Standardized reporting enabling buyer choice
- Reliable, verifiable information driving returns
- Life-cycle carbon-footprinted products mobilizing action

policy
page 49

innovation support	carbon pricing	targeted policies

metrics
page 52

upstream production net greenhouse gas emissions intensity reduction metrics for 2028:

24 kg CO_2e/boe for oil (global industry averages 46)	40% reduction from 2016
24 kg CO_2e/boe for gas (global industry averages 71)	26% reduction from 2016
2 kg CO_2e/boe for methane and a global methane detection campaign	53% reduction from 2016
0 routine flaring by 2030 and 3 kg CO_2e/boe for overall flaring	66% reduction from 2016

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Lessons and Takeaways for Private Sector Accounts

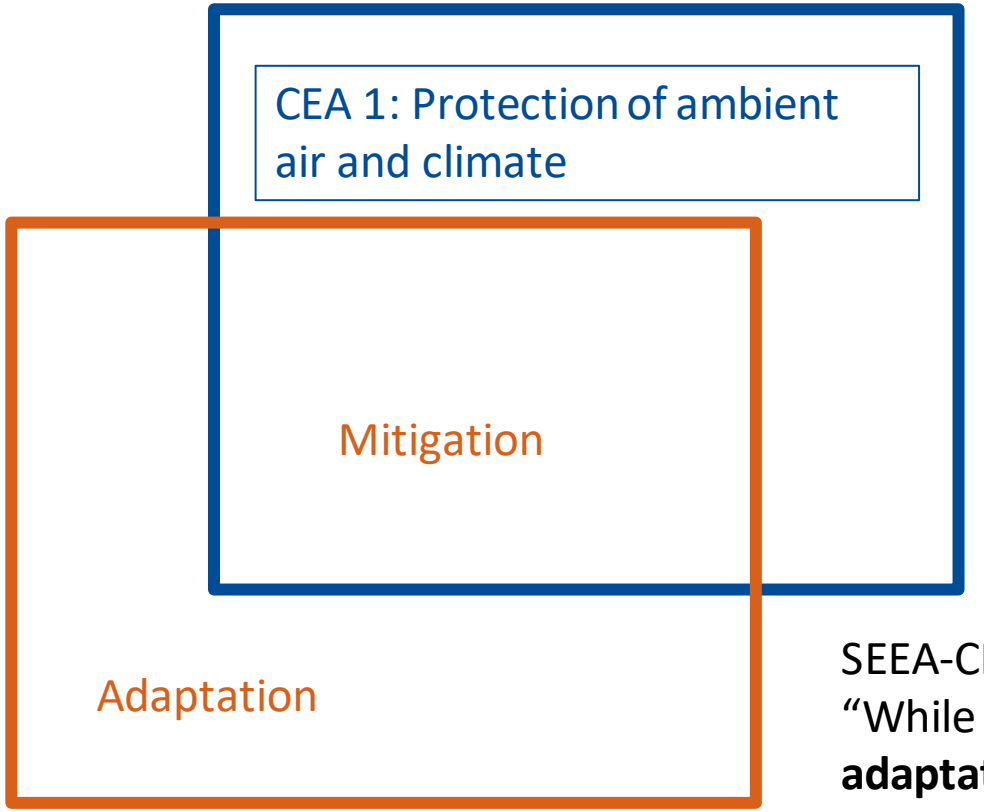
- EGSS, private firm expenditure data, and ESG reporting
  - What can we do? → Coarse estimates from industry data (for EGSS) and proprietary data from public firm disclosures
    - The North American Industry Classifications (NAICS), even at the 6 digit level, are sometimes too coarse or some classifications lump in non-environmental activities
      - In progress: what does a U.S. EGSS account look like if we use the EU's corresponding NACE codes and percentages?
    - Private firm data issues – **Big Data alone cannot save us here!** (yet)
      - Multinational firms do not disaggregate their ESG reporting by country and often not even by year.
      - Accounting definitions and classifications are not harmonized with SEEA. What does a firm consider environmental R&D, for example?

Lessons and Takeaways for Private Sector Accounts

- EGSS, private firm expenditure data, and ESG reporting
  - What should we do?
    - We argue that better alignment of definitions and classifications in private sector accounting with SEEA would provide more informative public disclosures for national accounts
      - The U.S. Securities and Exchange Commission (SEC) has called for public comment on climate change disclosures and an evaluation of how the SEC can best "regulate, monitor, review, and guide climate change disclosures in order to provide more consistent, comparable, and reliable information" → **Why not consider national statistical offices as a key stakeholder? If the selection of a standard to rally around is arbitrary, why not something more consistent with SEEA?**
    - Embrace the trend that survey response costs are a real issue → if we can, use surveys and/or admin data to complement public data (e.g., ESG disclosures) and fill in the gaps
      - Traditional approach of national statistical offices: large costly surveys to firms and individuals
      - 21st century approach: use surveys more sparingly and employ Big Data, administrative data, and other data sources when possible

III. Towards defining climate change expenditures

Environmental protection and Resource management expenditures



Climate change related expenditures

SEEA-CF §4.23
"While **economic activity associated with adaptation to climate change is not considered an environmental activity per se**, it is recognized that information on this activity may be of particular interest."

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Lessons and Takeaways for Climate Statistics

- Environmental economic accounts are not exactly synonymous with climate change statistics
  - In the paper, we identify where this is overlap and where there is not by exploring relationships between expenditures related to 1) EPE/RM, 2) climate change, and 3) disaster/hazard risk.
- Helpful to consider all three inter-related types of expenditures
  - climate change, disaster/hazard risk, environmental protection/resource management – at the same time rather than separately.
  - Need to avoid double counting when developing new statistics.
- Challenges with determining the selection criteria
  - 'Primary purpose' used for EPE/RM appears too restrictive to apply for climate change and disaster expenditures. Policy intension does not cover all CC-related expenditures.
  - One overarching practical challenge is how to determine if a given environmental expenditure, whose "primary purpose" is already environmental, is also climate-specific
    - What precisely do we mean by climate-specific?

Thank You!

Additional questions/comments?

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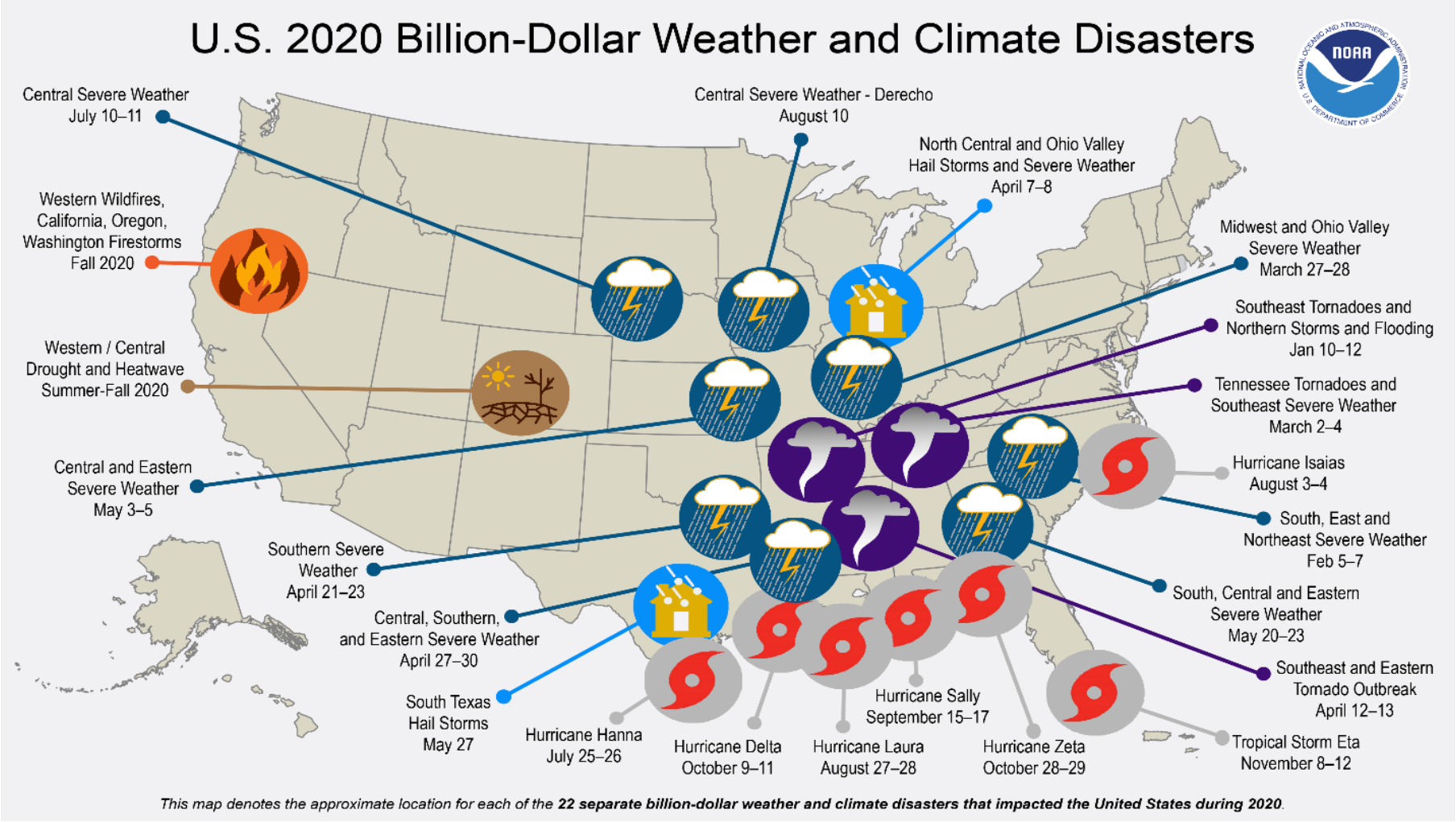
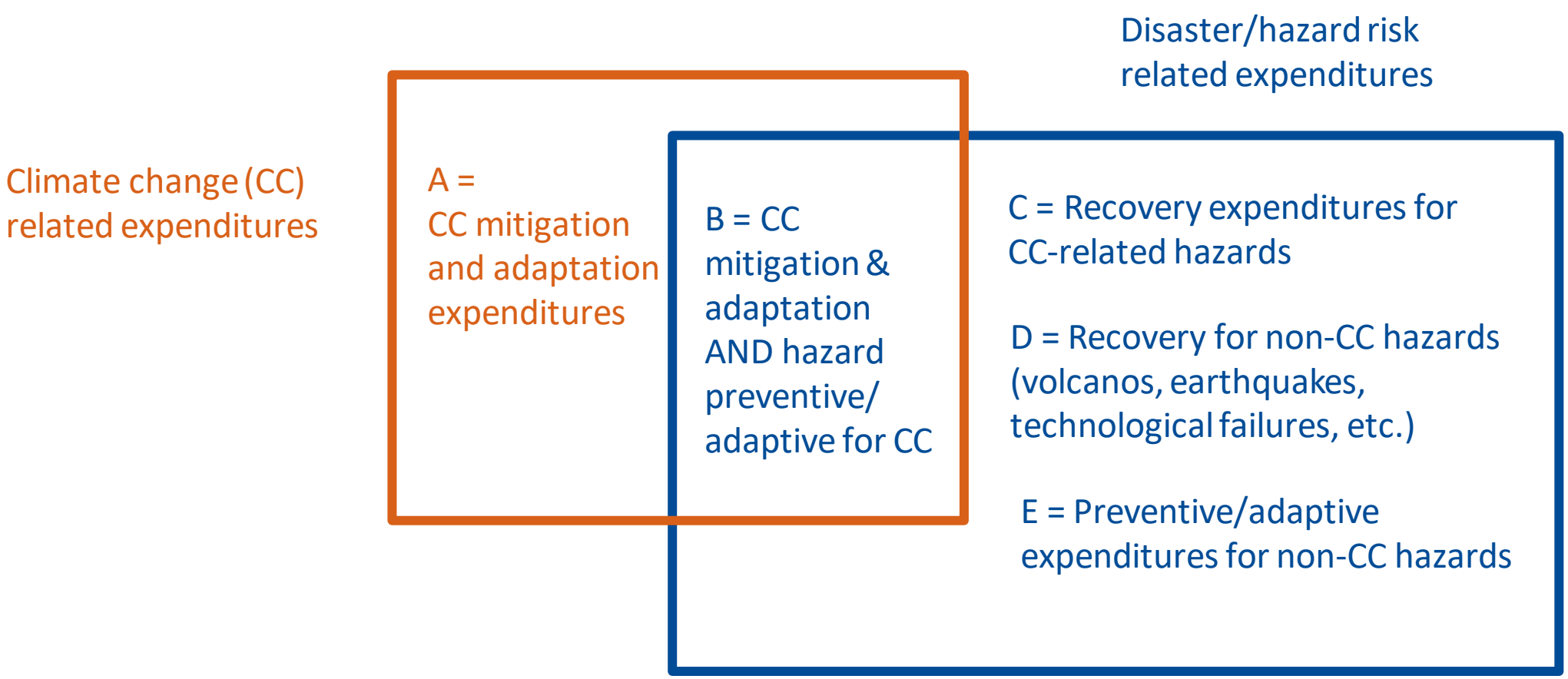
Annex Slides

Should disaster recovery expenditures be thought of as part of "climate change expenditures"?



Source: https://www.noaa.gov/stories/record-number-of-billion-dollar-disasters-struck-us-in-2020 see also: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021). https://www.ncdc.noaa.gov/billions/, DOI: 10.25921/stkw-7w73

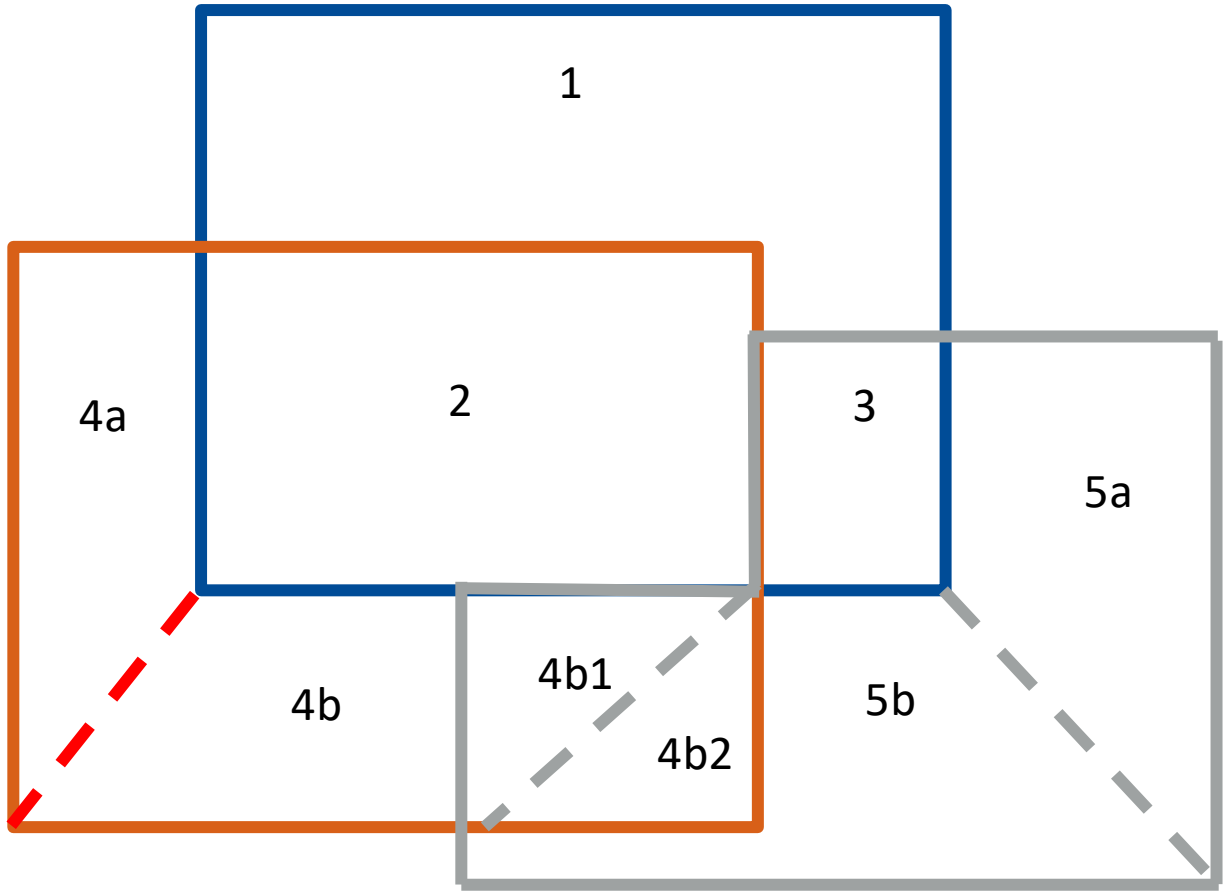
Climate change and disaster/hazard risk related expenditures - relationship



EP&RM + Climate change + Disaster/hazard

Environmental protection and Resource management expenditures

Climate change related expenditures



Disaster/hazard risk related expenditures

Area	Description
1	EPE-RM but not climate mitigation or disaster/hazard related
2	EPE-RM which are also CC mitigation but not disaster/hazard related
3	EPE-RM which are also disaster/hazard recovery and adaptive/preventive related
4a	CC Adaptations to the natural environment that are not EPE-RM expenditures (do not have environmental protection or resource management as 'primary purpose')
4b	CC Adaptation of human systems that are not EPE-RM or disaster/hazard related
4b1	CC Adaptation of human systems that are also disaster/hazard recovery related
4b2	CC Adaptation of human systems that are also disaster/hazard adaptive/preventive related
5a	Disaster/hazard adaptive/preventive related that are not related to climate or EPE-RM (primary purpose)
5b	Disaster/hazard recovery related that are not related to climate or EPE-RM (primary purpose)