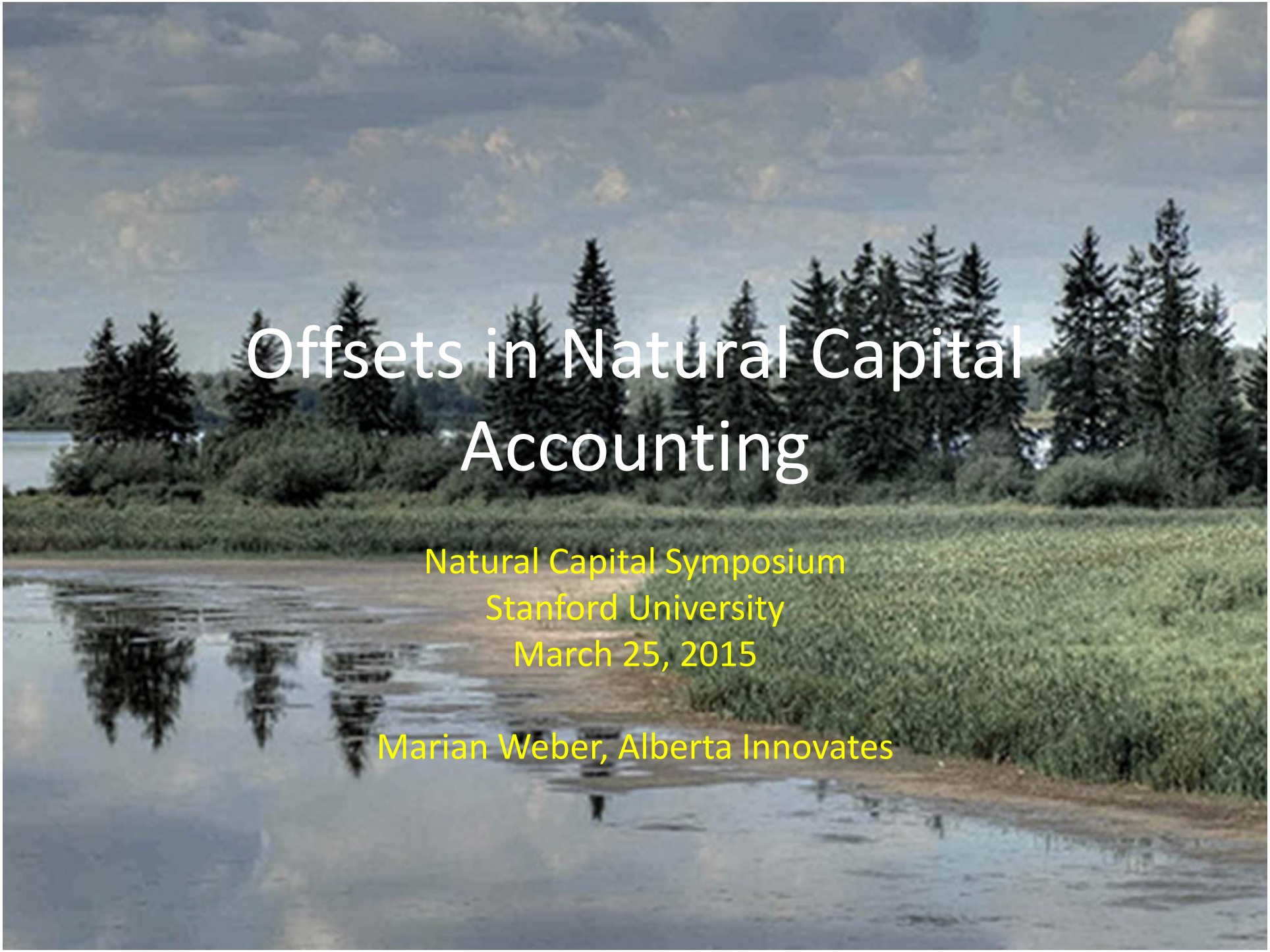

Offsets in Natural Capital Accounting

Natural Capital Symposium
Stanford University
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Marian Weber, Alberta Innovates

Question

- Can offset investments be linked to the productivity and value of the natural capital stock over time through national accounts
- How can natural capital accounts be linked back to offset markets to properly price future scarcities

Natural Capital Accounting

- **Natural capital accounting**
  - Calculates the total stocks and flows of natural capital
  - Physical or monetary
- **Ecosystem Service Assessment**
  - Measures the flows of services from natural capital and changes in stock
  - Measures values of the flows (NMV)
- **Offsets**
  - Investment in Natural Capital Stock
  - Price of offsets = cost of future services

Decision Making Contexts

MACRO

Natural Capital Accounts

- What is the wealth
- How much is enough (human and natural capital)
- Sustainability
- Instruments
  - Grading Bonds
  - National Growth Strategies
  - Fiscal Policy (interest rates;

MESO

ES Assessment

- Tradeoff Analysis (how much is enough)
  - Structure; composition; Processes; Functions;LocationExtent
- Instruments
  - Thresholds and Caps
  - Resource Allocation and Prioritization

MICRO

Offsets

- What is the contribution of a site to ES
- Equivalence = replacement Value
- Cost of supply
  - Structure;
  - Composition;
  - Processes
  - Functions;
  - Location;
  - Extent

Directions in Natural Capital Accounting

- **System of environmental-economic accounting (1993)**
  - Adjusted GDP (account for asset depletion)
  - SEEA Experimental Ecosystem Accounts
    - Introduce framework for ecosystems and ecosystem services
    - Non-market goods and services
- **Wealth Accounting and Value of Ecosystem Services (WAVES)**
  - Include natural capital measurements in national accounts
- **Inclusive Wealth Index (IWI)**
  - measures the productivity of an economy based on the shadow value of an economy's natural capital assets based on trajectory of future wealth

Challenges

- Measures such as IWI require accounting for the quality and quantity of ecosystem stocks and flows at sub-national scales
- measurement and accounting protocols are not well established
- information gaps including lack of site level ecological and economic data (Tallis et al. 2012; Statistics Canada 2013).
- Offset equivalence is determined by science based metrics which reflect substitutability of ecosystem components at a particular point in time
- Often not based on future scarcity
- What is the impact of offset investments at broader scales and collectively do they contribute to sustainability.

Natural Capital and Offsets

- National Accounts: GDP = C+I+G+X-M
- Adjusted Accounts (watershed boundary) = ES+I+X-M

– Wealth Accounting and Valuation of Ecosystem Services (WAVES)
System of Environmental-Economic Accounting (SEEA).
  - Develop internationally agreed guidelines for ecosystem accounting.
  - 2011 Eurostat directive to compile environmental accounts
  - Experimental - Consider how to expand accounts for the environmental goods and services sector.

Natural Capital Accounts

- Adjusted GDP
- Correct GDP by taking into account environmental degradation and natural resource depletion that affect future consumption and sustainability
- Adjusted net savings – change in total wealth over a time period

- : **Measuring the value of ecosystem services and providing an efficient level of provision of these services requires tackling three main tasks: Provision of ecosystem services; (“ecological production functions”); · Value of ecosystem services (“valuation”); Designing policies for efficient provision of ecosystem services (“incentives”).**

Working Landscapes

- Manage for both commodities and ecosystems (Ecosystem Services)
- Continual states of development, restoration, protection
- Investments and withdrawals
- Offsets, PES

- Inclusive Wealth Accounting for Regulating Ecosystem Services: An exploratory case study for Colombia, Heather Tallis, Stephen Polasky, Juan Sebastian Lozano, Stacie Wolny.
- 4 regulating services: climate regulation (carbon); nitrogen retention for drinking water quality; erosion regulation for drinking water quality; erosion regulation for reservoir maintenance. Success and challenges: Were able to Unbundle regulating services, account for each independently; Calculate supply and service at national scale, including sub-national spatial connections; Delineate servicesheds. Limitations: LULC data not regularly updated; Cost data difficult to access; Data on extraction points difficult to access (groundwater vs. surface, treatment plant outakes, etc.); ways to include more services.
-

Valuation in NKA

- National accounts based on market prices not consumer surplus
- Not a measure of welfare
- Cost of inputs
- Degradation; depreciaton – investment vs savings, consumption, transfers, why do we do this; two accounts capital, current

Supply

- Watershed is the firm
  - Exports and imports
  - Industry codes
- Cost of inputs
- Cost of offsets
  - Functional
  - Local
  - Watershed is the “firm”

Demand

- Value of outputs
- Aggregation

- REVISION OF THE SYSTEM OF ENVIRONMENTAL – ECONOMIC ACCOUNTING (SEEA), SEEA Experimental Ecosystem Accounting
- measurement of ecosystems, and measurement of the flows of services from ecosystems into economic and other human activity. The use of an accounting framework enables measures of ecosystems and measures of flows from ecosystems to be seen in relation to each other and also in relation to a range of other environmental, economic and social information it also incorporates accounting for the many unpriced services from ecosystems used in other human activity such as the purification of water, the filtration of air, and the amenity and cultural benefits of landscapes. The extended focus allows ecosystem accounting to organise information relevant to the assessment of trade-offs between different uses of ecosystems. First, ecosystem accounting involves accounting in physical terms, i.e. accounting for the stocks and flows related to ecosystems in terms of their quantity and quality. While ecosystem accounting may be undertaken in monetary terms this is not required. Second, ecosystem accounting involves accounting for relatively detailed, sub-national, spatial areas that can be aggregated to a national territory. There is sufficient evidence to support the development of an
- experimental accounting framework and there is growing evidence of the possibility of implementing ecosystem accounting at a national level. SEEA Experimental Ecosystem Accounting provides a synthesis of measurement concepts from a number of disciplines while aiming to retain flexibility for ongoing research.

- . Organising information on the environment from a spatial perspective describing, in a coherent manner, linkages between ecosystems and economic and other human activity. In order to meet the various accounting objectives, there are some specific considerations that are the focus of the SEEA Experimental Ecosystem Accounting. These are: (i) The objects of measurement – the ecosystems – need to be defined from a statistical perspective; (ii) Measurement units for the assessment of ecosystem assets need to be described; (iii) The definition of, and relationships between, ecosystem assets and ecosystem service flows with consideration of appropriate measurement scope and coverage; (iv) The structure of relevant accounts needs to be outlined including links to the accounts described in the SEEA Central Framework; and (v) The use of valuation techniques needs to be explained. In

National Accounts

Expenditure

- C+I+G+X-E
- Value of Inputs

Income

- Value of Outputs

Value Added: Income – Expenditures
Don't double count- final outputs vs intermediate inputs]
Intermediate inputs – distributionally important
Direct and indirect effects

Market Failures

Market Good Externalities

- Depreciation of timber stocks by non-sustainable harvest
- Market values not captured

Non-Market Good Externalities

- Non-market values not captured
- Input/production function functions not understood

Accounts

Retrospective

- Productivity increasing or decreasing
- Investment
- Depreciation
- Savings and borrowing
  - Capital markets
- Futures Markets
  - St

Future Sustainability

- NPV of resource streams from natural capital
- Lag times
- Production functions
- Cost of production
- Current vs future costs of assets
- Excess demand and equilibrating mechanism
  - Scarcity value goes up
  - Need relative prices

Scaling

Valuation

- Accounting standards for aggregating values
- Can we learn something from BT?
- Cost side vs Benefit side

Scalability

- How much is enough?
  - National vs local (G make this tradeoff all the time with fiscal policies and with other redistribution policies)
  - Sustainability at what scale?
  - Substitution of natural capital assets vs human capital assets
    - Irreversibility
    - replaceability
    - Why should human and natural K be treated differently if they are valued properly
- Shadow Costing vs Reporting
- Retrospective vs

challenges

- Missing data
- Excess capacity

- Offsets – compensating management actions which improve Quality and Quantity of ES
- Scale – watershed and smaller
- Attributes: metrics (quality, quantity); prices; activities, length of time
- Examples:
- Fish populations (DFO Fisheries Act s 35)
- Species at risk
- Outcomes – Alberta Environmental Management Frameworks
  - Biodiversity; water quality (P); relative wetland values

Issues for Discussion

- ES assessment is regional, local and contextual
  - What advances can be made to ES assessment to quantify the quality of natural capital measured at broad regional and national scales
  - What are challenges to measuring the relationship between stocks and flows of ES
  - Challenges in Valuation
  - Challenges in linking ES assessment to investments such as offsets to ES
- Identification of Case Studies

Linkages to Flows of ES

- Challenges in linking natural capital stocks to flows of ES exist both in terms of physical measurement and economic valuation. Physical challenges include linking ecosystem functions to services; aggregation and scalability; substitutability of components of the natural capital stock over time and space; and substitutability between human and natural capital. There are numerous international efforts to extend national accounting approaches to account for changes in ES. For example the Inclusive Wealth Index (Tallis et al. 2012) which includes natural, manufactured, human and social forms of capital, as well as the System of Environmental – Economic Accounting (UN 2012) which is based on measures of ES flows and benefits. These measures require accounting for the quality and quantity of ecosystem stocks and flows at sub-national scales, however measurement and accounting protocols are not well established and there are a number of information gaps including lack of site level ecological and economic data (Tallis et al. 2012; Statistics Canada 2013).

Linkages to Offsets

- Offsets are investments in natural capital designed to mitigate the impacts of withdrawals on the production of ES over time; they provide disaggregated information about the ecological value and costs of sites for ES. Similar to the aggregate accounting systems described above, substitutability, equivalence, and scale are key challenges addressed in the design of offset programs which are usually implemented at subregional or sub-watershed scales. Offset equivalence is determined by science based metrics which reflect substitutability of ecosystem components across spatial and temporal dimensions. However most offset registry and accounting systems are designed to track withdrawals and investments in natural capital at a local or site scale, and usually only at a particular point in time. Thus there is a gap in terms of understanding the impact of offset investments at broader scales and whether collectively they contribute to sustainability (Weber 2014).
- There are also valuation challenges. Fenichel and Abbott (2014) develop a framework for valuing natural capital based on accounting prices that reflect shadow prices for current

Valuation Challenges

- Fenichel and Abbott (2014) develop a framework for valuing natural capital based on accounting prices that reflect shadow prices for current management conditions and non-optimizing institutions. They demonstrate how accounting prices can be recovered through numerical methods for the Gulf of Mexico. Offset prices reveal information about shadow costs and the net present values of natural capital under different institutional constraints at sub-regional scales. Research on markets for offsets and environmental liabilities suggest that futures markets can also inform the pricing of natural capital values and risks over time and improve forecasts of discounted present values (Weber et al. 2014; Smith 2014). Thus there may be opportunities for offset prices to provide a direct link to accounting prices. Numerous efforts have been applied to assess the value of ES which could be linked to natural capital prices however the efforts tend to focus on final demand for ES and not the costs of ecological inputs which reflect tradeoffs between conservation and development. Similar to the need to reconcile both income and expenditure accounts in systems of national accounts both demand and supply analysis are necessary for understanding tradeoffs and reconciling values in natural capital accounts. Again, offset prices may provide opportunities to address these information gaps.

Linkages between accounting and assessment systems for natural capital, ecosystems services, and offsets

- Challenges linking ES to Natural Capital Accounts
- Challenges linking offsets to ES
- Challenges linking offset prices to natural capital asset prices
- Opportunities for case studies

Ecosystem Accounting

- Assess the environment through measurement of unpriced services from ecosystems
  - Water purification; cultural benefits; etc.
- Measures flow of services
- Values stock of capital

ES Assessment Methods

- Considerations in offset design
  - Structure;
  - Composition;
  - Processes
  - Functions;
  - Location;
  - Extent

Futures Markets and Offsets

- Fenichel and Abbott (2014)
  - Capital asset pricing theory – the value of natural capital = f(value of flows) + change in scarcity value (future prices))/(depreciation – change in productivity)
  - Solve at a non-optimum – this means for any set of environmental constraints – e.g. a particular policy such as no net loss
  - Can we use offset markets to determine some change in scarcity values
    - Cost of an offset = opportunity cost of future values
    - Bank that rents future credits …
    - Temporary offsets – restoration of different types of capital/functions at time t+1 can value the opportunity cost given the program; the changing scarcity value of capital types given environmental constraints

- **System of environmental-economic accounting**
- In September 1992, the Commission on the Environment of the Organization of American States (OAS) Permanent Council held a Seminar on Natural Resource and Environmental Accounts for Development Policy.[6] Many of the country participants expressed interest in developing accounting capacities for natural resources.[6] A proposal was made at that time to create a program to coordinate and strengthen the efforts of countries and institutions undertaking such initiatives.[6]
- The development of the first system of environmental-economic accounting (SEEA) in 1993 (SEEA-1993) was a major step towards establishing standards around integrating the environment into national accounts, and subsequently, environmentally-adjusting or "greening" macroeconomic indicators such as GDP.[7] While the SEEA-2003 and subsequent revisions being undertaken for 2013 have expanded the range of analyses within the framework, the purpose of the SEEA has remained the same. It is an accounting framework that records the stocks and flows that are relevant to both the environment and the economy.[8] Its Central Framework comprises three main accounts that can be integrated with the existing United Nations System of National Accounts (SNA), and each focuses on a different aspect of the interaction between the economy and the environment: physical flow accounts; functional accounts for environmental transactions; and asset accounts in physical and monetary terms.[9]
- The latest version of the SEEA (Q3, 2012) has two other parts, aside from the Central Framework: SEEA Experimental Ecosystem Accounts and SEEA Extensions.[10] The Experimental Ecosystem Accounts, specifically, introduces an accounting framework for ecosystems, despite the fact that many of its relevant stocks and flows are centered on non-market assets.[10] While some of the measurement concepts involved in the accounting process are still evolving, it is possible that the eventual valuation of ecosystems and their depletion could be included in the calculations of environmentally-adjusted macroeconomic indicators. This has implications for future policy, since the emphasis on certain projects or activities undertaken by governments will likely change, depending on how the above-mentioned measurements impact their respective accounts, and subsequent environmental adjustments to certain indicators.
- The London Group on Environmental Accounting and the UN Committee of Experts on Environmental-Economic Accounting are two groups, created in 1994 and 2005 respectively, to assist in the development of the SEEA and its implementation.[11] As well, the Working Group on Environmental Auditing, a subgroup of the International Organization of Supreme Audit Institutions, is working to improve auditing standards related to environmental issues.

- **Wealth Accounting and Ecosystem Partnership Services[edit]**
- The ability of developing countries to build their natural capital account capacities is being improved significantly through the Wealth Accounting and Ecosystem Partnership Services (WAVES), by encouraging the development of relevant measurement frameworks. WAVES is global partnership that was inaugurated in October 2010 by World Bank President Robert Zoellick at the Convention on Biological Diversity COP-10 meeting in Japan.[12] It aims to promote sustainable development by encouraging the inclusion of natural capital measurements in national accounts. Several projects have been initiated in developing countries such as Botswana, Colombia and Madagascar with a view to improving their capacity to implement the SEEA, in collaboration with UNEP, the UNDP, the United Nations Statistical Commission, and the financial support of NGOs and the governments of Australia, Canada, France, Japan, Norway and the United States.[12]
- **Ecological footprint accounts[edit]**
- Alternately, there have been many attempts to move away from integrated accounts, and towards novel sustainability indices or statistics. Ecological footprint accounts, developed by Monfreda et al. (2004) and since 2007, the Global Footprint Network, or the proposal for nine planetary boundaries within which humans can safely operate, by Rockström et al., are projects which advocate for new approaches to global sustainability.[5][13]
- **Inclusive Wealth Index[edit]**
- The UN International Human Dimensions Programme has created an inclusive sustainability indicator, the Inclusive Wealth Index (IWI), which measures the productive bases of an economy: produced, natural and human capital, and based on these three assessments, calculates the trajectory of a country's wealth.[14] The calculation of natural capital in the IWI is based on the shadow value of an economy's natural capital assets.
- A similar conceptual direction was taken by the Commission on the Measurement of Economic Performance and Social Progress, under the direction of economists Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi, at the behest of former French President Nicholas Sarkozy, in 2008. The authors concluded that a pragmatic measure of sustainability would combine an indicator based on the extended wealth approach, and a small dashboard of physical indicators.[2]
- While they have different theoretical underpinnings, what these approaches have in common with each other is a fundamental recognition of the limitations of traditional indicators in measuring economic performance and social progress, and the importance of sustainability in the long-run.