

Survey

The accounting push and the policy pull: balancing environment and economic decisions



Michael Vardon ^{a,b,*}, Peter Burnett ^c, Stephen Dovers ^a

^a Fenner School of Environment and Society, Australian National University, Canberra, Australia

^b World Bank, WAVES Programme, Washington DC, USA

^c College of Law, Australian National University, Canberra, Australia

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ABSTRACT

The use of information in environmental and economic policy has been a theme for over 100 years but standards for integrating environmental and economic information were not adopted until 2012, through the System of Environmental-Economic Accounting (SEEA). For 20 years the technical ‘push’ to develop accounts proceeded largely independently of the ‘pull’ from the intended or likely end-users of accounts. Consequently governments have little knowledge of the accounting or how it might be used. We examine why public policy imperatives have not yet pulled environmental accounting into the mainstream and explain how accounting can help reshape government decision-making. As part of this a model showing the place of accounts in the information system and the policy cycle is presented along with a research agenda and principles for the decision-centred design of accounts. We conclude that a phased implementation of the accounts as well as additional research into their applications will be needed to build practical understanding and political acceptance of the accounts.

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1. Introduction

Environmental policy is subject to large swings in both the amount of resources allocated and the focus of expenditures. With some exceptions, is not known if the current expenditures are enough to maintain a healthy environment or human wellbeing, nor, despite monitoring and audits, if the money expended has been well directed and efficiently used. Environmental accounting provides integrated information on the environment and the economy that can address these questions.

Agreement to establish integrated environmental and economic accounting was part of *Agenda 21*, the programme of action agreed at the Earth Summit (Rio de Janeiro in 1992¹). Consequently the United Nations led a technical programme of development, culminating in the System of Environmental-Economic Accounts (SEEA) being adopted as an international statistical standard in 2012 (UN et al., 2014a). The importance of environmental accounting continues to be recognised in, for example, Aichi Biodiversity Target 2 (CBD, 2010) and the proposed indicator 55 for the recently established Sustainable Development Goals (SDSN, 2015).

While the potential of environmental accounting has been acknowledged for some time (e.g. Hamilton et al., 1993), its actual use in policy has been little explored. That is, accountants from national statistical offices have done the technical work but policy advisers and decision-makers are mostly unaware of advances in environmental accounting. Little has been done to identify how account-derived information can

be presented to and used by decision-makers. It appears that, during the two decades it has taken to get internationally agreed environmental accounting standards, the benefits of having it have largely been forgotten by those who commissioned the work. In short, the “accounting push” has not been matched by a “policy pull”.

It is not specifically acknowledged, although possibly understood intuitively by policy-makers who have considered the question, that environmental accounting could be hard to promote to governments. This is because of its technical nature and the many policy and political implications of its use. These implications mean that implementation is unlikely to be left solely in the hands of technical experts.

This paper surveys the development of environmental policy and accounting and outlines how the divergent technical and policy paths followed since 1992 can be re-joined to improve government decision-making processes. As part of this, we introduce a model of the information and policy system showing the place of accounts as well as a research agenda.

The research agenda is intended for a broad audience and is based on identifying specific opportunities for clearly defined uses and users of accounts. It will require a collaborative and iterative approach to implementation, involving both researchers and policy advisers to renew the “policy pull” needed for the continued development, implementation and use of environmental accounting. Implicit in the agenda is the assumption that better information will enable better decision-making, although it is acknowledged that a rationalist approach such as this provides only a necessary, rather than a sufficient, basis for good policy. For an exposition of the political, participatory and other factors that also contribute to good environmental policy, please see Dovers and Hussey (2013.)

* Corresponding author.

E-mail address: michael.vardon@anu.edu.au (M. Vardon).

¹ See Agenda 21, UN (1992), paragraphs 8.41 to 8.54.

1.1. Note on Terminology for Environmental Accounting

The terminology surrounding the environmental accounting varies between agencies and over time. For example, the terms natural capital, natural resources and environmental assets are often used interchangeably and while very similar in concept may not be exactly the same thing in particular contexts. Similarly, ecosystem services are defined in several places (e.g. MEA, 2005, TEEB, 2010 and UN et al., 2014b) and again the concepts covered are not identical. The purpose of this paper is not to compare the terminology or definitions used in different places but to examine and improve the links between environmental accounting and policy. We have used terms in general use — such as natural capital and ecosystem services. In this article natural capital can be broadly equated with the environmental and ecosystem assets of the SEEA (UN et al., 2014a; UN et al., 2014b), while ecosystem services are also as defined in the SEEA (UN et al., 2014b).

2. Environmental Policy and Information

Environmental information and policy are seldom linked in the ideal manner of the virtuous “policy cycle” of the public policy literature (e.g. Howlett et al., 2009) or its more technical cousin, the adaptive management paradigm (e.g. Dovers and Hussey, 2013).² This is despite the importance of environmental information for policy being recognised for more than 100 years: the National Conservation Commission established in the USA by President Theodore Roosevelt produced an inventory of natural resources and policy recommendations (NCC, 1909), although Congress refused to appropriate funds and this initiative went no further (McCormick, 1989).

The important relationship between information and environmental policy received general recognition at the *Stockholm Conference on the Human Environment* convened by the United Nations in 1972. In particular, the *Stockholm Declaration* (UN, 1972) gave prominence to data collection, research and planning (see Chapter I, and in particular Principles 13, 14, 17, 18 and 20) and placed data at the heart of its recommended Action Plan for the Human Environment (Chapter II).

The report of the World Commission on Environment and Development (WCED, 1987), articulated the overarching goal of *sustainable development*, providing a concept well suited to a comprehensive approach to environmental policy. This is because sustainable development provides a clear objective and integrates key dimensions of the policy challenge: the short and long term (inter-generational equity), the concerns of north and south (intra-generational equity) and local and global (scalability).

Following WCED, the *Rio Declaration on Environment and Development* (UN, 1992) gave international endorsement to the goal of sustainable development. This was supported by a call for “[a] program to develop national systems of integrated environmental and economic accounting in all countries” and for the UN both to further develop the necessary accounting standards and to “... promot[e] the use of such techniques as natural resource accounting and environmental economics...” (UN, 1992).³

In parallel with this, the Organisation for Economic Cooperation and Development (OECD) has been leading policy development on the relationships between environment and economy since the early 1970s (OECD, 1972). Its work is taken here to be broadly representative of the environmental policy-development concerns of its member states. Table 1 lists key OECD environmental policy and information and

² See Fig. 1 for a common version of the policy cycle, to which the authors have added the “Information System”. The adaptive management paradigm is based on the principle of “learning by doing”, and so describes a cycle in which experience with managing a natural asset or other entity informs decisions to adjust the management technique or approach.

³ See Agenda 21 Chapter 8, section D, “Establishing systems for integrated environmental and economic accounting”, especially paragraph 8.41, and Chapter 38, paragraph 38.22 (c). Note that Agenda 21 also calls for the development of indicators and both national and international levels, especially at paragraph 40.6.

accounting decisions and publications. While recognising the importance of environmental accounting from an early stage, and participating in the development of SEEA, the OECD’s work on the role of information in environmental policy has focused on environmental indicators rather than on environmental accounting. Possible reasons for this are examined in Section 6 (below).

3. Environmental Accounting

Environmental accounting emerged from the *System of National Accounts* (SNA) (UN et al., 2014a) as a response to the recognised shortcomings of traditional accounting (e.g. Daly, 1973; Nordhaus and Tobin, 1972) and was accelerated by the call for accounting in Agenda 21. The first version of the UN System of Economic-Environmental Accounts (SEEA) (UN, 1993) followed shortly after the 1992 Rio Conference and was standardised via the SEEA in 2012 (UN et al., 2014a). There are ongoing extensions of the framework (UN et al., 2014b). The long gap between the initial work (1993) and adoption (2012) of the SEEA reflects the hesitancy of the international statistical community to accept the notion of integrated environmental and economic accounting, and especially the notion of adjusting GDP (Gross Domestic Product) (Smith, 2007). Agreement by the international statistical community that environmental accounting should be elevated to an international statistical standard was not achieved until 2007 (UNSC, 2007)⁴ and an editorial board was not established until 2010 (UN et al., 2014a, p. xi).

Literature relevant to environmental accounting continued to develop alongside the SEEA, mostly on the technical concepts and methods, including: ecosystem services (e.g. Bartelmus, 2015, Boyd and Banzhoff, 2007, Daily, 1997, Edens and Hein, 2013); “footprinting” (e.g. Chen and Chen, 2007, 2013 Wackernagel and Rees, 1996) and; valuation (e.g. Nordhaus and Kokkelenberg, 1999, Obst et al., 2015). In these the focus was on the technical aspects or production of accounts rather than on prospective policy applications, such as going beyond measurement to active management of levels of natural capital and the services it provides.

SEEA adoption means that the accounting discussion can move on from the technical details of “what” and “how”, so countries can proceed with the development of accounts with confidence. This is important for national statistics agencies charged with producing “official” statistics that can be reluctant to embark on new areas of information. The 20 year gap between the call for an international system of integrated environmental and accounting in 1992 and its delivery in 2012, highlights this issue.

We characterise the development of the SEEA as an “information push”, in which experts collaborated to solve the technical issues of environmental accounting. This work was not fully matched by any complementary “policy pull”; work by environmental policy experts to identify how best to interpret and apply the output from environmental accounts and integrate them into environmental policy-making. While the accounts may be seen as an end in themselves, without the “pull” of decision-making and policy they are unlikely to be adequately resourced or utilised.

Countries have developed and used accounts for specific analyses and applications (e.g. Åkerman and Peltola, 2012, Hamilton et al., 1993, Smith, 2014, EC et al., 2014, Van Dijk et al., 2014, Vardon et al., 2007) and statistical agencies have also linked accounts to particular policy issues (e.g. ABS, 2012, Statistics Netherlands, 2012). Generally, this is the producers of accounts pushing the applications with uptake primarily by researchers rather than by analysts that inform government decision-making.

Policy pull has not been completely lacking. More recent work examining the *economic* impacts of environmental problems has given fresh recognition to the need for environmental accounts and led to further developmental work: the UK Government’s Stern Review (Stern,

⁴ Report of the thirty-eight session. Decision 38/107 see <http://unstats.un.org/unsd/statcom/doc07/Report-English.pdf>.

Table 1
Key OECD environmental policy, information and accounting decisions and publications.

Year	Report	Notes
1979	Declaration on anticipatory environmental policies OECD (1979)	Inclusion of a commitment by members to: "... endeavour, to the extent practicable, to develop systems to account for changes in environmental quality and related resource stocks."
1998	Sustainable development: OECD policy approaches for the 21st century OECD (1998)	An overview and analysis of issues and trends, covering both broad issues such as policy integration and sectoral issues such as sustainable agriculture.
2000	Towards sustainable development: indicators to measure progress: OECD (2000)	One of several sets of environmental indicators developed by the OECD, intended as a tool for decision making and for assessing countries' environmental performance.
2001a	OECD environmental strategy for the first decade of the 21st century OECD (2001a)	The strategy notes the need to: "Further develop methods for environmental accounting in the context of the System of National Accounts" and; "Further develop the work on indicators, in particular through the revision of the core set of environmental indicators, headline indicators and indicators for policy integration, including the social and environmental interface, the development of targets and early warning indicators, and contribute to and support the OECD-wide effort on sustainable development indicators."
2003	OECD environmental indicators: development, measurement and use (reference paper) OECD (2003)	Consolidated guidance on environmental indicators
2008	Recommendation of the council on resource productivity OECD (2008)	Recommends that member states: "Promote resource productivity by strengthening their capacity for analysing material flows and the associated environmental impacts, and work to improve measurement systems for material flows and resource productivity..."
2011	Towards green growth OECD (2011)	Provides specific recommendations and measurement tools to support countries' efforts to achieve economic growth while ensuring that natural assets continue to provide the ecosystem services on which well-being relies. Advises that: "A first and crucial ingredient of the measurement agenda is thus to develop and populate a consistent environment-economy accounting framework." (p. 13)
2012	Review of the implementation of the OECD environmental strategy for the first decade of the 21st century: Making green growth deliver OECD (2012)	Review concludes that while good progress had been made in establishing robust information systems to support environmental decision-making, a common challenge is to "design environmental information systems so as to respond to the needs of decision-makers, and to avoid a supply- or technology-driven approach."
2014	Green growth indicators OECD (2014)	Presents the OECD framework for monitoring progress to green growth, including selected indicators for illustrative purposes.

2006) prompted G8 + 5 environment ministers to commission a study of the economic impact of biodiversity loss, *The Economics of Ecosystems and Biodiversity* (TEEB, 2010 (xvi) and ten Brink, 2011), while the French President's dissatisfaction with the state of statistical information about the economy and society led him to commission the *Report by the Commission on the Measurement of Economic Performance and Social Progress* (Stiglitz et al., 2009) to consider improved indicators of social progress. While these reports address environmental issues from a policy perspective and recognise the significance of environmental accounts, it was not part of their remit to explore the policy application of accounts in the terms canvassed here.

In countries, the United Kingdom (UK) has perhaps made the most systematic attempt to integrate accounts into public policy. The UK's Natural Capital Committee (NCC)⁵ terms of reference include providing advice to government on: when, where and how natural assets are being used unsustainably; how government should prioritise action to protect and improve natural capital, so that public and private activity is focused where it will have greatest impact on improving wellbeing; and research priorities to improve future advice and decisions on protecting and enhancing natural capital (NCC, 2015a). The NCC is probably unique in the world and has a role in both the "accounting push" and "policy pull". How to incorporate natural capital and its services into the decision-making is one of four research topics identified (NCC, 2015b).

4. Environmental Accounting in the Information System and Policy Cycle

Understanding where accounts fit into an information system used for public policy and decision-making is important. Environmental

accounts are both part of a broader information system covering basic data, accounts, interpretation and analysis as well as feeding into the policy (Fig. 1). Decision-making can occur at any stage in the policy cycle, for example: agenda setting (accounts identify issues); policy implementation and evaluation (accounts help target policy responses, e.g. to particular areas or industries); and measuring success. Policy responses may also be evaluated using environmental accounts, whether it be through simple forecasting based on past trajectories or more sophisticated modelling of the impacts of different policy alternatives.

The model linking the policy cycle and information (Fig. 1.) also needs to be interpreted in light of the multiple ways information is used and the different users of information (Table 2). Hezri and Dovers (2006) identify five ways information is used – instrumentally, conceptually, tactically, symbolically and politically – while the users may be viewed through the "three lenses" of evidence-based policy: 'scientific' (i.e. 'hard' data, used mainly by experts); public policy and administration (i.e. information relevant to implementation, used mainly by advisers and administrators); and political judgement (Head, 2008).

Accounts would boost the flow of consistent and regular information available to the public sector, minimising the need to commission one-off studies or to sift the reports of academic or science agencies that collect and interpret data for policy implications. Existing approaches are often ad hoc, and contrast starkly with the policy analysis of economic information, where data collection and accounting are undertaken mostly by national statistical offices and clearly separated from analysis and interpretation and decision-making done in policy or central planning agencies (e.g. Treasuries, Departments of Finance or Industry, etc.). Indeed, elevating the coherence and impact of environmental information to that enjoyed by economic information (especially via SNA) has been a consistent driver for the development of environmental accounts.

5. Policy Implications

Compiling national environmental accounts has implications beyond better understanding the relationship between environment and

⁵ The first NCC came to an end in September 2015 and a second NCC will be formed under the continuing chairmanship of Prof. Dieter Helm (see <https://www.gov.uk/government/news/appointment-of-dieter-helm-as-chair-of-natural-capital-committee-ncc>).

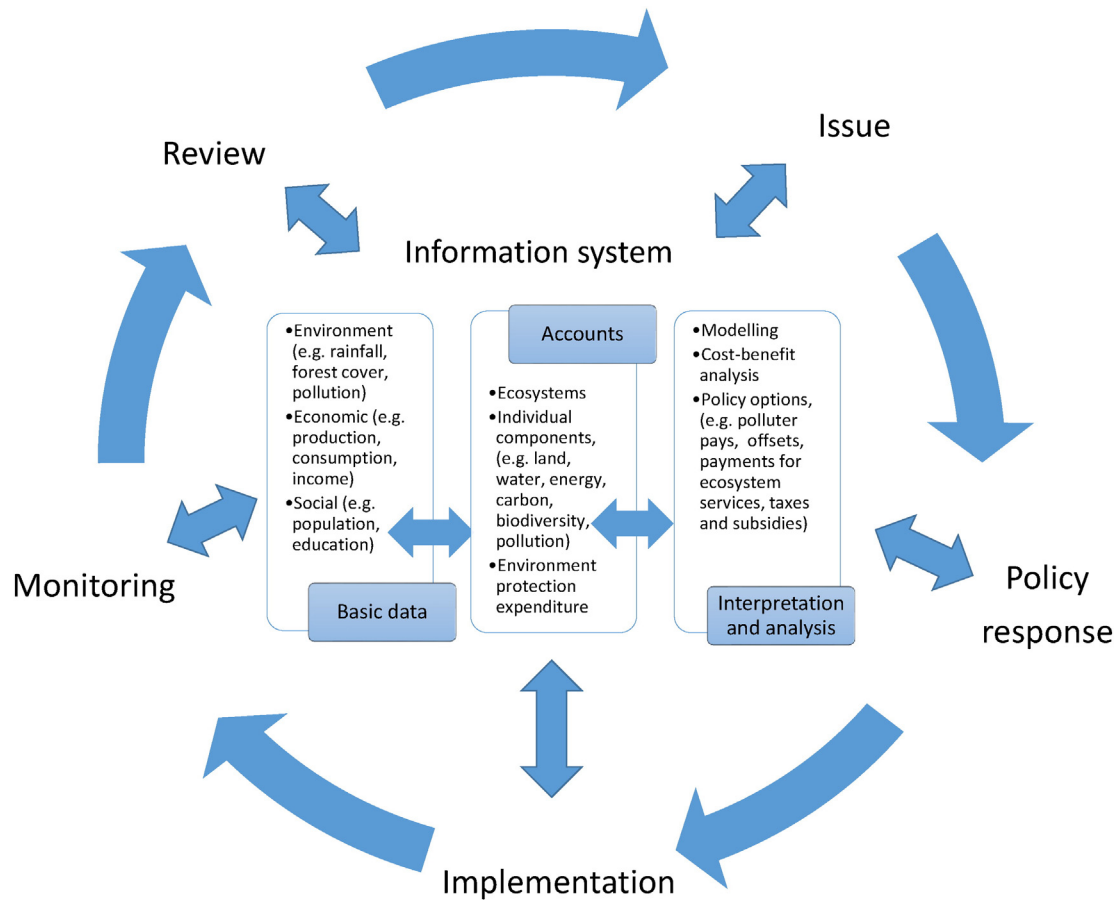


Fig. 1. The place of environmental accounts in the information system and policy cycle.

economy and improved decision-making at each stage of the policy cycle. Built on describing stocks and changes in stocks of environmental assets, the SEEA invites not just incremental policy improvement (e.g. more efficient use of resources), but adoption of a policy framework built around concepts of what levels of stocks are required (“sufficiency”), for both the short and long term, to support sustainable development. This in turn suggests managing environmental resources through an environmental budget, in which “receipts” of ecosystem services are accounted for as well as changes to the volume, extent and condition of the assets supplying these services. These services and assets would be reflected in both income accounts and balance sheets, along the lines outlined in the SEEA Experimental Ecosystem Accounts (UN et al., 2014b). Maintaining sufficient natural capital on the balance sheet to maintain a sustainable flow of ecosystem services would be a major step towards a goal of sustainability by addressing intergenerational equity. That is, future generations would inherit sufficient natural capital to ensure the flow

of essential ecosystem services such as food and water provision, air filtration, climate regulation and cultural and recreational opportunities.

Environmental accounts could be used by multiple layers of government (local, state/provincial and national) as well as by non-government actors. Accounts could facilitate polycentric governance of natural resources (Nagendra and Ostrom, 2012), by allowing multiple actors (within and outside of government) to make independent decisions, informed by a single authoritative source that integrated information across levels of governance, scales and resources (e.g. water, forests, biodiversity).

6. Reasons for Lack of Policy Pull

The relative lack of a policy pull to match the accounting push is superficially surprising, given the long-established acceptance of the need for accounts to inform decision-making. Whether viewed through a

Table 2
Uses and users of environmental accounts in public policy, with examples of uses to be assessed.

Information uses	Information users		
	Expert	Public policy and administration	Political
Instrumental	Programme evaluation, predictive models	Target expenditure, monitor policy impacts	Policy decisions
Conceptual	Searching for new patterns in the dynamics of stock-changes and flows	Using environmental accounts with national accounts to support whole-of-government policy integration	Better understanding of the dependency of human well being on natural capital and flows of ecosystem services
Tactical	Building the case for research	Ongoing analysis of the accounts and the significance of changes	Support and defend policies
Symbolic	Building the case for policy change	Environmental education	Make the case for major reforms
Political	Contributing to public policy debate	Advice and information to politicians to facilitate policy debate	Support election policies

scientific, policy or political lens, environmental issues are heavily data-centric. Through a science lens, environmental issues originate, have their primary manifestation, and require action, in the natural world; data is central to our understanding of what is occurring in that world. Through a policy lens good data is essential to good policy targeting and through a political lens the resulting precision and effectiveness is central to minimising the scope and consequences of the inevitable trade-offs, not only between shorter-term economic costs and longer-term environmental costs, but also between different areas and groups of society. Better presentation and analysis of data will obviously lead to improved decision-making. Why then has there been little “policy pull”?

Insight into this issue might be expected through the work of the OECD in its role as policy think tank for the most developed countries (OECD, 2001a; OECD, 2001b), and in particular its Environment Policy Committee (EPOC) composed of senior officials from each member country. However, there are mixed messages in the work of the OECD in terms of environmental accounts and decision-making. Despite its repeated endorsement of accounting systems involving concepts of stocks and flows, that it is one of the institutional authors of the SEEA and has undertaken joint work with the UNECE and Eurostat on stock and flow indicators for sustainable development (CES, Conference of European Statisticians, 2015), it has not developed policy models around accounting and has instead focused its work on sustainability information on environmental indicators (e.g. OECD, 2001a; OECD, 2001b, OECD, 2004).

One likely reason for this is that, once the concept and need for accounts was settled, the development task was allocated to technical experts in national accounting and environmental data. Policy makers and other potential users were not involved in the detailed and very technical process of developing the accounting standards and may have simply regarded accounting as a tool that was not available until the technical work was done. A related reason may be an under-appreciation by policy advisers of the management potential of accounts: in revealing the impact of transactions, accounts show the trade-offs that are so central to policy decisions (including future trade-offs through their capacity to support scenario modelling), yet the OECD seems to confine them to an *ex post* role associated more with measuring performance than making decisions. For example, the 1998 *Recommendation of the OECD Council on Environmental Information* commissioned work to “develop accounting systems and new indicators to enable better assessment of progress towards sustainable development”⁶; the entire decision is too long to quote here, but, particularly in its full context, conveys the impression that accounts are confined to a supporting role of measurement, monitoring and review.

Perhaps a deeper reason for a lack of “policy pull” with accounts is not conceptual, but political. Recall that the agenda of the OECD is set by its member governments. Intuitively, the clearer and more comprehensive the picture of environmental resources, the more likely that governments will be confronted with difficult and hard-to-avoid decisions, reaching beyond the environment to affect the economy and traditional notions of human wellbeing related to consumption and production. In fact, integrated use of SEEA with the SNA has the potential to affect the structure of executive government itself, to provide a platform for a policy integration that an OECD publication has described as the “key to sustainable development” (Long, 2000, p. 121). While there is no direct evidence of such political risk-aversion, there is indirect support for this argument through outcomes: a former OECD Director for Environment has described the OECD’s work on policy integration in an OECD publication as “falling well short of what is required”, despite significant effort and relative success in comparison with other international bodies (Long, 2000, p. 121). Two counter-arguments to such risk aversion – (1) that the resulting policy

interventions are likely to be more efficient and effective and (2) that if a difficult decision is required then it is better made sooner rather than later – are unappealing in the context of short political cycles.

If this analysis is correct, the best solution (recognising that nothing will make difficult political choices easy) would seem to lie in a phasing in of accounting for political reasons as well as for the practical reasons of novelty and complexity. A phased approach would allow the case for political acceptability to be built on the back of a much stronger evidence base for future policy choices.

7. Research for the Implementation and Application of Environmental accounting

The previous sections highlight the current disconnect between the account producers and the potential account users. This is reinforced by the research agenda in Annex 2 of the SEEA (UN et al. 2014a) that is entirely focused on technical aspects of accounting (e.g. definitions, classifications and valuation) and not on applications of the accounts. Research into the uses of environmental accounting is needed (NCC, 2015b). Reconnecting the divergent paths of the “accounting push” and the “policy pull” together will require account producers to work closely with potential users of accounts.

We identify five main research needs at this point: (1) a greater focus on end-uses in the design of accounts, which we see as central to a high level business-case to government as to why environmental accounting is an essential element of good policy; (2) systematic assessment of the past and potential uses of accounts in policy or programme management, to harvest existing experience; (3) a comprehensive understanding of the objects and objectives of environmental policy, to isolate principles for determining the appropriate accounting units and scalability of accounts; (4) development of “sufficiency standards” to specify the level of natural capital required in each unit; and (5) policy integration through designing an “environment budget” process. Under this last item, modelled on fiscal budgeting, whole-of-government decisions would be taken to allocate natural capital either to consumption or to conservation and, as appropriate, to invest in maintaining or replenishing it.

7.1. Focus on End-users of Accounts and Developing a Business Case

In progressing this research agenda, the overarching principle we propose is “decision-centred design” (Table 3). This draws on principles of “user-centred systems design” as applied in the field of information technology (see for example Gulliksen et al., 2003), which focuses on the usability of information and user-involvement in system design, to ensure user needs are met, but adds policy-related components that address the objective use of the information as well as the subjective needs of the user. Thus, environmental accounts and the reports derived from them should be designed to provide the most decision-relevant information in the most usable format to those making the decisions, whether these be of a policy, regulatory, or programmatic nature. For example, a national government should be able to see the stocks of environmental resources and, in light of advice on projected demand and “sufficiency levels”, be able to respond to adverse trends (e.g. by increasing resource-use efficiency or increasing investment in ecological regeneration). Or accounts might allow the administrator of a nature conservation programme to identify investment priorities and monitor investment impacts. While we focus on government instrumental uses here, decision-centred design also seeks to maximise the usefulness of the SEEA for other uses and other actors including industry, non-government organisations and the general public.

A collaborative and iterative design process will be required to draw information from environmental accounts and present it to decision-makers in a form that is, and continues to be, easy to use. We expect that, beyond the design and structure of accounts themselves, the application of decision-centred design will aid the development of high-level

⁶ Decision C(98)67/FINAL of 3 April 1998, accessed on 23 November 2015 at acts.oecd.org.

Table 3
Principles for decision-centred design.

Principle	Explanation
Decision-analysis	A process of identifying the quantitative components of decisions that need to be made, the data most relevant to quantitative components, and the appropriate measures of data quality. This includes, accuracy, timeliness, accessibility, interpretability and coherence (e.g. Statistics Canada, 2009).
Continuous improvement	Establishing and operationalizing environmental accounts is a complex and challenging exercise. Building on existing data, processes and institutions, together with phasing-in and testing through simulation, will not only be cost-effective, but again will build credibility and acceptance by putting the quality of decision-making alongside the quality of data.
Scalability	The capacity to derive aggregate indicators and reports from the accounts at various levels of detail and for different economic or environmental sectors, to suit the needs of the widest possible range decision-makers (e.g. national and state/provincial). This will ensure not only consistency but also the ability to aggregate information easily for reporting and further analysis.
Role separation	Ensuring that data gatherers and account producers are independent of decision-makers, to maximise the objectivity and credibility of the basic data and accounts and a clear separation from account interpretation and analysis. These are important considerations in securing social acceptance of decisions based on the (objective) information in the accounts that may lead to subsequent (value-based or political) policy decisions.

indicators that can be drawn from the accounts (though not determining what those indicators would be). Decision-centred design would also assist in the structuring of data in light of potential uses by various data analysts, especially for the purpose of modelling the impact of different policy options or tools.

7.2. Systematically Assessing the Past and Potential Uses of Accounts

A key part of the research agenda is to better understand how accounts, or information more generally, have been or could be used in public policy. As such the starting point for the agenda is the interface between the account producers and account users. These issues are likely to have much in common with those arising more generally from the science–policy interface (e.g. Gibbons et al., 2008) and the shared governance structures of government-funded research centres are one particular avenue to explore (see Burgman, 2015). While processes of engagement are likely to vary from place-to-place and over time, the key is to have effective on-going interactions between the two groups. While not set-up as a systematic approach to the issue, in parallel with the development of this paper we embarked on a series of round-table discussions (see the Acknowledgements). In these discussions accounting experts outlined the key features of the accounts and where they could potentially make a contribution, while policy advisers and programme managers outlined key issues and specific problems or processes to which they would like better information. The resulting discussions led to the development of lists of specific issues that might require research. This approach was a useful starting point for the authors and may be for others too.

Early progress in linking accounting to policy will be important, so that decision-makers have evidence, rather than promises, that accounting is useful to them. This would help build the business case to invest further in the compilation and use of accounts and create the necessary “policy pull” for the on-going regular production of accounts.

It will also be important to understand when information is more or less likely to influence decisions, to better understand the political as well as the environmental relevance of information. An obvious starting point would be to examine countries – like Australia, Canada, The Netherlands and Sweden – that have information systems that include accounts, and to assess the uses and users of accounts systematically, using the framework shown in Table 2. The information-policy cycle heuristic (Fig. 1) will be useful in this regard. Given the likely lack of instrumental uses of accounts, this assessment could be extended to cover all types of information (i.e. not just accounts) in decision-making. It would provide a set of between-country comparisons and point to key factors that determine the usefulness of accounts, and information generally, in decision-making.

7.3. The Objects and Objectives of Management, Accounting Units and Scalability of Accounts

This part of the research agenda for linking policy to accounts overlaps directly with the technical aspects of the research agenda outlined

in general in the SEEA Experimental Ecosystem Accounting (UN et al., 2014a; UN et al., 2014b). Better engagement between policy and accounting experts will lead to a better understanding of the effect of technical choices on the output of the accounts and enable the technical choices to be directly informed by policy considerations.

In this the objects of management (e.g. particular regions, species, industries, consumers, etc.) and the objectives of management (e.g. improve the condition of particular regions, lower the extinction risk of species, minimise the emissions of pollution, reduce consumption of natural resources, etc.) need to be matched with the units of accounting, both spatially and in terms of classes of producers and consumers (e.g. industries and households).

7.4. Developing “Sufficiency Standards”

Perhaps the most significant potential use of environmental accounts lies in *ex-ante* management of stocks of natural capital and flows of ecosystem services rather than *ex-post* measurement, although both are important. We envisage analogy as a starting point for research, with an examination of how the SNA is used in economic management and the applicability of macroeconomic techniques to the management of natural capital. It would be equally important to consider how well science can advise on what is required to maintain ecosystem or other environmental function.

In terms of future uses, there is a need to directly link accounting to specific policy tools, such as biodiversity offsets or payments for ecosystem services. This will create a pool of case studies to provide the much-needed evidence of the usefulness of accounts for policy. The selection of case studies for development can be guided by policy goals and priorities, for example the newly adopted Sustainable Development Goals or national strategies for biodiversity conservation. The principles of user-centred design (Table 3) would inform, and be tested by, the case studies and be updated as necessary.

An example of potential case study is the use of accounting to support environmental impact assessment and associated development approvals. A key problem in this field is that individual decisions are made at a local level, often without consideration of cumulative impacts. Accounts could be able to provide the broader context for such decisions and make cumulative impacts clear.

7.5. Policy Integration Through an “Environment Budget” Process

Deciding how much natural capital is “enough” is not simply a scientific question, but a policy choice that requires a whole-of-government approach to balancing environmental, economic and social considerations – trade-offs. In other words, this element of the research agenda concerns the elusive goal of policy integration. Consistent with the phased development of the accounts themselves, an environmental budget could be phased in through a “shadow” or parallel budget, under which environmental budgeting operates initially on a trial basis, in parallel with existing decision-making processes. This shadow budget would account for the implications of government decisions for

environmental stocks and flows in physical and, where transactions exist, in monetary terms. A shadow budget would help identify and iterate flaws and gaps in both data and process, and would only be made the authoritative information source for decisions once these issues were resolved.

A shadow budget process would also allow government to experiment with new decisional processes and to develop new policy approaches based on maintaining environmental stocks and flows. While this could be done within government, much of this represents new ground that is probably best explored with research partners.

8. Conclusions

The adoption of SEEA was a significant international achievement. It means that there is a general agreement on the key concepts and structure of environmental accounts. It also established an on-going process for the development of environment accounting. While it is unfortunate that a strong “policy pull” did not emerge in parallel with the “accounting push”, there are good reasons to stimulate a “policy pull” now, but also significant challenges. To aid such stimulation, a model of the place of accounting in the information system and policy is provided along with a research agenda and set of principles based on the concept of decision-centred design. This design is focused on making better links between basic data, accounting, research and analysis, the policy cycle and government decision-making. The research agenda proposed involves significant collaboration between government and researchers, applying an iterative process given a high degree of novelty and complexity. The political challenge will be to quickly and progressively demonstrate success and to use this success to help build new political narratives.

The application of decision-centred design to environmental accounting should enable integrated economic and environmental information to be brought into the mainstream decision-making processes of government and in particular to annual planning and budgetary cycles. It will also mean that non-government actors have regular and reliable information on which to judge the performance of environmental policy as well as the impact of other policies on the environment. Without integrated environmental-economic accounting the risks of most current approaches remain: that the impact of the declining state of the environment on the economy and human wellbeing more generally will be under-appreciated and that the choice of remedies to arrest the decline will be sub-optimal.

It is perhaps inevitable that adoption of environmental accounting will confront governments and others with difficult decisions, but those decisions are likely to be more robust and defensible with regular accounting information than without it. Delay in adopting and using environmental accounts is likely only to exacerbate current problems.

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