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Scientific Support for Sustainable Development Policies

A Typology of Science–Policy Interfaces with Case Studies

Roope Kaaronen
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Inquiries about the publication: julkaisut@sitra.fi

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Foreword

IN ORDER TO ACHIEVE SUSTAINABLE DEVELOPMENT and solve challenging societal problems in an ever more complex world, we need to understand the big picture. Accordingly, we are in dire need of interdisciplinary, intersectoral and intersocietal tools to solve widespread societal and sustainability concerns.

In a world of growing complexity, it is not uncommon to hear calls for evidence-based decision- and policymaking. As our everyday problem-solving capabilities are put to the test, we face a growing demand for scientific evidence. But how can we provide such evidence?

First, we should question the concept of evidence altogether. With complex problems there are often no single correct answers or practices. Different fields of science can – perfectly legitimately – provide evidence to steer decision-makers down different routes. This can happen within research, foresight and experimentation, all of which are required for thorough decision-making.

Therefore, it is fair to ask if reliable scientific information alone is sufficient for advising decision-makers. Indeed, we can question whether an expert group's "truthful" opinion is at all useful for policymakers. Complex sustainability concerns require commitment, determination and ambition, which stem not from 'evidence'-based reporting but deeply rooted social learning. This learning environment can be created by open platforms, where researchers, experimenters, decision-makers, stakeholders and other problem solvers meet. The outcome might not be completely scientifically valid, but it can spark significant change in the right direction.

The Finnish Expert Panel on Sustainable Development was formed to give a scientific perspective to complex societal questions. The panel has been both supportive and critical of Finland's sustainable development policies and strategies, and has strived to promote multi-perspective social dialogue on topical sustainable development concerns, as well as build networks with both Finnish and international expert panels or organisations.

The panel was originally launched for a trial period between 2014 and 2016; with that trial about to end it is time to look ahead. In June 2016, in order to support discussions and decision-making regarding the panel's future operation, the panel assigned Mr **Roope Kaaronen** to prepare this benchmark study on different models of scientific support for sustainable development policies.

The study and the experiences of our panel suggest that the work of scientific expert panels is urgently required in the field of sustainable development. Indeed,

it is alarming that both nationally and globally the development of science–policy interfaces has often been almost completely omitted in sustainable development policy documents. Does the scientific support for sustainable development policies really work well enough to warrant this indifference, or are we instead incapable of addressing the novel challenges brought about by an ever more complex world?

Examples from various countries show there is no single correct way to organise scientific support for sustainable development policies. The tricky task now for the expert panel is to consider which combination of working models would have the most impact in Finland, and how synergies between existing stakeholders could be intensified.

We want to thank all those who have provided material and comments to help compile this study. We hope that this publication can facilitate the processes for planning and implementing sustainable development policies as well as enable the development of effective scientific support, both in Finland and internationally.

Helsinki, 30 September 2016

Eeva Furman
Chair of the Expert Panel on
Sustainable Development
The Finnish Environment Institute

Eeva Hellström
Facilitator of the Expert Panel on
Sustainable Development
The Finnish Innovation Fund Sitra

Esipuhe

KESTÄVÄN KEHITYKSEN TAVOITTELU ja vaativien yhteiskunnallisten ongelmien ratkaiseminen entistä monimutkaisemmassa maailmassa edellyttää kykyä hahmottaa laajoja kokonaisuuksia. Tarvitsemme uusia poikkitieteellisiä, poikkisektoriaalisia sekä poikkiyhteiskunnallisia tapoja ratkaista laajoja yhteiskunnallisia ongelmia.

Kasvavan epävarmuuden maailmassa yhteiskunnassamme peräänkuulutetaan usein tietoon ja erityisesti evidenssiin pohjautuvaa päätöksentekoa. Kun arjen ongelmanratkaisukyky joutuu koetukselle, kasvaa tieteellisen näytön kysyntä. Miten tähän kysyntään voidaan vastata?

Ensinnäkin on syytä pohtia, mitä evidenssillä tämän päivän yhteiskunnassa tarkoitetaan. Monimutkaisten ongelmien ollessa kyseessä ei nimittäin useinkaan ole olemassa yhtä ainoata oikeaksi osoitettua tietoa tai ratkaisua. Eri tieteenalat voivat täysin perustellusti tarjota tietoa, joka viitoittaa päätöksentekoa hyvinkin eri suuntiin. Samoin voi käydä tutkimustiedon, ennakointitiedon ja kokeilupohjaisen tiedon kanssa, joita myös kaikkia tarvitaan päätöksenteon tueksi.

Perustellusti voidaan myös kysyä, riittääkö luotettavakaan tieto sellaisenaan päätöksenteon perustaksi, vaikka asiantuntijat olisivatkin totuudestaan yksimielisiä? Voiko asiantuntijajoukon ”totuutta” siirtää päättäjille? Vaativien kestävyysongelmien ratkaisu edellyttää yhteiskunnallisilta toimijoilta päättäväisyyttä ja määrätietoisuutta, jotka syntyvät syvästä sitoutumisesta ja yhteisestä oppimisesta. Tämä voidaan mahdollistaa muun muassa yhteisillä foorumeilla, joissa tutkijat, ennakoijat, kokeilijat, päättäjät ja muut ratkaisujen löytämiseen tarvittavat toimijat kohtaavat. Ehkä lopputulos ei tällöin täysimittaisesti vastaa tieteen suosituksia, mutta se saattaa kuitenkin käynnistää merkittäviä muutoksia, jotka vievät kehitystä oikeaan suuntaan.

Kestävän kehityksen asiantuntijapaneeli perustettiin tuomaan tieteen näkökulmaa vaikeisiin yhteiskunnallisiin kysymyksiin Suomessa. Paneeli on sekä tukenut että haastanut Suomen kestävän kehityksen politiikan suunnittelua ja toteutusta, pyrkinyt herättämään yhteiskunnallista keskustelua monista näkökulmista ajankohtaisiin kestävän kehityksen kysymyksiin sekä rakentanut verkostoja niin tulevaisuustyön tekijöihin kuin muihin asiantuntijapaneeleihin Suomessa ja kansainvälisesti.

Paneeli käynnistettiin Sitran isännöimänä kokeiluna (2014–16). Kokeilujakson nyt päättyessä on aika katsoa tulevaisuuteen. Paneelin tulevasta toimintamallista käytävän keskustelun ja päätöksenteon pohjustamiseksi teetimme kesällä 2016

tämän, **Roope Kaarosen** valmistaman benchmarking-selvityksen tavoista organisoida tieteellistä tukea kestävän kehityksen politiikalle.

Sekä paneelista saadut tähänastiset kokemukset että tämän selvityksen tulokset vahvistavat näkemystä, että tieteellisille asiantuntijapaneeleille on kestävän kehityksen työssä huutavaa tarvetta. Erityisen huolestuttavaa kuitenkin on, että sekä globaaleissa että monien johtavien maiden kestävän kehityksen linjauksissa ja politiikkaohjelmissa tieteen ja päätöksenteon välisen vuorovaikutuksen kehittäminen on unohdettu. Toimiiko kestävän kehityksen politiikan tieteellinen tuki niin hyvin, että asiaan ei tarvitse kiinnittää huomiota, vai emmekö muuttuvasta maailmasta huolimatta osaa riittävästi kyseenalaistaa aiemmin toimivaksi osoittautuneita tieteen ja päätöksenteon vuorovaikutusmalleja?

Eri maiden esimerkit kuitenkin osoittavat, että ei ole olemassa yhtä oikeaa tapaa organisoida tieteellistä tukea kestävän kehityksen politiikalle. Paneelin visaisena haasteena onkin nyt pohtia, millainen eri toimintamallien yhdistelmä voisi Suomen kontekstissa olla vaikuttavinta ja miten synergiaa eri toimijoiden välillä voitaisiin parhaiten vahvistaa.

Kiitämme lämpimästi kaikkia selvitykseen aineistoa antaneita ja selvitystä kommentoineita asiantuntijoita. Toivomme julkaisun hyödyttävän sekä kestävän kehityksen politiikan suunnittelu- ja toimeenpanomekanismien kehittämistä että mahdollistavan vaikuttavaa tieteellistä tuen kehittämistä sekä Suomessa että kansainvälisesti.

Helsingissä 30.9.2016

Kestävän kehityksen asiantuntijapaneeli

Eeva Furman
paneelin puheenjohtaja
Suomen ympäristökeskus

Eeva Hellström
paneelin fasilitaattori
Sitra

Abstract

SUSTAINABLE DEVELOPMENT (SD) is a particularly complex socio-ecological concern, and no less complex than that is the question of how to organise effective and relevant scientific support for SD policies. Whilst science, as humanity's 'best guess', is an essential prerequisite for developing a sustainable future, science–policy interfaces (SPIs) for sustainable development are still often inefficient, lacklustre or simply non-existent. Indeed, developing these interfaces is seldom a prime task of national governments. This study is intended, on the one hand, to provide a concise outlook and typology on how science–policy interfaces are organised in a variety of OECD (Organisation for Economic Co-operation and Development) countries, and on the other hand to respond to a systematic lack of discussion on the role of scientific knowledge in developing sustainable development policies.

The dynamics of science–policy interfaces for sustainable development policies can be classed into six (plus one) models in a comprehensive typology, developed in this study, as follows.

1. **The Independent Model** – Independent groups or panels of experts conducting scientific advice, assessment and monitoring. The Independent Model has particular strength as an impartial watchdog for governmental SD policies, yet the true impact of their reporting-biased approaches can often be questioned.

2. **The Integrated Model** – Groups of experts integrated into the governmental sphere, consisting not only of scientific experts but also of parliamentarians, political decision-makers and other stakeholders. Whilst integrated SPIs often succeed particularly in gathering a diverse variety of experts and stakeholders who operate in close proximity with government officials, experiences signify that outside and unwelcome voices are often silenced.

3. **The Assignment Model** – Cases where demand-driven scientific support is provided for policymakers by task forces when required. Assignment SPIs, often embodied by, for example, think tanks and consultancies, offer short-term solutions when most needed, but generally lack the comprehensiveness to act as major interfaces in SD concerns.

4. **The Nested Model** – Cases where scientific support is organised for policymakers via thoroughly institutionalised arrangements of nested expert hierarchies. Nested Model SPIs are especially successful in combining independent scientific rigour with high-level impact on policymakers, yet find particular challenges in co-ordination.

5. **The Adviser Model** – Scientific advisers directly informing the highest political actors, often aided by secretaries and advisory offices. The Adviser SPI is an oft-criticised model, particularly because of its systematic lack of transparency and social robustness, and is thus not well suited to complex and often controversial SD issues.

6. **The Platform Model** – Deliberative and co-productive knowledge brokering arenas for science–policy interaction often organised by third parties. These SPIs offer (face to face or online) forums for policy co-creation and design for those who might not else interact, yet are sometimes too short-lived to provide the longevity which SD-related SPIs require.

Moreover, a seventh model, **the Mixed Model**, is also discussed to assess hybrid models which do not fit neatly into one slot and have features of two or more of the six models above. Indeed, most SPIs include features from more than one model, and finding an iterative balance of operative models – either via networking or modification of existing models – seems essential, particularly since sustainable development concerns require a variety of responses for different contexts and levels of complexity.

Tiivistelmä

KESTÄVÄ KEHITYS on erityisen kompleksi sosio-ekologinen ongelma. Siksi myös tieteellisen tuen järjestäminen kestävän kehityksen politiikalle on monimutkaista. On kuitenkin selvää, että kestävä kehitys lukeutuu ihmiskunnan suurimpiin haasteisiin ja tarvitsee näin ollen parhaan mahdollisen tieteellisen tuen. Kestävän kehityksen politiikassa tieteen ja päättäjien yhteistoiminta on silti usein valitettavan vajavaista. Tämä selvitys pyrkii yhtäältä antamaan yleiskatsauksen tieteen ja politiikan rajapintoihin kestävässä kehityksessä ja toisaalta edistämään tieteen ja päätöksenteon välisen vuorovaikutuksen kehittämistä.

Selvityksessä kehitetään typologia, jossa kestävän kehityksen tieteen ja politiikan rajapinnat jaetaan kuuteen malliin:

1. **Itsenäinen malli**, jossa itsenäiset asiantuntijapaneelit toimivat tieteellisinä neuvonantajina, osallistuen myös politiikan monitorointiin sekä arviointiin. Itsenäinen malli toimii parhaillaan kansallisena kestävän kehityksen sananvaltaisena vahtikoirana, joskin sen yksisuuntaiseen raportointiin painottuvat toimintakäytännöt saattavat olla poliittiselta vaikuttavuudeltaan alhaisia.

2. **Integroitu malli** eli kansalliset kestävän kehityksen neuvostot, joissa asiantuntijaryhmät toimivat lähellä hallitusta ja jotka tieteellisten ryhmien lisäksi ottavat työhön mukaan myös parlamentaarikoita, muita päättäjiä sekä sidosryhmiä. Vaikka monimuotoinen osallistuminen ja poliittinen läheisyys ovatkin integroidun mallin vahvuuksia, käytännön kokemusten mukaan näin lähellä hallintoa on kuitenkin hankalaa tuoda esiin poliittisesta tai tieteellisestä valtavirrasta poikkeavia kriittisiä mielipiteitä.

3. **Toimeksianto-malli**, jossa päättäjien kysynnän perusteella värvätään tieteellistä tukea toimeksiantoryhmiltä (esimerkiksi ajatushautomot tai konsulttiyritykset). Nämä saattavat olla tehokkaita lyhyen aikavälin ratkaisuja, mutta pitkän tähtäimen kestävän kehityksen politiikan tueksi ne ovat useimmiten riittämättömiä.

4. **Sisäkkäinen malli**, jossa tieteellinen tuki on järjestetty kestävän kehityksen politiikalle usein vankasti institutionalisoituneiden sisäkkäisten asiantuntijarakenteiden kautta. Tämän mallin ruumiillistumia ovat yleisimmin tutkimuslaitokset ja muut instituutit, jotka ovat erityisen tehokkaita yhdistämään tieteellisen itsenäisyyden korkeatasoisen poliittisen vaikuttamisen kanssa. Sisäkkäisen mallin suurimmat haasteet piilevät monimutkaisen rakennelman ja hierarkian koordinoinnissa.

5. **Neuvonantaja-malli**, jossa tieteelliset neuvonantajat toimivat suorassa yhteydessä korkeimpiin poliittisiin toimijoihin (esimerkiksi pääministeriin), toimien välikätenä tieteellisten ja poliittisten yhteisöjen välillä. Neuvonantaja-mallia on erityisesti kritisoitu sen läpinäkymättömyydestä ja väitetystä puolueettomuudesta.

6. **Foorumi-malli**, jossa neuvottelukykyinen, yhteistoiminnallinen ja osallistumiseen kannustava kolmas osapuoli toimii välittäjänä tieteen ja politiikan välillä. Nämä tieteen ja politiikan rajapinnat tuovat päättäjät ja tutkijat saman katon alle toimien usein kasvokkaisten työpajojen, foorumeiden tai verkkoyhteisöjen välityksellä. Tämä mahdollistaa sosiaalisesti kestävän tiedon tehokkaan yhteistuottamisen. Foorumi-mallia edustavat rajapinta-organisaatiot ovat kuitenkin usein valitettavan lyhytikäisiä.

Lisäksi selvitys määrittelee seitsemännen mallin (**Sekamalli**) korostaakseen hybridimalleja, jotka eivät sovi minkään yhden mallityypin alle. Tarkalleen ottaen kuitenkin jokainen rajapinta-organisaatio on jossain määrin sekoitus useammasta kuin yhdestä toimintamallista. Itse asiassa toimintamalleja yhdistämällä voidaan yksittäisten mallien kohtaamat haasteet usein ylittää. Selvitys esittääkin typologiaa hyödyntäen, että yksittäiset kestävän kehityksen politiikan rajapinta-organisaatiot voivat kehittää toimintaansa omaksumalla toimintamallien sekoituksia tai rakentamalla yhteistoimintaa toisten, eri toimintamalleja edustavien organisaatioiden kanssa. Tällaisella toimintamallien ”palapelin” kansallisella yhteensovittamisella voidaan tavoitella yhä suurempaa tieteellistä osallisuutta kestävän kehityksen poliittisella kentällä. Monimutkaisena ilmiönä kestävä kehitys vaatii monimuotoista ja sopeutuvaa tieteellistä tukea, ja oikein järjestettynä diversiteetti on myös tieteellisen tuen kannalta rikkaus.

Sitra Studies 118
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Contents

1 Introduction

1.1 The Science–Policy Interface

Sustainable development is one of the most daunting and complex challenges faced by humanity in its history. Therefore, it follows naturally that sustainable development policies should be informed by humans' best available knowledge and scientific practices, and that scientific knowledge creation and political decision-making platforms should be, in this respect, intricately connected (Scientific Advisory Board of the UN Secretary-General, 2014). Indeed, if successful, such a reciprocal connection would 'help make research and scientific information more policy-relevant, and policy development and implementation more science based' (Glaser and Bates, 2011), facilitating the transition towards sustainable socio-ecological systems.

Consequently, developing institutional frameworks and knowledge-disseminating infrastructures to strengthen science–policy interaction (from here on referred to as the **science–policy interface**, or **SPI**) should be a prime agenda for any society striving for sustainability and meeting the sustainable development goals set by the 2030 Agenda for Sustainable Development (UN General Assembly, 2015). The science–policy interface, a concept used extensively in this paper, refers to 'organizations, initiatives or projects that work at the boundary of science, policy and society to enrich decision making, shape their participants' and audiences' understandings of problems, and so produce outcomes regarding decisions and behaviours' (Sarkki et al., 2015: 506). Yet just how this interface is best arranged is, largely due to the complexity of sustainable development, open for debate, and it is the particular task of this study to summarise the general tendencies – some more successful than others – of how scientific support can be organised for the benefit of sustainable development.

1.2 Complexity of Sustainable Development

The inherent complexity of sustainability concerns has resulted in calls for science–policy interaction to move from a linear 'one-directional transfer model' or a 'knowledge-deficit model' (i.e. speaking scientific 'truth' to people in 'power'; Sarkki et al., 2015) towards a more dialogical and deliberative learning process, enhancing the societal uptake of scientific knowledge and producing better informed and more effective policy practices. However, whilst the realms of science and politics have never been truly separate, much of today's science–policy debate is still informed by the evidence-based ethos of 'get the facts right, then act', consequently ignoring both the 'scientification of policy and the politicisation of science' (Weiland, 2011) – not to mention that that these evidence-based 'facts' themselves are more than often disputed and incomplete truths within the scientific and political communities. Whilst 'evidence-informed' methods, such as the utilisation of sustainability indicators and scientific reporting, are still undeniably of significant use and justly maintain their place in the scientifically informed policy debate, the sheer complexity of sustainable development (from here on sometimes abbreviated to **SD**) tends to elude simple parameters. Therefore, instead of linear knowledge transfer, a learning-based science–policy interface should focus on generating 'socially robust knowledge', or knowledge 'which is not only scientifically reliable, but is also accepted and applicable in the social [and political] contexts in which the relevant issue occurs' (Regeer and Bunders, 2009: 14). At the heart of this co-creative learning process should lie themes such as integration, participation, innovation, multidisciplinarity and interdisciplinarity (integrating 'the social, economic and environmental dimensions of sustainable development in an equitable manner'; Scientific Advisory Board of the UN Secretary-General, 2014), iterativity and experimentation, centred on the long-term objective of sustainability.

Indeed, as Niestroy (2007a: 68) notes, 'moving towards sustainable development is a process', and more particularly an iterative 'learning process' which

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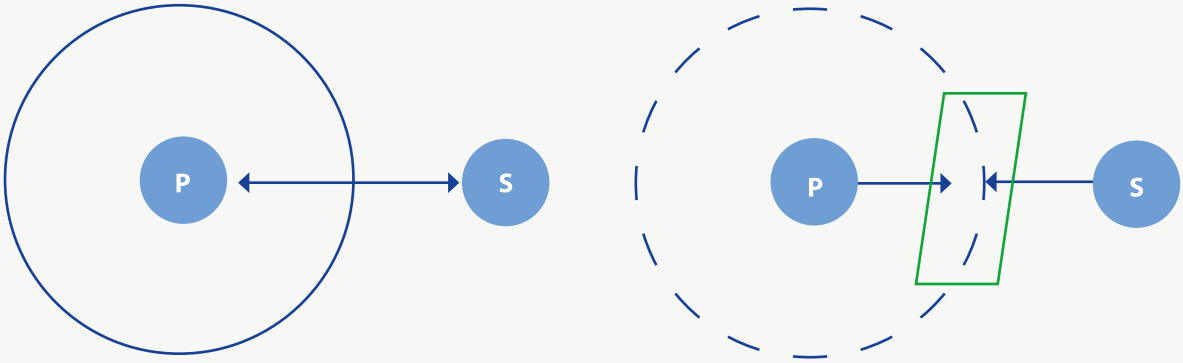
should be characterised by the co-production and co-creation of policy-relevant scientific knowledge. In other words, science–policy interfaces should be 'viewed as dynamic, evolving processes' rather than static and isolated institutions, and SPIs should emphasise iterative multidirectional dialogues and learning between science, policy, society and stakeholders (Sarkki et al., 2015). Therefore, next to the traditional SPI dimensions of 'credibility, relevance and legitimacy', SPIs should subscribe to 'iterativity' as a mode of operation (Sarkki et al., 2015). A successful and truly representative SD science–policy interface therefore requires the utilisation of iterative, holistic, inclusive and deliberative methods, and since 'sustainable development concerns all actors in democracies', it cannot possibly be brought about by isolated scientific institutions, governments or ministries (Niestroy, 2007a: 68). Instead, sustainable development should involve 'a deliberative component, with scrutinizing of existing policies, a "broadening of horizons", and seeking windows of opportunities, developing innovative approaches, identifying both win-win situations and true conflicts' (ibid.). Conclusively, these deliberative 'broadenings of horizons' and adaptive learning processes signify a move from 'evidence-informed' policymaking to experimental methods and foresight activities, acknowledging the shortcomings of and conflicts underlying linear 'facts-first' (e.g. indicator-based), backward-looking approaches.

Of course, no single plan for organising the complex science–policy interface in sustainable development is 'the right model' and any attempt at organising effective knowledge diffusion from science to policy (and vice versa) is subject to a multitude of variables related to changing local and global conditions as well as social, cultural, economic and personal factors. However, by learning from good practices and past experiences – as is done with the following typology and case studies (in Section 2) – and embracing uncertainty as a way of building understanding, we can seek to adapt to and tackle the complex challenges faced by science–policy interfaces related to SD policy, and iteratively alter our modes of operation to further enhance the interconnection and knowledge transfer between the science and policy arenas.

1.3 Distance between Science and Policy

Importantly, this study does not merely aim to analyse the linear impact of science over policy, but also attempts to define situations where science–policy interaction flourishes or takes problematic turns. Here, in particular, the proximal distance between scientific and political actors is a key factor, which is returned to repeatedly in this study. In many respects, a successful science–policy interface is not only dependent on its impact on 'highest' policy actors (Niestroy, 2007a), but also on the successful balancing act between the 'hot' policy arena and the 'cold' field of science. Therefore, 'complex "sustainable development processes" require balancing between "poles (extremes)"' (Niestroy, 2007a: 71), and this balancing act is highly dependent on not only locating but also actively maintaining an optimal Goldilocks zone (not too hot and not too cold, see Table 1 below). Getting this deliberative interface 'just right' is particularly important in complex sustainability concerns where 'facts are uncertain, values in dispute, stakes high and decisions urgent' (Funtowicz and Ravetz, 1993; Zamparutti et al., 2012).

Locating the Goldilocks zone for co-creation and co-production



Picture 1

The balancing act of finding the optimal relation between Science (S) and Policy (P) is depicted above.

Instead of the 'linear' relation between science and policy in the picture on the left (where science and policy merely inform each other), science–policy interfaces should involve co-creative and co-productive arenas, where boundaries between science and policy are temporarily dissolved and researchers and policymakers (and possibly stakeholders) are genuinely brought together under a deliberative platform (see the picture on the right). Here 'hybrid' (Hård and Jamison, 2005) expert groups – half scientist and half decision-informer – can play a central role as facilitators, deliberators and knowledge brokers.

Since humans are psychosocial cognitive actors, the influence of physical distance should not be underestimated when creating these co-creative arenas. According to some reports, face-to-face discussions and workshops have been the most important and impactful interfaces between science and policy, with physical infrastructure (such as workshop spaces) providing essential means for communication and knowledge diffusion (Zamparutti et al., 2012; Weichselgartner and Kasperson, 2010).

Locating the Goldilocks zone in the science–policy interface involves balancing between the critical independence of science and the effective authority of government, between the scientific rigor and the hot political environment, and between the delicate (and slow) scientific quality and the sometimes impulsive (and fast) policy arena. Indeed, numerous historical examples and precedents illustrate the delicate nature and risks of this dialectic balancing act. For example, in the United Kingdom in 2010, an event dubbed the 'bonfire of the QUANGOs' (quasi-autonomous non-governmental organisations) saw the vociferous Sustainable Development Commission, established by the Labour government, axed by the newly appointed coalition government, in an act described by the Commission's chair as 'ideological vandalism' (Porritt, 2011). The Royal Commission on Environmental Pollution (which had operated since 1970) came to a similar fate, along with several other advisory bodies.

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Interestingly, similar events (at times better described as political purges) seemed to happen on a global scale in the early 2010s among SD advisory councils (Osborn et al., 2014). Among the discontinued sustainable development councils or panels were the long-lived Swedish Miljövårdsberedningen[1] (MVB, abolished in 2011), Comhar in Ireland (integrated into the Irish National Economic and Social Council in 2012), the Advisory Council for Research on Spatial Planning, Nature and the Environment (RMNO) in the Netherlands (abolished in 2009), the National Council for Sustainability in Australia (axed by Tony Abbott's newly elected government in 2013, merely a year after the council's establishment), the Presidential Committee on Green Growth in South Korea (abolished in 2013) and the National Round Table on the Environment and the Economy in Canada (a quarter century-year-old notable advisory agency eliminated in 2013 by Stephen Harper's newly appointed Conservative government on the basis that it supported a carbon tax[2]). The Naturrådet in Denmark was abolished earlier in 2003 by, on a familiar note, a newly appointed government. Indeed, often the rationale behind abolishing these institutions was that the councils were perceived as being too closely affiliated with previous governments, or they simply were not deemed to fit with the new political ideology. Most of these councils have not since been replaced with comparable authorities. Appropriately, Osborn et al. (2014: 8) note that:

> *building mutual trust and understanding around this role of being a 'critical friend' is a crucial success factor. It is not an easy balance to maintain and there are examples of problems arising in both directions – for example, councils that have become too close to government, and have therefore lost public credibility and usefulness as an agent of change; and councils that have become too oppositional and have therefore lost access to and influence with government, sometimes to an extent that they have been disbanded or had their funding ended. Getting and keeping this balance right needs constant attention.*

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1 Niestroy (2005: 264) writes that in 2005, as a result of the Swedish open and stable political culture, the Minister-led MVB was unlikely to be abolished after government changes. Yet this seemed to exactly be the fate of MVB, which was replaced by the now seemingly inactive Miljöforskningsberedningen in 2012. This should be taken as a warning example for closely government-affiliated SD councils. Since 2015 however (on a more positive note), Sweden has experimented with an independent Scientific Advisory Council for Sustainable Development (Vetenskapliga rådet för hållbar utveckling, see end of Section 2.1 below) to provide long-term SD advice and monitoring (its exact role and mandate in the Swedish SD science–policy interface is still uncertain).

2 According to the Foreign Affairs Minister of Canada at the time, the people of Canada should not be responsible for funding an agency which supports a policy (the carbon tax) which the majority of people do not, claiming that "[i]t [the NRTEE] should agree with Canadians. It should agree with the government" (The Canadian Press, 2012). Whilst agreeing with governments is clearly not the mandate of independent advisory agencies, they are often expected to do so, with dire consequences for deviation. The Environment Minister (ibid.), on the other hand, claimed the NRTEE was unnecessary because citizens could access research 'through the Internet, and through universities and other think tanks' anyway, representing a dire yet common misunderstanding of the role of SPIs as mere knowledge producers.

Indeed, it seems that a central challenge for expert groups in assuring longevity – which successful science–policy interfaces in sustainable development necessarily require – is on the one hand maintaining a healthy and critical distance from politics, whilst on the other hand being close enough to have an impact on decision-makers (i.e. being the 'critical friend'). Allegorically speaking, the task is similar to that of Icarus: not flying so low that the sea's dampness clogs his wings or so high that the sun's heat melts them. Furthermore, a similar balancing act can be found in the supply and demand of policy advice: dangers in overemphasising the supply (or 'push') of advice in science–policy interfaces include risks of 'losing [policy] relevance and being ignored by policy makers', and conversely exaggerating the demand side risks 'losing credibility, [a] sense of independence and/or [the] ability to communicate emerging issues' (Sarkki et al., 2015).

Getting these balancing acts 'just right' – and reaching the Goldilocks zone – strengthens resilience, but it requires flexibility, iterativity, dynamic fluidity and a diverse variety of science–policy interaction and stakeholder involvement.

It seems that whilst researching science–policy interfaces related to SD policy, one is most likely to find oneself navigating through a grim mixture of dead links, inactive or abolished institutions, outdated information and unused e-mail addresses. However, more than anything else, this should be taken as an incentive to further study SD science–policy interfaces and good practices for knowledge dissemination.

1.4 Research Objectives

Acknowledging the complexities of sustainable development and SD policymaking, this benchmarking study defines a heuristic typology of science–policy interfaces in sustainable development, taking account of the following:

- examining the ways in which scientific support is organised for sustainable development policies in a variety of national and international contexts (with case studies from Belgium, Finland, Germany, New Zealand, the Netherlands, the United Kingdom and European Commission-funded projects);
- offering a particular focus on how expert panels, councils and other scientific expert groups are used as supporters of SD policy-related science–policy interfaces;
- identifying good practices for science–policy interaction and cases of effective knowledge dissemination.

Importantly, this study is also intended to address the systematic lack of discussion on the role of science in sustainable development policies. For example, the official Agenda 2030 document (UN General Assembly, 2015) does not significantly[3] address the role of science–policy interfaces in advancing national sustainable development policies. Similarly, the recently published National Voluntary Reviews[4] for the High Level Political Forum seem to include very little (if any) discussion on the role of science in realising the sustainable development goals.

Unfortunately, during the process of writing this study it also appeared increasingly evident that enhancing the dissemination of scientific knowledge into sustainable development policies is not a prime agenda in most OECD countries and consequently truly innovative approaches or case studies were difficult to find. Indeed, it seems that whilst researching science–policy interfaces related to SD policy one is most likely to find oneself navigating through a grim mixture of dead links, inactive or abolished institutions, outdated information and unused e-mail addresses. However, more than anything else, this should be taken as an incentive to further study SD science–policy interfaces and good practices for knowledge dissemination.

Also, due to the dearth of SD policy-advising bodies and agencies, this study includes case studies which are not purely SD-related; however, since the 'hows' of science–policy interfaces are more important than the 'whos' (i.e. we can learn from modes of operation even if it the operating body is not thematically relevant), this is perfectly justified.

3 Agenda 2030 does include (paragraph 70, see UN General Assembly, 2015) the launch of a 'Technology Facilitation Mechanism', or a multi-stakeholder forum for the promotion of science and technology development and transfer at the UN level. However, the initiative seems heavily biased towards technological resolutions for SD, and has little to do with improving national and local levels of science–policy interfaces.

4 See: https://sustainabledevelopment.un.org/hlpf/inputs

Moreover, with these cases it is appropriate to consider how working models found in other thematic fields could be integrated to enhance SD SPIs.

This study progresses as follows. First, in Section 2, seven models of science–policy interfaces (Independent, Assignment, Integrated, Nested, Adviser, Platform and Mixed models) are identified in a comprehensive typology of science–policy dynamics, with one to four case studies provided for each model. This typology is not intended to propose that static ideal-type models for science–policy interfaces do or should exist, and indeed most of the case studies contain features of more than one model (this is highlighted especially with the last, Mixed, model). However, a heuristic typology can be an effective and pragmatic tool for comparative analysis. In Section 3, a variety of 'outlier' cases are presented, illustrating some more innovative or smaller-scale approaches on science–policy interaction, particularly involving public and stakeholder participation. In Section 4, the models are set into a comparative context, identifying their strengths and weaknesses and providing a framework for the optimisation of SPI operating models. Section 4 also considers how different SPI models can complement each other's weaknesses, suggesting that an interconnected diversity of SPI actors might be required within a national context. Section 5, the final section of this study, sets the findings of this study to a forward-looking context, asking in particular what we can learn from past experiences to further develop SPIs and SPI networks.

2 Science–Policy Interfaces for Sustainable Development Policies

SCIENTIFIC SUPPORT is organised for sustainable development policies in many ways, often depending on the amount of available resources and political will, the political culture and pre-existing institutional frameworks. It naturally follows that no single science–policy interface model is prescriptively better or more impactful than the next one, with a myriad of variables and contextual factors affecting what works and what does not (some of these factors are discussed in more detail in Section 4.1). However, by identifying good (and, just as importantly, not so good) practices, expert groups involved with sustainable development policies can seek to learn and further develop their operating models. Indeed, by defining a **typology for sustainable development-related science–policy interfaces**, this section is intended to help identify the broad generalities of how science–policy interfaces operate, as well as highlight the benefits and challenges of these working models. Moreover, this section serves as a database for relevant SPI actors, particularly importantly so since these actors have not been comprehensively listed elsewhere.

Accordingly, via a combination of descriptive and critical assessment, the following sections discuss potential pathways for impactful scientific support and potential hazards and pitfalls in the process. However, since most expert groups/bodies are, for various reasons, not commensurable with each other, this paper is not focused on quantitative analysis of impact (i.e. case A is more impactful than case B) and instead focuses on how different science–policy interactions and dynamics occur and what can possibly be learned from them.

In all, six models of science–policy interfaces for sustainable development policies are identified in the comprehensive typology.

1. **The Independent Model**: independent groups or panels of experts conducting scientific advice, assessment and monitoring.
2. **The Integrated Model**: groups of experts integrated into the governmental sphere, consisting not only of scientific experts but also of parliamentarians, political decision-makers and other stakeholders.
3. **The Assignment Model**: cases where demand-driven scientific support is provided for policymakers by task forces when required.
4. **The Nested Model**: cases where scientific support is organised for policymakers via thoroughly institutionalised arrangements of nested expert hierarchies (often research institutes).
5. **The Adviser Model**: scientific advisers directly informing the highest political actors (often aided by secretaries and other bodies).
6. **The Platform Model**: deliberative and co-productive knowledge brokering arenas for science–policy interaction often organised by third parties.

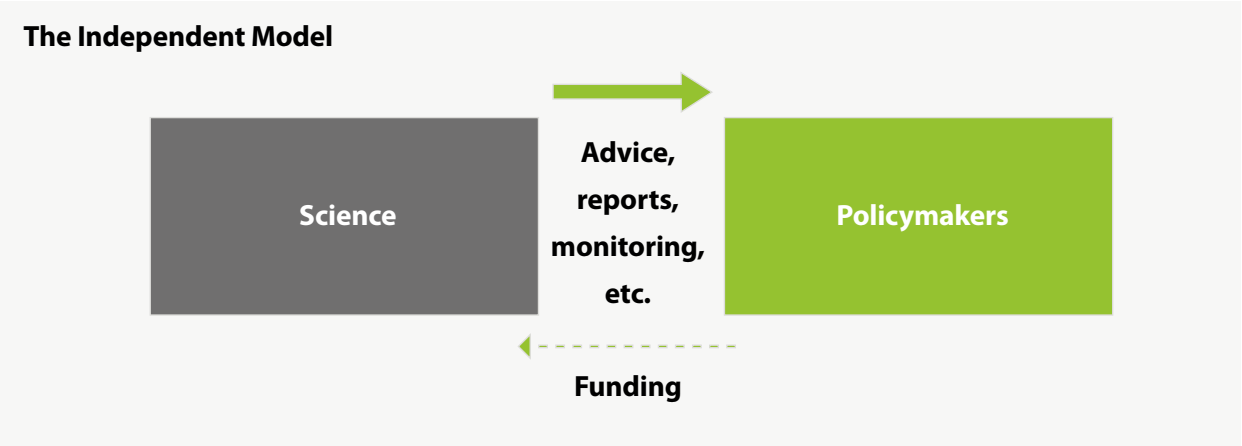
Moreover, a seventh model – **the Mixed Model** – is also discussed, to assess hybrid models which do not fit neatly into one slot and have features of two or more of the six models above. Whilst SPIs almost always share minor traits with more than one model type, some cases exist where the diversity of operating models is blatantly too broad to satisfactorily fit them under one model.

Indeed, before going into further detail, it should be noted that these models are merely ideal types separated for analytical purposes, with the typology mainly intended to aid comparative analysis and provide concise insight into the wide-ranging possibilities of SD science–policy interfaces. Most case studies below share traits from multiple different models and, as has already been noted, developing an effective science–policy interface for a problem as complex as sustainable development is necessarily an iterative learning process which cannot rely on static operative models. However, with the help of the 'static typology' I intend not only to illustrate what is done to improve networking and knowledge diffusion between scientists and decision-makers, but also to provide insights on the possibilities of what can be done. This helps both the identification and implementation of alternative modes of operation and provides insights on how features from one model might be integrated into another. Accordingly, a mixture of these models might prove to be both the most resilient (i.e. temporally and politically stable) and socially robust interface between science and policymakers (this shall be returned to in Section 4).

Furthermore, it is worth stating that whilst the models below are shown to have their respective strengths and weaknesses, this does not imply that these features are reflected on a national scale. In other words, in countries where sustainable development-related SPIs are strongly institutionalised (for example, in Germany, the Netherlands, Belgium and Finland), different models of SPIs have been formed to complement each other's weaknesses. Of course, in these cases the interactions and synergies between these institutions are what truly define the outcome regarding sustainable development policies, and developing these interconnections and co-operative measures is a particularly important task.

In the following sections each of the six (plus one) models are described and their possible challenges and benefits analysed, with one to four case studies provided for each model. In order to avoid unnecessary repetition and duplicates, the case studies have been chosen to represent varying approaches, although for the reader's interest an 'info box' can be found at the end of each sub-section, containing relevant information on other similar cases, making this study also a database for SD-related SPIs.

2.1 Independent Model: Scientific Advisory Groups and Expert Panels



Picture 2. The Independent Model for the science–policy interface.

Independent advisory panels, councils and expert groups are some of the more intuitive means of organising expert or scientific support for sustainable development policies, and indeed this model has strong historical roots and is one of the more common ways of disseminating scientific knowledge into policymaking. This model, sometimes referred to as the 'push' model of science–policy interaction (Dilling and Lemos, 2011), often relies on (variably) independent scientific bodies 'pushing' scientific knowledge and advice towards the policy sphere, although roles are usually not restricted to this linear dimension. A caveat to the 'push' title is, of course, that more often than not these expert panels are commissioned and/or funded by governmental bodies (in other words, historically, the dynamic is often more 'pull' or demand-driven). Regardless, these expert panels – either as part of governmental bodies, research institutes or in a non-affiliated capacity – generally enjoy significant degrees of independence and freedom, serving to various degrees the roles of:

- **reporter** – reporting to policy actors on relevant, current or acute scientific matters;
- **watchdog** – providing critiques and monitoring policy practices;
- innovative **think tank** – providing policymakers with novel scientific perspectives based on holistic and multidisciplinary long-term points of view;
- **deliberator** – facilitating societal dialogue on sustainable development policies, consulting stakeholder groups and civil society; or
- **strategist** – encouraging and stimulating good practice strategies (based on Niestroy, 2007a).

Moreover, Niestroy (2007a: 79) notes that independent council members are 'typically asked to act on the basis of their expertise and stakeholder background, and not to negotiate for the positions of their home organisations', and that 'experience and analysis suggest that the independent, deliberative type of sustainable development council is preferable to a representational one'. Indeed, the freedom from institutional constraints supports creativity, out-of-the-box thinking and critical points of view.

The freedom from institutional constraints supports creativity, out-of-the-box thinking and critical points of view.

The means of impact for independent expert panels is generally a mixture of:

1. comprehensive reviews of government policy (or reviews or foresight on broader social phenomena);
2. concise policy briefs and fact sheets;
3. stakeholder involvement and workshops; and
4. an authoritative presence in the media and the political environment.

Yet for most panels and other independent bodies (e.g. WBGU in Germany; see case 1), by far the most prolific mode of impact is reporting, with reports varying in length from pamphlets of a few dozen pages to lengthy publications of several hundred pages. Whilst, at times, such reports can be greatly influential and even paradigmatic – as was, for example, the case with Tim Jackson's 'Prosperity Without Growth', a report commissioned by the United Kingdom's abolished (see Section F1 above) expert panel, the Sustainable Development Commission – their cost-effectiveness and rationale can rightly be questioned. As Niestroy (2007a: 72) notes, comprehensive reviews and reports have a tendency to be 'opaque and/or confusing' as a result of:

a. the complexity of sustainability issues, and their nature as 'moving targets', with new priorities often evolving suddenly; and
b. 'their comprehensiveness so that a reader looking for an overview and orientation gets completely lost'.

Moreover, this pushing of scientific knowledge towards the policy arena might result in the production of information which 'may be seen as useful by scientists, but ultimately not usable by users' (Dilling and Lemos, 2011: 682). Indeed, the amount of labour-intensive publications gathering dust in barely accessible archives suggests that considering more adaptive responses with faster turnarounds (e.g. policy briefs, fact sheets, blogs and social media responses), as well as co-productive and co-creative methods (for example, participatory workshops and other deliberative processes), should be considered to, at the least, supplement these sometimes monumental research efforts.

Indeed, a particular challenge for Independent Model SPIs is the design of co-creative and co-productive approaches instead of relying too heavily on reporting and other linear knowledge dissemination. This is because the lack of deliberative and participatory platforms in a reporting-biased approach might result in the political neglect of this 'information/"evidence" on a platter', and certainly the cost-effectiveness and socio-cognitive efficacy of this approach can be cast in doubt (in other words, are the reports really assimilated and acted upon?). To sum up, whilst independent panels most often fulfil the aforementioned four roles of reporter, watchdog, think tank and strategist, their working models' capacity to act as public deliberator can often be questioned. Complementing reporting with co-productive platforms (see Section 2.6) and workshops might be a way to enhance the effect on political actors, public transparency and social robustness.

Generally, independent panels have a stable elected or delegated membership, although there seems to be no dogmatic reasoning as to why this should be the case. Evidently, however, the trade-off in member composition is between a) the group cohesion and unity, as well as the

This pushing of scientific knowledge towards the policy arena might result in the production of information which 'may be seen as useful by scientists, but ultimately not usable by users'.

perhaps increased productivity and louder voice of static-membership panels (e.g. WBGU, see case 1), and b) the dynamic fluidity, adaptability and multidisciplinarity of ad hoc groups formed from a broad pool of experts (for example, the expert groups of New Zealand's Royal Society; see case 7). A middle ground in member composition is also a possibility; for example the Dutch Council for the Environment and Infrastructure (RLI, see end of Section 2.2) combines a static set of permanent members with a complementary dynamic pool of expert associate members. The obvious challenge for static-membership panels is that the limited number of members almost necessarily entails limited capabilities and scientific perspectives (and, most likely, subject-specific bias), whereas ad hoc panels are likely to lack the longevity and stability to serve the watchdog role expert panels are often expected to play.

Moreover, independent panels necessarily require that the government or other policy actors are willing to listen and co-operate. Whilst this is often, at least to some extent, ensured by the fact that many panels are originally established or funded by governmental institutions themselves, variances in national political cultures seem to play an important role in how much experts are truly listened to (see Niestroy, 2005).

Another interesting observation is that often independent SD expert panels are biased towards the natural and environmental sciences (particularly climate and biodiversity sciences, and natural conservation), and only rarely foster more holistic perspectives on sustainability. An explanatory factor here is the fact that the 'mothers' of many sustainable development expert panels and/or research institutes were environmental policy committees influenced by the environmental 'awakening' of the 1960s and 70s, and which were further institutionalised in the early 1990s (post-Rio Earth Summit) (Niestroy, 2007a). However, the lack of integrative and holistic perspectives on sustainable development seems to more importantly (and, perhaps, worryingly) indicate that sustainable development is often still regarded merely as an environmental concern, detached from social and economic discourses.

Another interesting observation is that often independent SD expert panels are biased towards the natural and environmental sciences (particularly climate and biodiversity sciences, and natural conservation), and only rarely foster more holistic perspectives on sustainability.

Benefits	Challenges
Independence enables scrutiny of government policy and 'speaking out about perceived unsustainable policies and practices'.	Having true influence and impact over decision-makers and policies. Reporting and other linear means are often not enough to have real impact.
Can be very representative scientifically, offer multiple perspectives and have strong connections to substantial stakeholder networks at the subnational level.	Integrating enough perspectives on sustainable development, particularly 'ensuring interests and expertise that go beyond environmental issues'.
Independence allows for strong autonomy in identifying sustainable development challenges.	'Having representatives of a high enough status and standing'.
Scientific authority might put pressure on decision-makers, particularly if panels are in direct contact with governmental actors.	Securing long-term and politically resilient funding and ensuring longevity. Funding from external sources increases risk of being politically compromised.
	Being a 'critical friend' without being perceived as a nuisance.

Quotes from Osborn et al., 2014

Table 1. Benefits and challenges of the Independent Model for science–policy interface.

However, the lack of integrative and holistic perspectives on sustainable development seems to more importantly (and, perhaps, worryingly) indicate that sustainable development is often still regarded merely as an environmental concern, detached from social and economic discourses.

Case 1: German Advisory Council on Global Change, Germany

Themes	Global environment and development problems
Means of impact	Reviews, recommendations for action and public communications
Funded by	The Federal Government of Germany
Networks	The European Environment and Sustainable Development Advisory Councils (EEAC)
URL/Source	www.wbgu.de/en/

The German Advisory Council on Global Change (WBGU), set up by the German Federal Government in 1992 following the Rio Earth Summit, is an independent scientific advisory body with the mandate to 'periodically assess global environmental change and its consequences and to help all institutions responsible for environmental policy as well as the public to form an opinion on these issues'. The council's main objectives are to:

1. **analyse and report** on global environment and development problems, identifying planetary 'guard rails' that should not be crossed;
2. **review and evaluate** national and international global change research;
3. **provide foresight** on new socio-ecological phenomena;
4. **identify** gaps in applicable scientific knowledge and to initiate new research;
5. **monitor and assess** national and international policies for the achievement of sustainable development (the watchdog role);
6. **develop recommendations** and good practices for action and research;
7. **raise public awareness** of global change issues and increase media visibility.

Moreover, the council's nine members are all respected academics (in fact, as of July 2016, they are all professors) and consequently possess a considerable amount of prestigious authority. The council meets 11 times a year for two-day meetings and is appointed for a term of four years by the Federal Cabinet. The council is supported administratively and scientifically by a secretariat of 10 members, including six scientists.

Many of the aforementioned objectives are realised through a wide range of publications and reports varying in both size and scope. All publications are free and available as online PDF files, as well as paper copies. The most prominent of these reports are WBGU's flagship reports (books of 200 to 400 pages), published every two years (as the 'World in Transition' series) on themes of the council's choice. These flagship reports provide in-depth scientific inquiries on an impressively holistic variety of global change-related themes (for example, climate change, poverty, energy systems, environmental risks and marine governance). These reports are generally responded to by the federal government, which also distributes them as official papers to members of the Federal Parliament and Council. Whilst the reports are publicly available for anyone to read, a key factor to their political and social impact is this co-operation on the federal government's behalf – a factor that outside of the mutualistic and deeply rooted German sustainability culture would most likely not be counted on.

In addition to the independent flagship reports, the German government can also commission the council

to prepare special reports. Whilst not exactly aimed at 'moving targets', these 50- to 100-page booklets are published as the need arises on a variety of policy-laden themes such as climate protection. The two more dynamic and ad hoc publication channels are WBGU's policy papers (short, approximately 20-page, texts focused on issues requiring more urgent policy action, often produced prior to key conferences) and four-page fact sheets which provide quick overviews on themes related to WBGU's broader publications. Furthermore, some more innovative publications are WBGU's 140-page fully illustrated comic 'The Great Transformation', perhaps targeted at younger audiences, and the animated short film Human Power, explaining the concept of planetary guard rails. Indeed, the sheer scope and range of WBGU's publications reflect the work of a strong administrative staff and a large budget.

That is not to say that WBGU's modus operandi is strictly limited to publications: WBGU has organised conferences and other events (although event organisation is clearly not at the top of their agenda) and WBGU's policy recommendations are presented at parliamentary evenings, Bundestag committees, scientific conferences and United Nations conferences, resulting in moves from 'linear' knowledge diffusion to more participatory approaches.

See also

The European Environment and Sustainable Development Advisory Councils (EEAC):
http://eeac- network.eu/

The German Advisory Council on the Environment (SRU): www.umweltrat.de/EN/TheGermanAdvisoryCouncilOnTheEnvironment/Council/mission_node.html

Scientific Advisory Board of the UN Secretary-General, a UN-level sustainable development expert panel: http://en.unesco.org/un-sab/

Sweden's Scientific Council for Sustainable Development (Vetenskapligt rad för hållbar utveckling, VRHU) a multidisciplinary advisory panel operating under the Ministry of Environment and Energy with no official mandate. The council's objective is to be 'an arena for dialogue between the government and the scientific community and should provide a basis for the Government's work with long-term and strategic sustainability issues'. The council is a panel of eminent scientists representing various multidisciplinary and cross-sectoral approaches (including chemistry, philosophy and future studies, hydrology, environmental policy, economics and geography). Since it is a new council (appointed in July 2015), based in a country with a good SD track record, its development is particularly interesting to keep an eye on: www.sou.gov.se/jo-1968a-vetenskapligt-rad-for-hallbar-utveckling/

Council for Sustainable Development in Catalonia:
http://cads.gencat.cat/ca/inici/index.html (in Catalan only)

The European Commission's Science Advice Mechanism (SAM) and **the SAM High Level Group (HLG, expert panel):**

SAM: http://ec.europa.eu/research/sam/index.cfm?pg=about

HLG: http://ec.europa.eu/research/sam/index.cfm?pg=hlg

European Economic and Social Committee's (EESC) Sustainable Development Observatory:
www.eesc.europa.eu/?i=portal.en.sdo-observatory

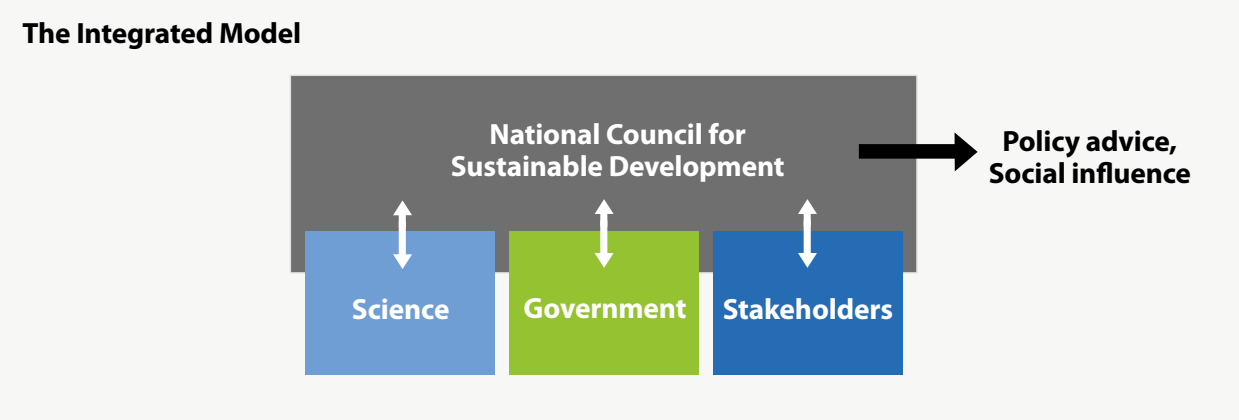
The UN International Resource Panel:
www.unep.org/resourcepanel/Home/tabid/133178/Default.aspx

The Spanish Observatory of Sustainable Development:
www.observatoriosostenibilidad.com/ (in Spanish only)

The Committee on Climate Change,
the United Kingdom: www.theccc.org.uk/

The Finnish Climate Panel:
www.ilmastopaneeli.fi/fi/in-english/

2.2 Integrated Model: Experts within Government



Picture 3. The Integrated Model for the science–policy interface.

The Integrated Model as defined in this study is in essence much like the Independent Model described in the previous section, with the exception that integrated councils operate one step closer to governments (or heads of state) and include within their membership parliamentarians, ministers, public officials and stakeholders. The difference mainly lies in tonality, with the Independent Model being more scientific of the two, and the Integrated Model being more inclusive of decision-makers and stakeholders. Regardless, the objectives and tasks of these two models are very similar, and distinction between the two is often synthetic. However, the two models do come with a different set of benefits and challenges. Whilst the integration of an expert panel into the governmental policy sphere does not necessarily entail loss of independence, this seems to be often implied in their work. In other words, operating a step closer to the government might result in the critical watchdog being tamed and inhibit non-conventional perspectives from being heard, although direct contact with the highest governmental actors and stakeholders has its obvious benefits regarding political and societal impact. Political impact might, for example, be ensured by governments being legally obliged to respond to the advice of integrated councils – this is the case in Belgium (FRDO, see case 3) and the Netherlands (RLI, see the end of Section 2.2).

Integrated models are often referred to in research (see for example Osborn et al. 2014; Niestroy 2005; 2007a) as National Councils for Sustainable Development (NCSDs). These panels are intended to promote sustainable development at a national level, although strictly speaking bundling all the NCSDs into one group (as is often done) seems at times counter-intuitive since the memberships and modes of operation of these councils vary significantly. For example, in Canada, the Sustainable Development Advisory Council (SDAC) is assembled and chaired by the Minister of the Environment; in several other countries (like Chile's Consejo de Ministros para la Sustentabilidad) the NCSD consists purely of ministers, whereas Germany's NCSD (see case 3 below) is chaired by a member of the religious society and is relatively independent in its operation. The Finnish National Commission on Sustainable Development, on the other hand, is geared towards stakeholder participation, providing a deliberative platform for policymakers, government officials, stakeholders and the scientific community. Indeed, the role of researchers and science representatives involved is a particularly important factor to consider here: to what extent does science–policy–stakeholder interaction enrich or impoverish scientific perspectives and knowledge diffusion, and what role does scientific knowledge have in this integrative whole? Moreover, many of these institutions originally labelled NCSDs were decommissioned at the dawn of the 2010s (see Section 1.3 above), thus somewhat endangering the whole concept of the NCSD.

The closer proximity to government enhances the 'potential for bridging the often perceived gap between government and non-governmental actors, as well as between science and policy-making, and for communicating collective views and knowledge of civil society to the government' (Niestroy, 2007a: 79). On the other hand, as has already been hinted at in the introduction to this study, the inclusion of (current or former) parliamentarians and public servants on the expert

panel might steer the council too close to the 'status quo' of governmental policy and stifle critical and creative voices, as well as endanger the council's longevity (as a result of it being, post-election, identified with previous governments), although this is by no means a deterministic fate of integrated councils.

Therefore, the mixed memberships of integrated councils, whilst often impressively participatory, come with obvious challenges. Indeed, contrary to independent panels, the members of representational councils are often not fully divorced from their background organisations and may have the incentive to act with vested interests in mind. Accordingly, different interest groups within councils might have varying opinions on, for example, the preferred role and agenda of the council. Almost certainly, organising mixed membership expert advice this close to central government also carries the risks of 'dominance of government voices over those of stakeholders', 'siloed thinking' and a lack of a critical voice (the watchdog role) (Osborn et al., 2014: 5). Moreover, integrated councils should also seek to ensure that a broad enough variety of scientific voices are heard in the SD policy advisory process. Regardless, the integrated councils' close relations to government departments, facilitated by the participation of government members and perhaps even legal obligations in the advisory process, have been noted to be at best effective, constructive and open (Niestroy 2006: 92-93).

Operating a step closer to the government might result in the critical watchdog being tamed and inhibit non-conventional perspectives from being heard, although direct contact with the highest governmental actors and stakeholders has its obvious benefits regarding political and societal impact.

Benefits	Challenges
Likely to be broadly representative, involving various stakeholder groups.	Avoiding the dominance of government voices over those of stakeholders and scientific experts. Facilitation and moderation is required.
Close relations with government officials facilitate political impact. Major public figures involved have a strong authoritative voice.	Avoiding siloed thinking and keeping track of broader sustainability issues.
Governmental bodies can facilitate greater public and stakeholder participation.	Lack of sufficiently broad scientific expertise to address complex sustainability problems.
Access to significant budgets and consequent possibilities for innovative large-scale approaches.	Co-existence with governmental bodies compromises autonomy and longevity and might silence critical voices.

Based on Osborn et al., 2014

Table 2. Benefits and challenges of the Integrated Model for the science–policy interface.

Case 2: The Federal Council for Sustainable Development, Belgium

Themes	Sustainable development on various themes, particularly from an international perspective
Means of impact	Government advice and involvement, seminars and workshops, minor publications
Funded by	The Federal Government of Belgium
Networks	Global Network of National Councils for Sustainable Development, The European Environment and Sustainable Development Advisory Councils (EEAC)
URL/Source	www.frdo-cfdd.be/en

The Federal Council for Sustainable Development (FRDO-CFDD, FRDO in Dutch and CFDD in French) is a mixed membership SD advisory body for the Belgian Federal Government, which co-ordinates Belgium's federal policy on sustainable development. FRDO-CFDD also aims at including the civil society in the making of Belgium's federal policies on sustainable development. The council, whose predecessor the National Council for Sustainable Development was formed in 1993, has its roots in the Rio Conference of 1992 and has particularly focused on fulfilling Belgium's international commitments, including Agenda 21, the Framework Convention on Climate Change, the Convention on Biological Diversity and, recently, Agenda 2030 and the Sustainable Development Goals. FRDO has operated with its current legal mandate since 1997 (the Belgian Act of 5 May 1997 on the Co-ordination of Federal Sustainable Development Policy).

FRDO-CFDD has a diverse membership, with a total of 24 members with voting rights and dozens of other members. Members with voting rights include representatives from environmental and development NGOs (for example, WWF and Oxfam), labour unions and employers' organisations, youth organisations, and ex-politicians. Other non-voting members include Belgium's King Philippe, ministerial staff, representatives from consumer protection groups and women's organisations, and professors and scientific advisers. Moreover, other observing members are included from a variety of Belgian public agencies and economic, social and environmental advisory bodies.

The council states the following objectives as its statutory duties.

- **To advise** the government on all measures concerning federal policy on sustainable development and to take part in policy dialogue with members of the government.
- **To serve as a forum** for the exchange of ideas on sustainable development. This includes the organisation of dialogues with stakeholders in preparation for the drafting of opinions within the statutory bodies, working groups and forums.
- **To provide information** and raise awareness about sustainable development among citizens, individuals and public bodies. This mainly takes the form of study days, the sustainable development press award, and publications.
- **To conduct research** in all areas relating to sustainable development.

The council's research activities are supported by five working groups (Strategies for sustainable development, Energy and climate, International relations, Product standards, and Biodiversity and forests) headed by its member professors. The council gives policy advice at the demand of ministers, secretaries of state or the parliament, or alternatively on its own initiative. In addition to policy advice, the government is legally responsible[5] to state the actions taken on the basis of the advice and, if none are taken, the reasons for deviation (Niestroy, 2005: 91).

The council produces brief bulletins and updates, informing the general public of its policy advice, dossiers and research studies (supported by the working groups), as well as an annual report. Moreover, the council organises seminars, round-table discussions, biannual lunch talks and a major annual forum. These events are intended to promote discussion and cohesion between the members (that is, various stakeholders from different and sometimes conflicting sectors), to strengthen public support for sustainable development as well as to co-ordinate the council's policy advice. Stakeholders within the council are on an equal footing and consensus is usually aimed for, even if it is not always achieved. The council has been a success overall and its relationship with government departments, facilitated by the participation of government representatives and legal obligations in the advisory process, has been particularly effective, constructive and open (Niestroy 2005: 92-93).

5 A similar legal obligation is found in the Dutch RLI's (The Council for the Environment and Infrastructure, see end of Section 2.2) as well as WRR's (see case 5) operation.

Case 3: The German Council for Sustainable Development, Germany

Themes	Promoting sustainable development in Germany, environmental conservation, economic development and social cohesion
Means of impact	Direct advice to the federal government, involvement with national sustainable development strategy design, policy and indicator proposals, promoting public discussion on SD
Funded by	The federal government; budget of 2.48 million euros in 2016
Networks	Global Network of National Councils for Sustainable Development, The European Environment and Sustainable Development Advisory Councils (EEAC) and other science and research networks
URL/Source	www.nachhaltigkeitsrat.de/en/

The German Council for Sustainable Development (RNE), established in 2001, is an advisory body for sustainable development operating on the mandate of and reporting back to the German Federal Government. The council was given a new mandate in June 2013 directly by Chancellor Angela Merkel. Appointed ad personam for three-year terms, the council consists of 15 public figures, including ex-parliamentarians and ex-ministers, business leaders, professors and academics, operating somewhat closer to the federal government than WBGU (see case 1). RNE is not, strictly speaking, a scientific expert panel, which is also reflected in its modes of operation. RNE seeks to make sustainable development a fundamental goal in all political, economic and societal areas, and develops in particular contributions to the national sustainable development strategy. Whilst RNE does occasionally produce studies and its individual members write topical contributions to sustainability issues, RNE mainly works towards citizens living sustainable lifestyles and 'seeks to broaden the discussion on sustainability within society and to make the outcomes of this more effective and more binding'. The work of RNE is supported by a general secretary and his staff.

Specifically, the federal government entrusts RNE with the following.

- Contributing to the national sustainable development strategy 'by responding to questions raised by Government or, additionally, choosing independent agenda points'. RNE has co-developed Germany's national strategy for sustainable development in critical dialogue with the federal government as well as other political, economic and social stakeholders.
- Proposing 'concrete areas for action and projects', as well as presenting proposals for sustainable development targets and indicators. Niestroy (2005: 146) notes that RNE has also been characterised by 'open brainstorming' on a wide range of sustainability issues.
- 'Boosting public discussion on sustainability.'

In other words, next to policy advice, RNE (in moderate contrast to the case 1: WBGU) fosters more inclusive means for science–policy–society interaction than mere linear research output, and includes a variety of stakeholder voices in the process of social dialogue. Accordingly, RNE states that its objective is 'to increase the level of awareness among all concerned and the population as to what sustainable development actually means by demonstrating the consequences of social action and discussing possible solutions'. RNE is a well-known and respected advisory body, and according to an RNE representative the Council's website has a monthly average of 200 000 visitors which result in some 6 million hits per month. RNE's newsletter has 11 000 subscribers.

RNE operates a variety of projects and dialogues to realise its social impact. By means of these projects RNE aims to invite the broader public to 'deal with the issue of sustainable development in a creative way'. Current projects include the following.

- **The Sustainability Code** – a flagship project established in 2010 aimed at benchmarking sustainable management in both German and (more recently) European arenas. The code operates on a voluntary basis, with companies writing (on a form covering 20 criteria for sustainability) the 'Declaration of Conformity with the Sustainability Code', explicitly stating how they meet sustainability standards and, if not, why (in other words, a principle of 'comply or explain'). Essentially, the code plays the

role of a public transparency standard, where companies benchmark their sustainability performance against other similar corporate entities. Participating organisations are awarded a 'signet', or a badge, which allows companies to go public with their compliance with sustainability standards.[6] The code is also used by investors in order to steer capital towards sustainable enterprises. RNE has also developed, with the assistance of external partners, a 'code training concept' to help companies complete the code application. At the beginning of 2016, following a several month long development process with some 50 higher education experts, RNE decided to launch a beta version of the Sustainability Code for Higher Education Institutions.

- **The Sustainability Code** has largely been a successful operation, with more than 50 major companies involved (from well over 150 total signatories). See www.sustainabilitycode.org/ for further information.
- **The Sustainable Shopping Basket** – a booklet (in English and German), a website and a mobile application, intended to inform consumers about making sustainable consumption and lifestyle choices. The basket includes information on both mundane consumer choices (like groceries) and rare consumer choices (like cars) and a seasonal vegetable and fruit calendar, as well as more general information on sustainability, tapping innovatively into the 'momentum in the scientific, political and business driven discussion' on sustainable consumption. However, the mobile application, released on various platforms in 2015, has received mixed feedback (based on an overview of application store reviews), which highlights the need for excellent product design, user interfaces and marketing when designing youthful sustainability applications.
- **The 'Sustainable City' Dialogue** – an inclusive discussion forum for 20 mayors of German cities facilitated by RNE. The dialogues centre on strategic issues on the theme of the 'Sustainable City', exchanging information on political decision-making strategies, as well as 'pursuing the question of how municipal sustainability policy can enhance its profile and influence at the federal level'. The dialogues have resulted in reports and publications (for example, a major publication entitled 'Making the Energiewende a success story thanks to strong local authorities'), promoting in particular the utilisation of local self-administration as an innovative and practical solution for the German energy transition and other sustainability issues.

RNE also hosts a variety of workshops as well as a major annual conference (attracting approximately 1,000 people) for sustainable development, attended by Chancellor Merkel herself. RNE has also organised a variety of idea competitions on, for example, sustainable corporate governance and intergenerational dialogue on sustainable development. In particular, RNE's inclusive means of bridging science, society, business and policy signify an innovative move from linear output to deliberative modes of knowledge co-production.

6 A similar incentive can be found in the Finnish Commitment to Sustainable Development (https://commitment2050.fi/).

See also

The European Environment and Sustainable Development Advisory Councils (EEAC): http://eeac- network.eu/

The Global Network of National Councils for Sustainable Development for lists of NCSDs from dozens of countries (the network, unfortunately, seems somewhat inactive and much of the information is outdated and many participant institutions have been abolished or discontinued): www.ncsds.org/

The European Sustainable Development Network (ESDN). ESDN's 'Country Profiles' provide information on NCSDs: http://www.sd-network.eu

The Council for the Environment and Infrastructure (RLI), the Netherlands: http://en.rli.nl/

The Interdepartmental Council for Sustainable Development, Belgium: www.cidd.belgium.be/fr (in French and Dutch only)

The National Commission on Sustainable Development, Finland: www.ym.fi/en-US/The_environment/Sustainable_development

Parliamentary Advisory Council on Sustainable Development, Germany: www.bundestag.de/en/committees/bodies/sustainability

Environmental Audit Committee, United Kingdom: www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/role/

CNADS, Portugal (English website is outdated): www.cnads.pt/en/

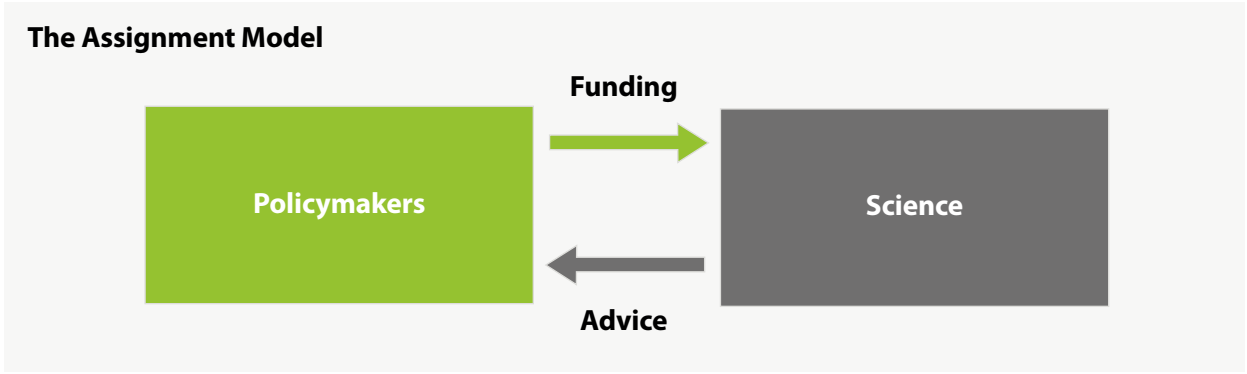
Hungarian National Council for Sustainable Development: http://nfft.hu/en/

The National Economic and Social Council (NESC) of Ireland: www.nesc.ie/

The French National Council for Ecological Transition: www.developpement-durable.gouv.fr/

Minaraad, the Environment and Nature Council of Flanders: www.minaraad.be/ (in Dutch only)

2.3 Assignment Model: Task Forces, Think Tanks and Consultancies



Picture 4. The Assignment Model for the science–policy interface.

The Assignment Model refers to demand-driven instances where governments or other policymakers seek outside advice for sustainable development policies. These outside parties can be, for example, private sector consultancies, public research institutes, universities or think tanks. Often advice consists of translation services, transcribing scientific knowledge to applicable policy advice/tools. This 'pull' model of science–policy interaction (Dilling and Lemos, 2011) is becoming more and more common as public institutions and advisory bodies are abolished (see Section 1.3) and subsequently replaced by private sector consultation services. Case 4 (Envirolink, New Zealand) below, however, illustrates how governments and regional bodies can also make use of pre-existing public research institutes in 'pulling' scientific policy advice.

Whilst the Assignment Model is an effective way of arranging small-scale and ad hoc policy advice with concrete 'evidence-informed' results, it does not come without risks and challenges. For one, the institutions demanding consultation (for example, governments) are not always aware of what information they particularly require and where exactly they need scientific advice. Moreover, Dilling and Lemos (2011: 682) argue that 'the downside of purely a ''demand pull'' model is that stakeholders may demand information which is not feasible to produce or scientifically robust'. In other words, scientific knowledge (or as it is sometimes, albeit controversially, referred to, 'evidence') which does not take into account the true complexity of the sustainability issue might be requested, and (particularly private sector) advisers often have vested interests or monetary incentives to come up with potentially artificial or overly simplified 'evidence'. This 'evidence' might also lack scientific quality assessment and, as a result of fast turnarounds, scientific evaluation processes might be cut short before widely distributed papers are published.

Moreover, in the Assignment Model the science and policy spheres still remain two separate systems, and again the mode of knowledge diffusion is rather linear: there is little deliberation, discussion or knowledge co-production when scientific knowledge is merely requested on demand. Even more so, there is no guarantee that policy advice is acted upon, particularly if the given advice does not fit with the demanding organ's agenda (Dilling and Lemos, 2011). Assignment SPIs' advice generally lacks the long-term continuity that sustainable development

This 'pull' model of science–policy interaction is becoming more and more common as public institutions and advisory bodies are abolished and subsequently replaced by private sector consultation services.

policy support requires (such as monitoring, being the watchdog for good practices, etc.) and they generally represent supplementary measures for regional-level SD policy rather than comprehensive science–policy interfaces for national-level sustainable development. Therefore, whilst the Assignment Model is a useful short-term tool for acquiring scientific assistance when required, it should at least be complemented by other models for more comprehensive, long-term and holistic policy advice.

The institutions demanding consultation are not always aware of what information they particularly require and where exactly they need scientific advice.

Benefits	Challenges
Concrete, short-term and potentially impactful advice summoned when required.	Do knowledge-demanding bodies know what they really need and whether the demanded knowledge is feasible?
No 'idling': policy advice is gained cost-effectively when it is most needed.	Specific policy advice risks siloed thinking and lack of multi-, inter- and transdisciplinary perspectives on sustainable development.
Can contribute to other, more comprehensive, models of science–policy interfaces.	Short-term advice lacks the longevity and vision which sustainable policies require.
Access to significant budgets and consequent possibilities for innovative large-scale approaches.	Risks of vested interests.
	Lack of knowledge co-production and heterogeneity of voices.
	Lack of scientific evaluation and quality assessment prior to publishing.

Table 3. Benefits and challenges of the Assignment Model for the science–policy interface.

Case 4: Envirolink, New Zealand

Themes	Improving science input to environmental management
Means of impact	Scientific advice and knowledge translation
Funded by	Ministry of Business, Innovation & Employment; 1.6 million NZ dollars (approximately 1 million euros) per annum
Networks	N/A
URL/Source	www.envirolink.govt.nz/

The Envirolink funding scheme in New Zealand is a prime example of scientific knowledge and advice being 'pulled' towards the policy sphere by public sector assignment. In all its simplicity, the scheme operates as follows: the New Zealand Ministry of Business, Innovation & Employment allocates Envirolink an annual budget of 1.6 million New Zealand dollars (approximately 1 million euros) to 'improve science input to the environmental management activities of regional councils'. Regional councils are eligible to apply for grants from Envirolink, with the caveat that these grants must be used to hire expert consultation services from pre-defined research organisations such as New

Zealand's Crown Research Institutes (New Zealand's corporatised centres of research excellence), universities or selected non-profit research organisations. These services include providing 'regional councils with advice and support for research on identified environmental topics and projects'. Research organisations have a large degree of independence regarding how this support is organised, but it generally involves communication between regional and national authorities, scientists, and the public (including New Zealand's native Maori communities) as well as the submission of a report with concrete practice recommendations.

Regional councils can apply for four types of on-demand Envirolink funding.

- Small advice grants (up to 5,000 NZ dollars), including expert consultation from research organisations to help regional councils identify information needs, receive advice on 'science techniques or meet training requirements'.
- Medium advice grants (up to 20,000 NZ dollars), including detailed expert consultation for specific projects and the application of existing scientific knowledge to policy.
- Large advice grants (up to 40,000 NZ dollars), which need to benefit more than one council.
- Tools development, or funding intended for the development or adaption of new or existing resource management tools.

After each project a questionnaire survey is issued, assessing the success of the project. This is basically a satisfaction survey where an average score out of 5 is calculated, with the average score for satisfaction having been high (4.6). However, should a project receive a score of under 3.5, Envirolink launches an investigation to understand the issues and to, in most cases, rectify the situation. Low scores have been rare, yet when they have occurred they have often been due to misunderstandings between councils and research providers as to what was required.[7]

A trial form of Envirolink started in 2005 and it is now a well-established investment scheme. This suggests that Envirolink's objectives of 'increasing the engagement of regional councils with the environmental RS&T sector' and 'contributing to greater collective engagement between councils and the science system' have generally been successful, and that the scheme has indeed succeeded in 'translating environmental science knowledge into practical advice'. This decentralised and locally adaptable form of policy advice is effective in bearing concrete and effective results and encourages regional councils to emphasise environmentally sound and scientifically informed policymaking. Moreover, the scheme encourages co-operation between New Zealand's research institutes, universities and regional-level decision-makers. Whilst Envirolink is mainly concerned with environmental issues, there is technically speaking nothing which prevents the design of similar funding schemes for other sustainability concerns.

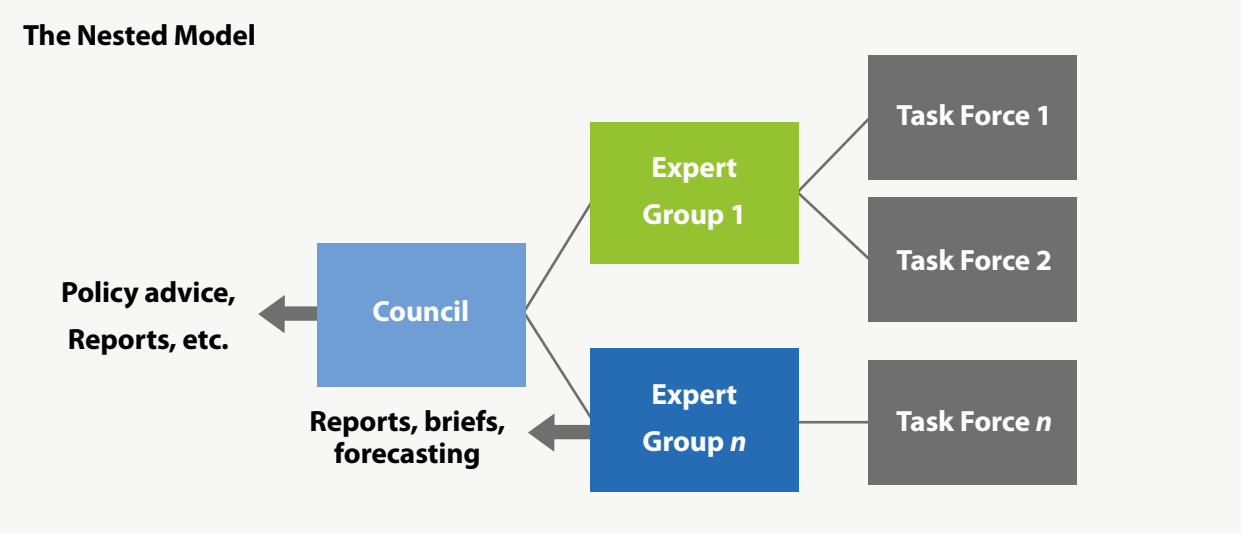
See also

Any sustainable development-related funding schemes, consultancies and think tanks, for example:

Sustainable Europe Research Institute (SERI):
www.seri.at/en/ueber/

7 Based on an online exchange with an Envirolink representative.

2.4 Nested Model: Research Institutes and Thematic Expert Groups



Picture 5. The Nested Model for the science–policy interface.

The Nested Model refers to expert bodies with several subgroups of experts. Here a higher level of expert – either a panel or a council of dignified members or the systemic body itself – is informed by working groups of lower-level experts, often working on varied thematic fields. For example, in Belgium, the Federal Planning Bureau (case 6), an advisory agency for the Belgian government, organises its work around 10 themes, providing necessary information for the bureau and the federal government. The Netherlands Scientific Council for Government Policy, studied in depth in case 5 below, and the Netherlands Environmental Assessment Agency (PBL) follow a similar logic of nested knowledge production and dissemination.

Whilst independent panels, such as WBGU (see case 1), do make use of supplementary scientific experts, the rationale for distinguishing the Nested Model (which could also be dubbed the Institute Model) from the Independent Model is its highly institutionalised structure and capability to integrate expertise on a broader thematic scale. Not surprisingly, this model is most often found where well-structured research institutes or expert communities are directly involved with the science–policy interface. Although these well-established structures for scientific advice generally require significant resources and funding – and thus the creation of new nested SPIs in the current economic and political climate is, to say the least, tricky – other models can learn from them, particularly with regard to their efficiency in utilising the co-operation of pre-existing public bodies (e.g. universities and research institutes) when producing expert advice for policymakers.

Not surprisingly, this model is most often found where well-structured research institutes or expert communities are directly involved with the science–policy interface.

However, similar to independent panels, these nested institutions often lack more deliberative and co-productive means of translating scientific knowledge into sustainable development policies and often rely heavily on linear research and publication output. Again, this might result in the production of information seen as useful by scientists, but not usable by policymakers (Dilling and Lemos, 2011: 682). It should be noted, however, that since nested SPIs are often research institutes, research output is basically what they are expected to do, with deliberative and stakeholder-inclusive SPIs found in other institutions within the national SPI framework. Yet, reporting-biased Nested Models might be somewhat overly optimistic about the prospect of these reports actually being read and taken into account in policy design. Having said that, however, policymakers are often included in the process of assembling these reports, and this might to some extent enhance knowledge dissemination capabilities.

Benefits	Challenges
Diversity of scientific perspectives. The Nested Model allows for a broad range of scientific expertise to be taken into account regarding complex sustainable development concerns.	Resource-heavy: the 'Nested Model' basically relies on pre-existing research institutes. With the current unstable economic climate, it might be unrealistic to establish Nested institutions 'from scratch'.
The nested hierarchy entails both close relations with government (for example by council members) as well as the independence and critical voice of expert groups (who are not directly responsible to the government).	'Chinese whispers' or the 'telephone game': relevant knowledge might be lost or misunderstood when disseminated first from lower experts to higher experts and then from higher experts to policymakers.
Strengthens co-operation between policy and pre-existing research institutes.	Lack of a clear unified, voice. Synthesising and co-ordinating the nested thematic groups might be complicated.

Table 4. Benefits and challenges of the Nested Model for the science–policy interface.

Case 5: The Netherlands Scientific Council for Government Policy, the Netherlands

Themes	Long-term direction of government policy
Means of impact	Reports and evaluation of sustainable development policies, foresight, sustainability indicators
Funded by	The Dutch Government
Networks	Close contacts and open dialogue with: Institute for Future Studies (IFFS, Stockholm), Centre d'Analyse Stratégique (CAS, Paris), National Economic and Social Council (NESC, Dublin) and The Bureau of European Policy Advisers (BEPA, Brussels)
URL/Source	www.wrr.nl/en/home/

The Netherlands Scientific Council for Government Policy (WRR) is an independent advisory body and think tank directly advising the Dutch government on a broad variety of matters relevant to governmental policy. WRR is not tied to a single policy perspective, and integrates a variety of themes of which several could be associated with a broad definition of sustainable development.

- Labour, welfare and care
- Sustainability and the living environment
- Economy, innovation and technology
- Globalisation and Europeanisation
- Governance, constitutional democracy and citizenship
- Education, culture and science.

The breadth of the thematic scope, however, results in the fact that WRR's nine council members – albeit

experts/professors in their fields, including finance and economics, law, administration, medicine, sociology and engineering – cannot be expected to solely report on these complex matters. Since the council is a working council (i.e. the council members participate in writing and reporting), the council is supported by a notable scientific staff (some 30 staff members, including professors, researchers, master's students and interns) as well as external experts.

Essentially, this results in a Nested Model of science–policy interaction where the government (and WRR itself) is informed by an expert council, who in turn are informed by subject-specific expert groups working on thematic projects. For example, under each of the aforementioned six themes, WRR operates interim project teams working on about a dozen active dossiers or subject-specific projects with titles such as 'Sustainable development: perspectives for strengthening the capacity to act', 'Health equality and inequality', 'The future of work' and, laconically, 'Food'. These dossiers are run in co-operation with WRR's partners, which include universities, research institutes, policymakers and other governmental advisory bodies. WRR also employs interim workforce from these cooperative partners, particularly from universities. Each dossier is led by council members but also chaired by a senior academic member (such as a professor) and supported by a range of junior members, including the services of master's-level students. WRR is therefore particularly successful in bringing research institutes, universities and policymakers into the same room.

This effective method of connecting the research society with a body directly responsible to the Government of the Netherlands was originally mandated by the act Establishing a Scientific Council on Government Policy of 30 June 1976. The council's working method is mainly based on writing advisory reports (usually in Dutch), which the Dutch government is legally bound to respond to. This establishes a solid ground for WRR's work. However, in order to increase adaptability and freedom, WRR can also write policy briefs and working papers, which the government can respond to yet have no legal obligation to do so. When finished, these reports, briefs and other papers are released as Amsterdam University publications.

WRR boasts an impressive publication and research capacity, and in the interim between project commission and publication a variety of studies are produced, including investigations, background studies, policy briefs and fact sheets. These interim reports are more efficient and dynamic at tackling moving targets and this translates into greater opportunities for giving advice both on request and on the council's own initiative. Adaptable and concise reports are released when deemed necessary, whilst detailed and expansive publications are centred on foresight and in-depth reviews. WRR also publishes studies, articles and essays. Moreover, WRR hosts a (somewhat inactive) blog, and is active on social media (for example, Twitter).

WRR plans its research publications deliberatively, with considerable reflection and consultation of opposing views taking place prior to commencement. Consulted bodies include representatives from policy, politics, society and trade and industry, and deliberation takes place in order to target themes most relevant for WRR and Dutch society. Prior to establishment, WRR's strategic programme is consulted along with the Prime Minister of the Netherlands.

The council meets with its scientific staff every two weeks. The meetings are by nature open and inclusive, with everyone from junior staff members to the council chairman offered a say on where the projects are heading. Via this system of internal (and somewhat informal) peer reviewing, WRR aims to guarantee the quality of its work.

Case 6: The Federal Planning Bureau (and the Task Force on Sustainable Development), Belgium

Themes	Energy, international economy, labour market, macroeconomics, public finances, sectoral and environmental accounts and analyses, social protection, demography and prospective studies, structural studies, transport and sustainable development
Means of impact	Reporting, policy assessments and foresight for the federal government
Funded by	The Federal Government of Belgium
Networks	Several, see: www.plan.be/aboutus/institution_desc.php?lang=en
URL/Source	www.plan.be/index.php?lang=en and http://sustdev.plan.be

The Federal Planning Bureau (FPB) is an independent Belgian public agency founded in 1959. Boasting a permanent staff of about 100 members, the FPB conducts studies, reports and foresight on economic, social and environmental policy issues, and their integration in the context of sustainable development. The FPB's main mission is to support the political decision-making process, and for that purpose, 'it shares its expertise with the government, parliament, social partners and national and international institutions'. The FPB not only provides (pushes) expert advice, but the Belgian government, parliament, social partners and national and international institutions also appeal to (pull from) the FPB's well-established scientific expertise for guidance. According to FPB, the public is also 'informed of the results of its research activities, which contributes to the democratic debate'.

The FPB arranges its work around 10 themes: Energy, International economy, Labour market, Macroeconomic forecasts and analyses, Public finances, Sectoral and environmental accounts and analyses, Social protection, demography and prospective studies, Structural studies, and Transport and Sustainable development. The team responsible for SD issues is named the Task Force on Sustainable Development (TFSD).

The TFSD operates under the same legal mandate (the Belgian act of 5 May 1997 on the Co-ordination of Federal Sustainable Development Policy) as FRDO-CFDD (see case 3), which is the nexus for the SD science–policy interface in Belgium. The TFSD's particular missions include 'reporting on the evaluation of sustainable development policies and proposing long-term foresight scenarios'. This is accomplished by operating in four subthemes under the parent theme of sustainable development.

1. **Federal reports** – assessing governmental policies on sustainable development (e.g. the commitments made since the Rio Summit of 1992) and providing long-term foresight. The reports (documents of around 200 pages) are heavily indicator-laden, comparing a set of social, environmental and economic indicators (see www.indicators.be) with the political objectives of Belgium. Federal reports also describe foresight scenarios (up to 2050) and tools to transcribe SD commitments into reality.
2. **Policy assessments** – assessing the existing situation of Belgium's stance on sustainable development. The assessment uses, again, the same set of indicators to assess Belgium's current situation with its international commitments and long-term objectives. The TFSD also assesses 'the strategic and participatory aspects' of SD policies. This is intended to further develop Belgium's Federal Strategy for Sustainable Development, which co-ordinates (again, under the legal mandate of 1997) the interaction of Belgium's SD policy actors, which include the Federal Council for Sustainable Development (see case 3), the Interdepartmental Council for Sustainable Development (an inter-ministerial organ which prepares the Belgian Federal policies for sustainable development, see end of Section 2.2) and the federal government's policy cells on sustainable development.
3. **Foresight** – facilitating the 'realisation of the long-term vision on sustainable development'. Again, the 1997 law on the co-ordination of the federal policy for sustainable development requires the FPB to provide foresight on the expected evolution of Belgium's development in a European and international context, as well as long-term alternative scenarios for sustainable development. The FPB currently promotes two sustainable

scenarios for socio-ecological transitions, one consumer-driven and the other producer-driven. These scenarios present viable pathways to a sustainable Belgium in 2050 (with a variety of sustainable development goals realised), also fuelling democratic debate on required societal development. The TFSD uses 'backcasting' methods to develop its SD scenarios. These methods start with the identification of a desired future (for example, a sustainable Belgium in 2050), which is based on participatory discussions with expert panels. After the targets are identified, a variety of alternative pathways to achieve them are devised.

4. **Models and indicators** – developing highly elaborate modelling tools and indicators for the benefit of the other three subthemes (foresight, federal reports and policy assessments).

All in all, the FPB relies heavily on its manpower and knowledge-creation capabilities to support the federal level with relevant SD knowledge, assessments and foresight. Whilst the dissemination of knowledge is very linear here, basically operating on a science-to-policy basis, it is important to note that the FPB is merely one actor in Belgium's multifaceted SD science–policy interface. In other words, the FPB also provides relevant knowledge for the use of other Belgian SD policy actors, such as FRDO-CFDD (see case 3), a more participatory and socially inclusive SPI. Indeed, Belgium's federal-level attempts at improving the co-ordination of its SD policy actors, based on the Belgian act of 5 May 1997 on the Co-ordination of Federal Sustainable Development Policy, are central to the Belgian SD nexus. The act, for example, calls for Belgium to develop a national SD strategy and SD goals for 2050, and facilitates the interdepartmental co-operation between Belgium's SD policy institutions.

Case 7: The Royal Society of New Zealand, New Zealand

Themes	Science, technology, social sciences and the humanities
Means of impact	Advice regarding best scientific practices and research, policy proposals, expert analysis, peer reviewing, publication of accessible information and evidence
Funded by	Government of New Zealand (expert advice is supported by 2-3 permanent staff members; experts themselves are volunteers)
Networks	Several, see: www.royalsociety.org.nz/organisation/international-connections/#international-scientific-unions
URL/Source	www.royalsociety.org.nz/

Although more modest in scale than its London-based cousin,[8] New Zealand's Royal Society (or The RSNZ, founded in 1867) maintains steady scientific and political impact and is a major independent body in New Zealand's science–policy interface. Whilst the Royal Society of New Zealand practises a wide array of public and scientific services (such as research funding, publishing services and fostering a science-friendly culture) it also dynamically utilises the expertise of its voluntary[9] fellows to produce expert advice for policymakers and contributes to public debate.

The RSNZ fosters a community of about 400 elected fellows, consisting of some of New Zealand's (and Australia's) top science and technology experts, as well as some 60 foreign honorary fellows. In practice, this community also serves the purpose of being a wide-ranging pool of experts from which static committees and dynamic working groups are formed. These expert groups serve two roles. Firstly, they conduct independent research and produce informative publications and policy responses. Second, the expert groups' research enables the society itself to 'respond to rapidly changing concerns or emerging issues'. The Royal Society of New Zealand is thus a self-organising nested system of experts. It possesses a strong voice as a unified group of experts, capable of releasing impactful statements, as well as consisting of member fellows and temporary expert groups who inform the society itself and who also enjoy significant individual prestige in the public arena.

8 The President, Council, and Fellows of the Royal Society of London for Improving Natural Knowledge, or simply The Royal Society (see end of Section 2.4), is the world's oldest and perhaps most significant learned society. Similar learned societies, which also provide significant policy advice for governments within the Commonwealth, exist in Canada and most of Australia's states.

9 In exchange for these voluntary services, fellows are entitled to use the honorary title FRSNZ (Fellow of the Royal Society of New Zealand) after their name, signifying authority and prestige. Travel expenses and other similar expenses are reimbursed by the society.

The RSNZ's expert advice is organised via the following method. First, relevant ideas for topics are identified by the involvement of a wide group of societal actors, including, for example, fellows, stakeholder groups, government agencies, the Prime Minister's Chief Science Advisor (see Section 2.5 below), civil society and non-profit organisations. A directory body then proposes topics (prioritised for example by their relevance to New Zealand, the feasible pathways for achieving an impact and a risk-benefit analysis) to a subcommittee, narrowing the topics down to the most relevant and compelling ones. Expert advice is then iteratively tailored to suit the topic best and involves the use of some of the following.

- **Longer-term** deliberative advice on complex issues by standing expert committees and reference groups. The RSNZ has moved from 'dynamic' short-term expert panels to long-term 'static' committees (like the National Committee on Antarctic Research).[10]
- **Submissions** or informative policy proposals, often completed within a short time frame (thus enabling quick reactions to urgent issues). Submissions are reviewed by society staff and experts.
- **Publications**, evidence and easily accessible information about specific current issues where long-term deliberations are not deemed necessary. Publications are often formatted as fact sheets and are prepared and reviewed by society members. The RSNZ's expert advice papers include themes such as climate change mitigation, a green economy and the sustainable carrying capacity of New Zealand.
- **Peer reviews**, which the society's experts provide for other bodies' work.
- **Research practice advice**, essentially consultation services on best international practices.
- **Workshops**, often following the release of the society's more notable publications and submissions. Workshops are organised in order to bring expert scientists and policymakers together, hosting topic-relevant discussions and deliberations.

The Royal Society of New Zealand supports its expert advice initiatives with a relatively small group of 2 to 3 staff members, funded by a core government grant. The RSNZ maintains its reliable status as an independent statutory organisation and refuses to accept funding from sources where independence and trust might be compromised. Whilst the society does not advocate particular policies (and is in this respect politically neutral), it does provide informative advice regarding existing policies and practices (although the society does not identify itself as a research institute). When preparing expert advice, fellows act as individuals and are free to pursue personal interests; however, when projects are finalised, all advice is published under the name of the Royal Society of New Zealand. The society emphasises a sufficient skill mix ('including leadership and communication of complex societal-science issues characterised by multiple world views') and learning opportunities for expert advisers. The society's expert advice is rather heavily biased towards the natural sciences, although this is not an uncommon practice in anglophone countries, where science is generally associated with natural rather than social sciences (Raivio, 2014).

Whilst the societal impact of the Royal Society of New Zealand relies heavily on its (and its fellows') prestige and authority (after all, the society is nearly a century and a half old and carries on the tradition and name of the London-based Royal Society, possibly the world's oldest learned society for science), it also achieves significant impact through effective packaging of information – always tailored to specific needs – and good communication. Indeed, the society's pathways to political and social impact include a variety of 'published reports, website data, infographics, pamphlets, interactive websites, social media campaigns, follow up meetings and workshops with government stakeholders, and public lectures and debates', complementing long-term deliberative advice (committees) with short-term information 'punches'. The Royal Society of New Zealand's deliberative advice processes are always comprehensively reviewed within six months of the projects' completion to inform future processes, and The RSNZ fosters a strong quality assurance and peer review culture for its advice.

10 Former panels have, for example, dealt with climate change (the New Zealand Climate Expert Panel, which also released the influential 'Climate change statement' in 2008). See: www.royalsociety.org.nz/2008/07/10/climate-change-statement-from-the-royal-society/.

See also

International Institute for Sustainable Development (IISD): www.iisd.org/

The Arctic Council, and its Sustainable Development Working Group (SDWG) and nested Expert Groups: www.sdwg.org/

The Stockholm Environment Institute operates on a 'nested' logic with staff for a variety of Environmental themes and subthemes: www.sei-international.org/about-sei

The Netherlands Environmental Assessment Agency (PBL), the Dutch national institute for strategic policy analysis in the fields of the environment, nature and spatial planning (around 200 employees, and part of the Ministry of Infrastructure and the Environment): www.pbl.nl/en

ACOLA, a forum for Australia's four learned societies which gives policy advice to the Australian government. ACOLA also hosts Future Earth Australia (along with other SD-related projects), seeking 'new ways to accelerate sustainable development': www.acola.org.au/ and www.acola.org.au/index.php/projects/future-earth

The Royal Society of Canada: www.rsc-src.ca/

The Royal Society (London-based): https://royalsociety.org/

Royal Society of Arts (a London-based spin-off of The Royal Society with particular focus on social perspectives and the arts): www.thersa.org/

And several other Royal Societies within the Commonwealth (Royal Societies of Edinburgh, New South Wales, Victoria, etc.)

The National Academy of Sciences: www.nasonline.org/about-nas/policy-studies-and-reports/ and www.nas.edu/about/whatwedo/index.html

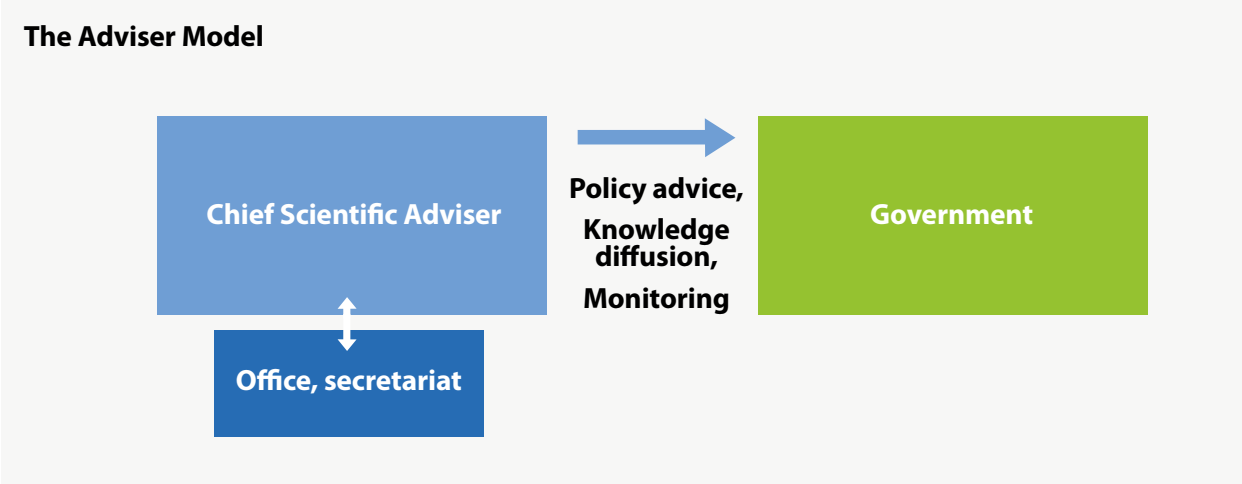
European Academies Scientific Advisory Council (EASAC): www.easac.eu/home.html

Leopoldina, the German National Academy of Sciences, provides 'science-based advice to policymakers and society', SD themes included: www.leopoldina.org/en/leopoldina-home/

The Netherlands' National Academy **KNAW** hosts a variety of Advisory Councils, some of which (for example, the Council for Earth and Life Sciences) report on SD issues: www.knaw.nl/en

GIZ, a German Federal Government-owned major (turnaround of 2.1 billion euros) sustainable development and development aid company, which also provides Assignment Model-style consultation and competency-building services for other governments and the private sector. See www.giz.de/en/html/about_giz.html and www.giz.de/en/ourservices/management_services.html for GIZ's comprehensive list of used methods with detailed PDF descriptions

2.5 Adviser Model: Chief Scientific Adviser or Advisers



Picture 6. The Adviser Model for the science–policy interface.

The Adviser Model refers to direct scientific advice given to decision-makers by a single (government) Chief Scientific Adviser (GCSA or CSA) or similar actor who is generally, in turn, often advised by either lower advisers or an advisory office. This has historically been a model found in most major English-speaking countries (including the United Kingdom, Canada, Ireland, Australia and New Zealand, see end of this section). Usually, the CSA informs the highest political authority about good scientific practices and current trends in science, technology, engineering and mathematics (STEM) and summarises or translates scientific knowledge for governmental policies, as well as functioning as a general high-profile individual capable of exerting a high degree of political impact (Raivio, 2014). Particularly if the CSA is a cabinet-level appointee, they will be likely to have the trust of and thus access to chief executives, accelerating the transmission of information from the scientific community to the policy community by acting as 'a conduit of advice rather than a single expert opinion' (Doubleday and Wilsdon, 2013). Hypothetically, the CSA could therefore play the role of an impartial, vocal and trustworthy authority, disseminating SD-relevant scientific knowledge to decision-makers when most needed. Kari Raivio, for one, (2014: 44) has proposed that Finland should establish a similar body to the GCSA, on the basis that the prime minister and leading officials should have a reliable contact person to disseminate scientific expertise to policy practices when required.

However, this model of scientific advice is certainly not without its critics, who argue that the Adviser Model entrusts too much power, voice and responsibility to one (possibly politically compromised) person. Indeed, with this power comes significant questions regarding how this power is rightly used. The adviser is essentially a representative of science as a whole, yet the idea that 'science' has a single, evidence-based, true opinion which transcends personal, social and economic interests and opinions is disliked by many. For example, a coalition of environmental groups (Muilerman et al., 2014) criticised the European Commission's CSA in 2014, claiming that 'the post of Chief Scientific Adviser is fundamentally problematic as it **concentrates too much influence in one person**, and undermines in-depth scientific research and assessments carried out … in the course of policy elaboration'.

With this power come significant questions regarding how this power is rightly used.

The European Commission's CSA body was subsequently axed by newly appointed president Jean-Claude Juncker (again highlighting the risks of scientific advice drifting too close to the policy sphere) and replaced

The Adviser Model does not necessarily produce 'socially robust' advice (that is, advice which is not only scientifically reliable, but also accepted and applicable in the social contexts in which the relevant issue occurs).

by an independent expert panel, the High Level Group of the Commission's Science Advice Mechanism (see end of Section 2.1) Moreover, the CSA was criticised for being unaccountable, non-transparent and controversial' as well as 'one-sided' and 'partial', with the true nature of her advice remaining widely 'unknown'. Whilst the concentration of this much power for a single adviser might indeed result in personal and political bias as well as a monotony of scientific perspectives, regardless of whether or not this actually occurs it is important to understand that it is often perceived to happen. In other words, the Adviser Model does not necessarily produce 'socially robust' advice (that is, advice which is not only scientifically reliable, but also accepted and applicable in the social contexts in which the relevant issue occurs; Regeer and Bunders, 2009: 14), since even if its advice were scientifically valid it is often perceived by others as biased, unaccountable and not transparent. Indeed, critics (Muilerman et al., 2014) have argued that advice should instead be taken 'from a variety of independent, multi-disciplinary sources, with a focus on the public interest', and some (see for example Morgan, 2015) have questioned the legitimacy of the CSA institution altogether.

It could thus be concluded that the adviser is not as holistic a representative as a well-organised expert panel or council. Whilst there is nothing prescriptive in the Adviser Model as an institution which entails personal or political bias, a heuristic risk-benefit analysis suggests that the model is neither representative nor inclusive enough to be a good model for tackling complex SD policy issues. This is particularly the case since whether or not such claims are true, the adviser is almost certainly vulnerable to claims that they would be politically or scientifically biased. This makes the Adviser Model a poorly socially robust science–policy interface.

Whilst the adviser does not necessarily have to include sustainability or sustainable development in her or his agenda, the adviser certainly has the opportunity to do so with considerable impact, and some CSAs (such as the United Kingdom's former GCSA, John Beddington) have been very vocal about sustainability issues during their terms in office. That being said, if the adviser is not vocal on sustainability issues, this might even have adverse effects on national sustainable development policies and lead to a backlash effect. Indeed, cases exist where sustainability does not seem to be a prime agenda for a CSA or their office, making this is a very substantial risk. However, the notion that advisers might not make very good SD representatives (unless significantly complemented by more deliberative SPI models) does not at all imply that this post is unworthy or unnecessary in other policy/scientific areas (e.g. scientific education) – indeed the case is quite the opposite.

Whether or not such claims are true, the adviser is almost certainly vulnerable to claims that they would be politically or scientifically biased. This makes the Adviser Model a poorly socially robust science–policy interface.

Benefits	Challenges
Potential for strong political impact as a result of proximity to highest government officials. Personal relations facilitate getting the message through.	Not broadly representative of the scientific community or stakeholders. Recruitment processes are easily politicised, lowering credibility.
Can be a public spokesperson for the good of science and sustainable policies.	Risks siloed thinking and neglect of sustainability issues. Personal opinions and socio-economic incentives put at risk the adviser's impartiality, and the adviser's scientific advice is often perceived as biased.
Authority enables mobilisation of other actors in society.	Lack of sufficiently broad scientific expertise to address complex sustainability problems.
A credible, popular and trustworthy CSA might bring welcome continuity to the science–policy interface.	Closeness to and direct interaction with the government compromises autonomy.
	Continuity risked because of closeness to political actors; political successors might not take kindly to a known 'friend of an enemy'.

Table 5. Benefits and challenges of the Adviser Model for the science–policy interface.

Case 8: Government Chief Scientific Adviser and Chief Scientific Advisers, the United Kingdom

Themes	Scientific advice and assessment of government policy
Means of impact	Direct advice for highest officials, including the prime minister and the cabinet, speeches, announcements and public and media involvement, knowledge diffusion from the broad scientific community to high-level policymakers
Funded by	Her Majesty's Government
Networks	N/A
URL/Source	https://www.gov.uk/government/people/mark-walport#current-roles www.gov.uk/government/organisations/government-office-for-science

The Government Chief Scientific Adviser (GCSA) has, since the post was established in 1964, been the United Kingdom's government's most significant and influential scientific expert. The GCSA:

- **provides scientific advice to the prime minister** and cabinet members;
- **advises the government** on science and technology policies;
- **is a watchdog** for the quality and use of scientific evidence and advice in government.

The GCSA is, in turn, advised by a network of departmental Chief Scientific Advisers (CSAs).[11] Each major department (or ministry) has a representative CSA (for example, the CSA for Environment, Food and Rural Affairs, the CSA for Health and the CSA for Energy and Climate Change) who are most often professors or other individuals with significant academic merits. Specifically, the CSA networks' objectives are to 'provide advice to ministers, through the Cabinet committee

11 A gender-neutral pronoun is not used here since the current GCSA, Mark Walport, is male and, more interestingly, because the GCSA has never in its history been female – arguably an institutional fault and certainly an issue worth problematising in the Adviser Model.

system; discuss and facilitate implementation of policy on science, technology, engineering and mathematics (STEM); identify and share good practice in STEM-related areas, including the use of scientific advice in policy making' and to 'facilitate communication on particular high profile STEM-related issues and those posing new challenges for government'.

The GCSA also heads and is supported by the Government Office for Science, a major government advisory agency (of about 80 members) for science policy, which conducts research, foresight and policy advice. The GCSA is appointed by the cabinet secretary and approved by the prime minister. Both the GCSA and CSAs are 'civil servants, appointed through fair and open competition'.[12] Moreover, the GCSA/CSA model in the United Kingdom overcomes some challenges faced by the Adviser Model, particularly since governmental departments often have their respective advisory councils, such as the Science Advisory Council of the Department for Environment Food and Rural Affairs (Defra),[13] which provides 'expert independent advice' to Defra and aids Defra's CSA in giving ministerial scientific advice. This nested hierarchy of experts, in many respects, counteracts the challenges of having a single adviser. However, since members of these advisory councils are often appointed by invitation, the expert councils allegedly favour advice closer to a scientific and political status quo (or 'normal science'), particularly since appointees are often senior academic members. This is, by some, considered to inhibit deviating or radical opinions on scientific or political issues from being heard, which might be a concern regarding sustainable development policies in particular.

See also

Canada's Commissioner of the Environment and Sustainable Development:
www.oag-bvg.gc.ca/

New Zealand's Chief Scientific Adviser:
www.pmcsa.org.nz/

Australia's Chief Scientist:
www.chiefscientist.gov.au/

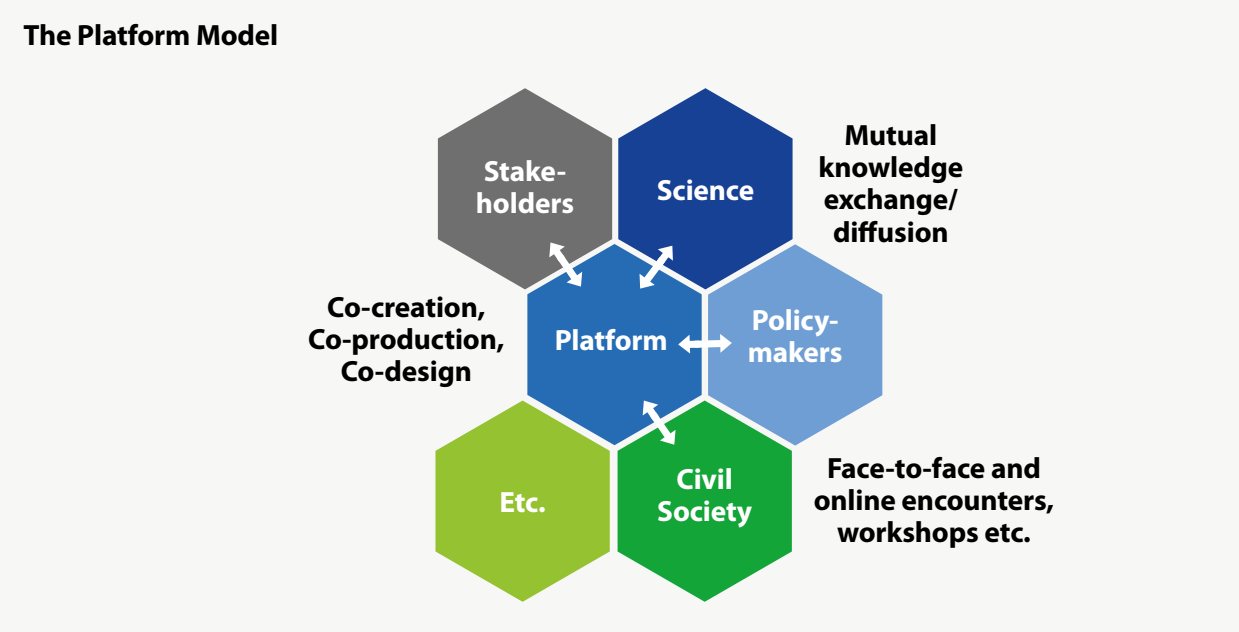
Chief Scientific Adviser to the Irish Government:
www.c-s.ie/

The European Union's Chief Scientific Adviser (active 2010-2014): http://ec.europa.eu/archives/commission_2010-2014/president/chief-scientific-adviser/index_en.htm

12 Based on an e-mail exchange with an official from the Government Office for Science.

13 See: www.gov.uk/government/organisations/science-advisory-council.

2.6 Platform Model: Knowledge Brokering and Networking



Picture 7. The Platform Model for the science–policy interface.

The Platform Model refers to instances where a third party (for example, an expert group or institution) organises an impartial and deliberative co-productive arena, or platform, for discussion, idea exchanges, knowledge brokering and training between scientists and policymakers. Here scientific support is not as much advice as it is networking – that is, connecting scientific experts with decision- and policymakers and other stakeholders or civil society members to form (partly) self-organising networks, arranging effective face-to-face (or online) workshops, seminars, tutoring and so forth. These platforms are generally not involved in creating new scientific knowledge or (significant) research or reporting activities, although they can be experimental and applicative arenas for innovative and novel methodological tools.

The Platform Model seems to be a particularly good interface when discrepancies or disagreements exist between (or within) scientists and policymakers and when collaboration between various parties would otherwise be clearly lacking or inefficient (this, unfortunately, is often the case with SD policy-related SPIs!). The Platform Model is also utilised in regional science–policy interfaces, such as the Baltic 21, whose Expert Group on Sustainable Development serves as a 'forum for cooperation across borders and between stakeholder groups' and connects the members of the Council of the Baltic Sea States, and the Future Earth initiative, a global research and policy networking platform (see end of Section 2.7). Today, of course, more and more knowledge brokering platforms make use of online communities (see for example cases 10 to 12).

Face-to-face encounters are often reported to be the most effective and effective way of organising scientific advice.

According to Zamparutti et al. (2012) the emphasis on creating and maintaining (partly self-organising) networks is a cost-effective way of organising scientific support for policymakers. Indeed, face-to-face arrangements and workshops require both fewer resources and less time than

linear (i.e. science-to-policy) research-oriented output production. Moreover, these face-to-face encounters are often reported to be the most effective and effective way of organising scientific advice, largely due to the cognitive and social benefits (such as trust and capacity building) of personal relationships and first-hand tacit knowledge transfer (Weichselgartner and Kasperson, 2010; Polanyi, 1954 and 2009). An obvious benefit from these networking procedures is that it is not merely the policy professionals who learn from these encounters, but also both junior and senior researchers. Particular challenges for platform SPIs are, of course, that they are largely dependent on the enthusiasm and initiative of both policy professionals and researchers and that these sometimes barely institutionalised networks face the risk of fading away without constant maintenance and upkeep, endangering the temporal continuity required for sustainable policymaking. Owing to financial restraints, these platforms might also be funded by outside parties, leading to pressures in maintaining their political neutrality (Zamparutti et al., 2012). These financial restraints might also endanger the continuity of platforms, since they are often temporarily funded prototype-phase projects – repetitive discontinuations might, of course, also hinder people's belief and trust in these projects, making continuity particularly important.

Moreover, platform SPIs often host such a large variety of voices (from businesses to NGOs) that it is unlikely that they can provide as coherent and impactful policy advice or watchdog-style critique as, for example, independent and integrated SPIs, although importantly this is usually not the platforms' role to begin with. Indeed, platform SPIs instead focus on building trust and capabilities within their participatory frameworks, facilitating knowledge diffusion through many other channels. However, for a Platform Model to be truly successful and effective, it has to draw a large enough audience from both policymakers and academia, and this requires the development of incentives and motivation to ensure policymakers and researchers 'take the bait' (people are, somewhat self-evidently, unlikely to participate in knowledge brokering networks unless they deem them worthy of their time). Whilst many platforms are active in advocating their services and provide incentives such as capacity building activities or workshops, ensuring a large enough participation is an essential challenge.

All in all, the Platform Model represents a clear shift from 'linear' or 'facts-first' scientific support to more deliberative, iterative, co-productive and co-creative knowledge brokering arenas. Technically speaking, insights and operational designs from this model can also be integrated into any of the previous five models. Since platform SPIs seem to generally include more innovative and experimental methods for knowledge brokering than the other SPI models, they also make particularly interesting case studies, and therefore a total of four cases are studied below.

Benefits	Challenges
Facilitates mutual knowledge exchange by bringing together participants who might not else interact with each other.	Operation and success are largely dependent on the enthusiasm and initiative of participants (stakeholder fatigue).
Brings various perspectives together in the same room (often literally), ensuring dialogue on a broad variety of perspectives on complex issues and overcoming siloed thinking.	The longevity of the created networks is highly dependent on a third party or a moderator – the whole network might collapse if the moderator's funding is halted or the moderator is inactive.
If networks are institutionalised, they can serve long-term purposes. Platform SPIs' networking services can be integrated into several other models of science–policy interfaces.	Interaction and idea exchange between scientists and policymakers does not necessarily entail impact on actual policies. The network might not have a unified authoritative voice on policy issues (and lack in watchdog monitoring and/or foresight).
Face-to-face encounters are particularly efficient modes of knowledge dissemination. Personal relations foster the transfer of not only explicit (formalised) but also tacit and personal knowledge.	The organising third party's or the moderators' agenda might influence the overall outcome of the deliberative process.

Table 6. Benefits and challenges of the Platform Model for the science–policy interface.

Case 9: Centre for Science and Policy of the University of Cambridge, the United Kingdom

Themes	Development and infrastructure; Emerging technologies and society; Global resources and sustainability; Innovation and public services; Research, evidence and policy; Risk, uncertainty and resilience; Well-being and behaviour
Means of impact	Linking policymakers with good science practices, providing a discussion arena for those in the fields of science and policy, providing training, support and opportunities for researchers and policymakers
Funded by	The University of Cambridge, David and Claudia Harding Foundation and the Isaac Newton Trust
Networks	N/A
URL/Source	www.csap.cam.ac.uk/

The Centre for Science and Policy (CSaP) at the University of Cambridge is a networking and knowledge brokering platform which facilitates the interconnection between policy professionals, scientific experts, business leaders, early career researchers and other relevant stakeholders. Its mandate is to help 'the sciences and technology to serve society by promoting engagement and networking between researchers and policy professionals'. Specifically, CSaP:

- enables policymakers to access advanced academic thinking and practices in all academic disciplines;
- creates opportunities for engagement between research expertise and public policy, to discuss and develop innovative ideas;
- enhances researchers' capability to engage with policymakers by providing training, support and opportunities.

CSaP achieves these goals by conducting a variety of programmes intended to link researchers with policymakers and vice versa. These programmes include the following.

The Policy Fellowships Programme, or the appointment of policy professionals in the public sector for one- or two-year fellowships at CSaP. The Policy Fellowship addresses questions identified by the newly appointed fellow, a list of approximately five policy-relevant questions on which the fellow requires expert advice. Fellows apply and are selected on the basis of these questions. The fellow is then linked with between 20 and 30 researchers with expertise appropriate to the question set. During a five-day period at Cambridge, the fellow participates in one-to-one discussion sessions with the experts, gaining heterogeneous and multidisciplinary perspectives and insights in the process. After this initiation period, fellows have the opportunity to participate in and initiate a variety of CSaP events, including workshops, lectures and other ad hoc meetings. Policy fellows join the Policy Fellows Network, 'a peer-to-peer network of Policy Fellows from the public sector, civil society, industry, and 1100+ researchers at Cambridge'. The Policy Fellow scheme is thus aimed at developing a self-organising and expert-advised network of policy professionals, researchers and other stakeholders. According to CSaP, the 'Programme has been welcomed in academia as an effective pathway to impact, and in government and industry as efficient professional development'.

The Professional Development Programme, which is focused on introducing young researchers to the multifaceted field of policy. The aim of this programme is to link early and mid-career researchers with early and mid-career policymakers. This is accomplished via a variety of workshops (where researchers discuss with policymakers and academics how research evidence is disseminated into policy) and internships (where PhD students spend time either at CSaP or governmental agencies as policy interns). According to CSaP, participants gain a greater understanding of 'how public policy intersects with research' and 'the implications of their research to public policy, society and the economy', as well as 'develop lasting connections with policy professionals', understanding 'the way in which expert advice is sought and communicated'.

Policy Workshops provide in-depth focus on problems identified by Policy Fellows. Workshops bring together small groups of interdisciplinary academic experts with public policy stakeholders, generating high-level discussion of specific policy problems, and providing decision-makers with insights and recommendations.

The Annual Conference, a major event linking science and policy and open to members of academia, government and other stakeholders.

CSaP has identified seven recurring themes that interest fellows and academic experts in the Policy Fellows Network. Many of these themes are associated with sustainable development, as the aim of CSaP is to tackle the complex, large-scale challenges that society faces. These themes, as of July 2016, are: Development and infrastructure; Global resources and sustainability; Risk, uncertainty and resilience; Well-being and behaviour; Emerging technologies and society; Innovation and public services; and Research, evidence and policy. Each theme represents networks created by CSaP.

CSaP also conducts comparative empirical research on science–policy interfaces, informing not only the centre's operation but also scholarship and practice.

Case 10: RESPONDER, the European Commission

Themes	Sustainable consumption and economic growth
Means of impact	Knowledge brokering, linking science–policy and science–science, conflict management
Funded by	European Commission (The 7th Framework Programme)
Networks	The RESPONDER consortium, co-ordinated by the Vienna University of Economics and Business Institute for Managing Sustainability, consisted of two ministries, five universities and three research institutes For further details, see: www.scp-responder.eu/partners
URL/Source	www.scp-responder.eu/

RESPONDER was a pilot-phase online and face-to-face knowledge brokering system which operated from early 2011 to mid-2014, funded by the European Commission and organised by the Vienna University of Economics and Business, Institute for Managing Sustainability. Narrowing its focus down to the two themes of Sustainable consumption and Economic growth, RESPONDER aimed to develop, implement and evaluate a knowledge brokerage system to manage the contradictions between these two often disconnected scientific and political fields. RESPONDER thus fostered a knowledge brokering framework for science–policy and science–science interfaces as well as 'pro-growth' and 'beyond-growth' interfaces (business stakeholders and civil societies, etc. included), aiming to bridge the social, political, ecological and economic disagreements between these disjointed and near-antagonistic fields. In this multi-, inter- and transdisciplinary framework, social psychology-oriented research findings (on things such as consumer behaviour) were linked with macroeconomic theories to produce an integrative whole, informing debates on 'green growth, beyond growth and de-growth'. RESPONDER did not conduct research but instead exploited existing research to link research results to policymaking.

RESPONDER's mode of operation was based on a particularly innovative systems-learning approach called 'participatory system mapping' (see Sedlacko et al., 2014 and Martinuzzi et al., 2016), hosting a structured learning environment for scientists and policymakers across Europe. The participatory system map was modelled to (literally) illustrate the social, political, ecological and economic dimensions of sustainable consumption and economic growth. The systems model was a 'causal loop diagram', depicting causal relations between selected variables as well as 'positive and negative feedback loops and development trends'. Since the total system map included all contradictory paradigms (pro-growth, de-growth, etc.), different sections of the map could be highlighted[14] to illustrate differences between various stakeholders' and scientists' – often equally legitimate – views. The method improved and shared understanding between the participants, whilst the visual map also offered a problem-solving framework, helping to locate common problems and tools that would otherwise have been left unaddressed because of conflicts, disagreements and misunderstandings.

The project also included an online illustrated system map where data (for example, research and policy

14 See: www.sd-network.eu/pdf/conferences/2012_kopenhagen/presentations/Martinuzzi.pdf

papers) could literally be pinpointed, helping researchers and policymakers locate relevant information on a large variety of themes. The website also served as a knowledge database for a variety of background information, research and workshop reports, as well as a location for a (somewhat inactive) discussion forum and news feed for events, petitions, book releases and so forth. Moreover, the 'Internet-Based Knowledge Brokerage System' facilitated the continual exchanges of questions and answers between policymakers and researchers. Several face-to-face and professionally moderated workshops were also organised to strengthen the working community and individual connections, fostering a sense of togetherness, trust and understanding. A central aim of these workshops was to nurture a collective ownership of topical issues for people otherwise separated by disagreements over paradigms.

Overall, the deliberative knowledge brokering approach of RESPONDER seems to have been successful and effective, with over a dozen events held and over 1,000 (online) members involved. In particular, the 'participatory systems mapping' process was reported to produce 'different insights on issues related to sustainable consumption and enabled participatory reflection and sharing of knowledge' (Sedlacko et al., 2014). Moreover, the approach was noted (ibid.) to support 'a systemic understanding' of sustainable consumption issues and thus provide 'instruments for coping with complexity when formulating policies'. However, RESPONDER has been inactive since 2014 (when its EC funding ended), and has not (at least, for now) advanced to a post-prototype phase, although its systems-based approach has been widely documented (see for example Sedlacko et al., 2014 and Martinuzzi et al., 2016) and its methodological insights have been publicly disseminated for further exploitation.

Case 11: Oppla, the European Commission

Themes	Natural capital and ecosystem services
Means of impact	Online database; Q&A services; providing knowledge on good practices and case studies; networking between researchers, policymakers and stakeholders; marketplace for services
Funded by	European Commission (mainly)
Networks	Oppla operates in collaboration with over 60 universities, research institutes, agencies and enterprises
URL/Source	http://oppla.eu/

Oppla is a beta phase online platform, developed from the co-operation between two research projects funded by the European Commission's 7th Framework Programme (OpenNESS and OPERAs), aiming to bring together knowledge about European natural capital and ecosystem services. Oppla represents a trendy and online-era approach to the science–policy interface, hosting an online platform for data sharing (including a knowledge database and case studies) and a variety of online and offline services. Anyone, including researchers, policymakers, NGOs, businesses, spatial managers, economists or businesses, can use the platform free of cost, whilst expert advice and knowledge is provided from the 'most innovative communities of science, policy and practice', including over 60 universities, research institutes, agencies and enterprises. Accordingly, Oppla states as its main objective, 'to assist people in making nature work for the benefit of humankind'.

Oppla aims to be a 'one-stop shop' for the latest knowledge and good practices on environmental issues. Oppla promises to disseminate nature-based solutions for both experts and newcomers in the field, and helps users find useful advice, tools and techniques with little effort. For example, Oppla's crowdsourced Q&A forum ('Ask Oppla') is easily accessible (it requires a brief registration process where one can state their topical interests, which where one can state their topical interests, which subsequently affect one's newsfeed) with answers provided promptly (although the Q&A feature is not yet in full swing). Whilst the project is still in the prototype phase, Oppla has big ambitions and aims 'to grow into Europe's foremost platform for sharing environmental knowledge'. Moreover, Oppla intends

to expand its services 'both geographically (becoming a global platform) and thematically (going beyond ecosystem services, natural capital and nature-based solutions to encompass "environmental science, policy and practice" more generally)'. [15]

When ready, Oppla will also feature a marketplace for the promotion of products and services (both free of cost and commercial) and Oppla will also encourage co-design and innovation within its community. Oppla's networking services (including conferences, workshops, an online 'matchmaking system' and Webinars) will help 'members to collaborate and work together across different sectors in developing solutions to today's challenges'. These services (the marketplace, networking and Q&A forum) should in their own right be enough of an incentive for policymakers and researchers to participate and run the programme sustainably.

Whilst European Commission-funded programmes (such as case 10, RESPONDER) are often discontinued at the post-prototype phase, Oppla seeks continuity by collaborating with other projects (for example, the Horizon 2020 projects) as well as providing sub-contracting services and additional 'pay-to-use' services on the Oppla platform (NB Oppla's core services will always remain free). Conclusively, Oppla represents a very contemporary and even fashionable move towards online science–policy–society interfaces with low knowledge barriers (based on open data system) and high knowledge dissemination capabilities, and will most likely prove to be an efficient knowledge brokering platform for the benefit of both policymakers and researchers.

The full Oppla platform (Beta version) was launched on 20 September 2016. It will be maintained in the future by the Oppla European Economic Interest Grouping (EEIG), a not-for-profit legal entity comprising founding members from the Netherlands and the UK.

Case 12: EKLIPSE, the European Commission

Themes	Biodiversity and ecosystem services
Means of impact	Knowledge synthesising, networking, joint-creation of knowledge, Q&A services
Funded by	European Commission (Horizon 2020), total budget around 3 million euros
Networks	Several project partners, see: www.eklipse-mechanism.eu/about_eklipse; co-operation with other EC-funded projects.
URL/Source	www.eklipse-mechanism.eu/home

EKLIPSE is a European Commission-funded (Horizon 2020) 'knowledge and learning mechanism' for the improvement of the science–policy-society interface on biodiversity and ecosystem services. EKLIPSE, a 'network for science–policy interfaces' and online forum for networking and knowledge dissemination, aims to 'provide trustworthy evidence for policy and society upon request and will make the knowledge community more able to provide synthesized and timely evidence by providing a platform for mutual learning and engagement'. Whilst EKLIPSE is, for now, merely in the prototype phase, it is a promising prospect particularly since it aims to create a sustainable self-organising knowledge brokering system which would outlive its four-year funding period. Moreover, according to EKLIPSE, 'once established, the self-sustaining mechanism will be handed over to the wider community of institutions, knowledge holders and stakeholders'. Importantly, EKLIPSE makes significant use of previously conducted (mostly European Commission-funded) projects, utilising past experiences and good practices. EKLIPSE has three main objectives.

1. **Building a 'network of networks'.** EKLIPSE aims to create an online community with participants with the right knowledge sets (related to biodiversity and ecosystem services) and enthusiasm to support decision-makers and thus have a positive impact on environments and well-being. By engaging with European local and international networks from a variety of subject areas, EKLIPSE will map existing knowledge on relevant subject areas and find out how to best synthesise the knowledge for the use of

15 Based on an e-mail interview with an Oppla representative.

decision-makers. This knowledge brokering effort will also help EKLIPSE identify gaps where capabilities are clearly lacking and provide specific training in these areas.

Moreover, by creating an online 'Science–Policy–Society Forum', EKLIPSE aims to create networks that continuously refine its community, and facilitate both the interaction of members within EKLIPSE as well as participants from the outside. These services are intended for policymakers (who can utilise the network for locating relevant expertise and advice), scientists (who can connect with other experts and thus improve science-to-science knowledge dissemination, as well as build capacities by attending training events) and interested citizens (who, in turn, can learn from the 'open knowledge' network and participate in processes which interest them).

EKLIPSE also works in close co-operation with Oppla (see case 11), and EKLIPSE refers its clients to Oppla's crowdsourced Q&A service.

2. **Synthesising available knowledge.** EKLIPSE aims for an 'in-depth collection, analysis and synthesis of existing knowledge', scientific or other, in order to answer questions from decision-makers on biodiversity and ecosystem services. EKLIPSE's synthesising process is based on that from another EC-funded project (KNEU[16]). Central to this synthesising process is EKLIPSE's expert body, the Knowledge Coordination Body (or KCB), a group of 10 experts with diverse backgrounds (currently an interim group, which is about to be replaced after an open call nomination of experts), as well as a Strategic Advisory Board (up to 15 advisory members who also act as 'ambassadors' promoting the EKLIPSE mechanism). Briefly, the synthesising process[17] involves policy- or decision-makers bringing forward questions or issues after which a dialogical joint-scoping process takes place between the experts and policymakers. Here knowledge needs, costs and so forth are identified together, after which the findings are synthesised. Then, an open call for expertise is launched, after which an ad hoc group of experts is formed to carry forward the methods and work required to 'answer' the synthesised question (of course, the dialogical process amounts to more than mere question asking and answering!). The KCB then organises peer reviewing of the results, after which a final report is assembled. Finally, the finished report is disseminated to those requesting the knowledge and other relevant stakeholders.

Moreover, the whole synthesising process is transparent and documented online. Lessons learned during the process are shared 'via capacity building activities for both researchers and policy makers', fostering a learning environment for both policymakers and researchers.

3. **Jointly identifying research needs.** EKLIPSE also aims to 'improve the integration of emerging issues into policy development' and will take innovative means to reach this objective. These will include 'participatory town hall meetings such as the World Wide Views[18] events', e-consultations and interactive online platforms in order to reach all 'relevant stakeholders from society, research and policy in the identification of current knowledge gaps and emerging issues'.

Since EKLIPSE only started in February 2016, its successes and challenges are difficult to analyse in much detail. However, it is evident that EKLIPSE seems to combine the strengths of several different models of science–policy interfaces: it has an independent expert group at its core (although it is not perhaps as vocal a watchdog as most independent panels) and an independent Strategic Advisory Board (with key representatives from science, policy and society), it offers both 'push' knowledge as well as responding to demand-based (Assignment Model) information needs. Moreover, it forms ad hoc nested groups of experts which operate under both the KCB and the knowledge brokering society of EKLIPSE itself. Indeed, EKLIPSE is arguably the most multifaceted case study of the 12 analysed so far in this study, and is for that reason a particularly promising project. Moreover, EKLIPSE represents a move from 'static' policy advice to a more dynamic and iterative model, where the advisory process itself is iterated once good working practices are identified (this is to be achieved by internal evaluation throughout EKLIPSE's four-year funding period).

16 www.biodiversityknowledge.eu/index.html

17 For further detail, see www.eklipse-mechanism.eu/synthesizing_available_knowledge

18 A multi-site citizen consultation service, involving citizens on multiple sites debating the same policy-related questions on the same day. See: http://wwviews.org/the-world-wide-views-method/

See also

Science and Technology in Society Forum (STS): www.stsforum.org/

RESPONDER's report summary for the FP7: http://cordis.europa.eu/result/rcn/159248_en.html

Baltic 21 Expert Group on Sustainable Development: www.cbss.org/sustainable-prosperous-region/egsd-baltic-21-2/

The All-Party Parliamentary Group (APPG) on Limits to Growth, a UK-based platform for cross-party dialogue on sustainable economic growth: http://limits2growth.org.uk/about/

And other European Commission-funded projects, including

CORPUS (RESPONDER's precursor): www.scp-knowledge.eu/ and http://cordis.europa.eu/result/rcn/57653_en.html

SPIRAL: www.spiral-project.eu/content/about-spiral

2.7 Mixed Models

As with most typologies (and basically, any static descriptions of processual entities), 'hybrid' (see for example Latour, 1993) cases remind us of the fact that instances always remain where complex processes elude static definitions and precise definitions are difficult to prescribe. Therefore, whilst it has already been established that cases within most models can be weakly associated with one or more other models (for instance, case 5: WRR was headed by an independent council yet had a nested structure; case 3: RNE was relatively independent in its operation considering it was strongly integrated to governmental decision-making bodies; case 12: EKLIPSE, an interactive platform, has an independent expert group at its core and includes features from a variety of other models; case 7: The Royal Society of New Zealand has a nested structure yet fosters a variety of different working methods from platform-esque workshops to independent expert committees), instances remain where it is impractical to allocate a case to a single model. For this purpose, a seventh – and final – model, the Mixed Model is classified in order to highlight cases which do not satisfactorily fit into a single slot of the aforementioned typology. This final hybrid model cannot, however, be assessed in a similar way to the other models, since true to its title it has no unified working model and therefore no clear benefits or challenges can be identified.

Case 13: Expert Panel on Sustainable Development, Finland

Themes	Sustainable development policies, particularly from a social perspective
Means of impact	Advising governmental bodies, contributions to public discussions, workshops
Funded by	Sitra (the Finnish Innovation Fund)
Networks	Co-operation with other expert panels, but not yet a part of any substantial networks
URL/Source	www.sitra.fi/en/future/expert-panel-sustainable-development

The Expert Panel on Sustainable Development, hosted and facilitated by Sitra (the Finnish Innovation Fund, an independent public foundation operating under the supervision of the Finnish Parliament), was established in December 2013 'to inspire action on sustainable development, by giving science a voice on the Finnish political scene'. The panel contributes to public discussions and supports the Finnish National Commission on Sustainable Development, Finland's integrated NCSD. Recently, the expert panel has also been involved in platform-style workshopping, and is currently contemplating a more active role as a public deliberator following good experiences in the field.

The expert panel therefore implements features from three SPI models.

1. It is **independent** in its strategic position and member composition. Its eight members are non-representational (i.e. detached from home institutions) professors or researchers, and the expert panel provides independent policy advice to governmental actors and to an extent serves as a watchdog for sustainable practices – the panel themselves note that 'an expert panel with renowned names can also "raise its voice" when necessary'. However, the panel is not involved with independent-style reporting and/or assembling significant research output (compare with case 1, WBGU), although smaller-scale policy briefs are in development. The panel also hosts an active online blog.
2. The expert panel is in direct in contact with Finland's National Commission on Sustainable Development. Whilst members of the expert panel are not de jure part of the National Commission, they can de facto, as 'observing non-members', attend the National Commission's meetings. In other words, the expert panel is also **integrated** (along with a broad variety of other stakeholders) into Finland's governmental SD policy sphere, despite being independent in its operation and member composition.
3. The expert panel also hosts **platform**-style workshops and an online platform for sustainability commitments (Commitment 2050, see below), bringing a variety of actors together under the unifying agenda of Finnish sustainable development. Of the panel's five or six annual meetings, some are arranged as workshops or round-table discussions, and its workshops in particular have been regarded as an effective means of knowledge co-production. For example, in February 2016, the expert panel hosted a meeting point-style workshop attended by some 80 people,[19] including government officials, scientific experts and relevant stakeholders.

Commitment 2050 (The Finland we want by 2050 – Society's commitment to sustainable development; see https://commitment2050.fi/), on the other hand, is a social innovation and online platform co-created by the expert panel and Finland's NCSD, aiming to encourage anyone from Finnish companies, households and governmental bodies to engage with sustainable development. With Commitment 2050, individuals or collectives can publicly commit themselves to sustainable development goals and challenge others to do the same. The commitment process includes a description of the 'operational commitment' and subsequent self-reviews on the commitment's progress (commitments can also be altered and iterated later on). Participants can (similarly to the Sustainability Code in case 3, RNE) also wear a commitment insignia and publicly share (via social media channels) information on their commitment, which might positively promote their public image. As of August 2016, 168 commitments have been made, and the initiative has received positive feedback.

19 See www.sitra.fi/en/artikkelit/expert-panel-sustainable-development/getting-things-done-sustainable-development.

See also

Future Earth initiatives (research, monitoring and networking platforms supporting transitions towards sustainability): www.futureearth.org/who-we-are and various **Future Earth National Structures**, for example Future Earth Finland (http://futureearthfinland.fi/index.php/in-english) and Future Earth UK (hosted by The Royal Society, https://royalsociety.org/about-us/international/international-work/uk-future-earth/). Future Earth initiatives, to varying extents, serve the roles of **independent** monitoring and research, **platform**-style networking and are sometimes a part of **nested** organisations (such as Future Earth UK at The Royal Society). Future Earth initiatives are also strongly **integrated** to international SD policymaking, particularly so with developing the UN's sustainable development goals and climate and biodiversity agreements (such as the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity).

3 Other Approaches

THE POSSIBILITIES FOR SCIENTIFIC SUPPORT for SD policies are not, of course, limited to the dynamics of the aforementioned models or case studies. Indeed, the typology presented in Section 2 of this study is merely a heuristic tool intended to help grasp the broader picture of science–policy interfaces and facilitate comparative analysis, as is done below in Section 4. This section, in turn, briefly addresses some 'outlier' cases that demonstrate how stakeholder involvement, public initiatives and other innovative solutions might aid the dissemination of SD-relevant scientific knowledge for the use of policymakers. Whilst many of the following cases and examples are certainly not the most comprehensive ways to organise SPIs (and do not thus warrant models of their own), they represent particularly interesting supplementary tools for the inclusion of a wider civil society in the SD science–policy interface.

3.1 Social and Innovation Labs

Social Labs and Innovation Labs are small independent or government-owned platforms (or laboratories) created for brainstorming, social experimentation, civic engagement, foresight and the application of evidence-informed creative methodologies, often aiming at bringing new techniques to public policy departments.

For example, MindLab is a cross-governmental innovation unit created in Denmark in 2002, which 'involves citizens and businesses in creating new solutions for society'. By utilising expertise in design and the social sciences, MindLab particularly helps decision-makers to see a variety of policy problems 'outside-in' – that is, from a citizen's perspective – using its mostly social scientific methodology as a basis for knowledge co-creation with civil society. Its central tasks are, in other words, to ensure that policy practices actually work from the citizens' perspective whilst also innovating with novel approaches (Annala et al., 2015). A similar body in the Netherlands is KennisLand, which 'develops solutions for a knowledge-driven society' by promoting citizen participation in policy processes at the demand of local decision-makers. These innovation hubs have gathered momentum in recent years, with similar bodies established in, for example, the United Kingdom (such as PolicyLab). Recently, the Finnish Government also launched a key project called 'Culture of experimentation', focusing not only on the promotion of experimental and learning-based policymaking, but also the legislative facilitation of such endeavours.

See also

MindLab: http://mind-lab.dk/en/KennisLand

KennisLand, a Dutch civic organisation aiming to promote civil society involvement in decision-making. Local-level decision-makers in the Netherlands can hire KennisLand's (mostly social scientific) services in design and citizen research in order to further target and enhance their policies.
www.kl.nl/en/

PolicyLab: https://openpolicy.blog.gov.uk/

Finnish Government's **'Culture of Experimentation'** (pages 89-90)
http://valtioneuvosto.fi/documents/10616/1986338/Action+plan+for+the+implementation+Strategic+Government+Programme+EN.pdf/12f723ba-6f6b-4e6c-a636-4ad4175d7c4e

3.2 Challenges, Competitions and Incentive-Based Approaches

An innovative – and, thanks to the internet and social media, a particularly outreaching and effective – means for involving civil society and stakeholders in tackling sustainability issues is the organisation of challenges or competitions (or 'hackathon'-type problem-solving workshops), with either monetary or honorary prizes. Their visibility generally attracts interest from policymakers, public officials and governments, who also often play a part in organising these events (with public officials regularly involved as, for example, members of the competitions' juries).

Since sustainability issues concern such a broad range of societal actors and are generally considered 'trendy', these idea challenges often attract significant audiences and participation. Sustainability-themed challenges have been organised by a variety of public entities (including, for example, the German Council for Sustainable Development; see case 3 above), with the most prolific challenges offering prizes worth tens or hundreds of thousands of euros. Unsurprisingly, this has also attracted the interest of leading research groups. That is not to say, however, that prizes have to be of such a high value, and (particularly for less technical and resource-intensive challenges) a small prize or simply an honorary mention might be enough of an incentive to participate, particularly if participants consider themselves stakeholders in the problem-solving process.

See also

The What Design Can Do Refugee Challenge
www.whatdesigncando.com/

United Nations Global Pulse Competitions and Hackathons (e.g. Big Ideas Competition 2016: Sustainable Cities) www.unglobalpulse.org/challenges-hackathons

The 2015 Smart Living Challenge
http://2015.smartlivingchallenge.com/

Helsinki Challenge 2016
http://challenge.helsinki.fi/

Ratkaisu 100
www.sitra.fi/en/challenge-theme/ratkaisu-100

3.3 Modifying Living and Decision-Making Environments (and Nudging)

Governments have, particularly since turn of the 2010s, employed environmental and behavioural experts for the purpose of designing decision-making and living environments which afford (i.e. are capable of providing) both socially and ecologically sustainable lifestyles. These are often scientifically informed experimental approaches aimed at designing environments which simply 'work' sustainably. Most often, these approaches focus on exploiting the often irrational tendencies of 'merely human' actors.

For example, Good Places, Better Health (GPBH) was a project embarked on by the Scottish government in 2008 which intended to positively reinforce childhood health and sustainable well-being through the better design of living environments, particularly in the less fortunate neighbourhoods of Scotland. Whilst the improvement of living environments has traditionally focused on the reduction of toxins, pollutants and other physical threats, the GPBH found that nowadays the negation of threats should be supplemented by the positive reinforcement of environments that are capable of providing sustainable well-being. Identifying and changing the 'ugly scarred and threatening environments' which 'foster hopelessness and stress, discourage active healthy lives and healthy behaviours' thus became a prime agenda for the Scottish government, and importantly an agenda where policymakers, scientific experts and local stakeholders were brought together in the process of creating healthier environments (Scottish Government, 2008; 2011).

In summary, the GPBH project assembled together a range of experts in environment and health, members of the civil society and other stakeholders, engaging a variety of experts with both evidence gathering and analytical work-stages. The project commenced with a

Living environments that afford sustainable lifestyles generally continue to exist even when less sustainable governments take office and pro-sustainability organisations are abolished.

holistic problem-framing period, where a broad range of experts examined the range of problems and issues to be explored. A modified version of the World Health Organization's DPSEEA (Drivers, Pressures, State, Exposure, Effects and Actions) risk-mapping model was used in the framing process, identifying causal links between the living environment and health, as well as possible intervention points.

After a lengthy process of reviews and workshops, the causal maps were scrutinised in the light of past research and experiences, after which the findings were validated by investigative field research, which included interviews, discussions and workshops with local communities. The gathered 'mixed economy of evidence' was then handed to an independent group of experts (the Evaluation group), who eventually translated the findings into a 10-step policy brief with concrete recommendations for action. The prototype phase of the project lasted until 2011, resulting in a series of concrete political recommendations answering the research question of 'What is needed to deliver places that nurture good health for children?'.

Since environment- or behaviour-altering expert-driven projects such as GPBH provide long-term, concrete and sustainable solutions for lifestyle changes, they can be effective supplements for the previously assessed models of SD science–policy interfaces. The effects of these projects are particularly sustainable since the improved 'affordances' (whereby living environments are designed to promote sustainable behaviour; see Gibson, 1979 and Heft, 2001 for a more detailed discussion on 'affordances') for sustainability continue to exist regardless of social, cultural, economic or psychological turbulence. In other words, living environments that afford sustainable lifestyles generally continue to exist even when less sustainable governments take office and pro-sustainability organisations are abolished (see Section 1.3 for examples of this).

Moreover, environment-modifying endeavours need not assume a scale as grandiose as the GPBH's. 'Nudging' refers to deliberate yet minute changes to the living environment (for example, the 'choice architecture') which positively reinforce desired types of behaviour (Thaler and Sunstein, 2008). Expert knowledge, particularly from the behavioural sciences, can be deployed by policymakers to positively reinforce sustainable, healthy and environmentally sound behaviour. For example, ecological and health-enhancing consumer choices can be significantly reinforced by merely: a) emphasising that the majority of other people choose sustainable products (tapping into the so-called 'herd mentality' of human beings); b) promoting ecological and/or healthy, for example plant-based, food choices as 'default options' in buffets or grocery stores (thus overcoming the often unsustainable 'status quo bias'); or c) arranging the choice architecture so that it promotes sustainable choices (by, for example, placing healthy and eco-friendly food-items in prominent eye-level locations) (Thaler and Sunstein, 2008).

Similar small-scale nudges could lead to concrete local results for sustainable and healthy lifestyles, supplementing the global dimensions of national sustainable development policies (Thaler and Sunstein,

Expert knowledge, particularly from the behavioural sciences, can be deployed by policymakers to positively reinforce sustainable, healthy and environmentally sound behaviour.

2008). Indeed, nudging experts have been deployed for government policy advice in, for example, the United Kingdom (the Behavioural Insights Team) and the United States (the Social and Behavioral Sciences Team). Nudging and design-influenced policymaking has also been proposed to the Finnish Government to promote experimental learning in government policy (see Annala et al., 2015). Whilst nudging is often criticised for only offering short-term solutions to long-term problems, there is obviously no reason why nudging should be the only means for advancing sustainable development or science–policy co-operation; nudging can be used efficiently to complement any other model of organising science–policy interfaces.

See also

Good Places, Better Health:
www.gov.scot/Topics/Health/Healthy-Living/Good-Places-Better-Health

The Behavioural Insights Team, also known as the 'Nudge Unit' of the United Kingdom, is a half government-owned research group which provides policy advice and conducts academic research on nudge-themed issues:
www.behaviouralinsights.co.uk/

The Behavioural Insights Team of the European Commission's Joint Research Centre:
https://ec.europa.eu/jrc/en/research/crosscutting-activities/behavioural-insights

The Social and Behavioral Sciences Team, or the research-driven and policy-advising 'nudge unit' operating under the Federal Government of the United States:
https://sbst.gov/

4 Lessons Learned

SO FAR IT HAS BEEN ESTABLISHED that mainstream science–policy interfaces can be grouped into six models (**Independent**, **Integrated**, **Assignment**, **Nested**, **Adviser** and **Platform**), each with their own unique challenges and benefits, whilst a number of outlier cases and **Mixed** models suggest that the possibilities for arranging SD science–policy interfaces are practically inexhaustible. Indeed, perhaps even the deliberate 'hybridisation' of operating models might be the rational way to tackle the obvious shortcomings of one-dimensional 'pure' models – this is analysed in more detail in the following sections (particularly Section 4.2).

However, at this point it is sensible to reflect on the 'so far, so good, so what?' of the model typology and case studies. Indeed, a number of lessons can be learned from the discussion above. Fortunately, prior research (particularly by Sarkki et al., 2015) has been conducted on factors defining the outcomes of science–policy interfaces, and in order to recap and assess the above case studies we can aim to answer the supplementary research question, 'what can be learned from the typology of Section 2 that will help design better SD science–policy interfaces?'

4.1 Factors Defining Science–Policy Interface Outcomes

As has been discussed above, each model of science–policy interface has its own benefits and challenges. Whilst this is informative in its own right, in order to develop more comprehensive and effective interfaces it makes sense to consider how different models could be combined, connected, networked or hybridised to refine them further and address their shortcomings. Here the theoretical framework of Sarkki et al. (2015) is used to identify where different cases succeed and where they face challenges, after which the six models are assessed in regard to the framework suggested by Sarkki et al. This is followed by a scrutiny of how different models might be able to learn from each other to develop more comprehensive, iterative, adaptable and dynamic 'hybrid models' or networks of science–policy interfaces with enhanced and refined capabilities.

Based on empirical observations on biodiversity-related science–policy interfaces, Sarkki et al. (2015) identify 14 factors that explain the outcomes (both successes and failures) of science–policy interfaces (SPIs): **independence**, **participation**, **resources**, **vision**, **knowledge drivers**, **foresight**, **continuity**, **conflict management**, **trust building**, **capacity building**, **adaptability**, **knowledge transfer**, **quality assessment** and **knowledge translation**. These parameters define the structure, objectives, working processes and outputs of SPIs. The 14 factors are defined in detail below, whilst they are also mirrored in the case studies studied in Section 2. Moreover, two more factors, **multidisciplinarity** and **integration**, are added to the mix to highlight the specific needs of sustainable development SPIs. Note that these factors below should not be read in a linear fashion; that is, having more of one factor (for example, independence) does not mean that the SPI is necessarily better (or vice versa). Instead, success in these factors is, more than anything else, dependent on a delicate and iterative balancing act between too little and too much (in other words, locating the Goldilocks balance of proportionality as described in Section 1.3 of this study).

Success in these factors is, more than anything else, dependent on a delicate and iterative balancing act between too little and too much.

1. **Independence**. Whilst absolute independence is unattainable in SPIs – and indeed undesirable, since any constructive relationship between those in science and policy necessitates a loss of independence in some respect – independence is a particularly important factor in the outcome of SPIs. This is particularly because those working in SPIs should not be dominated by particular interest

groups and should be left to act according to their best available knowledge with minimal vested interests. If possible vested interests exist, they should at least be transparent (as was the case with case 2, FRDO). As was discussed in the introduction to this study, independence is a variable whose success is dependent on constant balancing between (scientific) autonomy and (political) involvement. Whilst, for example, independent panels (as in case 1, WBGU) face the challenge of maintaining an effective yet independent distance from policymakers, integrated councils might find themselves too closely associated with governments and even face post-election abolishment (see Section 1.3 above).

2. **Participation**. Participation refers to the balance of the SPIs' participants in, for example, geographical location, gender and scientific opinions, as well as their openness towards new members. For example, case 8, GCSA, offers one example of a particularly poor gender balance, since a female has never been appointed to the post of Government Chief Scientific Adviser. A broad participation enhances the coverage of expertise and interests related to SD issues, and might result in increased competence. However, too broad a participation might also result in problems, which is a relevant concern particularly with multi-stakeholder integrated councils. Case 12, EKLIPSE, on the other hand, adds to the variety of participation by not only including a wide range of policymakers and researchers in its knowledge synthesising processes, but also being inclusive towards wider civil society. Again, however, finding a balance between too broad (and inefficient or conflicted) and too narrow (and biased) participation is key to success.
3. **Resources**. Resources refer to financial, human and temporal resources available to the members within the SPI. Generally, having more resources means being more capable of acting, although this is not necessarily the case (for example, assembling work-intensive reports might take a lot of resources but their real impact and efficiency might be questioned, as was discussed with the Independent and Nested Models). Most of the case studies in this study were, relatively, heavily and steadily funded, with the main exceptions being case 10, RESPONDER, case 11, Oppla, and case 12, EKLIPSE, which relied/rely on interim funding from the European Commission.
4. **Vision**. Vision refers to the clarity, scope and transparency of the SPI's objectives and working models. Whilst long-term SPIs often have a clearly set agenda (for example, case 1, WBGU, has a clearly stated mission leaflet and in case 2, FRDO's mandate is based on federal law) or a well-established variety of agendas (case 5, WRR, and case 6, FPB), which motivate and facilitate action, short-term SPIs might either lack vision or have a vision incompatible with other relevant actors (such as the European Commission's CSA, as discussed in Section 2.5).

Those working in SPIs should not be dominated by particular interest groups and should be left to act according to their best available knowledge with minimal vested interests.

5. **Knowledge drivers**. Knowledge drivers refer to the balance between the 'demand-pull' and 'supply-push' of policy-relevant information. Overemphasising the supply side risks advice not being taken seriously (since a heavy report load might easily be ignored, as was discussed with Independent and Nested Models), whilst overemphasising the demand side risks losing independence (as happens when, for example, governments hire consultancies to promote their agenda – this was discussed in more detail with the Assignment Model). Case 6, FPB, on the other hand, illustrated how a long-lived and highly trusted SPI is not only relied upon for 'pushing' knowledge towards public officials, but also acts on a demand-pull basis dependent on the needs of public bodies. Moreover, case 2, FRDO, was particularly successful in balancing drivers of knowledge, since it not only produced knowledge on its own initiative but was also supported by the legal mandate of the government having to act according to its advice (or else, explain its deviance). Indeed, (legal) mandates can be effective in facilitating the balance of knowledge drivers (Sarkki et al. 2015: 509), and getting the drivers just right is, of course, not only down to the expert body but also the prevalent political culture, legal institutions and political actors.

6. **Foresight**. Foresight, or 'horizon scanning' as Sarkki et al. describe it (2015: 509), can increase the relevance of both produced and disseminated knowledge by 'anticipating science and policy developments', and particularly aids SPIs in helping to set a coherent and productive vision. Adjusting an SPI's operation to match the 'latest knowledge and policy needs' increases performance particularly in the complex and changing contexts of sustainable development. A successful SD SPI therefore requires at least some sort of foresight, since otherwise targeting relevant issues is near impossible. Whilst the independent and integrated panels all included some forms of foresight (usually detailed in flagship reports or mission leaflets), significant and high-end 'SD forecasting' requires heavy resources and is mainly done by nested research institutes with specific forecasting experts (for example, the backcasting methods discussed in case 6, FPB).
7. **Continuity**. As has been repeated several times during this study, successful scientific advice and support for SD policies requires long-term co-operation, social learning, relationship building and policy co-development. The continuity of an SPI is thus an obvious factor determining its impact and outcome. Sarkki et al. (2015: 509) define continuity as the 'repetitive internal processes and continuity of personnel in the same positions'. The continuity of an SPI, therefore, refers to the iterative learning capabilities of the SPI's members, as well as the continued building of expertise and necessary networks for knowledge transfer, and particularly the nurturing of positive continuous 'institutional memory' (Sarkki et al., 2015: 511). Again, though, continuity is a balancing act: too many personnel in the same positions for too long might lead to biased opinions, stagnant working procedures and even vested interests, and changes in membership composition might bring about welcome new perspectives (which is why independent and integrated panels often seem to have a moderately short-term – for example, a two- to four-year – delegation). On the other hand, too little continuity (such as 'one-off' assignments) means that advice might lack long-term watchdog-style monitoring and the iterative and adaptive learning which SD policies necessarily require.

Successful scientific advice and support for SD policies requires long-term co-operation, social learning, relationship building and policy co-development.

8. **Conflict management**. Conflict management refers to the SPIs' ability to act as third-party facilitators, bringing together dissonant voices from the policy and research arenas. Whilst Sarkki et al. (2015: 509) note that biodiversity issues are widely 'contested and often involve multiple sectors', this is perhaps even more so with sustainable development, where paradigm differences exist between, for example, pro-growth, de-growth and non-growth communities (and, importantly, also within scientific and political circles). As was illustrated with case 10, RESPONDER, a knowledge brokering and deliberative SPI can successfully bring dissonant voices into the same (literal or metaphorical) room and foster trust and communication within its participants. This is an essential compromise-building practice if true change in the SD political atmosphere is the goal.
9. **Trust building**. Trust building is a very similar factor to conflict management, with the slight tonal difference being its more 'human-scale' approach: trust building is achieved through informal discussions, participatory meetings and workshops and transparent procedures within the SPI. For example, case 9, CSaP, relied extensively on trust building between policy and research experts, and involved one-on-one discussions and transparent and participatory self-organised networking. Moreover, case 5, WRR, showed how informal and inclusive discussion sessions within a group of experts can increase the quality of its work and increase the expert body's internal trust-building capabilities.
10. **Capacity building**. Capacity building means 'helping policy makers to understand science and scientists to understand policy making' as well as building the overall knowledge and practice capacities of participants within the SPI (Sarkki et al., 2015: 509). This essentially refers to the co-creative learning environment discussed extensively in this study.

For example, case 9, CSaP, is a prime example of a science–policy interface where a learning environment was fostered for both researchers and policymakers (via the Policy Fellowship scheme), benefiting all participants. Case 11, Oppla, also used innovative online tools for capacity building (Q&As, tool distribution and so on).

11. **Adaptability**. Adaptability 'helps SPIs to remain relevant in changing contexts' and technically refers to the iterative capabilities of the SPI. In other words, adaptability refers to how well an SPI is able to respond (internally) to external political turbulence and how well it is able to respond to new challenges and moving targets (Sarkki et al., 2015: 509). A good example of adaptability was found in the Royal Society of New Zealand's work (case 7), where diverse groups of experts could be formed (sometimes interim and ad hoc) from a wide pool of merited experts, along with a variety of knowledge diffusion channels including 'published reports, website data, infographics, pamphlets, interactive websites, social media campaigns, follow up meetings and workshops with government stakeholders, and public lectures and debates'. Case 12, EKLIPSE, is also a prime example of an adaptable and iterative SPI, constantly shaping itself as a self-organising network and potentially changing its practices according to emerging needs. A lack of adaptive measures can, of course, make an SPI redundant or undesirable, as happened with many SD expert councils at the dawn of the 2010s (see Section 1.3 above), as well as result in SPIs being incapable of responding to quickly changing sustainability challenges ('moving targets' or, in the worst case, environmental and economic crises and catastrophes[20]).

A lack of adaptive measures can, of course, make an SPI redundant or undesirable, as happened with many SD expert councils at the dawn of the 2010.

12. **Knowledge transfer**. This factor is determined by timely, accessible, comprehensive and, above all, efficient policy-relevant knowledge dissemination within the SPI, as well as by the availability of good (scientific) knowledge. To achieve this, scientists must 'communicate their knowledge to policy makers in brief and understandable ways, tailored to specific target audiences, and in a timely manner with respect to deadlines in decision processes' (Sarkki et al., 2015: 509). Whilst cases 1 (WBGU), 3 (RNE), 5 (WRR) and 6 (FPB) all involved reporting procedures tailored for the purpose (from short-turnaround pamphlets to long-turnaround books), successful knowledge transfer also involves personal (one-to-one) relations and co-operative/co-creative platforms, as found in, for example, case 9, CSaP, and case 12, EKLIPSE. Indeed, having a variety of publishing channels with personal one-to-one discussions (case 9, CSaP) or inclusive workshops (case 10, RESPONDER) seems the most reasonable way to strike a balance between scientific independence and participatory and co-creative platforms. Correspondingly, Weichselgartner and Kasperson (2009: 276) note that a 'feasible way for knowledge producers and users to generate a deeper mutual understanding of each other's needs and constraints is to increase the amount and intensity of face-to-face interaction by creating institutional contexts where both are encouraged to interact'.
13. **Quality assessment**. Scientific support for SD policies must, of course, be of high quality and meet the standards of good practices. Whilst (particularly ad hoc) advice must not always be scientifically qualified (or peer reviewed; this is particularly due to the fact that peer-reviewing processes might be too slow to tackle moving targets), internal (for example case 5, WRR, and case 12, EKLIPSE) or external (as in case 2 and FRDO's 'extended stakeholder review' by monitoring members), quality assessments can help locate weaknesses in SPIs' policy advice and thus refine existing practices.
14. **Translation**. Translating knowledge from highly subject-specific and intra-disciplinary normal science to the (often not so scientifically literate) policy arena is a notoriously difficult task. Successful knowledge translation, particularly from science to policy, requires 'conveying messages across different domains and actors, and making the message relevant for various audiences via different formats' (Sarkki et al., 2015: 510). Whilst specialist knowledge

20 A notable example of an ad hoc and highly adaptable expert panel was the 'White House oil spill commission' formed in midst of the Deepwater Horizon oil spill. The panel, formed at short notice, was able to probe the causes of the oil spills as well as provide insight into how to avoid such a crisis happening again.

translation services exist for the translation of science into specific policy needs (as in case 4, Envirolink), knowledge translation is also necessarily a two-way process and entails translation from policy to science. Building a joint understanding for two-way knowledge translation 'takes time and often requires repetitive meetings [see, for example, case 9, CSaP, case 10, RESPONDER, and case 12, EKLIPSE] for policy makers to really understand science and for scientists to comprehend policy needs' (Sarkki et al., 2015: 510, brackets added).

Successful knowledge translation, particularly from science to policy, requires 'conveying messages across different domains and actors, and making the message relevant for various audiences via different formats'.

15. **Multidisciplinarity**. Since sustainable development is a notoriously multifaceted field (and can basically refer to anything from local health or community developments to global climate change), SD policy-related SPIs should host a variety of scientific voices. Experts should be drawn to form broad and all-encompassing scientific expertise (as in, for example, cases 1, WBGU, and 5, WRR) with a broad understanding of sustainable development issues and methodological capabilities.
16. **Integration** of various perspectives on sustainable development. This final factor – like factor 15, which is not included in the Sarkki et al. list (2015) – is again a specific challenge to sustainable development SPIs. There is a slight yet important tonal variation here with factor 15 (Multidisciplinarity[21]), since an integrative SPI not only hosts multiple (multidisciplinary) voices but also integrates (interdisciplinarily, see footnote 19) them to form a coherent whole. As has been noted, sustainability is still often framed in an environmental (or some other single perspective) concern, whilst other socio-ecological dimensions are sometimes left completely unaddressed. Indeed, SD SPIs should not only be concerned with environmental sustainability, but should also integrate social, economic and even psychological perspectives into their agenda (as highlighted by the universal sustainable development goals[22]) to form a coherent and functional whole. In contrast, if multidisciplinarity (factor 15) refers to a variety of voices being heard (imagine magnets scattered on an empty table), integration (or interdisciplinarity) means connecting these voices together (imagine the metaphorical magnets clustering) to form an emergent comprehensive understanding of sustainability. For example, in case 6 (FPB) we saw how this nested SPI not only hosted multidisciplinary thematic groups related to sustainable development, but also a task force specifically integrating SD perspectives. Of course, there is nothing wrong with highly subject-specific policy advice and expertise (indeed, this 'Kuhnian' specialisation is essentially what the scientific enterprise is built on), but as per national-level SD policy advice these discrete units of expertise ought to be somehow pulled together to provide holistically sustainable advice, which is a specific challenge for 21st-century science–policy interfaces.

Sustainability is still often framed in an environmental (or some other single perspective) concern, whilst other socio-ecological dimensions are sometimes left completely unaddressed.

21 Three terms should be distinguished here: 1. multidisciplinarity refers to those from a variety of disciplines working together; 2. interdisciplinarity is the integration of methods and knowledge from different disciplines; and 3. transdisciplinarity is the creation of unified frameworks and methodologies.

22 See https://sustainabledevelopment.un.org/sdgs.

4.2 Comparative Analysis of the Models

Having identified 16 factors, which to a large extent define the benefits and challenges of SPIs (but not completely[23]), it is possible to work towards a synthesis of what we have learned from the models and case studies.

Sustainable development is a particularly dynamic socio-ecological process which simply cannot be organised by static and isolated institutions.

First of all, what seems glaringly evident is that as a result of the particular shortcomings of different model types, a variety of different models should be operated within the national (or subnational and international) context. Whilst, as has been noted, some countries with highly institutionalised SD actors (and National Sustainable Development Strategies) – such as Germany, the Netherlands, Finland and Belgium – foster a variety of different models for SD-related SPIs, these countries should **focus on creating networks between these interfaces** in order to complement their individual weaknesses. Again, this is due to the fact that sustainable development is a particularly dynamic socio-ecological process which simply cannot be organised by static and isolated institutions. These interconnections could, for example, be enhanced via the networking (preferably face-to-face interaction) of SPIs, creating mutually beneficial visions, trust and capacity building, as well as adaptable means to tackle national challenges. Moreover, **individual SPIs should perhaps seek to integrate features from other SPI models to complement their respective shortcomings**.

Next, on the basis of the aforementioned 16 factors, six SPI models (Independent, Integrated, Assignment, Nested, Adviser and Platform) are briefly assessed to determine what they can afford other SPI models and what they should perhaps seek to learn from other models.

1. **The Independent Model** seems to excel mostly in the following factors: independence (somewhat self-evidently), vision, continuity, quality assessment, multidisciplinarity and integration. These are, unsurprisingly, also the most scientific variables. However, what independent SPIs clearly lack are conflict management, trust building and other participatory processes. Independent SPIs could clearly consider including operating models from, for example, Platform SPIs, by integrating participatory approaches, workshops, face-to-face encounters and so forth to further enhance knowledge transfer and diffusion (and thus also improve the balancing of knowledge drivers by not only 'pushing' knowledge but also 'pulling' relevant knowledge from relevant stakeholders and indeed co-creating socially robust SD policy-relevant knowledge). Moreover, whilst the independence of independent SPIs is a clear perk – allowing them to critically assess governmental policies and so forth – they should also seek to operate close enough to governmental policy actors (or integrated councils) to ensure their advice is acted upon (and if not, be vocal about it).
2. **The Integrated Model** largely differs from the Independent Model in that its independence is compromised by its proximity to high-level officials, which may (or may not) inhibit nonconventional voices from being heard. Integrated models should strive to overcome this challenge by organising platform-style arenas and workshops where non-involved members can express their concerns and introduce novel ideas.
3. **The Assignment Model** seems to be, at best, an adaptable means for using knowledge transfer and translation as supplementary measures for a more comprehensive SPI. Assignment SPIs lack the vision, continuity, trust building and conflict management to act as 'mainstream' SPIs, and should rather be considered as providing short-term investigative punches when required. The fact that this model is becoming more and more popular in science–policy interaction is slightly concerning, and more holistic and inclusive measures would certainly be preferable (unless, again, the 'assignments' are complementary to other SPI processes!).
4. **The Nested Model** is particularly strong at maintaining its independence and continuity (as a result of resilient institutionalisation), and a coherent and institutionalised vision, as well as conducting thorough foresight (signifying a move

23 Some obvious omitted factors include, for example, institutional issues, legal contexts, social settings and values, existing (personal) relationships, trust relations, stakeholder/associate values, national policy and science structures (and e.g. national sustainability strategies), infrastructures, personal traits, stages in policy cycles and so forth (Sarkki et al., 2015: 510).

Whilst platform SPIs are often short-lived, they have longer lifespans if they were institutionalised and integrated into the operation of more long-standing SPIs.

from backward-looking evidence-based advice to anticipatory and forward-looking activities). Nested SPIs could, however, significantly benefit from some sort of integrative force at the head of the organisation, bringing together relevant knowledge and ideas to synthesise concrete policy advice. Whilst forming new nested institutes is probably out of the question (because of high resource requirements), other models should seek to adopt the logic behind nested 'expert groups within expert groups', and connect with researchers and foster direct collaborative efforts. For example, there is no reason why independent or integrated panels could not benefit from direct interaction with university-level thematic research groups. Moreover, to enhance knowledge translation, drivers and overall dissemination, nested SPI institutes should seek to collaborate with platform SPIs and actively participate in such knowledge transfer processes.

5. **The Adviser Model**, accordingly with the analysis in this study, seems to be portrayed at best as a supplementary measure to other more comprehensive and holistic SD-related SPIs, and perhaps might be best avoided altogether in the SD context. This is particularly since most sustainability issues are complex and indeed controversial enough to spark conflicts, particularly if advocated by a dictator of 'scientific opinion' (recall how a single comment on gene manipulation sparked outrage towards the European Commission's CSA; see Section 2.5). Whilst the Adviser Model might be suitable for the advancement of STEM issues in general, it does not seem to be representative enough to be considered key to scientific support for sustainable development policies.
6. **The Platform Model** certainly seems the best-suited model for capacity and trust building as well as conflict management, and often organises highly diffusive knowledge drivers built on personal relations and participatory networks. In many respects, this seems to be the best model for tackling complex and conflictive sustainable development issues, although a Platform SPI necessarily requires an independent expert core for knowledge synthesis and moderation. Whilst platform SPIs are often short-lived, they have longer lifespans if they were institutionalised and integrated into the operation of more long-standing SPIs. Therefore, platform SPIs could be considered to be strong co-operative partners for independent/integrated/nested SPIs in particular.

An ideal-type SPI could then have an independent core panel (members with the ability to raise their voices when required) and also be strongly connected to universities and research institutes (benefiting from the nested working groups within these organisations and freeing the independent panel's time to allow more participatory processes). The SPI could be integrated into the government sphere (involving personal contact with high-level decision-makers), whilst also organising, or at least being strongly involved with, active platforms for science–policy–stakeholder meetings and workshops. It seems more rational, however, to achieve this synthesis of operational models through co-operation and networking (with already existing actors) rather than creating a single, perhaps too complex, SPI.

5 Conclusions and Discussion

IN CONCLUDING THIS STUDY, it is worthwhile recapping its central findings and setting them into a forward-looking context: where to move from here? What can we learn from past experiences with science–policy interfaces, and what factors should we consider when developing new interfaces or refining our current science–policy interface (SPI) working models?

First of all, it seems particularly important that in a complex socio-ecological context the variety of responses both within and between science–policy interfaces has to be diverse enough to enable the tackling of both long-term targets (such as the sustainable development goals) and short-term moving targets, as well as to engage with sustainability problems of different levels of complexity with appropriate means tailored for the purpose. Therefore, both stabile continuity and dynamic flexibility are required, with short-term SPIs complementing longer-term interfaces. For example, conflict-laden issues should be approached via a more deliberative platform-style pathway whilst less complex knowledge deficits can be contributed to by smaller-scale assignments. Independent Model SPIs can serve as the long-term watchdogs for sustainable policies, whilst perhaps relying on the work of ad hoc and interim nested task forces for short-term policy 'punches'. In this nexus of diversity in temporal factors and complexity, each of the SPI models (**Independent**, **Integrated**, **Assignment**, **Nested**, **Adviser** and **Platform Models**) might find their respective niche. Different working contexts call for different approaches. In other words, diversity is richness when it comes to science–policy interfaces, but only when different SPI models work together to complement each other's weaknesses and shortcomings.

Diversity is richness when it comes to science–policy interfaces, but only when different SPI models work together to complement each other's weaknesses and shortcomings.

The typology developed in this study can help boundary organisations involved with science–policy interfaces to locate their place in the SPI nexus and consider how they could complement their work by networking with other SPIs with different operative models, or alternatively seek to refine their own modus operandi. Science–policy interfaces within the same national framework might, for example, seek to promote co-operation with other SPIs by setting common agendas, visions and so forth in order to piece together the SPI puzzle in the most reasonable and socially and politically effective way. Again, sustainable development cannot be pursued by isolated and static institutions, and we should instead focus on fostering 'dynamic social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making and/or research' (Sarkki et al, 2015: 506). Moreover, by networking both nationally and internationally, SPIs can seek to foster a learning environment where good practices and experiences from effective working models, or combinations of working models, are shared.

Furthermore, it should be once more emphasised that scientific support for sustainable development policies should not be taken for granted. Indeed, whilst conducting this study it seemed like SD policy-related SPIs are a particularly vulnerable or even endangered species, and recent (even anti-intellectual) trends within the OECD's political climate spark further concerns. This was apparent in the 'purge' of National Councils for Sustainable Development (NCSDs) (see Section 1.3 above) at the turn of the 2010s, but the tide seems not to have turned. This highlights the notion that a national sustainable development policy framework should not rely on a single interface, or in other words, all eggs should not be kept in one basket. Diversity, in this context, also entails robustness and adaptability in the face of political turbulence. Indeed, scientific support for sustainable development policies therefore needs collective ownership, particularly collective ownership of complex sustainability issues by

The Platform Model in particular seems integral to providing a trust-building forum where collective problems are co-designed within a learning culture focused not only on building evidence, but also on experimentation, foresight and deliberative iteration.

both the scientific and political communities. Moreover, this complexity should not be reduced too far: multiple voices should be heard in the (preferably literal) same room, within a deliberative arena that promotes conflict resolution and understanding.

Therefore, the Platform Model in particular seems integral to providing a trust-building forum where collective problems are co-designed within a learning culture focused not only on building evidence, but also on experimentation, foresight and deliberative iteration. This means not only looking backwards (at, for example, sustainable development indicators), but also looking forwards and integrating different modes of knowledge (both tacit and explicit, both rigorous and from first-hand experience) into the social learning process. But this is again a balancing act: deliberation does not mean that non-scientific voices are offered dominance over scientific expertise or evidence, nor does it imply that scientific actors should dull the edges of the scientific method. Nor, importantly, is it implied that scientific independence should be compromised in the advisory process. What is implied however is that whilst providing scientific support, SPIs should seek to consider the social robustness of their advice; that is, whether or not the advice is applicable in the social and political contexts in which the relevant issue occurs. Finding the right distances between science, society and policy, or the Goldilocks zone (not too hot and not too cold, see Section 1.3), of the science–policy interface, is fundamental to this task. This is an iterative and contextual task, and might require some trial and error.

Moreover, whilst conducting this study it appeared that expert panels and councils in OECD countries are still heavily biased towards 'linear' models (also known as information deficit models) of knowledge dissemination, that is, evidence-based direct knowledge transfer from science to policy intended to respond to perceived knowledge deficiencies in the policy arena (i.e. speaking the scientific 'truth' to people in 'power'; Sarkki et al., 2015). Consequently, knowledge production and reporting are still the prime modes of operation for most expert panels, groups and councils. Whilst it should not be suggested that these linear modes of knowledge production are in vain or ineffective, these means seem rather non-inclusive and non-participatory for tackling sustainability challenges which affect the whole of society, and have a tendency to overemphasise the capability of mere evidence to bring about true change in policy and society. Therefore, this study deliberately set out to distinguish in its case studies some more innovative approaches for knowledge dissemination, since a descriptive account of dozens of similar reporting-biased bodies would not be worthwhile or informative. Consequently, this study is not so much of an overview on the existing conditions of SD science–policy interfaces as much as it is a benchmarking study of good and innovative practices and the benefits and challenges these practices come with.

This study deliberately set out to distinguish in its case studies some more innovative approaches for knowledge dissemination, since a descriptive account of dozens of similar reporting-biased bodies would not be worthwhile or informative.

This 'selection bias', if you may, is also evident in the fact that most case studies studied here host a rather impressively comprehensive and integrative approach to sustainable development. In other words, next to the perhaps more obvious environmental focus (which, today, is still what most people associate sustainable development with), the case studies above hosted welcome perspectives on social, economic and even technological sustainability, promoting a more holistic perspective on sustainability and sustainable well-being from both local and global perspectives. This universality, as advocated by the sustainable development goals, should not however be confused with representing the status quo of sustainable development-related science–policy interfaces. Most often, it seems, expert panels and committees are still concerned with a single perspective on sustainable development, with the most common fields being natural conservation, climate change and biodiversity sciences. Again, I do not wish to say that this 'siloing' is a pathological feature (which it is obviously not, since much – if not most – of the scientific enterprise is built on siloed expertise!), but it is merely implied that single-perspective SPIs should at the least seek to collaborate with those in different fields, and experts should not shy away from stepping into uncomfortable political arenas that do not quite fit their particular niche of expertise. Therefore, following a familiar note, if comprehensive, integrated or holistic (multi-, inter- and even transdisciplinary) perspectives – which take into account the interconnections between socio-ecological phenomena – cannot be fostered within an SPI, they should at least be advanced and cultivated between SPIs. Moreover, seeking novel perspectives on sustainability issues from more unconventional and unexpected fields, such as behavioural or cognitive science, could be an interesting way to move forward.

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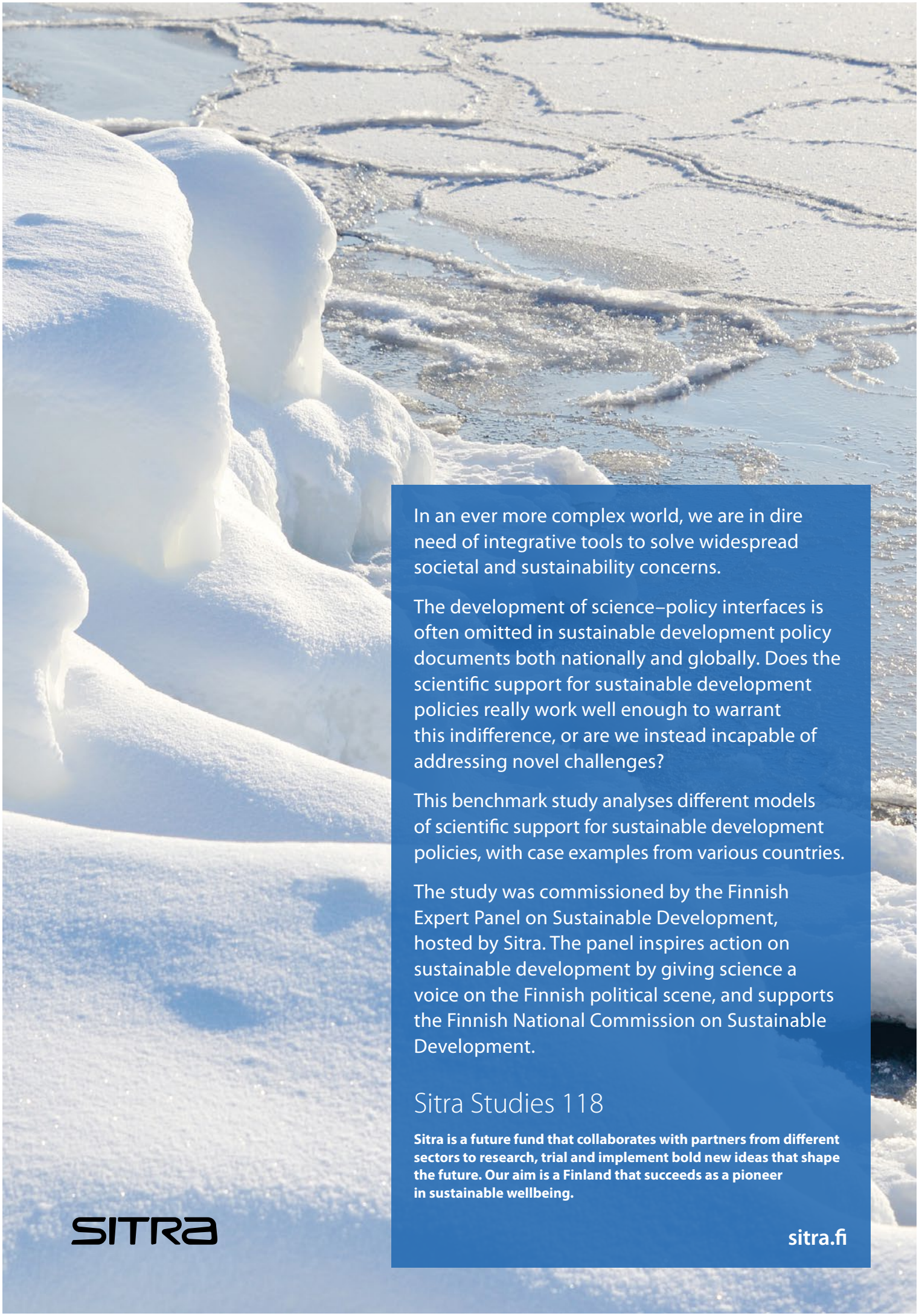

In an ever more complex world, we are in dire need of integrative tools to solve widespread societal and sustainability concerns.

The development of science–policy interfaces is often omitted in sustainable development policy documents both nationally and globally. Does the scientific support for sustainable development policies really work well enough to warrant this indifference, or are we instead incapable of addressing novel challenges?

This benchmark study analyses different models of scientific support for sustainable development policies, with case examples from various countries.

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