Identifying Interactions for SDG Implementation in Ireland

"Identifying Interactions for SDG Implementation in Ireland"

(Ref: 2018-SE-MS-12)

D3.1 Report on methodological tools for investigating SDG interactions

&

D3.2 Guidelines for Toolkit

Martin Le Tissier & Hester Whyte

Contents

1 Preamble

The EPA funded "*Identifying Interactions for SDG Implementation in Ireland*" (SDGs4I) project specifically addresses SDG target 17.14 to "enhance policy coherence for sustainable development". The challenges for policy coherence have been set out in *D2.1: Report on international review of SDG interactions*, and within Ireland's context by *D2.2. Report on SDG interactions in context of Ireland sustainable development goals*. At a national level the SDGs present a challenge because action to meet one SDG and/or its targets could have unintended consequences on others if they are pursued separately. Analysis is also required to reconcile the fact that the categorisation of the SDGs does not fit well with the way in which governments operate and are organised. D2.2 proposed that the SDGs themselves present an implementation tool to link and integrate across discrete areas of national-level policy (Figure 1), and this integrative facility between SDG implementation and national policy implementation is the focus for the development of a tool in the SDGs4I project.

1.1 Report Structure

Sections 2 and 3 are "*D3.1 Report on methodological tools for investigating SDG interactions*" that provides an assessment of tools and methodologies to assess the SDGs in support of balancing their environmental dimensions and the interlinkages between individual SDGs and their Targets. Section 4 is "*D3.2 Guidelines for Toolkit*" that outlines the criteria for tool development as part of the SDGs4I project. The report focuses on frameworks that aim to help policy makers design more coherent and resource effective approaches to generate progress on the 17 SDGs overall, and specifically those relevant to horizontal integration across Government in the context of Target 17.14 of SDG 17.
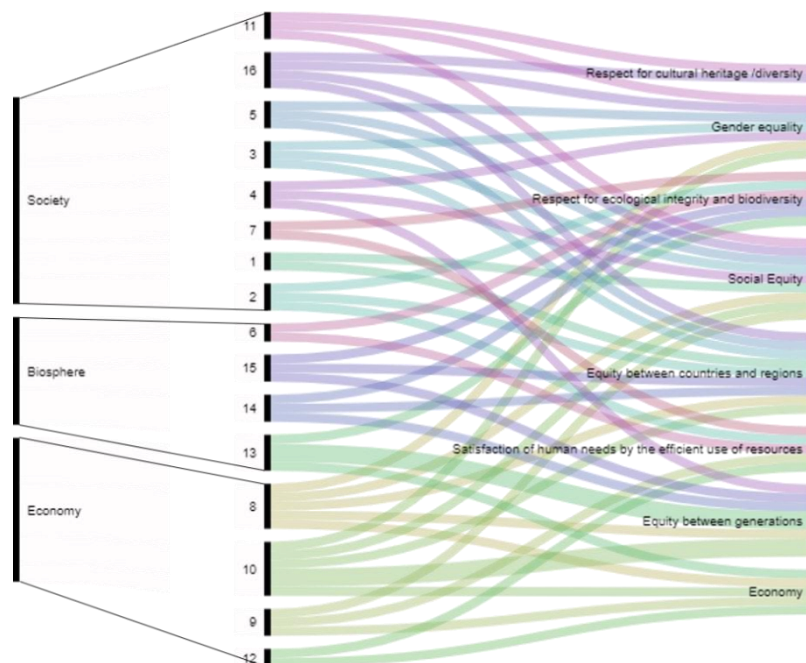
Figure 1. Association of SDG Economic, Society and Biosphere categories and Goals and the categories of sustainable development identified in Ireland's framework for sustainable development [1] showing how each SDG links to more than one of the sustainable development framework categories and can thus act as an integrating mechanism between areas of policy that might otherwise be implemented in isolation. Source: Authors elaboration based on [8].

2   Introduction

Practitioner and academic communities have recognised the need to provide support to policy makers to more effectively understand and use the nature of interactions between SDGs/targets – both positive and negative – to plan and drive coherent and efficient policy design and implementation [1,2]. A component of this support is how to address the outcome from Rio+20 [3] and an underpinning principle to the 2030 Agenda [4] to produce a set of universally applicable sustainable development goals (SDGs) that balance the environmental, social and economic dimensions of sustainable development [5]. The three dimensions of sustainable development that the 2030 Agenda outlines—economic prosperity, social justice and environmental protection—as "intertwined" [6]. Interconnectedness and the role of the environment in sustainable development have been recognised by the Government of Ireland in its strategies for sustainable development [7] and implementing the SDGs [8].

2.1   Background to Identifying Interactions for SDG Implementation in Ireland

Ireland's first Sustainable Development Goals National Implementation Plan (NIP) [8] sets out how Government will implement the Sustainable Development Goals (SDGs) domestically and internationally. Ireland has adopted a whole-of-Government approach as the SDGs are relevant to, and will require coherent contributions from, all Departments for their successful implementation. This is reflected in the NIP that has identified the alignment of the then portfolio of existing policy documents with the SDGs and noted opportunities for policy coherence, in particular, in the context of Ireland's sustainable development framework [7] and Project Ireland 2040 [9].

The "*Identifying Interactions for SDG Implementation in Ireland*" (SDGs4I) project addresses the SDGs as a complex chain of interlinked goals to better understand how to implement the SDGs in a more integrated way, and avoid having to choose between allocating efforts [10,11] whilst meeting both international and national objectives. The 17 SDGs are broken down into 169 associated targets that describe the action required to achieve a sustainable future state [4,12]. Although the intent of the SDGs and targets are integrated and indivisible, governments can adjust the targets and adapt their indicators to reflect their particular situation and circumstances to, at a national level, achieve the global goals (para. 21 & 55 [4]).

Policy implementation towards national strategies and SDGs presents several challenges that could lead to contradiction between integrating the SDGs into national policy and ensuring compatibility between the SDGs and Ireland's development strategy at home and abroad, for instance:

1. Many of the individual targets contribute to several goals, and while in some cases interactions can lead to synergistic outcomes in others goals and targets may conflict; action

to meet one target could have unintended consequences on others if they are pursued separately [6,10,11].

2. Individual policies that connect to one target could lead to an outcome from that target which then has negative (or conversely synergistic) outcomes on other targets [13,14].

3. Individual policies may connect to multiple targets such that a focus on its action on individual goals and/or targets could lead to perverse outcomes and progress across multiple elements of the 2030 Agenda [13,15,16].

4. How policies, that are usually designed to address a specific sector purpose, can be implemented in the context of a wider 'systems' perspective as required by the SDGs [17,18].

5. Analysis is also required to reconcile the fact that the categorisation of the SDGs does not fit well with the way in which governments operate and are organised.

These challenges could lead to contradictions integrating the SDGs into national policy, and ensuring compatibility between the SDGs and Ireland's current national Sustainable Development Strategy "Our Sustainable Future"[7]; The National Planning Framework [19]; and The National Development Plan [9] amongst the portfolio of Ireland's policy strategies (see p.19 [8]).

2.2   The Environment and SDG Implementation Ireland

Environmental pressures affect every country, and climate change, pollution and the loss of natural habitats undermine prosperity and security nationally and internationally, for instance threatening food and freshwater supplies and contributing to the spread of disease. Humanity is hosted within a closed biosphere and is entirely dependent on provisioning and regulatory processes of planetary ecosystems to sustain life. Given this background and Ireland's recognition of the importance and place of the environment in its future a theme of biodiversity, climate change threats and the environment has been chosen to frame the SDGs4I project. The fundamental underpinning role of biodiversity and the biosphere to sustainable development and the SDGs has been widely promoted [20–26], and is reflected in the "Our Sustainable Future" Theme: Respect for ecological integrity and biodiversity [7] and Ireland's Biodiversity Plan [27,28]. Biodiversity and healthy ecosystems are central to many economic activities (e.g. SDGs 8, 9, 12) and societal objectives (e.g. SDGs 1, 2, 3, 5, 7), and is directly affected by climate change (SDG 13) as well as providing significant mitigating potential.

Ireland's approach to sustainable development, the role the environment plays coupled with the exacerbating challenges presented by climate change, is compliant with the aspirations of the European Union's 7th Environment Action Programme (EAP); 1) to protect, conserve and enhance natural capital; (2) become resource-efficient, green with a competitive low-carbon economy; and (3) develop resilience to environment-related pressures and risks to health and well-being [29]. The United Nations (UN) SDGs provide a framework and logic for transformative change that are required

to evolve policy outcomes that acknowledges the interdependence of social, economic and environmental targets. It has been recognised that success in achieving such transformative changes are in large part dependent on Government's ability to integrate environmental goals into sectoral policy through improved policy coherence.

3 Tools for SDG Implementation

There are many SDG implementation initiatives[1] underway that seek to bring expertise, tools and approaches to support countries' and stakeholders' efforts in implementing the SDGs through provision of technical solutions for the implementation of individual SDGs and targets. Tools that enable and facilitate engagement across multiple areas of government and policy to exploit benefits and opportunities arising from SDG synergies, whilst mitigating trade-offs, are less common. An assortment of tools and frameworks, some bespoke and others adapted from pre-existing ones, have been advocated in support of SDG implementation and an integrated agenda for national and international development [30–32]. A number of these tools and frameworks are focussed on the type of future that may emerge from the successful implementation of the SDGs (e.g. Qualitative scenario building) – and specifically addressing links between the economic, social and environmental dimensions of investment, trade and related economic activity (e.g. Input-output analysis) [31,33].

3.1 Characterising SDG Tools

The word 'tool' can have different meanings depending on its mode of employment and who is using it [34]. Essentially a tool is anything that helps accomplish a task, so can include a guide/manual as well as an actual entity (physical or virtual) that delivers a product/solution. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) [op. cit.] differentiated a typology (a classification according to general type) of tool types (Table 1).

Table 1. Typology of tool types identified to support SDG implementation: Source: after UNESCAP [34].

Typology	Description
Framework/ Approach	A set of definitions and principles that provides definition and structure to describe a complex concept. A framework may be delivered as part of an "approach" that is the overall strategy to achieve a targeted outcome or result.
Guidance/ Methodology	Provide an overview and advice on how to go about a task or process (in collaboration with other people). They provide a structured sequence of steps to help people do something better and achieve a general outcome without specifying its exact detail.
Tool	A stand-alone instrument which is used to produce a particular output or outcome. Tools can be used in and with any of the previous tool types described above, and can include online portals, statistical and dynamic simulation models, spreadsheets and grids, etc.

---

[1] See for instance https://sdghelpdesk.unescap.org/toolboxes which is the Sustainable Development Goals Help Desk that provides a one-stop online service providing access to Sustainable Development Goal (SDG)-related tools, knowledge products, data portals, expertise and advice.
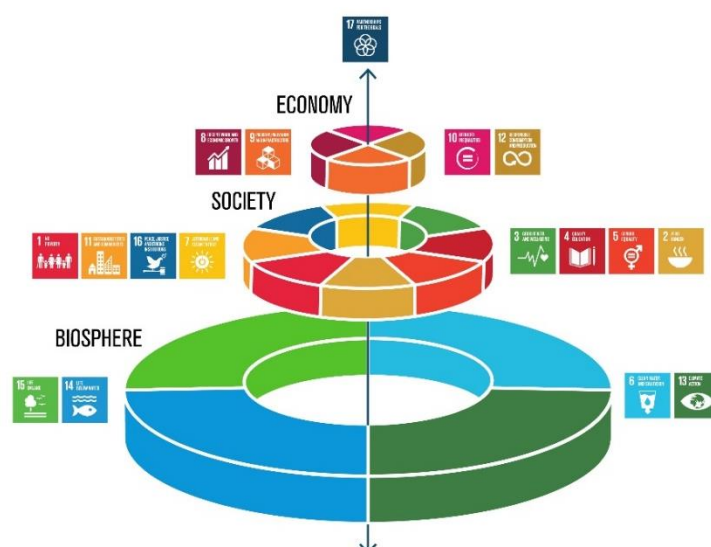
Figure 2. The "wedding cake" illustration of the SDGs to shift the focus to the biosphere (environment/biodiversity) as underpinning societal and economic dimensions of the Sustainable Development Goals. Source: https://www.stockholmresilience.org/research/research-news/2016-06-14-how-food-connects-all-the-sdgs.html.

3.2   Tools in support of environmental dimensions of SDG implementation

All the SDGs have direct or indirect environmental sustainability linkages and underpinnings that mean that for their achievement, the environmental goals should feature across not only SDG implementation but also within national policy and planning contexts. The so called 'wedding cake' arrangement of the SDGs best illustrates this (Figure 2) and although there is some disparity amongst sources between 56 and 86 SDG targets across the SDGs have an environmental dimension [23,35–37]. For sustainable development to achieve its objective the SDGs recognise that the environment should be given equal consideration alongside a government's economic, social, and climate change priorities [38]: environmental SDG targets need to be well integrated into national and sectoral policies, plans, and programmes, and ministries and agencies across the government should work together to understand the impact of their policies not only on their own policy area but on that of others too.

UNESCAP produced a compendium to 134 tools related to the integration of environment into policy and planning in order to deliver sustainable development in the Asia and Pacific region [34] expanded to 143 tools in a joint Asian Development Bank and UN Environment tool compendium [39]. Both publications included tools that supported an integration process to SDG implementation as well as tools specifically relevant to SDGs 12 (responsible consumption and production), 13 (climate action), 14 (life below water), and 15 (life on land) as well as environmental dimensions across all SDGs. The need for such tools was driven by a recognition that the implementation of SDGs with an environmental focus shows the least progress of all (Figure 3) [39,40].
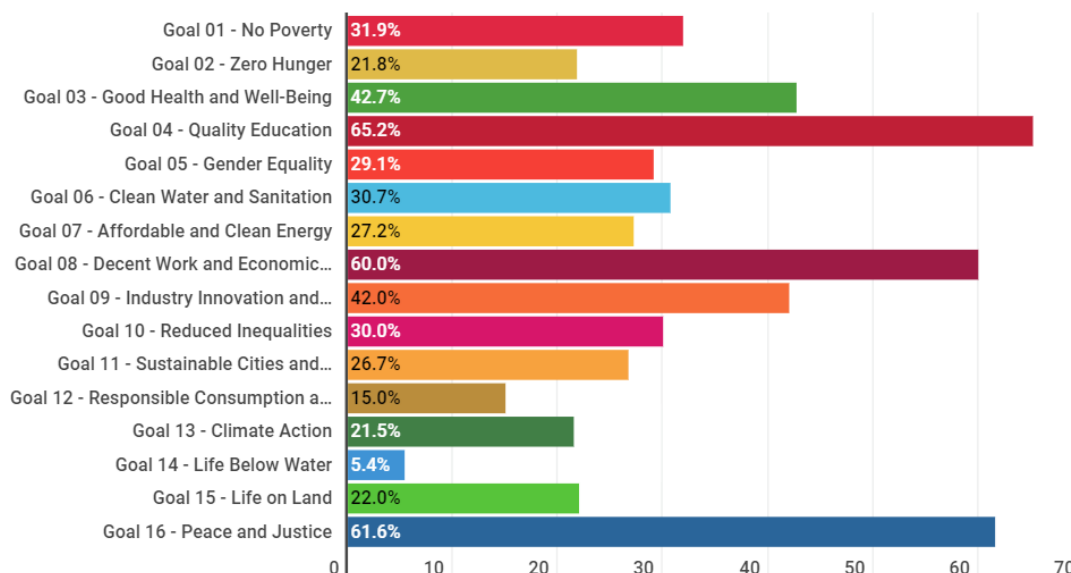
Figure 3. A survey of 3,500 leaders in developing countries found that marine conservation is almost universally considered the least important of the United Nations' 17 Sustainable Development Goals. Source: : https://www.npr.org/sections/goatsandsoda/2018/05/31/61 based on [40].

The application of tools to promote environmental objectives into overall policy implementation [34] can be focused at:

- **Strategic concerns** – ensuring that environmental goals are balanced with economic and social objectives and present opportunity for coherence across high-level strategic policy frameworks (such as Project Ireland 2040).

- **Procedural concerns** – involves applying assessment procedures to evaluate whether environmental integration is taking place.

- **Organisational change** – involves changes in institutional arrangements to ensure equality of voices across environmental as well as economic and social stakeholders.

A framework that is increasingly applied to environmental dimensions of the SDGs is a nexus or integrated approach to managing and governing natural resources, such as land, water, and energy, to address not only environmental sustainability but also, climate, human, and political security [41–48]. Based on the idea that policy objectives in different domains are often "intrinsically connected," the nexus approach singles out issues with particular interdependences to support research on those linkages and possible solutions for integrated policy making. Whilst this has gained traction in academic circles from a practical perspective implementation of such an approach is constrained by strong sectoral silos, insufficient incentives for integrated planning and policy making at all levels, and limited vision, knowledge, and experience [41]. The water-energy-food nexus is the most commonly explored although others that include climate have also been studied [48,49]. Although the nexus approach is not without criticism, with some authors reflecting that it neglects livelihoods and a holistic view of the environment as well as governance [50], it is promoted for guiding policy development and governance structures for sustainable use of natural resources [51].

3.3   Tools to support the SDG implementation

The SDGs4I project has made a snapshot of the types of tools available to support SDG implementation and to identify linkages, overlaps and potential conflict between the SDGs and SDG targets. Annex 1 provides a selection of the most relevant tools including an assessment of their main purpose and potential use.

The purpose of SDG tools

Since the inception of the 2030 Agenda and the SDGs many tools and guides have been developed that are freely and widely available. Many of these tools have a very specific themed focus which allows for a deeper understanding of certain aspects and features of the SDGs but do not deal with the interlinkages between the SDGs and how to address these interactions in setting out policies across different sectors and by different departments as part of building a more coherent policy climate. An example is Strengthening the environmental dimensions of the sustainable development goals in Asia and the Pacific – Tool compendium' whosemain purpose is to offer practical guidance. Knowing which tools are available to assist and support their efforts, and how these tools have been used by others, is a critical initial step in promoting more integrated and coordinated approaches to
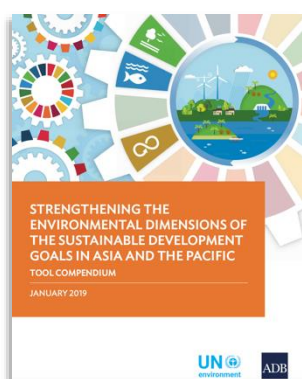
the environment. This tool compendium presents an inventory of tools, methods, and approaches that policy makers can use to better (i) understand the critical interlinkages within and between environment-related goals and targets; (ii) promote policy coherence and integration of the environmental dimensions of the SDGs; and (iii) develop and select appropriate indicators, policies, and institutional arrangements to support the effective implementation of the environmental dimensions of the SDGs. **Full report downloadable here**.

The '*SDG Interlinkages Analysis & Visualisation Tool*' developed by the Institute for Global Environmental Strategies is an example of a tool that does specifically address the interlinkages between SDGs but only identifies and visualises these linkages. An upgraded version of the IGES SDG

Interlinkages Analysis & Visualisation Tool (Version 3.0) is now available online for free. Since 2015, IGES has developed the SDG Interlinkages Analysis & Visualisation Tool to support integrated SDG policymaking. It enables users to visualise the quantified causal links between SDG targets, identify potential synergies and trade-offs, and compare country progress and performance over time. The

updated tool now offers wider country coverage, improved methodology, updated data, and an enhanced interface, among other new features. **Download the tool here.**

These two tools are examples that can be considered to have aspects that can be utilised in the process of policy making in the context of SDG implementation but do not go beyond being of an informational nature with the functionality of being used for reporting purposes on the SDGs. To extend beyond a reporting capacity, a tool needs to be able to address the relationships and the interlinkages between all of the SDGs and illustrate ways that this can support implementing existing policy and/or developing new policies. This is particularly important as many policies do not exist in isolation but should exist harmoniously and coherently with others to be successful. This requires a tool to be interactive and lead to outcomes that reflect shared understanding and intentions. However, many tools rely on literature reviews, which can lead to gaps that reflect not an absence of a relationship, but an absence of relevant literature. An example is a Joint Research Centre Technical Report that proposes an original method to identify and deal with inter-linkages. This method enables the

identification of inter-linkages in a systemic way as a pivotal element of science supporting policy coherence for SDGs implementation and consistent with the key principles guiding the 2030 Agenda implementation in the international context. The proposed method consists of two tools adopting two different perspectives. The first tool is based on the review of the current literature on inter-linkages by identifying the main approaches and classifying the literature along them. This exercise allows the development of a first dashboard indicating the "agreed" inter-linkages from the literature. The second dashboard, developed

starting from the existing European Union legislation, allows the identification of policy priority areas where the EU added value is maximized and where EU policy nodes can represent the levers to exploit synergies for the SDGs implementation. The combination of the two dashboards provides an effective operational method to develop policy implementation strategies at Goal and target levels which can support the overall policy coherence for sustainable development. **Read the full report here.**

Providing an environmental/climate lens on tools

The SDgs4I project is focused on the environmental SDGs and targets and links with national climate and planning policies, there is analysis available on existing tools linking the climate, environment and sustainable development agendas. To help decision-makers identify and address existing interdependencies and interactions, a multitude of quantitative and qualitative methods and tools have been developed. However, due to the lack of a systematic mapping and the large variety of

available tools as well as their complexity and different qualities, it is often not clear to policymakers which tool can be useful for what policy issue. The aim of this study is to assess the applicability and usefulness of existing tools for policymakers. The study describes a first attempt to classify existing instruments and evaluate their practical benefits for policymakers and to support them in identifying the right tool for a specific use. The analysis shows that there is no 'silver bullet'. Rather, each tool serves specific purposes, and understanding what each tool can and cannot do is a first step towards using the right tool for a specific task and objective. **Read the entire report here.** The report highlights 2 specific tools to illustrate the connection of the SDGs with climate and biodiversity:

The first tool is the Biodiversity Indicator Partnership (BIP), which is a global initiative to promote the development and delivery of biodiversity indicators. Its primary role is to serve the global user community by responding to the indicator requests of the CBD and other biodiversity-related Conventions, for IPBES, for reporting on the Sustainable Development Goals, and for use by national and regional governments. Biodiversity indicators are not only important at the global level, but at the national (and sub-national) level too. Indicators are an essential aspect of monitoring and reporting progress towards the achievement of national targets, such as those set in NBSAPs or sustainable development strategies. They are also important in facilitating adaptive management. This online platform allows a search by country to find a list of indicators that have data available by country/territory. Links to data, and information on the indicator suitability, methods involved, and examples of national use can be found on the 'National use of indicator' section of each indicator page. It also shows how the indicators relate to the Aichi targets, the SDGs and other Multilateral Environmental Agreements (MEAs) and processes. Part of the BIP platform is the, currently in beta stage, UN Biodiversity Lab which is an online platform that allows policymakers and other partners to access global data layers, upload and manipulate their own datasets, and query multiple datasets to provide key information on the Aichi Biodiversity targets and nature-based Sustainable Development Goals. The core mission of the UN Biodiversity Lab is three-fold: to build spatial literacy to enable better decisions, to use spatial data as a vehicle for improved transparency and accountability, and to apply insights from spatial data across sectors to deliver on the Convention on Biological Diversity and the 2030 Agenda for Sustainable Development.

A second tool is the UNDP Climate Impact (CLIP) Tool, which is an impact assessment tool that helps stakeholders during the design, development and implementation of mitigation and adaptation actions under the NDCs. Specifically, the tool helps to consolidate and assess information about a specific intervention. It can ultimately lead to identify and quantify significant impacts of the

intervention in relation to SDGs, while also defining indicators, setting targets and tracking the progress of this specific action. The tool is a bottom-up tool, providing a series of questions and prompts in order to consolidate and initiate discussion on a given intervention or project, and can be applied to track 'significant, direct impacts' of actions. The tool is separated into seven impact categories that are linked to the relevant SDGs. The user will be prompted to provide a series of data and information under each category which will then be used to quantify and track the impact of the given mitigation and adaptation actions (which contribute to NDCs) in relation to the SDGs. The tool can assess any type of climate action, namely mitigation or adaptation, that can take the form of either a project (in the UNFCCC parlance, this would be similar to a standalone CDM project) or a programme (such as a sectoral or multi-sectoral initiative, typically at scale larger than a single project activity). The tool therefore can be applied to various types of climate actions defined under an NDC that is either national, regional, sectoral or local in nature. This online platform requires you to create a log in account before you can use the tool. It provides details on the objectives and potential of the tool as well as the application and instructions for using this tool. It provides access to online summaries and graphs and you can export data into pre-formatted reports for editing and sharing.

3.4   Tools in support of mapping interactions between the SDGs

Since the adoption of the 2030 Agenda for Sustainable Development attention has been paid to how to deliver the SDGs and targets as an "indivisible whole" nature, with the objectives to propose viable methods and tools for integrated planning of their implementation (Figure 4) [52–55]. Such efforts are critical to overcome traditional compartmentalisation of Government organisation that leads to conflicts of interest, interpretations of sustainable development and decreases coherence and
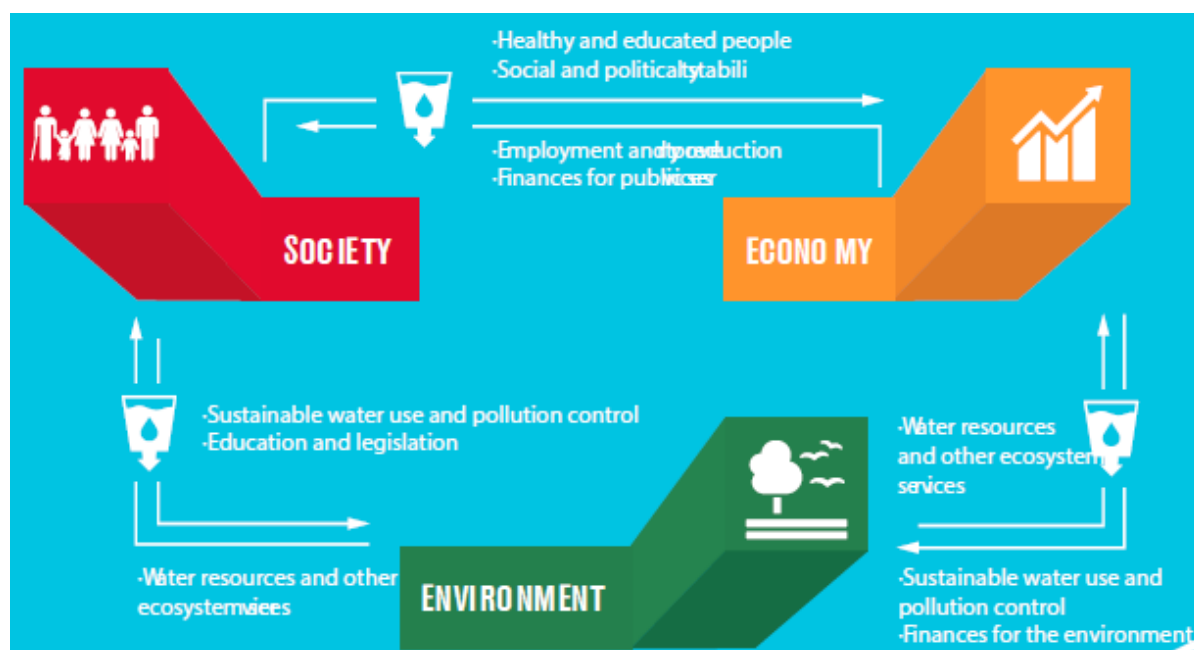

Figure 4. Interlinkages based on the three dimensions of sustainable development using SDG6 (Water) as an example showing how healthy and resilient ecosystems, including freshwater resources, are vital for the social and economic dimensions of sustainable development. Source: [85].

transformative opportunities of policy implementation [56–58]. Efforts to develop a better understanding of the linkages among the SDGs, both at the Goal level and among their targets, have focussed on the intersections (meeting points) and complex causal relationships to model the network of interlinkages and analysing clusters of issues ([48], Table 2).

Table 2. Examples of tools highlighted by the SDG Knowledge Hub as approaches and tools available to analyse and understand linkages, and to examine the impacts of specific policies and strategies on interlinked issues. Source [48].

Source	Details	Reference
UN Department of Economic and Social Affairs (DESA)	Network mapping technique derived from social network analysis to provide a map of direct references in SDG targets to other SDGs, based on the wording of the targets.	[59,60]
	The result is a visual representation of the references between SDGs and targets to make linkages explicit for institutions whose work often focuses on issues within a specific Goal	
The Stakeholder Forum	Classification of Type and Nature of SDG Interlinkages by defining eight types of interactions that are grouped into three categories: Supporting; enabling/disenabling; and relying.	[61,62]
	The analysis suggests that identifying the type of interlinkage can help policy makers amplify the impact of policies and identify "missing linkages," that policy makers can consider ways of creating such linkages through national policies that ensure further integration of SDG implementation in accordance with national priorities and circumstances.	
The Millennium Institute	The Integrated Sustainable Development Goals Planning Model (iSDG) as a simulation tool to help policy makers understand the interconnections among the SDGs and their targets, enabling them to design synergistic strategies for SDG implementation. The Model includes a broad selection of tools to conduct an in-depth analysis of the simulated outcomes, including a Synergy Assessment Tool to assesses the contribution of each policy within a broader SDG strategy and reveals the synergies or trade-offs that might emerge from interactions among different policies.	https://www.millennium-institute.org/isdg
	For each SDG, the Model offers a range of interventions that are expected to affect progress towards that Goal. Policy makers can select different levels of investment for each intervention and see how the country's progress towards that goal and all other SDGs changes.	
The Organization for Economic Co-operation and Development (OECD)	The OECD New Framework Policy Coherence for Sustainable Development aims to assist countries in updating current institutional mechanisms, processes and practices towards policy coherence to ensure they are "fit for purpose" for SDG implementation that can be adapted to national circumstances.	[1]
	The PCSD Screening tool includes options for monitoring data, indicators modelling tools and other approaches available to track institutional mechanisms, policy interactions, and policy effects.	
	OECD Measuring distance to SDG targets uses indicators aligned with UN Global Indicator list and assesses 105 of 169 targets at country-level, and for only 87 of these it has been possible to assess whether indicators have been moving towards the target levels, rather than away from them.	[63]
	The assessment is based only on what can be measured at present. Data coverage is poorest on some of the planet-related goals, such as Oceans and Sustainable Production, and best in relation to goals on Health and Education.	

There are a growing number of tools introduced to explore interactions and interlinkages between SDGs and targets to assist implementation of existing policy, as well as design of future policy, to meet

the aspirations of the 2030 Agenda and sectoral implementation processes are required [32,64]. These tools address such aspects as descriptive analysis of potentials, scientific methods for quantifying and qualifying interactions, as well as guidelines for integrated policymaking [op. cit.]. However, there is not currently a tool that enables and facilitates conversations between policymakers around how SDG interactions impact upon their own policy area, or how existing and planned policy in a national context interacts with the SDGs and their targets.

4 Guidelines for a toolkit for SDG Implementation in Ireland

This section constitutes deliverable "*D3.2 Guidelines for Toolkit*" that sets out the criteria for a tool that will allow better exchange between different areas of policy for an evidence-based approach to address the multiple challenges encapsulated by the SDGs. An underpinning rationale for developing a tool is to support the notion that SDG implementation offers a potential to promote synergies among sectoral policies to overcome silos and fragmentation. This will enhance consistency and equality across social, economic and environmental outcomes of sustainable development, and national priorities, as well as reshape sustainable development policies [65,66]. However, reviews of country responses to the 2030 Agenda and the SDGs indicate that while many have made commitments to the environment it remains a challenge to translate these into meaningful action, move beyond 'conventional' environmental issues and break out from isolated sectoral perspectives [29,39,67–69]. A tool to move beyond a convention framing of environmental issues, and embed the environment as part of transformative change encouraged by the 2030 Agenda, needs to support collaborative governance responses to interdependent sustainability issues [32,70]. To achieve this a tool should assist recognition of how multiple issues and actors are interlinked in order to close governance gaps that intersect several sectors of society, such as livelihoods, agriculture and biodiversity conservation [70].

An objective of the SDGs4I project is to provide a tool that supports the inculcation of the SDGs and their targets into the policy-making process and allows environmental perspectives to be equally considered alongside economic and social perspectives. To work such a tool needs to support different stages in the policy cycle [71] and take the outcomes and learnings from different "building blocks" of analytical and process-related tools, such as those outlined by UNESCAP [34] and ADB [39]. Most existing tools do not include interactive features with interfaces that greatly facilitate participation and engagement associated with SDG assessment and those that do are usually not (fully) open source; their application is resource-intense, both in terms of time and money [57]. The use of integrated models requires lengthy and costly engagement with the tool developers for access, understanding and use of the tools. In addition, extensive time and financial resources are needed for

gathering the required extensive data sets, making decisive assumptions at many analytical stages, as well as finding and hiring the people who can support the operation of the model.

There is now extensive literature focussed on assessing and evaluating interactions between SDGs and their targets, however, this is largely conceptual in outlook and there are few publications that provide direct policy relevancy [32,72,73]. Studies have focussed on subsets of goals and targets (e.g. [44]), or network analysis across all goals (e.g. [59,74]) including on a country basis (e.g. [75]). Other studies have focussed on progress made towards achieving the goals and targets (e.g. [63,76]). Similarly there has been considerable focus on the potential for synergistic and trade-off interactions between gaols and targets (e.g. [14,62]. Many tools only report against existing data and/or activities [30,64] and cannot be used as an interactive tool for discussion and exploration of possible linkages between different SDGs and/or between the SDGs and existing or planned policies. Integration between SDGs and with national-level planning and policy is important in order to fulfil the ambition of the 2030 Agenda of "achieving sustainable development in its three dimensions—economic, social and environmental—in a balanced and integrated manner" [31], but the "how" of integration has not been well defined. In the context of integration a key requisite is a mechanism for policy coherence [48,58,64,77,78] that is able to capture and align interests and perspectives of potentially disparate interest groups and formulate policy that offers synergistic benefits and mitigates trade-offs. Equally, such mechanisms need to avoid shortcomings that foster conflict and prevents timely inclusion of knowledge.

In practice meeting nationally defined priorities and sustainability solutions is a highly contested space [56,57,79] and a tool that promotes dialogue and understanding across sectors and policy areas, using the SDGs as a framing mechanism could lead to better outcomes. To address these challenges the SDGs4I project has partnered with the International Science Council (ISC) and the European Commission's Joint Research Centre's (EC-JRC) Global Conservation and Development Knowledge Management Unit to further progress a recently developed transparent analytical approach that can support a whole-of government perspective to SDG implementation. This approach to evolves a version of a tool developed by the Stockholm Environment Institute (SEI) (https://www.sei.org/featured/visualize-sdg-interactions-colombia/) into a web-based application that allows users to enter the scores digitally into an online matrix leading to a quick visualization of results either individually or as part of wider stakeholder discussions. The *Enabling SDGs* tool is designed to support SDG implementation in the context of national policy instruments. provides assessment methods to explore systemic and contextual interactions of SDG targets, using a typology for scoring interactions in a cross-impact matrix [6,14,72,80–82].

4.1 Scoring interactions

Linkage relationships can be either synergistic (interactions have a positive outcome) or trade-off (interactions with negative effects and that hinder or reverse sustainable development) [42,83]. To better understand the nature and dynamics of those interactions, ICSU and Nilsson et al. [6,14,82] developed a framework tool to classify the extent to which a relationship is positive or negative, using a seven-point scale, using interactions associated with a food-water-energy nexus [84,85] (Figure 5). The scoring scale extends beyond the common but overly simplified dichotomy of synergies vs. trade-offs categorisation to one that supports policy coherence by an assessment of interlinkages that focuses on the degree to which instruments and actions to pursue one set of objectives affect our ability to pursue another set [6,72]. The scale is intuitive and relatively easy to use as a first level of assessment of the interlinkages among determined at the level of SDG, targets, or at the level of policy interventions and instruments to determine potential synergies and trade-offs. The scale can also assist "organize evidence and support decision-making about national priorities […] to help policy makers to identify and test development pathways that minimize negative interactions and enhance positive ones" [82]. The magnitude of the score, in whichever direction, provides an indication of how influential a given SDG or target is on another, or if the interaction is neutral a score of 0 ('consistent') is assigned.

Interaction	Name	Explanation	Example
+3	Indivisible	Inextricably linked to the achievement of another goal.	Ending all forms of discrimination against women and girls is indivisible from ensuring women's full and effective participation and equal opportunities for leadership.
+2	Reinforcing	Aids the achievement of another goal.	Providing access to electricity reinforces water-pumping and irrigation systems. Strengthening the capacity to adapt to climate-related hazards reduces losses caused by disasters.
+1	Enabling	Creates conditions that further another goal.	Providing electricity access in rural homes enables education, because it makes it possible to do homework at night with electric lighting.
0	Consistent	No significant positive or negative interactions.	Ensuring education for all does not interact significantly with infrastructure development or conservation of ocean ecosystems.
-1	Constraining	Limits options on another goal.	Improved water efficiency can constrain agricultural irrigation. Reducing climate change can constrain the options for energy access.
-2	Counteracting	Clashes with another goal.	Boosting consumption for growth can counteract waste reduction and climate mitigation.
-3	Cancelling	Makes it impossible to reach another goal.	Fully ensuring public transparency and democratic accountability cannot be combined with national-security goals. Full protection of natural reserves excludes public access for recreation.

Figure 5. Scoring scale developed by ICSU and Nilsson for measuring interactions between SDG Targets using water as a nexus example. Source: UN-Water 2016 & UNESCAP 2017 & Nilsson et al Nature 2016.

4.2 Cross-impact matrix

Rather than focus on individual interactions it is more likely that clusters of interacting targets reflect where cross-sectoral collaboration will have more policy relevancy for priority setting [72,80]. To visualise where clusters of interactions exist, and the degree to which they lead to positive (synergistic) or negative (trade-off) outcomes a cross-impact matrix tool designed for analysing relationships between variables, factors, events, etc. associated with policy instruments is used [72,80]. The use of a cross-impact matrix allows policy-makers from multiple areas of Government to maintain a comprehensive view of the 2030 Agenda to account for systemic effects rather than focussing on a specific entry point and one-on-one interactions from one sector to others [62,81]. Each cell of the matrix (see Figure 6 for example) is scored by asking the question ''If progress is made on target x (rows), how does this influence progress on target y (columns)''? [72] so the discussion is focused on the interaction that occurs when making progress on a target to another target, and not the interaction that would emerge from fully achieving it. The application of the cross-impact matrix, using the scoring scale to categorize individual cells, provides a strongly systemic and visual for understanding how SDG targets interact and can be interrogated in the context of specific policy areas

Selected SDG targets (influenced targets)

Selected SDG targets (influencing targets)

Row	SUM
1.3	25
1.5	26
2.2	13
2.4	23
3.4	4
3.8	11
4.1	17
4.4	30
5.4	24
5.5	31
6.5	22
6.6	9
7.2	12
7.3	20
8.4	40
8.5	29
9.4	28
9.5	29
10.1	11
10.7	15
11.1	13
11.2	21
12.1	43
12.5	29
13.1	28
13.2	13
14.1	13
14.4	13
15.2	12
15.5	16
16.4	19
16.6	51
17.11	-9
17.13	11

Column SUM (for columns 1.3, 1.5, 2.2, 2.4, 3.4, 3.8, 4.1, 4.4, 5.4, 5.5, 6.5, 6.6, 7.2, 7.3, 8.4, 8.5, 9.4, 9.5, 10.1, 10.7, 11.1, 11.2, 12.1, 12.5, 13.1, 13.2, 14.1, 14.4, 15.2, 15.5, 16.4, 16.6, 17.11, 17.13): 26, 37, 16, 32, 21, 14, 15, 24, 15, 15, 20, 20, 4, 15, 26, 27, 25, 17, 28, 22, 17, 21, 29, 18, 30, 29, 21, 13, 20, 28, 11, 17, -2, 21
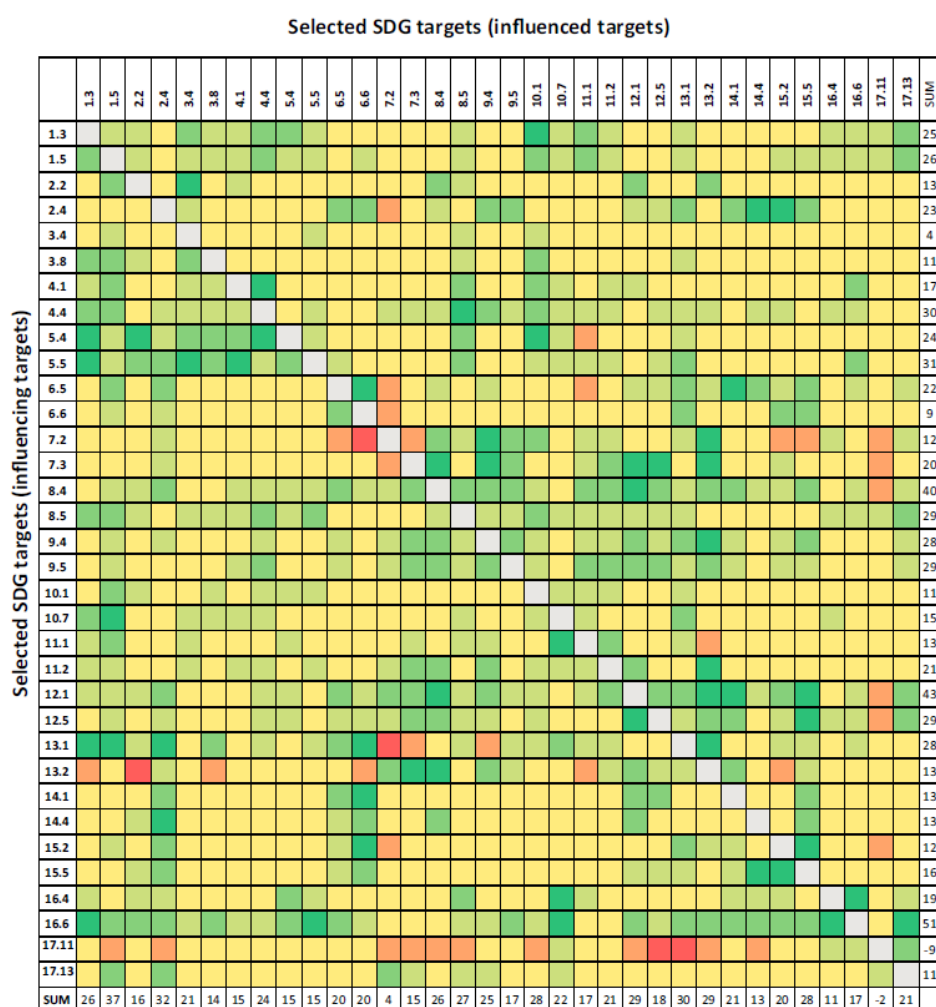
Figure 6. Example of a cross-impact matrix of 34 targets and their interaction in Sweden. Colour according to scale in Fig. 1: from dark red (-3/cancelling) to dark green (+3/indivisible). The net influence from a target on all other targets is shown by the row-sum and the column-sum shows how much a target is influenced by all other targets in total. Source: [72].

and choices. A key aspect for completing the matrix is that the scoring can be engaged with in a cross-sectoral/departmental collaborative manner to foster holistic discussion for priority setting and assessing existing and new policy pathways across not only the 2030 Agenda but national policy portfolios. For instance, targets that have a strong positive influence on many other targets (taking into account both direct and indirect interactions), or ones that are supported by progress in others, or where one negatively affects progress in others can be identified and prioritised for policy support to enhance synergies and address potential trade-offs and negative spill-over effects (Figure 7) [op. cit.]. Taking all 17 SDGs and 169 targets leads to a possible 28,392 interlinkages and it is necessary to narrow the scope of analysis and address a subset of targets relevant to a particular policy focus.

Figure 7. The illustration shows how target 6.6 makes an even larger contribution to the 2030 Agenda than is seen at first glance, due to positive ripple effects (top row): progress on protecting and restoring water-related ecosystems (target 6.6) contributes to climate adaptation (target 13.1), which in turn has a positive impact on the implementation of social protection systems (target 1.3). Conversely, heavy reliance on hydropower as a source of renewable energy might mean that progress on Target 6.6 would conflict with target 7.2 (increasing the share of renewable energy), and thus hinder target 7.2's positive influence on other targets such as 11.1 (safe and affordable housing). Source: [80].

4.3 Application of the cross-impact matrix and scoring in Ireland

The utility of the matrix and scoring tool is not as a scientific assessment of data relating to either specific SDG targets and/or policy actions but as a tool to support policy making, with a high degree of transparency and opportunity for engagement compared to modelling approaches [72]. Scoring is predominantly qualitative and judgment-based from the expertise and knowledge held by those responsible for implementing relevant policy areas under investigation. However, scoring can also be informed by relevant datasets (e.g. the EPA geoportal (http://gis.epa.ie/) and Ireland's Central Statistics Office (CSO) SDGs data hub (https://irelandsdg.geohive.ie/)). A resultant matrix shows patterns of relative frequency of positive and negative interactions that point to where implementation of policy linked to those areas could lead to synergistic or trade-off outcomes. A key development of the current project from the original matrix design of SEI is that goals and targets is that it will be possible to make an assessment against existing policy instruments in order to directly provide a policy perspective. For instance, a Department could evaluate whether a policy action focussed on one target affects additional targets and thereby where collaborations are needed for cooperation with policy instruments linked to those additional targets. Such an approach can enable 'whole-of-government' approaches for SDG implementation and foster policy cohesion by indicating where existing policy has dependency on each other, and decision makers should collaborate across policy areas. The tool will be trialled as part of Work package 4 and a guidance document produced.

5 References

[1]   OECD, Better Policies for Sustainable Development 2016. A New Framework for policy coherence, OECD Publishing, Paris, 2016.

[2]   M. Nilsson, E. Chisholm, D. Griggs, P. Howden-Chapman, D. McCollum, P. Messerli, B. Neumann, A.S. Stevance, M. Visbeck, M. Stafford-Smith, Mapping interactions between the sustainable development goals: lessons learned and ways forward, Sustain. Sci. 0123456789 (2018) 1–15. doi:10.1007/s11625-018-0604-z.

[3]   UN, The future we want - Outcome document of the United Nations Conference on Sustainable Development, United Nations, 2012. https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf.

[4]   UN, Transforming our world: The 2030 agenda for sustainable development, United Nations, 2015. https://sustainabledevelopment.un.org/content/documents/7891Transforming Our World. pdf.

[5]   UNEP, Embedding the Environment in Sustainable Development Goals, United Nations Environment Programme (UNEP), 2013.

[6]   M. Nilsson, D. Griggs, M. Visbeck, C. Ringler, A draft framework for understanding SDG interactions, International Council for Science (ICSU), 2016.

[7]   Government of Ireland, Our sustainable future: A Framework for Sustainable Development for Ireland, DOE, 2012.

[8]   DCCAE, The Sustainable Development Goals National Implementation Plan 2018-2020, Department of Communications, Climate Action & Environment, 2018.

[9]   DPER, Project Ireland 2040: National Development Plan 2018-2027, Department of Public Expenditure and Reform, Government of Ireland, 2018. https://assets.gov.ie/19240/62af938dce404ed68380e268d7e9a5bb.pdf.

[10]   M. Elder, P. King, Realising the Transformative Potential of the SDGs, Institute for Global Environmental Strategies (IGES), 2018.

[11]   M. Elder, M. Bengtsson, L. Akenji, An optimistic analysis of the means of implementation for sustainable development goals: Thinking about goals as means, Sustain. 8 (2016). doi:10.3390/su8090962.

[12]   OECD, An SDG-based results framework for development co-operation, OECD, 2016. https://www.google.ch/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ve d=0ahUKEwjgyZHU89vVAhUHIcAKHTnkB1sQFggmMAA&url=https%3A%2F%2Fwww.oecd.org %2Fdac%2Fpeer-reviews%2FSDG- based%2520results%2520framework.docx&usg=AFQjCNGP_RDm2jmVRohkRvxSUtYmhGxfc.

[13]   OECD, Policy Coherence for Sustainable Development in the SDG Framework. Shaping Targets and Monitoring Progress, OECD, 2015. http://www.oecd.org/development/pcd/Note on Shaping Targets.pdf.

[14]   M. Nilsson, Understanding and mapping important interactions among SDGs: Readying institutions and policies for integrated approaches to implementation of the 2030 Agenda., in: Expert Meet. Prep. HLPF 2017, 2016: pp. 1–33. https://sustainabledevelopment.un.org/content/documents/12067Understanding and mapping important interactions among SDGs.pdf.

[15]   OECD, Framework For Policy Coherence For Sustainable Development: A Self-Assessment Tool to Design, Implement and Track Progress on Mutually Supportive Policies for Sustainable Development, OECD, 2015. https://www.oecd.org/pcd/TOOLKIT FRAMEWORK FOR PCSD.pdf.

[16]   Independent Group of Scientists appointed by the Secretary-General, Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development, United Nations, 2019. doi:10.1016/S0262-4079(12)60125-0.

[17]   ICSU & ISSC, Review of Targets for the Sustainable Development Goals: The Science Perspective, International Council for Science (ICSU), 2015.

[18]   J.H.P. Dawes, Are the Sustainable Development Goals self-consistent and mutually achievable?, Sustain. Dev. (2019) 1–17. doi:10.1002/sd.1975.

[19]   Department of Housing Planning and Local Government, Project Ireland 2040. National Planning Framework, Government of Ireland, 2018.

[20]   Anon, Biodiversity and the Sustainable Development Goals, in: Ninth Trondheim Conf. Biodivers. Backgr. Doc., 2019: p. 4.

[21]   M. Schultz, T.D. Tyrrell, T. Ebenhard, The 2030 Agenda and Ecosystems: A discussion paper on the links between the Aichi Biodiversity Targets and the Sustainable Development Goals, SwedBio at Stockholm Resilience Centre, Stockholm, Sweden, 2016.

[22]   S.L.R. Wood, S.K. Jones, J.A. Johnson, K.A. Brauman, R. Chaplin-Kramer, A. Fremier, E. Girvetz, L.J. Gordon, C. V. Kappel, L. Mandle, M. Mulligan, P. O'Farrell, W.K. Smith, L. Willemen, W. Zhang, F.A. DeClerck, Distilling the role of ecosystem services in the Sustainable Development Goals, Ecosyst. Serv. 29 (2018) 70–82. doi:10.1016/j.ecoser.2017.10.010.

[23]   Secretariat of the Convention on Biological Diversity, Biodiversity and the 2030 Agenda for Sustainable Development, (2016). https://www.cbd.int/development/doc/biodiversity-2030-agenda-technical-note-en.pdf.

[24]   C. Folke, R. Biggs, A. V. Norstrom, B. Reyers, J. Rockstrom, Social-ecological resilience and biosphere-based sustainability science, Ecol. Soc. 21 (2016). doi:10.5751/ES-08748-210341.

[25]   N. Seddon, G.M. Mace, S. Naeem, J.A. Tobias, A.L. Pigot, R. Cavanagh, D. Mouillot, J. Vause, M. Walpole, Biodiversity in the anthropocene: Prospects and policy, Proc. R. Soc. B Biol. Sci. 283 (2016) 1–9. doi:10.1098/rspb.2016.2094.

[26]   SIDA, Agenda 2030 and Ecosystems, Swedish International Development Cooperation Agency, 2016.

[27]   DCHG, National Biodiversity Action Plan 2017-2021, Government of Ireland, 2017. http://nbaindia.org/uploaded/Biodiversityindia/NBAP.pdf.

[28]   DCHG, Ireland's 6th National Report to the Convention on Biological Diversity, Department of Culture, Heritage and the Gaeltacht, 2019.

[29]   EEA, The European environment — state and outlook 2020. Knowledge for transition to a sustainable Europe, 2019. doi:doi:10.2800/96749.

[30]   J. Grainger-Brown, S. Malekpour, Implementing the sustainable development goals: A review of strategic tools and frameworks available to organisations, Sustain. 11 (2019) 1381. doi:10.3390/su11051381.

[31]   UNESC, Integrating the three dimensions of sustainable development: A framework and tools, United Nations, 2015. www.unescap.org.

[32]   A. Breuer, H. Janetschek, D. Malerba, Translating Sustainable Development Goal (SDG) interdependencies into policy advice, Sustain. 11 (2019) 2092. doi:10.3390/su1102092.

[33]   UNESC, Strategic foresight for the post-2015 development agenda Report of the Secretary-General Executive summary Economic and Social Council, United Nations Economic and Social Council, 2015.

[34]   UNESCAP in partnership with ESCWA and OICT, Environmental SDGs tool compendium, Regional Technical Assistance 9245 Supporting Implementation of Environment-Related Sustainable Development Goals in Asia and the Pacific, 2018. http://sdghelpdesk.unescap.org/e-library/environmental-sdgs-tool-compendium.

[35]   UNEP, Measuring progress towards achieving the environmental dimension of the SDGs, United Nations Environment Programme, 2019.

[36]   M. Elder, S.H. Olsen, The Design of Environmental Priorities in the SDGs, Glob. Policy. 10 (2019) 70–82. doi:10.1111/1758-5899.12596.

[37]   UNEP, A contribution to the global follow-up and review in the 2016 High Level Political Forum (HLPF) on the work of the United Nations Environment Programme, United Nations Environment Programme, 2016. https://sustainabledevelopment.un.org/content/documents/10554UNEA inputs to the HLPF 2016 (Final).pdf.

[38]   ADB, Strengthening the environmental dimensions of the Sustainable Development Goals in Asia and the Pacific. Stocktake of National Responses to Sustainable Development Goals 12, 14, and 15, Asian Development Bank and the United Nations Environment Programme, 2019. doi:10.22617/TCS199911-2.

[39]   ADB, UNEP, Strengthening the environmental dimensions of the sustainable development goals in Asia and the Pacific: Tool compendium, Asian Development Bank and the United Nations Environment Programme, 2019. doi:HTTP://DX.DOI.ORG/10.22617/TIM190002-2.

[40]   S. Custer, M. DiLorenzo, T. Masaki, T. Sethi, A. Harutyunyan AIDDATA, Listening to Leaders 2018: Is development cooperation tuned-in or tone-deaf?, Williamsburg, VA: AidData at the College of William & Mary, 2018. http://docs.aiddata.org/ad4/pdfs/Listening_To_Leaders_2018.pdf.

[41]   H. Hoff, S.A. Alrahaife, R. El Hajj, K. Lohr, F.E. Mengoub, N. Farajalla, K. Fritzsche, G. Jobbins, G. Özerol, R. Schultz, A. Ulrich, A nexus approach for the MENA region-from concept to knowledge to action, Front. Environ. Sci. 7 (2019) 1–14. doi:10.3389/fenvs.2019.00048.

[42]   M. Fader, C. Cranmer, R. Lawford, J. Engel-Cox, Toward an Understanding of Synergies and Trade-Offs Between Water, Energy, and Food SDG Targets, Front. Environ. Sci. 6 (2018) 1–11. doi:10.3389/fenvs.2018.00112.

[43]   M. Kettunen, C. Bowyer, L. Vaculova, Sustainable Development Goals and the EU: uncovering the nexus between external and internal policies, Think2030 discussion paper, IEEP Brussels, 2018.

[44]   J. Liu, V. Hull, H.C.J. Godfray, D. Tilman, P. Gleick, H. Hoff, C. Pahl-Wostl, Z. Xu, M.G. Chung, J. Sun, S. Li, Nexus approaches to global sustainable development, Nat. Sustain. 1 (2018) 466–476. doi:10.1038/s41893-018-0135-8.

[45]   UN, A Nexus Approach For The SDGs: Interlinkages between the goals and targets, 2015. https://www.un.org/ecosoc/sites/www.un.org.ecosoc/files/files/en/2016doc/interlinkages-sdgs.pdf.

[46]   SEI, Cross-sectoral integration in the Sustainable Development Goals: a nexus approach (Discussion Brief), The Stockholm Environment Institute (SEI), 2015.

[47]   I. Boas, F. Biermann, N. Kanie, Cross-sectoral strategies in global sustainability governance: towards a nexus approach, Int. Environ. Agreements Polit. Law Econ. 16 (2016) 449–464. doi:10.1007/s10784-016-9321-1.

[48]   SDG Knowledge Hub, Policy Brief: Towards Integrated Implementation: Tools for understanding linkages and developing strategies for policy coherence, 2016. https://sdg.iisd.org/commentary/policy-briefs/towards-integrated-implementation-tools-for-understanding-linkages-and-developing-strategies-for-policy-coherence/.

[49]   A. Endo, I. Tsurita, K. Burnett, P.M. Orencio, A review of the current state of research on the water, energy, and food nexus, J. Hydrol. Reg. Stud. 11 (2017) 20–30. doi:10.1016/j.ejrh.2015.11.010.

[50]   D. Wichelns, The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective?, Environ. Sci. Policy. 69 (2017) 113–123. doi:10.1016/j.envsci.2016.12.018.

[51]   G.B. Simpson, G.P.W. Jewitt, The development of the water-energy-food nexus as a framework for achieving resource security: A review, Front. Environ. Sci. 7 (2019) 1–9. doi:10.3389/fenvs.2019.00008.

[52]   UNESCAP, Integrated Approaches for Sustainable Development Goals Planning: The case of

Goal 6 on water and sanitation, Environment and Development Division United Nations Economic and Social Commission for Asia and the Pacific, 2017.

[53] D.L. McCollum, L.G. Echeverri, S. Busch, S. Pachauri, S. Parkinson, J. Rogelj, V. Krey, J.C. Minx, M. Nilsson, A.S. Stevance, K. Riahi, Connecting the sustainable development goals by their energy inter-linkages, Environ. Res. Lett. 13 (2018) 24. doi:10.1088/1748-9326/aaafe3.

[54] P.J.K. McGowan, G.B. Stewart, G. Long, M.J. Grainger, An imperfect vision of indivisibility in the Sustainable Development Goals, Nat. Sustain. 2 (2018) 1. doi:10.1038/s41893-018-0190-1.

[55] IAEG-SDGs, Interlinkages of the 2030 Agenda for Sustainable Development, Interlinkages Working Group of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators, 2019.

[56] S. D'Errico, T. Geoghegan, I. Piergallini, Evaluation to connect national priorities with the SDGs. A guide for evaluation commissioners and managers, IIED, London, 2020. http://pubs.iied.org/17739IIED.

[57] EEA, FOEN, Is Europe Living within the natural limits of our planet, European Environment Agency, 2020. https://www.eea.europa.eu/publications/is-europe-living-within-the-planets-limits.

[58] K.L. Nash, J.L. Blythe, C. Cvitanovic, E.A. Fulton, B.S. Halpern, E.J. Milner-Gulland, P.F.E. Addison, G.T. Pecl, R.A. Watson, J.L. Blanchard, To Achieve a Sustainable Blue Future, Progress Assessments Must Include Interdependencies between the Sustainable Development Goals, One Earth. (2020) 1–13. doi:10.1016/j.oneear.2020.01.008.

[59] D. Le Blanc, Towards integration at last? The sustainable development goals as a network of targets, Division for Sustainable Development, United Nations Department of Economic and Social Affairs, UN DESA, 2015.

[60] D. Le Blanc, Towards Integration at Last? The Sustainable Development Goals as a Network of Targets, Sustain. Dev. 23 (2015) 176–187. doi:10.1002/sd.1582.

[61] A. Coopman, D. Osborn, Healthier Planet - Healthier Lives. An analysis of the connections between environment and health - related targets in the Sustainable Development Goals and the 2030 Agenda, Stakeholder Forum, 2016.

[62] A. Coopman, D. Osborn, F. Ullah, E. Auckland, G. Long, Seeing the Whole: Implementing the SDGs in an Integrated and Coherent Way - A Research Pilot by stakeholder forum, Bioregional and Newcastle University, A research pilot by Stakeholder Forum, Bioregional and Newcastle University, 2016. https://flic.kr/p/5sbJAj.

[63] OECD, Measuring distance to the SDG targets 2019. An assessment of where OECD countries stand, OECD Publishing, Paris, 2019. doi:https://doi.org/10.1787/a8caf3fa-en.

[64] A. Ochs, L. Indriunaite, S. Engstroem, Towards policy coherence: An assessment of tools linking the climate, environment and sustainable development agendas, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2020.

[65] OECD, A Territorial Approach to the Sustainable Development Goals: Synthesis report, OECD Urban Policy Reviews, OECD Publishing, Paris, 2020. doi:10.1787/e86fa715-en.

[66] OECD, Towards Sustainable Land Use: Aligning Biodiversity, Climate and Food Policies, OECD Publishing, Paris, 2020. doi:https://doi.org/10.1787/3809b6a1-en.

[67] EEA, Sustainability transitions: policy and practice, European Environment Agency, 2019. doi:doi:10.2800/641030.

[68] D. Azizi, F. Biermann, R.E. Kim, Policy Integration for Sustainable Development through Multilateral Environmental Agreements, Glob. Gov. 25 (2019) 445–475. doi:10.1163/19426720-02503005.

[69] A. Oliveira, R. Calili, M.F. Almeida, M. Sousa, A systemic and contextual framework to define a country's 2030 Agenda from a foresight perspective, Sustain. 11 (2019). doi:10.3390/su11226360.

[70] A. Bergsten, T.S. Jiren, J. Leventon, I. Dorresteijn, J. Schultner, J. Fischer, Identifying governance gaps among interlinked sustainability challenges, Environ. Sci. Policy. 91 (2019) 27–38. doi:10.1016/j.envsci.2018.10.007.

[71] OECD, Policy Coherence for Sustainable Development 2019: Empowering People and Ensuring Inclusiveness and Equality, OECD Publishing, Paris, 2019. doi:10.1787/a90f851f-en.

[72] N. Weitz, H. Carlsen, M. Nilsson, K. Skånberg, Towards systemic and contextual priority setting for implementing the 2030 Agenda, Sustain. Sci. 13 (2018) 531–548. doi:10.1007/s11625-017-0470-0.

[73] A. Miola, S. Borchardt, F. Neher, D. Buscaglia, Interlinkages and policy coherence for the Sustainable Development Goals implementation: An operational method to identify trade-offs and co-benefits in a systemic way, EUR 29646 EN, Publications Office of the European Union, Luxembourg, 2019. doi:10.2760/472928.

[74] K. Vladimirova, D. Le Blanc, Exploring Links Between Education and Sustainable Development Goals Through the Lens of UN Flagship Reports, Sustain. Dev. 24 (2016) 254–271. doi:10.1002/sd.1626.

[75] X. Zhou, M. Moinuddin, Sustainable Development Goals Interlinkages and Network Analysis: A practical tool for SDG integration and policy coherence, IGES Research Report No. RR1602, Institute for Global Environmental Strategies (IGES), 2017. https://pub.iges.or.jp/pub/sustainable-development-goals-interlinkages.

[76] J. Sachs, G. Schmidt-Traub, C. Kroll, G. Lafortune, G. Fuller, Sustainable Development Report 2019: Transformations to achieve the Sustainable Development Goals, Bertelsmann Stiftung and Sustainable Development Solutions Network, 2019.

[77] IRP, Policy Coherence of the Sustainable Development Goals. A Natural Resource Perspective, International Resource Panel, United Nations Environment Programme, 2015. http://www.unep.org/resourcepanel/Portals/50244/publications/Policy_Coherenceofthe_Sustainable_DevelopmentGoals.pdf.

[78] OECD, Policy Coherence For Sustainable Development 2017: Eradicating Poverty and Promoting Prosperity, OECD Publishing, Paris, 2017. doi:http://dx.doi.org/10.1787/9789264272576-en.

[79] R. Wong, J. van der Heijden, Avoidance of conflicts and trade-offs: A challenge for the policy integration of the United Nations Sustainable Development Goals, Sustain. Dev. (2019) 838–845. doi:10.1002/sd.1944.

[80] N. Weitz, SDG Synergies: An approach for coherent 2030 Agenda implementation, Stockholm Environment Institute, 2019. https://www.sei.org/wp-content/uploads/2019/04/sei-brief-2019-sdg-synergies-2.pdf.

[81] ICSU, A Guide To SDG Interactions: From Science to implementation, D.J. Griggs, M. Nilsson, A. Stevance, D. McCollum (eds)]. International Council for Science, Paris, 2017. doi:10.24948/2017.01.

[82] M. Nilsson, D. Griggs, M. Visbeck, Map the interactions between Sustainable Development Goals, Nature. 534 (2016) 320–322. doi:10.1038/534320a.

[83] D. Donoghue, A. Khan, Achieving the SDGs and 'leaving no one behind': maximising synergies and mitigating trade-offs, ODI, 2019.

[84] N. Weitz, M. Nilsson, M. Davis, A Nexus Approach to the Post-2015 Agenda: Formulating Integrated Water, Energy, and Food SDGs, SAIS Rev. Int. Aff. 34 (2014) 37–50. doi:10.1353/sais.2014.0022.

[85] UN-Water, Water and sanitation interlinkages across the 2030 Agenda for Sustainable Development, United Nations, Geneva, 2016. http://www.unwater.org/publications/water-sanitation-interlinkages-across-2030-agenda-sustainable-development/.

[86] UNDG, Mainstreaming the 2030 Agenda for Sustainable Development Reference Guide to UN Country Teams, United Nations Development Group, 2016.

Annex 1: A review of tool-types to support SDG Implementation

Annex 1 provides an extensive review of tools that have been developed in support of integrated implementation of goals and targets of the 2030 Agenda. Such analysis and understanding of interlinkages can help inform setting of policy priorities and implementation of existing policies, as well as assist assessments of the effectiveness of policies and potential gaps in policy [73]. The UN Development Group produced a reference guide and tools [86] to support adaptation of the global SDGs to national contexts and mainstreaming them into national development plans and planning processes including horizontal policy coherence. A conclusion from the reports and tools available is that interlinkages between the SDGs and their targets are not only unavoidable because of biophysical and socioeconomic interactions, but can be employed to improve integrated decision making, policy effectiveness and efficiency of the measures taken to achieve the SDGs.

Table A1. Examples of tools to support SDG implementation categorised according to a typology of:
Data & Information;

Guides and Reports; and

Standalone tools.

TOOL NAME | LINK TO TOOL | DESCRIPTION	WHAT IT DOES | FUNCTIONALITY
Ireland's Sustainable Development Goals (SDGs) data hub. A collaboration platform for reporting on progress towards the goals and sharing information on related initiatives. http://irelandsdg.geohive.ie	This is Ireland's public platform for exploring, downloading and combining publicly available data relating to the UN and the European Union (EU) Sustainable Development Goals. Ireland's progress against each Goal is measured using a set of globally and EU agreed Indicators and here you can search for, discover and visualise the data we use to create those Indicators. From the home page, you can access information on specific goals, view our video and sign up to receive updates.
IGES SDG Interlinkages Analysis & Visualisation Tool This is a practical and science-based tool that can support national policymaking, shifting from a silo-based approach to an integrated approach in implementing the Sustainable Development Goals (SDGs). https://sdginterlinkages.iges.jp/visualisationtool.html For more details: https://iges.or.jp/en/news/20190829	IGES has developed the SDG Interlinkages Analysis & Visualisation Tool to support integrated SDG policymaking. It enables users to visualise the quantified causal links between SDG targets, identify potential synergies and trade-offs, and compare country progress and performance over time. The updated tool now offers wider country coverage, improved methodology, updated data, and an enhanced interface, among other new features.
The iSDG model | Integrated Simulation Tool The iSDG model enables policy makers and planning officials at all levels of governance to understand the interconnectedness of policies	The Integrated Sustainable Development Goals (iSDG) model is a policy simulation tool designed to help policy makers and other stakeholders make sense of the complex web of interconnections between the SDGs. Unlike databases and indexes that provide a measure of

designed to achieve the SDGs and test their likely impacts before adopting them. To access the web version of the model, go to https://goo.gl/Zzf3j1. More information at: https://www.millennium-institute.org/isdg	where a country stands, iSDG focuses on the dynamic interactions within the SDG system to reveal the best paths and progression towards achieving the SDGs.
Goal Tracker Platform | A visual data tool for the global goals Digital platform that enables countries and their citizens to visually track implementation of the Global Goals and related national policies. https://www.goaltracker.org	Goal Tracker is built on a foundation of core features and data visualisation tools that can be adapted to any country. Together with local partners available data and relevant policies are analysed and then the platform is customised for each country. It draws on national statistics but can also pull data from many of other sources. Requirements to use this tool: 1) Strong governmental commitment to the 2030 Agenda, 2) Statistical agency that can provide indicator data and meta data in one of the supported JSON/CSV or SMDX formats, 3) one full-time point of contact with strong knowledge in English, Management, Web development project management, 4) one full-time data engineer/data scientist with strong knowledge in Python, SDMX, open data standards.
Strengthening the environmental dimensions of the Sustainable Development Goals in Asia and the Pacific | Tool Compendium A good example of how tools can be assessed, organised and used within the different stages of policy delivery. https://www.adb.org/sites/default/files/publication/481446/environmental-dimensions-sdgs-tool-compendium.pdf	This tool compendium reflects the high-level commitment of ADB, UN Environment, and UNDP to the environmental dimensions of the SDGs. It is hoped that it will provide a useful reference resource for those working on policy and planning in Asia and the Pacific, and beyond. This tool compendium was prepared by the Asian Development Bank (ADB) in collaboration with the United Nations Environment Programme (UN Environment) under the first phase of the ADB technical assistance (TA) project Supporting Implementation of Environment- Related Sustainable Development Goals in Asia and the Pacific.1 Given the multiplicity of the environmental dimensions of the Sustainable Development Goals (SDGs), for practical reasons, the TA project is focused on helping ADB developing member countries (DMCs) effectively integrate SDGs 12, 14 and 15,2 and selected environment-related targets determined to be directly related to responsible consumption and production, and to sustainable marine and terrestrial ecosystems management, into national policies, plans, and programmes.
SDG – Human Rights Data Explorer | making the link between human rights and sustainable development The SDG – Human Rights Data Explorer can be used to explore how human rights recommendations for individual countries are linked to specific SDG targets. http://upr.humanrights.dk	SDG-Human Rights Data Explorer, allows users to explore the links between human rights and the SDGs. The database aims to promote a more coherent, systematic framework for implementing the 2030 Agenda for Sustainable Development as well as to facilitate follow-up and review of the 2030 Agenda. The SDG – Human Rights Data Explorer lets you explore 150,000 recommendations and observations from 67 monitoring mechanisms of the international human rights system. Almost 60% of these are directly linked to a SDG target and hence immediately relevant for national SDG implementation.
UN Environment Management Group Nexus Dialogues Visualization Tool	Showing linkages between the SDG's and their targets from the perspective of UN organisations. It visualises the linkages and you van focus in/select specific SDG's,

Illustrating linkages and visualising the complexity of how the different UN agencies and bodies are connected to the SDG's and their targets and to what degree. https://embed.kumu.io/f29ef5c11bd23aa4bb17d5adec370161#overview/targets-by-pillar-of-sustainability	targets and choose specific viewpoints: social, economic or environment and combinations of these. The limitations are that this is purely a tool to see existing linkages but cannot be used to apply to anything else that the UN agencies and bodies included in the tool. So, from a more global perspective it is a valid way of showing the linkages between different conventions and agreements.
**NDC-SDG Linkages	Climate Watch** **Online platform designed to empower** policymakers, researchers, media and other stakeholders with the open climate data, visualizations and resources they need to gather insights on national and global progress on climate change. https://www.climatewatchdata.org/ndcs-sdg	Identify potential alignment between the targets, actions, policy measures and needs in countries' Nationally Determined Contributions (NDCs) and the targets of the Sustainable Development Goals (SDGs).
Sustainable Asset Valuation (SAVi) Tool: Helping Governments and Investors See the Value of Sustainable Infrastructure A project by the International Institute for Sustainable Development. https://iisd.org/savi/ More information at: http://www.greengrowthknowledge.org/learning/sustainable-asset-valuation-savi-tool-helping-governments-and-investors-see-value	Sustainable Asset Valuation (SAVi) tool to help governments and investors assess the true costs–and risks–associated with infrastructure projects in order to make better decisions. SAVi combines robust science, systems thinking and financial valuation. Its three features—simulation, valuation, and customization—are inherently interlinked.
SDG Climate Action Nexus tool (SCAN-tool) This tool will provide you a first 'scan' of the potential links (synergies and trade-offs) between SDGs and the mitigation actions in different sectors. http://ambitiontoaction.net/scan_tool/ More information at: https://newclimate.org/2018/11/08/the-scan-tool-a-new-way-to-explore-links-between-climate-action-and-sdgs/	The SDG Climate Action Nexus tool (SCAN-tool) is designed to provide high-level guidance on how climate actions can impact achievement of the Sustainable Development Goals (SDGs). The SCAN-tool aims to be user-friendly and practical and it is meant to support policy makers across different departments and state levels, to achieve greater policy coherence and to improve the efficiency of implementation by providing them with an initial indication of which climate actions may impact -positively or negatively- specific SDG targets. The SCAN-tool was developed to support policy makers across different departments and state levels, to identify and understand which climate mitigation actions may impact -positively or negatively- specific SDG targets. The SCAN-tool can support countries in presenting more ambitious NDC targets – required by the Paris Agreement – as a better understanding of how climate action can reinforce national sustainable development targets will improve political buy-in. Moreover, the tool may be helpful for a broader set of stakeholders, including the international support community and civil society, to better formulate their engagement strategies.
**The Sustainable Development Scorecard	a means of assessing a development's contribution to the social, economic and environmental pillars of sustainable development, as defined by the National Planning Policy Framework.**	What if you want to assess a proposed development's contribution to the social, economic and environmental pillars of sustainability? A new free online tool has been launched to do just that, to score its 'golden thread of sustainability'

Based on the UK's national planning policy framework it's a tool to assess the level of sustainability. https://www.thescorecard.org.uk More information at: https://atlasofthefuture.org/project/the-sustainable-development-scorecard/	
OECD Policy Coherence for Sustainable Development Toolkit The PCSD online toolkit provides practical **guidance**, **self-assessment** checklists, **good practice** examples and **tools** to analyse, enhance and track progress on policy coherence in the implementation of the Sustainable Development Goals (SDGs). http://www.oecd.org/governance/pcsd/toolkit/ http://www.oecd.org/governance/pcsd/toolkit/tools/	A list of available tools developed and piloted by organisations involved in the PCSD Partnership (#SDGAction12066) to support country efforts in enhancing policy coherence for sustainable development. It also includes tools developed by the OECD. The respective links provide more detailed description of the tools' specific features. This list includes a number of the tools also separately evaluated within its annex.
UN-Water SDG 6 Data portal Global data portal on SDG 6 http://sdg6data.org	The SDG 6 Data Portal brings together data on all the SDG 6 global indicators and other key social, economic and environmental parameters. Through maps, charts and tables, the Portal offers tailored options for visualization and analysis of the data, including on interlinkages. The SDG 6 Data Portal is an entry point to the wealth of water and sanitation information available within the UN system. The portal complements the Global SDG Indicators Database and indicator-specific databases by offering more in-depth information across all SDG 6 indicators. Overviews per region/country are available like this one for Ireland: https://www.sdg6data.org/country-or-area/Ireland
LinkedSDG A demo app that automatically extracts key concepts related to sustainable development from text documents and links them to the most relevant sustainable development goals, targets, indicators and series. LinkedSDGs provides a foundation for the standard-based data exchange and build a common framework and guidelines to improve the visibility, interoperability and usability of citizen-science data on SDGs. http://linkedsdg.apps.officialstatistics.org/#/ More information at: https://sustainabledevelopment.un.org/LinkedSDGs/about	LinkedSDGs application has been developed under the leadership of the Statistics Division and the Division for Sustainable Development Goals' (DSDG) of the Department of Economic and Social Affairs, with the support of resources from the EU grant entitled "SD2015: delivering on the promise of the SDGs". It showcases the usefulness of adopting Semantic Web technologies and Linked Open Data principles for extracting SDG related metadata from documents and establishing the connections among various SDGs. It is hosted under the infrastructure of the UN Global Platform for Official Statistics initiative. A pilot application, available at LinkedSDGs, showcases the usefulness of adopting semantic web technologies and Linked Open Data (LOD) principles for extracting SDG related metadata from documents and establishing the connections among various SDGs. The application automatically discovers the semantic links between text documents, relevant SDG entities and the statistical data.
NDC-SDG Connections Connecting climate action to the Sustainable Development Goals: Analyse and compare how	The research and visualisation project aim at illuminating synergies between the 2030 Agenda for Sustainable Development and the Paris Agreement, and at identifying entry points for coherent policies that

climate actions formulated in Nationally Determined Contributions (NDCs) corresponds to each of the 17 Sustainable Development Goals (SDGs). https://klimalog.die-gdi.de/ndc-sdg/	promote just, sustainable and climate-smart development. The aim of this joint initiative of DIE and SEI is to reveal the connections and synergies with the SDGs that can be found in the current NDCs, and thus to identify potential entry points for more coherent policymaking and action. In future, the data set and visualisation will include countries' updated NDCs as well as voluntary national reviews of the SDGs.
The KnowSDGs platform This EU platform allows you to look at interlinkages and then it visualise the results. There are three sections: 1. Interlinkages 2. Mapping EU policies into SDGs 3. EU key policy nodes https://knowsdgs.jrc.ec.europa.eu/interlinkages/info	This platform provides a tool to visualize the cumulated interlinkages from a set of publications. It allows users to quickly see and understand for which interlinkages there is strong agreement in the literature. The tool aside from showing interlinkages between the SDG's and targets also maps EU policies into SDGs and in the EU key policy nodes section the cumulated inter linkages from a set of publication as reported in the section on interlinkages is combined with the results of the mapping EU polices into SDGs. This exercise allows the identifications on key policy nodes in terms of co-benefits or trade offs which should be investigated in order to define a SDGs impact assessments for EU policies.
CLIMATE ACTION IMPACT TOOL Assessing climate action contributions to the Sustainable Development Goals An action under the tool, is a type of climate action, namely mitigation or adaptation that can take the form of a programme (such as a sectoral or multi-sectoral initiative, typically at scale larger than a single project activity) or a project (in the UNFCCC parlance, this would be similar to a standalone CDM project). The tool therefore can be applied to various type of climate actions defined under an NDC that is either national, regional, sectoral or local in nature. https://climateimpact.undp.org/#!/	UNDP has developed this tool to help a broad range of stakeholders in managing the design, development, implementation, financing, measurement, reporting and verification of the various type of actions. This will enable the stakeholders to identify significant impacts, define indicators, quantify impacts and set targets and track the progress of the actions towards the NDCs. The tool is a bottom-up tool that can be applied to track 'significant, direct impacts' of actions. The outputs of the tool can be broadly categorized into 3 categories: • Descriptive elements of the tool can be collated into a single summary report that provides an overview of the planned actions to a broad range of stakeholders including beneficiaries, donor community and policy makers. • Qualitative elements of the tool provide a graphic visualisation as a comparative overview of how the various impact categories compare. • A quantitative assessment that will directly feed into the MRV section of the tool.
BIP | Biodiversity Indicators Partnership The Biodiversity Indicators Partnership (BIP) is a global initiative to promote the development and delivery of biodiversity indicators. https://www.bipindicators.net/	Its primary role is to serve the global user community by responding to the indicator requests of the CBD and other biodiversity-related Conventions, for IPBES, for reporting on the Sustainable Development Goals, and for use by national and regional governments.
Knowledge Hub on SDGs Portal of the United Nations Economic Commission for Europe | Statistical Division https://w3.unece.org/sdghub/ https://statswiki.unece.org/display/SFSDG/GUIDELINES+AND+TOOLS	Platform designed to support stakeholders in measuring and monitoring SDGs in countries. Our goal is to enable efficient coordination of SDG monitoring and reporting at regional level between relevant international organizations and between international organizations and national statistical offices.