Working paper

A systems description of the national well-being system. Version 1.0

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Abstract

Policymakers are confronted with hard-to-address questions, such as

- **What is the ultimate impact of very different policies on the well-being of citizens?**
- **How to anticipate, which policies will promote well-being the most and which ones will lead to tough trade-offs?**
- **How to focus scarce resources and maximize the positive impact on the well-being of citizens?**

Economic growth is ceasing down, and, moreover, in most of the developed countries additional growth does not promote the well-being of citizens as much as it used to. But what is well-being? According to a dictionary, well-being is a state of feeling happy, healthy or prosperous. In 1980s, a group of sociologists, philosophers and economists led by Amartya Sen and Martha Nussbaum suggested a framework to *understand well-being beyond the economic indicators*, such as the GDP. In fact, in the modern world, well-being itself becomes a prerequisite for economic growth and for social and economic stability.

Governments begin to focus their attention directly on the multi-dimensional national well-being including and going beyond economic and material aspects. They look for new under-utilized resources that would raise the national well-being even despite weak economic growth. To discover effective and efficient solutions, one needs to *maximize synergies and reduce losses from trade-offs*. Systems analysis offers tools to do so.

This challenge was presented to the International Institute for Applied Systems Analysis (IIASA) by the National Economic Council of Israel in 2018. In response, IIASA developed a pilot version of a systems description of the national well-being system that covers four major subsystems: economic subsystem, natural subsystem, human capacity subsystem, and social subsystem, each described by a set of indicators. This Working Paper presents the results of this pilot work.

We rely on the OECD well-being framework as a basis to measure multi-dimensional well-being and work with 68 factors, of which 39 represent the OECD indicators. Based on evidence we collate from solid scientific literature, we connect these 68 factors by causal relationships and obtain a *comprehensive systems map of the National Well-being System (NWS)* (a causal loop diagram) comprising 208 directed links between factors.

This systems map allows to trace all *indirect effects and feedback loops* between factors in a systematic fashion thus helping acquire a holistic understanding about the national well-being system. Empirical evidence clearly indicates that systems thinking is difficult to practice when causal interconnections become more complex, especially when it involves indirect effects and feedback loops. As a formal tool from qualitative systems analysis, our NWS map can assist policymakers to reveal trade-offs and synergies, reduce the problem's "wickedness" and discipline a dialogue.

This version 1.0 can and should be developed further. This includes expert validation and fine-tuning, as well as customizing it to particular national and policy contexts. Eventually, our ambition is to develop a policy simulation tool that enables comparison of different policy options and their ultimate impact on well-being.

We invite interested parties to join us in this endeavour!

Acknowledgements

1.   Introduction

Well-being as a new policy target

Policy planning in modern states increasingly recognises that national economic growth per se does not reflect necessarily whether citizens have a good life. Macro-economic indicators, in particular, the GDP, do not cover all dimensions of the nation's development progress. Furthermore, due to the volatility of economic cycles and interdependency of a country with the global economy, national policymakers have limited power to master growth. Well-being is becoming a new target for the national policy.

Even though economic welfare is one of the key prerequisites of citizens' well-being, it has been recognized that there is a need for a more comprehensive approach to measuring well-being to inform policymakers and the general public, as well as to support efficient policymaking. There have been proposed various definitions of well-being. Well-being refers to the state of feeling healthy and happy, or the state of being happy, healthy or prosperous (Merriam-Webster, 2019). Theoretical sociological literature also refers to freedoms (Sen, 1993, 2005) and capabilities (M. C. Nussbaum, 2011, p. 33) when well-being is not only perceived as attaining pleasure but also as "the striving for perfection that represents the realisation of one's true potential". *UN Human Development Index* (HDI) covers life expectancy and education level in addition to the GDP (UNDP, 2018). *OECD Better Life Index (How's life?)* combines a wide variety of indicators from the economy to housing and health (OECD, 2017c). These two frameworks are examples of how the concept of well-being has been operationalized for policymakers.

In this report, we adopt the OECD *well-being framework* (OECD, 2017c). Its indicators closely reflect the capability approach of Sen-Nussbaum and relate to the outcomes achieved in the two broad domains: material living conditions (income and wealth, jobs and earnings, housing conditions) and non-material quality of life (health status, work-life balance, education and skills, social connections, civic engagement and governance, environmental quality, personal security and subjective well-being). Capabilities for well-being in the future are measured as outcomes of four capitals: economic, natural, human knowledge, and social capitals.

The major challenge of policy planning is to understand and navigate across trade-offs between different components of well-being. For instance, to achieve economic growth, natural resources may be overexploited, or cultural values may be compromised. Multiple and potentially lagged interdependencies between components of well-being are difficult to oversee and comprehend by the human brain in the absence of special tools, while the lack of a systems perspective on well-being increases the risks of unintended adverse consequences. The presence of these risks plagues policy planning to a degree uncomfortable for policymakers.

Systems analysis as an approach to analysing national well-being

Systems analysis is an approach that can help policy planners and decision-makers facing a complex problem with many interdependencies across different fields of governance. At its best, systems analysis is able to obtain new insights about the system and its behaviour by analysing relationships between different parts of a problem and reveal how a change in one part can kick-off further changes in the system.

Qualitative systems modelling is one approach of systems analysis whereby a complex and often "wicked" problem is decomposed into rather well-defined elements and causal connections between them. This process is often called *systems mapping* and a resultant systems representation as a set of elements and directed links between them is called a *systems map*. Both the systems mapping process as such and a resultant systems map are useful as they assist in structuring the problem and help bringing stakeholders to the same page. However, if a problem is really "wicked", often it is very difficult or even impossible to arrive at a consensus systems map.

Besides the function of structuring a problem, a systems map and its analysis can help policy planners and analysts seeing

- Which components of the system are potentially more important than others,
- What major feedback mechanisms drive the behaviour of the system,
- What the main implications are for the entire system in the event of one component being impacted by policy intervention, and
- How the impact of a policy intervention spreads throughout the system.

Objectives of this study

This report presents the results of the pilot phase of a joint project of IIASA and the Israeli National Economic Council. This project was undertaken in 2018-2020 with the aim to

(i) Examine the feasibility of applying qualitative systems analysis as an approach to enhance our systems understanding of national well-being, and
(ii) Produce a pilot version of a systems description of the national well-being system.

Scope

In this study, we adopt the OECD *well-being framework* (OECD, 2017c), see

Figure 1. To construct a systems perspective on well-being, we assume that the OECD indicators of current well-being related to the material conditions and non-material quality of life constitute major system components, while the four capitals (natural, economic, human and social capital) form main subsystems of the well-being system; their indicators are included in the systems description too.
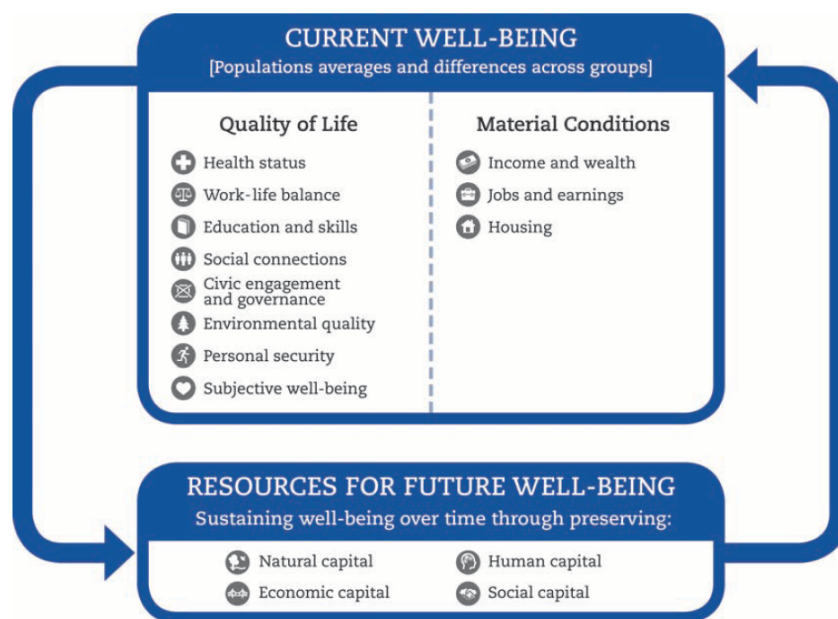
Figure 1. The OECD well-being framework (OECD, 2017c).

Structure of the report

The rest of this paper is organized as follows. **Chapter 2** outlines the methodological principles of mapping of the national wellbeing system. **Chapter 3** presents a brief overview of the entire national map resulted from this study, while **Chapter 4** describes in some detail the subsystems of well-being corresponding to the four capitals. **Chapter 5** presents some descriptive analysis of the systems map aimed to help comprehend this complex system, and **Chapter 6** presents some final remarks including the proposed steps forward.

2.   Principles of the national well-being systems mapping used in this study

This study focuses on the **national** well-being system, which produces well-being for citizens of a country. This study is guided by two main principles: The OECD *well-being framework* is used as a starting point of the analysis, and a systems mapping approach based on causal loop diagrams is used as a tool. These two principles are explained below.

OECD Indicators: From categorical to systems thinking

OECD has been focusing on well-being indicators in various constellations since 2011 (OECD, 2011). Data have been collected across the OECD countries in a consistent manner, which enables inter-country comparison. The OECD well-being indicator family consists of total 49 indicators, which measure either the

current state of well-being or the state of capitals underlying the well-being system. Quite a few indicators go beyond purely economic factors, however, overall, the OECD approach keeps a strong focus on economic drivers of well-being with almost half of the indicators measuring economic outcomes.

In the OECD well-being framework, indicators of the current well-being (25 indicators) are categorised into material conditions and quality of life; each category is split further into subject areas as shown in Table 1. Indicators of the future well-being (32 indicators) partially overlap with those of the current well-being; they are categorised with respect to four capitals – the economic capital, the natural capital, the human capital, and the social capital. The scope of this study, i.e., the breadth and depth of the well-being map we develop, is based on this categorisation.

Table 1. Headline indicators of the current well-being and illustrative indicators of the future well-being resources. Source: (OECD, 2017).

Headline indicators of the current well-being		Illustrative indicators of the future well-being resources	
Material conditions		**Economic capital**	**Human capital**
Income and wealth	Household income	Produced fixed assets	Young adult educational attainment
	Household net wealth*	Gross fixed capital formation	Educational expectancy
Jobs and earnings	Employment	Financial net worth of the total economy	Cognitive skills at 15
	Earnings	Intellectual property assets	Adult skills*
	Labour market insecurity	Investment in R&D	Long-term unemployment
	Job strain	Household debt	Life expectancy at birth
	Long-term unemployment	Household net wealth*	Smoking prevalence
Housing	Rooms per person	Financial net worth of government	Obesity prevalence
	Housing affordability	Banking sector leverage	
	Basic sanitation		
Quality of life		**Social capital**	**Natural capital**
Work-life balance	Working hours	Trust in others	Greenhouse gas emissions from domestic production
	Time off	Trust in the police	CO_2 emissions from domestic consumption
Health status	Life expectancy*	Trust in the national government	Exposure to PM$_{2.5}$ air pollution*
	Perceived health	Voter turnout*	Forest area
Education and skills	Educational attainment	Government stakeholder engagement	Renewable freshwater resources
	Adult skills*	Volunteering through organisations	Freshwater abstractions
	Cognitive skills at 15		Threatened birds
Social connections	Social support		Threatened mammals
Civic engagement and governance	Voter turnout*		Threatened plants
	Having a say in government		
Environmental quality	Water quality		
	Air quality*		
Personal security	Homicides		
	Feeling safe at night		
Subjective well-being	Life satisfaction		

*Components marked with * are both current well-being headline indicators and future well-being resources illustrative indicators.*

The OECD well-being framework has proven to be useful for informing policymakers about the dynamics of multiple dimensions of well-being of citizens of their country (Exton & Shinwell, 2018), and to allow for the comparison with other countries to benefit from their experience. Yet, interdependencies between the indicators have not been fully understood and communicated to policymakers. This understanding is, however, necessary to anticipate the multi-dimensional impact of new policy actions on well-being. This report attempts to fill in this gap by presenting major direct and indirect causal links between the well-being indicators, collected and consolidated from the existing literature. Our results add a systems thinking perspective to the categorical thinking on well-being developed by OECD.

Thus, we aim at describing a National Well-being System (NWS) and assume that it consists of four main subsystems: natural subsystem, economic subsystem, human capacity subsystem and social subsystem. In this report we use the term subsystem instead of capital because elements of these subsystems will be stocks, flows, and other variables connected by causal relationships (as opposed to stocks connected by flows).

Systems Mapping

In this report, we apply the methodology of qualitative systems mapping, which we briefly describe below. The main product of a systems mapping process is a systems map. It consists of meaningful components of different nature (stocks, flows, factors, processes, etc.) representing a real system under investigation. Components are connected by directed links. Each link represents an impact (causal influence) that one component makes on another. The impact can be positive (which means that if the state of the impacting component increases/decreases, the state of the impacted component increases/decreases too) or negative (which means that if the state of the impacting component increases/decreases, the state of the impacted component changes in the opposite direction, i.e., decreases/increases). One can also assign a strength and/or a lag of an impact to every link, but in this report, we do not do this. The entirety of components and connecting links is called a systems map.

In order to construct a systems map, a researcher should answer the following general questions:
- (i) Where to place the system's boundaries in a meaningful way in order to be able to cover system components that are necessary to address the research question, for which this systems map is being designed; the answer to this question will define the breadth of the system representation;
- (ii) What the systems map resolution should be, in other words, what level of details is appropriate for the purposes of a particular systems mapping process; the answer to this question will define the depth of the system representation; in practical terms, it will define how many components the systems map will include (typically varies between 20 and 50).

In many cases, for example, when a systems map is to be used to enhance our understanding regarding possible effects of a particular policy intervention, a researcher should also define output variables (objectives, criteria) to be used to evaluate the policy intervention impact.

There are two different ways to substantiate a systems map. One possibility is to rely on previous research and evidence, and to extract meaningful system components and causal links from the existing literature (Sterman, 2001). Another possibility is to elicit this information from human subjects (decision-makers, stakeholders, experts, or the general public), for example, through a participatory process (Sedlacko, Martinuzzi, Røpke, Videira, & Antunes, 2014; Sterman, 2001). In any case, every step of the process involves a lot of subjective judgment, which is to be done by a researcher who performs the investigation (Williams & Imam, 2006). For the same research question, therefore, there may be created multiple maps. In creating a systems map, much depends on the researcher's thinking, prior knowledge in the area, value system etc. (Borenstein, Hedges, Higgins, & Rothstein, 2009). It is not possible to eliminate this subjectivity from the systems mapping process, but the researcher should make sure to document key decisions, which have been made, and – to the extent possible – the reasons behind them. S/he should also make sure to give fair treatment to alternative propositions, should they emerge, abstaining as much as possible from influencing the outcome with own beliefs and knowledge (unless the purpose of the process is to create a systems map that represents the mental model of the researcher him/herself). In this report, we use the first approach building on the existing literature.
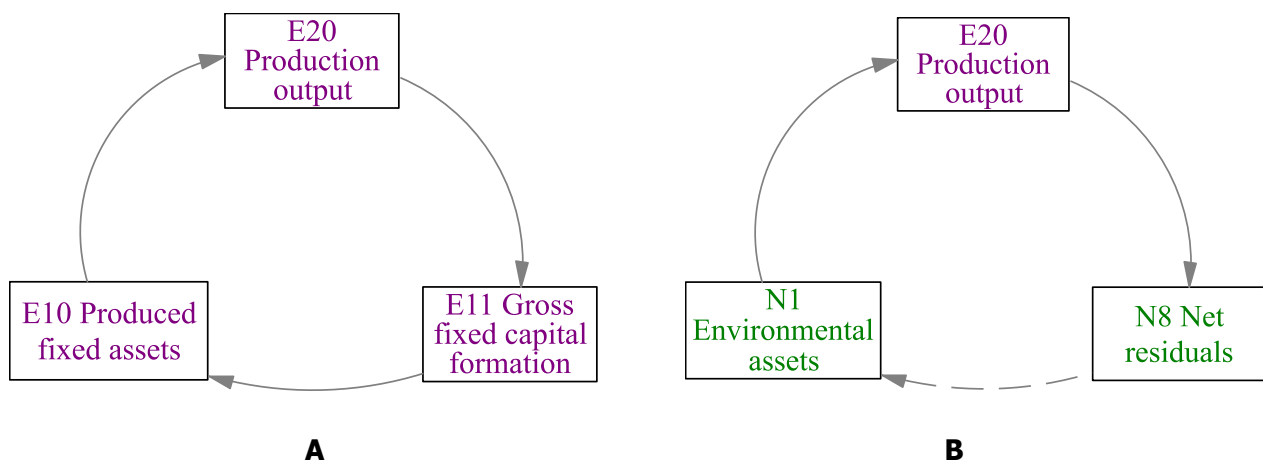
Figure 2. An example of a reinforcing feedback loop (Panel A) and an example of a balancing feedback loop (Panel B). Solid/dashed lines denote positive/negative links.

Figure 2 presents examples of what is called a *feedback* loop, which is a sequence of links connecting components by forming a cycle, i.e., the sequence begins and ends in the same component. A feedback loop can be either *reinforcing*, which means that an initial increase/decrease of the state of any component further increases/decreases after every cycle, or *balancing*, which means that, on the contrary, an initial increase/decrease of the state of any component decreases/increases after every cycle. The feedback loop in Panel A of Figure 2 is reinforcing: Higher "Production output" enables higher "Gross capital formation", which in turn leads to a higher level of "Produced fixed assets" enabling higher production. On the contrary, the feedback look in Panel B of Figure 2 is balancing: In this case, higher "Production output" creates more "Net residuals", which deteriorate "Environmental assets", which in turn can reduce "Production output".

Decomposing a complex system into balancing and reinforcing feedback loops helps understanding its dynamics and can guide the introduction of policy interventions. To act upon a specific policy objective, a policymaker can take advantage of the systems perspective explicated by the corresponding systems map. Sometimes instead of acting directly upon the component representing the policy goal, it might be more

effective – or feasible or leading other co-benefits – to work with another component in the system, whose changed state can trigger further changes in the system including a change in the component of interest in the desired direction.

3.   National Well-being System

A National Well-being System (NWS) describes major factors that make either direct or indirect impact on the citizens' well-being, as well as their interrelations. These factors are represented as components in the systems map; causal connections between them are represented as links.

Figure 3 represents the main result of our study – the entire NWS systems map. It consists of 68 components and 208 links informed by about 100 sources (articles in peer-reviewed journals, book chapters, reports, etc.) with several gaps we had to film in using our expert knowledge. The core of the map are 39 well-being indicators, inspired by the OECD well-being indicator framework, of which 30 are the OECD indicators as they are and 9 are results of merging two OECD indicators into one. The details on this can be found in Appendix 1. The other 29 components of the NWS systems map are support variables needed to capture the major causal interrelations according to the literature. The NWS systems map consists of four subsystems – economic, human capacity, environmental and social subsystems.

National Well-being System: Illustrative analyses

While in the spirit of Occam's razor principle, our NWS systems mapping exercise aimed at creating an as-simple-as-possible model to describe the national well-being system, nevertheless, the resultant systems map turns out to be too complex than a human brain can comprehend upon an optical observation. In this section, we present examples of how this (or such kind of) systems map can be analysed, Namely, we can

- (i)   Trace **impact pathways** of a policy intervention;
- (ii) Illustrate alternative sources of impact using a **causes tree;** and
- (iii) Analyse **feedback loops**.

Impact pathways. One of the key advantages of a systems map is that it allows tracing the impact of a proposed policy intervention onto a system's component of interest throughout all the first and indirect pathways within the considered system. For example, in Figure 4, we show two particular pathways through which investing in education eventually affects the life expectancy. One pathway generates an overall positive impact: A higher "Educational attainment" is expected to enhance eco-consciousness thus leading to a better state of "Untouched nature", which supports a higher value of the "Environmental assets", which in turn enables a larger "Production output". The latter creates a higher "Labour demand" and increases the "Employment rate". The increasing rate of employment has a positive impact on the "Average household income", which evidently has a positive effect on the "Life expectancy". Thus, this pathway connects "Educational attainment" as an element of the human subsystem with the life expectancy through the economic and environmental subsystems. Another pathway generates a negative impact: Enhanced "Educational attainment" diversifies norms and values in the society (i.e., lowers the "Homogeneity of norms and values"), which decreases "Interpersonal trust", weakens "Stakeholder engagement in politics" and lowers the "Perception of the meaningfulness of life".

Figure 3. The full systems map of the NWS. Solid/dashed lines denote positive/negative links. Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/ natural/human capacity/economic subsystems.
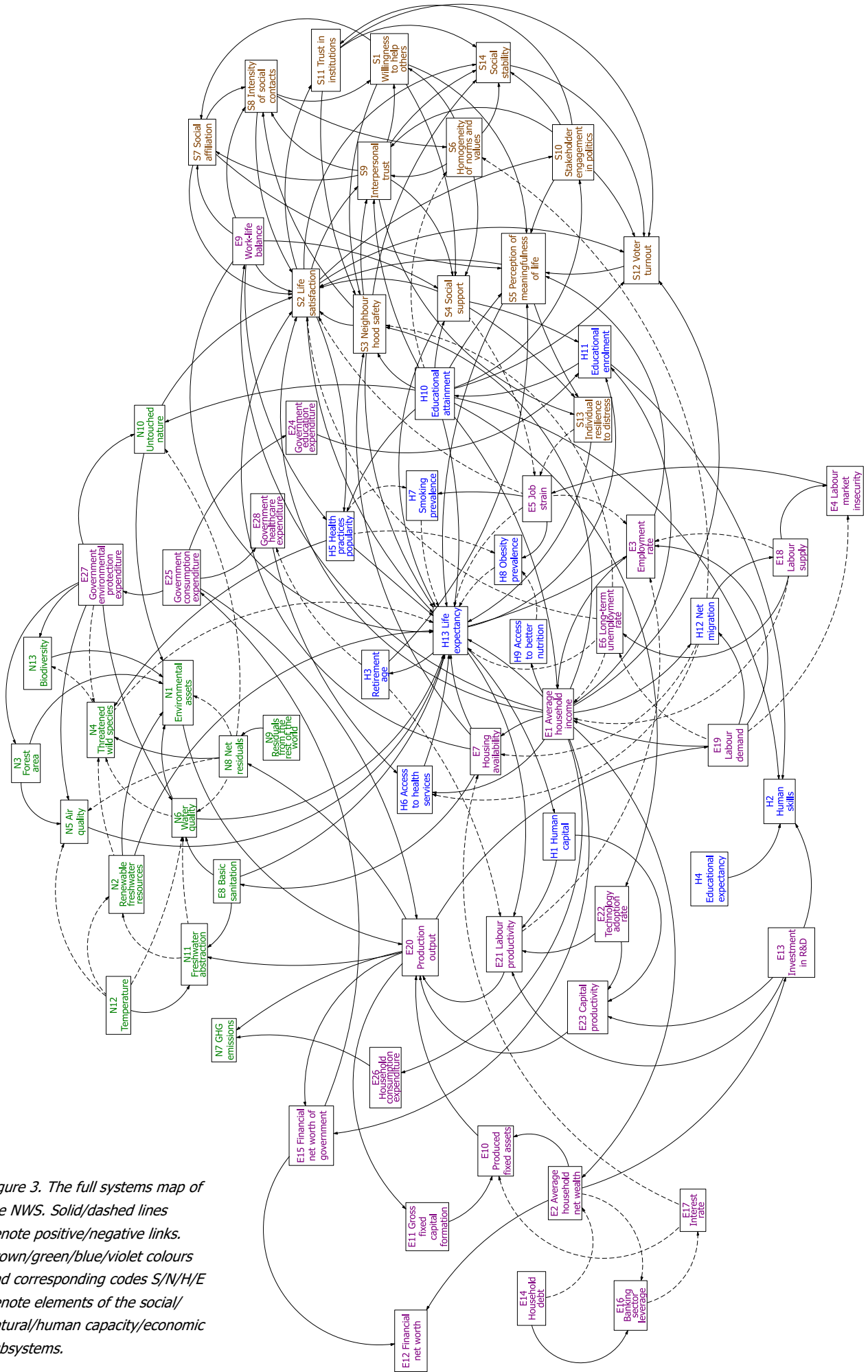
Figure 4. Two examples of pathways through which element H10 Educational attainment makes indirect impact on element H13 Life expectancy in the NWS (red/black chains of arrows). Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/ natural/human capacity/economic subsystems.

A lower meaningfulness of life ultimately decreases "Life expectancy". In this case, "Educational attainment" as an element of the human subsystem is connected w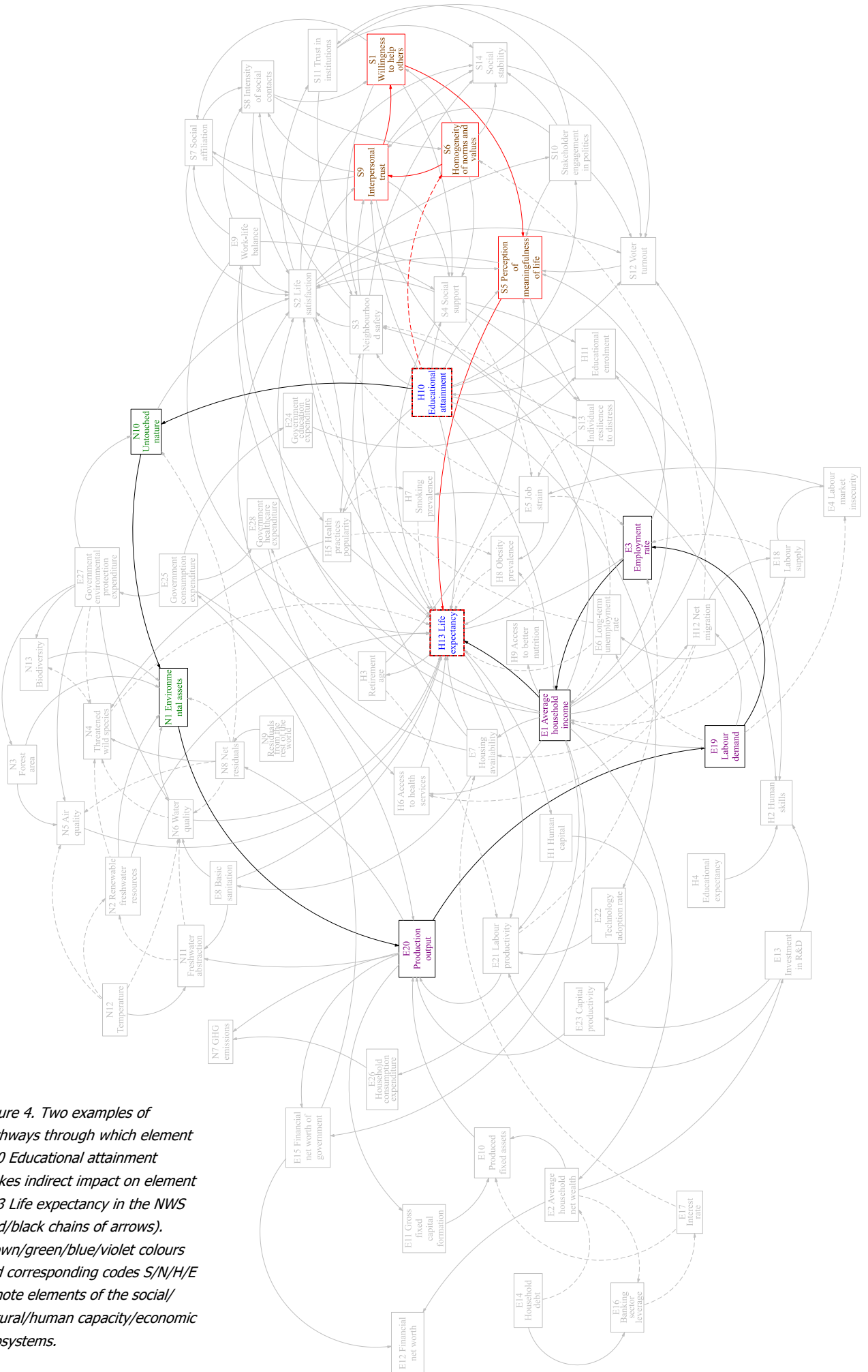ith the life expectancy through the social subsystem. We emphasize again here that most of the causal links presented here are supported by literature, see Appendix 2.

This caricatured example shows how one policy action can generate both desired and undesired effects at the same time. The overall effect can be estimated by combining *all indirect effects* also taking into account their strengths and possible lags. Equipped with such insights, policymakers can introduce policies that would dampen undesired effects. In the presented example, elements aiming at uniting the society around common values could be added to the education process, thus, potentially reducing or even turning the negative effect of the second pathway into a positive one.

Causes tree. A causes tree consolidates all *direct* and *indirect effects* (up to a given length of causal chains) that a focal system component experiences from various other elements of the system. A causes tree is a convenient tool to assist to a policy planning process, when desired outcome(s) are specified, and an efficient and effective combination of interventions is to be identified. Causes trees extracted from a systems maps can help reveal indirect causal effects overlooked by the common-sense thinking or disciplinary focused considerations. For example, Figure 5 illustrates a part of our NWS systems map with the focal component "Life satisfaction" and all direct and indirect effects of length two. "Life satisfaction" is a part of the social sub-system of the NWS. Eleven elements impact "Life satisfaction" directly, of which five are other elements of the social sub-system, while the remaining six are from the economic and natural sub-systems. Each of these eleven elements is impacted by several other elements from the NWS and thus total 53 elements (taking into account repetitions) have an indirect impact on "Life satisfaction; each impact is either positive or negative. For instance, "Long-term unemployment rate" not only makes a direct negative effect on "Life satisfaction", but also makes further adverse effects on it by decreasing "Average household income" and compromising "Neighbourhood safety". Thus, a policy intervention reducing unemployment would increase citizens' life satisfaction through at least these three mechanisms.

Feedback loops. Yet another way to use a systems map to aid a policy planning process is to analyse its feedback loops (see Section Systems Mapping in Chapter 2). To a large extent, the dynamics of the policy system described by a systems map is defined by the combined effect of the plethora of its reinforcing and balancing feedback loops. For example, component "Life expectancy" of our NWS systems map is a part of more than 35 million feedback loops (of which, however, "only" 7,552 include not more than 10 components). Figure 6 depicts four of them for illustration. Loop A is a reinforcing loop, through which "Life expectancy" is increasing driven by higher "Average household income" resulting from increasing "Production output". Production grows because higher "Life expectancy", acting as a proxy of public health, increases "Labour productivity". By strengthening this feedback loop, policy makers can trigger an increase in life expectancy. This loop can be rather effective, but in case of developed countries it is costly to improve any of its elements significantly.
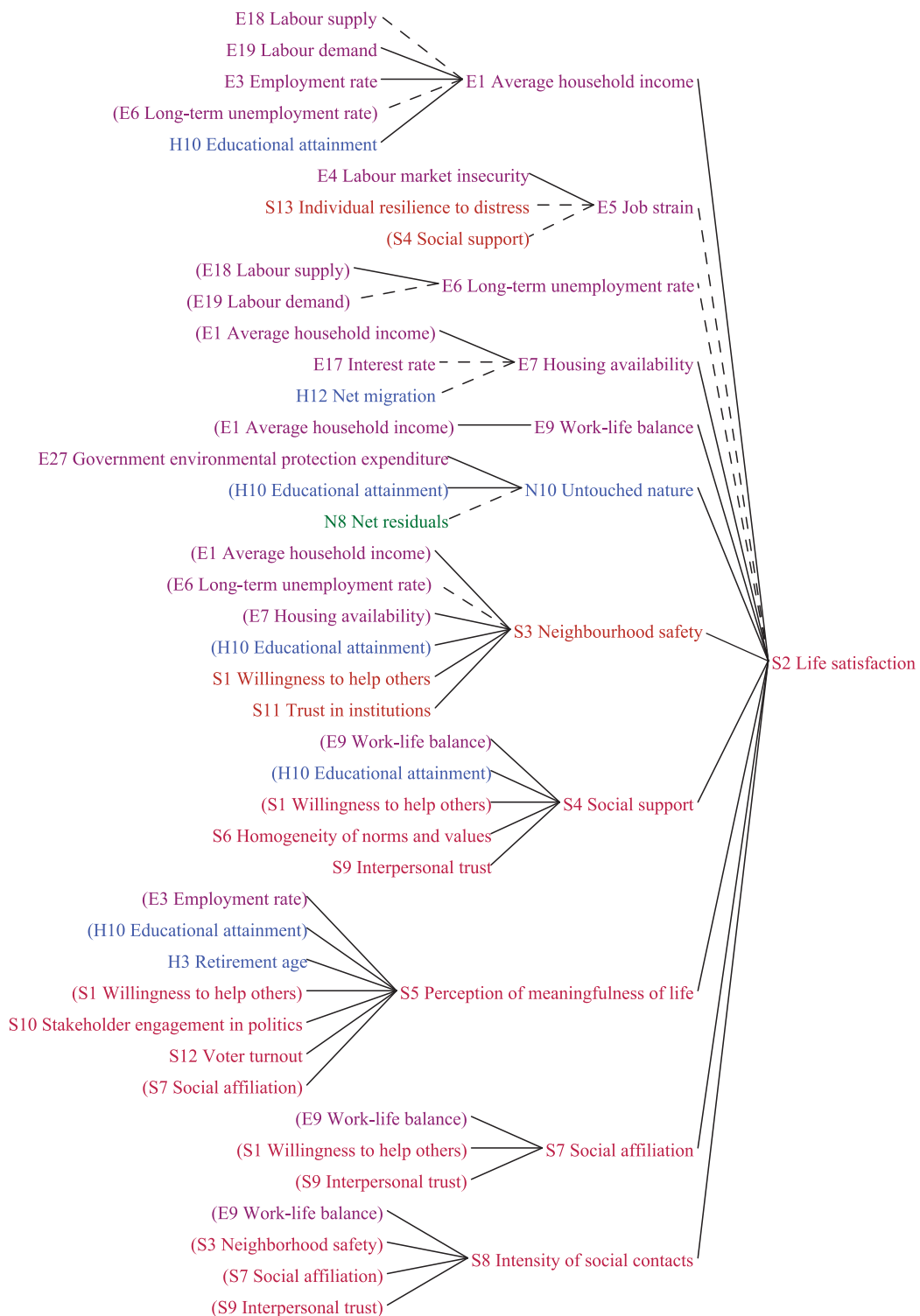
Figure 5. A causal tree illustrating direct and indirect effects of length two of various NWS components onto the focal component "Life satisfaction". Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/ natural/human capacity/economic subsystems.

Another reinforcing feedback loop, Loop B, also involves the positive effect of "Life expectancy" on "Labour productivity" and further on onto "Production output" and "Average household income". It complements Loop A, which contains a direct positive effect of "Average household income" on "Life expectancy" due to improved material conditions and access to better healthcare, by a positive indirect effect of "Average household income" on "Life expectancy" via higher "Life satisfaction". This feedback loop suggests that if a policy increasing life satisfaction – not necessarily through material or economic means – could be identified and effectively implemented, it can not only increase the life expectancy, but also can trigger production activity and even welfare.

Loop C incorporates another indirect effect between "Average household income" and "Life expectancy" accounting for the role of education, which, through stronger "Perception of meaningfulness of life" increases "Life expectancy". As in loops A and B, "Life expectancy" has a positive chain impact on "Average household income", which makes Loop C also reinforcing. On the contrary, Loop D illustrates a mechanism through which "Educational attainment" reduces "Life expectancy". This mechanism incorporates elements of the social sub-system, namely, it is based on a negative effect "Educational attainment" has on "Homogeneity of norms and values", which in turn suppresses trust and safety leading a lower "Life satisfaction" hence lowering public health and life expectancy of citizens. Indeed, according to (Hall, 2018) people with higher levels of education possess more cognitive skills and cultural knowledge, and thus are perceptive to the plurality of ideas of various sort. In terms of our NWS, it justifies our assumption that a higher "Educational attainment" decreases "Homogeneity of norms and values". This negative effect makes Loop D balancing.
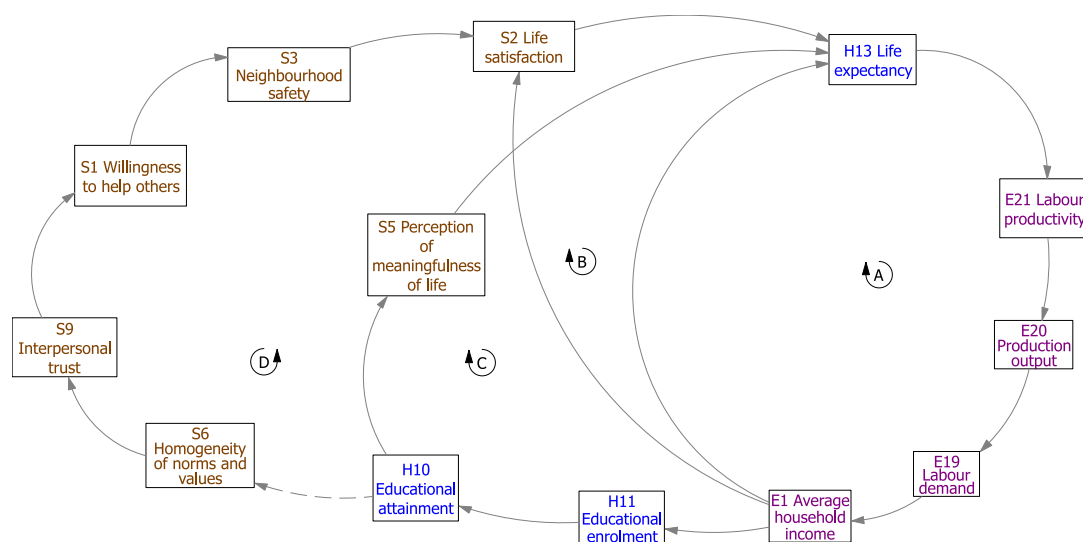
Figure 6. Five exemplary feedback loops (of more than 35 million) of the NWS systems map, in which "Life expectancy" is involved.

4. Subsystems maps

In this section, we present and discuss systems maps of economic, human capacity, environmental, and social subsystems of NWS one by one separately.

4.1. Economic subsystem

The systems map of the economic subsystem covers the processes of creation, transformation, exchange and transfer of economic value (UN, 2010). It includes 16 components motivated by the corresponding OECD indicators (of which 8 describe future capabilities) and 12 intermediate components, which enable a meaningful description of this sub-system. For simplicity, we omit issues related to financial markets and focus on the real sector. See Table 2 in Appendix 1 for the full list of components of the economic sub-system and their formal definitions with references to literature. Figure 7 depicts the economic subsystem.

Figure 7. The systems map of the economic subsystem. Only elements belonging to the economic subsystem and their immediate neighbours from other subsystems (direct sources or destinations of its links) are displayed. Filled/dashed arrows denote positive/negative impacts. Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/ natural/human capacity/economic subsystems. Colours of the elements belonging to other subsystems than economic are muted.

4.2. Human capacity subsystem

The human capacity subsystem is inspired by the concept of human capital. At its inception, this notion emphasized the role of the productivity of individuals and their contribution to the economic value creation as knowledge, skills and competences were considered to be significant drivers of economic growth (Becker, 1994). Recent studies highlight the contribution of human capital to the well-being of individuals and societies, and argue that "people and their culture are more than just capital inputs into a system, and their value much greater than a means of promoting economic growth, which the use of the term 'capital' implies." (Forgie, 2016). It is for this reason we chose to call this subsystem human capacity subsystem and not human capital subsystem.

OECD defines human capital as "knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (Keeley, 2007). The OECD well-being indicators related to the human capacity subsystem cover formal education, skills and health. Figure 8 depicts the human capacity subsystem of our NWS. It includes 6 components motivated by the corresponding OECD indicators (of which 3 describe future capabilities) and 7 intermediate components, which enable a meaningful description of this subsystem. See Table 3 in Appendix 1 for the full list of components of the human subsystem and their formal definitions with references to literature.
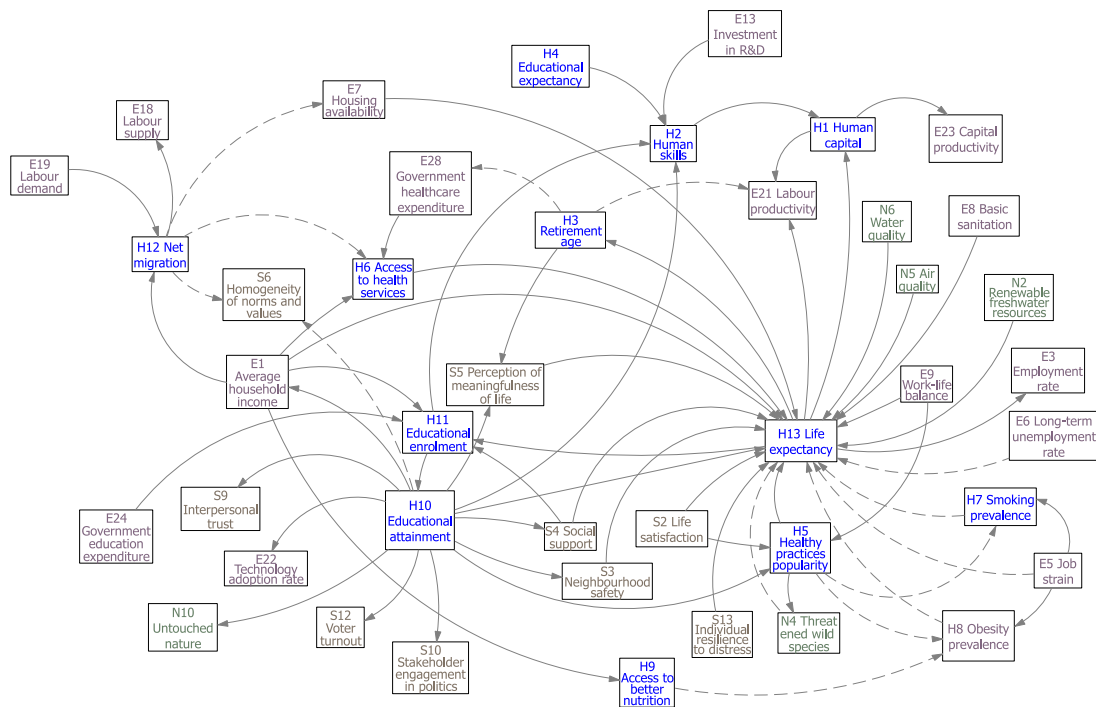
Figure 8. The systems map of the human capacity subsystem. Only elements belonging to the human capacity subsystem and their immediate neighbours from other subsystems (direct sources or destinations of its links) are displayed. Filled/dashed arrows denote positive/negative impacts. Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/ natural/human capacity/economic subsystems. Colours of the elements belonging to other subsystems than human capacity are muted.

4.3. Social subsystem

The social subsystem is defined as a set of factors and relations that provide valuable resources to individuals through participation in social networks with shared norms, values and understandings (Boeri, Gardner, Gerken, Ross, & Wheeler, 2016), (Glaeser, Laibson, & Sacerdote, 2002, p. 438), (Putnam, 2000, p. 9) and provide the community with norms and trust (Putnam, 1995). This scope corresponds to the OECD definition of the social capital as "networks together with shared norms, values and understandings that facilitate cooperation within or among groups" (OECD, 2001). It resonates with Fukuyama's definition "Social capital is a set of informal values or norms shared among members of a group that permits cooperation among them" (Fukuyama, 1995). Nussbaum argues that social capital (in the form of deep social relationships and feeling of acceptance and strong affiliation) is also one of the capabilities that produce well-being (M. C. Nussbaum, 2011).

We wish to point here that the social dimension of well-being is the least studied in the literature, especially from the empirical angle. When constructing the systems map describing the social subsystem, several important components not present in the OECD well-being framework popped up. For example, the multitude of processes that can be accumulated under the short name "Helping others" seem to play a central role in social network building, well-being and happiness (Glaeser, 2001; Oarga, Stavrova, & Fetchenhauer, 2015).
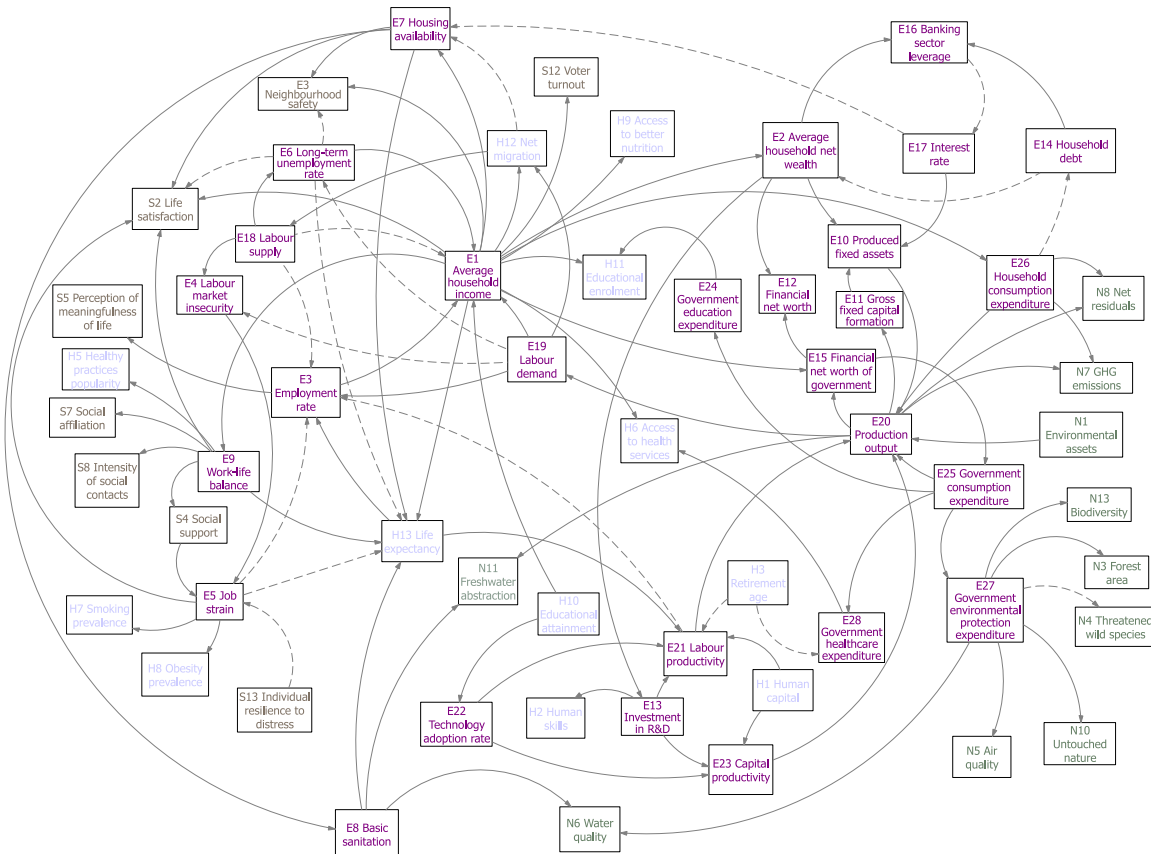

Figure 9. The systems map of the social subsystem. Only elements belonging to the social subsystem and their immediate neighbours from other subsystems (direct sources or destinations of its links) are displayed. Filled/dashed arrows denote positive/negative impacts. Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/ natural/human capacity/economic subsystems. Colours of the elements belonging to other subsystems than social are muted.

Figure 9 depicts the social subsystem of our NWS. It includes 8 components motivated by the corresponding OECD indicators (of which 5 describe future capabilities) and 9 intermediate components, which enable a meaningful description of this subsystem. See Table 4 in Appendix 1 for the full list of components of the economic sub-system and their formal definitions with references to literature.

4.4. Natural subsystem

It is acknowledged that the quality of humans' life is affected by the state of the natural environment. Nature provides goods and services that contribute to the well-being of humans and every other species on the planet. "Natural capital includes the land, water, atmosphere, and the many natural resources they contain, including ecological systems with living (biotic) and non-living (abiotic) components. Natural capital provides the energy, raw materials, and waste absorption or filtering services that are critical to the modern economy and human life on Earth." (The Encyclopedia of Earth, 2007).

We use the World3 model and the System of Environmental-Economic Accounting (SEEA) as major sources to inform the construction of the natural subsystem map. The World3 model is based on Forrester's global model World2 (Forrester, 1971) that was further developed by Donella and Dennis Meadows and Jurgen Randers by the request of the Club of Rome in early 1970s (Meadows, Meadows, Randers, & Behrens, 1972). The latest version of this model was published in 2012 (Randers, 2012). World3 (Meadows, Randers, & Meadows, 2004) is a system-dynamics simulation model with a strong global sustainability perspective. It intends to describe plausible scenarios emerging from the interconnection between economic growth and the limits of the Earth system. The model consists of five systems: the food production system, the industrial production system, the population system, the non-renewable resources system, and the pollution system described by almost 300 variables (OpenModelica, 2004), all interconnected with each other.

SEEA (UN, 2014) is not a traditional systems model, but merely an ecosystem accounting system. The benefit of SEEA for the NWS description is that it summarizes the current knowledge regarding relationships between the economy and nature. It is quantitative by nature as it applies the SNA (System of National Accounting) principles (UN, 2010) used worldwide for national accounting. SEEA applies the accounting concepts, structures, rules and principles of the SNA to environmental information including the physical flows of materials and energy within the economy and between the economy and the environment; the stocks of environmental assets and changes in these stocks; and economic activity and transactions related to the environment.

Additionally, we have added component "Temperature" to the natural subsystem as, according to extensive evidence, it has a significant impact on air and water resources (Horton, Skinner, Singh, & Diffenbaugh, 2014; Rio, Rey, Prudhomme, & Holman, 2018; UNESCO, 2015).

Figure 10 depicts the natural subsystem of our NWS. It includes 7 components motivated by the corresponding OECD indicators (of which 5 describe future capabilities) and 6 intermediate components. See Table 5 in Appendix 1 for the full list of components of the natural subsystem and their formal definitions with references to literature.
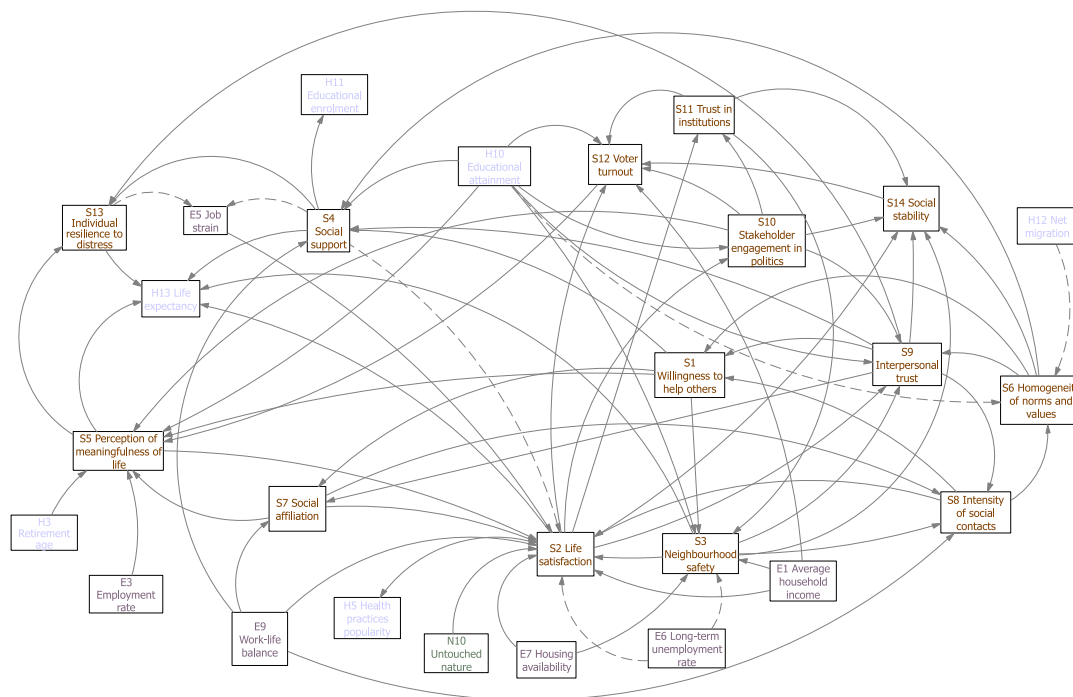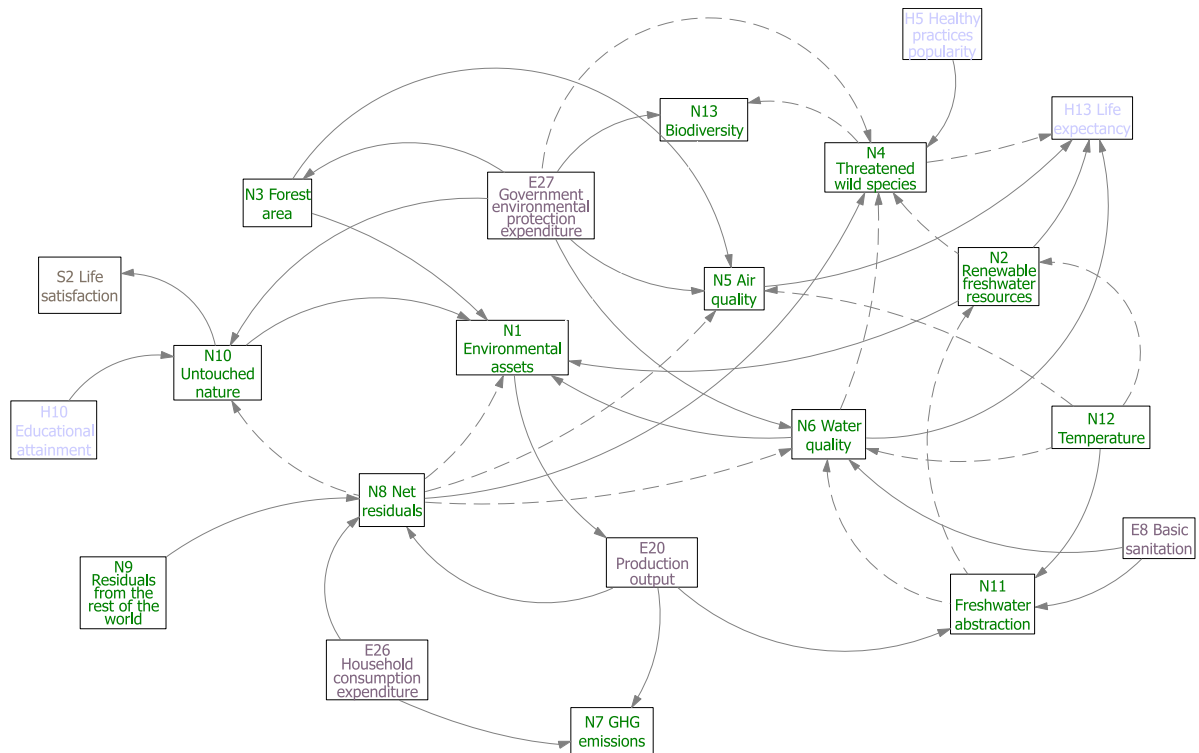
Figure 10. The systems map of the natural subsystem. Only elements belonging to the social subsystem and their immediate neighbours from other subsystems (direct sources or destinations of its links) are displayed. Filled/dashed arrows denote positive/negative impacts. Brown/green/blue/violet colours and corresponding codes S/N/H/E denote elements of the social/natural/human capacity/economic subsystems. Colours of the elements belonging to other subsystems than natural are muted.

5. Key NWS components and basic loops

There are several elements of the NWS systems (see Figure 3) map that stand out as key factors in the system judging by their connectivity with other components. Panel A in Figure 12 illustrates the distribution of the total degree (the sum of the incoming and outgoing links into a node) in the system. Nine nodes (see Panel B in Figure 11) have the degree higher than 10 – we will consider these elements as key system elements. "Life expectancy" has the highest total degree, 25, and thus can be regarded as the most important element in the system. Interestingly, some studies suggest that the life expectancy can serve as the main indicator of well-being, which seems to be supported by our NSW. "Life satisfaction" and "Average household income" share the second place with the total degree 18. This parity nicely reflects the dichotomy between the material and non-material dimensions of well-being. The fact that of nine key elements, five are from the social subsystem, highlights the importance of the latter for well-being.

Figure 12 illustrates direct interrelationships between nine key elements and Figure 13 illustrates their location in the entire NWS systems map. Interestingly, "Production output" is not connected directly with the other eight key elements, who are however highly interconnected among themselves.

Furthermore, Figure 14 illustrates all feedback loops consisting of three components, in which at least one of the nine key elements is present. We call such simplest feedback loops basic loops. Conceivably, basic loops can be considered as building blocks, of which our complex NWS consists. Figure 14 presents all 19 basic loops, to each of which we assign a caricatured interpretation from the well-being perspective. We further cluster them into 6 clusters. Cluster 1 "Education, work, wealth, and life expectancy" includes four reinforcing feedback loops incorporating life expectancy and education, possibility to work, and income as its key determinants. Cluster 2 "Political engagement and life satisfaction" highlights the reinforcing effects of influencing and engaging in politics and the life satisfaction. Cluster 3 "Social ties, helping others, safety, and life satisfaction" includes seven reinforcing feedback loops connecting life satisfaction and safety with factors describing social networks and social behaviour of people. Cluster 4 "Education, social ties and wealth" describes how education promotes not only wealth, but also social networks. Cluster 5 "Migration, production, and wealth " focuses on the links between investment, production, and wealth in the society, highlighting, however, that higher wealth can attract more migrants, which potentially increases labour supply and household income. The latter effect described by a balancing feedback loop will trade off with the reinforcing effects of other loops. Lastly, Cluster 6 "Environmental quality and production" consists of one loop describing the adverse effect of increased industrial production on the environmental quality, which in turn limits production possibilities. These six clusters arguably represent major systems processes influencing the national well-being.
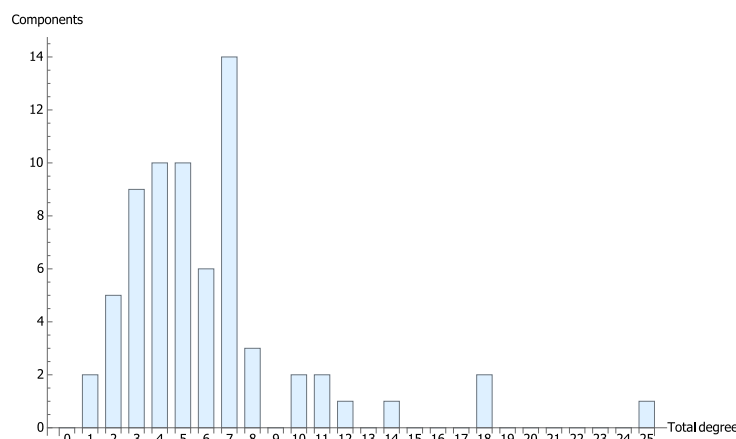
A

Element code	Element name	Total degree
H13	Life expectancy	25
S2	Life satisfaction	18
E1	Average household income	18
H10	Educational attainment	14
E20	Production output	12
S9	Interpersonal trust	11
S3	Neighbourhood safety	11
S5	Perception of meaningfulness of life	10
S4	Social support	10

B

Figure 11. The degree distribution of the NWS systems map (Panel A) and the list of nine systems elements having the total degree higher than 10 (Panel B).
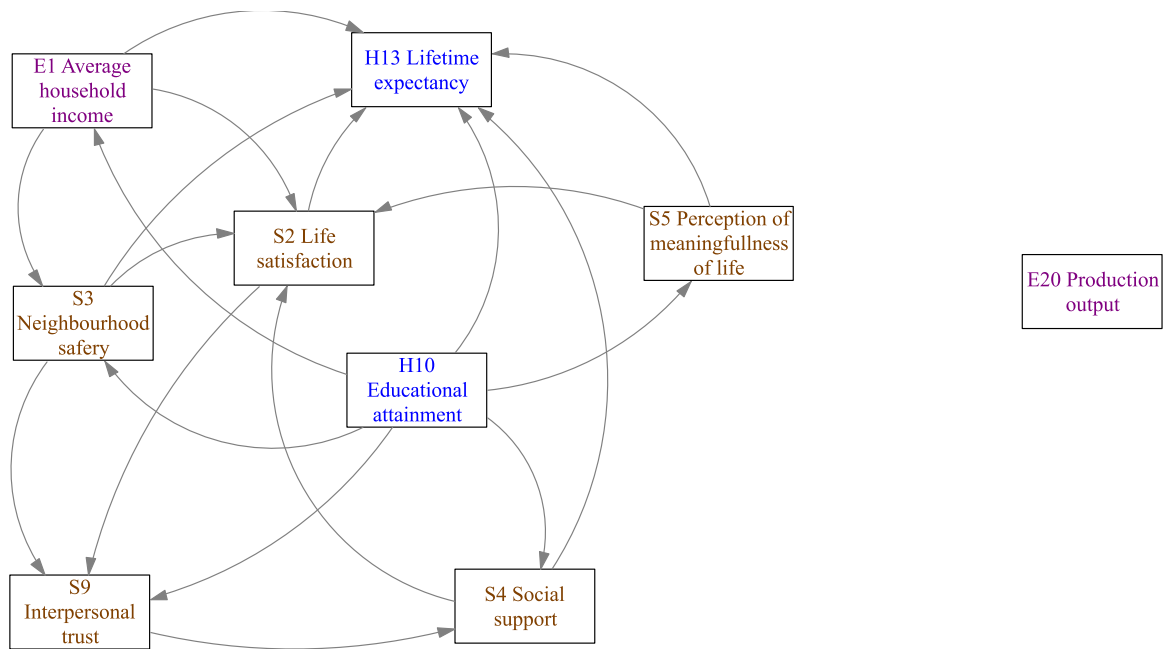
Figure 12. Direct interrelationships between nine key elements of the NWS systems maps (i.e., elements whose total degree is greater than 10).
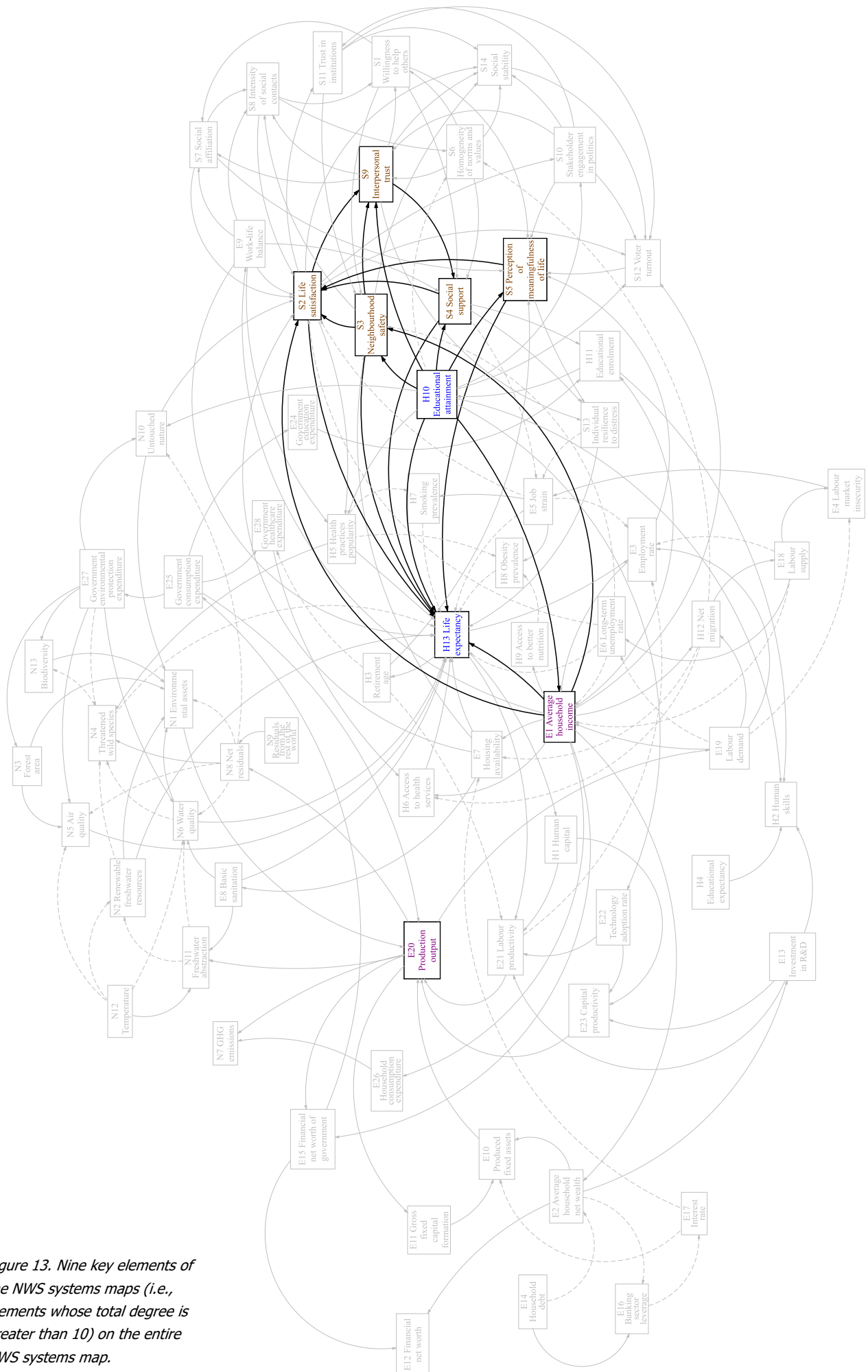
Figure 13. Nine key elements of the NWS systems maps (i.e., elements whose total degree is greater than 10) on the entire NWS systems map.
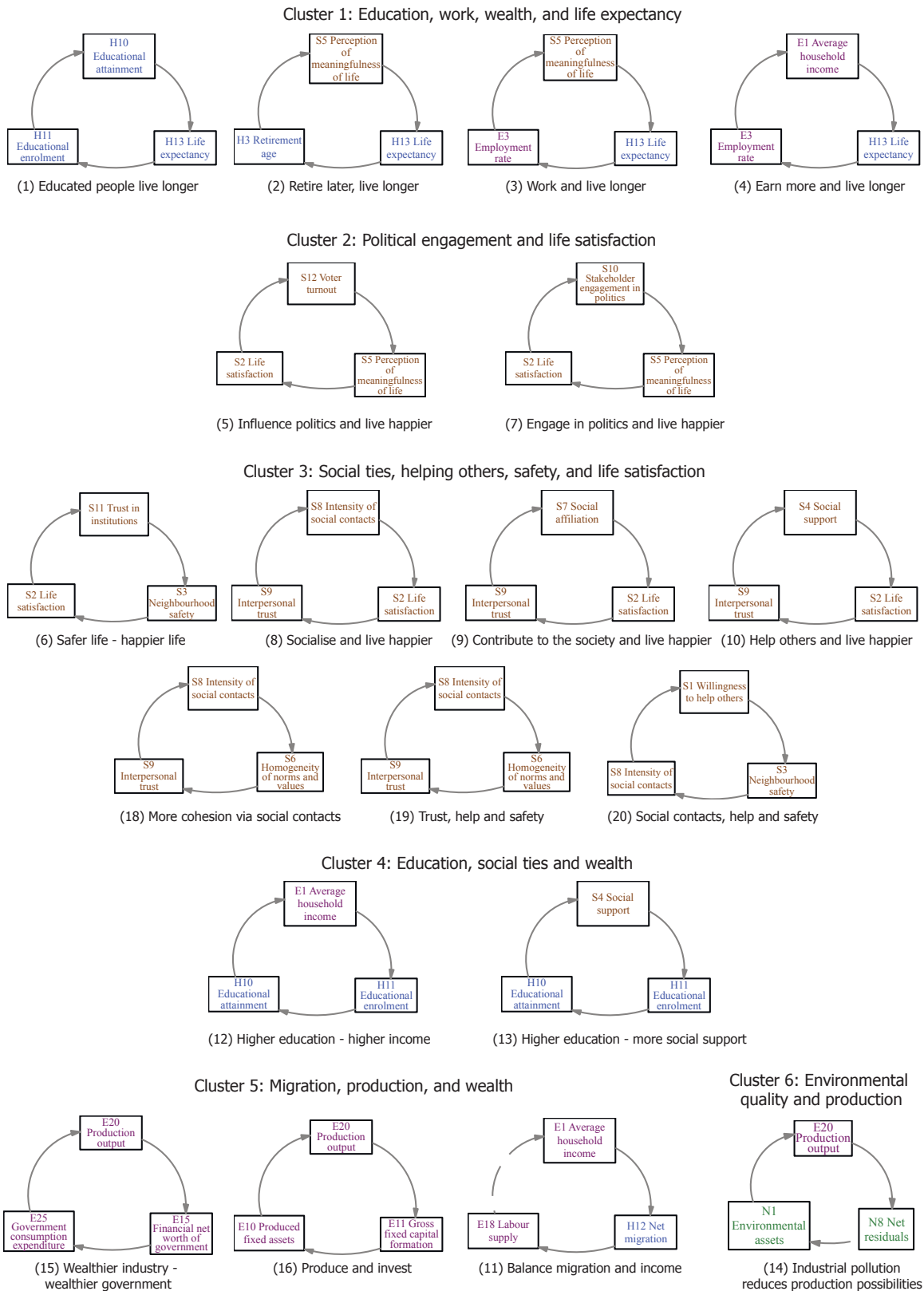
Figure 14. Nineteen basic feedback loops containing at least one key element of the NSW system clustered into six clusters.

6.   Final remarks

In this Working Paper we presented a pilot version of a systems description of the national well-being (NWS) system. In so doing, we relied on the OECD well-being framework (OECD, 2017c). The resultant systems map is supported by the evidence we collated from solid scientific literature. The NWS systems map consists of 68 components covering four major subsystems – economic subsystem, natural subsystem, human capacity subsystem, and social subsystem – and 208 causal links connecting components and thus subsystems (see Figure 3). We wish to mention here that generally, the literature contains more information regarding causal links within subsystems, than across them. Interconnectedness of the social subsystem ended up being higher than that of other subsystems.

Also, note that generally we follow the OECD approach (OECD, 2017c) and do not consider a separate cultural subsystem, but rather see it as a part of the social subsystem, see, for example, component "Homogeneity of norms and values" (Putnam 2000). In fact, the cultural dimension is missing in the OECD framework, while our NWS systems map suggests that it plays an important role in generating the national well-being.
Of 68 system components, the following 9 have the highest connectivity with the entire system, which makes us call these components key NWS components: "Life expectancy", "Life Satisfaction", "Average household income", "Educational attainment", "Production output", "Interpersonal trust", "Neighbourhood safety", "Perception of meaningfulness of life", and "Social support". These 9 key components are part of nineteen basic (three-element) feedback loops, which, arguably, can be seen as building blocks of the NWS (see Figure 14).

In our NWS systems map, component "Life expectancy" turns out to be the most connected indicator, making a direct causal effect on 5 other components and being impacted by 20. This prominent role of "Life expectancy" in our study resonates with a recent proposition made by other IIASA scientists to use an indicator that they call "Empowered Life Years (ELY)" as the major ultimate indicator of well-being (Lutz, 2017; Lutz, Lijadi, Strießnig, Dimitrova, & de Souza Lima, 2018). The ELY framework assumes that a person has "empowered" life if s/he "is healthy, out of poverty, able to read and write and has high life satisfaction".

The NWS systems map presented here can be used to trace impact pathways of a policy intervention, to illustrate alternative sources of impact using a causes tree, and analyse feedback loops (see Section 3 for illustrative examples). All these functions ultimately should aid the thinking process of a policy maker. For instance, we considered educational attainment as an impacting factor and life expectancy as an impacted parameter. We showed how increasing educational attainment can generate not only positive effects on life expectancy through positive effects on the environmental assets and economic dynamics, but also negative effects by reducing the homogeneity of the society and eroding social ties.

As discussed in Section 2, any qualitative systems description of a policy system incorporates a large amount of subjectivity in what concerns the choice of systems boundaries, the resolution level, the selection of elements and links. In this work, in making these decisions, we were guided by the OECD well-being indicator framework and related scientific literature. Obviously, we could not even review, let alone use, all the existing relevant literature and hence our systems map depends on the choice of the literature we used. Total we relied on about 100 sources to elicit information on components and links, which we consider a sufficient base

for the pilot case. In future research, we intend to increase this base to strengthen the scientific foundation of the results.

Another way to increase the reliability of the NWS systems map is to conduct an extensive validation process with experts and potentially even stakeholders. The pilot NWS systems map presented here received a limited – yet very useful – validation of this sort via one workshop with IIASA experts (five experts participated and gave feedback) and several discussions with experts in Israel and Finland.

We wish to emphasize that the processes underlying and eventually generating the national well-being are very complex and often context-dependent. This means that the ambition to create a universal systems description of the NWS can only be realized to some degree – even if we arrange the most careful and extensive validation. In this pilot exercise, we attempted to create a universal systems description of the NWS of a developed country. This can serve as a basis for systems maps to be tailored to specific countries at particular development stages as well as to address specific policy challenges.

There are three extensions we would like to mention here, to which the future efforts could be directed. First, a very useful addition to the NWS systems map containing factors, phenomena, and parameters – and their relationships – would be a map of agencies acting upon these factors, phenomena, and parameters. Note that the systems description we present here relates to the national-level well-being, not to the well-being of an individual or groups. Thus, ideally and eventually, it should be used by help policymakers seeing concretely where they should apply their efforts in addressing problems. Second, a purely qualitative picture of the NWS as a composition of elements and (binary) links can be enriched by adding quantitative information on link strengths and lags. The existing literature cannot be expected to contain this information in the required format, hence it should be elicited from experts. Having such information would allow to evaluate the overall impacts of alternative impact pathways and feedback loops, also depending on the time horizon. Third, with help of the information on link strengths and lags, one could arrange a simulation model operationalizing the NWS systems map. Implemented as a system dynamics simulation, it would allow testing and comparing quantitatively different scenarios of policy interventions in a more plausible way, also taking into consideration that systems components are sensitive to policy interventions to a different degree.

All in all, the presented here NWS systems map is one step towards a systemic perspective to the national well-being of developed countries. As any model of a complex system, it drastically simplifies the reality with the intention to focus on key aspects. To our knowledge, an approach of using a systems map to delineate a systems nature of the national well-being system is quite unique. We are aware of only one earlier study in the same spirit – a PhD dissertation by Vicky Forgie (Forgie, 2016) – which applied a similar methodology to well-being. Forgie conducted two participatory systems mapping case-studies and complemented these by a literature-based analysis of linkages between different components of the well-being system. However, the latter was implemented for a significantly smaller number of indicators, namely, for the eleven OECD Better Life Index dimensions. Our much more extended approach gives a more comprehensive picture that enhances our understanding of the potential of utilizing synergies and reducing trade-offs, which is key for the effective and efficient policy planning to enhance citizens' well-being worldwide.

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Appendix 1. Components of the NWS systems maps

*Table 2. Components of the economic subsystem. The components in **bold** are either direct mappings of the corresponding OECD indicators or combine several of them.*

Code	Component name	Component definition	Source	Comments
E1	**Average household income**	Sum of people's gross income (earnings, self-employment and capital income, as well as cash transfers, received from other sectors) and the social transfers in-kind that households receive from government (such as education and health care services) less taxes on income and wealth, as well as the social security contributions paid by households (measured in USD per capita, adjusted using current purchasing power parities (PPPs) for actual individual consumption)	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Household income" and "Average gross earnings" indicators as the latter is part of the former
E2	**Average household net wealth**	Sum of both the real and financial assets and liabilities held by private households resident in the country (measured in USD per capita at current PPPs)	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Household net wealth" and "Intellectual property assets" indicators; household wealth includes intellectual property assets by definition
E3	**Employment rate**	Share of the working-age population (people aged 15 to 64 in most OECD countries) who declare having worked in gainful employment for at least one hour in the previous week; it also includes persons who, having already worked in their present job, were temporarily absent from work during the reference period while having retained a formal attachment to their job (e.g. due to parental leave, sickness, annual leave)	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
E4	**Labour market insecurity**	Expected monetary loss that an employed person would incur upon becoming and staying unemployed and is expressed as a share of previous earnings. This loss depends on the risk of becoming unemployed, the expected duration of unemployment and the degree of mitigation against these losses provided by	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	

		unemployment benefits (effective insurance).		
E5	Job strain	Share of employees who report a situation in which job demands (e.g. time pressure, and exposure to physical health risks) exceed their job resources (e.g. work autonomy, opportunities for learning, and good workplace relationships)	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
E6	Long-term unemployment rate	Share of the working-age population who have been unemployed for one year or more. Unemployed persons are defined as those who did not perform any work in the survey reference week but are willing to do so and actively searching for work	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
E7	Housing availability	Share of household gross adjusted disposable income remaining after spending on housing and maintenance of the house *multiplied by* the number of rooms in a dwelling, divided by the number of persons living in the dwelling	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Housing affordability" and "Rooms per person" indicators
E8	Basic sanitation	Share of the population living in a dwelling with an indoor flushing toilet for the sole use of the household.	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	The original indicator has the opposite semantics, i.e., share of the population living in a dwelling *without* an indoor flushing toilet for the sole use of the household.
E9	Work-life balance	Share of the total number of employees of all ages whose usual working hours are less than 50 hours or more per week, expressed as *multiplied by* number of hours that people in full-time employment devote to leisure and personal care.	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Working hours" and "Time off" indicators
E10	Produced fixed assets	Value of a country's stock of produced economic assets, such as dwellings, non-residential buildings, infrastructure, machinery and equipment (measured in USD per capita at 2010 PPPs)	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	

E11	**Gross fixed capital formation**	Total expenditures devoted to buildings and machinery (i.e. investment in dwellings, buildings and other structures, transport equipment, other machinery and equipment, cultivated assets and intangible fixed assets) undertaken within a country (measured in USD per capita at 2010 PPPs)	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	
E12	**Financial net worth**	Total financial assets less total liabilities, expressed in per capita terms. As domestic assets and liabilities cancel each other, this measure captures the net foreign asset position of a country with respect to the rest of the world. This stock includes monetary gold, currency and other forms of bank deposits, debt securities, loans, equity and investment fund shares/units, insurance pension and standardised guarantees, and other accounts receivable/payable (measured in USD per capita at current PPPs)	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	The original indicator's name is "Financial net worth of the total economy"
E13	**Investment in R&D**	Expenditure undertaken by resident producers on creative work carried out on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (measured as a percentage of GDP)	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	
E14	**Household debt**	Total outstanding debt of households (measured as a percentage of their disposable income). Debt is calculated by summing liability categories such as loans, debt securities except financial derivatives, and other accounts payable	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	
E15	**Financial net worth of government**	Total value of financial assets minus the total value of outstanding liabilities, excluding pension liabilities, held by the general government sector (measured as a percentage of GDP)	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	
E16	**Banking sector leverage**	Ratio between selected financial assets of the banking sector (i.e. loans, currency and deposits, securities other than shares except financial derivatives, as recorded on the asset side of the financial balance sheet) and their own equity (i.e. shares and other equity, except mutual fund shares, as	(OECD, 2017, tab. 5.4, Online Data Annex: Resources for Future Well-Being)	

		reported on the liability side of the financial balance sheet).		
E17	Interest rate	Cost or price of borrowing, or the gain from lending (measured as an annual percentage amount)	(OECD, 2020b)	
E18	Labour supply	The total labour force, or currently active population, which comprises all persons who fulfil the requirements for inclusion among the employed or the unemployed during a specified brief reference period.	(OECD, 2020b)	
E19	Labour demand	Number of labour-hours that all employers are willing to hire based on the various exogenous (externally determined) variables they are faced with, such as the wage rate, the unit cost of capital, the market-determined selling price of its output, etc.	(Wikipedia, 2019)	
E20	Production output	Total output of production carried out by all establishments resident in the country. Production is an activity carried out under the control and responsibility of an institutional unit that uses inputs of labour, capital, and goods and services to produce outputs of goods or services. Output consists of those goods or services that are produced within an establishment that become available for use outside that establishment, plus any goods and services produced for own final use.	(OECD, 2020b)	
E21	Labour productivity	Output per unit of labour input	(OECD, 2020b)	
E22	Technology adoption rate	The pace at which a new technology is acquired and used by the public (measured by the number of members of a society who start using a new technology or innovation during a specific period of time)	(Kenton, 2018)	
E23	Capital productivity	The ratio between the volume of output, and the volume of capital input, defined as the flow of productive services that capital delivers in production, i.e., capital services	(OECD, 2019)	

E24	Government education expenditure	Purchases by a government agency of educational resources to be used by educational institutions (e.g., direct payments of teachers' salaries by a central or regional education ministry, direct payments by a municipality to building contractors for the construction of school buildings, and procurement of textbooks by a central or regional authority for subsequent distribution to local authorities or schools) and payments by a government agency to educational institutions that have the responsibility for purchasing educational resources themselves (e.g., a government appropriation or block grant to a university, which the university then uses to pay staff salaries and to buy other resources; government allocations of funds to fiscally autonomous public schools; government subsidies to private schools; and government payments under contract to private companies conducting educational research).	(OECD, 2020b)	
E25	Government consumption expenditure	Expenditure, including imputed expenditure, incurred by general government on both individual consumption goods and services and collective consumption services.	(OECD, 2020b)	
E26	Household consumption expenditure	Expenditure, including imputed expenditure, incurred by resident households on individual consumption goods and services, including those sold at prices that are not economically significant.	(OECD, 2020b)	
E27	Government environmental protection expenditure	Internal operational spending on environmental protection activities including, for example, wages and salaries of people involved with the operation of pollution control equipment and environmental management, leasing payments for environmental equipment, and materials such as air filters and scrubbers. External expenditure such as waste disposal by specialists contractors, waste water treatment, regulatory charges to environmental agencies and so on are also treated as current expenditure whether made by enterprises, government or households.	(OECD, 2020b)	

Code	Component name	Component definition	Source	Comments
E28	Government healthcare expenditure	General government (excluding social security) expenditure on health refers to expenditures incurred by central, state/regional and local government authorities, excluding social security schemes. Included are non-market, non-profit institutions that are controlled and mainly financed by government units	(OECD, 2020b)	

Table 3. Components of the human subsystem. The components in **bold** are either direct mappings of the corresponding OECD indicators or combine several of them.

Code	Component name	Component definition	Source	Comments
H1	Human capital	Productive wealth embodied in labour, skills and knowledge	(OECD, 2020b)	
H2	**Human Skills**	Mean proficiency of adults aged 16-65 in literacy and numeracy *multiplied by* mean score of students aged 15 in reading, mathematics and science	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Cognitive skills at 15" and "Adult skills" indicators
H3	Retirement age	Age from which the individual is eligible for pension benefits (measured in years)	(OECD, 2020b)	
H4	**Educational expectancy**	Average duration of education that a 5-year-old child can expect to experience during his/her lifetime until reaching the age of 39, if current enrolment rates persist for the next 34 years.	(OECD, 2017, tab. 5.3, Online Data Annex: Resources for Future Well-Being)	
H5	Healthy practices popularity	Share of people who report demonstrating healthy practices to maintain or improve personal health (i.e., smoking cessation, physical activity, healthy food behaviour and moderate alcohol consumption)	(WHO, 1999)	
H6	Access to health services	Share of the population eligible for a core set of health care services – whether through public programmes or primary private health insurance.	(OECD, 2017b)	
H7	**Smoking prevalence**	Share of people aged 15 and over who report smoking every day	(OECD, 2017, tab. 5.3, Online Data Annex: Resources for Future Well-Being)	
H8	**Obesity prevalence**	Share of the population aged 15 and older with a Body Mass Index of 30 or more	(OECD, 2017, tab. 5.3, Online Data Annex: Resources for Future Well-Being)	

Code	Component name	Component definition	Source	Comments
H9	Access to better nutrition	Share of adults who consume at least one fruit or vegetable per day, excluding juice and potatoes	(OECD, 2017b)	
H10	**Educational attainment**	Share of adults aged 25-64 having completed at least an upper secondary education	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
H11	Education enrolment	Persons enrolled and/or registered in a programme of education.	(OECD, 2020b)	
H12	Net migration	The difference between immigration into and emigration from the area during the year	(OECD, 2020b)	
H13	**Life expectancy**	The average number of years that people born today could expect to live, based on currently prevailing age-specific death rates *multiplied by* Share of adults reporting "good" or "very good" health. Life expectancy at birth for the population as a whole is computed as a weighted average of life expectancy for men and women.	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Life expectancy" and "Perceived health" indicators

Table 4. Components of the social subsystem. The components in **bold** are either direct mappings of the corresponding OECD indicators or combine several of them.

Code	Component name	Component definition	Source	Comments
S1	Willingness to help others	Willingness to donate to charities, voluntary work or help to a stranger	(OECD, 2014c)	The original indicator's name is "Helping others"
S2	**Life satisfaction**	Mean average score on an 11-point scale based on the survey question "Overall, how satisfied are you with life as a whole these days?"	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
S3	**Neighbourhood safety**	Share of people declaring that they feel safe when walking alone at night in the city or area where they live *divided by* deaths due to assault age-standardised rate per 100 000 population	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	Combines "Homicides" and "Feeling safe at night" indicators
S4	**Social support**	Share of people who report that they have friends or relatives whom they can count on in times of trouble	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
S5	Perception of meaningfulness of life	Share of people answering positively to the survey question "Do you feel your life has an important purpose or meaning?"	(Graham & Nikolova, 2015)	

S6	Homogeneity of norms and values	Degree to which members of a society share similar behaviour and values or beliefs	(Calabuig, Olcina, & Panebianco, 2017)	
S7	**Social affiliation**	Share of the working-age population who declared having volunteered through an organisation at least once a month over the preceding year	(OECD, 2017, tab. 5.5, Online Data Annex: Resources for Future Well-Being)	The original indicators' name is "Volunteering through organisations"
S9	**Interpersonal trust**	Mean average, on a scale from 0 (you do not trust any other person) to 10 (most people can be trusted) to the survey question "Would you say that most people can be trusted?"	(OECD, 2017, tab. 5.5, Online Data Annex: Resources for Future Well-Being)	
S10	**Stakeholder engagement in politics**	Share of people aged 16-65 who feel they have a say in what the government does	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	The original indicator's name is "Having a say in government"
S11	**Trust in institutions**	"How much do you personally trust each of the following national institutions…the police", which respondents answer using an 11-point scale, ranging from 0 ("No trust at all") to 10 ("Complete trust") *multiplied by* Share of the population responding positively to a question about confidence in the national government	(OECD, 2017, tab. 5.5, Online Data Annex: Resources for Future Well-Being)	Combines "Trust in the police" and "Trust in the national government" indicators
S12	**Voter turnout**	Share of votes cast among the population registered to vote	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
S13	**Individual resilience to distress**	Share of people replied negatively to the survey question "When things go wrong in my life it generally takes me a long time to get back to normal	(Huppert & So, 2013)	
S14	Social stability	Existence of legitimacy of constitutional order and stability as a multifaceted societal attribute	(Pirages, 1980)	

*Table 5. Components of the natural subsystem. The components in **bold** are either direct mappings of the corresponding OECD indicators or combine several of them*

N1	Environmental assets	Naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity. Although they are naturally occurring, many environmental assets are transformed to varying degrees by economic activities.	(UN, 2014, para. 2.17)	
N2	**Renewable freshwater resources**	Long-term annual average availability of the stock of renewable freshwater (measured in cubic metres per capita)	(OECD, 2017, tab. 5.2, Online Data Annex: Resources for Future Well-Being)	
N3	**Forest area**	Stock of forest and wooded land (measured in square kilometres per thousand people)	(OECD, 2017, tab. 5.2, Online Data Annex: Resources for Future Well-Being)	
N4	**Threatened species**	Share of mammals, birds, *fish* and vascular plants that are critically endangered, endangered or vulnerable – i.e. those plants and animals that are in danger of extinction or soon likely to be, based on the IUCN Red List categories and criteria	(OECD, 2017, tab. 5.2, Online Data Annex: Resources for Future Well-Being)	The original indicator is complemented by considering fish species
N5	**Air quality**	Population-wide average exposure to outdoor air pollution by fine particulate matter that is less than 2.5 microns in diameter (PM2.5) (measured as population-weighted mean PM2.5 concentrations, micrograms per cubic metre)	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
N6	**Water quality**	Share of people satisfied with water quality	(OECD, 2017, tab. 5.1, Online Data Annex: Current Well-Being)	
N7	**GHG emissions**	Man-made emissions of six different greenhouse gases – carbon dioxide (CO_2, including emissions from energy use and industrial processes, e.g. cement production; *including CO_2 emitted abroad and embodied in imports*); methane (CH_4, including methane emissions from solid waste, livestock, mining of hard coal and lignite, rice paddies, agriculture and leaks from natural gas pipelines); nitrous oxide	(OECD, 2017, tab. 5.2, Online Data Annex: Resources for Future Well-Being)	Combines "Greenhouse gas emissions from domestic production" and "CO_2 emissions from domestic consumption"

		(N2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF6) – weighted by their "warming potential" (measured by per capita of CO2 equivalent)		
N8	Net residuals	Flows of solid, liquid and gaseous materials, and energy, that are discarded, discharged or emitted to the environment (e.g., emission to air) by establishments and households through processes of production, consumption or accumulation but may also flow within the economy.	(UN, 2014, para. 2.92)	
N9	Residuals from the rest of the world	Residuals supplied (originating) from the rest of the world economic activities or from the rest of the world environment (cross border environmental inflows) less their use (destination) by (to) the rest of the world environment (cross border environmental outflows).	(OECD, 2020b)	
N10	Untouched nature	Habitats free from obvious signs of human activity.	(Nuwer, 2016)	
N11	**Freshwater abstraction**	Gross abstraction from groundwater or surface water bodies (measured in cubic metres per capita)	(OECD, 2017, tab. 5.2, Online Data Annex: Resources for Future Well-Being)	
N12	Temperature	Average annual temperature in the area		
N13	Biodiversity	Range of genetic differences, species differences and ecosystem differences in the area	(OECD, 2020b)	

Appendix 2. Links of the NWS systems maps

Table 6. Literature-based evidence for the links of the National Well-being system map. Some rather trivial effects are described with authors' own words, therein no reference is provided.

Link #		Source component		Target component	Polarity	Explanation	Reference (where applicable)
1	E1	Average household income	E2	Average household net wealth	+	"Earning a higher income makes saving easier, and saving is necessary to build wealth."	(Wolla & Sullivan, 2017)
2	E1	Average household income	E7	Housing availability	+	"Income determines the quality, location, and size of housing that is affordable. Higher income increases house affordability"	(Forgie, 2016, Appendix 4b)
3	E1	Average household income	E9	Work-life balance	+	"Higher incomes allow people to increase their work-life balance by working less hours. There are diminishing marginal gains from additional income due to relativity."	(Forgie, 2016, Appendix 4b)
4	E1	Average household income	E15	Financial net worth of general government	+	"All transactions that increase the net worth of the general government sector are classified as revenue. Governments receive three major types of revenue from their fiscal operations: taxes, social contributions, and other revenue."	(IMF, 2001)
5	E1	Average household income	E26	Household consumption expenditure	+	"Income is a principal determinant of consumption"	(Diacon & Maha, 2015)
6	E1	Average household income	S2	Life satisfaction	+	"Adequacy of income has an impact on life satisfaction. Wealthier people are happier than those on lower incomes, however life satisfaction does not increase proportionally as income increases."	(Forgie, 2016, Appendix 4b)
7	E1	Average household income	S3	Neighbourhood safety	+	"People with higher incomes can afford to live in safer areas and afford more security (e.g. burglar alarms)."	(Forgie, 2016, Appendix 4b)
8	E1	Average household income	S13	Voter turnout	+	"Voter turnout generally increases with individual income"	(Forgie, 2016, Appendix 4b)
9	E1	Average household income	H6	Access to health services	+	"Both individual income (material circumstances) and income inequality (relative income) make a difference to health. Therefore, there is a 'social gradient' in health, which means that	(Forgie, 2016, Appendix 4b)

						every step up the socio-economic ladder leads to an increase in health."	
10	E1	Average household income	H9	Access to better nutrition	+	"Lower income households purchase less healthful foods compared with higher income households"	(S. A. French, Tangney, Crane, Wang, & Appelhans, 2019)
11	E1	Average household income	H11	Education enrolment	+	"Family income levels impact on the achievement level of students. Higher socio-economic groups provide more financial support for schools, pay school fees etc. Students' socioeconomic background tends to have an impact on their education. People who are successful as a result of their education are role models for others. They are also more likely to encourage and financially support their children to achieve high levels of education."	(Forgie, 2016, Appendix 4b)
12	E1	Average household income	H12	Net migration	+	"Income opportunities in the destination country, significantly increase the size of emigration rates."	(Mayda, 2010)
13	E1	Average household income	H13	Life expectancy	+	"Life expectancy increases continuously with income."	(Chetty et al., 2016)
14	E2	Average household net wealth	E10	Produced fixed assets	+	"Net stock of produced fixed assets (net capital stock) reflects the wealth of the owner of the asset at a particular point of time"	(OECD, 2014a)
15	E2	Average household net wealth	E12	Financial net worth	+	"A country's net worth is calculated as the sum of the net worth of all companies and individuals resident in this country, plus the government's net worth."	(Wikipedia, 2020)
16	E2	Average household net wealth	E16	Banking sector leverage	-	Wealthier households have higher saving rates. Savings are often deposited in banks, thus, increasing financial assets of banks	
17	E2	Average household net wealth	E17	Investment in R&D	+	Wealthier households have more investment possibilities; intellectual property (contributing to household wealth) is an enabling factor for R&D investments	
18	E3	Employment rate	E1	Average household income	+	"Jobs and the type of jobs people do (or don't do) are the main determinant of income level and distribution of income. Jobs provide people with	(Forgie, 2016, Appendix 4b)

						incomes to enable them to meet their basic needs and to contribute to their material comfort."	
19	E3	Employment rate	S5	Perception of meaningfulness of life	+	"Employment gives life purpose and meaning."	(Forgie, 2016, Appendix 4b)
20	E4	Labour market insecurity	E5	Job strain	-	Potential high losses connected with unemployment may require employees to work beyond their capacity to retain their jobs	
21	E5	Job strain	E3	Employment rate	-	"There is consistent support for the proposition that employees with elevated job strain are more likely to voluntarily resign from their organizations than employees with low strain"	(Cartwright & Cooper, 2008)
22	E5	Job strain	S2	Life satisfaction	-	"Workers in high-strain jobs, who don't receive adequate support to cope with difficult work demands, are more likely to suffer from job burnout"	(Forgie, 2016, Appendix 4b)
23	E5	Job strain	H7	Obesity prevalence	+	Workers facing job strain (or its components—high job demands and low job control) smoke more (if they are smokers) or have greater difficulty quitting smoking	(Hellerstedt & Jeffery, 1997)
24	E5	Job strain	H8	Smoking prevalence	+	Workers with job strain are heavier and exercise less	(Hellerstedt & Jeffery, 1997)
25	E5	Job strain	H13	Life expectancy	-	"Workers in high-strain jobs, who don't receive adequate support to cope with difficult work demands, are more likely to suffer from job burnout, to develop musculoskeletal disorders, hypertension, and cardiovascular disease."	(Forgie, 2016, Appendix 4b)
26	E6	Long-term unemployment rate	E1	Average household income	-	"Cumulative loss of income increases as unemployment continues, but expected wages at reemployment also fall, leading to a permanent loss of future income"	(Nichols, Mitchell, & Lindner, 2013)
27	E6	Long-term unemployment rate	S2	Life satisfaction	-	"Evidence from the literature shows that unemployment has a strong negative effect on life satisfaction, after controlling for other factors associated with employment. The impact of unemployment on life satisfaction is one of the strongest findings from the literature."	(Forgie, 2016, Appendix 4b)

28	E6	Long-term unemployment rate	S3	Neighbourhood safety	-	"There is a general positive relation between joblessness and crime, that appears most strongly in comparisons of unemployment rates and crime rates across area"	(Freeman, 1994)
29	E6	Long-term unemployment rate	H13	Life expectancy	-	"Research shows that losing your job has the next highest impact on health after divorce and death."	(Forgie, 2016, Appendix 4b)
30	E7	Housing availability	E8	Basic sanitation	+	"Dense living conditions are often a sign of inadequate water and sewage supply"	(OECD, 2020i)
31	E7	Housing availability	S2	Life satisfaction	+	"Having adequate housing improves life satisfaction."	(Forgie, 2016, Appendix 4b)
32	E7	Housing availability	S3	Neighbourhood safety	+	"Overcrowding causes tension and conflict. Overcrowding is defined by the number of people who stay in a room and the amount of space they have there."	(Forgie, 2016, Appendix 4b)
33	E7	Housing availability	H13	Life expectancy	+	"Surveys of hospital admissions demonstrate a strong association between poor housing and poor health, especially for children. This situation is compounded by overcrowded housing which impacts on mental health and social wellbeing."	(Forgie, 2016, Appendix 4b)
34	E8	Basic sanitation	N6	Water quality	+	Use of basic sanitary amenities reduces flows of untreated sewage into water bodies	
35	E8	Basic sanitation	N11	Freshwater abstraction	+	Basic sanitation facilities require water	
36	E8	Basic sanitation	H13	Life expectancy	+	"A lack of basic sanitary amenities such as a flushing toilet is a clear sign of poor quality housing and considered a health risk"	(Forgie, 2016, Appendix 4b)
37	E9	Work-life balance	S2	Life satisfaction	+	"A balance between work and time to devote to family, community and other interests contributes significantly to Life Satisfaction. Some people opt to turn down promotions to maintain this balance."	(Forgie, 2016, Appendix 4b)
38	E9	Work-life balance	S4	Social support	+	"Higher levels of work enhancement were associated with high levels of positive affect, life satisfaction, positive spouse support, and positive friend support."	(Banovich, 2016)

39	E9	Work-life balance	S7	Social affiliation	+	"Participating in arts and cultural activities can create a sense of identity and connectedness for people and communities."	(Forgie, 2016, Appendix 4b)
40	E9	Work-life balance	S8	Intensity of social contacts	+	"If people work less hours they are able to connect with people"	(Forgie, 2016, Appendix 4b)
41	E9	Work-life balance	H5	Health practices popularity	+	Good work-life balance enables physical activity and healthier food behaviour	(Forgie, 2016, fig. 7.4)
42	E9	Work-life balance	H13	Life expectancy	+	"Working shorter hours may be good for your health. Longer working hours seem to lead to higher premature mortality. Stress, for example, can contribute to range of problems like heart disease and depression".	(Forgie, 2016, Appendix 4b)
43	E10	Produced fixed assets	E20	Production output	+	Physical capital is a major production factor	
44	E11	Gross fixed capital formation	E10	Produced fixed assets	+	"Gross fixed capital formation, often known more briefly as investment, is defined as net purchases of produced fixed assets"	(Lequiller & Blades, 2014)
45	E13	Investment in R&D	E21	Labour productivity	+	"Investment in information and communication technologies (ICT) in particular enables new technologies to enter the production process and is seen as an important driver of productivity growth."	
46	E13	Investment in R&D	E23	Capital productivity	+	"Investment in information and communication technologies (ICT) in particular enables new technologies to enter the production process and is seen as an important driver of productivity growth."	
47	E13	Investment in R&D	H2	Human skills	+	"Investment in R&D represents a flow that adds to the stock of a country's intellectual property assets."	(OECD, 2017c)
48	E14	Household debt	E2	Average household net wealth	-	"Household debt includes consumer debt and mortgage loans. Both types are listed under the liabilities (negative) component of household wealth"	(OECD, 2013)
49	E14	Household debt	E16	Banking sector leverage	+	High amount of unpaid loans and mortgages increases baking sector leverage	
50	E15	Financial net worth of	E12	Financial net worth	+	"A country's net worth is calculated as the sum of the net worth of all companies and individuals resident in	(Wikipedia, 2020)

		general government				this country, plus the government's net worth."	
51	E15	Financial net worth of general government	E25	Government consumption expenditure	+	Cutting sovereign debt enables more social spending; a natural disaster can lead to cuts in spending	
52	E16	Banking sector leverage	E17	Interest rate	-	"When leverage ratio of the banking sector is high, reflecting a developed financial technology, the bank leverage–led growth produces the slack in the market, thereby pressing down the interest rate".	(Park, 2015)
53	E17	Interest rate	E10	Produced fixed assets	-	"Lower interest rates encourage additional investment spending"	(Neugarten, 2019)
54	E17	Interest rate	E7	Housing availability	-	A higher interest rate leads to more expensive (i.e., less available) mortgages	
55	E18	Labour supply	E1	Average household income	-	A higher labour supply leads to decrease of wages[1]	
56	E18	Labour supply	E3	Employment rate	-	A higher labour supply and a stable labour demand[1] leads to decrease of employment rate	
57	E18	Labour supply	E4	Labour market insecurity	+	A higher labour supply leads to increased competition for workplaces[1]	
58	E18	Labour supply	E6	Long-term unemployment rate	+	A higher labour supply leads to increased competition for workplaces[1] and makes it more difficult for the unemployed to find a job	
59	E19	Labour demand	E1	Average household income	+	A higher labour demand leads to increase of wages[2]	
60	E19	Labour demand	E3	Employment rate	+	A higher labour demand creates additional workplaces[2]	
61	E19	Labour demand	E4	Labour market insecurity	-	A higher labour demand makes the current jobs more secure[2]	
62	E19	Labour demand	E6	Long-term unemployment rate	-	The Beveridge curve reflects the negative relationship between vacancies and unemployment	(Rodenburg, 2011)
63	E19	Labour demand	H12	Net migration	+	A higher labour demand attracts immigrants seeking for a job	

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[1] Assuming a low production output growth

[2] Assuming a stable labour supply

64	E20	Production output	E11	Gross fixed capital formation	+	A higher production output increases reinvestment in physical capital	
65	E20	Production output	E15	Financial net worth of general government	+	A higher production output leads to more total tax payments on production	
66	E20	Production output	E19	Labour demand	+	Labour is a major production factor, thus, increase of production output requires more labour	
67	E20	Production output	N7	GHG emissions	+	"The Industry sector produces the goods and raw materials we use every day. The greenhouse gases emitted during industrial production are split into two categories: direct emissions that are produced at the facility, and indirect emissions that occur off site, but are associated with the facility's use of electricity."	(United States Environmental Protection Agency, 2014)
68	E20	Production output	N8	Net residuals	+	"'Wastes' such as paper, cardboard, packaging wastes, glass, building debris, food wastes chemicals and pesticide residues are inevitable by-products of economic activity"	(Bisson & Proops, 2002)
69	E20	Production output	N11	Freshwater abstraction	+	Agriculture is a water-intensive sector and is responsible for over 90% of freshwater abstraction	
70	E21	Labour productivity	E3	Employment rate	-	If labour productivity increases, less labour is needed to produce the same amount of production	
71	E21	Labour productivity	E20	Production output	+	More output can be produced with the same amount of production factors	
72	E22	Technology adoption rate	E21	Labour productivity	+	"Investment in information and communication technologies (ICT) in particular enables new technologies to enter the production process and is seen as an important driver of productivity growth."	(OECD, 2015)
73	E22	Technology adoption rate	E23	Capital productivity	+	"Investment in information and communication technologies (ICT) in particular enables new technologies to enter the production process and is seen as an important driver of productivity growth."	(OECD, 2015)
74	E23	Capital productivity	E20	Production output	+	More output can be produced with the same amount of production factors	

75	E24	Government education expenditure	H11	Education enrolment	+	"Public spending on education at all levels has been increasing in OECD countries over recent years, reflecting both increased participation (especially at the post-compulsory stages) as well as increased spending per student in real terms"	(OECD, 2001)
76	E25	Government consumption expenditure	E20	Production output	+	Government final consumption expenditure is a part of the final demand in National Accounts	(Lequiller & Blades, 2014)
77	E25	Government consumption expenditure	E24	Government education expenditure	+	Education expenditure is a part of the overall government expenditure	
78	E25	Government consumption expenditure	E27	Government environmental protection expenditure	+	Nature conservation expenditure is a part of the overall government expenditure	
79	E25	Government consumption expenditure	E28	Government healthcare expenditure	+	Healthcare expenditure is a part of the overall government expenditure	
80	E26	Household consumption expenditure	E14	Household debt	+	"Debt is calculated as the sum of the following liability categories: loans (primarily mortgage loans and consumer credit) and other accounts payable"	(OECD, 2020c)
81	E26	Household consumption expenditure	E20	Production output	+	"Household spending is typically around 60% of gross domestic product (GDP) and is therefore an essential variable for economic analysis of demand."	(OECD, 2020d)
82	E26	Household consumption expenditure	N7	GHG emissions	+	"When both supply-chain effects and the volume of household expenditures are taken into account, however, household consumption of services excluding electric utilities and transportation services proves to be responsible for 37.6% of total industrial GHG emissions in the United States, almost twice the amount due to household consumption of electric utility and transportation services"	(Suh, 2006)
83	E26	Household consumption expenditure	N8	Net residuals	+	"As household consumption grows, environmental pressures grow. Our purchasing choices directly and indirectly involve the consumption of natural resources and the generation of waste, as goods and services are produced and delivered."	(Forgie, 2016, Appendix 4b)

84	E27	Government environmental protection expenditure	N3	Forest area	+	"Examples of policies that aim directly at forest management include tax credits or subsidies for forest conversion, forestation and wood production."	(FAO, 1995)
85	E27	Government environmental protection expenditure	N4	Threatened wild species	-	"Examples of government spending on biodiversity and landscapes include federal and provincial parks, wildlife and species monitoring and watershed conservation projects."	(Statistics Canada, 2018)
86	E27	Government environmental protection expenditure	N5	Air quality	+	"There exists a direct link between the effectiveness of government financial input to promote air quality and the air quality index, which means when the pollutant standards index is poor (i.e., the corresponding pollutant concentration is higher), the effectiveness will be more apparent."	(Xie & Wang, 2018)
87	E27	Government environmental protection expenditure	N6	Water quality	+	"Expenditures to clean up rivers, lakes, and other surface waters have exceeded the cost of investments to clean up air pollution and also have exceeded the costs of most other US environmental initiatives. Research has found that many of these expenditures have decreased water pollution"	(Keiser, Kling, & Shapiro, 2019)
88	E27	Government environmental protection expenditure	N10	Untouched nature	+	"Examples of government spending on biodiversity and landscapes include federal and provincial parks, wildlife and species monitoring and watershed conservation projects."	(Statistics Canada, 2018)
89	E27	Government environmental protection expenditure	N13	Biodiversity	+	"Examples of government spending on biodiversity and landscapes include federal and provincial parks, wildlife and species monitoring and watershed conservation projects."	(Statistics Canada, 2018)
90	E28	Government healthcare expenditure	H6	Access to health services	+	"Recent OECD analysis suggests that health care spending growth has contributed to the improvement in life expectancy"	(OECD, 2020h)
91	S1	Willingness to help others	S3	Neighbourhood safety	+	"Keeping your neighbourhood sate is important, too. Something as simple as reporting broken glass in a play area may prevent other children from getting hurt. Being a good example to younger children is also helpful."	(Raum, 2012)
92	S1	Willingness to help others	S4	Social support	+	"Helping others improves social support"	(Guam Behavioral

								Health and Wellness Center, n.d.)
93	S1	Willingness to help others	S5	Perception of meaningfulness of life	+	"Every participant reported that helping others was a central part of her sense of life calling. This altruistic focus varied from participant to participant, and included such things as assisting children through education and parenthood; helping those with medical needs through nursing, physiotherapy, and medicine; and supporting the community through policing. Many participants described themselves as caring and nurturing and wanting to express those aspects of their lives through helping others."	(J. R. French & Domen, 2010)
94	S1	Willingness to help others	S7	Social affiliation	+	Volunteering is a common form of helping others	
95	S2	Life satisfaction	S9	Interpersonal trust	+	"Life satisfaction, contentment, affection, and joy often have positive outcomes such as […] a citizenry that largely trusts their neighbours and leaders"	(Diener & Tov, 2012)
96	S2	Life satisfaction	S10	Stakeholder engagement in politics	+	"People satisfied with life are more inclined to be trusting of public service and participate in civil duties such as voting and submission making. Dissatisfaction in life breeds apathy, resulting in poor civic engagement from these individuals."	(Forgie, 2016, Appendix 4b)
97	S2	Life satisfaction	S11	Trust in institutions	+	"People satisfied with life are more inclined to be trusting of public service."	(Forgie, 2016, Appendix 4b)
98	S2	Life satisfaction	S12	Voter turnout	+	"People satisfied with life are more inclined to be trusting of public service and participate in civil duties such as voting and submission making."	(Forgie, 2016, Appendix 4b)
99	S2	Life satisfaction	S14	Social stability	+	"Life satisfaction, contentment, affection, and joy often have positive outcomes such as […] a citizenry that largely trusts their neighbours and leaders, and ultimately the social stability that is the underpinning of democratic governance."	(Diener & Tov, 2012)
100	S2	Life satisfaction	H5	Health practices popularity	+	"The prevalence of smoking, obesity, physical inactivity, and heavy drinking	(Forgie, 2016, Appendix 4b)

							also increased with decreasing level of life satisfaction."	
101	S2	Life satisfaction	H13	Life expectancy	+	"People who are satisfied with life are happier which has a positive impact on health. A review of more than 160 studies of human and animal subjects has found "clear and compelling evidence" that – all else being equal – happy people tend to live longer and experience better health than their unhappy peers… Your subjective well-being – that is, feeling positive about your life, not stressed out, not depressed – contributes to both longevity and better health among healthy populations."	(Forgie, 2016, Appendix 4b)
102	S3	Neighbourhood safety	S2	Life satisfaction	+	"Individuals in high-crime areas are relatively less satisfied with life than those who live in low- crime counties – even after controlling for other county amenities such as population density, home ownership, and pollution. Perceived neighbourhood safety is relatively more important than county-level crime rates."	(Cohen, 2008)
103	S3	Neighbourhood safety	S8	Intensity of social contacts	+	"Crime and the fear of crime may also reduce social cohesion within communities".	(Forgie, 2016, Appendix 4b)
104	S3	Neighbourhood safety	S9	Interpersonal trust	+	"Crime does not only victimize individuals; it can also weaken the fabric of social life by increasing fear, suspicion, and distrust"	(Corbacho, Philipp, & Ruiz-Vega, 2012)
105	S3	Neighbourhood safety	S14	Social stability	+	"Crime affects not only individuals but also society as a whole. There are the tax-payer expenses of hospital care and law enforcement, as well as the loss of the victim's input into their community. The victim's family and friends are likely to suffer grief and anger."	(Forgie, 2016, Appendix 4b)
106	S3	Neighbourhood safety	H13	Life expectancy	+	"Being able to safely exercise and commute (by walking or cycling) contributes to health. In this respect urban design is important. Safety is fundamental to health: violence and avoidable injuries, at their most extreme, threaten life itself and corrode quality of life in many ways."	(Forgie, 2016, Appendix 4b)

107	S4	Social support	E5	Job strain	-	"Social support was found to act as a robust mediator between job control and job strain. This finding underscored the importance of social support in enabling skill utilization and decision making at the job place to reduce job strain."	(Blanch, 2016)
108	S4	Social support	S2	Life satisfaction	+	"Community engagement (your social support network) contributes to your life satisfaction as you have help when needed and are not isolated."	(Forgie, 2016, Appendix 4b)
109	S4	Social support	S13	Individual resilience to distress	+	"Community (includes family and friends) are a source of personal support which helps people deal with stressful events when they occur."	(Forgie, 2016, Appendix 4b)
110	S4	Social support	H11	Education enrolment	+	"Community networks support education (by providing assistance/encouragement for study and fundraising for schools)"	(Forgie, 2016, Appendix 4b)
111	S4	Social support	H13	Life expectancy	+	"Good social relationships contribute to mental health. Community activities (involving exercise) improve physical health."	(Forgie, 2016, Appendix 4b)
112	S5	Perception of meaningfulness of life	S2	Life satisfaction	+	"Eudaimonic well-being captures people's perceptions of meaning and purpose in their lives and reflects the Aristotelian notion of happiness as life purpose, challenges, and growth"	(Graham & Nikolova, 2015)
113	S5	Perception of meaningfulness of life	S13	Individual resilience to distress	+	"To be resilient in adverse conditions, individuals need to affirm or regain faith and a sense of meaning in life, in addition to other cognitive, emotional, and behavioural strategies"	(Wright & Masten, 2007)
114	S5	Perception of meaningfulness of life	H13	Life expectancy	+	"Numerous studies demonstrated a protective role of meaning in life in mental health and health-related behaviours. A sense of meaning in life was associated with better mental health (e.g., fewer psychosomatic symptoms, better psychological well-being) and a lower level of risky health behaviours (e.g., binge drinking, drug use)"	(Du, Li, Chi, Zhao, & Zhao, 2017)
115	S6	Homogeneity of norms and values	S1	Willingness to help others	+	"Relatively homogeneous societies invest more in public goods, indicating a higher level of public altruism"	(Frank, 2007)

116	S6	Homogeneity of norms and values	S4	Social support	+	"In a dense, homogeneous network it is more likely that network members will discuss a problem and agree on an appropriate means of providing emotional support."	(Walker, MacBride, & Vachon, 1977)
117	S6	Homogeneity of norms and values	S9	Interpersonal trust	+	"When norms of reciprocity are shared and reciprocated by many, the behaviour of strangers becomes more predictable and allows a sense of trust to be built"	(Geva, Greenspan, & Almog-Bar, 2020)
118	S6	Homogeneity of norms and values	S14	Social stability	+	"A highly homogeneous society is expected to be fairly stable, whereas a more heterogeneous society is expected to be less stable"	(Carley & Lawler, 1996)
119	S7	Social affiliation	S2	Life satisfaction	+	"When viewed in the perspective of sustainable well-being, the critical cognitive resources are those that reflect a positive disposition towards others, a sense of belonging to a community, and a positive outlook of the future"	(Geva et al., 2020)
120	S7	Social affiliation	S5	Perception of meaningfulness of life	+	"Correlations between meaningfulness and satisfaction with volunteering, time committed, and duration are small, but positive. Satisfaction with volunteer engagement is accompanied by meaningfulness."	(Schnell & Hoof, 2012)
121	S7	Social affiliation	S8	Intensity of social contacts	+	"Volunteering is helping volunteers establish new relations and networks through volunteering communities"	(Karayel, 2019)
122	S8	Intensity of social contacts	S1	Willingness to help others	+	"A very strong predictor of altruism is social connectedness. That is, the people who give blood, give money, and have volunteered their time are people who are more connected. By far the best predictor of philanthropy, for example, is not how much money you have, but how many clubs you go to or how often you go to church. There is a very strong affinity between social connectedness and altruism."	(Putnam, 2001)
123	S8	Intensity of social contacts	S2	Life satisfaction	+	"Loneliness appears to be a major correlate of life satisfaction for both men and women: those respondents who report feeling lonely have consistently lower life satisfaction mean scores than those who do not. As expected then, all dimensions of	(Demakakos, Nunn, & Nazroo, 2006)

						loneliness influence people's life satisfaction."	
124	S8	Intensity of social contacts	S6	Homogeneity of norms and values	+	"In so-called "close-knit groups" the formation and enforcement of cooperation norms is more likely than in groups with only weak social relations"	(Ellickson, 1991)
125	S9	Interpersonal trust	S1	Willingness to help others	+	Trusting people is a prerequisite to help them	
126	S9	Interpersonal trust	S4	Social support	+	"Individuals who maintain positive expectations about how others will treat them (i.e., have a high degree of interpersonal trust) enjoy higher-quality social support than do people who are unsure of how their friends or family will respond to their crises."	(Mortenson, 2009)
127	S9	Interpersonal trust	S7	Social affiliation	+	"Among "have-not" high-school seniors, trust in other people plummeted, while seniors from the "right side of the tracks" showed no decline at all in social trust. On indicator after indicator—general and academic self-esteem, academic ambition, social friendships, and volunteering the kids who could be described as the "haves" grew in confidence and engagement while their not-so-well-off contemporaries slipped farther into disengagement with every year. Among other things, this means that the overall rise in youth political engagement and volunteering since 9/11 masks a pair of subtrends that are headed in different directions, with lower-class youth growing less involved while better-off youngsters become more involved"	(Sander & Putnam, 2009)
128	S9	Interpersonal trust	S8	Intensity of social contacts	+	"The connection between trust and loneliness can be observed both on an individual and a state level. Countries whose inhabitants exhibit higher degrees of interpersonal trust are consistently those with a relatively low prevalence of loneliness. Similarly, countries with low trust levels are consistently those with high loneliness levels."	(Svendsen, 2017)

129	S9	Interpersonal trust	S13	Individual resilience to distress	+	"Relationships that create love and trust, provide role models and offer encouragement and reassurance, help bolster a person's resilience."	(APA, 2020)
130	S9	Interpersonal trust	S14	Social stability	+	"Without trust, there is no open society, because there are not enough police to patrol every opening… it is trust that allows us to take down walls, remove barriers, and eliminate friction at borders"	(Friedman, 2007, pp. 557–558)
131	S10	Stakeholder engagement in politics	S5	Perception of meaningfulness of life	+	"When people are pondering over big questions about meaning and purpose, they may attempt to discover what gives them meaning by engaging in pro-environmental activities or taking up political causes. Civic engagement may provide people with an answer, though inconclusive, about where they belong, how much self-worth they possess, the extent to which they can control and predict their lives, and whether their lives can become immortal. All of these gains consolidate the building blocks of meaning in life"	(Lin, 2019)
132	S10	Stakeholder engagement in politics	S9	Interpersonal trust	+	"Open and inclusive policy making can strengthen trust, social cohesion and capital through its inclusive approach".	(OECD, 2016)
133	S10	Stakeholder engagement in politics	S11	Trust in institutions	+	"By consulting all affected parties, stakeholder engagement enhances the inclusiveness of policies and supports the development of a sense of ownership of regulations. This in turn strengthens trust in government, social cohesion and compliance with regulations."	(OECD, 2017a)
134	S10	Stakeholder engagement in politics	S12	Voter turnout	+	"High voter turnout is a measure of citizens' participation in the political process."	(OECD, 2020e)
135	S10	Stakeholder engagement in politics	S14	Social stability	+	"Democratization is positively associated with political stability"	(McMahon, 2002)
136	S11	Trust in institutions	S3	Neighbourhood safety	+	"If the police demonstrate to citizens of diverse communities that they are effective, fair, and aligned with local interests, then this not only makes the police more directly accountable. It also strengthens the moral connection between people and their police, thus	(Jackson & Bradford, 2010)

						encouraging greater civic participation and more active public engagement in domains of security, policing, and the regulation of social and community life."	
137	S11	Trust in institutions	S12	Voter turnout	+	"Aggregate-level analysis shows that there is a clear and linear relationship between trust in parliament and turnout. In the individual-level analysis, trust in parliament increases the likelihood of voting"	(Grönlund & Setälä, 2007)
138	S11	Trust in institutions	S14	Social stability	+	"Trust in institutions is essential for social stability, efficient policy implementation, public sector performance and democracy"	(OECD, 2014b)
139	S12	Voter turnout	S5	Perception of meaningfulness of life	+	"Civic engagement may provide people with an answer, though inconclusive, about where they belong, how much self-worth they possess, the extent to which they can control and predict their lives, and whether their lives can become immortal."	(Lin, 2019)
140	S13	Individual resilience to distress	E5	Job strain	-	"High strain work environments (high demand, low influence, and low support) have an unfavourable effect on all outcomes. Resilience has a protective effect on all outcomes. For stress, burnout, and sleep, higher resilience has a more protective effect under low-strain conditions. For depression, absence and productivity, resilience has a more protective effect when job strain is high."	(Shatté, Perlman, Smith, & Lynch, 2017)
141	S13	Individual resilience to distress	H13	Life expectancy	+	"Building resilience is a key factor in protecting and promoting health and well-being at both the individual and community levels"	(WHO, 2013)
142	S14	Social stability	S12	Voter turnout	+	"The empirical results of the 24 studies that include population stability measures show that with only few exceptions, the theoretically expected positive relation between stability and turnout is statistically significant"	(Geys, 2006)
143	N1	Environmental assets	E20	Production output	+	"Around one-third of all industrial sectors have significant environmental links in terms of biodiversity and eco-system services. This contribution of	(Forgie, 2016, Appendix 4b)

						biodiversity and eco-system services to the economy comes through: • provisionary services, such as food, fibre, fuel and water; • regulating services, i.e. benefits obtained from ecosystem processes that regulate the • environment, such as the regulation of climate, floods, disease, wastes, and water quality; • cultural services such as recreation, aesthetic enjoyment and tourism; • supporting services, i.e. services that are necessary for the production of all other ecosystem services, such as soil formation, photosynthesis, and nutrient cycling."	
144	N2	Renewable freshwater resources	N1	Environmental assets	+	"Natural resources are a subset of environmental assets. Natural resources include […] water resources."	(UN, 2014, para. 5.18)
145	N2	Renewable freshwater resources	N4	Threatened wild species	-	"Reduced flows can lead to changes to and the loss of habitat for aquatic animals, plants and insects. For example, more fish deaths during periods of droughts."	(West Cumbria Rivers Trust, 2020)
146	N2	Renewable freshwater resources	H13	Life expectancy	+	"Freshwater is essential to maintain human health. Threats to freshwater resources mean threats to human health"	(WHO, 2020)
147	N3	Forest area	N1	Environmental assets	+	"Given both the distinction between forests and timber resources, and the resource focus for environmental assets in the Central Framework, the classification of environmental assets includes forests as a subcategory of land and distinguishes the timber resources located on this land as a separate environmental asset."	(UN, 2014, para. 5.30)
148	N3	Forest area	N5	Air quality	+	"Forests and green spaces help improve air quality in urban and rural areas. They extract a wide range of air pollutants from the air such as	(European Environment Agency, 2019)

						particles and carbon oxides, emitted, for example, by traffic and industry."	
149	N4	Threatened wild species	N13	Biodiversity	-	Threatened species (% of known species) is the OECD indicator of biodiversity. The dataset on biodiversity shows numbers of known species and threatened species with the aim of indicating the state of mammals, birds, freshwater fish, reptiles, amphibians and vascular plants.	(OECD, 2020a)
150	N4	Threatened wild species	H13	Life expectancy	-	"We are foreclosing the possibility of discovering the secrets they contain for the development of new life-saving medicines and of invaluable models for medical research, and we are beginning to disrupt the vital functioning of ecosystems on which all life depends. We may also be losing some species so uniquely sensitive to environmental degradation that they may serve as our "canaries," warning us of future threats to human health."	(Chivian, 2001)
151	N5	Air quality	H13	Life expectancy	+	"Globally the health impacts of urban air pollution continue to worsen, with air pollution set to become the top environmental cause of premature mortality by 2050."	(OECD, 2020g)
152	N6	Water quality	N1	Environmental assets	+	"The quantity and quality of the surface water and groundwater available affect the functions provided by water resources."	(Turner, Georgiou, Clark, Brouwer, & Burke, 2004)
153	N6	Water quality	N4	Threatened wild species	-	"The outcome of pollution on freshwaters, whether as a result of industrial, domestic or agricultural activities, is often catastrophic and can result in the elimination of fish species, and dead rivers and lakes."	(Reid, Contreras MacBeath, & Csatádi, 2013)
154	N6	Water quality	H13	Life expectancy	+	"Safe water is crucial for human health and well-being."	(WHO, 2019)
155	N8	Net residuals	N1	Environmental assets	-	Pollution leads to deterioration of various environmental assets	
156	N8	Net residuals	N4	Threatened wild species	+	"9 percent of the 494 critically endangered species in the US are predicted to continue to decline in the future, with 48 species expected to suffer as a result of wastewater,	(The Ecologist, 2019)

						industrial and agricultural effluents, rubbish, pollutants and excess energy pollution"	
157	N8	Net residuals	N5	Air quality	-	"Incineration activities release pollutants to ambient air"	(Sastre, 2015)
158	N8	Net residuals	N6	Water quality	-	"The leachate produced by waste disposal sites contains a large amount of substances which are likely to contaminate ground water."	(Vasanthi, Kaliappan, & Srinivasaragh avan, 2008)
159	N8	Net residuals	N10	Untouched nature	-	"Pollution destroys habitat for plants and animals, endangers the health of park visitors and staff, damages the symbols of our nation's heritage"	(National Parks Conservation Association, 2006)
160	N9	Residuals from the rest of the world	N8	Net residuals	+	Residuals received from rest of the world increase Residuals stock	(UN, 2014, Table 3.1)
161	N10	Untouched nature	S2	Life satisfaction	+	An unspoiled environment is a source of satisfaction, improves mental well-being, allows people to recover from the stress of everyday life and to perform physical activity.	(Forgie, 2016, Appendix 4b)
162	N10	Untouched nature	N1	Environmental assets	+	Nature in an untouched state can provide a maximal stock of environmental assets	
163	N11	Freshwater abstraction	N2	Renewable freshwater resources	-	"Abstraction changes the natural flow pattern and the amount of water in the environment."	(West Cumbria Rivers Trust, 2020)
164	N11	Freshwater abstraction	N6	Water quality	-	"Abstraction reduces the amount of habitat, prevents natural movement of species and concentrates pollution in the water environment."	(West Cumbria Rivers Trust, 2020)
165	N12	Temperature	N2	Renewable freshwater resources	-	"Water availability may decline in many regions due to climate change and competing demands for water"	(Rio et al., 2018)
166	N12	Temperature	N5	Air quality	-	"Climate change is poised to worsen air quality in many parts of the globe"	(Horton et al., 2014)
167	N12	Temperature	N6	Water quality	-	Changing weather and climate patterns "may increase in return the occurrence of extreme weather conditions and modify the normal balance of water bodies and ecosystems, leading to the degradation of water quality."	(UNESCO, 2015)
168	N12	Temperature	N11	Freshwater abstraction	+	"A reduction of summer precipitation and an increase in the probability of extreme events such as heatwaves and	(Rio et al., 2018)

						droughts are likely to increase irrigation water demand."	
169	N13	Biodiversity	N1	Environmental assets	+	"There is a range of natural biological resources that provide inputs to the economy and also form an important part of local biodiversity. These resources may include wild berries, fungi, bacteria, fruits and other plant resources that are harvested for sale or own consumption. Alternatively, they may include wild animals such as deer, boar or moose that are killed for sale or own consumption."	(UN, 2014, para. 5.461)
170	H1	Human capital	E21	Labour productivity	+	"Expansion of scientific and technical knowledge raises the productivity of labour and other inputs in production."	(Becker, 1994)
171	H1	Human capital	E23	Capital productivity	+	"Expansion of scientific and technical knowledge raises the productivity of labour and other inputs in production."	(Becker, 1994)
172	H2	Human skills	H1	Human capital	+	"Human capital is defined by individually possessed knowledge and skills"	(OECD, 2001)
173	H3	Retirement age	E21	Labour productivity	-	"Workforce aging is likely to be a significant drag on European productivity growth over the next few decades."	(Aiyar, Ebeke, & Shao, 2016)
174	H3	Retirement age	E28	Government healthcare expenditure	-	Part of the healthcare costs for working elderly is covered by themselves or their employers (e.g., private subsidised health insurance)	
175	H3	Retirement age	S5	Sense of meaningfulness of life	+	"People who approached their careers as a calling reported greater meaning in life, life satisfaction, and career decision-making efficacy, and fewer depressive symptoms than those who did not approach their work as a calling"	(Steger & Dik, 2009)
176	H4	Educational expectancy	H2	Human skills	+	"The statistical analysis indicates that a significant and strong relationship exists between the mean years of schooling and adult literacy skills"	(Demirbolat, 2019)
177	H5	Health practices popularity	N4	Threatened wild species	+	"Health and well-being are among other factors increasingly influencing consumption decisions. Fish has a particular prominence in this respect, following mounting evidence confirming the health benefits of eating fish"	(FAO, 2010)

						Approximately 85% of the world's fisheries are fished at (53%) or beyond (32%) their maximum sustainable limits	
178	H5	Health practices popularity	H7	Smoking prevalence	-	Healthy lifestyle assumes smoking cessation	(WHO, 1999)
179	H5	Health practices popularity	H8	Obesity prevalence	-	Healthy lifestyle assumes healthy eating which is a major obesity prevention practice.	(WHO, 1999)
180	H5	Health practices popularity	H13	Life expectancy	+	"People who refrain from engaging in risky health behaviours not only have a very long life but that most of these additional years of life are spent in good health."	(Mehta & Myrskylä, 2017)
181	H6	Access to health services	H13	Life expectancy	+	"Health care coverage, through government schemes and private health insurance, provides financial security against unexpected or serious illness."	(OECD, 2017b)
182	H7	Smoking prevalence	H13	Life expectancy	-	"Both men and women who had never smoked had a substantially longer overall and disability-free life expectancy"	(Mehta & Myrskylä, 2017)
183	H8	Obesity prevalence	H13	Life expectancy	-	"For both men and women, obesity had a small effect on overall life expectancy and a more substantial effect on disability-free life expectancy"	(Mehta & Myrskylä, 2017)
184	H9	Access to better nutrition	H8	Obesity prevalence	-	The causes of obesity "range from the absence of optimal nutrition, unhealthy infant and child feeding practices, the increasing availability and promotion of unhealthy foods" "People are much more likely to make healthier food choices when nutritious food is readily available, recognizable and affordable"	(FAO, 2019)
185	H10	Educational attainment	E1	Average household income	+	"Good education greatly improves the likelihood of earning enough money to satisfy needs."	(Forgie, 2016, Appendix 4b)
186	H10	Educational attainment	E22	Technology adoption rate	+	"Education has a causal impact on measures of technology use associated with higher order tasks undertaken by "knowledge workers""	(Riddell & Song, 2017)
187	H10	Educational attainment	S3	Neighbourhood safety	+	"Studies show that educated individuals […] commit fewer crimes."	(OECD, 2020f)

188	H10	Educational attainment	S4	Social support	+	"There is a clear relationship between the availability of social support on the one hand, and people's education level, on the other."	(Forgie, 2016, Appendix 4b)
189	H10	Educational attainment	S5	Perception of meaningfulnes s of life	+	"Whatever we make central to education, we presuppose to be central to the life for which the education is a preparation…meaning of education is primarily that of initiating [children] into the meaning or meanings of life"	(Allen, 1991)
190[3]	H10	Educational attainment	S6	Homogeneity of norms and values	-	"Formal education, particularly higher education, tends to expose individuals to an eclectic mixture of ideas and cultural norms."	(Hall, 2018)
191	H10	Educational attainment	S9	Interpersonal trust	+	"Educational attainment is a major driver of trust at the individual level, and it is an essential control variable to include when trust data are collected."	(OECD, 2017d)
192	H10	Educational attainment	S10	Stakeholder engagement in politics	+	"Studies show that educated individuals […] participate more actively in politics and in the community where they live."	(OECD, 2020f)
193	H10	Educational attainment	S12	Voter turnout	+	"Research has shown that people who are more highly educated, are much more likely to vote than those who are less educated"	(OECD, 2020e)
194	H10	Educational attainment	N10	Untouched nature	+	"We find a substantial causal effect of educational attainment on pro-environmental behaviour"	(Meyer, 2015)
195	H10	Educational attainment	H2	Human skills	+	"The skills needed in the labour market are becoming more knowledge-based. This shift in demand has made an upper secondary degree, or high-school degree, the minimum credential for finding a job in almost all OECD countries."	(OECD, 2020f)
196	H10	Educational attainment	H5	Health practices popularity	+	"Education increases health as people can learn about how to get/stay healthy, care for children etc."	(Forgie, 2016, Appendix 4b)
197	H10	Educational attainment	H13	Life expectancy	+	"Studies show that educated individuals live longer"	(OECD, 2020f)
198	H11	Educational enrolment	H2	Human skills	+	"Enrolment rates of secondary and tertiary education need to be improved	(OECD, 2018)

[3] This causal connection is highly uncertain, herein we assume it according to the definition by (Hall, 2018).

						to promote the further upskilling of the workforce"	
199	H11	Educational enrolment	H10	Educational attainment	+	Educational attainment rate of population is a direct consequence of educational enrolment rate	
200	H12	Net migration	S6	Homogeneity of norms and values	-	"Different groups subscribe to different norms. This holds not only for immigrants but also for urban and rural populations or for younger and older people. The heterogeneity is still greater between countries."	(Opp, 2015)
201	H12	Net migration	H6	Access to health services	-	"Migration, by creating more pressure on consolidated services or requiring new ones, affects the demand and supply of health goods."	(Caterina Francesca & Petretto, 2019)
202	H12	Net migration	E7	Housing availability	-	"Population increases, resulting from international migration, internal migration […], should have a negative impact on housing availability, assuming a relatively constant housing composition nationwide"	(Tyrcha, 2020)
203	H12	Net migration	E18	Labour supply	+	"Immigration affects the labour supply, as it increases the pool of workers in certain sectors of the economy."	(Ruhs & Vargas-Silva, 2020)
204	H13	Life expectancy	E3	Employment rate	+	"Ability to work is impacted by the health of the population. People with poor health have more sick days from work or are unable to hold down a job."	(Forgie, 2016, Appendix 4b)
205	H13	Life expectancy	E20	Labour productivity	+	"Health and physical factors include existing (long-term) health conditions as well as physical factors such as blood pressure or cholesterol levels is one of determinants of workplace productivity"	(Hafner, Van Stolk, Saunders, Krapels, & Baruch, 2015)
206	H13	Life expectancy	H1	Human capital	+	Health is one of the components of human capital	(Becker, 1994)
207	H13	Life expectancy	H3	Retirement age	+	"With an increase in life expectancy the date of retirement should in theory show an upward movement and not a downward trend."	(Dalen & Verbon, 1999)
208	H13	Life expectancy	H11	Educational enrolment	+	"Good health facilitates the ability to learn and achieve high levels of education. Absence from school due to sickness (especially primary level) for many children is a barrier to learning as once children drop behind they struggle to catch up."	(Forgie, 2016, Appendix 4b)