

Workshop Background Paper:

BMU/EEAC Expert Workshop

Safe Operating Space – Current State of Debate and Considerations for National Policies

January 23rd (12.30 pm) - January 24th (4.30 pm)

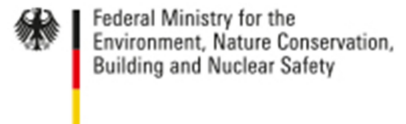
“Espai Catalunya Europa”. Rue de la Loi/Wetstraat 227, Brussels.

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This workshop is organised by the Network of European Environment and Sustainable Development Advisory Councils (EEAC) and the Advisory Council for the Sustainable Development of Catalonia (CADS), with the financial support from the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU).

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1. Workshop background and objectives

Environmental policy has shifted attention from dealing with visible, acute or local issues to global and long-term impacts of human interference into life-supporting earth systems. There is increasing evidence, that the “safe operating space for mankind” is about to be bypassed. Earth systems are moving from the Holocene, determined by natural cycles into the Anthropocene, determined by human activities. Environmental policy also increasingly deals with the cultural, social, economic and technological drivers of environmental degradation, the societal options and challenges to expand, grow and develop without undermining and destroying the natural fundamentals of wealth.

At the same time environmental policy has to operate in a multilevel, multisystem context, obliged to evidence based operations, guided by clearly set goals and indicators, linking itself to sustainability principles of integrated, interdisciplinary, intersectoral, international and intergenerational responsible thinking. And even more, environmental policy has to explain well and communicate appropriate to experts, public, media and highly differentiated target groups.

These and additional challenges for present and future environmental policy making imply that its traditional underlying and guiding concepts have to be critically reflected and new ones to be seriously discussed.

The concept of a safe operating space (SOS) seeks on the basis of precaution to establish thresholds at different scales, beyond which human activities risk irreversible damage, changes of natural systems (regime shifts) either as a long-term gradual process or even suddenly if tipping points are exceeded. This concept could and should possibly play a relevant role in environmental policy programmes in future political frameworks in general, nationally as well as on EU level.

Proposed by Rockström *et al* (2009a, 2009b) in a first discussion paper, the concepts of safe operating space and planetary boundaries have gained popularity within the scientific community and social stakeholders and kicked-off a rich scientific and political debate. Certainly there are still large knowledge gaps, and political acceptance is only gradually getting stronger. At the international level, planetary boundaries have been argued to be relevant for the integration of the environmental dimension into the upcoming framework of the UN sustainable development goals (SDGs). At EU level, they are included in the recently approved 7th EU Environment Action Programme "Living well, within the limits of our planet"¹, with the mandate to further explore the concepts as part of the knowledge agenda for implementing the action programme.

The question therefore emerges, whether the concept could and should possibly play a more substantial role in environmental policy programmes in future political frameworks, in general but more specifically on national and European level. In this context, the Network of Environment and Sustainable Advisory Councils (EEAC), and the German Federal Ministry

¹ http://ec.europa.eu/environment/newprg/pdf/PE00064_en.pdf

for the Environment, Nature Conservation, Building and Nuclear Safety, want to foster an informed debate on the political applicability of the concept a lower scales.

Workshop participants will discuss the rationale behind the concept of safe operating space and planetary boundaries, key related topics and the implications of assuming the overall goal of securing a safe operating space within planetary boundaries both for governance and for the science needed for policymaking. Besides the perspectives of the concept in the international sphere, the main focus of the workshop will be how this framework could be implemented within EU and national policies.

Therefore, the objectives of the workshop are:

- To analyse the relevance of the SOS framework for policy making at a global, European, national and subnational level.
- To identify the main challenges that SOS framework implies for governance.
- To identify what science is needed for implementing the SOS framework in policymaking.
- To improve understanding of all participants on the SOS framework.
- To construct a shared view on the applicability of the SOS framework in policy making

In order to fulfil these objectives the workshop will gather up to 34 European and international experts coming from different backgrounds that could contribute to the debate. Participants include leading scientists working on these areas, representatives of international and European institutions (such as UNEP, OECD, European Commission, EEA), representatives from national governments, members of the EEAC councils and NGOs.

2. Safe operating space and planetary boundaries: origin and related concepts

In 2009, a group of 28 renowned scientists lead by Prof. Johan Rockström, from the Stockholm Resilience Centre (SRC), published a paper called “A safe operating space for humanity” (Rockström et al, 2009b), where nine planetary boundaries were identified – i.e. those boundaries within which humanity can operate safely and continue to develop and thrive for generations to come².

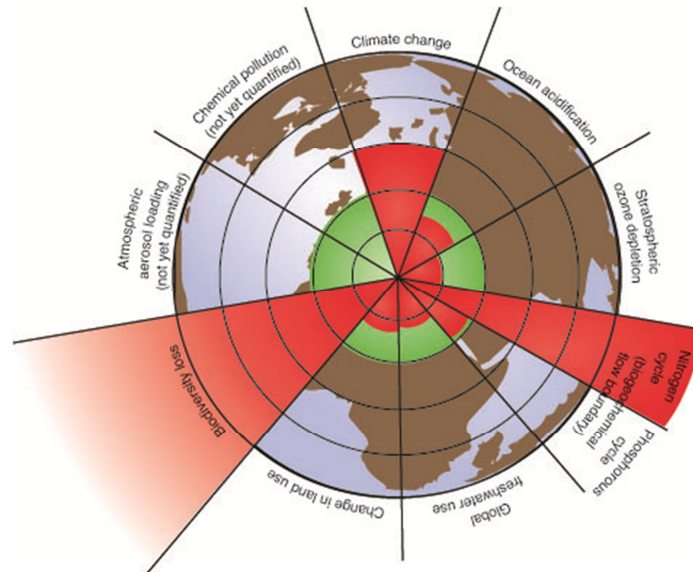
The nine planetary boundaries suggested were related to the following issues (see Figure 1 and table 1):

- Climate change
- Ocean acidification

² More information on planetary boundaries is available at the SRC website:
<http://www.stockholmresilience.org/21/research/research-programmes/planetary-boundaries.html>

- Biodiversity loss
- Nitrogen and phosphorus flows
- Ozone depletion
- Global freshwater use
- Land system change
- Atmospheric aerosol loading
- Chemical pollution.

Figure 1: The nine planetary boundaries



Source: Azote Images/Stockholm Resilience Centre

The authors provided quantified estimations for seven of them (all except for two, where more research was considered necessary) (table 1). According to Rockström *et al* (2009b), transgressing one or more of these planetary boundaries may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger abrupt environmental change. The boundaries are strongly interconnected, and thus transgressing one may both shift the position of other boundaries and cause them to be transgressed. The authors suggest that humanity has already transgressed three planetary boundaries: for climate change, rate of biodiversity loss, and changes to the global nitrogen cycle.

Table 1. The nine planetary boundaries proposed by Rockström et al. (2009b)

Earth system process	Control variables	Proposed boundary	Most recent measurement
Climate change	– Atmospheric carbon dioxide concentration (parts per million by volume)	350 ppm	393.81 ppm
	– Change in radiative forcing (watts per metre squared)	+1 W/m ²	+1.87 W/m ²
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90
Stratospheric ozone depletion	Concentration of ozone (Dobson units)	276 DU	283 DU
Biogeochemical flows: nitrogen cycle and phosphorus cycle	– Amount of N ₂ removed from the atmosphere for human use (millions of tonnes per year)	35 Mt	121 Mt
	– Quantity of P flowing into the oceans (millions of tonnes per year)	11 Mt	8.5–9.5 Mt
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis	To be determined	To be determined
Freshwater use	Consumption of freshwater by humans	4,000 km ³	2,600 km ³
Land use change	Percentage of global land cover converted	15%	11.7%
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10 E/MSY	>100 E/MSY
Chemical pollution	For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in the global environment, or the effect on ecosystem and functioning thereof	To be determined	To be determined

Source: Nykvist et al (2013) based on Rockström et al. (2009b) with updated most recent measurements.

The 2009 papers received the interest from the scientific community –including controversies on the definition of some of the boundaries– but also from other stakeholders, as it provides a framework for conceptualizing the Earth system conditions within which a sustainable development can occur. It needs to be acknowledged, however, that the authors themselves stress the tentativeness of the boundaries as the identification of thresholds and the effects of passing them are based on limited knowledge on the underlying subsystems. The whole

framework is therefore connected with scientific uncertainties and more research is needed to substantiate the concept.

Most attention has been given to the planetary boundaries concept in the global arena. Actually, it was put forward by different stakeholders in the Rio+20 Conference and it is a discussion topic in the post-Rio agenda (see section 4). The concept has also been taken up by stakeholders and scientists, as the foundation of the Planetary Boundaries Initiative³ shows.

Social scientists have also taken up the concept and added social dimensions to the planetary boundaries – i.e. there are not only ecological ceilings but also minimum levels for a socially just development for humanity (Raworth, 2012). A further challenge is how this relates to the green economy debate, e.g. is the potential for decoupling welfare from environmental pressures sufficient to stay within the safe-operating space or must the overall level of consumption or even the level of economic activity be addressed?

There are few references, however, as regards the feasibility of downscaling the planetary boundaries concept to regional, national or subnational level, and on the potential use of the concept for informing policy making at those levels, except for climate policy (see section 4.2).

The European Sustainable Development Network (ESDN), an informal network of public administrators and other experts who deal with sustainable development strategies and policies, published in October 2013 a report on *Planetary Boundaries for SD. From an international perspective to national applications* (Pisano and Berger, 2013). The report provides background information on the planetary boundaries and related frameworks and its relation to sustainable development. Moreover, it shows that the planetary boundaries framework has reached the discourses in the international, EU and European national ministries, although attempts for applying the framework into national and international policies are few.

Safe operating space vs. planetary boundaries

Although “planetary boundaries” is how the concept is better known in the scientific and stakeholder arena, the workshop topic refers to “safe operating space” which might be a more flexible object for policy making, as it can be applied to different scales of human activity and includes a notion of precaution in its wording.

We define the **safe operating space** as the space where humanity can *safely stay* without affecting the capacity of planet Earth to provide the life-support systems of the planet. It is, i.e., the space within planetary boundaries.

By *safely stay* we mean that the adaptive capacities of human societies might not be overburdened. Significant change is taking place even within the boundaries and it is certain that societies will not go unaffected even when staying within the safe operating space.

³ <http://planetaryboundariesinitiative.org/>

The planetary boundaries framework was developed at a time when climate change policies captured the international agenda and both the policy and public attention. In this context, it provided a framework that included climate and other environmental issues. However, it should be mentioned that the safe operating space framework can be related to other frameworks that have been present in the international environmental agenda for many decades, from the limits to growth debate started in 1972 by the Club of Rome, to the sustainable development framework established by the Brundtland Commission report in 1987, and the Rio principles in 1992. Other related concepts are the carrying capacity of the Earth system, the ecological footprint, environmental space, ecosystem services and the work of the Millennium Ecosystem Assessment, among others.

There are also other principles of similar political and conceptual outreach, of which some are competing and other are subsidiary. Some related principles are: the precautionary principle, the principle of emergency response and averting dangerous impacts; no-regret-principle, cooperation, and environmental profit and loss calculation.

3. State of Knowledge and Current Scientific Background

On the scientific side, predecessor to the safe operating space was the concept of guard rails developed by WBGU (German Advisory Council of Global Change) in a series of reports from 1995 onwards⁴. The WBGU defines guard rails as limits that „demarcate the realm of desirable and sustainable development trajectories“. „A breach of these limits would give rise either immediately or in future to intolerable consequences so significant that even major utility gains in other fields could not compensate for the damage.“ The concept is thus very similar to the planetary boundaries. It has, inter alia, been formulated for climate change (the 2°C guard rail) and for oceans (acidification, sea-level rise, marine ecosystems).

The planetary boundaries agenda started in 2009 has been followed by a number of papers published on the issue, both further expanding the knowledge available for each of the nine boundaries and discussing on the science behind them.

According to the review undertaken by Nykvist et al (2013), a majority of scientific citations and references to the initial 2009 paper appears to support the concept of planetary boundaries, although some exceptions are mentioned⁵. Some specific definitions proposed in 2009 have been questioned and others have been proposed or reformulated⁶. According to Nykvist et al (2013), the original set is currently being revised by the Stockholm Resilience Centre.

Major issues which need to be discussed and refined further are:

⁴ e.g. WBGU (2006).

⁵ Nykvist et al (2013) refers to: Lewis, SL. (2012). *Column World view: We must set planetary boundaries wisely*. Nature 485(417); Nordhaus, T, et al. (2012). *Planetary Boundaries Hypothesis: Review of the Evidence*. Oakland, The Breakthrough Institute; Brook, B, et al., (2013). *Does the terrestrial biosphere have planetary tipping points?* TREE.

⁶ Johan Rockström published a paper addressing some critiques. Available at: <http://www.stockholmresilience.org/21/research/research-news/7-2-2012-addressing-some-key-misconceptions.htm>

- **A systematic problem:** On the one hand, the 9 suggested boundaries relate to different dimensions: some to genuine Earth systems (e.g. climate change, ozone depletion), others to important pressures (e.g. land use change), to overexploited resources (fresh water) and again others to effects (biodiversity loss). On the other hand, the nine PB are debatable: what about marine littering, migrating species, food waste, food – water – soil nexus, and others? Or, why emphasizing “global” freshwater? Nitrogen and phosphorus need to be treated separately (different cause-impact issues, different sourcing, different option for action).
- **The multilevel and multiscale dimension of boundaries:** There is no global threshold for most of the boundaries. Climate change and the ozone depletion are global, but some others have at least a strong local or regional dimension (e.g. nutrients; water scarcity, biodiversity loss) and emerge at different scales. So the global dimension is at least partially a consequence of scaling up local or regional problems. This issue has been intensively discussed at the example of reactive nitrogen, which in its multiple compounds is a local issue (nitrates), a cross-border issue (ammonia) and a global issue (nitrous oxide, effect on biomass productivity) (Vries et al., 2013).
- **Non-threshold effects:** For some impacts it is difficult to establish a “boundary” as – in the case of some chemicals or of nitrogen – there will be a negative effect at lowest doses and there will be a wide range of effect thresholds depending on the choice of indicator species or system. So what is needed is developing a concept of “acceptable risk”.
- **The systemic dimension:** some of the issues interact. So establishing a safe threshold for one issue might underestimate the dimension of the overall problem. Although the interlinkages between the different dimensions/boundaries are mentioned in the Rockström et al. 2009 texts, they are not conceptually considered. In fact the boundaries are determined based on the assumption that they are independent of each other.
- **The social dimension:** There are not only ecological thresholds but also social requirements to feed a world population of 9 billion people and to ensure minimum social and health standards (e.g. Raworth, 2012). Corridors between social minimum standards and environmental thresholds need to be explored more systematically.
- **Issues of fair distribution of globally constrained budgets of resource use:** As in the climate debates, there are different approaches for allocating a “fair share” of the use of global resources to individual countries or to citizens.
- **The salience dimension:** In abstract terms it is highly plausible that leaving the Earth system conditions of the Holocene has major implications for human welfare, economic and political stability. This socio-economic feed-back has not yet been made specific enough to attract broader stakeholder or civic society response to the challenges ahead. What is needed might be a Stern-Type of report for the other boundaries (this is, of economic consequences of acting and not acting).

- **A missing reflection on the socio-economic capacities to stay within the safe operating space:** Problems may face difficulties to get communicated without the availability of solutions, which address the problems. Again we know more on the transformation of the energy systems for effective climate mitigation than on many other issues.
- **The governance dimension:** To address politically the global commons might be more challenging than to address local commons, where “polluters” and “victims” much more closely interact. On the other side new concepts of “polycentric approaches” for addressing the Commons (Ostrom, 2010) might be more innovative and dynamic, than waiting for a global consensus for an effective environmental regime. So the multiscale dimension of most environmental problems might also be an opportunity, since even though the political process is blocked at one level it gets unblocked at another.
- **Framework conditions for human development:** They are based on limits derived for conditions characterising the Holocene, which might not be the best conditions for human development (De Vries et al, 2013).

So in total – as the principle of the limited carrying capacity of the planet is plausible, further work seems to be necessary to strengthen the scientific robustness, the political legitimization and the societal robustness of the concept (Hey, 2012).

4. Relevance for Environmental Policy Making

Although there are few political experiences applying the concept of SOS, the following paragraphs present some attempts at international, European, and national level.

4.1 The International Policy Dimension

The Planetary boundaries framework was present at the preparations for the Rio+20 Summit held in June 2012 and other international forums:

- a. The UN Secretary-General Ban Ki-moon referred to it during a speech to the Leaders' Dialogue on Climate Change, in September 2011. He said: "Help us defend the science that shows we are destabilizing our climate and stretching planetary boundaries to a perilous degree"⁷.
- b. It was included in the report of the UN Secretary-General's high level panel on global sustainability (2012), called *Resilient people, resilient planet: A future worth choosing*⁸. The report makes broad references to planetary boundaries, environmental thresholds and tipping points. In particular, here we highlight that it is included in the vision in the recommendations:

⁷ <http://www.un.org/apps/news/story.asp?NewsID=39627>

⁸ Available at: http://www.un.org/gsp/sites/default/files/attachments/GSP_Report_web_final.pdf

“Therefore, the long-term vision of the High-level Panel on Global Sustainability is to eradicate poverty, reduce inequality and make growth inclusive, and production and consumption more sustainable, while combating climate change and respecting a range of other planetary boundaries. (...) [page 11]

“Recommendation 51

255. Governments and the scientific community should take practical steps, including through the launching of a major global scientific initiative, to strengthen the interface between policy and science. This should include the preparation of regular assessments and digests of the science around such concepts as “planetary boundaries”, “tipping points” and “environmental thresholds” in the context of sustainable development. This would complement other scientific work on the sustainable development agenda, including its economic and social aspects, to improve data and knowledge concerning socio-economic factors such as inequality. In addition, the Secretary-General should consider naming a chief scientific adviser or establishing a scientific advisory board with diverse knowledge and experience to advise him or her and other organs of the United Nations.” [page 75].

- c. The planetary boundaries framework has been suggested by the Nordic Council of Ministers to play a role in the definition of the Sustainable Development Goals (see e.g. Schultz, 2013). In November 2013, Finland, in cooperation with Sweden, Norway, Denmark, UNEP and Stockholm Resilience Centre (SRC) organized an international workshop called *Planetary boundaries and environmental tipping points: What do they mean for sustainable development and the global agenda?* As included in the workshop’s concept note, Finland, and the co-organizers of the workshop, are advocating for the need to advance the understanding of the biophysical boundaries of global development in policy making. The focus of the workshop was to increase the understanding of the importance of the biophysical boundaries in sustainable development and to recognize the social and economic aspects linked to it.

4.2 The EU and national relevance of the concept

At the European level, the EU has recently approved and turned into law the new 7th Environment Action Program, which will guide the environmental policy agenda up to 2020. The 7EAP, agreed June 2013, is called “Living well, within the limits of our planet”⁹, and includes direct references to the concept of planetary boundaries.

- a. It is mentioned at the initial statements: *8. (...) there is evidence that planetary boundaries for biodiversity, climate change and the nitrogen cycle have already been transgressed (...)*

⁹ The 7th Environment Action Program (7EAP) became law in 20th November 2013: http://ec.europa.eu/environment/newprg/pdf/PE00064_en.pdf. The proposal from the Commission is available in: http://ec.europa.eu/environment/newprg/pdf/7EAP_Proposal/en.pdf

- b. Within the priority objective of improving the knowledge and evidence base for Union environment policy: 71.(1). (..) *While available evidence fully warrants precautionary action in such areas, further research into planetary boundaries, systemic risks and our society's ability to cope with them will support the development of the most appropriate responses. (..)*
- c. In relation to international environmental policy: 73. *In order to improve the knowledge and evidence base for Union environment policy, the 7th EAP shall ensure that by 2020: (...) (d) the impact of the Union and its Member States in international science-policy fora is enhanced in order to improve the knowledge base for international environment policy. This requires, in particular: (i) coordinating, sharing and promoting research efforts at Union and Member State level with regard to addressing key environmental knowledge gaps, including the risks of crossing environmental tipping-points and planetary boundaries; (...)*
- d. In relation to the reduction of the impact EU consumption beyond EU borders and the post-2015 framework: 106.(c).(viii) (...) *ensuring that economic and social progress is achieved within the carrying capacity of the Earth, by increasing understanding of planetary boundaries, inter alia, in the development of the post-2015 framework in order to secure human well-being and prosperity in the long-term.*

Moreover, the European Environmental Agency has commissioned a research paper to Stockholm Environment Institute (SEI) on 'environmental tipping points, planetary boundaries and a safe operating space' which explores the relevance of scaling planetary boundaries¹⁰.

Regarding national experiences, **Sweden** is the leading nation in the framework of planetary boundaries. The Swedish Environmental Protection Agency commissioned in 2013 a report to the Stockholm Resilience Centre and the Stockholm Environment Institute on the "National Environment Performance on Planetary Boundaries" (Nykvist et al, 2013). This is the first attempt of downscale the planetary boundaries to the level of countries –and individuals, since a *per capita* approach is taken in measuring environmental performance on each of the boundaries- and using these data for comparison amongst countries. Interestingly, they used consumption-based indicators for several boundaries for assessing the impacts of the Swedish economy not only domestically (territorially) but also beyond Sweden's borders.

The first step developed in the study was to compare the 9 planetary boundaries to the Swedish national environmental objectives, so they concluded that the framework could be used. Then, the authors proposed different indicators that translate the global PB into a per capita boundary, and thus they are able to compare performance among countries. For example, regarding climate change the 350 ppm for CO₂ concentration in the atmosphere is argued to correspond to 2 tons CO₂ emissions per capita per year. This is compared to per capita territorial emissions and consumption based emissions (this is, counting the emissions caused by services and products consumed by Swedish citizens although they occur abroad) for more than 60 countries. In the case of Nitrogen, a 5 kg N per capita per year is established, basically using the Rockström et al. (2009) divided by the world population.

¹⁰ This will be presented at the workshop (cf. the workshop agenda).

After this depth analysis, Nykvist et al (2013) looked at four policy questions:

- a. Whether the planetary boundaries framework can be used to measure the environmental and health impact of the Swedish economy beyond borders. They used consumption based indicators and conclude that the framework is useful since it is comprehensive and establishes absolute per capita boundaries.
- b. Whether it is useful to quantify the Sweden's "legal competence deficit" –this is, the lack of capacity to deal with (global) environmental problems. For climate impact they found a 99% deficit, but this was not possible to quantify for more regional boundaries.
- c. Which countries should be prioritised for bilateral cooperation with Sweden? They found the PB framework useful to identify countries with similar problems, but conclude that this is not the only aspect to be considered in such decision.
- d. How well the planetary boundaries are matched with existing multilateral environmental agreements (MEAs). They found that all boundaries are covered by MEAs except for ocean acidification but the main problem is the limited progress on already existing goals.

On the other hand, **Switzerland** has also commissioned a study on "Green Economy: Translating the Limits of Our Planet into Environmental Targets for Switzerland", which started in December 2013 and is planned to be finished in June 2014¹¹.

5. SWOT analysis

The first part of this document contains a brief description on how the SOS/PB is considered at the global and national level, with some initial attempts to downscale it in Sweden and Switzerland. This analysis has allowed us to identify some key issues to be discussed during the workshop, which are gathered and presented in the following SWOT (is: Strengths, Weaknesses, Opportunities and Threats).

¹¹ This will be presented at the workshop (cf. the workshop agenda).

The Safe Operating Space Concept – SWOT analysis (*Work in progress*)

<i>regarding ...</i>	Strengths	Weaknesses	Opportunities	Threats
State of Knowledge and Current Scientific Background	<ul style="list-style-type: none"> – Formulating 9 different dimensions: <ul style="list-style-type: none"> • underlines natural/physical system aspects beyond human/social management potential • fosters conservation/protection aspects of natural systems besides utilization aspects • fosters relevance of natural resources in a broad sense. – The sampling and similar structuring of 9 dimensions: <ul style="list-style-type: none"> • underlines the multitude of natural systems we depend on • attracts attention to the interlinkages and interdependencies of natural systems. 	<ul style="list-style-type: none"> – Number of 9 dimensions is to certain degree questionable (e.g. nitrate and phosphor as one dimension?, additional/other ones of crucial systemic relevance?). – Conceptual/knowledge deficiencies regarding specific dimensions (e.g. boundary water, phosphorus, biodiversity). – Absence of a global threshold for most of the 9 boundaries; some boundaries seem to be arbitrary. – Notion of “planetary” has different meanings with respect e.g. to “greenhouse gas” or “ozone” (globally systemic) and “phosphor” (globally aggregated local). Notion of “planetary boundaries” partially misleading. – Boundaries have different political defined character. – Interlinkages of boundaries are being underestimated. 	<ul style="list-style-type: none"> – Defining a (safe operating) space to act from a natural/physical point of view, i.e. opening up debate, conceptual work and policy making. – Through the formulated linkages of dimensions external effects of local, national, regional activities/policies become visible. – Institutionalisation of integrative policy making, cluster of PBs as criteria basis for impact assessment. – May serve to focus research and monitoring activities. 	<ul style="list-style-type: none"> – The underlying hypothesis of the <i>Anthropocene</i> may imply that also boundaries are shifted/changed/cancelled through human intention/impact. – Boundaries will be shifting in the medium/long term due to human activities. The concept is not as static as it may seem.

<i>regarding ...</i>	Strengths	Weaknesses	Opportunities	Threats
Underlying/ related concepts	<p>The sampling and similar structuring of 9 dimensions</p> <ul style="list-style-type: none"> • offers the linkage to multisystem, nexus, resilience approaches • offers the linkages to tipping point and guard rail concepts 	<p>Interlinkages between dimensions/boundaries to a high degree not known / not quantifiable yet. Scientific uncertainties.</p>	<p>The related concepts can push each other on the political and scientific agendas.</p>	<p>Stressing the linkages between the 9 different processes as well as the linkages between the SOS concept and related concepts threatens the original simplicity and intuitive rationale of the concept.</p>
Relevance for environmental policy planning	<p>The notion of boundaries/SOS:</p> <ul style="list-style-type: none"> • serves goal/target and evidence based governance approaches • supports interest in concrete science and policy • supports a global, integrative view on the Earth system • forces policy to consider deep/transformational changes to current modes of production and consumption • implies strong questions about growth and development 	<p>– The notion of boundaries/SOS</p> <ul style="list-style-type: none"> • does not deliver prescription how SOS should be used • threshold between safe/unsafe space depend on degree of societal risk aversion / influence of prevention principle • includes uncertainties concerning the natural robustness/reliability and socio-political robustness/definition of boundaries • (political, communicative) negative association of “boundary” • may imply to accept present environmental degradation or expanded use of SOS 	<p>– Attractive for international policy processes beyond the single different boundaries at least on a superficial level, e.g. for SDG / post 2015-process.</p> <p>– Transferring the greenhouse gas and ozone regime philosophy to other areas of environmental policies.</p> <p>– Institutionalisation of integrative, transdisciplinary research and policy consulting for each of the dimensions (like IPBES, IPCC) and crosscutting approaches (e.g. nexus, resilience).</p> <p>– The aspect of systemic complexity (multilevel, multidimensional interlinkages between natural structures</p>	<p>– In case of ozone and greenhouse gas emissions international policy processes are already in operation on basis of politically accepted limitations. This limits appliance for entire PB/SOS-concept in international policy frames (like SDGs).</p> <p>– Ambiguity of political success of climate regime philosophy.</p> <p>– Far reaching uncertainties and the missing political binding character make the concept not viable as basis for burden-sharing.</p>

<i>regarding ...</i>	Strengths	Weaknesses	Opportunities	Threats
		<ul style="list-style-type: none"> - Downsizing and operationalisation for national/regional/local policy is very difficult. 	<p>and processes) has a close link to the concepts of sustainability, subsidiarity/coherence and nexus in defining policy strategies. This ecosystem complexity aspect should be elaborated, used and communicated systematically to strengthen the political concepts from the physical pillar.</p>	

6. Safe operating space as a concept for National Policy?

The planetary boundaries concept constitutes a scientifically based framework, rather than a policy framework with politically agreed target levels (Nykvist et al, 2013). However, as will be discussed during the workshop, it provides a framework that has been argued to be useful for global environmental governance as well as for regional or national policy making.

Several questions are open for discussion. These are only some suggestions:

- The notion of a “safe operating space” is highly attractive for environmental policy planning. However as it implies notions of uncertainty, precaution and fairness, it is not only a purely science based concept. So how can the science-policy interface be organized to produce salient, robust and legitimate knowledge? What can be learned from other science policy interfaces orientated towards formulating targets and thresholds (e.g. IPCC, ICES, LRTAP-Convention etc.)?
- The Swedish EPA study suggests that planetary boundaries could be a framework for communicating national environmental performance and its relationships to global environmental challenges. But how is this organized? What are appropriate concepts and indicators to allocate “fair national shares”? How to address primary local, regional or interregional environmental dimensions of some of the issues?
- Apart from this comparison and communication aspect, would it be possible to use the concept of a safe operating space for informing national or European processes to set environmental goals and targets? In other words, could we define and agree – amongst stakeholders - on which is the safe operating space for one specific country or region? Is this feasible or desirable and if yes, why?

Following the SWOT analysis presented before some opportunities have been identified for the Safe operating space as a concept for National Policy:

- National policy could use SOS especially to strengthen the international policy strategies as an influential framework for national policy making.
- Without losing the natural science based qualitative and quantitative information and arguments it seems of added value to link up SOS with other societal, economic or political system oriented concepts, especially as regards the still missing link between a discourse on problems and a discourse on the solutions.
- SOS could be more systematically used in integrated policy assessment, as a standard to make effects more transparent on the basis of a specific state of scientific knowledge/definition of SOS.

REFERENCES

Hey, C. (2012): Safe Planetary Boundaries: A new environmental policy frame? Contribution to the "2012 Berlin Conference on Evidence for Sustainable Development" 5-6 October, 2012. Available at: http://www.berlinconference.org/2012/wp-content/uploads/2012/10/hey_safe-planetary-boundaries_a-new-environmental-policy-frame.pdf

Nykvist, B., Person, A., Moberg, F., Persson, L., Cornell, S., Rockström, J. (2013). *National Environmental Performance on Planetary Boundaries. A study for the Swedish Environmental Protection Agency*. Report 6576. Swedish Environmental Protection Agency. June 2013.

Raworth, K. (2012). *A Safe and Just Space for Humanity*. Oxfam Discussion Paper.

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley (2009a). A safe operating space for humanity. *Nature* 461 (7263): 472–475

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. (2009b). Planetary boundaries:exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. [online] URL: <http://www.ecologyandsociety.org/vol14/iss2/art32/>

Pisano, U.; Berger, G (2013). *Planetary Boundaries for SD. From an international perspective to national Applications*. ESDN Quarterly Report N°30. October 2013. Available at: http://www.sd-network.eu/quarterly%20reports/report%20files/pdf/2013-October-Planetary_Boundaries_for_SD.pdf

Ostrom, E. (2010). Polycentric systems for coping with collective action and global. *Global Environmental Change* 20 (2010) 550–557

Schultz M, Rockström J, Öhman MC, Cornell S, Persson Å, Norström A. (2013). *Human prosperity requires global sustainability – a contribution to the post-2015 agenda and the development of Sustainable Development Goals*. A Stockholm Resilience Centre Report to the Swedish Government Office (21 pp)

United Nations Secretary-General's High-level Panel on Global Sustainability (2012). *Resilient People, Resilient Planet: A future worth choosing*. New York: United Nations http://www.un.org/gsp/sites/default/files/attachments/GSP_Report_web_final.pdf

Vries, W. de, Kros, J., Kroeze, C. and Seitzinger, S.P. (2013). Assessing planetary and regional nitrogen boundaries related to food security and adverse environmental impacts. *Current opinion in Environmental Sustainability*, 2013, 5:392-402.

WBGU (2006). *The Future Oceans – Warming Up, Rising High, Turning Sour*. WBGU, Berlin.

Annex. Final agenda, format and topics to be discussed in each session

The workshop is organized in four sessions devoted to specific topics, and a final discussion aimed at recommendations for EU and national governments.

Each session will include 3 to 4 short presentations (15-20 minutes) from key participants. Several time for discussion amongst all participants will be allowed for in each session.

AGENDA (updated 15/01/2014)

1 st Day: Safe Operating Space and Environmental Policy Planning – State of the Art	
12.30h	Light business lunch
13.30h	<p>Introduction: Objectives of the workshop</p> <p>Dr. Jörg Mayer-Ries, Head of Division General and Strategic Aspects of Environmental Policy, Environmental Protection and Sustainability Strategies. German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).</p> <p>Mr. Arnau Queralt, director of the Advisory Council for the Sustainable Development of Catalonia (CADS).</p>
13.45h	Tour de Table – Background, Concerns and Interest
14.30h	<p>Session I. Safe Operating Space – State of Knowledge and Current Scientific Background</p> <p>Introduction and moderation: Dr. Christian Hey, secretary general of German Advisory Council on the Environment (SRU).</p> <p>Keynote: Prof. Will Steffen, Climate Change Institute at the Australian National University.</p> <p>Complementary and critical comments concerning:</p> <ul style="list-style-type: none"> – Economic aspects: Ms Kate Raworth, Senior Visiting Research Associate. Oxford University's Environmental Change Institute. – Environmental Justice within Planetary boundaries: Prof. Joan Martínez-Alier, Autonomous University of Barcelona. Former President of the International Society for Ecological Economics (ISEE). – Governance aspects: Dr. Falk Schmidt, Academic Officer Executive Office. Institute for Advanced Sustainability Studies (IASS) Potsdam.
	<p>Topics for discussion:</p> <ul style="list-style-type: none"> – What are the core (political) messages of the concept of Safe operating space (SOS)? – What is the state of the science regarding planetary boundaries/safe operating space

	<p>and the associated scientific evidence?</p> <ul style="list-style-type: none"> – Strengths and weaknesses regarding: <ul style="list-style-type: none"> • the level of application (global, national, regional), • the kind of functionality (scientific, social, political, communicative), • social, economic and governance aspects of the concept.
16.30h	Coffee-Break
16.45h	<p>Session II: Underlying concepts</p> <p>Introduction and moderation: Ms Agneta Andersson. International coordinator, Dutch Council for the Environment and Infrastructure (RLI).</p> <ul style="list-style-type: none"> – The value of Ecosystem Services as key argument. Dr. Laurence Jones, Researcher at Centre for Ecology and Hydrology. Environment Centre Wales. – The systemic dimension, security and precaution: Interlinkages and Interdependence. A resource nexus perspective: Prof. Dr. Raimund Bleischwitz. BHP Billiton Chair in Sustainable Global Resources. University College London, Institute for Sustainable Resources. – Resource Efficiency and Resilience: when is the one fit of the other? Mr Thomas Henrichs. Project manager. Integrated environmental assessments. European Environment Agency (EEA). <p>Topics for discussion:</p> <ul style="list-style-type: none"> – The SOS concept relates to other issues already present in the global and national environmental agenda: <ul style="list-style-type: none"> • the valuation of ecosystem services • precaution and the systemic dimension of environmental problems in regard to their interlinkages and interdependence • the relationship between resource efficiency and resilience – Which political experiences have been made and are currently being made with this and underlying concepts concerning agenda setting, goal setting, vision building, mobilisation, etc?
18.45h	<i>Short walk to the restaurant</i>
19:00h	<p>Dinner</p> <p>Speech by Prof. Hans Bruyninckx. Executive Director. European Environment Agency (EEA).</p>

2 nd Day: PB's and Environmental Policy Planning – Perspective	
9.00h	Wrap-up of Day 1
9.15h	<p>Session III. International Policy Dimension of Planetary Boundaries</p> <p>Introduction and moderation: Mr Jan De Smedt. Executive Director. Belgian Federal Council for Sustainable Development.</p> <ul style="list-style-type: none"> – Dr. Shardul Agrawala. Head of the Environment and Economy Integration Division. Environment Directorate (EEI/ENV). Organisation for Economic Co-operation and Development (OECD). – Mr Jakub Wejchert. Policy Officer for Global Sustainability. European Commission (DG ENV). – Dr. Pascal Peduzzi. Head of Global Change and Vulnerability Unit. DEWA/GRID-Geneva/United Nations Environment Programme (UNEP).
	<p>Topics for discussion:</p> <p>What are the strengths and weaknesses of the SOS concept on the international level regarding e.g.</p> <ul style="list-style-type: none"> • the development of Sustainable Development Goals (SDGs). • International environmental reports (i.a. UNEP, OECD)?
10.30h	Coffee Break
10.45h	<p>Session IV. The EU and national relevance of the concept</p> <p>Introduction and moderation: Dr. Jörg Mayer-Ries, BMU.</p> <p>Dr. Björn Nykvist. Research fellow at Stockholm Environment Institute (SEI) and Stockholm Resilience Centre (SRC).</p> <p>A national perspective:</p> <ul style="list-style-type: none"> – Ms Katrin Zimmer. International cooperation unit, Swedish Environmental Protection Agency. – Mr Andreas Hauser. Scientific officer, Federal Department of the Environment, Transport, Energy and Communications, Switzerland – Prof. Dr. Maarten Hajer, Director, PBL Netherlands Environmental Assessment Agency.
	<p>Topics for discussion:</p> <p>What are the strengths and weaknesses of the SOS concept on the regional and national level regarding e.g.</p> <ul style="list-style-type: none"> • the implications of multilevel governance on the downscaling of planetary boundaries • the opportunities and threats to be expected when the SOS concept is used for defining national environmental goals and targets • the mismatch between scientific uncertainty about tipping points and the

	political need for reliable boundaries resp. long-term goals/targets.
12.30h	Lunch
13.30h	<p>Open Debate</p> <p>Introduction and moderation: Prof. Dr. Miranda Schreurs. Chair of the EEAC and member of SRU.</p> <p>Topics for discussion:</p> <ul style="list-style-type: none"> – How should SOS be further developed into a (more) useful and better applicable concept? – How/in which way should they be supplemented in order to be better suited for National Environmental Policy Planning?
15:15h	<p>Summary</p> <p>Dr. Jörg Mayer-Ries, BMU.</p> <p>Dr. Sarah Cornell. Coordinator of the Planetary Boundaries Research Initiative. Stockholm Resilience Centre (SRC).</p>
15.30h	Farewell