UNEP

The Emissions Gap Report 2016

A UNEP Synthesis Report

Foreword

There is a troubling paradox at the heart of climate policy. On the one hand, nobody can doubt the historic success of the Paris Agreement. On the other hand, everybody willing to look can see the impact of our changing climate. People already face rising seas, expanding desertification and coastal erosion. They take little comfort from agreements to adopt mitigation measures and finance adaptation in the future. They need action today.

That is why the Emissions Gap Report tracks our progress in restricting global warming to 1.5 - 2 degrees Celsius above pre-industrial levels by the end of this century.

This year's data shows that overall emissions are still rising, but more slowly, and in the case of carbon dioxide, hardly at all. The report foresees further reductions in the short term and increased ambition in the medium term. Make no mistake; the Paris Agreement will slow climate change. The recent Kigali Amendment to the Montreal Protocol will do the same.

But not enough: not nearly enough and not fast enough. This report estimates we are actually on track for global warming of up to 3.4 degrees Celcius. Current commitments will reduce emissions by no more than a third of the levels required by 2030 to avert disaster. The Kigali Amendment will take off 0.5 degrees Celcius, although not until well after 2030. Action on short-lived climate pollutants, such as black carbon, can take off a further 0.5 degrees Celcius. This means we need to find another one degree from somewhere to meet the stronger, and safer, target of 1.5 degrees Celcius warming.

So, we must take urgent action. If we don't, we will mourn the loss of biodiversity and natural resources. We will regret the economic fallout. Most of all, we will grieve over the avoidable human tragedy; the growing numbers of climate refugees hit by hunger, poverty, illness and conflict will be a constant reminder of our failure to deliver.

None of this will be the result of bad weather. It will be the result of bad choices by governments, private sector and individual citizens. Because there are choices. This report highlights plenty of them. For example, it shows how UN Environment can help governments to ensure that every dollar they invest and every regulation they introduce will help to increase the scale and speed with which those choices deliver results.

Even beyond government, the report shows many regions, cities and industrial sectors are choosing to target emissions reductions above those pledged by governments. Investors and bankers are choosing a more inclusive green economy. Authorities and legislators are choosing to improve energy efficiency, building codes and operating standards. While small scale businesses, farmers and families are choosing better production and consumption habits, like less waste and smarter travel.

So, the choices are ours. The historic deals of last year are within reach, but we must redouble our effort. That's why today, as the Paris Agreement legally enters into force, we sincerely hope this report will be a wakeup call to the world.

Erik Solheim
Head of UN Environment

Jacqueline McGlade
UN Environment Chief Scientist

6. Pathways for staying well below 2 and 1.5°C require deep emission reductions after, and preferably also before, 2020 and lower levels of emissions in 2030 than earlier assessed 2°C pathways.

The central aim of the Paris Agreement is to keep the global temperature increase by the end of the century to well below 2°C compared to pre-industrial levels, with an ambition to limit the temperature increase even further to 1.5°C. While these global goals are quite clear, there is a need to interpret what they mean. For example, what if the global average temperature exceeds these goals during the century, but is below the goals by end of it? Similarly, it is necessary to define an acceptable probability for achieving the goals, which in the end is a political rather than scientific question, as it requires value judgments about what is acceptable and desirable to society. In line with the Intergovernmental Panel on Climate Change's definition of "likely", this report generally uses a 66 per cent or higher probability.

A large body of literature is available on least-cost pathways that limit warming to below 2°C with a 66 per cent or higher probability. This issue has been covered extensively by the Intergovernmental Panel on Climate Change and earlier Emissions Gap Reports. For a 1.5°C goal, the body of literature is much more sparse and there are no published scenarios that meet the 1.5°C limit permanently with more than 66 per cent probability. Therefore, the studies assessed operate with a 50 per cent probability, which in Intergovernmental Panel on Climate Change terminology is considered "about as likely as not". The 2018 Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways by the Intergovernmental Panel on Climate Change will provide a more comprehensive picture as it will cover new studies. Table ES1 presents the pathway characteristics for achieving the two different temperature goals, showing the median acceptable emission levels for key years between 2020 and 2100.

As in the earlier Emissions Gap Reports, it is important to highlight that most scenarios that are available in the literature, and that limit warming to below 2 or 1.5°C, assume the use of so-called negative emissions technologies in the second half of the century -- that is the active and permanent removal of carbon dioxide from the atmosphere. This can be achieved, for example, through sustainable afforestation and reforestation, enhanced soil carbon absorption, biochar, and the combination of bio energy with carbon capture and storage. Important challenges have been identified for large-scale application of negative emissions technologies. For example, with biomass there is a challenge to produce enough biomass without harming biodiversity and a potential for competition between energy and food production over land and water resources.

Table ES1: Overview of pathway characteristics for two global temperature targets.

1.5°C (>50% in 2100)	**Pathways limiting warming to below 1.5°C by 2100 with >50% probability Limited action until 2020 and cost-optimal mitigation afterwards**				
Number of available scenarios: **6**; Number of contributing modelling frameworks: **2** Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **(2060-2080)**; total CO_2 (including LULUCF): **(2045-2050)**; CO_2 from energy and industry: **(2045-2055)**					
	Annual emissions of global total greenhouse gases [$GtCO_2e$/year]				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**56**	**47**	**39**	**8**	**-5**
range and spread**	53(-/-)56	46(-/-)48	37(-/-)40	4(-/-)14	-5(-/-)-3
	CO_2 carbon budgets [global total cumulative CO_2 emissions in $GtCO_2$]				
Time period	*2015-2030*	*2030-2050*	*2050-2075*	*2075-2100*	*2015-2100*
median*	**552**	**236**	**-199**	**-353**	**217**
range and spread**	503(-/-)567	178(-/-)259	-146(-/-)-277	-288(-/-)-372	71(-/-)383
2°C (>66% in 2100)	**Pathways limiting warming to below 2°C by 2100 with >66% probability Limited action until 2020 and cost-optimal mitigation afterwards**				
Number of available scenarios: **10**; Number of contributing modelling frameworks: **4** Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **2085 (2080-2090)**; total CO_2 (including LULUCF): **2070 (2060-2075)**; CO_2 from energy and industry: **2070 (2060-2075)**					
	Annual emissions of global total greenhouse gases [$GtCO_2e$/year]				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**52**	**48**	**42**	**23**	**-3**
range and spread**	49(49/53)55	44(46/50)53	29(31/44)44	17(18/27)29	-11 (-9/-[illegible])0
	CO_2 carbon budgets [global total cumulative CO_2 emissions in $GtCO_2$]				
Time period	*2015-2030*	*2030-2050*	*2050-2075*	*2075-2100*	*2015-2100*
median*	**533**	**362**	**70**	**-288**	**553**
range and spread**	481(499/582)572	242(258/431)447	-97(-52/175)187	-120(-146/-327)-342	483(490/[illegible]34)988
* Rounded to the nearest 1 $GtCO_2e$/year ** Rounded to the nearest 1 $GtCO_2e$/year. Format: minimum value (20th percentile/80th percentile) maximum value – no percentiles are provided if less than 10 scenarios are available. † Rounded to nearest 5 years. Format: median (20th percentile – 80th percentile); (minimum – maximum) if less than 10 scenarios are available.					

Table 3.1: Overview of pathway characteristics for two global temperature targets. A detailed overview of scenario names is provided in Annex A.1. available online. Source: UNEP (2015) and additional calculations.

1.5°C (>50% in 2100)	**Pathways limiting warming to below 1.5°C by 2100 with >50% probability Limited action until 2020 and cost-optimal mitigation afterwards**				
Number of available scenarios: **6**; Number of contributing modelling frameworks: **2** Year of global annual emissions becoming net zero† for: Kyoto greenhouse gases (GHGs): **(2060-2080)**; total CO_2 (including land use, land-use change and forestry (LULUCF)): **(2045-2050)**; CO_2 from energy and industry: **(2045-2055)**					
	Annual emissions of global total GHGs [$GtCO_2e$/year]				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**56**	**47**	**39**	**8**	**-5**
range and spread**	53(-/-)56	46(-/-)48	37(-/-)40	4(-/-)14	-5(-/-)-3
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Time period	*2015-2030*	*2030-2050*	*2050-2075*	*2075-2100*	*2015-2100*
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range and spread**	49(49/53)55	44(46/50)53	29(31/44)44	17(18/27)29	-11 (-9/-1)0
	CO_2 carbon budgets [global total cumulative CO_2 emissions in $GtCO_2$]				
Time period	*2015-2030*	*2030-2050*	*2050-2075*	*2075-2100*	*2015-2100*
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* Rounded to the nearest 1 $GtCO_2e$/year

** Rounded to the nearest 1 $GtCO_2e$/year. Format: minimum value (20th percentile/80th percentile) maximum value – no percentiles are provided if less than 10 scenarios are available.

† Rounded to nearest 5 years. Format: median (20th percentile – 80th percentile); (minimum – maximum) if less than 10 scenarios are available.

1.5°C. Each of these publications draws upon scenarios published earlier (Luderer *et al.*, 2013; Rogelj *et al.*, 2013a; Rogelj *et al.*, 2013b).

More literature is forthcoming and will be assessed in the framework of a Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways by the IPCC. This report will be finalized by 2018, in time to inform the facilitative dialogue under the UNFCCC.

Based, on the available literature, it is possible to identify four key characteristics of 1.5°C scenarios that start a least-cost pathway from 2020 and limit warming to below 1.5°C in 2100 with greater than 50 per cent probability. These are:

(1) Immediate mitigation action: all available scenarios consistent with this definition, peak global greenhouse gas emissions around 2020.

(2) The rapid up-scaling of the full portfolio of mitigation technologies: this includes widespread adoption of renewables, the phase-out of unabated fossil fuels, and the use of negative emissions technologies that allow for the active removal of carbon dioxide (CO_2) from the atmosphere.

NB

(3) Development along a low-energy demand trajectory.

(4) Temperature overshoot: almost all available scenarios consistent with this definition, temporarily exceed the 1.5°C limit during the 21st century.

The issues of negative emissions and temperature overshoot are discussed in more detail in the following.

A large proportion of the scenarios that limit warming to below 2°C, available in the literature, assume the use of so-called negative emissions technologies (Tavoni and Socolow, 2013; Williamson, 2013; UNEP, 2014; UNEP, 2015; Smith *et al.*, 2016) – the active removal and permanent sequestration of CO_2 from the atmosphere. This can be achieved, for example, through the combination of bio-energy with carbon capture and storage (Obersteiner *et al.*, 2001). Scenarios with significantly lower amounts of negative emissions exist, but the exclusion of this mitigation option at times renders ambitious climate goals unattainable (IPCC, 2014a; Riahi *et al.*, 2015). The IPCC (2014a) reported that all scenarios currently available that limit warming to below 1.5°C by 2100, require CO_2 removal in the second half of the century (see table 3.1). Furthermore, virtually all scenarios currently available in the literature for limiting warming to below 1.5°C by 2100 temporarily exceed the 1.5°C limit during the 21st century, and, thus, peak and decline temperatures in order to again fall below 1.5°C in

2100. For this to happen at the scale and rate required, global negative emissions are required. A large overshoot can be avoided through strong near-term action.

Important challenges have been identified for negative emissions technologies (Smith *et al.*, 2016) which have to be addressed, for example, the potential competition between biomass and food production over land and water (Bonsch *et al.*, 2016). In most cases, the amounts of bio-energy assumed in scenarios limiting median warming to below 1.5°C in 2100 are within the assessed limits of estimated sustainable biomass production, that is, they do not impede on sufficient global food production (Creutzig *et al.*, 2015; Bonsch *et al.*, 2016). However, this can change over time, for example, if local climate impacts happen to be more severe than currently anticipated. Furthermore, in absence of strong local institutions that can provide good governance and prevent illegal deforestation and illegal expropriation, the sustainable potentials might be lower.

NB

Because of uncertainties in availability of future technology studies have explored how the absence of a specific technology would influence the attainability of temperature goals (Kriegler *et al.*, 2013; Luderer *et al.*, 2013; Rogelj *et al.* 2013b; Krey *et al.*, 2014; Riahi *et al.*, 2015). These studies focus on a 2°C temperature goal, but found that a limitation or absence of bio-energy with carbon capture and storage significantly limits the feasibility of keeping temperature rise to low levels. At the same time, hedging against a strong reliance on bio-energy with carbon capture and storage in the long-term is possible by reducing emissions more steeply in the very near-term, that is, over the coming 5 to 15 years.

Further research that explores the trade-offs and synergies of negative emissions technologies in relation to limiting warming to 1.5°C would be extremely valuable.

Box 3.1: Integrated Assessment Models' strengths and opportunities.

The IPCC defines Integrated Assessment as "a method of analysis that combines results and models from the physical, biological, economic, and social sciences, and the interactions among these components in a consistent framework to evaluate the status and the consequences of environmental change and the policy responses to it" (IPCC, 2014b). Integrated Assessment Models are the models used in such a scientific exercise.

For the study of climate change mitigation scenarios, Integrated Assessment Models often include a representation of: (1) the socioeconomic driving forces, (2) the level of climate change mitigation and, (3) the physics of the climate system to estimate the impact on global temperature rise. To systematically explore socioeconomic driving forces, the research community recently developed a set of five narratives that describe worlds with very differing adaptation and mitigation challenges. These are referred to as the "Shared Socioeconomic Pathways" (O'Neill *et al.*, 2014; O'Neill *et al.*, 2015). Subsequently, these narratives are used to explore if and how stringent mitigation targets can be reached (Riahi *et al.*, in Press).

Most commonly, Integrated Assessment Models are used to create scenarios, which attempt to achieve global mitigation at minimum cost. Such "cost-optimal" (or "least-cost") scenarios let the model decide when (now, in a decade, or at the end of the century) and where (in which geographical region and/or in which sector) emissions are reduced. The model user can also add additional constraints regarding which mitigation technologies are available in the model. Ultimately, the model chooses between different alternatives based on their relative cost, and the social discount rate, which makes investing in the near-term more expensive than in the longer term.

Integrated Assessment Models are powerful tools, which allow the assessment of trade-offs and synergies between various mitigation options. Importantly, Integrated Assessment Model scenarios provide the costs of reducing emissions, for example, the costs to transform the energy system or limit the emissions from land-use and land-use change. However, they typically do not cover the economic and social costs of avoided climate change impacts or side effects. Recent studies have shown that these benefits can be significant and easily outweigh the costs of reducing emissions (West *et al.*, 2013). Furthermore, Integrated Assessment Model scenarios provide detailed technological transformation pathways that allow keeping emissions within a specific limit. Such transformation is often based on our understanding of transformations that took place in the past, like the transition of horse carriages to cars. However, Integrated Assessment Models typically do not contain much information on how to achieve the required pace of transformation in the future. Social science research can help to further understand the determinants and the key steps required to achieve a global low-carbon transition (Geels *et al.*, 2016).

6.3 The role of the SDGs in reducing greenhouse gas emissions: path-alignment and path-contingency

While the SDGs are highly interdependent, the relationships are not always inherently mutualistic (Nilsson *et al.*, 2016). Prior authors have emphasized the potential for conflict between certain SDGs and climate change objectives. The remainder of this chapter explores a complementary approach, analysing the SDGs particularly relevant fo[r] mitigation, divided into two key areas: agriculture, forestr[y] and other land-uses, and energy-related emissions. Certai[n] goals and associated targets are defined in ways that ar[e] synergistic, or "path-aligned". Their achievement wil[l] generally facilitate the achievement of the mitigatio[n] objectives of the Paris Agreement. Others are define[d] in ways that may or may not be antagonistic with thes[e] mitigation objectives, depending on how they are pursued.

Table 6.1: Path-alignment and path-contingency of selected SDGs

SDG	Topic	Alignment	Analysis
SDG2	Hunger and food security	Path-contingent	Target 2.4 emphasizes the need for alignment of improvements in sustainability and productivity, and pursuit of hunger and food security objectives, and increases in agricultural productivity envisioned in targets 2.3 and 2.a have the potential to materially increase emissions if they lead to extensification, soil degradation and other effects at odds with reduction of agriculture, forestry and other land-use emissions. Alternatively, these could align effectively with climate goals if pursued in an integrated fashion with target 2.4, and taking into account the opportunities to reduce food losses and improve distributional considerations. Impacts of improvements to productivity depend on technology, policy and context significantly, and thus alignment of the SDG is contingent upon these factors.
SDG7	Sustainable Energy Access	Path-aligned	The specific energy demands of universalizing energy access under target 7.1 are low, and there is formidable evidence that the preponderance are best served by low-carbon distributed technologies. The risk of potential trade-offs between expanded energy consumption and climate objectives are embedded within other SDGs, such as SDGs 8 and 9 discussed below. Targets 2.2 and 2.3 aim to promote increases in renewable energy and energy efficiency, and greater success against these targets directly serves the mitigation objectives of the Paris Agreement.
SDG8	Growth and employment	Path-contingent	Historic economic growth has been strongly correlated with greenhouse gas emissions. While the goal heading itself makes reference to sustainability, the only target level reference to sustainability is with respect to "sustained growth" under target 8.1, leaving open the mitigation implications of growth pathways on its face. Target 8.4 discusses decoupling of growth from environmental degradation generally but focusing on the sustainability of consumption and production as per SDG15. Growth's historic correlation with increased greenhouse gas emissions underscores that the compatibility of this SDG with the mitigation objectives of the Paris Agreement hinges on the ability of growing economies to accelerate the decoupling economic output from emissions.
SDG9	Infrastructure, industrialization, and innovation	Path-contingent	Targets 9.1, 9.4 and 9.a focus on the expansion of infrastructure. Infrastructure development is paradoxically a strong correlate of emissions growth, and a critical requirement to decarbonization. This is because incumbent infrastructure choices have been associated with increases in energy demand and intensity and land use change; decarbonization will require both the replacement of incumbent infrastructure and expansion of infrastructure services through low-carbon options. Some infrastructure locks in patterns of inefficiency, other choices lead to decarbonization, energy efficiency, and pollution reduction. The result of these targets on emissions will be highly contingent on the nature of these infrastructure choices. Targets 9.2 and 9.3. focus on the promotion of industrialization. While target 9.2 does acknowledge the need for "sustainable" industrialization, historic processes of industrialization have been drivers of emissions growth. New paths of industrialization, particularly if enabled by innovation promoted under targets 9.5, 9.b and supplied with low-carbon energy sources, have the potential change this historical pattern if innovation is geared toward decarbonizing technologies and processes. The emissions implications of the target are therefore contingent upon realizing this potential.
SDG11	Sustainable Cities	Path-aligned	The 10 targets of the goal are generally well-aligned as seven of the ten targets as-drafted focus on measures that expressly improve the resource efficiency of urban form, and thus also ones that benefit climate: factors to achieve them would be policies that improve, for example, compactness, public transport, and other efficiency inducing measures. Target 11.1 on access to housing does leave open the possibility of climate-conflicting approaches, but the goal taken as a whole emphasizes that improvements to urban form entail measures that are sustainability enhancing.
SDG12	Sustainable consumption and production	Path-aligned	Improving the resource-use efficiency of production, reducing pollution and promoting more sustainable consumption patterns diminish the pressure on the environment, including impacts on the climate. This makes the targets under this goal well aligned with SDG14. Achievement of these targets will also further the scope for the climate-alignment of agricultural production, industrialization, and corollary economic growth under SDGs 2, 8 and 9, respectively.
SDG15	Terrestrial Ecosystems	Path-aligned	Terrestrial ecosystems, particularly forests, hold large carbon stocks that, if disrupted, could have severe consequent emissions. The halting of deforestation is an important lever for agriculture, forestry and other land-use mitigation. While carbon stock preservation does not necessarily serve all of the objectives of terrestrial ecosystems preservations found in SDG 15's targets, the targets are largely salutary to mitigation efforts.

Hence, they are considered to be "path-contingent". With these goals and targets, strategic choices matter. Once these choices about how to achieve these SDGs are made, they may be difficult or costly to reverse.

Table 6.1 identifies SDGs that fall under each category, with a brief rationale. The approach focuses on the specific definition of SDG goals and targets, and what this means for their ability to align or conflict with the mitigation objectives of the Paris Agreement. Goals are regarded as path-aligned, where both the overarching SDG and individual targets are expressly defined in a way that reinforces the mitigation objectives of the Paris Agreement. Goals are also regarded as path-aligned if several associated targets are synergistic to mitigation objectives and others primarily neutral -- that is, collective progress on the goal does not impede simultaneous progress towards the mitigation objectives of the Paris Agreement. Goals are regarded as path-contingent, where either the goal or one or more targets are defined in a way capable of undermining the mitigation objectives of the Paris Agreement, depending on how it is pursued.

6.3.1. SDG implications for agriculture, forestry and other land-use based greenhouse gas emissions

Agriculture, forestry and other land-uses account for around 25 per cent of annual global greenhouse gas emissions (Smith *et al.*, 2014). The goals and targets related to universal food security (SDG2) and sustainable management of terrestrial ecosystems (SDG15) are specific examples of areas where multiple interests in the land-use context converge. How these interests are integrated in development policies and practice will have implications for progress towards the mitigation objectives of the Paris Agreement.

Hunger and food security (SDG2): Path-contingency

Food security improved during the Millennium Development Goals, but close to 800 million people continue to suffer from hunger, and the global community fell short of the stated Millennium Development Goal ambition of halving the proportion of chronically undernourished people between 1990 and 2015 (FAO, IFAD and WFP, 2015).

While ending extreme hunger and achieving food security remain central concerns of the SDGs, SDG2 also represents an expansion in scope. The goal now targets the eradication of all forms of malnutrition, taking both undernourishment and nutritional quality into account. It also targets the improvement of agricultural productivity, especially for small-scale producers (target 2.3, UN, 2015), and provides strategic guidance on how to achieve this, assigning particular importance to sustainable food production systems and resilience of agriculture practices (target 2.4, UN, 2015).

How societies decide to meet food security and nutrition targets will have direct implications for agriculture-related emissions, and indirect implications through agriculture's impact on maintaining forests and sustaining terrestrial ecosystem functions (SDG15). While more quantitative understanding of SDG interactions is needed, early results from integrated assessments highlight that single sector policies may harbour considerable policy trade-offs, while a system's perspective informing policy formulation can help anticipating and minimizing these (Obersteiner et al, 2016; see also von Stechow et al, 2016 on climate and energy related SDGs). For example, Obersteiner *et al.* (2016) show that for land-use decisions, the interactions between environmental and food security outcomes are more tightly associated with each other than population and economic growth scenarios.[1] Furthermore, an emphasis on measures that reduces energy and other consumption demand, generally benefits overall development concerns by freeing up solution space for other SDGs, including on food security and infrastructure (Obersteiner et al., 2016; von Stechow *et al.*, 2016).

Alexandratos and Bruinsma (2012) project substantial increases in global food consumption accompanied with structural changes in diets, expecting that by 2050 around 52 per cent (or 4.7 billion people) of the world population will live in countries with a national average of 3000 kilocalories per person per day in comparison to 28 per cent (1.9 billion people) today. How malnourishment—related to both over- and under-consumption—is addressed through agricultural practices, land-use choices and distributional choices will have implications for aligning mitigation efforts with the objectives of the Paris Agreement. The choice of policies and measures that integrate productivity demands with an advancement of sustainable agricultural practices will influence the level of emissions from land-use (Valin *et al.*, 2013), as well as the pressure on biodiversity, natural ecosystems, and forests (SDG15).

As Section 3.2 showed, almost all 1.5 and 2°C pathways currently available assume negative emission technologies during the second half of the century. This has consequences for available land-use options and, hence, the ability to achieve other SDGs that depend on the ecosystem goods and services provided by land. Land use based technologies, such as bioenergy carbon capture and storage, afforestation and reforestation, and biochar are among the most promising negative emission technologies. Depending on the type and scale of negative emission technologies deployed, there may be synergies or trade-offs with land demand for food security and environmental conservation targets. For example, soil carbon sequestration and biochar applications can be applied on existing agricultural lands, do not require specific land-use changes, and are also considered to have beneficial impacts on soil nutrients and land productivity, while having negligible impacts on water-use and albedo (Smith, 2016). By contrast, increased deployment of bioenergy carbon capture and storage, as well as afforestation and reforestation activities, may require land-use changes. Locally, their deployment may conflict with certain means to achieve food security targets, and vice versa (Hasegawa *et al.*, 2015).

1 The existing literature on the food-energy-water-environment nexus offers further insights on policies and practices aimed at managing interactions in the land-use space (Biggs et al., 2015; Howells *et al.*, 2013; Ringler et al., 2013).