Umweltforschungsplan des
Bundesministeriums für Umwelt,
Naturschutz, Bau und Reaktorsicherheit

Forschungskennzahl 3715 41 109 0

Climate initiatives, national contributions and the Paris Agreement

Annex - methodologies

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Im Auftrag des Umweltbundesamtes

October 2016

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List of Abbreviations

ABAOCP	Caring for Climate, the American Business Acts on Climate Pledge
C40	Cities Climate Leadership Group
CAT	Climate Action Tracker
CCAC	Climate and Clean Air Coalition
CP	Current Policies Scenario from the IEA World Energy Outlook 2015
EWI	European Wind Initiative
GBPN	Global Buildings Performance Network
GCFTF	Governors' Climate and Forests Task Force
GFEI	Global Fuel Economy Initiative
GHG	Greenhouse gas
GMI	Global Methane Initiative
ICI	International Climate Initiative
INDC	Intended Nationally Determined Contributions
LULUCF	Land-use, land-use change and forestry
MRV	Monitoring, Reporting and Verification
$MtCO_2e$	Megatons of CO_2 equivalent
NAZCA	Non-State Actor Zone for Climate Action
NGO	Non-governmental organisation
NPS	New Policy Scenario from the IEA World Energy Outlook 2015
NYD	New York Declaration on Forests
RE	Renewable Energies
SEAD	Super-efficient Equipment and Appliance Deployment Initiative
SEII	Solar Europe Industry Initiative
UIC	Low-Carbon Sustainable Rail Transport Challenge
ULCOS	Ultra-Low CO2 Steelmaking Initiative
UNEP	Unites Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WEO	World Energy Outlook

1. Introduction

In this Appendix, we collect full detail on all of the following:

- Full qualitative descriptions of all initiatives selected in this study (including those not selected for quantification);
- Full methodological descriptions of the calculations performed for the quantification of emission reduction potential of each initiative selected for quantification;
- Full methodological description of the approach used to account for overlaps between different initiatives.

The Appendix is subdivided into different chapters, one per thematic area of initiatives (ten in total), and one on the overlap quantification. Each chapter lists all initiatives considered in this study within a thematic area and provides qualitative descriptions and, where necessary, the documentation of the quantification. All assumptions made in the quantification are described in body text, and all quantitative data used in the calculations are collected in tables along with full references.

Each chapter is appended by a table providing an overview of a short qualitative analysis into the potential impacts of all initiatives. This includes both an assessment of whether or not these initiatives could directly result in emission reductions (even where we did not quantify them), as well as an overview of which potential other benefits and impacts the initiative could have beyond purely reduction of greenhouse gas emissions.

In Table 1, we show an overview of all initiatives, per thematic area, considered in this report.

Table 1: Initiatives selected for quantitative and qualitative analysis

Name of initiative	Region
Agriculture and Forestry	
Bonn Challenge	global
CCAC Agriculture Initiative	global
Forest Carbon Partnership Facility (FCPF)	global
Governors' Climate and Forests Task Force (GCFTF)	global
New Vision for Agriculture	global
Rainforest Alliance	global
The New York Declaration on Forests (NYD)	global
Tropical Forest Alliance 2020	global
Africa Climate Smart Agriculture Alliance	Africa
Cities	
C40 Cities Climate Leadership Group (C40)	global
Carbon*n* Cities Climate Registry (cCCR)	global

Name of initiative	Region
Clean Air Asia	Asia and the Pacific
Climate Alliance	global
Covenant of Mayors	Western Europe/ Eastern Europe
Under 2 MOU	global
District Energy Accelerator	global
Efficiency in buildings	
Global Buildings Performance Network (GBPN)	global
Renovate Europe	Western & Eastern Europe
Super-efficient Equipment and Appliance Deployment (SEAD) Initiative	global
En.lighten	global
Transport	
Global Fuel Economy Initiative (GFEI)	global
Low-Carbon Sustainable Rail Transport Challenge (UIC)	global
Industry and business	
American Business Act on Climate Pledge (ABAOCP)	North America
Caring for Climate	global
RE100	global
Haga Initiative	Western Europe
Ultra-Low CO_2 Steelmaking (ULCOS)	Western &Europe
Eco Partnerships	North America and Asia
Others (SLCPs, policy development, standard development)	
Climate and Clean Air Coalition To Reduce Short-Lived Climate Pollutants (CCAC)	global
CCAC Initiative: Phasing Down Climate Potent HFCs	global
CCAC Initiative: Mitigating SLCPs from the Municipal Solid Waste Sector	global
Global Methane Initiative (GMI)	global
Greenhouse Gas Protocol	global
Renewable Energy and Energy Efficiency Partnership (REEEP)	global
The Global Alliance for Clean Cook stoves (GACC)	global
The Roundtable on Sustainable Biofuels (RSB Standard)	global

Name of initiative	Region
UITP Declaration on Climate Leadership	global
International Partnership on Mitigation and MRV	global
Low Emissions Development Strategies Global Partnership	global
Finance/Fiscal	
Portfolio Decarbonisation Coalition	global
Global Subsidies Initiative (GSI)	global
Breakthrough Energy Coalition	global
Renewable Energy	
European Wind Initiative (EWI)	Western Europe/ Eastern Europe
Solar Europe Industry Initiative (SEII)	Western Europe/ Eastern Europe
SunShot Initiative	North America
Wind Program	North America
Africa Renewable Energy Initiative	Africa
Renewable Energy and Energy Efficiency Partnership	global
Clubs der Energiewende	global
International Solar Alliance	global

2. Agriculture and forestry

2.1 Bonn Challenge/The New York Declaration on Forests

2.1.1 Description

The Bonn Challenge launched in 2011 aspires to restore 150 million hectares of degraded and deforested lands by 2020. The New York Declaration on Forests (NYD) endorsed at the UN Climate Summit in 2014 raised the Bonn Challenge's ambition by calling for restoration of an additional 200 million hectares by 2030.

The Bonn Challenge is overseen by the Global Partnership of Forest Landscape Restoration (GPFLR). The GPFLR is a network of governments, international organizations and civil society,

aims to catalyze and reinforce a network of diverse examples of restoration of degraded and deforested lands that delivers benefits to local communities and to nature.[1]

The Bonn Challenge is intended to serve as a practical means of realizing many existing international commitments on forest ecosystems and environment (e.g. CBD Aichi Target 15, the UNFCCC REDD+ goal, and the Rio+20 land degradation neutral goal).[2]

As of April 2016, 13 commitments have been made under the Bonn Challenge, which would restore 83 million hectares of degrade and deforest lands by 2020 (57% of the target), sequester 4.77 $GtCO_2e$ and deliver nearly 16 billion USD of economic activities.[3]

2.1.2 Quantification

We have quantified the potential impact of the Bonn Challenge and NYD as follows. As the website of the Bonn Challenge states, 57% of the 150 Mha target has already been achieved (as of 10 April, 2016). We assume that the initiative thus consists of achieving the remaining 43% (64.5 Mha) by 2020 and further 200 Mha by 2030.

As the initiative covers both reforestation of deforested lands and restoration of degraded lands, we have used a range of carbon content factors from IPCC data to calculate how much additional carbon could be sequestered if the above-surface areas were restored or reforested. We assume that half of the initiative will focus on reforestation of deforested lands (which we assume have negligible carbon stock compared to forested lands), and that the other half can be achieved through restoration of degraded lands (which have lower carbon stock than forested lands). We translate this to amounts of CO_2 that could be sequestered on a yearly basis in the two periods up to 2020 and 2030 if the initiative achieved its targets. Our estimation, which takes potential wide uncertainties in forest carbon content into account, suggests that the Bonn Challenge could help to sequester 1.7 to 4.5 $GtCO_2$ per year until 2020 and the New York Declaration 2.6 to 7.0 $GtCO_2$ per year between 2020 and 2030.

We split the potential impact of the initiative between the eight investigated countries by using historical FAO data on afforestation and reforestation in each of them (or data from the European Commission in the case of the EU). The rationale is that countries with historically high shares in the global total of afforestation and reforestation are likely to have higher potential to contribute to achieving the goals of the Bonn Challenge / NYD. Specifically, we calculate the share of affor-

1 http://www.bonnchallenge.org/content/global-partnership-forest-landscape-restoration (accessed 10 April, 2016)
2 http://www.bonnchallenge.org/content/challenge (accessed 10 April, 2016)
3 http://www.bonnchallenge.org/ (accessed 10 April, 2016)

estation/reforestation rates (in Mha/year) of each of the 8 countries in the global total afforested/reforested area and use it to split the total target of the initiative (in Mha to be reforested/restored) across the eight countries. Together, we find that these countries account for more than 97% of global afforestation and reforestation.

These historical afforestation and reforestation rates are, at the same time, used as baseline values. We assume that the historical rates would carry on at the same level in the future (i.e. up to 2030). This means that the initiative is estimated to have an impact only insofar as its target would go *beyond* this baseline. As Brazil and China have quantified elements on reforestation in their INDCs, there is potential overlap between these and the Bonn Challenge / NYD (and the baseline). This is discussed in the last chapter of this Appendix. In Table 2, we provide the values that have been used in our estimation of the initiative's impact with their sources.

Table 2: Parameter descriptions, values, units and sources used in the quantification of the Bonn Challenge and New York Declaration on Forests.

Description	Value	Unit	Source
Forest carbon density (lower bound)[4]	60	tC/ha	IPCC (2000) [5]
Forest carbon density (upper bound)[6]	120	tC/ha	IPCC (2000)[7]
Shrubland carbon density[8]	49	tC/ha	Coomes et al. (2002)[9]
Forest volume content	100	m^3/ha	FAO (2000)[10]
CO_2/C mass ratio	3.67		
Brazil afforestation rate	266	kha/year	FAO 2015 Country Report Brazil[11]

4 Used as proxy for minimum "forested" land stock density. Corresponds to temperate forest carbon density.

5 IPCC (2000), Land Use, Land Use Change and Forestry, ISBN 0521804957, Table 3 (p. 12)

6 Used as proxy for maximum "forested" land stock density. Corresponds to tropical forest carbon density.

7 IPCC (2000), Land Use, Land Use Change and Forestry, ISBN 0521804957, Table 3 (p. 12)

8 Used as proxy for "degraded" land stock density

9 Coomes et al. (2002), Designing systems to monitor carbon stocks in forests and shrublands, Forest Ecology and Management 164 (1-3)

10 FAO (2000), Global Forest Resources Assessment 2000, Chapter 2: Wood Volume and Woody Biomass, http://www.fao.org/docrep/004/y1997e/y1997e07.htm

11 http://www.fao.org/3/a-az172e.pdf

Brazil reforestation rate	519	kha/year	
USA afforestation rate	28	kha/year	FAO 2015 Country Report USA[12]
USA reforestation rate	2900	kha/year	
China afforestation rate	1497.3	kha/year	FAO 2015 Country Report China[13]
China reforestation rate	290.1	kha/year	
Japan afforestation rate	0	kha/year	FAO 2015 Country Report Japan[14]
Japan reforestation rate	24	kha/year	
Indonesia afforestation rate	1910.1	kha/year	FAO 2015 Country Report Canada[15]
Indonesia reforestation rate	866.7	kha/year	
India afforestation rate	1038	kha/year	FAO 2015 Country Report India[16]
India reforestation rate	0	kha/year	
EU afforestation rate	340	kha/year	European Commission 2003[17]
EU reforestation rate	0	kha/year	
Russia afforestation rate	6.6	kha/year	FAO 2015 Country Report Russia[18]
Russia reforestation rate	1018.7	kha/year	
World afforestation rate	5622	kha/year	FAO (2010) [19] [20]
World reforestation rate	5348	kha/year	

12 http://www.fao.org/3/a-az367e.pdf
13 http://www.fao.org/3/a-az186e.pdf
14 http://www.fao.org/3/a-az247e.pdf
15 http://www.fao.org/3/a-az181e.pdf
16 http://www.fao.org/3/a-az316e.pdf
17 http://ec.europa.eu/agriculture/publi/brochures/forestry/full_en.pdf
18 http://www.fao.org/3/a-az238e.pdf
19 FAO (2010), World Forest Resources Assessment, http://www.fao.org/docrep/013/i1757e/i1757e.pdf, p. 96
20 In absence of this data from the 2015 FAO State of the World's Forests, we used 2010 data for global numbers.

2.2 Governors' Climate and Forest Task Force

2.2.1 Description

The Governors' Climate and Forests Task Force (hereinafter, "GCF Task Force") is a subnational collaboration between 29 states and provinces from Brazil, Indonesia, Ivory Coast, Mexico, Nigeria, Peru, Spain, and the United States established in 2008. The GCF Task Force aims to advance jurisdictional programs designed to promote low emissions rural development and REDD+, and link them with emerging GHG compliance regimes and other pay-for-performance opportunities.

The GCFTF focuses on all aspects of the effort to reduce emissions from deforestation and establish lasting frameworks for low emissions development. The activities under the GCF Task Force would:

- "Facilitate the exchange of experiences and lessons learned across leading states and provinces;
- "Synchronize efforts across these jurisdictions to develop policies and programs that provide realistic pathways to forest-maintaining rural development;
- "Support processes for multi-stakeholder participation and engagement;
- "Seek financing for jurisdictional programs from a range of sources, including pay-for-performance public finance, emerging carbon markets, and ongoing efforts to decarbonize agro-food supply chains.

One of the key activities of the GCF Task Force is the training programs offered in several of the aforementioned countries to meet the most critical knowledge gaps in implementing jurisdictional programs at the regional level.[21]

2.2.2 Quantification

A quantified goal of the GCFTF is to reduce deforestation by 80% by 2020, conditional on adequate finances being available. We have calculated the potential for emission reduction of this target as follows. Reference deforestation levels in all signatory regions from Brazil and Indonesia were obtained from an Earth Innovation Institute's assessment of the GCFTF's goal's mitigation potential[22]. These together accounted for more than 92% of all deforestation in the signatory regions apart from the EU and the USA. We have assumed in our quantification that the "reduction of deforestation" target has a much larger mitigation potential in tropical countries than in the EU

21 http://www.gcftaskforce.org/training_program/about

22 http://www.gcftaskforce.org/documents/2014_annual_meeting/gcf_emissions_reduction.pdf

and the USA, and therefore have focused on Brazil and Indonesia only for the country-level assessment.

Emission reduction potential is calculated by assuming that the reference deforestation levels are the baseline through 2020 and 2030, and calculating the emissions corresponding to an avoidance of 80% of the reference level by 2020. For the 2030 impact, we assume that the same impact as for 2020 is carried through till 2030, i.e. the same baseline deforestation level is avoided until 2030.

For values of carbon content of forests, we have used the same parameters as in the quantification of the Bonn Challenge / New York Declaration.

Our estimation of the total potential of the target worldwide is 0.2 to 0.5 $GtCO_2e$ reduction per year. This is close to what the Earth Innovation Institute's assessment estimates (which translates to 0.55 $GtCO_2e$ reduction per year in the seven-year period 2014 to 2020).

2.3 Climate and Clean Air Coalition (CCAC): Agriculture Initiative

The CCAC Agriculture Initiative aims "to reduce methane and black carbon emissions from key agricultural sectors by sharing and implementing best practices, in order to enhance food security and livelihoods in accordance with broader climate change objectives." The initiative "focuses on identifying and facilitating the implementation of best management practices and technologies tailored to national and local circumstances", including "needs assessments and studies, raising awareness, training & capacity building, and working with farmers, policymakers, and other stakeholders."[23] There are four components under the CCAC Agriculture Initiative: (1) livestock and manure management; (2) open agricultural burning; (3) paddy rice cultivation; and (4) enteric fermentation.

With regard to progress to date, an action plan has been developed and being implemented for a SLCP mitigation practice in paddy rice production in three countries (Bangladesh, Colombia and Vietnam), and opportunities for practice change towards integrated manure management are promoted in Argentina, Bangladesh, Costa Rica, Vietnam, Ethiopia and Malawi.[24]

The expected impact of the CCAC Agriculture Initiative was not quantified because it does not contain a quantified target that can be translated into emission reductions.

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23 http://www.ccacoalition.org/fr/initiatives/agriculture (accessed 15 March, 2016)
24 http://www.ccacoalition.org/en/resources/ccac-annual-report-2014-2015 (accessed 15 March, 2016)

2.4 Forest Carbon Partnership Facility (FCPF)

The FCPF is a global partnership of governments, businesses, civil society, and Indigenous Peoples focused on REDD+ activities. Its four objectives are to: (1) assist countries in their REDD+ efforts through financial and technical assistance on capacity building, (2) pilot a performance-based payment system for REDD+ activities, (3) conserve biodiversity and test approaches to sustain and enhance livelihoods of local communities, and (4) disseminate knowledge on REDD+ readiness development and emission reduction activities.[25] Two separate trust funds (with the World Bank being a trustee) under the FCPF focus on the development of REDD+ readiness and carbon finance mechanism, respectively.[26]

As of April 2016, 47 developing countries joins the FCPF and 1 billion USD has been contributed or committed by the financial contributors.

The expected impact of the FCPF initiative was not quantified because it does not have a specific quantified or quantifiable target that can be translated into emission reductions.

2.5 New Vision for Agriculture

The New Vision for Agriculture initiative, established in 2009 under the World Economic Forum, supports the agricultural sector to deliver food security, environmental sustainability and economic opportunity while meeting the world's needs sustainably.[27] The initiative sets a goal of 20% improvement per decade until 2050 in each of the aforementioned themes,[28] and focuses on the following activities:

- "Facilitating leadership commitment to action by facilitating dialogue, commitment building and collaboration among diverse stakeholders;
- "Supporting country transformation by catalysing and supporting action-oriented, multi-stakeholder partnerships at regional and country levels;

25 http://www.forestcarbonpartnership.org/about-fcpf-0

26 http://www.forestcarbonpartnership.org/sites/fcp/files/New%20FCPF%20brochure%20--%20low%20resolution%20051809_0.pdfu_8_z_0.pdf

27 http://www.weforum.org/global-challenges/food-security-and-agriculture/projects/new-vision-for-agriculture (accessed 15 March, 2016)

28 Metrics for tracking progress are not entirely clear.

- "Promoting innovation and best practice by facilitating exchange of innovation, experiences and best practices among stakeholders and regions, and monitoring partnership impact to track progress.

Through catalyzing dialogues and partnerships at both global and country/regional level, the New Vision initiative have contributed to mobilize "over US $10.5 billion in investment commitments, of which US$1.9 billion has been implemented, reaching over 9.6 million smallholder farmers."

The expected impact of this initiative was not quantified because we deem the quantified goal of "20% improvement in food security, environmental sustainability and economic opportunity" not specific enough for our analysis to be converted to possible emission reductions.

2.6 Rainforest Alliance

Established in 1987, the Rainforest Alliance aims to conserve biodiversity and ensure sustainable livelihoods through transformation of land-use practices, business practices and consumer behavior.[29] Focus areas include: sustainable agriculture, sustainable forestry, sustainable tourism, climate change, environmental education and sustainable finance.

To achieve the aforementioned objectives, the Rainforest Alliance works with forward-thinking farmers, foresters and tourism entrepreneurs to conserve natural resources and ensure long-term economic health of forest communities. The Rainforest Alliance's approach includes training and certification to promote healthy ecosystems and communities in some of the world's most vulnerable ecosystems.[30]

The Rainforest Alliance monitors a range of impacts delivered through the certification and verification schemes it developed, e.g. increased carbon levels in above-ground vegetation in certified forestland, reduced agrochemicals and water-contamination risks in certified banana plantations and increased agricultural yield and income in certified cocoa farms.[31]

The expected impact of this initiative was not quantified due to the lack of a quantified target or aspirational goal.

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29 http://www.rainforest-alliance.org/about
30 Ibid.
31 http://www.rainforest-alliance.org/work/impact

2.7 Tropical Forest Alliance 2020

The Tropical Forest Alliance 2020 (TFA 2020) is a global public-private partnership founded in 2012 at Rio+20, following the Consumer Goods Forum's commitment in 2010 to zero net deforestation by 2020 for palm oil, soy, beef, and paper and pulp supply chains. The TFA 2020 aims to catalyze cross-sector voluntary actions by governments, the private sector and civil society to reduce the tropical deforestation associated with the aforementioned key agricultural commodities. Through reduced deforestation, the TFA2020 will reduce global greenhouse gas emissions, improve the livelihoods of millions of smallholder farmers, conserve natural habitats, and protect tropical landscapes for future generations.[32]

Partner countries, companies and civil society organizations under the TFA2020 work together to:[32]

- "Improve planning and management related to tropical forest conservation, agricultural land use and land tenure;
- "Share best practices for tropical forest and ecosystem conservation and commodity production, including working with smallholder farmers and other producers on sustainable agricultural intensification, promoting the use of degraded lands and reforestation;
- "Provide expertise and knowledge to assist with the development of commodity and processed-commodity markets that promote the conservation of tropical forests;
- "Improve monitoring of tropical deforestation and forest degradation to measure progress"

The expected impact of this initiative was not quantified due to a lack of available data on the amounts of commodities sourced by the private stakeholders involved in this Alliance. However, we refer the reader to a study by CDP and New Climate Institute (2016) in which quantification of zero-deforestation commitments of a similar nature was performed.[33]

2.8 Africa Climate Smart Agriculture Alliance

The Africa Climate Smart Agriculture (CSA) Alliance was officially launched in 2014 to "support the rapid scaling-up of CSA across Africa, through the collaborative efforts and practical, on-the-ground experience of Alliance members in agricultural research and implementation".[34] The dissemination of CSA will deliver the following benefits to the farmers: (1) enhanced food security, (2) increased smallholder resilience and adaptation to the likely effects of climate change, and (3)

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32 https://www.tfa2020.org/about-tfa/objectives/

33 https://newclimateinstitute.files.wordpress.com/2016/06/business-end-of-climate-change.pdf

34 http://africacsa.org/#climate-smart-agriculture

(where appropriate) reduced greenhouse gas emissions from agriculture and improved carbon sequestration.[35]

This initiative aims to support the uptake of CSA practices by at least 6 million farming households in Sub-Saharan Africa, contributing to the African Union's broader goal of supporting 25 million farming households by 2025.

The Africa CSA Alliance will develop the following through inclusive cooperation with all relevant stakeholders across the sector:[36]

- A vehicle for multilateral and bilateral investment for implementation of CSA activities at scale across Sub-Saharan Africa;
- A collaborative platform for identification, design and implementation of the most efficient and effective programmes; and
- A comprehensive evidence framework, capacity and vulnerability mapping tools and a web-based knowledge sharing platform.

The expected impact of this initiative was not quantified since the goal of "supporting the uptake of CSA by at least 6 million farming households" was not deemed specific enough to enable a reliable estimate of emission reductions.

2.9 Overview of qualitative achievements

In Table 3, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the agriculture and forestry sectors (not limited to the initiatives whose potential for emission reduction was quantified in this study). The boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

35 http://africacsa.org/wp-content/uploads/2015/09/White-Paper-Link-between-the-African-Global-CSA-Alliances-30.10.14.pdf

36 http://africacsa.org/#climate-smart-agriculture

Table 3: Categories of qualitative achievements for the agriculture and forestry initiatives covered in our analysis. [37] [38] [39]

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")									Notes/comments
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits	
Bonn Challenge and New York Declaration on Forests	y	X	(X)						X	• Avoiding land degradation • Biodiversity	Due to the nature of the coordinating body (GPFLR), we consider that the Bonn Challenge contributes indirectly to political/institutional development.
GCFTF	(indirect)	X							(X)		
CCAC Agriculture initiative	y	X	X			X		X	X	• Food security	We consider that initiative would have direct impact on the identified thematic areas because it aims to implement methane and black carbon reduction projects on the ground.
Forest Carbon Partnership Facility	y	X							X	• Biodiversity	
New Vision for Agriculture		X	X					(X)	(X)	• Food security	We consider that initiative would have indirect impact on the identified thematic areas (except for informational diffusion) because the initiative itself focuses on enhanced communication, dialogue and partnership.

37 For "Other (co-benefits)", we did not consider thematic areas that are broad and vague (e.g. "livelihood" or "environmental sustainability").

38 Capacity building for farmers and local residents were counted under "Informational diffusion" and capacity building for governments are counted under "Political/institutional effects". Educational projects for children are reported under "Other activities".

39 Distribution of REDD+ credit revenues to local communities are considered to contribute to economic development.

Rainforest Alliance	(indirect)	X			• Education			X	X	• Biodiversity	This initiative works on environmental education projects for children, which we separated from informational diffusion.
Tropical Forest Alliance 2020	(indirect)	X						X	X	• Biodiversity	
Africa Climate Smart Agriculture Alliance	(indirect)	X	X							• Food security	It is also described that the Alliance focuses its efforts on "strengthening CSA-related entrepreneurship development and market linkages between farming households and other market actors through community mobilization". [40] We consider that the wording is too vague to quality for "economic development".

40 http://africacsa.org/#climate-smart-agriculture

3. Cities and Regions

3.1 C40 Cities Climate Leadership Group (C40)

3.1.1 Description

C40 is a network of the world's megacities committed to address climate change. Founded in 2005 by the Mayor of London in collaboration with representatives from 18 other megacities, the C40 Cities Climate Leadership Group connects today more than 80 of the world's greatest cities, representing 600 million people and one quarter of the global economy. C40 is focused on tackling climate change and driving urban action that reduces GHG emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens[41].

Driven by the fact that almost all member cities report climate change to be a risk to their communities, about 10,000 concrete actions to reduce GHG emissions and climate risks have been taking by this network. Further, C40 cities have committed to help implementing the Paris Agreement and have agreed to reduce emissions by "3 Gigatonnes of CO_2e by 2030[42]", although it is unclear in relation to which baseline.

3.1.2 Quantification

The quantification of the potential impact of the C40 initiative in reducing emissions is detailed in this section. As a first step, we collected the emissions reduction targets - when available - from the C40 website for every member city of the 8 countries and regions which this study focused on (Brazil, China, the EU, India, Indonesia, Japan, Russia and the USA). We assumed that the cities' commitments would apply to the population of the mayor's jurisdiction; therefore, we also collected data on the cities' population for the target's base year from the C40 website[43]. An overview of data sources used herein is given in Table 4. In a next step, we assumed that a cities' emissions can be approximated by taking the share of the city in the country's population and multiplying it by the total emissions from the country. In other words, this is equivalent to assuming that the city inhabitants have the same average CO_2e emissions per capita emissions as the country average.

We acknowledge that this assumption can be challenged on different grounds. According to existing estimates of city emissions, significant discrepancies can exist between city-level per-capita

41 http://c40-production-images.s3.amazonaws.com/fact_sheets/images/1_About_C40_April_2016.original.pdf (accessed June 15th, 2016)

42 http://www.c40.org/about (accessed 15 June, 2016)

43 Example of city website from which target and population was collected: http://www.c40.org/cities/austin (accessed 15 June, 2016)

emissions and the country average[44]. There is no general rule for this, as city-level per-capita emissions can be higher than the country average (such as in the case of Rotterdam compared to the Netherlands' national average), roughly at the same level (such as in the case of Athens), or lower (such as in Stockholm). Due to this lack of generality, as well as to the unavailability of comparable city-level data for all cities investigated (especially for non-recent base years, such as 1990), we have used the simplified approach as described.

We note here that for cities in the United States, data does seem to point out that per-capita emissions in major cities are generally lower than the country average. Not having taken this into account would mean that we have overestimated the potential impact of the C40 initiative in the United States. It must be mentioned, though, that the calculations we have done throughout (for C40 and Under2MOU) are basically a proxy for comparing the "ambition" of city/region-level emission reduction pledges versus the national ones. This is only possible if we have a consistent approach on how to scale down country-level pledges to city/region level. If we would take into account cities' lower per-capita emissions, it would also be realistic to assume that the INDC targets requires less stringent action from these cities than from other regions. However, we do not claim to know how a country's INDC targets would be distributed across the country, and thus have not used such an approach.

The second phase of the quantification of the impact of this initiative included a comparison of the cities' targets with their corresponding countries' INDCs. The idea is to estimate the additionality of the cities' pledges to the INDCs. The underlying assumption here is that all cities within the country will reduce their emissions at least at the same rate as the country has established in its pledge, i.e. there will be an even distribution of the emissions reduction across the country. In order to do the comparison, we downscaled the INDCs to a city level, again using the cities' population and assuming all cities have the same average CO_2e/per capita emissions in the country.

Once the INDCs were downscaled, we compared the potential emission reduction that would be achieved through the INDC and the cities' targets, respectively. If the ambition of a city's commitment is not higher than the one corresponding to the INDC, the city's contribution to emissions reduction was discarded, based on the assumption that all cities will at least contribute with what the INDC has pledged to reduce. In this way, the additional contribution to emissions reduction from cities was estimated for both 2020 and 2030. Those contributions were then added up, back to the country level. Finally, based on population shares, we estimated that the cities assessed for

44 World Bank (2011), Representative GHG Baselines for Cities and their Respective Countries, http://siteresources.worldbank.org/INTUWM/Resources/GHG_Index_Mar_9_2011.pdf

the 8 countries of this study represent around 86% of the total impact of this initiative. Table 4 shows the sources used to collect population data of each city, by country.

As C40 initiative and Under2MOU have reduction targets for cities and regions, some of the cities' targets might be overlapping with the regions' targets. In the case that a city has established a less ambitious target than its corresponding region (and if the regions has subscribed to the Under2MOU), we only took into account the most ambitious target to avoid double counting. Additionally, emissions reductions targets coming from other sectors such as transport and buildings would contribute to achieving the cities'/regions' targets. These potential overlaps and our approach to avoid double counting the emissions reduction is discussed in the section on country-level overlaps in the last chapter of this Appendix.

Table 4: Population data sources used in the quantification of the C40 initiative

Country	Data sources [45]
USA	United States Census Bureau; UN data; C40 cities; World Bank Indicators
Indonesia	C40 cities
India	(not needed as no quantified city targets available)
Brazil	United Nations, Department of Economic and Social Affairs, Population Division; C40 cities; World Bank Indicators
China	(not needed as no quantified targets available that stretch beyond 2015)
Japan	Tokyo Metropolitan Government; UN data; C40 cities; World Bank Indicators
Russia	C40 cities; World Bank Indicators
EU	Eurostat; C40 cities; World Bank Indicators

45 United States Census Bureau (http://www.census.gov/); UN data (http://data.un.org/); C40 cities (http://www.c40.org/cities); World Bank Indicators (http://data.worldbank.org/indicator); United Nations, Department of Economic and Social Affairs, Population Division (http://www.un.org/en/development /desa/population/); Tokyo Metropolitan Government (http://www.metro.tokyo.jp/ENGLISH/ABOUT/HISTORY/ history03.htm); Eurostat (http://ec.europa.eu/eurostat/data/database); interpolation used between years when a specific year's population was not available.

3.2 Under2MOU

3.2.1 Description

The Under2MOU, or Memorandum of Understanding on Subnational Global Climate Leadership, is an initiative that brings together ambitious subnational governments to make a number of key commitments to strengthen momentum in the lead-up to COP21. The Under 2 MOU originated from a partnership between the state of California (USA) and the state of Baden-Württemberg (Germany).[46]

Each signatory commits to reduce GHG emissions to the levels consistent with the 2°C goal, i.e. 80-95% below 1990 levels or below 2 tCO_2e per capita by 2050. The MOU is not a contract or a treaty, thus not legally binding. As of 14 April, 2016, a total of 128 jurisdictions representing 28 countries and six continents have signed or endorsed the Under2MOU. They together represent more than 740 million people and $20.7 trillion in GDP, equivalent to more than a quarter of the global economy.

Besides the main objective of generating momentum in the lead-up to COP21, the Under2MOU also aims to offer an opportunity for states, regions, and cities to share ideas and best practices on how to reduce GHGs and promote renewable energy.

3.2.2 Quantification

For the quantification of the potential impact of the Under2MOU initiative, we first listed the signatory regions within the 8 focus countries and regions of this study (Brazil, China, the EU, India, Indonesia, Japan, Russia and the USA)[47]. When the subscribed regions did not include an Annex with a clear emissions reduction target, then the analysis was based on the Under2MOU's general target (80-95% reduction below 1990 levels by 2050). As for the rate of reduction of emission, we assume the decrease would happen linearly until 2020/2030, unless the region had stated intermediate goals for those years.

Similar to the methods applied for the C40 quantification, we assume that a region's emissions can be approximated by multiplying the share of the region in the country's population by the country's overall emissions. In other words, we assume that the region inhabitants have the same average emissions per capita emissions as the country average. In the particular case of the European Union, The Under2MOU's long-term targets are the same as of the EU. However, this is not part of the EU's INDC and the INDC has the interim pledge of 40% reduction by 2030. We therefore

46 http://under2mou.org/

47 http://under2mou.org/?page_id=238

assume that Under2MOU signatory regions have increased ambition compared to the EU as a whole in the sense that they would directly go on a linear pathway to the Under2MOU's long-term target; otherwise there would have been no motivation to sign on to the Under2MOU as this would fall under the EU's long-term targets.

Again, as in the case of the C40 initiative, we compared the regions' targets with their corresponding INDCs to estimate the additionality of the Under2MOU to the INDCs. We assume that the signatory regions will anyway reduce their emissions at least at the same rate as the country has established in its INDC, i.e. there will be an even distribution of the emissions reduction within the country's regions. In order to do the comparison, we downscaled the INDCs to a regional level using the regions' population and assuming all regions have the same average per capita emissions in the country.

Once the INDCs were downscaled, we compared the potential emissions reduction that would be achieved through the INDC and the Under2MOU. If the ambition of a region's commitment under the MOU is not higher than the one corresponding to the INDC, the region's contribution to emissions reduction was discarded, based on the assumption that all regions will at least contribute with what the INDC has pledge to reduce. In this way, the additional contribution to emissions reduction from cities was estimated for both 2020 and 2030. Those contributions were then added up, back to the country level. Finally, based on population shares, we estimated that the regions assessed for the 8 countries of this study represent around 87% of the total impact of this initiative. Table 5 shows the sources used to collect population data each region, by country.

As C40 initiative and Under2MOU have reduction targets for cities and regions, some of the cities' targets might be overlapping with the regions' targets. In the case that a city has established a less ambitious target than its corresponding region (and if the regions has subscribed to the Under 2 MoU), we only took into account the most ambitious target to avoid double counting. Additionally, emissions reductions targets coming from other sectors such as transport and buildings would contribute to achieving the cities'/regions' targets. These potential overlaps and our approach to avoid double counting the emissions reduction is discussed in the section on country-level overlaps in the last chapter of this Appendix.

Table 5: Population data sources used in the quantification of the Under2MOU initiative .

Country	Data sources [48]
USA	Under 2 MoU Region's Annex; United States Census Bureau; World Bank Indicators
Indonesia	-
India	-
Brazil	Under 2 MoU Region's Annex; Brazil's Population Census 2010; UNFCCC emissions summary for Brazil
China	(Not quantified. Two regions and one city are given as signatories of the Under2MOU, but without any specific targets. This means the overall targets of the MOU (80-95% reduction below 1990 levels by 2050) is not comparable to China's INDC with the same methodology as used for the other countries, as China's INDC target on emissions is quantified in terms of emission intensity of GDP, not total emissions as in the other countries and the EU.)
Japan	Under 2 MoU Region's Annex; World Bank Indicators
Russia	-
EU	Under 2 MoU Region's Annex; World Bank Indicators

3.3 Clean Air Asia

Clean Air Asia is an international non-governmental organization established in 2001 by the Asian Development as "the premier air quality network for Asia". Clean Air Asia aims to reduce air pollution and GHG emissions in more than 1000 cities in Asia through policies and programs that cover air quality, transport and industrial emissions and energy use.[49]

48 Under 2 MoU Region's Annex (http://under2mou.org/?page_id=238); United States Census Bureau (http://www.census.gov/); World Bank Indicators (http://data.worldbank.org/indicator); Brazil's Population Census 2010 (http://noticias.uol.com.br/censo-2010/populacao/); UNFCCC emissions summary for Brazil (https://unfccc.int/files/ghg_data/ghg_data_unfccc/ghg_profiles/application/pdf/bra_ghg_profile.pdf); interpolation used between years when a specific year's population was not available.

49 http://cleanairasia.org/about-us/

Clean Air Asia works with national governments (energy, environment, health and transport ministries), cities, private sector and development agencies to provide leadership and technical knowledge in the following areas: air quality and climate change, low emissions urban development, clean fuels and vehicles and green freight and logistics. Clean Air Asia also hosts the biennial Our Better Air Quality Conference, which gathers more than 1000 policymakers, practitioners and industry related to air quality.[5] This initiative does not set any quantitative targets for both air quality improvement and GHG emissions reductions.

3.4 Climate Alliance

The Climate Alliance of European Cities with Indigenous Rainforest Peoples (hereinafter, "the Climate Alliance", established in 1990, is a broad alliance of more than 1700 cities, municipalities and districts in 26 European countries. In 2006 the Climate Alliance set voluntary targets to (1) cut CO_2 emissions by 10% every 5 years and (2) to halve per capita emissions from 1990 levels by 2030 at the latest. Moreover, the Climate Alliance aims at a 2.5 tCO_2e per capita emissions in the long-term through energy saving, energy efficiency and renewable energy.[50]

An interesting feature of this initiative is that the coalition of like-minded European cities further partner with indigenous peoples, mainly through the Coordinating Body for the Indigenous Peoples Organisation of the Amazon Basin (COICA). The Climate Alliance also sets voluntary targets to (3) preserve the tropical rainforests by, e.g. avoiding the use of tropical timber and supporting the initiatives of the indigenous partners, and (4) to support projects and initiatives of the indigenous partners. Members of the Climate Alliance have passed local resolutions embracing the aforementioned two voluntary commitments.

The Climate Alliance's European Secretariat provide various services including: exchange of experience through e.g. conferences and workshops, provision of climate policy recommendations, aids and tools for efficient implementation of local climate policies, and lobbying for improved framework conditions for local climate policies on both international and national levels.[51]

As the Climate Alliance only covered European cities, we estimate its potential impact to be lower than that of the worldwide C40 cities initiative; thus, due to the considerable overlap with C40 goals, we did not quantify the Climate Alliance targets' implications for emissions. However, for a quantitative assessment we refer the reader to a study by Höhne et al (2015), where the Climate Alliance goals' implications were quantified for the German context.[52]

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50 http://www.climatealliance.org/our-objectives0.0.html

51 http://www.climatealliance.org/our_activities0.0.html

52 https://newclimateinstitute.files.wordpress.com/2015/11/15013-initiatives-final-report.pdf

3.5 Covenant of Mayors for Climate and Energy

The Covenant of Mayors for Climate and Energy (CMCE) was launched in October 2015 by the European Commission and is an upgrade to the original Covenant of Mayor, which comprised of local and regional authorities voluntarily committing to meet and exceed the European 20% CO_2 reduction objective through energy efficiency and renewable energy. The CMCE defines three pillars: mitigation, adaptation and secure, sustainable and affordable energy. CMCE signatories pledge action to support implementation of the EU's 40% GHG reduction target for 2030 and the adoption of a joint approach to address climate change mitigation and adaptation, as well as to endorse a shared vision for 2050 towards decarbonisation of their territories.

As of April 2016, there are over 6600 signatories accounting for more than 211 million inhabitants. Signatories are required to submit a Sustainable Energy Action Plan and their progress is monitored through regular submission of implementation reports.[53]

As the Covenant of Mayors' targets were estimated to be overlapped to a large extent by targets set under the C40 initiative, which has a wider network of subscribers worldwide, we did not quantify the potential impact of these targets on emission reductions.

3.6 District Energy Accelerator

The District Energy Accelerator is one of the five sub-programmes that comprise the Global Energy Efficiency Accelerator Platform established in the occasion of 2014 UN Climate Summit under the UN Sustainable Energy for All Initiative to support cities and national/local governments to develop, retrofit or scale up district energy systems.[54] The District Energy Accelerator focuses on the removal of various barriers to large-scale deployment of distributed energy systems. The Accelerator engages partner cities and national/local governments together with a range of other stakeholders to develop an integrated policy and investment roadmap for deployment of district energy systems as well as to support successful implementation of the roadmap. Moreover, the Accelerator will also initiate partnerships between partner cities to allow city governments to share their experiences and assist each other in policy planning and district energy system strategy development.

It is estimated that the 19 cities which expressed their intention to join the Accelerator at the time of the launch could together deliver emissions reduction of more than 5 $MtCO_2$ per year.[52] The lat-

53 http://www.covenantofmayors.eu/about/covenant-step-by-step_en.html
54 http://www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/07/ENERGY-SE4ALL-Platform.pdf

est document indicates that 30 cities have committed to developing and expanding distributed energy system strategies.[55]

3.7 Carbon Climate Registry

The carbon*n* Climate Registry (cCR), launched originally as carbon*n* Cities Carbon Registry at the World Mayors Summit on Climate in Mexico City on 21 November 2010, is a mechanism developed for local governments by local governments to measure, report and verify (MRV) their climate action developments, including: GHG reduction commitments, emissions inventories and climate mitigation and adaptation actions. cCR aims to enhance transparency, accountability and credibility of climate actions taken by local and subnational governments, and is designated as the central repository of the Compact of Mayors launched at the 2014 UN Climate Summit.[56]

As of November 2015, there are more than 600 reporting jurisdictions from 62 countries, representing 8% of the global population and 14% of the world's urban population, respectively.[57]

The cCR publishes guidance documents and provides webinars for registry development, contributing to the capacity building for local governments on MRVing their climate actions.

It is estimated that the commitments made by cCR members could account for 1 $GtCO_2e$ reduction by 2020 (below respective base year values).[58] However, as these commitments are not made to the Registry, we do not attribute any direct effects on emission reductions to the cCR as an initiative.

3.8 Overview of qualitative achievements

In Table 6, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives of cities and regions (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

55 http://www.se4all.org/sites/default/files/l/2014/09/Accelerator_District-Energy-0615.pdf
56 http://carbonn.org/
57 http://e-lib.iclei.org/wp-content/uploads/2015/12/cCR2015_5Year_Report.pdf
58 Ibid.

Table 6: Categories of qualitative achievements for the city/region initiatives covered in our analysis[59] [60]

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")									Notes/comments
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits	
C40	y	X	(X)								As one of the most prominent climate-conscious city network initiatives including a large number of the world' largest cities, we consider that the initiative has indirect political/institutional impact.
Under 2 MOU	y	X									
Clean Air Asia	(indirect)	X	X			(X)		(X)			While this initiative focuses primarily on air quality issues, we consider that its contribution to air quality improvement is only indirect because its main function is a network hub.
Climate Alliance	y	X	(X)							• bio-diversity	The initiative claims lobbying for improved framework conditions for local climate policies. We consider this would indirectly contribute to generating political/institutional impact.
Covenant of Mayors	y	X					(X)				

59 For "Other (co-benefits)", we did not consider thematic areas that are broad and vague (e.g. "livelihood" or "environmental sustainability").

60 Capacity building for national/local government officials were counted under "Informational diffusion" and capacity building for governments are counted under "Political/institutional effects". Educational projects for children are reported under "Other activities".

District Energy Accelerator	y	X	X			X					Air pollution is not explicitly mentioned in any of the referenced documents, but the shift from conventional separate generation of power and heat to combined heat and power systems reduce fuel consumption, likely contributing to reduced air pollution.
carbonn Climate Registry		X									We consider the capacity building in local governments on registry/inventory preparation through provision of guidance documents and webinars (in addition to learning-by-doing) to be important contribution to climate action.

4. Energy efficiency in buildings

4.1 Global Buildings Performance Network (GBPN)

4.1.1 Description

The Global Buildings Performance Network (GBPN) is a best-practice network, initiated by the Climate Works Foundation, that carries out research and distributes the knowledge to diverse key stakeholders in energy performance in buildings to capture the economic, technical potential of energy performance in buildings. It focuses on four priority regions: China, India, Europe, and the U.S. GBPN's goal is to contribute to the building sector achieving its full energy savings and CO_2 mitigation potential of more than 2.1 $GtCO_2$ by 2030[61].

GBPN describes its main missions as capacity building for implementation, policy analysis and validation, and sharing of knowledge, data and best practices between regions[62]. Therefore, impacts on informational diffusion and political / institutional effects can be expected. Via the improvement of energy performance in buildings, GBPN aims at achieving multiple benefits such as job creation, economic stimulus, affordable and sustainable energy services, improved public health and thermal comfort. Building insulation to reduce energy consumption can also reduce heat stress within a building in summer and, hence, avoid additional measures to adapt to climate change.[63]

61 GBPN website: http://www.gbpn.org/about

62 GBPN brochure: http://www.gbpn.org/sites/default/files/gbpn%20brochure_15.7.14.pdf

63 Harrison, N. et al. (2014): Enhancing Ambition through International Cooperative Initiatives. ISBN 978-92-893-2746-6. http://dx.doi.org/10.6027/TN2014-518.

4.1.2 Quantification

We have quantified GBPN's potential impact as follows. First of all, it is not clear whether the goal of 2.1 Gt refers to a baseline or historic emissions, but GBPN provides a deep efficiency scenario that quantifies energy savings[64]. GBPN's goal is thus assumed to be the realization of the deep efficiency scenario, which assumes that the annual rate of renovation increases to 3% by 2020. The potential impact is then given by the relative reduction of thermal energy in buildings in the deep efficiency scenario from 2013 to 2020 or 2030 respectively.

To calculate the potential impact in addition to current policies and in addition to the INDCs, we assume as the reference that the thermal energy demand of buildings develops as in the the New Policies Scenario (NPS) of the World Energy Outlook 2015[65] (WEO 2015). Here the thermal energy demand is approximated by the total energy demand of buildings without the electricity demand of buildings in WEO 2015. The additional global potential of GBPN is then given by the difference between the reduction derived from the deep efficiency scenario compared to NPS. For the former, the relative emissions reduction from the deep efficiency scenario is being applied to the WEO numbers for global thermal energy demand to estimate compensate for differences in the baseline.

To translate the thermal energy savings into emission savings, we assume that saving thermal energy reduces either oil or gas consumption of buildings. Here for each of oil and gas, the emission intensity of buildings is taken to be the emissions from its corresponding fuel consumption per its total final energy consumption. In this way, uncertainty ranges result from uncertainty about the type of fuel consumption avoided.

Our estimates suggest that the GBPN's potential global energy savings are 166 Mtoe per annum higher than those of current policies in 2020 and 362 Mtoe per annum higher than those of current INDCs in 2030. The resulting additional emission reductions are 0.4 $GtCO_2$ per annum in 2020 and 1.0 – 1.1 $GtCO_2$ per annum in 2030.

The same procedure is applied to derive the additional potential impact by region. To this end, we analogously assume that the local share of additional saving potential is given by the difference of the regional reduction in deep efficiency scenario and NPS. The emission intensity of TFC oil and gas in the regions is taken to be equal to the global average. Since the WEO 2015 does not cover Indonesia but only Southeast Asia as a whole, we also assume Indonesia's share in Southeast Asia's energy demand stays constant. In Table 7, we provide the values that have been used in our estimation of the initiative's impact with their sources.

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64 GBPN (2013): Buildings for our Future – The Deep Path for Closing the Emissions Gap in the Building Sector, http://www.gbpn.org/sites/default/files/06.BuildingsForOurFurture_Low.pdf

65 World Energy Outlook 2015: http://www.worldenergyoutlook.org/weo2015/

Table 7: Parameter descriptions and sources used in the quantification of the Global Buildings Performance Network's potential impact[66]

Description	Global values	Country values	Source	Comments
Thermal energy demand of buildings in GBPN's deep efficiency scenario in 2013, 2020 and 2030	*2013*: 1770 Mtoe *2020*: 1696 Mtoe *2030*: 1513 Mtoe	See source for values for China, Eastern Europe, Former Soviet Union, India, Latin America and Caribbean, Other Asia Pacific, Pacific OECD, USA, Western Europe	Downloaded from GBPN's website on 15 March 2016: http://www.gbpn.org/databases-tools/mrv-tool/scenario-data-analysis	Rate of reduction in Western + Eastern Europe used for the EU, Asia Pacific for Japan, Latin America and Caribbean for Brazil, Other Asia Pacific for Indonesia, Former Soviet Union for Russia
Energy demand of buildings in 2013	3004 Mtoe	See source for values for Brazil, China, EU, India, Indonesia, Japan, Russia, Southeast Asia, United States	World Energy Outlook 2015, Southeast Asia Energy Outlook 2015, IEA inventories 2013	The difference of energy demand and electricity demand in buildings is used as a proxy for thermal energy demand of buildings
Electricity demand of buildings in 2013	888 Mtoe			
Energy demand of buildings in the New Policies Scenario in 2020 and 2030	*2020*: 3195 Mtoe *2030*: 3453 Mtoe	Brazil, China, EU, India, Indonesia, Japan, Russia, Southeast Asia, United States	World Energy Outlook 2015, Southeast Asia Energy Outlook 2015	The difference of energy demand and electricity demand in buildings is used as a proxy for thermal energy demand of buildings
Electricity demand of buildings in the New Policies Scenario in 2020 and 2030	*2020*: 1030 Mtoe *2030*: 1282 Mtoe			
Final consumption of oil and gas in 2013	Oil: 3662 Mtoe Gas: 1372 Mtoe	-	World Energy Outlook 2015	The global quotient of TFC emissions and final consumption is used as a proxy for regional emission intensities.
TFC emissions from oil and gas in 2013	Oil: 9317 $MtCO_2$ Gas: 2999 $MtCO_2$	-		
Final consumption of oil and gas in the New Policies Scenar-	*2020*: Oil: 3959 Mtoe Gas: 1578 Mtoe	-	World Energy Outlook 2015	The global quotient of TFC emissions and final consumption is used as a

66 For conciseness, only global values have been included (the main text describes which values have been used for the country split).

io in 2020 and 2030	*2030*: Oil: 4203 Mtoe Gas: 4027 Mtoe			proxy for regional emission intensities.
TFC emissions from oil and gas in the New Policies Scenario in 2020 and 2030	*2020*: Oil: 9932 MtCO_2 Gas: 3411 MtCO_2 *2030*: Oil: 10413 MtCO_2 Gas: 3991 MtCO_2	-		

4.2 Super-Efficient Equipment and Appliance Deployment Initiative

4.2.1 Description

The Super-Efficient Equipment and Appliance Deployment (SEAD) Initiative is a government-led multinational collaboration between Australia, Brazil, Canada, the European Commission, Germany, India, Indonesia, Japan, South Korea, Mexico, Russia, South Africa, Sweden, the United Arab Emirates, the United Kingdom, and the United States. It seeks to transform international markets for highly efficient appliances and equipment. Through its activities and projects, the SEAD Initiative is engaging governments and the private sector to measure the potential of appliance and equipment efficiency. If all SEAD governments were to adopt current policy best practices for product energy efficiency standards, 2000 TWh of annual electricity could be saved in 2030[67].

The SEAD Initiative supports this effort by providing knowledge and tools that help impact policy change, raising awareness about the importance of increasing the efficiency of common appliances and equipment, identifying and highlighting technologies that will save energy, and providing technical expertise and best practices to stakeholders[68]. As a consequence, the SEAD Initiative expects to accelerate technological learning and innovation rates for energy efficient products and technologies in global markets[69]. Another co-benefit may be the reduction of peak-loads. Letschert

67 SEAD website: http://www.superefficient.org/About-Us/What-Is-the-SEAD-Initiative

68 SEAD Initiative Overview Factsheet: http://www.superefficient.org/About-Us/~/media/Files/SEAD%20Factsheets/SEAD%20Initiative%20Overview%20Jan2015%20FINAL.pdf

69 Dreyfus, G. et al. (2013): Driving market transformation and international collaboration through the super-efficient equipment and appliance deployment (SEAD) initiative. ECEEE 2013 Summer Study.

(2012) estimated that realization of the SEAD Initiative's goal will save consumers more than US$1 Trillion between 2010 and 2030[70].

4.2.2 Quantification

We have quantified the SEAD initiative's potential impact as follows. The global and regional saving potentials by applying best-practice policies with regard to energy efficiency of appliances has been calculated based on the BUENAS model in McNeil et al 2013[71]. SEAD's goal is assumed to be given by the reduction of electricity use in buildings in the BUENAS business-as-usual (BAU) scenario from 2013 to 2030 by 2000 TWh.

To calculate the potential impact in addition to the full implementation of current INDCs, we assume as the reference that the electricity demand for appliances develops as in the New Policies Scenario (NPS) of the World Energy Outlook 2015 (WEO 2015). Here the energy demand of appliances is approximated by the electricity demand of buildings in WEO 2015 and we assume that the demand shares of all SEAD countries not disaggregated in WEO 2015 stay constant within the corresponding world regions (see Table 8). The additional global potential of GBPN is then given by the difference between the reduction goal applied to the BUENAS BAU compared to NPS. For the former, we assume that the electricity demand of buildings in 2013 given in WEO 2015 contains savings of the recent-achievements scenario of the BUENAS model[72] and 2020 is estimated by linear interpolation between 2013 and 2030.

To translate the thermal energy savings into emission savings, we assume that saving electricity reduces either generation from coal or gas plants. Here the emission intensity of power generation in the SEAD economies is taken to be equal to the global average, as SEAD economies cover a large share of global power generation. And the emission intensity of power generation for each of coal and gas is taken to be the CO_2 emissions from its total use in power generation per total electricity generated from it. Our estimates suggest that the SEAD's potential global energy savings are not higher than those of the full implementation of current INDCs in 2020 but 310 Mtoe per annum

70 Letschert, V. E. (2012): Estimate of Cost-Effective Potential for Minimum Efficiency Performance Standards in 13 Major World Economies Energy Savings, Environmental and Financial Impacts. Permalink: http://escholarship.org/uc/item/5rt7q3w4

71 McNeil, M.A., Letschert, V. E., de la Rue du Can, S., Ke, J. (2013): Bottom–Up Energy Analysis System (BUENAS)—an international appliance efficiency policy tool. Energy Efficiency 6:191–217.

72 McNeil, M.A., Letschert, V.E., de la Rue du Can, S., Ke, J. (2012): Bottom Up Energy Analysis System – Methodology and Results. Accessed 15 March 2016 at: http://www.superefficient.org/Resources/~/media/Files/BUENAS%20-Methodology.pdf.

higher in 2030. As a consequence, there are no additional emission reductions in 2020 and the additional emission reductions vary between 0.1 – 0.3 $GtCO_2$ per annum in 2030.

In order to derive the additional potential impact by region, we split the total saving potential of 2000 TWh according to the regional shares provided in Letschert (2012). This study also contains savings for China, but China is not a formal member of the SEAD initiative but only an observer and thus not included in the estimates. Then the local share of additional saving potential is given by the difference of that regional reduction and the regional reduction in the NPS. The emission intensity of TFC oil and gas in the regions is taken to be equal to the global average. Since the WEO 2015 does not cover Indonesia but only Southeast Asia as a whole, we also assume Indonesia's share in Southeast Asia's energy demand stays constant.

In Table 8, we provide the values that have been used in our estimation of the initiative's impact with their sources.

Table 8: Parameter descriptions and sources used in the quantification of the Super-Efficient Equipment and Appliance Deployment Initiative.[73]

Description	Global values	Country values	Source	Comments
Electricity savings in buildings in recent-achievements scenario in 2013	289 TWh (in total of SEAD economies)	-	McNeil, M.A. et al (2012): http://www.superefficient.org/Resources/~/media/Files/BUENAS%20-Methodology.pdf.	for 2013, we assume that WEO 2015 contains savings of recent achievements scenario
Electricity demand in buildings in the BUENAS BAU scenario in 2030	10529 TWh (in total of SEAD economies)	-	McNeil, M.A. et al (2013). Energy Efficiency 6:191–217.	linear interpolation with 2013 for 2020
Share of total electricity savings in buildings in SEAD economies	-	See source for values for Brazil, EU, India, Indonesia, Japan, Russia, United States	Letschert, V. E. (2012), http://escholarship.org/uc/item/5rt7q3w4	The source contains savings for China, too, but China is not a formal member of the initiative and thus not included in the esti-

73 For conciseness, only global values have been included (the main text describes which values have been used for the country split).

				mates.
Electricity demand of buildings in 2013	888 Mtoe	See source for values for Brazil, Chile, EU, India, Indonesia, Japan, Middle East, New Zealand, OECD America, OECD Asia Pacific, Russia, Southeast Asia, South Africa, United Arabic Emirates, United States	World Energy Outlook 2015, Southeast Asia Energy Outlook 2015, IEA inventories 2013	Asia Pacific without New Zealand for the total of Australia, Japan and South Korea, Latin America and Carribean for Brazil, Asia Pacific for Indonesia, OECD America without Chile for the total of the US Canada, and Mexico
Electricity demand of buildings in the New Policies Scenario in 2020 and 2030	*2020*: 1030 Mtoe *2030*: 1282 Mtoe	See source for values for Brazil, Chile, EU, India, Indonesia, Japan, Middle East, New Zealand, OECD America, OECD Asia Pacific, Russia, Southeast Asia, South Africa, United Arabic Emirates, United States	World Energy Outlook 2015, Southeast Asia Energy Outlook 2015	Constant demand shares of Chile, Indonesia, New Zealand and the United Arabic Emirates within the respective world region assumed
power generation from coal and gas in 2013	Coal: 9612 TWh Gas: 5079 TWh	-	World Energy Outlook 2015	The global quotient of CO_2 emissions from power generation and power generated is used as a proxy for regional emission intensities.
CO_2 emissions from coal and gas power generation in 2013	Coal: 9781 MtCO_2 Gas: 2760 MtCO_2	-		
Power generation from coal and gas in 2020 and 2030	*2020*: Coal: 10171 TWh Gas: 5798 TWh *2030*: Coal: 10867 TWh Gas: 7385 TWh	-	World Energy Outlook 2015	The global quotient of CO_2 emissions from power generation and power generated is used as a proxy for regional emission intensities.
CO_2 emissions from coal and gas power generation in 2020 and 2030	*2020*: Coal: 10023 MtCO_2 Gas: 2872 MtCO_2 *2030*: Coal: 10264 MtCO_2 Coal: 3381 MtCO_2	-		

4.3 Renovate Europe

The Renovate Europe Campaign was initiated by EuroACE (The European Alliance of Companies for Energy Efficiency in Buildings). It is calling for an ambitious roadmap to be drawn up on how to triple the annual renovation rate of the EU building stock from the current rate of 1% to 3% by 2020 and to ensure that the aggregate result of those renovations leads to an 80% reduction of the energy demand of the building stock by 2050 as compared to 2005.[74]

Renovate Europe is a political communications campaign with the ambition to reduce the energy demand of the EU building stock by 80% by 2050 compared to 2005 levels through legislation and ambitious renovation programs. Thus impacts on informational diffusion and political / institutional effects are to be expected. Renovate Europe provides evidence that this results in direct benefits for economic development, air-pollution and health by fostering investments in buildings and reducing the firing of fossil fuels as well as indirect impacts on energy security by reducing the need of importing fuels.[75]

As Renovate Europe and GBPN both aim at an annual rate of renovation of 3 % by 2020, Renovate Europe's potential impact agrees with GBPN's impact in the EU. Thus Renovate Europe is not quantified separately. However, for a quantitative analysis of Renovate Europe in the context of Germany, we refer the reader to a study by Höhne et al (2015).[76]

4.4 UNEP/GEF en.lighten initiative

The en.lighten initiative is a public-private partnership between the United Nations Environment Programme (UNEP) and companies OSRAM and Philips Lighting, with support from the Global Environment Facility (GEF). It has been established to accelerate global market transformation to environmentally sustainable lighting technologies by developing a coordinated global strategy and providing technical support for the phase-out of inefficient lighting.[77] En.lighten directly supports countries participating in the Global Efficient Lighting Partnership Program, while engaging other countries in setting ambitious lighting strategies, with the goal to phase out inefficient lamps by as soon as 2016.

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74 Renovate Europe website: http://renovate-europe.eu/the-campaign/ambition-objectives/

75 Copenhagen Economics (2012): Multiple benefits of investing in energy efficient renovation of buildings. Available at: http://renovate-europe.eu/wp-content/uploads/2015/10/Multiple-benefits-of-EE-renovations-in-buildings-Full-report-and-appendix.pdf

76 https://newclimateinstitute.files.wordpress.com/2015/11/15013-initiatives-final-report.pdf

77 En-lighten website: http://www.enlighten-initiative.org/About.aspx

En.lighten propagates that shifting from inefficient to efficient lighting systems has many co-benefits, including cost savings at both the householder and a national level and decreased peak electricity demand, thereby the potential to reduce blackouts[78].

The goal of the UNEP/GEF en.lighten initiative to phase out inefficient lamps is covered by the SEAD initiative as well. Thus UNEP/GEF en.lighten initiative is not quantified separately.

4.5 Overview of qualitative achievements

In Table 9, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the buildings sector (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

Table 9: Categories of qualitative achievements for the initiatives on energy efficiency in buildings covered in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")									Notes/comments
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits	
Global Buildings Performance Network (GBPN)	y	X	X			X	(X)	X	X		• Capacity building for implementation, policy analysis and validation, and sharing of knowledge, data and best practices between regions. → impacts on informational diffusion and political / institutional effects • Multiple benefits such as job creation, economic stimulus, affordable and sustainable energy services, improved public health and thermal comfort. → impacts on economic development, air-pollution and health; indirect impacts on energy security

78 Harrison, N. et al. (2014): Enhancing Ambition through International Cooperative Initiatives. ISBN 978-92-893-2746-6. http://dx.doi.org/10.6027/TN2014-518

Super-efficient Equipment and Appliance Deployment (SEAD) Initiative	y	X	X	(X)			(X)		X		• Raising awareness about the importance of increasing the efficiency of common appliances and equipment; providing technical expertise and best practices to stakeholders. → impacts on informational diffusion and political / institutional effects • SEAD Global Efficiency Medals led to improved test lab capacity in India + the Philippines. → indirect impact on technology development • Save consumers in SEAD economies more than US$1 Trillion between 2010 and 2030; accelerate technological learning + innovation rates for energy efficient products + technologies; reduce peak-loads → impact on economic development; indirect impact on energy security
Renovate Europe		X	X			X	(X)	X	X		See row on GBPN above
UNEP/GEF en.lighten initiative	y	X	X	(X)			(X)		X		See row on SEAD Initiative above

5. Transport

5.1 Global Fuel Economy Initiative (GFEI)

5.1.1 Description

The Global Fuel Economy Initiative (GFEI) is a partnership of six organizations – IEA, ITF, UNEP, ICCT, UCDavis, and FIA Foundation – which seeks to promote the potential of a substantial but attainable improvement in vehicle fuel economy. Its main goals are

- a 50% reduction in the average fuel consumption of all light duty vehicles in use in 2050, compared to a 2005 baseline; and
- all new sold cars and vans must reach a similar target by 2030.

Achieving these goals is estimated to save $400 billion of oil use in 2050 (up to $8 trillion cumulated savings until 2050). Additional benefits of reduced oil use also include reduced fossil fuel dependence, reduced emissions of short-lived climate pollutants, such as black carbon, and improved air quality.

The global average annual improvement rate of fuel economy has remained close to 2.0% per year since 2005; 3.1% per year improvement is required to reach the GFEI target. OECD countries are improving at a rate of 2.6% on average per year; improvement rates in non-OECD countries are much lower, with an average improvement of 0.2% annually[79].

The 3 core activities of the GFEI are:

- Data and research analysis of fuel economy potentials by country and region;
- In-country capacity-building support for national and regional policy-making efforts;
- Outreach and awareness campaigns raising to stakeholders (e.g. vehicle manufacturers);

The GFEI Toolkit team are able to establish a baseline in each country; present policy options and case studies; and enable all stakeholders to engage in the policy process. Countries such as Indonesia, Kenya, Ethiopia and Chile are already taking part in this policy development process, and we want to share their experiences with others.[80]

5.1.2 Quantification

The GFEI directly provide a quantification of their impacts by providing CO_2 emissions from LDV in a baseline and a policy scenario. According to the GFEI, the impact is 282 $MtCO_2e$ in 2020 and

79 http://www.globalfueleconomy.org/about-gfei
http://www.globalfueleconomy.org/media/203446/gfei-state-of-the-world-report-2016.pdf

80 Ibid.

765 $MtCO_2e$ in 2030. To estimate the contribution of the GFEI beyond NDCs we compared the policy scenario with the development of energy use from transport (all modes) taken from the WEO 2015 new policies scenario. To do this we assumed that all modes of transport have the same growth of energy consumption. The resulting contribution of the GFEI is a reduction of 162 $MtCO_2e$ in 2020 and 355 $MtCO_2e$ in 2030 beyond the WEO NPS.

The following assumptions were used for the breakdown by country:

- Direct application of global goal to each country (i.e. halve fuel consumption compared to national 2005 efficiency);
- BAU scenario: linear continuation of 2005-13 improvement trend until 2050;
- Regional growth rates of vehicle-kilometers for passenger transport from ITF Transport Outlook 2015, scaled linearly for intermittent years and applied uniformly to all countries within a region;
- Transformation person-km to vehicle-km using a load factor of 1.5;
- Efficiency increases do not affect the vehicle-kilometers (i.e. no rebound effects).

GHG emission reductions were then calculated as the difference between emissions under the BAU vehicle efficiency and the GFEI vehicle efficiency.

Table 10: Parameter descriptions, values, units and sources used in the quantification of the Global Fuel Economy Initiative (GFEI).

Description	Value	Unit	Source
CO_2 emissions from LDVs (GFEI scenario)	4190 (2013), 4522 (2020), 4480 (2030)	$MtCO_2$	GFEI State of the World report 2016[81]
Transport emission development	8% above 2013 in 2020, 17% in 2030	%	WEO 2015 NPS
Regional growth of vehicle km for passenger transport		%	ITF Transport Outlook 2015[82]
Historic amount of pkm of private cars by country		million pkm	ITF Transport Outlook 2013, ITF Transport Outlook 2015, ICCT

81 http://www.globalfueleconomy.org/media/203446/gfei-state-of-the-world-report-2016.pdf

82 http://dx.doi.org/10.1787/888933168734

			transport roadmap Energy model, DG Move Statistical Pocketbook 2015[83], (for Indonesia) combination of data from World Bank[84] (pkm of rail) and Global Investment Center[85] (share of rail and road transport in total pkm)
Conversion pkm to vkm	1.5	Passengers/car	Umweltbundesamt[86]

5.2 UIC Low Carbon Rail Transport Challenge

5.2.1 Description

The challenge was announced by UIC in September 2014 and sets 2030 and 2050 targets for energy consumption, CO_2 emissions and modal shift:

1. Reduction in specific average final energy consumption (kJ/tkm and pkm) from train operations:
   - 50% reduction by 2030 (relative to a 1990 baseline);
   - 60% reduction by 2050 (relative to a 1990 baseline).
2. Reduction in specific average CO_2 emissions (gCO_2/tkm and pkm) from train operations:
   - 50% reduction by 2030 (relative to a 1990 baseline);
   - 75% reduction by 2050 (relative to a 1990 baseline).
3. Rail share of passenger transport (passenger/km) to achieve a:
   - 50% increase by 2030, relative to a 2010 baseline;
   - 100% increase, a doubling by 2050, relative to a 2010 baseline.
4. Rail share of freight land transport (tonne/km) to be:
   - equal with road by 2030;
   - and 50% greater than road by 2050.

Railway companies will achieve these targets across the world, in aggregate terms. These targets will be achieved through procuring more efficient rolling stock, electrification, use of renewable energies, energy and traffic management systems as well as efficient driving. The UIC are seeking partnerships to achieve these targets and help to secure the IEA's 2 Degree S.[87] These include:

- partnerships with the private sector to support innovation and greater energy efficiency;

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83 http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2015_en.htm

84 http://data.worldbank.org/indicator/IS.RRS.PASG.KM?end=2014&locations=ID&page=2&start=1989

85 *Indonesia Investment, Trade Strategy and Agreements Handbook - Strategic Information and Basic Agreements (World Business and Investment Library),* September 10, 2015, Int'l Business Publications, USA; ISBN-13: 978-1514521922

86 https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten

87 http://old.uic.org/IMG/pdf/low_carbon_rail_challenge_technical_report.pdf

- partnerships with national governments and International Institutions to support modal shift.

5.2.2 Quantification

In quantifying the UIC challenge, we used the following assumptions:

- The 2030 emission target is identical to the efficiency target (no fuel shift) and not evaluated separately.
- Linear growth of freight and passenger transport until 2050.
- Modal split of freight transport 2030: global goal is achieved already, breakdown of target to countries is interpreted as keeping current shares in each country.
- Modal split passenger transport: BAU is equivalent to no change of shares until 2030. 50% increase is met at national level.
- Efficiency of cars improves by 2% annually to estimate the modal shift impact (taken from GFEI calculations). Energy efficiency of rail improves at historic rates in the NDC case (no explicit efficiency policies).
- Autonomous efficiency increase of rail transport until 2030 is estimated in the scenarios: at historic rates and half of the historic rates.

To calculate emissions in the BAU case for efficiency improvement, we estimated the autonomous efficiency improvement of rail transport based on historic improvement rates which are typically in the order of 1% to 3% per year in the different countries. Historic activity data and efficiencies are published by UIC, projected activity data is taken from the ITF Transport Outlook 2015. To estimate the impact of the modal shift in passenger transport, the difference in emission intensity in gCO_2/pkm between cars and train on a country level is used.

Table 11: Parameter descriptions, values, units and sources used in the quantification of the UIC Low Carbon Rail Transport Challenge.

Description	Value	Unit	Source
Historic activity data for rail freight and passenger transport by country		Tkm or pkm	UIC Railway Handbook 2015, UIC Railway Handbook 2013, OECD[88], DG Move Statistical Pocket Book 2015[89], World Bank[90]
Projected activity data for rail freight		Tkm/pkm	ITF Transport Outlook 2015[91]

88 http://stats.oecd.org/Index.aspx?DataSetCode=ITF_PASSENGER_TRANSPORT#

89 http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2015_en.htm

90 http://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6

and passenger transport by country			
National CO_2 intensities of car transport in 2005		gCO_2/pkm	Estimated from fuel economy values in GFEI State of the World report 2016[92]
Improvement of CO_2 intensity of car transport	2% per year	%	GFEI target, starting in 2005

5.3 SmartWay

SmartWay is an US EPA program that helps the freight transportation sector improve supply chain efficiency. SmartWay Transport aims to increase the availability and market penetration of fuel efficient technologies and strategies that help freight companies save money while also reducing adverse environmental impacts. Specifically, SmartWay Transport programs lower emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), and particulate matter (PM). Since 2004, SmartWay Partners report:

- Saving 144.3 million barrels of fuel; $20.6 billion in fuel costs saved;
- Eliminating 61.7 million metric tons of CO_2;
- Eliminating 1,070,000 tons of NO_x;
- Eliminating 43,000 tons of PM.

In addition to the U.S. EPA program, SmartWay has been administered in Canada by Natural Resources Canada since 2012. SmartWay continues to positively influence green freight programs in other regions of the world, creating a single seamless network that can effectively cut carbon from our global goods movement system. The Mexican program "Transporte Limpio" is modelled on SmartWay.93

This program has not been quantitatively analysed because it does not provide a quantitative goal or sufficient historical data to estimate future emission reductions.

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91 http://dx.doi.org/10.1787/888933168674, http://dx.doi.org/10.1787/888933168621, http://dx.doi.org/10.1787/888933168734, http://dx.doi.org/10.1787/888933168693

92 http://www.globalfueleconomy.org/media/203446/gfei-state-of-the-world-report-2016.pdf

93 https://www3.epa.gov/smartway/about/index.htm

5.4 UITP Declaration on Climate Leadership

The goal of the International Association of public transport (UITP) is to double the market share of public transport worldwide by 2025. 550 $MtCO_2$ could be saved in 2025 by such a shift towards public transport, cycling and walking. Around 350 climate pledges, commitments and actions from over 110 public transport undertakings from both the private and public sector have been identified that will help support of UITP's goal.94 These actions can be grouped into five categories:

1. Public Transport – Buses: initiatives and actions relating to clean fuels and efficiency including the development of new lines and low carbon buses.
2. Public Transport – Trains, Trams and Metros: includes initiatives and actions relating to new lines and train cars as well as initiatives designed to improve vehicle efficiency.
3. Combined Mobility – includes enhancements in walking facilities, car and bike sharing schemes (including shared transport systems) and cycle lanes and facilities.
4. Improvements and Investments in Infrastructures – includes initiatives improving the efficiency of lighting (e.g. LEDs); energy production systems and use of green electricity, energy efficient buildings, stations and green procurement.
5. Awareness and Action – includes stakeholder engagement (internal and external) and development of carbon reduction strategies.

The UITP has not been quantitatively analysed because this would require city-level information on GHG emissions from public and private transport, which is generally not available and very uncertain to estimate.

5.5 Overview of qualitative achievements

In Table 12, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the buildings sector (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

94 http://www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/09/TRANSPORT-Action-Plan-UITC.pdf

Table 12: Categories of qualitative achievements for the initiatives on transport in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")									Notes/comments
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits	
SmartWay	Y	X	(x)	(x)		X	X	X	X		Indirect effects due to creating demand for efficient trucks/trailers and logistics. Partners need to report annually for each truck/trailer and pledge to reduce emissions, i.e. forcing them to implement MRV-Systems and analyse the data.
Global Fuel Economy Initiative	Y	X	X	(x)	Lobbying, policy advice	X	X	X	X		
UIC Rail challenge	Y		(X)			X	X	X			The challenge does not really explain how the target will be achieved/ what actions UIC is taking. It seems to be up to the individual members to act.
UITC Challenge	Y	X	X			X		X	X	Reduced land use	The majority of actions are planned to be undertaken in Europe and around one third will be undertaken in regions distributed relatively evenly around the globe in just over 80 cities and regions.

6. Industry and Business

6.1 American Business Acts on Climate Pledge

6.1.1 Description

The American Business Acts on Climate Pledge (ABAOCP) is a collection of commitments from individual companies[95]. The commitments set company-specific goals for several indicators, i.e. emission reductions, renewable energy production or water use.

95 http://www.whitehouse.gov/ClimatePledge

6.1.2 Quantification

We quantify emission reductions individually for companies that present an emission target and for which company-wide emission data is available in CDP's Global 500[96]. For these companies, we project that their emissions would have declined as fast as total US emissions in the New Policies Scenario of the IEA's World Energy Outlook, which includes INDC pledges. The comparison of this baseline to the emission target of each company gives the impact of the initiative.

For companies that do not specify an explicit emission target in the ABAOCP, but who do spell out targets in other areas such as renewable energy, we assume an implicit emission target consisting of the average target of the companies with targets available. Further, for companies without emission data available, we assume that the emission reduction impact of the ABAOCP per $ of revenue is equal to that of companies with emission data available. Revenue data for this calculation is sourced from the Fortune Global 500[97] or from annual reports.

Following this procedure, we estimate the impact of the ABAOCP to be 17 $MtCO_2e$ in 2020. As only very few companies have specified targets beyond 2020, we assume that the emissions of all companies stay constant after 2020 until 2030. The comparison to the WEO baseline in 2030 then shows that the impact in 2030 under this assumption is less than one $MtCO_2e$. Table 13 provides the sources of all parameters and values used in the quantification of the ABAOCP.

Table 13: Parameter descriptions, values, units and sources used in the quantification of the American Business Acts on Climate Pledge.

Description	Value	Unit	Source	Comments
Emission targets by company		-	The White House (2015)[98]	
Historical emissions by company		tCO_2e	CDP [99]	
Decline of total US emissions between	-3.4%	-	IEA WEO 2015 New Policies Scenario	

96 https://data.cdp.net/Climate-Change/Global-500-Emissions-and-Response-Status-2013/marp-zazk
97 http://fortune.com/global500/
98 http://www.whitehouse.gov/ClimatePledge
99 https://data.cdp.net/Climate-Change/Global-500-Emissions-and-Response-Status-2013/marp-zazk

2013 and 2020				
Revenue by company		US$	Fortune Global 500 [100]	
Total revenue of ABAOCP companies	4.2	Trillion US$	The White House (2015)	

6.2 Caring for Climate

6.2.1 Description

Caring for Climate (C4C) was launched by the UN Secretary General in 2007. Participating businesses must set climate targets and strategies, and must regularly disclose their GHG emissions. C4C further organizes periodic business summits to highlight business activities and to provide a forum for dialogue between business and government officials.

6.2.2 Quantification

Only few of the participating companies in C4C provide sufficient data to assess the GHG impact of their activities. Therefore, we have to rely on the data provided in the Progress Report 2015[101]. The report analyses GHG emissions from a sample of 139 companies for 2013 and 2014 and provides an estimate for future reductions, if the GHG emission targets are met. Although no date for these future reductions is given, we assume that they occur in 2020 and are additional to the reductions between 2013 and 2014, as given in the Progress Report. Further, we assume that the relative GHG reductions of these 139 companies are representative for all C4C participants and that their share of total C4C emissions is as high as the share of companies with data available in the American Business Acts on Climate Change initiative. Following this procedure, we estimate the emissions of all C4C members to be 1.6 $GtCO_2e$ in 2020, if the climate targets are met.

For a comparative baseline, we assume that without the C4C initiative, emissions would have grown as global emissions in the New Policies Scenario of the IEA's World Energy Outlook, from 2013 levels. As current business climate targets rarely go beyond 2020, we assume that emissions

100 http://fortune.com/global500/

101 https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/C4CReport2015.pdf

under the C4C initiative stay constant between 2020 and 2030. The comparison to the baseline then shows the potential impact of the C4C to be 490 $MtCO_2e$ in 2020 and 600 $MtCO_2e$ in 2030.

As most participating businesses act internationally, we do not attempt to break down the impact into reductions in different countries. Overlaps with other business initiatives are instead calculated by comparing member companies for all initiatives and eliminating double counting of the reductions of one company. Table 14 provides the sources of all parameters and values used in the quantification of C4C.

Table 14: Parameter descriptions, values, units and sources used in the quantification of Caring for Climate.

Description	Value	Unit	Source
Share of total reductions from companies with data available in ABAOCP	78%	-	Analysis for ABAOCP (see above)
Sample companies' scope 2 emissions in 2013	1570	$MtCO_2e$	Progress Report 2015 [102]
Sample companies' scope 2 emissions in 2014	1355	$MtCO_2e$	Progress Report 2015
Sample companies' future GHG reductions, if targets are met	94	$MtCO_2e$	Progress Report 2015
Growth of global GHG emissions between 2013 and 2020	4.5%		IEA WEO 2015 New Policies Scenario
Growth of global GHG emissions between 2013 and 2030	10.1%		IEA WEO 2015 New Policies Scenario

6.3 RE100

RE100 is an initiative of companies that have committed to source 100% of their electricity from renewable sources by a certain individual target year. The work of RE100 is supported by a Steering Committee and a Technical Advisory Group.

102 https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/C4CReport2015.pdf

6.3.1 Quantification

We base our quantification of the impact of RE100 on general information provided in the Annual Report 2016[103] and on company-specific data provided on the RE100 website[104]. The report provides total and renewable electricity consumption by RE100 members in 2014 and the average target of all companies for RE share in 2020, 80%. We assume that the targeted RE share is reached linearly over time and that total electricity consumption grows at the same rate as projected for global electricity generation in the New Policies Scenario (NPS) of IEA's World Energy Outlook. Further, we assume that without the initiative, the RE share of RE100 members would have grown at the same rate as the global RE share in the NPS. The comparison of the targeted RE share and the share projected by the NPS allows us to calculate the additional renewable electricity use attributable to RE100. We then translate this additional RE use into a range of GHG emission reductions. For the lower limit of the range, we assume that RE replaces gas, while the replacement of coal is assumed for the upper limit. Emission factors for gas and coal are sourced from the NPS.

For 2020, the procedure estimates an additional RE use of 34 TWh, which translates to a potential impact of 17 to 34 $MtCO_2e$. For 2030, we perform company-specific calculations for those companies, whose target year is beyond 2030, again assuming a linear increase of their RE share. As a few companies have not published their target year yet, we assume that those companies will reach 100% RE in 2030. The result for 2030 is an additional RE use of 53 TWh, or GHG reductions of 24 to 50 $MtCO_2e$.

Similar to Caring for Climate, we do not attempt to break down the impact of RE100 into reductions in different countries and overlaps with other business initiatives are calculated on a company level. We also note here that – as for other business initiatives – we have not taken into account the fact that these initiatives will grow in scope by getting more and more subscribing companies in the coming years. However, such a quantification is available in a study by CDP and the New Climate Institute (2016).[105]

Table 15 provides the sources of all parameters and values used in the quantification of RE100.

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103 http://media.virbcdn.com/files/f9/d6e716c56a9b3312-RE100AnnualReport2016_v17.pdf

104 http://there100.org/companies

105 https://newclimateinstitute.files.wordpress.com/2016/06/business-end-of-climate-change.pdf

Table 15: Parameter descriptions, values, units and sources used in the quantification of RE100.

Description	Value	Unit	Source
Total electricity use of RE100 members in 2014	75.5	TWh	RE100 Annual Report 2016
Renewable electricity use of RE100 members in 2014	25.5	TWh	RE100 Annual Report 2016
Average target for RE share of RE100 members in 2020	80%	-	RE100 Annual Report 2016
Company-specific electricity use, RE share and RE100 target year			RE100 list of companies on http://there100.org/companies
Growth of global electricity generation between 2014 and 2020	13.8%		IEA WEO 2015 New Policies Scenario
Growth of global electricity generation between 2014 and 2030	38.8%		Ibid.
Growth of global RE share between 2014 and 2020	18.3%		Ibid.
Growth of global RE share between 2014 and 2030	38.7%		Ibid.
Emission factor gas in 2020	0.50	tCO_2 / MWh	Ibid.
Emission factor coal in 2020	0.99	tCO_2 / MWh	Ibid.
Emission factor gas in 2030	0.46	tCO_2 / MWh	Ibid.
Emission factor coal in 2030	0.94	tCO_2 / MWh	Ibid.

6.4 Ultra-Low Carbon Dioxide Steelmaking

6.4.1 Description

The initiative for Ultra-Low Carbon Dioxide Steelmaking (ULCOS) is a consortium of European steel companies and organizations. ULCOS develops and tests four new steelmaking technologies that could deliver significant CO_2 reductions. The aim of the initiative is to reduce "the CO_2 emis-

sions of today's best routes by at least 50 percent"[106].

6.4.2 Quantification

Of the four new technologies developed by ULCOS, only the "HIsarna" technology has a chance to be available by 2030 (Arens et al., 2016).[107] HIsarna improves the CO_2 intensity of blast furnace (BF) steel, but is not applicable to electric arc furnace (EAF) steel. In 2010, ULCOS expected the results from its research program to be rolled out into production plants "some 15 to 20 years from now"[108]. Therefore, we estimate a range of the GHG impact of ULCOS, by varying the starting year of the rollout. For the lower limit, we assume that the rollout starts in or after 2030; the corresponding GHG impact is zero in both 2020 and 2030. For the upper limit, we assume that the rollout starts in 2025 and estimate the corresponding GHG impact in 2030.

We use the diffusion rate of new technologies in the steel sector given in Arens et al. (2016) and the projection of European steel production and CO_2 intensities given in BCG (2013).[109] Further, we assume that the rate of BF steel to EAF steel in 2030 remains equal to the rate in 2010. Finally, we assume that without ULCOS the CO_2 intensities of BF steel and of EAF steel remain at the 2010 level in 2030, as was done in BCG (2013).

Following this procedure, we estimate CO_2 emissions of the European steel sector in 2030 to be 255 $MtCO_2e$ with the new HIsarna technology, compared to 264 $MtCO_2eq$ without the technology. Consequently, the upper limit for the potential impact of the ULCOS initiative in 2030 is estimated at 9 $MtCO_2eq$. However, as most new technologies developed under ULCOS are only expected to be rolled out after 2030, the impact of ULCOS could grow considerable in the long-term after 2030, more so than for other initiatives. Table 16 summarizes the sources of all parameters and values used in the quantification of ULCOS.

Table 16: Parameter descriptions, values, units and sources used in the quantification of ULCOS.

Description	Value	Unit	Source
Diffusion of new technology 5 years after rollout	15%		Arens et al. (2016)
HIsarna CO_2 intensity	1.349	tCO_2 / t steel	Arens et al. (2016)

106 http://www.ulcos.org/en/about_ulcos/home.php

107 http://dx.doi.org/10.1016/j.jclepro.2015.12.097

108 http://www.ulcos.org/en/about_ulcos/perspectives.php

109 http://www.stahl-online.de//wp-content/uploads/2013/09/Schlussbericht-Studie-Low-carbon-Europe-2050_-Mai-20131.pdf

BF steel CO_2 intensity	1.888	tCO_2 / t steel	BCG (2013)
EAF steel CO_2 intensity	0.455	tCO_2 / t steel	BCG (2013)
EU crude steel production in 2030	204	Mt steel	BCG (2013)
BF steel production in 2010	101	Mt steel	BCG (2013)
EAF steel production in 2010	71	Mt steel	BCG (2013)

6.5 Eco Partnerships

The US – China EcoPartnerships program[110] promotes partnerships between businesses, universities, localities and non-profits involving at least one partner from each of the two countries. Each partnership has to develop and demonstrate an innovation or a pilot project in clean energy, climate change and/or environmental solutions within three years[111]. The initiative does not provide funding for the partnerships, but helps with bureaucratic hurdles and promotes the partnerships' achievements. This involves a signing ceremony at a high-profile US – China dialogue, press releases and presentation opportunities.

The EcoPartnerships program was established in 2008. "A handful" of new partnerships are selected each year and replace finished ones, leaving a roughly consistent number of 25 active partnerships. Current partnerships include a pilot concentrated solar power plant with 24/7 operation[112], the incorporation of transport emissions into Shenzhen's emissions trading scheme[113], the reduction of emissions from ships in ports[114] and a demand side management program in Beijing[115].

The expected impact of the EcoPartnerships program was not quantified because it does not have a target on GHG emission and the selection process of new partnerships is only vaguely specified and not based on emission reductions.

110 https://ecopartnerships.lbl.gov/

111 https://ecopartnerships.lbl.gov/sites/all/files/ecop-factsheet-11-2015.pdf

112 Wilson Solarpower and Shenzhen Enesoon Science & Technology Co.

113 Environmental Defense Fund and Shenzhen Low Carbon Development Foundation

114 Port of Los Angeles and Shanghai Municipal Transportation Commission

115 Natural Resources Defense Council and Beijing Energy and Environmental Protection Center

6.6 Overview of qualitative achievements

In Table 17, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the business and industry thematic area (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

Table 17: Categories of qualitative achievements for the business and industry initiatives covered in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")									Notes/comments
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits	
ABAOCP	y		(X)								
Caring for Climate	y		X								
RE100	y		(X)				X				
ULCOS				X							
Eco Partnerships	y	X	X	X					X		We consider that the initiative directly causes GHG reductions, technology development and economic development, because some of the pilot projects implemented by the partnerships directly contribute in these areas.

7. Renewable Energy

7.1 European Wind Initiative

7.1.1 Description

The European Wind Initiative (EWI) sets out an ambitious target for wind energy to account for a 20% share of total EU electricity consumption by 2020 (33% by 2030). The objective is to make onshore wind the most competitive energy source by 2020, with offshore following by 2030. "TP Wind estimates that the levelised cost of energy can be reduced up to 50% for offshore wind energy and up to 20% for onshore compared to 2008 over the next 20 years".[116]

The initiative intends to achieve this objective by coordinating with wind energy professionals and researchers, together with the European Commission, in order to establish common R&D priorities for wind energy so that industry and public research funds are effectively targeted. The European Wind Initiative requires a total investment of €6 billion between 2010-2020 from both public and private resources in wind energy R&D. 'Half of this amount should come from private investors, and the remaining part from public funds: 52% private (€3.1bn), 31% (€1.86bn) from the EU budget and the remaining 17% (about €1bn) from Member States' national programmes'.[117] In addition, it is also envisaged that the implementation of the European Wind Initiative will also lead to the creation of 250 000 new skilled jobs in the EU by 2020.

The European Wind Initiative has so far contributed to the following achievements in the wind energy sector:

- Since the establishment of the European Wind Initiative, levels of investment in wind energy have increased with coordinated efforts contributing to the installation of 117 GW of wind capacity in Europe, which in a normal year would generate 257 TWh of electricity (equivalent to 8 % of the electricity consumption of the EU).[118]
- "The European wind industry has a positive trade balance for wind turbine components of €2.45 billion in 2012. In the same year, European companies held 55% of global wind energy patent applications, compared to the EU industry overall share of 32.5%."[119]
- In 2011, the European wind industry employed 270,000 people and this could increase up to 675,000 by 2020 according to the European Commission.[120]

116 http://www.windplatform.eu/fileadmin/ewetp_docs/Documents/reports/TPWind_SRA.pdf
117 http://www.windplatform.eu/fileadmin/ewetp_docs/Documents/reports/TPWind_SRA.pdf
118 http://www.windplatform.eu/fileadmin/ewetp_docs/Documents/reports/TPWind_SRA.pdf
119 http://www.windplatform.eu/fileadmin/ewetp_docs/Documents/reports/TPWind_SRA.pdf
120 http://www.windplatform.eu/fileadmin/ewetp_docs/Documents/reports/TPWind_SRA.pdf

7.1.2 Quantification

We have quantified the potential impact of the European Wind Initiative as follows. The values for wind generation and total electricity generation are taken for the years 2020 and 2030 under the WEO New Policies Scenario. The additional wind generation in TWh is then calculated based upon the difference between the targets set under the European Wind Initiative in both 2020 and 2030 (as a share of total electricity generation corresponding to the WEO NPS) and the expected level of wind power generation assumed under the WEO NPS (as a share of the total electricity generation). We then estimate a range of GHG impact depending upon whether renewables displace natural gas first, then oil and then coal (low estimation) or coal first, then oil and then gas (high estimation) using emission factors that have been derived from WEO data. The data used in the quantification are given in Table 18.

Table 18: Parameter descriptions, values, units and sources used in the quantification of the EWI.

Description	Value	Unit	Source
Total electricity generation EU (2020)	3266	TWh	IEA WEO 2015 New Policies Scenario
Total electricity generation EU (2030)	3352	TWh	
EU electricity generation from wind (2020) – INDC scenario	400	TWh	
EU electricity generation from wind (2030) – INDC scenario	631	TWh	
Emission factor coal (2020)	1.02	tCO_2 / MWh	
Emission factor oil (2020)	0.89	tCO_2 / MWh	
Emission factor gas (2020)	0.47	tCO_2 / MWh	
Emission factor coal (2030)	1.04	tCO_2 / MWh	
Emission factor oil (2030)	0.95	tCO_2 / MWh	
Emission factor gas (2030)	0.44	tCO_2 / MWh	

7.2 Solar Europe Industry Initiative (SEII)

7.2.1 Description

The Strategic Energy Technology (SET) plan was a European initiative, which was originally launched in 2006 with the objective to accelerate the development and deployment of low carbon technologies. The Solar Europe Industry Initiative (SEII) was established by the European Photovoltaic Industry Association (now SolarPower Europe) in 2006 to underpin the implementation of the SET plan in the photovoltaic sector. The vision of the SEII was to 'establish PV as a mainstream clean, sustainable and competitive energy technology providing up to 12% of the European electricity demand by 2020, up to 20% in 2030 and 30% in 2050'.[121] In order to achieve these objectives, the initiative aims to co-ordinate R&D efforts in order to bring down the cost of solar PV to increase usage of the technology. The research priorities of the SEII, along with estimated budgets and funding instruments are outlined in the 3-year Implementation Plan 2010-2012 and in the 3-year Implementation Plan 2013-2015. In September 2015, the European Commission announced a new integrated SET plan, which is based upon 10 actions structured around the research and innovation priorities of the Energy Union Strategy. To reflect the establishment of new governance structures, the SEII was merged with the European Photovoltaic Technology Platform (a network of academics, member state representatives and industry) to form the European and Technology Innovation Platform (ETIP) in January 2016.[122]

The Solar Europe Industry Initiative has so far contributed to the following achievements in the solar energy sector:

- The initiative has contributed to an increase in the deployment of solar energy in the EU with 80 GW installed by 2013 based upon data from the World Energy Outlook.
- "Parity with wholesale market electricity will be reached by 2030 almost everywhere. There is every reason to believe that this development will continue after 2030 because there is still a huge improvement potential in various PV technologies."[123]

7.2.2 Quantification

We have quantified the potential impact of the Solar Europe Industry Initiative as follows. The values for solar generation and total electricity generation are taken for the years 2020 and 2030 under the WEO New Policies Scenario. The additional solar generation in TWh is then calculated based upon the difference between the targets set under the Solar Europe Industry Initiative in both 2020 and 2030 (as a share of total electricity generation corresponding to the WEO NPS) and the expected level of solar generation assumed under the WEO NPS (as a share of the total electricity generation). We then estimate a range of GHG impact depending upon whether renewables

121 http://www.aie.eu/files/Directives_EU/Solar%20europe%20Industry%20Initiative-%20DRAFT%20SUMMARY%20IMPLEMENTATION%20PLAN%202010-2012.pdf

122 http://www.eupvplatform.org/set-plan.html

123 http://www.eupvplatform.org/publications/other-publications/pv-costs.html

displace natural gas first, then oil and then coal (low estimation) or coal first, then oil and then gas (high estimation) using emission factors that have been derived from WEO data. The data used in the quantification are given in Table 19.

Table 19: Parameter descriptions, values, units and sources used in the quantification of the SEII.

Description	Value	Unit	Source
Total electricity generation EU (2020)	3266	TWh	IEA WEO 2015 New Policies Scenario
Total electricity generation EU (2030)	3352	TWh	
EU electricity generation from solar PV (2020) – INDC scenario	127	TWh	
EU electricity generation from solar PV (2030) – INDC scenario	161	TWh	
Emission factor coal (2020)	1.02	tCO_2 / MWh	
Emission factor oil (2020)	0.89	tCO_2 / MWh	
Emission factor gas (2020)	0.47	tCO_2 / MWh	
Emission factor coal (2030)	1.04	tCO_2 / MWh	
Emission factor oil (2030)	0.95	tCO_2 / MWh	
Emission factor gas (2030)	0.44	tCO_2 / MWh	

7.3 SunShot Initiative (US)

7.3.1 Description

The SunShot Initiative was established by the U.S. Department of Energy (DOE) in February 2011, with the aim to drive down the cost of solar electricity to $0.06 per kilowatt-hour or $1 per watt (not including incentives). This in turn will enable solar-generated power to account for 15–18%

of America's electricity generation by 2030.[124] In order to achieve this goal the SunShot Initiative funds collaborative research between private companies, universities, state and local governments, non for profit organisations and national laboratories across five program areas: photovoltaics (PV), concentrating solar power (CSP), soft costs (or balance of systems costs), systems integration, and technology to market. Based upon this coordinated research effort it is expected that the initiative will facilitate the development, demonstration and deployment of solar energy projects.[125]

SunShot has contributed to driving down costs of solar energy over the last five years and the solar industry is already more than 70% of the way to achieving the cost target of the Initiative. Furthermore, as a consequence of investments from the SunShot Initiative and the accelerated pace of industry to fulfil the cost target, solar generated electricity is now price competitive with traditional energy sources in 14 states across the United States (including California, Hawaii and Texas). 'Increased deployment of affordable and accessible solar energy is growing quickly across the country. In 46 of America's 50 largest cities, a fully-financed, typically-sized solar PV system is a better investment than a typical stock market index fund.'[126]

7.3.2 Quantification

We have quantified the potential impact of the Sunshot Initiative as follows. The values for solar generation and total electricity generation are taken for 2030 under the WEO New Policies Scenario. The additional solar generation in TWh is then calculated based upon the difference between the targets set under the Sunshot Initiative in 2030 (as a share of total electricity generation corresponding to the WEO NPS) and the expected level of solar generation assumed under the WEO NPS (as a share of the total electricity generation). We then estimate a range of GHG impact depending upon whether renewables displace natural gas first, then oil and then coal (low estimation) or coal first, then oil and then gas (high estimation) using emission factors that have been derived from WEO data. The data used in the quantification are given in Table 20.

Table 20: Parameter descriptions, values, units and sources used in the quantification of the SunShot Initiative.

Description	Value	Unit	Source
Total electricity generation USA (2020)	4467	TWh	IEA WEO 2015 New Policies Scenario
Total electricity generation USA (2030)	4638	TWh	
USA electricity generation	72	TWh	

124 http://www.uspvmc.org/about_PVMC_sunshot.html (accessed 24 March, 2016)

125 http://energy.gov/eere/sunshot/about-sunshot-initiative

126 Ibid.

from wind (2020) – INDC scenario			
USA electricity generation from wind (2030) – INDC scenario	142	TWh	
Emission factor coal (2020)	0.91	tCO_2 / MWh	
Emission factor oil (2020)	0.70	tCO_2 / MWh	
Emission factor gas (2020)	0.40	tCO_2 / MWh	
Emission factor coal (2030)	0.90	tCO_2 / MWh	
Emission factor oil (2030)	0.67	tCO_2 / MWh	
Emission factor gas (2030)	0.39	tCO_2 / MWh	

7.4 Wind Program (US)

7.4.1 Description

The U.S. Department of Energy (DOE) published a report in 2008, which assessed the technical feasibility of generating 20% of the nation's electricity demand via wind energy by 2030.[127] In order to achieve such an increase in the deployment of wind energy the report concludes that it will be necessary to:

- Enhance the transmission infrastructure, improve the reliability and operation of wind systems and increase wind manufacturing capacity in the country;
- The number of turbine installations would need to increase from approximately 2000 per year in 2006 to almost 7000 per year in 2017;

The Wind Program, established by the U.S. Department of Energy (DOE), therefore aims to accelerate the deployment of wind power technologies by removing barriers, lowering costs and improving performance.[128] In order to achieve this aim, the initiative collaborates with national laboratories, industry, universities and other federal agencies to conduct common research and development activities through competitively selected, directly funded and cost-shared projects. The Wind Program supports the deployment of wind energy in the U.S. by investing in improvements to wind plant design, technology development and the identification of high quality wind resources.[129]

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127 http://energy.gov/eere/wind/20-wind-energy-2030-increasing-wind-energys-contribution-us-electricity-supply

128 http://energy.gov/eere/wind/about-doe-wind-program

129 Ibid.

The Wind Program has contributed to a considerable increase in the deployment of wind energy in the country by funding research to lower costs and remove barriers. Key trends in the wind industry in the U.S. include:

- According to the World Energy Outlook, in 2013 the U.S. reached over 60,000 MW of installed wind capacity, which is approximately 1/5 of the wind capacity required in 2030 to provide 20 % of all electricity for the nation.[130] Based upon the 2014 Wind Technologies Market Report, the installation of wind energy capacity increased further in 2014 with 4,584 MW of new capacity added in the United States and $8.3 billion invested.[131]
- "Wind turbine prices have since dropped substantially, despite increases in hub heights and especially rotor diameters. Recently announced transactions feature pricing in the $850–$1,250/kW range. These price reductions, coupled with improved turbine technology, have exerted downward pressure on project costs and wind power prices."[132]
- "Solid progress on overcoming transmission barriers continued. About 2,000 miles of transmission lines came on-line in 2014 — substantially lower than 2013 but consistent with the 2009 - 2012 time period. The wind industry has identified 18 near-term transmission projects that — if all were completed —could carry 55 - 60 GW of additional wind capacity." [133]

7.4.2 Quantification

We have quantified the potential impact of the Wind Program Initiative as follows. The values for wind generation and total electricity generation are taken for 2030 under the WEO New Policies Scenario. The additional wind generation in TWh is then calculated based upon the difference between the targets set under the Wind Program Initiative in 2030 (as a share of total electricity generation corresponding to the WEO NPS) and the expected level of wind generation assumed under the WEO NPS (as a share of the total electricity generation). We then estimate a range of GHG impact depending upon whether renewables displace natural gas first, then oil and then coal (low estimation) or coal first, then oil and then gas (high estimation) using emission factors that have been derived from WEO data. The data used in the quantification are given in Table 21.

130 http://www1.eere.energy.gov/wind/pdfs/wind_accomplishments.pdf

131 http://energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf

132 Ibid.

133 http://climateinitiativesplatform.org/index.php/Wind_Program (accessed 24 March, 2016)

Table 21: Parameter descriptions, values, units and sources used in the quantification of the US Wind Program.

Description	Value	Unit	Source
Total electricity generation USA (2020)	4467	TWh	IEA WEO 2015 New Policies Scenario
Total electricity generation USA (2030)	4638	TWh	
USA electricity generation from wind (2020) – INDC scenario	277	TWh	
USA electricity generation from wind (2030) – INDC scenario	474	TWh	
Emission factor coal (2020)	0.91	tCO_2 / MWh	
Emission factor oil (2020)	0.70	tCO_2 / MWh	
Emission factor gas (2020)	0.40	tCO_2 / MWh	
Emission factor coal (2030)	0.90	tCO_2 / MWh	
Emission factor oil (2030)	0.67	tCO_2 / MWh	
Emission factor gas (2030)	0.39	tCO_2 / MWh	

7.5 African Renewable Energy Initiative

Africa pledged its support for renewables during the Conference of Parties (COP) 21 meeting in Paris by establishing the African Renewable Energy Initiative (AERI). 'The Initiative is led by the African Union's commission, the New Partnership for Africa's Development (NEPAD)'s Agency, the African Group of Negotiators, the African Development Bank, the UN Environment Program (UNEP), and the International Renewable Energy Agency (IRENA).'[134] The overall goals of the AERI are to achieve the following:

- Help achieve sustainable development, enhanced well-being, and sound economic development by ensuring universal access to sufficient amounts of clean, appropriate and affordable energy;

134 http://newsroom.unfccc.int/lpaa/renewable-energy/africa-renewable-energy-initiative-increasing-renewable-energy-capacity-on-the-african-continent/

- Help African countries leapfrog to renewable energy systems that support their low-carbon development strategies while enhancing economic and energy security.[135]

The AERI will be implemented in several stages. The establishment phase of the initiative (2015-mid 2016) will involve the mobilisation of resources, setting up governance and management structures and the identification of Phase I projects to financially support. Phase I (2016-2020) will then, in co-operation with bilateral and global partners, will seek to achieve at least 10 GW of new and additional generation capacity. Phase II (2020-2030) will be more ambitious with a full scale implementation of national determined policies, programmes and incentives as initiated under Phase I. It is expected that during Phase II at least 300 GW of new and additional generation capacity of renewable energy will be scaled up under the initiative. Given that the AERI is still in its infancy – no assessments are yet available on the impact of the initiative on the deployment of renewables in Africa, which will only be evident in the coming years therefore this analysis should be updated in the future.[136]

7.6 International Solar Alliance Initiative

The International Solar Alliance (ISA), which consists of 121 countries with strong solar energy resources, was launched at the COP 21 meeting in Paris. The declaration of the initiative includes the following text:[137]

'We share the collective ambition to undertake innovative and concerted efforts with a view to reducing the cost of finance and cost of technology for immediate deployment of competitive solar generation assets in all our countries and to pave the way for future solar generation, storage and good technologies adapted to our countries'' individual needs.

United by our objective to significantly augment solar power generation in our countries, we intend making joint efforts through innovative policies, projects, programmes, capacity building measures and financial instruments to mobilize more than 1000 Billion US Dollars of investments that are needed by 2030 for the massive deployment of affordable solar energy. We recognize that the reduced cost of finance would enable us to undertake more ambitious solar energy programmes to bring development and prosperity for our people.

We intend working together towards the development of appropriate benchmarks, facilitating resource assessments, supporting research and development and demonstration facilities, with a view to encouraging innovative and affordable applications of solar technologies.

Desirous of establishing an international alliance of countries dedicated to the promotion of solar energy as an effective mechanism of cooperation, we agree to create an International Steering Committee, open to interested counties, to provide the necessary guidance, direction and advice to establish the international solar alliance.'

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135 http://www.arei.org/wp-content/uploads/2016/01/summary_eng.pdf (accessed 24 March, 2016)

136 Ibid.

137 http://newsroom.unfccc.int/clean-energy/international-solar-energy-alliance-launched-at-cop21/

India and France have already pledged finance for the initiative, however given the infancy of the initiative no qualitative review of progress is currently available and will need to be updated in the future.

7.7 Renewable Energy and Energy Efficiency Partnership (REEEP)

Following the Johannesburg Conference of Sustainable Development, REEEP was established in 2002 to support small projects promoting renewable energy and energy efficiency. REEEP encourages more effective public energy policies to allow the private sector to provide clean energy solutions in developing countries. The organisation operates on the basis of annual calls for proposals, from which a short list of projects are selected for financial support – with the ultimate aim of scaling up successful business models for clean energy[138]. Key outcomes include:

- **Tamil Nadu Municipal EE Program**: REEEP provided funding to pursue EE projects in India to create and demonstrate a replicable financing model for energy efficiency in the municipal sector. On street lighting EE in Chennai, 40% completion is reported. This amounts to 44,000 lights. Projects in other Tamil Nadu municipalities are smaller, but many projects are ongoing.[139]

- **Progressive Purchase of Solar Lights:** REEEP funding allowed a technology company called Simpa to re-engineer its solar PV system technolgy and re-work their pricing model in India. The innovative energy solution uses mobile phone technology to manage the progressive purchase of the system (i.e. users pre-pay for energy services).[140]

- **Solar water heating mass rollout**: REEEP funding helped to facilitate the uptake of solar water heating (SWH) in major cities by establishing sustainable delivery vehicles in the form of either ESCOs or city owned SWH utilities.[141]

7.8 Clubs der Energiewende

The Clubs der Energiewende is an initiative that brings together like minded countries that share the common goal of scaling up the deployment of renewable energy worldwide. The initiative was established by Federal Environment Minister Peter Altmaier. The founding members are China, Denmark, France, Germany, India, Morocco, South Africa, Tonga, United Arab Emirates, United Kingdom and the Director-General of IRENA Adnan Amin. The members of the club agree to put renewable energy on the political agenda in the future and in doing so support and supplement

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138 http://www.reeep.org/sites/default/files/1302305-31%20REEEP%20evaluation%20Final%20report.pdf
139 Ibid.
140 Ibid.
141 Ibid.

the work of the International Renewable Energy Agency (IRENA). As a network and driver of ideas, the club will support efforts to promote the global transformation of the energy system.[142]

7.9 Overview of qualitative achievements

In Table 22, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the renewable energy sector (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

Table 22: Categories of qualitative achievements for the renewable energy initiatives covered in our analysis

Name of initiative	Initiative directly causes GHG reduc-tion? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")								
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits
European Wind Initiative (EWI)	y			X		X	X	(X)	(X)	
Solar Europe Industry Initiative (SEII	y			X		X	X	(X)	(X)	
SunShot Initiative (US)	y			X		X	X	(X)	(X)	
DOE Wind Program (US)	y			X		X	X	(X)	(X)	
Africa Renewable Energy Initiative	y			X		X	X	(X)	(X)	
International Solar Alliance	y			X		X	X	(X)	(X)	
REEEP	y	X		X		(X)	(X)		X	
Clubs der Energiewende	y	X	X							

[142] http://www.bmub.bund.de/en/press/press-releases/detailansicht-en/artikel/representatives-from-ten-pioneering-countries-establish-renewables-club/#

8. Finance

8.1 Portfolio Decarbonisation Coalition

8.1.1 Description

The Portfolio Decarbonisation Coalition (PDC) is run by AP4 along with the United Nations Economic Programme (UNEP), Amundi and the CDP (formerly the Carbon Disclosure Project).[143] The goals of the PDC are two fold:

1) The first goal is for institutional investors, who together manage assets of at least USD 500 billion, to measure and disclose their carbon footprint.
2) The second goal is to reduce the carbon footprint, which entails gathering investors who use different strategies to undertake to reduce the indirect emissions the assets generate.

According to the Annual Report, as of November 2015 the PDC included 25 asset owners and asset manager signatories, representing over US$3,200 billion in assets under management. Half of the members of the PDC have already set targets for the decarbonisation of their portfolio.[144] However, the extent to which these targets can be quantified into emission reductions varies depending upon the information available in individual company reports.

We have performed an exploratory quantification of a number of investment funds, with the objective to develop a methodological framework for quantifying such portfolios. However, we have not taken the results along in the aggregation and per-country analysis, as we were able to quantify only four of the investment funds under the initiative, and the results were small in any case compared to other initiatives.

8.1.2 Quantification

We have quantified only four investment funds (i.e. ABP, AP4, Australian Ethical and CDC) in this analysis due to limited data availability. We assume that the decarbonisation targets of each fund, which all vary slightly in the metric applied, will be met with the future value of their investment portfolios remaining stable. The targets of the four investment funds are outlined in the following bullet points:

- ABP aims to reduce the carbon footprint of its entire listed equity portfolio by 25% per Euro invested between 2015 and 2020 (see key data in Table 23);
- AP4's target is to have 100% of its global equities portfolio invested in low carbon strategies by 2020, with intermediate targets of 10% by the end of 2014 (see key data in Table 24);

143 http://unepfi.org/pdc/members/

144 http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf (accessed 24 March, 2016)

- Australian Ethical target their portfolio to be net zero emissions intensive by 2050 (see key data in Table 25);
- CDC is setting a carbon footprint reduction goal of 20% per thousand euros invested in its directly held listed equity portfolios for the 2014 to 2020 period (see key data in Table 26).

The key data tables below show the range of assumptions that need to be made in order to estimate emission reductions from decarbonising investment funds. It is important to acknowledge that we only calculate the emission reductions of a fund where possible, therefore our estimation represents an underestimation of the likely overall impact of the PDC.

Table 23: Parameter descriptions, values, units and sources used in the quantification of the PDC (ABP)

Quantity	Value	Unit	Source	Comments
CO_2 footprint of equity investment (2014)	28.0	MtCO_2	https://www.abp.nl/images/responsible-investment-report.pdf	Refer to page 17
CO_2 emissions per unit of investment (2014)	237.0	tCO_2 / M$ of equity investment	http://www.ap4.se/globalassets/formular/rapportarkiv/eng-2010-2014/en_ap4_arsredovisning_2014.pdf	Refer to table on page 14
Estimated Value of Equity Portfolio (2014)	117.0	Billion $	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Estimate based on 30 % of value cited in the Annex of the report for ABP
Estimated CO_2 footprint in Equities Portfolio (2014)	27.7	MtCO_2	Own calculation	Equal to the 28 MtCO_2 value cited in the ABP investment report.
CO_2 emissions per unit of investment (2020)	177.8	tCO_2 / M $ of equity investment	Own calculation	Assume that the value here is 25 % lower in 2020 in line with the target
Estimated Value of Equity Portfolio (2020)	117.0	Billion $	Own calculation	Assume that the value of the Portfolio remains the same in 2020.
Estimated CO_2 footprint in Equi-	20.8	MtCO_2	Own calculation	Multiply CO_2 emissions per unit by value of equity portfolio

ties Portfolio (2020)				
Additional Emission Saving 2020 (stable asset value)	6.9	MtCO_2	Own calculation	2020 CO_2 footprint subtracted from 2014 CO_2 footprint

Table 24: Parameter descriptions, values, units and sources used in the quantification of the PDC (AP4)

Quantity	Value	Unit	Source	Comments
Share of global equities portfolio invested in low carbon strategies (2014)	10.0	%	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Refer to overview on page 30
Global Equities Portfolio GHG emissions (2014)	2,470,853	tCO_2	http://www.ap4.se/globalassets/formular/rapportarkiv/eng-2010-2014/en_ap4_arsredovisning_2014.pdf	Refer to table on page 14
Assets under management (2014)	35.0	US$ Billion	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Refer to overview on page 30
Share invested in Global Equities Portfolio (2014)	41.0	%	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Refer to overview on page 30
Asset value for divestment (2014)	14.4	US$ Billion	Own calculation	Assets multiplied by share in equities in 2014
Share of global equities portfolio invested in low carbon strategies (2014)	10.0	%	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Refer to overview on page 30
GHG emissions per unit of in-	20.7	tCO_2e/SEKm	http://www.ap4.se/globalassets/formular/rapportarkiv/eng-2010-	Refer to table on page 14

vestment (Dec 2014)			2014/en_ap4_arsredovisning_2014.pdf	
Share of global equities portfolio invested in low carbon strategies (2020)	100.0	%	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Refer to overview on page 30
Global Equities Portfolio GHG emissions (2020)	0.25	tCO_2	Own calculation	Based upon the relationship between level of divestment in 2014 and GHG emissions - we scale by a factor of 10 if 100 % divestment is achieved by 2020
GHG emissions per unit of investment (Dec 2020)	2.1	tCO_2e/SEKm	Own calculation	Value converted into SEK by a factor of 0.12 - is based on the asset value remaining the same as in 2014
Additional Emission Saving 2020 (stable asset value)	2.2	$MtCO_2$	Own calculation	Difference in emissions between 2014 and 2020

Table 25: Parameter descriptions, values, units and sources used in the quantification of the PDC (Australian Ethical)

Quantity	Value	Unit	Source	Comments
Australian Ethical shareholdings carbon footprint (2014)	172.42	tCO_2e/AUD m	https://www.australianethical.com.au/wp-content/uploads/2015/05/Sustainability-Report-2015.pdf	Page 26
Superannuation Fund (2014)	776.60	$m	https://www.australianethical.com.au/wp-content/uploads/2015/05/Sustainability-Report-2015.pdf	Page 12
Estimated emissions (2014)	0.13	$MtCO_2$	Own calculation	Multiplication of carbon foot print by fund value in 2014
Annual rate of reduction to decarbonise portolio	4.79	tCO_2e/AUD m	Own calculation	Divide the emissions per unit of investment in 2014 by the number of years until 2050

Australian Ethical shareholdings carbon footprint (2020)	143.7	tCO_2e/AUD m	Own calculation	Estimate of emission intensity of portfolio (assuming linear reduction until 2050)
Australian Ethical shareholdings carbon footprint (2030)	95.8	tCO_2e/AUD m	Own calculation	Estimate of emission intensity of portfolio (assuming linear reduction until 2050)
Australian Ethical shareholdings carbon footprint (2050)	0.00	tCO_2e/AUD m	Own calculation	Decarbonisation target for 2050
Estimated emissions (2020)	0.11	$MtCO_2$	Own calculation	Multiplication of carbon foot print estimated in 2020 by fund value in 2014
Estimated emissions (2030)	0.074	$MtCO_2$	Own calculation	Multiplication of carbon foot print estimated in 2030 by fund value in 2014
Additional Emission Saving 2020 (stable asset value)	0.02	$MtCO_2$	Own calculation	Subtraction of estimated emissions in 2020 from 2014
Additional Emission Saving 2030 (stable asset value)	0.06	$MtCO_2$	Own calculation	Subtraction of estimated emissions in 2030 from 2014

Table 26: Parameter descriptions, values, units and sources used in the quantification of the PDC (CDC)

Quantity	Value	Unit	Source	Comments
CO_2 emissions per unit of investment (2014)	0.5	tCO_2 / 1000€ of equity investment	http://www.caissedesdepots.fr/sites/default/files/medias/institutionnel/investissement_responsable/group_climate_finance_policy_0.pdf	Refer to page 4
Estimated Value of Equity Portfolio (2014)	55.0	Billion EUR	http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf	Refer to CDC Case study

Estimated CO_2 footprint in Equities Portfolio (2014)	24.9	MtCO_2	Own calculation	Multiply CO_2 emissions per unit in 2014 by estimated value of portfolio
CO_2 emissions per unit of investment (2020)	0.4	tCO_2 / Thousand EUR of equity investment	Own calculation	Assume that the value here is 20 % lower in 2020 in line with the target
Estimated Value of Equity Portfolio (2020)	55.0	Billion $	Own calculation	Assume that the value of the Portfolio remains the same in 2020.
Estimated CO_2 footprint in Equities Portfolio (2020)	19.9	MtCO_2	Own calculation	Multiply CO_2 emissions per unit in 2020 by estimated value of portfolio (stable at 2014)
Additional Emission Saving 2020 (stable asset value)	5.0	MtCO_2	Own calculation	Difference between 2014 and 2020 CO_2 emissions

Information on the action of other PDC signatories that were unable to be quantified due to insufficient data include:

- **Allianz** to stop financing coal-based business models by divesting equity stakes in coal-based business models by the end of March 2016; fixed income stakes can be held until maturity (run-off).[145]
- **'Amundi** has worked with AP4, FRR and MSCI to create the MSCI Low Carbon Leaders Index, which it offers to its clients. The index excludes the top 20% of companies based on carbon emissions intensity (i.e. Scope 1 and Scope 2 emissions per million euros of turnover), subject to a maximum exclusion of 30% of the companies by weight in any one sector.'[146]
- **'Hermes** have set long term targets to reduce its absolute (tCO_2) and relative to area (tCO_2/m^2) carbon emissions from those assets in its real estate portfolio where it has direct

145 https://www.allianz.com/v_1448622620000/media/responsibility/Energy_Guideline_PublicVersion_final.pdf (accessed 24 March, 2016)

146 http://www.unepfi.org/fileadmin/documents/FromDisclosureToAction.pdf (accessed 24 March, 2016)

management control by 40% by 2020 from a 2006 baseline. It also has operational targets to reduce its absolute carbon emissions (tCO_2) and its relative energy consumption (kWh/m^2) from these assets by 5% year-on-year'.[147]

We anticipate that as the reporting methodologies improve, we will be able to conduct a more comprehensive analysis of the carbon footprint of investment portfolios.

8.2 Global Subsidies Initiative

The Global Subsidies Initiative (GSI) was set up by the International Institute for Sustainable Development (IISD) and 'is dedicated to analyzing subsidies – transfers of public money to private interests – and how they support or undermine efforts to achieve sustainable development'.[148]

The aim of the initiative is to influence the decision making of individual governments to make unilateral reforms on subsidy policy which would deliver 'clear economic, environmental and social benefits and to generate a consensus in the World Trade Organization and in other forums on the need to take resolute, ongoing and systematic action to reduce or eliminate subsidies that are both trade-distorting and undermine sustainable development'.[149]

Given that there is no quantifiable target publicised by the Global Subsidies Initiative it was not possible within the scope of this project to quantify its possible impact on global emission reductions. However, based upon research commissioned by the Global Subsidies Initiative there are a range of estimates available in the literature for the impact of subsidy reform on global emission reductions. For example, the research cites work from Burniaux & Chateau (2014) that estimates that global GHG emission reductions of 6.1 gigatonnes of carbon dioxide could be achieved by 2050 with the staggered removal of consumer fossil fuel subsidies (based on 2008 subsidy figures).[150]

8.3 Energy Breakthrough Coalition

Initiative to help countries increase their public research by providing skills from the private sector. Nineteen countries from across the world, representing 80% of global clean energy research and development, are committing to double their respective R&D investments over five years. The 'Breakthrough Energy Coalition' a global group of private investors, spearheaded by Bill Gates, will support Mission Innovation. (Countries: Australia, Brazil, Canada, Chile, China, Denmark, France, Germany, India, Indonesia, Japan, Republic of Korea, Mexico, Norway, Saudi Arabia, Sweden, the United Arab Emirates, the United Kingdom, and the United States).[151]

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147 Ibid.

148 https://www.iisd.org/gsi/about-gsi (accessed 24 March, 2016)

149 Ibid.

150 http://norden.diva-portal.org/smash/get/diva2:786861/FULLTEXT02.pdf (accessed 24 March, 2016)

151 http://www.breakthroughenergycoalition.com/en/index.html (accessed March 24, 2016)

8.4 Overview of qualitative achievements

In Table 27, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the finance area (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

Table 27: Categories of qualitative achievements for the finance initiatives covered in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")								
		Informational diffusion	Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development
Global Subsidies Initiative			X	X		(X)				
Portfolio Decarbonisation Coalition	y					(X)				
Breakthrough Energy Coalition	y		X	X		(X)	(X)			

9. Short-Lived Climate Pollutants

9.1 Climate and Clean Air Coalition

9.1.1 Description

The Climate and Clean Air Coalition (CCAC) targets the "implementation of policies [...] that will deliver substantial short-lived climate pollutant (SLCP) reductions in the near- to medium-term (i.e. by 2030)" (CCAC 5-Year Strategic Plan[152]). The CCAC claims to have already made several steps to reduce SLCPs. The following information is from the Annual Report 2015[153], unless otherwise indicated.

The CCAC provided funds to 14 countries to integrate SLCPs into their policy and planning process, through the so-called Supporting National Planning for Action on SLCPs (SNAP) initiative. For example, the Republic of Korea created a regulation of refrigerants used for air conditioning. Mexico revised its vehicle standard to comply with US EPA or EURO VI limits. Mongolia included regulation of HFCs under its Air Law. Also, several countries explicitly included action on SLCP in their INDC.

Several technology demonstration projects were undertaken under the CCAC. These included demonstration of clean cooking fuels, refrigeration using low-GWP HFCs, diesel particulate reduction technologies, and integrated manure management.

Also, the CCAC raised awareness of the benefits of SLCP reductions at the political level. This included a statement in support of a phase-down of HFCs under the Montreal Protocol and several statements at the Climate Summit of the UN Secretary General in September 2014. Further, the CCAC claims to have been heavily involved in passing the Resolution on Air Pollution and Health[154] at the World Health Assembly in May 2015.

For the timeframe up to 2030, the CCAC claims that global action to reduce SLCPs would save around 3 million lives by cutting indoor and outdoor air pollution, as well as increase crop yields by around 52 million tonnes (UNEP, 2011)[155].

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152 http://www.ccacoalition.org/en/resources/ccac-five-year-strategic-plan

153 http://www.ccacoalition.org/en/resources/ccac-annual-report-2014-2015

154 http://apps.who.int/gb/ebwha/pdf_files/WHA68/A68_R8-en.pdf

155 UNEP, WMO (2011): Integrated Assessment of Black Carbon and Tropospheric Ozone. http://www.unep.org/dewa/Portals/67/pdf/BlackCarbon_report.pdf

9.1.2 Quantification

We focused the quantification on methane (CH_4) and HFCs, as these types of SLCPs are usually included in GHG emission scenarios. Further, we obtained a rough estimate for the impact of a reduction of black carbon (BC) emissions. As BC is usually not included in GHG emission scenarios, the results were not included in the overall impact of the CCAC and are only presented here for completeness.

Finally, Table 28 provides the values that have been used in our estimation of the impact of all SLCPs, with their sources.

9.1.2.1 Methane (CH4)

We assume that the CCAC targets a reduction of CH_4 emissions in line with the "CH_4 + BC group 1 and 2 measures" scenario from UNEP (2011), as the measures considered in this scenario are referenced in the CCAC's Annual Report 2015 and the benefits of SLCP reduction cited by the CCAC[156] are sourced from UNEP (2011). Specifically, we assume a reduction target of 26% in 2030, compared to the 2005 level, and assume that this target is reached linearly over time, starting in 2016. Historic CH_4 emission data was sourced from the EDGAR database[157]. The target then translates to a CH_4 emission level of 5.4 $GtCO_2e$ in 2030. As no scenario for future CH_4 emissions under INDCs is available yet, we used Reduced Concentration Pathway RCP6.0[158] as a baseline for future CH_4 emission development. The comparison of CCAC target and baseline then shows a reduction of 1.4 $GtCO_2e$ beyond this baseline in 2030.

We split the potential impact between the eight investigated countries according to their share of global CH_4 emissions in 2010, again using data from the EDGAR database. However, the overlap with the Global Methane Initiative (see below) was calculated on a global level, as for both the CCAC and the GMI reductions are not differentiated by country.

9.1.2.2 HFCs

For HFCs, we assume that the CCAC targets a phase-down as proposed in the North American HFC Submission to the Montreal Protocol[159], with linear reductions between phase-down steps. For

156 http://www.ccacoalition.org/en/science-resources
157 http://edgar.jrc.ec.europa.eu/overview.php?v=42FT2012
158 RCP database: http://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=about
159 https://www.epa.gov/sites/production/files/2016-01/documents/hfc_amendment_2015_summary.pdf

2030, this means a reduction below a set baseline of 27% for Article 5 Parties[160] and 70% for non-Article 5 Parties. This baseline is determined by historical HFC and HCFC emissions between 2011 and 2013, as set out in the North American Proposal.

We source historical HFC emission data from EDGAR via the World Bank Indicator Database[161] and HCFC production data from the UNEP Ozone Secretariat[162]. The application of the phase-down schedule to the calculated baseline results in an HFC emission level of 0.7 $GtCO_2e$ in 2030. To calculate the associated reductions, a replacement for a scenario under INDCs is needed, similar to CH_4. We use the scenario with the lowest projected HFC emission level from the literature, which is Labat et al. (2015)[163]. Further, for the eight countries investigated in detail in this report, we use a baseline set by national regulations or HFC targets in INDCs, if available. This applies to the EU, whose regulation on fluorinated gases[164] is actually more ambitious than the phase-down schedule under the proposed Montreal Protocol amendment, and Japan, whose INDC sets an absolute target for HFCs in 2030[165]. Compared with the scenario set by Labat et al. (2015) and national regulations in the EU and Japan, the CCAC produces HFC reductions of 456 $MtCO_2e$ in 2030.

HFC emissions and reductions are split onto the eight investigated countries based on the countries' share of global HFC emissions in 2010. If available, national HFC emission data is based on National Communications or reports, otherwise EDGAR data, as referenced above, was used.

9.1.2.3 Black carbon

We assume that the CCAC targets a reduction of BC emissions in line with the "CH_4 + BC group 1 and 2 measures" scenario from UNEP (2011), similar to CH_4. This translates to a reduction of 78% in 2030, compared to 2005. As neither clear historical data nor specific emission projections are available for BC, we use the RCP scenarios. The four RCP scenarios do not show a specific order in regards to the amount of BC emitted. Therefore, we use the average value of all four scenarios as the estimate for emissions in 2005, and the highest and lowest value as a range of baseline emissions for 2020 and 2030.

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160 Article 5 Parties are developing countries that meet the criteria set out under Article 5 of the Montreal Protocol. The current list of Article 5 Parties is available at http://ozone.unep.org/en/article-5-parties-status

161 http://data.worldbank.org/indicator/EN.ATM.HFCG.KT.CE?page=1

162 http://ozone.unep.org/en/data-reporting/data-centre

163
Labat et al. (2015), Global Energy and Climate Outlook: Road to Paris, ISBN 978-92-79-48233-5, European Union, 2015, http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=LFNA27239

164 http://eur-lex.europa.eu/legal-content/EN/LSU/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG

165 http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Japan/1/20150717_Japan's%20INDC.pdf

Based on these numbers, we estimate a BC emission level of 1.5 $GtCO_2e$ in 2030. Depending on the baseline, this corresponds to reductions between 4.2 and 4.7 $GtCO_2e$.

As the results for BC were not taken along for further consideration, no country level split was performed.

Table 28: Parameter descriptions, values, units and sources used in the quantification of the Climate and Clean Air Coalition.

Description	Value	Unit	Source	Comments
CH_4 emission reductions in "CH_4 + BC measures" scenario in 2030, rel. to 2005	-26%	-	UNEP (2011),[166] Figure 5.3b	
CH_4 Global Warming Potential (100 years)	21	CO_2e/CH_4	UNFCCC[167]	
Historic CH_4 emissions		$MtCH_4$	EDGAR[168]	
Projected CH_4 emissions in 2020 and 2030		$MtCH_4$	RCP database[169]	RCP 6.0
Historic HCFC production		ODP Tonnes	UNEP Ozone Secretariat[170]	
HCFC average ODP[171]	0.055	HCFC/ODP	UNEP Ozone Secretariat[172]	
HCFC average GWP	1810	CO_2e/HCFC	UNEP Ozone Secretariat[173]	
Historic HFC emissions		$MtCO_2e$	EDGAR via World Bank Indicator	

166 http://www.unep.org/dewa/Portals/67/pdf/BlackCarbon_report.pdf
167 http://unfccc.int/ghg_data/items/3825.php
168 http://edgar.jrc.ec.europa.eu/overview.php?v=42FT2012
169 http://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=about
170 http://ozone.unep.org/en/data-reporting/data-centre
171 Ozone Depletion Potential
172 http://ozone.unep.org/Events/ozone_day_2011/HCFC%20Leaflet.pdf
173 Ibid.

			Database[174]	
Projected HFC emissions in 2030	1240	$MtCO_2e$	Labat et al. (2015)[175]	Use as proxy for scenario under INDCs
HFC cap 2020 for Article 5 Parties	100%	-	North American HFC Submission to Montreal Protocol	% of baseline emissions.
HFC cap 2020 for non-Article 5 Parties	85%	-	North American HFC Submission to Montreal Protocol	% of baseline emissions.
HFC cap 2030 for Article 5 Parties	73%	-	North American HFC Submission to Montreal Protocol	% of baseline emissions.
HFC cap 2030 for non-Article 5 Parties	30%	-	North American HFC Submission to Montreal Protocol	% of baseline emissions
EU HFC cap in 2030, rel. To 2009-2012 levels	21%	-	EU Regulation No 517/2014	
Historic HFC emissions in the EU		$MtCO_2e$	EEA Technical report No 15/2014[176]	
Japan HFC cap in 2030	21.6	$MtCO_2e$	Japan's INDC[177]	
BC emission reductions in "CH4 + BC measures" scenario in 2030, rel. to 2005	-78%	-	UNEP (2011), Figure 5.3b	
BC Global Warming Potential (100 years)	830	Unit of CO_2e per unit of BC	IPCC Expert Meeting on the Science of Alternative Metrics[178]	

174 http://data.worldbank.org/indicator/EN.ATM.HFCG.KT.CE?page=1

175 http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=LFNA27239

176 http://www.eea.europa.eu//publications/f-gases-2013

177 http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Japan/1/20150717_Japan's%20INDC.pdf

Historic BC emissions		Mt BC	RCP database[179]	Average of four RCP scenarios
Projected BC emissions		Mt BC	RCP database[180]	Range set by four RCP scenarios

9.1.3 Promoting HFC Alternative Technology and Standards

The CCAC initiative on the reduction of HFCs, Promoting HFC Alternative Technology and Standards[181], undertakes several capacity building efforts, mainly in developing countries. This is in addition to the global effort under the Montreal Protocol mentioned above. Three types of measures are carried out by the initiative: HFC inventories, case studies and awareness raising.

The initiative recently completed HFC inventories for six developing countries[182]: Bangladesh, Chile, Colombia, Ghana, Indonesia and Nigeria. The inventories include recent HFC consumption data and projections for future development. Inventories in eight more countries are supposed to be completed by mid-2016.

A set of case studies is being carried out on the potential and cost of HFC reduction in different situations. This includes a study on district cooling on the Maldives, as well as studies on the commercial refrigeration and transport refrigeration sectors.

Finally, technology conferences on different sectors are currently occurring. Also, an interactive online tool ("HFC-ville"[183]) was developed, showing different uses of HFCs and mitigation potential.

178 https://www.ipcc.ch/pdf/supporting-material/expert-meeting-metrics-oslo.pdf
179 http://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=about
180 Ibid.
181 http://www.ccacoalition.org/en/initiatives/hfc
182 http://www.ccacoalition.org/en/news/hfc-inventories-six-countries-now-available
183 http://new.ccacoalition.org/hfcville

The expected impact of the CCAC initiative on HFCs was quantified as part of the total CCAC impact.

9.1.4 Mitigating SLCPs from the Municipal Solid Waste Sector

The CCAC initiative on waste in cities seeks to reform waste management in developing countries, leading to reduced methane and black carbon emissions, as well as health and economic co-benefits[184].

The core of the initiative is a mentoring program, which brings together cities from developing countries with mentor cities that already have advanced waste management programs, to develop policy and planning solutions. This is combined with technical support from the CCAC and training of city officials and staff. The initiative also carries out baseline assessments of the situation in participating cities and has created a tool to quantify the emissions from the waste sector.

While the mentoring program has so far only connected four pairs of cities, baseline assessments were undertaken for 30 cities and a total of 50 cities have committed to reform their waste sector by 2020 [185]. In the future, the initiative hopes to expand the network to 150 cities by 2020 and claims that this will motivate a further 1000 cities to join thereafter[186].

Reforms of waste management in cities can create substantial co-benefits[187]. Poorly managed landfills can contaminate ground water, while open burning of waste creates black carbon and thus increases air pollution. Also, the capture of methane from landfills not only reduces GHG emissions, but provides economic benefits via the value of the captured methane.

The expected impact of the CCAC initiative on waste in cities is part of the total CCAC impact on methane and black carbon emissions, which was quantified above.

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184 http://www.ccacoalition.org/en/initiatives/waste

185 http://www.ccacoalition.org/en/resources/municipal-solid-waste-factsheet

[186] The C40 initiative, a network of cities also analysed in this report, is a member of the CCAC initiative on waste. Therefore, some of the potential impact of the C40 initiative could also be seen as achievements of the CCAC waste initiative. As the CCAC waste initiative does not provide quantified emission targets, this possible overlap was not quantified for this report.

187 http://www.ccacoalition.org/en/initiatives/waste

9.2 Global Methane Initiative

9.2.1 Description

The Global Methane Initiative (GMI) targets the recovery and use of methane that would otherwise be emitted into the atmosphere, from agriculture, coal mines, municipal solid waste, oil and gas systems, and wastewater[188]. GMI claims that the recovery of methane can stimulate economic growth and improve air and water quality. The GMI partner countries account for approximately 70 percent of global methane emissions[189]. GMI provides a database[190] of its methane recovery projects, which currently has 619 entries (correct as of 15 June, 2016).

9.2.2 Quantification

The GMI does not have a quantifiable target for the reduction of methane emissions. However, it does provide an estimation of the amount of cumulative methane reductions for each year since 2004, with projections until 2017[191]. From these estimations, we calculate annual emission reductions and linearly extrapolate the reductions until 2020. This procedure returns an estimated impact of 46 $MtCO_2e$ in 2020. For the longer time period, we assume constant annual emission reductions at the 2020 level for all years after 2020. Therefore, we estimate the impact in 2030 to be as high as in 2020.

9.3 Global Alliance for Clean Cookstoves

9.3.1 Description

The Global Alliance for Clean Cookstoves promotes the use of clean and/or efficient cookstoves and fuels in developing countries. Its goal calls for 100 million such cookstoves to be adopted by 2020. In 2014, 28 million clean cookstoves were already adopted[192].

The Alliance undertook several steps to standardize the evaluation of cookstoves. A meeting was held under the International Organization for Standardization, which adopted an agreement[193] setting guidelines on how to evaluate cookstove performance. Also, the alliance supports 16 cookstove testing centres in 14 countries. These centres feed the Clean Cooking Catalogue[194], a

188 https://www.globalmethane.org/about/index.aspx
189 https://www.globalmethane.org/partners/index.aspx
190 https://www.globalmethane.org/activities/search.aspx
191 https://www.globalmethane.org/about/infographic.aspx
192 Five Years of Impact Report. http://cleancookstoves.org/binary-data/RESOURCE/file/000/000/406-1.pdf
193 IWA 11:2012. http://www.iso.org/iso/catalogue_detail?csnumber=61975
194 http://catalog.cleancookstoves.org/

database of over 300 cookstoves and their performance. Further, more than $5 million was invested into over 40 research studies on clean cooking.

To strengthen the supply of clean cookstoves, the Alliance has triggered more than $400 million in grant and investment pledges, of which $60 million have already been deployed. These pledges have been used to support close to 200 companies and 28 of those companies have collectively increased clean cookstove production by over 300% in the last five years. On the demand side, the Alliance undertakes awareness raising campaigns using marketing, product demonstrations and outreach.

The transition to clean cooking is thought to provide substantial benefits, mainly by reducing the negative health impacts of air pollution from traditional cooking practices. The Alliance estimates that nearly 3 billion people still rely on solid fuels for cooking. The resulting air pollution causes roughly 4.3 million deaths[195] and costs of $123 billion per year. It is estimated that the work by the Alliance can reduce deaths by 640,000 and save 6.2% of income for affected households by 2020.

9.3.2 Quantification

We quantified the emission reduction impact of the goal of 100 million clean cookstoves by 2020 according to the certified reductions by similar CDM projects. For such projects, the approved emission reduction per cookstove varies between 1 and 5 tCO_2e (Dresen et al., 2014).[196] Accordingly, we estimate the impact of the initiative to be between 100 and 500 $MtCO_2e$ in 2020. This estimate includes the implicit assumption that none of the recipients of a clean cookstove would have adopted one without the initiative. As the initiative does not give a goal for the period after 2020, we assume that no additional cookstoves will be distributed, but that the 100 million clean cookstoves already distributed until 2020 will stay in use until (at least) 2030. Therefore, the impact in 2030 is equal to the impact in 2020.

9.4 Overview of qualitative achievements

In Table 29, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the non-CO_2 area (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

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195 http://cleancookstoves.org/impact-areas/health/index.html
196 doi:10.3390/land3031137

Table 29: Categories of qualitative achievements for the non-CO_2 emission reduction initiatives covered in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")								
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits
CCAC		X	X	X		X		X	X	
CCAC - HFCs		X	X	X						
CCAC-Waste			X			X		X	X	
Global Methane Initiative	y					X		(X)	X	
Global Alliance for Clean Cookstoves	y	X			• Investment into supply	X		X	X	

10. Policy development and implementation

10.1 International Partnership on Mitigation and MRV

The International Partnership on Mitigation and MRV[197] was founded in 2010 by Germany, South Africa and South Korea[198]. The majority of the approximately 90 member countries are developing countries. The aim of the partnership is "to support a practical exchange on mitigation-related activities and MRV between developing and developed countries in order to help close the global ambition gap". In particular, the partnership focuses on the design and implementation of INDCs, LEDS, NAMAs and MRV systems.

197 http://mitigationpartnership.net/

198 http://mitigationpartnership.net/about-partnership

The partnership organizes frequent meetings in which members exchange their experiences with national policies[199]. This is supposed to "foster mutual learning" and build "trust, capacity and expertise" between members[200]. Good practices are identified and disseminated via a webinar series[201].

Further, the partnership organizes annual workshops for 25-30 participants, who receive training and discuss varying issues around mitigation and MRV[202]. Regional groups also organize shorter technical workshops. In 2015, six regional workshops were organized in addition to the annual workshop[203].

Finally, the partnership also developed an online course for the development of NAMAs[204] and provides a database of LEDS, NAMA and MRV projects[205].

The expected impact of the International Partnership on Mitigation and MRV was not quantified because the initiative does not have an emissions target and the impact of its activities on emissions occurs only indirectly.

10.2 Low Emission Development Strategies Global Partnership

The Low Emission Development Strategies (LEDS) Global Partnership "links practitioners and policymakers through a network of three dynamic regional platforms and six crosscutting working groups"[206]. Regional platforms are available for Africa, Asia and Latin America and the Caribbean. The working groups focus on Land Use, Energy, Transport, Finance, benefits assessment of LEDS and subnational integration of LEDS.

The partnership provides several online resources to support the design and implementation of LEDS[207]. These include reports, calculation tools and webinars, as well as an online database of existing LEDS programs[208]. Further, countries that intend to implement LEDS can receive online

199 http://mitigationpartnership.net/partnership-meetings
200 http://mitigationpartnership.net/about-partnership
201 http://mitigationpartnership.net/gpa
202 http://mitigationpartnership.net/capacity-building
203 http://mitigationpartnership.net/partnership-activities-2015-0
204 http://mitigationpartnership.net/e-learning-course-development-nationally-appropriate-mitigation-actions-namas-has-been-launched
205 http://mitigationpartnership.net/map
206 http://ledsgp.org/about/
207 http://ledsgp.org/resources
208 http://ledsgp.org/programs

assistance through the "Remote Expert Assistance on LEDS (REAL)" service[209]. This service connects country teams to outside experts from three participating centres at no cost.

The expected impact of the LEDS Global Partnership was not quantified because the initiative does not have an emissions target and the impact of its activities on emissions occurs only indirectly.

10.3 Overview of qualitative achievements

In Table 30, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives in the policy development area (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

Table 30: Categories of qualitative achievements for the policy development initiatives covered in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")								
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits
Int. Partnership on Mitigation and MRV		X	X							
LEDS Global Partnership		X	X							

209 http://ledsgp.org/assistance

11. Standards

11.1 Greenhouse Gas Protocol

The Greenhouse Gas Protocol[210] develops standards and calculation tools to help corporations and governments in reporting their GHG emissions[211]. It is a partnership between the World Resources Institute and the World Business Council for Sustainable Development. The first Corporate Standard was published in 2001. Since then, standards were developed for the corporate value chain, a product's life cycle and emission reductions of a mitigation project. In addition, three standards were developed to assist governments. These are standards for the GHG emissions of cities, for measuring progress towards a GHG reduction goal, and for the GHG reductions of policies and actions[212].

Further, the initiative has developed calculation tools for the specific GHG reporting of 13 sectors[213]. They also provide an overview of databases, which can be used to calculate product life cycle or corporate value chain emissions.

The expected impact of the GHG Protocol was not quantified because the initiative does not have an emissions target and the impact of its activities on emissions occurs only indirectly.

11.2 The Roundtable on Sustainable Biomaterials

The Roundtable on Sustainable Biomaterials (RSB) is "an independent and global multi-stakeholder coalition which works to promote the sustainability of biomaterials"[214]. RSB has developed several sustainability standards relating to GHG calculation, certification of bio-products, risk management, chain of custody for bio-products, and other issues[215].

Companies can also apply to RSB to receive RSB certification. While RSB handles the initial application, the audit itself is conducted by an independent certification body[216]. To help companies complete the certification process, RSB provides guidelines, compliance indicators and an online GHG calculator[217].

Finally, in 2013 RSB launched the "Smallholder Program", which "seeks to improve the livelihoods of smallholder farmers by linking them to markets and promoting sustainable practices based on the RSB standard"[218]. This is reaction to the problem of large biofuel plantations replacing local food

210 http://ghgprotocol.org/
211 http://ghgprotocol.org/about-ghgp
212 http://ghgprotocol.org/standards
213 http://ghgprotocol.org/calculation-tools
214 http://rsb.org/about/what-is-rsb/
215 http://rsb.org/sustainability/rsb-sustainability-standards/
216 http://rsb.org/pdfs/documents_and_resources/cert-guide-2015.pdf
217 http://rsb.org/sustainability/rsb-tools-guidelines/
218 http://rsb.org/activities-and-projects/smallholder-program/

sources in developing countries. The local farmers supported by the program can market certified sustainably produced biofuels. For example, a project in Brazil involves around 100 families, organized as a "farmer cooperative", operating a joint oil processing facility running on collected fruits[219].

The expected impact of the RSB was not quantified because the initiative does not have an emissions target and the impact of its activities on emissions occurs only indirectly.

11.3 Overview of qualitative achievements

In Table 31, we present an overview of the qualitative benefits that we estimate could be achieved by each of the investigated initiatives on standard development (not limited to the initiatives whose potential for emission reduction was quantified in this study). The different boxes are ticked if an initiative is estimated to result in benefits other than direct GHG emission reductions.

Table 31: Categories of qualitative achievements for the standard development initiatives covered in our analysis

Name of initiative	Initiative directly causes GHG reduction? ("y" if yes)	Thematic area of contribution (direct impact: "X", indirect impact: "(X)")									Notes/comments
		Informational diffusion	Political / institutional effects	Technology development	Other activities	Air pollution	Energy security	Health impacts	Economic development	Other co-benefits	
Greenhouse Gas Protocol		(X)									We consider that the initiative has an indirect impact on informational diffusion, because the use of its protocols allows for the consistent reporting of GHG emissions or reductions.
Roundtable on Sustainable Biomaterials	y	(X)							X		We consider that the initiative has an indirect impact on informational diffusion, because the use of its standards allows for the consistent reporting of GHG emissions or reductions. We consider that the initiative directly causes GHG reductions and economic development through the projects in the "Smallholder Program".

219 https://content.sierraclub.org/grassrootsnetwork/documents/sustainable-biofuels-improve-lives-smallholders

12. Overlap quantification

In this section, we explain the methods behind the quantification of overlaps between initiatives that has been done on a country-level for most initiatives and globally for the rest.

12.1 Introduction

The generic approach was as follows. After having done the global potential estimation for each initiative and broken down the initiative's contribution on a per-country basis, as explained in the previous sections, the possible overlaps among initiatives within each country were analyzed. This generally resulted in a range of emission reductions corresponding to different rates of overlaps between initiatives.

In this range, the lower bound of reductions corresponds to the highest possible overlaps between initiatives, i.e. a situation where initiatives do the "least cumulative work while still reaching their respective targets". The higher bound corresponds to assuming the initiatives are completely "additional" to each other, i.e. achievements from one initiative do not diminish ambition in another.

Overall, the types of overlaps that we have considered can be roughly grouped into one of four categories, which are explained in more detail below. The specific cases where these overlaps had to be calculated are listed in Table 32.

One significant type of overlap that has not been taken into account is that of initiatives with emission-trading schemes. For example, for renewable power initiatives in the EU, whose power sector falls under the ETS, we assume that reduction in emissions from initiatives' actions would not result in the sale of emission allowances to someone else (e.g. that the allowances are cancelled, or that the ETS cap is lowered in response to additional renewable power production). This is consistent with our assumption throughout that the enhanced ambition of initiatives does not reduce ambition elsewhere (in this context, buying emission credits falls under the latter).

Table 32: Types of overlaps considered and the instances in which specific calculations were made in the country-level analysis.

Type of overlap	For which initiatives	Overlaps with	Applied in countries
Duplicate target	Under2MOU	C40	EU, USA, Japan
	Caring for Climate	ABAOCP	Worldwide
	RE100	ABAOCP	Worldwide
	RE100	Caring for Climate	Worldwide
Similar target setting	EWI	SEII	EU
	US Wind Program	SunShot Initiative	USA
	CCAC	GMI	All individual countries; worldwide
	CCAC	GACC	Worldwide
	CCAC	Montreal Protocol	Worldwide

Unspecific target setting	C40 and Under2MOU	EWI, SEII, SEAD, GBPN, GFEI	EU
		US Wind Program, SunShot Initiative, SEAD, GBPN, GFEI	US
		SEAD, GBPN, GFEI	Japan
	Under2MOU	SEAD, GFEI	Brazil
Partly covered by sector-specific INDC targets	Bonn Challenge / NYD	INDC element	China, Brazil
	GCFTF	INDC element	Brazil
	UIC	INDC element	India
Business versus non-business	Caring for Climate, RE100, ABAOCP	Non-business initiatives in general	Worldwide

12.2 Duplicate targets

This type of overlap happens when some specific entity's target is part of more than one initiative. The specific examples where this was the case are a city setting an emission reduction target under the C40 initiative, while its region as a whole simultaneously set a reduction target under the Under2MOU; and certain companies being subscribed to more than one business initiative. Such overlaps are thus not subject to uncertainty; we do not have to calculate a range of possible reductions assuming varying degrees of overlap, as there is complete certainty that this overlap is definite.

We have taken out the effect of this potential double-counting by checking for each country (or on the worldwide level for the business initiatives) which instances of double targets occur, and selecting the most ambitious of these in each case. For example, if a city is found to be part of both the C40 and Under2MOU initiative, and its target is not substantially more ambitious under the C40, then its potential for reduction is counted in the Under2MOU because this one has a larger scope (regions instead of cities) to start with.

12.3 Similar target setting

This occurs when different initiatives have targets that are either directly overlapping as they are expressed in the same metric, or targets that aim to achieve the same goal (through undefined means), or targets that could potentially compete with each other. Concrete examples of this are, respectively:

1) The CCAC and GMI initiatives, both of which aim to reduce methane emissions through various means (CCAC does more than this, while GMI is focused exclusively on methane). As the methods proposed by both initiatives for methane emissions reduction overlap to a large extent, we have assumed that the upper bound of potential reduction is when both initiatives are 100% additional to one another, and the lower bound is when the overlap is maximal. As our estimations suggest the scope of reduction by CCAC is higher than for the GMI, this translates to the assumption that the GMI could be fully overlapped by the CCAC methane ambitions.

2) The target for HFC reduction under the CCAC initiative is based on a proposed amendment of the Montreal Protocol. To reflect this, we consider that the HFC reductions under the CCAC might be overlapped by action under the Montreal Protocol by up to 100%. Therefore, the lower bound of potential reduction of CCAC does not contain any HFC reductions, while the upper bound contains the full potential impact of HFC reductions under the phase-down schedule.
3) The renewable energy initiatives in the United States and the European Union, where in both cases one initiative targets a certain percentage of power generation to come from solar by 2020/2030, and the other a certain percentage to come from wind power. While these targets are in principle complementary, quantifying their potential impact is only possible taking into account the potential competition between the two. For instance, the upper range of reduction of the European Wind Initiative on its own could be calculated by assuming the wind power replaces first coal, then oil and then gas in the power mix. The same can be done for the SEII. But the sum of the two upper bounds of EWI and SEII is not equal to the upper bound of the two initiatives together, because there would not be enough coal in the power mix to start with. So the fact that the two can compete in "replacing fossil fuels" impacts their potential maximum impact when both are assumed to be implemented.

12.4 Unspecific target setting

Various cities and regions have set "INDC-style" emission reduction pledges under the C40 and Under2MOU initiatives, respectively, usually expressed in a % reduction to be achieved by a certain target year and relative to a certain base year. While some cities go into a bit of detail on how this is to be achieved, overall, there is a broad range of activities that could help cities attain their targets, i.e. sustainable energy deployment, better building standards, etc. Thus, other initiatives in relevant sectors, if implemented, could simultaneously contribute to cities/regions reaching their own targets.

To estimate the overlaps involved herein, we have made the estimation that city/region initiatives can be overlapped principally by

1) Initiatives in the sustainable energy sector, i.e. the wind and solar programs in the EU and US;
2) Initiatives in the buildings sector, i.e. GBPN and SEAD;
3) Initiatives in the road transport sector, i.e. GFEI.

We have made the assumption that the potential emission reductions from these initiatives can contribute towards meeting the city/region goals by the same share of reductions as these cities/regions have in population of the country. For example, in the EU, we estimate that roughly 25% of the total population live in regions covered by the Under2MOU. To calculate the overlap between the Under2MOU and the European Wind Initiative, we then estimate that 25% of the reductions by the EWI could contribute to the Under2MOU (and the other 75% would occur in regions that are not covered by the Under2MOU). Subtracting this 25% from the potential reductions attributed to the Under2MOU gives the lower range of reductions. The upper range is taken equal to the full potential, i.e. assuming that regional actions to reach Under2MOU goals are additional to other initiatives.

12.5 Partly covered by sector-specific INDC targets

We have compared the impact of initiatives with baseline scenarios that take INDCs into account as much as possible. Wherever this was not the case, we compared the potential reductions to what we

deem realistic baseline scenarios either from literature or from own estimations. In some cases, this had to be based on own assumptions of how a certain quantity would develop until 2030. For example, for the Bonn Challenge, we assumed that the most recent reforestation/afforestation rates available could serve as baseline values.

Some countries include very specific sectoral targets in their INDCs which helped us set such baseline scenarios and calculate the overlap of these with initiatives' targets. The concrete instances of this are China and Brazil having quantified targets on reforestation and reducing deforestation, respectively, in their INDCs, and India's INDC including a target on increasing the share of railways in total transportation.

We have quantified the overlaps as follows. China's INDC target can be translated into an average additional area to be reforested per year. This number turns out to be lower than the baseline (historic reforestation rate) in relation to which we quantified the Bonn Challenge / NYD contribution. Thus, the *additionality* of the Bonn Challenge does not overlap with the INDC target, as this is not more ambitious compared to what is already happening.

For Brazil, the situation is different. We estimate Brazil's INDC target on reforestation / restoration to be more ambitious, in terms of hectares per year, than the potential impact of the Bonn Challenge / NYD, which therefore has zero potential contribution in Brazil in our results. Furthermore, the Brazilian INDC pledges zero illegal deforestation in the Amazonia region" by 2030. The Amazonia region covers the states subscribed to the GCFTF, which aims for 80% reduction in deforestation by 2020. Seeing the shorter timeline of the GCFTF goal, we estimate that it could have a substantive impact beyond the INDC in the next five years, but that by 2030 full implementation of the INDC would be more ambitious than what the GCFTF aimed for. Thus, the potential impact by 2030 of the GCFTF is also estimated to be zero in Brazil.

In India, the target on modal shift is to increase the share of rail in total transportation from 36% to 45%. This overlaps with the sub-target of the UIC to achieve a 50% increase (relative to 2010) of rail in passenger transport. As the share of rail in total transportation is different from the share of rail in passenger transport, we translate the INDC target into share of rail in passenger transport using the same relative increase: a rise from 36% to 45% corresponds to a 25% increase. We then calculate the overlap between the UIC potential reduction in India and the INDC scenario in which the share of rail in passenger transport is increased by 25%.

12.6 Business versus non-business action

We did not quantify the action of business initiatives on a country-by-country level, as we lack the information that would be necessary to allocate different companies' emissions to various countries where the companies operate. Instead, we have quantified the selected business initiatives on a worldwide level. Regarding their overlap with other initiatives, we have made the simplest possible assumption that they could either be completely covered by other actions (100% overlap) or not at all (0% overlap). This range has been taken along as part of the range of possible reductions below worldwide emissions under INDC scenario projections.

13. Transparency, data availability and reporting

This section briefly summarizes the performance of each initiative quantified for this report in regards to transparency, data availability and reporting.

13.1 Agriculture and forestry

The two forestry initiatives analyzed in this study provide a rather rich documentation of background information. In particular, the Bonn Challenge provide regularly updated information on the already achieved progress towards their target[220] and their own estimate of the emission reductions and economic benefits associated with this. Their target is quite clearly defined, although exactly what qualifies as "restoration" is unclear. The webpage lists all specific commitments made by various restoration programs under the Bonn Challenge worldwide, and includes a section on "opportunity assessments" which are, apparently, currently underway. However, detailed methodological descriptions of their calculations do not seem to be available, although our calculations suggest similar numbers to what is listed on the Challenge's webpage. The Governor's Climate and Forests Task Force have also published an assessment of the potential reduction under achievement of the 80% reduced deforestation target[221], which provided useful background data for our own quantification that turns out consistent with their results. Detailed documents on relevant development in all their subscriber subnational entities are available as well, as are contact details for each of them.

13.2 Cities and Regions

The two quantified initiatives for this section, C40 Cities Climate Leadership Group and the Under 2 Memorandum of Understanding, collect a good list of cities and regions commitments to reduce GHG emission. The Under2MOU signatories present in many cases an Annex with useful information on the region (population, economic context, etc.) and the specific reduction targets it has set to achieve[222]. For those regions without such an Annex, we have assumed that they will take on the MoU's long-term reduction targets for the quantification. The C40 initiative, on the other hand, have an online database with every city that has joined the network[223]; however, the source of this data is not available and, for some of the numbers shown, it is not clear to what it refers (e.g. emissions graph without specifying if it refers to potential emissions reduction or emissions or a particular year). As a consequence, the data that we were able to take from the cities' website was in most cases limited to only the cities' targets and their population (once it had been cross-checked with other sources). Additionally, C40 does not seem to have restrictions in regards to what a city commitment should look like (base year, target year, reduction target), which represented a challenge for the quantification exercise. Finally, we were not able to find information on the already achieved aggregate progress of the towns, cities and regions towards the goals that they have set, leading us to revert to simplified linear interpolations in our calculations.

220 http://www.bonnchallenge.org/

221 http://www.gcftaskforce.org/documents/2014_annual_meeting/gcf_emissions_reduction.pdf

222 http://under2mou.org/?page_id=238

223 Example of a city website in the C40 initiative: http://www.c40.org/cities/berlin

13.3 Energy efficiency in buildings

The available information on the two efficiency-in-buildings initiatives quantified in this project, Global Buildings Performance Network (GBPN)[224] and Super-efficient Equipment and Appliance Deployment (SEAD)[225], is rich but still not fully transparent. To assess their potential impacts, additional data has had to be collected. At first sight, both GBPN and SEAD have a clearly formulated goal that is also quantified in terms of emission reductions and energy savings respectively. However, the quantitative goals are specified with neither a baseline to compare it to nor a clear reference to the literature. Moreover, the formulation of the goal partly varies between different documents. This is particularly astonishing, as both initiatives are backed up by extensive research papers that provide detailed information on the mitigation potentials. In addition, also the research papers partly do not provide baseline developments. Still, the research papers increase the transparency of the initiatives' potential impacts significantly, as they partly compare the potentials to the impact of current policies and assess the economic implications. The latter even allows a quantification of some of the initiatives' co-benefits. Finally, it is noteworthy that GBPN has put an online tool on its website that allows to assess the potential savings in different world regions and scenarios[226].

13.4 Transport

The Global Fuel Economy Initiative (GFEI) and the UIC Low Carbon Rail Challenge both provide detailed information on their targets, assumptions and historic data by country. While additional information and assumptions where necessary to calculate the impacts of these initiatives their reporting is transparent and they publish regular updates.

The SmartWay program by the US EPA provides information on historic reductions achieved but has not targets for the future. Reductions are calculated by each participating company and not published in detail. Other initiatives screened (Fleet for Change, UEMI, UITP) did not provide details on participating entities, reductions achieved, status and planned impacts. They were not quantified due to a lack of data and partially even clear objectives.

13.5 Industry and Business

The business initiatives quantified in this project, the American Business Acts on Climate Pledge (ABAOCP), Caring for Climate (C4C), RE100 and Ultra-Low CO_2 Steelmaking (ULCOS), are a mixed bag regarding public data availability. RE100 does a very good job, as each participating company has a dedicated page on the RE100 website[227], listing key business indicators, current electricity use and renewable electricity percentage, and the renewable electricity target. However, data is missing for several companies. While ULCOS does not provide a target year for its CO_2 emission target, it does report on the progress of its research of new steel technologies[228]. C4C publishes an annual Progress

224 GBPN brochure: http://www.gbpn.org/sites/default/files/gbpn%20brochure_15.7.14.pdf

225 http://www.ulcos.org/en/research/where_we_are_today.php

226 GBPN website: http://www.gbpn.org/about. As both the potential savings provided by the online tool and the potential savings calculated in this report are based on the mentioned research papers, the results agree up to a different choice of world sub regions.

227 http://there100.org/companies

228 http://www.ulcos.org/en/research/where_we_are_today.php

Report[229], but it mainly focuses on past emissions and does not give target emission reductions for a certain future year. Also, no central overview of targets and emission levels for each company is available. The ABAOCP provides an overview of targets for each participating company, but it currently lacks emission data.

13.6 Renewable Energy

The renewable energy initiatives quantified in this project, the European Wind Initiative (EWI), Solar Europe Industry Initiative (SEII), Sunshot Initiative (US) and Wind Program (US), all clearly provide information on their set targets (which all correspond to a share in future electricity generation). It is less clear, what the baseline for each target is however this was overcome within the quantification of the initiatives by using a standardised baseline from the WEO, which includes publicly available data on projected electricity data by technology type and by country.

13.7 Finance

The fiscal initiative quantified in this project was the Portfolio Decarbonisation Coalition, however, due to a different levels of reporting amongst the participating companies, it was only possible to quantify the emissions impact of four investment funds (ABP, AP4, Australian Ethical and CDC). Decarbonisation targets varied considerably by participating company as did the metrics used for assessing progress. Often information was not sufficient to estimate absolute emission reductions over a given time period. It was also necessary to make a series of simplified assumptions to quantify the four investment funds in this study. We anticipate that as the reporting methodologies improve, we will be able to conduct a more comprehensive analysis of the carbon footprint of investment portfolios.

13.8 Short-Lived Climate Pollutants

The Climate and Clean Air Coalition (CCAC) is clear on its general objectives and strategies, but vague on specific reduction targets. For example, the CCAC Five-Year Strategic Plan states that the CCAC will “support [...] policies [...] that will deliver substantial SLCP reductions in the near- to medium-term (i.e. by 2030)”[230]. While the target year is clear, the specific target should be quantified. The Global Methane Initiative (GMI) publishes detailed accounts of its activities, but it does not say anything about future goals. The Global Alliance for Clean Cookstoves is a model for good reporting: it has a clear, quantified goal and it publishes reports on its progress and activities.

229 http://caringforclimate.org/resources-2/
230 http://www.ccacoalition.org/en/resources/ccac-five-year-strategic-plan