On behalf of Kreditanstalt für Wiederaufbau (KfW)

Methodology for CDM eligibility criteria definition

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Executive Summary

The role of market mechanisms in the current transition period in the international climate policy regime is characterized by an increasing supply of available carbon credits as well as weak demand for these credits due to generally low mitigation ambition among Annex-I countries. This has resulted in a price depression for UNFCCC-backed carbon credits which potentially jeopardizes recent improvements in the Clean Development Mechanism's regulatory and methodological framework. Still, carbon markets are expected to continue to play an important role in persuading countries to make ambitious 'contributions' to global mitigation efforts, as offsets can provide the flexibility that is a precondition for binding commitments to deep emission reductions. However, in the future climate regime, it is expected that all countries will need to contribute to global mitigation efforts. It is highly likely that a more differentiated spectrum of national contributions by developing countries will also result in a more strongly differentiated eligibility of CDM project types and host countries. In response to criticisms of the CDM, the EU Emissions Trading System has already restricted the use of CERs from CDM projects outside LDCs registered after 2012 as well as CERs from industrial gas projects.

Further proactive reform of carbon markets and smart limitations of offset flows may be able to contribute to CER price stabilization as well as achieving the political objectives of the climate regime. These include both a more equitable distribution of the benefits of the CDM as well as a more ambitious greenhouse gas (GHG) mitigation efforts by more advanced developing countries. Therefore, instead of relying on a simplistic distinction between LDCs and non-LDCs, or quantitative limitations to CER imports, more sophisticated eligibility criteria linked to country or project type characteristic may better reflect the evolving political context. In addition, they may succeed in driving investment to high-quality CDM activities, and steering more advanced developing countries to more ambitious mitigation contributions beyond offsetting.

This study analyzes different approaches related to defining approaches to limit CDM eligibility in the context of the evolving climate regime. First, the study develops a set of criteria for limiting CDM eligibility, including:

1) *Socio-economic development indicators of CDM host countries*
2) *Responsibility for climate change of CDM host countries*
3) *Contribution to global mitigation efforts of CDM host countries*
4) *Sustainable development impacts of CDM project types.*

A database has been generated that assess relevant authoritative data for all indicators. After a thorough assessment and discussion, four scenarios for limiting CER supply for imports into ETS are developed. These include the scenarios

1) *"LDCs only", which is essentially a continuation of current EU ETS policy*
2) *"Common but differentiated responsibility and respective capacity", which aims at defining a set of criteria that more adequately more consider national circumstances*
3) *"Sustainable development and environmental integrity" which considers both sustainable development impacts and conservativeness of the respective baseline methodology.*

4) *"Climate Change Responsibility" considers contribution to climate change as well as mitigation efforts by CDM host countries.*

Based on the indicator sets and the chosen scenarios representing different choices of eligibility criteria, chapter 3 models the respective quantities, geographic distribution and project type distribution quantitatively in order to arrive at an estimation of the impact on CER supply of each scenario. In order to model CER supply until 2020 and 2030 with a high degree of validity, two potential sources of supply will be distinguished. These are, first, CDM projects that have already been initiated (Pipeline Supply), as well as, second, future CDM projects (Non-Pipeline supply). Furthermore, a Combined Model merges the two previous models into an aggregated view. These models are utilized to assess the four scenarios that have been defined in the previous analytical steps. The models allow estimating how CER supply will respond to price signals in a range between EUR 0.15 – EUR 15.00 (see sections 3.1.5, 3.2.5, 3.3.5). In addition to volume of supply over time, these models enable us to make predictions on how specific host countries will be affected by the various eligibility criteria that underlie the scenarios. For instance, the models predict that China remains the dominant host country whenever the country remains eligible, even if industrial gas and large-scale power projects are excluded. However, when China is excluded, India is most likely to become the dominant CDM host country in scenarios 2 and 4. The models clearly predict that CER Pipeline supply expected in Scenario 1 will not be more than 30-60 million CERs and 30-80 million CERs in 2014-2020 and 2021-2030 respectively, which is insignificant compared to the potential 4 billion under full eligibility.
In addition, the non-pipeline supply model also allows for predictions on how CER volumes react to different price thresholds. A key finding is that, according to the model used in this analysis, a CER price of EUR 5.00 will increase supply significantly, whereas a further price shift from EUR 10.00 to EUR 15.00 increases CER supply only marginally further.

Chapter 4 adds another perspective to the goal of limiting CER supply and strengthening the mitigation impact of the CDM by discounting of CERs, i.e. that one t of emissions reductions from a CDM project would yield less than one CER. As discussed by Butzengeiger et al. (2010), higher CER discount factors for countries that have a high level of development and/or responsibility for climate change could provide incentives for these countries to take on emission reduction targets. This chapter finds that discounting can be a very effective tool to reduce CER supply, and is versatile enough to be designed in a way that reaches a significant level of supply. Discounting is less effective in improving the environmental integrity of the CDM, at least during a phase of low CER prices. While there is a possibility to develop a matrix of discount factors taking into account a number of different criteria, negotiating such a matrix will be more challenging than a very simple approach. Therefore, country-category specific discounting is most likely to be acceptable.

The final chapter 5 builds on the findings of the previous chapters, and expands the explanatory scope by assessing how innovative elements of the CDM's institutional framework can be utilized for scaled-up and more complex market mechanisms such as (credited) NAMAs or sectoral crediting and/or trading mechanisms under the NMM/FVA. In a first step, we establish conceptual differences between the CDM and new market mechanisms, and also identify which innovative CDM elements *can serve as useful building blocks for the design and evolution of new mitigation instruments (5.1). In a second step, we assess the suitability of standardized baselines with a high likelihood of continued relevance in light of likely CER limitation scenarios as defined above (5.2). Third, we assess a range of possible transformation options which include a continued role of a strongly reformed "CDM+", how CDM elements could be integrated in NMM and FVA, as well as synergies between carbon market and climate finance instruments (5.3). These analytical steps are aligned with the research interest of the indicators, methodology, scenario results, and discounting discussion which have been the subject of the preceding chapters.*

In sum, this study shows that options exist to set strong incentives that strengthen the positive developments in the CDM, and to further align the mechanism with the political objectives of the UNFCCC process. Such measures could contribute to unlocking the CDM's full potential, through smart eligibility restrictions, adjusted uses of the CDM through innovative uses of offset credits, as well as through new applications of its methodological toolkit.

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Acronyms

ADP	Ad Hoc Working Group on the Durban Platform for Enhanced Action
A/R	Afforestation / reforestation
AR	Assessment report
BAU	Business as usual
BL	Baseline
BoP	Base of Pyramid
CBDRRC	Common but differentiated responsibility and respective capacity
CCDM	Chinese CDM
CCER	Chinese CER
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CDM EB	Clean Development Mechanism Executive Board
CER	Certified Emission Reduction
CFL	Compact fluorescent lamps
Ci-Dev	(World Bank) Carbon Initiative for Development
CME	Coordinating and Managing Entity
CMP	The Conference of the Parties serving as the Meeting of the Parties (to the Kyoto Protocol)
CO_2	Carbon Dioxide
COP	Conference of the Parties
CP	Crediting period
CPA	Component Project Activity
CPI	Corruption Perception Index
DECC	British Department of Energy and Climate Change
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
EE	Energy efficiency
EnDev	Energising Development Programme
EPC	Energy Performance Certificate
ER	Emission reduction
ETS	Emissions Trading Scheme
EU	European Union
EU ETS	European Union Emissions Trading System
EUR, €	euro
fNRB	Fraction of non-renewable biomass
FVA	Framework for Various Approaches
G20	Group of Twenty
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Grid emission factor

GET FIT	Uganda Feed In Tariff Program
GHG	Greenhouse gas
GNI	Gross national income
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
h	hour
HDI	Human Development Index
HFC	Hydrofluorocarbon
HIPC	Heavily indebted poor countries
IEA	International Energy Agency
JCM	Joint Crediting Mechanism
ICS	Improved cook stove
JI	Joint Implementation
KP	Kyoto Protocol
KfW	Kreditanstalt für Wiederaufbau
LCC	Low Carbon City program
LDCs	Least Developed Countries
LLDC	Landlocked developing country
LoA	Letter of Approval
LRT	Light rail transit
LUCF	Land-Use change and forestry
LULUCF	Land use, land-use change and forestry
MIGA	Multilateral Investment Guarantee Agency
MRV	Measurement, Reporting and Verification
MSL	Municipal Street Lighting
Mt	megatonne
MW	megawatt
MWh	megawatt hour
N_2O	Nitrous oxide
NAI	Non-Annex-I country
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-governmental organisation
NMM	New Market Mechanism
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
PDD	Project Design Document
PFC	Power Factor Correction
PoA	Programme of Activities
PoA-DD	Programme of Activities Design Document
PMR	Partnership for Market Readiness
PP	Project Participant
PPP	Public–private partnership
QA/QC	Quality assurance and quality control

RBF	Results-based finance
RCC	UNFCCC regional CDM collaboration centres
REDD	Reducing Emissions from Deforestation and Degradation
REFIT	Renewable Energy Feed-in-Tariff
SB	Standardized baseline
SCM	Sectoral crediting mechanism
SD	Sustainable Development
SF_6	Sulphur hexafluoride
SIDS	Small Island Developing States
SSC	Small scale
STM	Sectoral trading mechanism
t	metrical tonnes
T-COP	Thailand Carbon Offsetting Program
T-VER	Thailand Voluntary Emission Reduction program
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
URC	UNEP Risø Centre
US	United States
w/	with
w/o	without
WB	World Bank
WG	Working group
yr	year
$	dollar

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1. Introduction

1.1. Background

The international climate policy regime, which has been built around the United Nations Framework Convention on Climate Change (UNFCCC), is currently in a transition period. The role of market mechanisms in this phase is characterized by an increasing supply of available carbon credits as well as weak demand due to generally low mitigation ambition among Annex-I countries, especially those that are not actively participating in the second commitment period of the Kyoto Protocol (KP). This has led to a continued price depression for UNFCCC-backed carbon credits. Increased demand depends on an increased level of mitigation ambition, as well as political decisions on the eligibility of types and sources of emission reduction certificates. In the future climate regime, it is expected that all countries will need to contribute to global mitigation efforts. In contrast to pre-2009 expectations for a “Kyoto-style” agreement with binding national emission targets, a “bottom up” regime of national emission reduction pledges with only limited oversight by international institutions is currently seen as the most likely medium-term outcome. The role of market mechanisms in this larger architecture is not yet defined. However, it seems evident that markets will continue to play an important role in persuading countries to make ambitious ‘contributions’ to global mitigation efforts, as offsets can provide the flexibility that is a precondition for binding commitments to the deep emission reductions that climate science demands.

The Clean Development Mechanism (CDM) has demonstrated its ability to generate more than 1.5 billion certified emission reductions (CERs) from more than 7,500 registered projects in over 90 non-Annex I (NAI) countries. The CDM’s scale has shown the effectiveness of market-based incentives to mobilize mitigation action companies by private and public actors. Yet, the CDM has also been criticized for the alleged weak environmental integrity of some project types (e.g. industrial gas, large-scale hydro and coal power), high transaction costs, uneven sustainable development benefits as well as an inequitable geographical distribution of its projects and associated benefits. Moreover, for advanced developing countries, the CDM’s financial incentives can be seen as a barrier for taking up more ambitious domestic mitigation commitments as they may lose CER revenues in sectors that had previously been eligible for the CDM. In order to immediately address some of these concerns, the European Union (EU) has prohibited companies that are covered by the EU Emissions Trading System (EU ETS) to use CERs from CDM projects outside least developed countries (LDCs) registered after 2012 as well as CERs from industrial gas projects. This policy has directed the focus of new CDM activities to LDCs.

Still, the mechanism has demonstrated its ability to respond to some of these criticisms, e.g. by operationalizing reforms such as Programmes of Activities (PoAs) and standardized approaches to establishing baselines, additionality and measuring, reporting and verification (MRV). These successful regulatory reforms have led to a notable increase of CDM uptake in “under-represented” countries such as LDCs and African countries. However, due to the historically low price of CERs, private sector engagement in the CDM has essentially stopped since 2012 and the CDM portfolio remains in hibernation, even though its regulatory framework continues to evolve. Still, some of the human and institutional capacity able to develop CDM projects has already been lost.

At the same time, the UNFCCC process considers to elaborate new market-based approaches such as the New Market Mechanism (NMM) as well as a Framework for Various Approaches (FVA), which may integrate mechanisms that are emerging outside of the UNFCCC context such as the Japanese bilateral Joint Crediting Mechanism (JCM). Key objectives of these mechanisms include simplified procedures as well as own contributions of the host country to mitigation efforts. Until today, however, the CDM remains the only source of UNFCCC compliance-grade carbon credits from developing countries. Although the CDM may be complemented by other mechanisms in the future, the evolution of the CDM and other mechanisms clearly show that it takes several years before institutions, procedures and methodological tools become operational, and allow for implementation at scale (Dransfeld et al 2014, p.52). Therefore, the CDM can be expected to retain relevance in the medium-term, both as a source of CERs from the current portfolio that can be used for compliance purposes, as well as a methodological toolkit on which emerging mechanisms, including results-based finance instruments that do not rely on the carbon market, may build.

In the short term, however, an increase in CER demand seems unlikely. In addition, the emerging architecture of the new climate agreement suggests that a more differentiated spectrum of national contributions by developing countries will also result in a more strongly differentiated eligibility of CDM project types and host countries. Therefore, proactive regulation of carbon markets may contribute to price stabilization as well as achieving the political objectives of the climate regime, including both a more equitable distribution of the benefits of the CDM as well as a more ambitious greenhouse gas (GHG) mitigation efforts by more advanced developing countries. For these purposes, instead of relying on a simple distinction between LDCs and non-LDCs, or quantitative limitations to CER imports, more sophisticated eligibility criteria linked to country or project type characteristics may better reflect the current and future political context. Key challenges of defining such eligibility limitations are how these can drive investment in high-quality CDM activities, and steer more advanced developing countries to more ambitious mitigation contributions beyond offsetting.

1.2. Objectives

This study analyzes various issues that are related to the overarching issue of defining approaches to limit CDM eligibility. First, the study develops a set of criteria for limiting the CDM eligibility of host countries and project types. These criteria encompass multiple dimensions, ranging from contribution to global emission reduction to sustainable development impacts of CDM projects. In a next step, based on these criteria, four scenarios for limiting CER supply for imports into European Trading Scheme (ETS) are developed.

We differentiate according to pre-defined country groups and quantitative indicators operationalizing the principle of “common but differentiated responsibility and respective capacity” on a country level, as well as project-type specific differentiation. Each scenario will be modeled quantitatively in order to understand the respective impacts on CER supply. Then, the study turns to more fundamental transformation options for the CDM. First, the study assesses whether discounting of CERs could lead to similar outcomes than restricting eligibility. In a final step, a qualitative assessment of CDM ongoing reform processes, which focuses on the ongoing standardization of the CDM’s methodological toolbox and programmatic approaches, establishes linkages to the evolution of new carbon market mechanisms and climate finance instruments.

1.3. Methodological approach and outline

This study develops and applies a methodology for defining factors for CER eligibility, which consider both host country circumstances as well as other parameters. A key aspect is to develop a classification for CDM host countries whose CERs are eligible for import into an ETS (including, but going beyond the EU ETS). For this purpose, we apply a three-step process in order to ensure methodologically rigorous results. First, we discuss a broad range of criteria that can serve as factors for limiting CER supply. Second, the most suitable indicators are consolidated in four different scenarios for CER limitation, which consider a broad range of factors. Third, from these scenarios a quantitative estimate of the effects on CER supply will be derived. This estimate uses a modelling methodology based on long-term experience with the CDM market.

1.3.1. Screening and choice of indicators

Step one consists of selecting indicators, classified in four different categories, and subsequently identifying adequate thresholds to distinguish between eligible and non-eligible CDM host countries. The indicators are compiled in a separate database which later serves to model the scenario outcomes. Category 1 indicators describe the **economic development** of CDM host countries.[1] The indicators include per capita GDP (PPP), aggregated indicators such as the World Bank (WB) economic country classification, or the Human Development Index (HDI). Others are debt, corruption related and membership in international country groupings such as Organisation for Economic Co-operation and Development (OECD), G20 or United Nations (UN) country groups. Category 2 comprises indicators that explain a country's **responsibility for greenhouse gas emissions**, including absolute or relative GHG emissions differentiating between energy-related and emissions from land use, land use change and forestry. The indicators 'subsidization of diesel' and 'subsidization of gasoline' serve as proxies for the subsidization of fossil fuels. Category 3 considers countries' climate change **mitigation efforts** in the context of the CDM and beyond, including national mitigation policies (pledges, Nationally Appropriate Mitigation Actions (NAMAs), low-carbon development strategies or national climate funds). However, beyond CDM project pipeline data, our assessment has shown that national mitigation commitments remain inconsistent and partly speculative at this stage, and are therefore difficult to quantify and measure, and have therefore mostly not been considered in the scenarios.

Category 4 indicators are **project type** and technology related parameters such as sectoral scope, the expected issuance from respective CDM projects in the pipeline, the existence of sustainable development co-benefits, the conservativeness of baselines in approved methodologies, the availability of standardized baselines (SBs), and the further standardization potential of methodologies.

1.3.2. Scenario Building

The indicators analyzed in step 1 will inform four scenarios for CDM eligibility (see section 2.2):

(1) LDCs only

[1] Indicators listed here are illustrative only. For a complete list of indicators, please see section 2.1.

(2) Common but differentiated responsibilities and respective capacities (CBDRRC)
(3) Sustainable development and environmental integrity
(4) Climate Change Responsibility

These scenarios represent a diverse set of assumptions and eligibility factors, which are operationalized through a selection of criteria and thresholds from the database. The choice of scenarios and related indicators encompasses a wide range of factors which comprise geographic distribution, project types and resulting quantitative effects. The first scenario is equivalent to the current EU policy to limit eligibility of new CDM activities[2] to LDCs. Therefore, it serves as a kind of “baseline”. Scenario 2 aims to operationalize the capacity principle of “Common but differentiated responsibility and respective capacity”. It focuses on development-related indicators, such as per capita income and the level of the HDI, but also on less frequently used indicators such as a country’s research capacity and membership in economic integration institutions. Scenario 3 makes CDM eligibility dependent on sustainable development benefits and environmental integrity of CDM project types. Scenario 4 considers countries climate change responsibility.

1.3.3. Quantitative modeling of scenario outcomes

Based on the indicator sets and the chosen scenarios representing different choices of eligibility criteria, the respective quantities, geographic distribution and project type distribution are modeled quantitatively in order to arrive at an estimation of the impact on CER supply of each scenario. In order to model CER supply until 2020 and 2030 with a high degree of validity, two potential sources of supply must initially be distinguished:

Initiated CDM projects (Pipeline supply)

Initiated CDM projects are all projects listed in the United Nations Environment Program (UNEP) Risø CDM Pipeline (UNEP Risø Center (2014a)) as of May 2014. The key criterion for a CDM project to be included in the Pipeline is that it has been available for public comment under validation or at a later stage in the project cycle. They might also be labelled so-called Pipeline projects.

Future CDM projects (Non-Pipeline supply)

Future CDM projects are all GHG abatement activities that might be initiated as CDM projects or PoAs after the date of the version of the Pipeline used for this report. If initiated, such projects would enter the Pipeline when starting the public commenting period under validation in the future. Figure 1 provides an overview of inputs, outputs and interactions in the modelling exercise of initiated CDM projects and future CDM projects.[3]

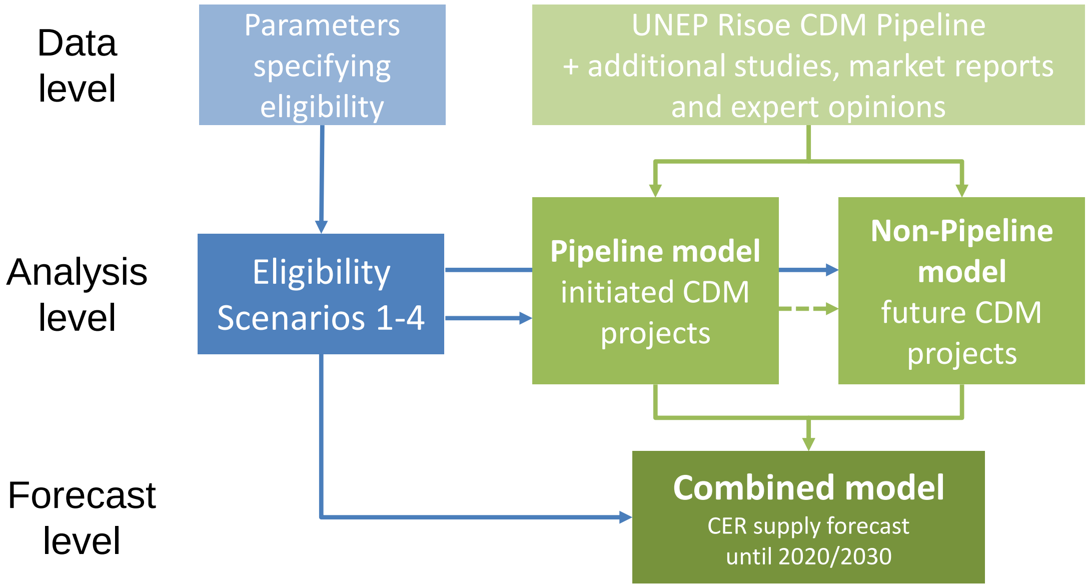
1. At the **data level**, the UNEP Risø CDM Pipeline is used as the primary base for quantitative analysis of the CDM. Additionally, various studies, market reports and expert opinions are taken into consideration in order to develop realistic assumptions.
2. At the **analysis level**, this input leads to two different models with the first one focussing on the Pipeline supply, i.e. supply from initiated CDM projects, and the second one dealing with

[2] For the purposes of this study, “CDM activities“ refers to both CDM project activities and CDM PoAs.
[3] The study does not consider any possible CER supply from Programme of Activities – neither in the Pipeline nor in the Non-Pipeline model.

the Non-Pipeline supply, i.e. supply from future CDM projects. The outcomes of these individual models are assessed against the four CDM eligibility scenarios in order to draw preliminary conclusions on their quantitative impact.

3. At the final **forecast level**, the two individual models are merged into an aggregated view which is called the Combined Model. These aggregated results are assessed once again against the four eligibility scenarios in order to draw final conclusions on the expected CER supply in 2014-2020 and 2021-2030.

Figure 1 – Modelling process of CER supply from the Pipeline model and the Non-Pipeline model to the Combined Model



1.3.4. Outline

As a result, this study will be structured as follows: Chapter 2 develops the methodological foundations for developing and calculating CER import limitations. First, four categories of indicators for CER limitation are defined, assessed, and selected (2.1), including explanations of the choice of parameters and data sources. Then, four scenarios are built based on various combinations of these indicator sets (2.2.). Chapter 3 describes the modelling tool for calculating the impacts of these scenarios on CER supply. This includes CDM activities that have already been initiated (3.1), future CDM activities (3.2), and all CDM activities, which combines the former two categories (3.3). This section concludes with a discussion of the results, explanatory potential and limitations of this approach. Chapter 4 adds another perspective to the debate on limiting CER supply by discussing various discounting options for CERs and their quantitative implications. Chapter 5 takes up the results of the previous analytical steps, and develops a more qualitative outlook on possible options for the CDM may evolve. This includes the identification of innovative CDM elements that have originated from recent reforms such as standardization of various methodological elements (5.1), the suitability of standardizing baselines in further project types (5.2), as well as an assessment of CDM transformation options and linkages with new mitigation mechanisms (5.3).

2. Identification of CDM eligibility factors and scenario development

2.1. Indicators for CER limitation

There is a wide range of criteria that can be used to define which countries or projects should be eligible to generate CERs. We group them into four categories, which

- reflect the **development status** of a CDM host country;
- define the **responsibility for anthropogenic climate change** by CDM host country
- define the contribution of the CDM host country to **climate change mitigation**
- are linked to the **sustainable development benefits** and **environmental integrity** of a CDM project type

For each category, we discuss a range of indicators and select those will inform the scenarios developed in Chapter 3. A separate database has been created in which values for each of indicator has been gathered from the most recent, complete and authoritative sources. This database is the key methodological tool to define the applicability and threshold values for each indicator. All indicators will be presented in tabular format for each of the four categories, in order to provide the reader with a quick understanding of the relevance of individual indicators. Indicators highlighted in green have fully been integrated into the scenarios. Indicators that have not been considered in the quantitative modelling, but have been discussed in Chapter 5 are marked in yellow. Indicators without coloring have been found to be inapplicable, either due to a lack of relevance or because it was not possibly to operationalize them. These indicators have therefore not been integrated either in the scenarios or the transition pathways. When applicable, threshold values for selected indicators are presented and their respective pros and cons are discussed in section 2.2. It is worth noting that in particular indicators in category three, which describe a host country's contribution to climate change mitigation efforts, have been found extremely difficult to operationalize on a sound comparative basis. Key reasons include a lack of rules for the MRV of such measures, and the early stage development of climate policies, NAMAs and national climate funds in most host countries.

Table 1 – Indicator Category 1: Development-related Criteria

Indicator	Years, levels or categories	Indicator included?	Scenario	Comments
GDP per capita, PPP terms ($)	**1990, 2000, 2010**	**Yes**	2	Commonly used proxy indicator, threshold value can be varied easily. Per capita value allows to control for country size
Gross national income (GNI) per capita, PPP ($)	**1990, 2000, 2010, 2012**	**Yes**		Similar to preceding indicator
World Bank country economy classification (2012)	**Low-income**	**Yes**		Less versatile than the two preceding indicators. Still, this classification is increasingly relevant for climate finance instruments, e.g. Climate Investment Funds. However, it led to massive conflicts in the recent negotiations on the Summary for Policymakers of the IPCC 5th Assessment Report.
	Lower middle-income	**Yes**		
	Upper middle-income	**Yes**		
	High income	**Yes**	2	
GDP growth rate, PPP (%)	**average 2000-2010**	**No**		Adds little value to previous indicators, in particular as there is wide gap between the basis of growth between countries at different stages of development
GDP (billion $)	**2010**	**No**		Only reflects size of countries, not their relative capacity
Domestic capital formation (% GDP $)	**2010**	**No**		Relevant for the potential for domestic investments in mitigation activities, but not valid for CDM eligibility.
Domestic capital formation (billion $)	**2010**	**No**		Relevant for the potential for domestic investments in mitigation activities, but not valid for CDM eligibility.
Central Government Debt, Total (% of GDP)	**2000, 2010**	**No**		Reflects capacity to some extent, but insufficiently to be further taken into account.
Cash surplus/deficit (% of GDP) 2010	**2000-2010**	**No**		
Foreign direct investment, net inflows (BoP, current US$)	**2000, 2010**	**No**		Reflects capacity to some extent, but insufficiently to be further taken into account.
Human Development Index (%)	1990, 2000	**Yes**	2	Widely accepted and used index. Threshold value can be varied easily.

Share in global patents issued (%)	2000, 2010	**Yes**	2	Patents show capacity of country regarding technological innovation. Threshold can be varied easily.
Level of Corruption Perception Index (CPI) (score)	1990, 2000, 2010	**Yes**		A high level of corruption is unduly limiting development pathways. Threshold can be varied easily, but proximity to climate-related factors is considered not strong enough.
Membership in economic integration institutions: OECD	y/n	**Yes**	1	OECD membership shows high level of economic development and corresponding capacity to mitigate and adapt to impacts of climate change.
Membership in economic integration institutions, G20	y/n	**Yes**		G 20 membership is more linked to overall size of country than to its capacity.
Net official development assistance received ($)	2000, 2010	**No**		Indicators covers net flows, which are sometimes negative due to repayments, despite comparatively low levels of economic development
Membership in UN-specified country groups (category)	LDCs	**Yes**	1	LDC membership shows very low level of economic development and corresponding capacity to mitigate and adapt to impacts of climate change.
	SIDS	**Yes**		Highly vulnerable, but not directly linked to capacity as also high-income countries are included. Most vulnerable Small Island Developing States (SIDS) with low capacity are included in LDC category
	HIPC	**No**		Considering this indicator may lead to rewarding bad governance
	LLDCs	**No**		No added value to LDC category for the purposes of this study

Table 2 – Indicator Category 2: Responsibility for climate change

Indicator	Years, levels or categories	Indicator included?	Scenario	Comments
GHG emissions per capita, excluding LUCF (tCO_2e)	**1990, 2000, 2010**	**Yes**	**4**	Key indicator for current responsibility for climate change. Threshold value can be varied easily.
GHG emissions increase (tCO_2e)	**1990-2010**	**Yes**	**4**	Important to capture trends, even though relative nature of this indicator needs to be considered
Cumulative emissions of CO_2 from fossil fuel combustion (million t)	**1950-2010, 1990-2010**	**Yes**	**4**	Critical to capture historic responsibility. Threshold value can be varied easily.
Per capita emissions from LULUCF (forest conversion; tCO_2eq)	**1990, 2000, 2010**	**No**	**4**	LULUCF-related data are subject to uncertainties, most relevant activities and sectors are not included in CDM
Per capita emission of N_20 (million tCO_2 eq.)	**1990, 2000, 2010**	**Yes**	**4**	Important emissions category, high uptake in the CDM
Per capita emission of F-gases (tCO_2 eq.)	**1990, 2000, 2010**	**Yes**	**4**	Important emissions category, high uptake in the CDM
Per capita emission of methane (tCO_2 eq.)	**1990, 2000, 2010**	**Yes**	**4**	Important emissions category, high uptake in the CDM
Subsidization of diesel	**high subsidy" - "moderate subsidy" - "moderate tax" - "high tax"**	**No**	**-**	Key parameter, but insufficient data available, therefore shifted to qualitative discussion
Subsidization of gasoline	**high subsidy" - "moderate subsidy" - "moderate tax" - "high tax"**	**No**	**-**	Key parameter, but insufficient data available, therefore shifted to qualitative discussion

Table 3 – Indicator Category 3: Contribution of the country to climate change mitigation

Indicator	Years, levels or categories	Indicator included	Scenario	Comments
CDM Projects	**Registered, total, 2012k CERs, 2020k CERs**	**No**	**-**	Demonstrates country engagement in harnessing mitigation potential, but does not weigh country and population size.
CDM PoAs	**Registered, total, 2012k CERs, 2020k CERs**	**No**	**-**	Demonstrates country engagement in harnessing mitigation potential, but does not weigh country and population size.
Annual CERs/GDP (tCO_2/million US$)		**No**	-	Wide disparity between CDM host countries hides which countries can graduate from the CDM, poorer countries get disadvantaged
Annual CERs / country emissions (%)		**No**	**-**	Not a reliable indicator, as its relative nature leads to the situation that emissions intensive countries, such as oil-based Gulf economies have much lower shares than e.g. LDCs with low GHG emissions
Existence of pledge under Copenhagen Accord and Cancun agreement	**(%) reduction from BAU by 2020**	**No**	**-**	There is not enough agreement on indicators to measure impact and effectiveness of such measures yet, in particular regarding the consistency of base years, accounting standards and other key parameters.
Existence of NAMAs (NAMA registry or NAMA database)	**Sector, type of mitigation action; annual reduction $MtCO_2e$/yr, annual and accumulated reduction in 2020 $MtCO_2e$/yr**	**No**	**-**	There is not enough agreement on indicators to measure impact and effectiveness of such measures yet, in particular as most NAMAs are still in planning stages.
Existence of national climate policy or low-carbon development strategy	**y/n**	**No**	-	There is not enough agreement on indicators to measure impact and effectiveness of such measures yet, in particular regarding the enforcement of climate policies.
Existence of national climate fund and/or climate finance received	**y/n and volume of financial resources**	**No**	-	There is not enough agreement on indicators to measure impact and effectiveness of such measures yet, in particular regarding the enforcement of climate policies.

Table 4 – Indicator Category 4: Project type and technology related criteria

Indicator	Years, levels or categories	Indicator included	Scenario	Comments
Expected issuance from CDM projects in Pipeline	**No. of projects, 2012 kCERs, 2020 kCERs, 2030 kCERs**	**No**		Indicator does not allow to determine project type quality
CDM projects with CERs issued	**Projects, Issued kCERs, Issuance success**	**No**		Indicator does not allow to determine project type quality
Project size	**MW, tCO_2e**	**Yes**	3	Very large projects are less likely to be additional, at least in a number of key sectors.
Existence of sustainable development co-benefits	**high (3), medium (2), low (1)**	**Yes**	3	Key parameter for legitimacy of continued CDM eligibility, especially in combination with conservativeness of baseline
Conservativeness of baseline		**Yes**	3	Key parameter for legitimacy of continued CDM eligibility, as contribution to net mitigation of market mechanisms is a key negotiation issue
Availability of standardized baselines and further standardization potential		**No**		Indicator cannot be operationalized for CDM eligibility of individual project types or origins, but will be discussed in Chapter 5

Data sources: Boden et al. (2013), CAIT2.0 (2014a-e), DESA (2014), GIZ (2011a,b), IEA (2013), OECD (2014), UNDP (2014) UN-OHRLLS (2014 a,b), UNEP Risø Center (2014a-c), WIPO (2014), World Bank (2014a-c)

These indicators comprise a broad range of factors which allow developing scenarios that consider different aspects of CDM eligibility limitation.

2.2. CER limitation scenarios

As discussed in the preceding section, only the criteria that have been deemed most relevant in terms of mitigation impact and political feasibility have been selected for the final scenario design, in close interaction with KfW. We have compiled a CDM eligibility database that serves as a foundation for the methodological design of the scenarios below. The scenarios aim at providing a broad range of different perspectives that weigh different sets of criteria, e.g. development, climate change responsibility and project type factors differently. We have listed our choice of eligibility indicators and relevant thresholds for the various scenarios. Then, we have also offered possible variations of these indicators, which could either replace or complement the first choice of indicators.

Scenario 1: "LDCs only"

Brief description: Eligibility is based on "Development" criteria. Scenario is based on a (adjusted) continuation of current EU ETS policy.

Eligibility indicators and thresholds:

- **Membership in UN-specified country groups:** only **LDCs** are eligible to export CERs (other memberships are not relevant)

Comment: This scenario excludes all non-LDCs; as a result most non-Annex I (NAI) countries would not be eligible to export CERs anymore.

Scenario 2: "Common but differentiated responsibility and respective capacity"

Brief description: Eligibility is based on "Development" criteria. Scenario aims at aligning CER eligibility more closely with the UNFCCC principle of common but differentiated responsibility and respective capacity (CBDRRC), taking into account various criteria.

Eligibility indicators and thresholds:

- **GDP per capita (PPP) 2010:** all countries above **world average** are excluded from exporting CERs
- **Share in global patents issued (2010):** all countries above **1%** share of all global patents in 2010 only (not accumulated) are excluded from exporting CERs
- **Human Development Index (2010):** All countries above **an HDI of 0.7** are excluded from CER exports[1]
- **Membership in economic integration institutions (y/n):**
  - **OECD:** all members are excluded from CER exports
  - **G20:** only **high income** G20 members (i.e. Saudi Arabia) are excluded from CER exports

Comment: Only countries that are below the thresholds for all criteria remain eligible to export CERs.

Scenario 3: "Sustainable development and environmental integrity"

Brief description: Eligibility is based on "Project type" criteria, and considers the most widely used CDM methodologies. The scenario is based on a relatively broad exclusion of technologies with very low mitigation costs as well as a combined indicator comprised of sustainable development (SD) impacts of project types, as well as the conservativeness of the corresponding baseline.

Eligibility indicators and thresholds:

a. Exclude technologies that have already been excluded by most CER buyers: HFCs, N_2O (adipic acid) (all methodologies)
b. All power generation and efficiency projects >100MW as per UNEP Risø CDM Pipeline are excluded

- **Sustainable Development (SD) Benefits:** Project types with **low SD benefits** are excluded unless they have a conservative baseline (**Conservativeness of baseline:** low and medium conservative baseline methodologies are excluded), only methodologies with >20 applications:
  a. AMS-II.B, ACM7

Comment: This scenario will exclude entire sectors or technologies, but would allow considering conservativeness and environmental integrity of individual project types more strongly.

	High/medium conservative BL	low conservative BL
High/medium SD impacts	Eligible	Eligible
Low SD impacts	Eligible	excluded

Scenario 4: "Climate Change Responsibility"

Brief description: Eligibility is based on "Climate Change Responsibility" as well as "Mitigation" criteria. Scenario excludes all countries which rank above the defined thresholds for one or more of the relevant indicators.

Eligibility indicators and thresholds:

- **GHG emissions per capita, excluding Land-Use change and forestry (LUCF) (2010):** countries above NAI average are excluded from exporting CERs.
- **GHG emissions from LUCF (2010):** countries above NAI average are excluded from exporting CERs
- **GHG emissions increase (1990-2010):** countries above NAI average of emissions increases are excluded from exporting CERs. Countries that emit <2tCO_2 e per capita in 2010 would still be eligible to export CERs in order to consider "development rights".

Comment: This scenario excludes a more diverse set of countries. Fossil fuel subsidies are potentially very important, but data availability remains very poor, preventing e.g. to consider subsidies for coal and other fuel sources more thoroughly.

After having designed these scenarios, which account for a broad range of factors for CER limitation, the impacts of these limiting variables will be quantitatively modelled in order to estimate possible impacts on CER supply.

3. Quantitative modelling of CER supply and assessment of reduction impact in CDM eligibility scenarios

3.1. Initiated CDM projects (Pipeline supply)

3.1.1. Specific approach

The Pipeline model calculates for each year until 2030, the expected emission reductions to be generated for each initiated CDM project. It takes into account the current project status, the project type as well as historical failures and issuance successes.

Table 5 presents the distribution of initiated CDM projects according to their current project status in the Pipeline. It becomes evident that the project statuses to be considered are:

- Projects Pre-validation
- Projects Post-registration w/o issuance
- Projects Post-registration w/ issuance

Projects with a project status different than mentioned above can be disregarded for the following reasons:

- Projects Pre-registration only account for a tiny share of the current projects.
- Projects Non-relevant cover, by definition, all projects whose CDM process had been officially ended (e.g. validation failure, registration failure, withdrawal or replacement) and will not be able, not even theoretically, to generate any emission reductions (ERs) in the future.[4]

Table 5 – Distribution of initiated CDM projects according to new report statuses[5]

Project status	Number	%	Total emission reductions by 2012 (ktCO2e) based on estimated PDD values	%	Total emission reductions by 2020 (ktCO2e) based on estimated PDD values	%
Pre-validation	1'221	14%	5	0%	1'624'292	15%
Pre-registration	21	0%	494	0%	9'146	0%
Post-registration w/o issuance	4'917	56%	344'197	15%	4'203'432	38%
Post-registration w/ issuance	2'579	30%	1'876'876	84%	5'352'342	48%
Sub-total Pipeline projects alive	***8'738***	***100%***	***2'221'572***	***100%***	***11'189'211***	***100%***
Non-relevant	3'454		1'377'636		4'117'057	
Sub-total Pipeline projects ended	***3'454***		***1'377'636***		***4'117'057***	
Total Pipeline projects all	**12'192**		**3'599'207**		**15'306'268**	

For the projects with a status to be considered, the future supply was modelled by applying the following two-step forecast process:

[4] Please refer to Annex 4 for the exact correspondence between project statuses used in the current report and project statuses used in the Pipeline.
[5] The emission reductions by 2012 and 2020 were taken from the UNEP Risø Pipeline which calculates these values based on PDD values of each project.

1. **Application of price filter**
    a. Is the assumed CER price high enough to cover both the expected future costs as well as the required profit margin in the first or current crediting period?
        - e.g. For projects Post-registration w/ issuance, the assumed CER price must be sufficient to cover only verification/issuance costs and the profit margin so that the project will generate and issue CERs.
        - e.g. For projects Pre-validation, the assumed CER price is supposed to exceed abatement costs, CDM upfront costs and CDM verification/issuance costs as well as the profit margin in order to enable the project to issue.
    b. Is the assumed CER price high enough to cover both the expected future costs as well as the required profit margin in possibly renewed crediting periods, if applicable?
        - e.g. For all projects, the assumed CER price is required to be higher than the CDM verification/issuance costs and renewal costs as well as the profit margin in the renewed crediting period to allow the project to continue.

Applying this filter, it was determined for each project and each price over which time period (i.e. from when and how long) the project will issue CERs.
Provided that a project passed this price filter and a specific time period for issuance could be determined, the project's issuance level was determined:

2. **Calculation of generation level**
    a. Which project issuance level can be expected over the time period defined for each specific project having passed the price filter?
        - e.g. For registered projects with previous issuance, the expected future issuance level can be based on the previous issuance track record, while technology-specific average issuance rates have been used for all other projects that have not had any issuance yet.

All assumptions taken with regard to the costs, profit margin, issuance levels and other variables can be found in the following chapter 3.1.2.

3.1.2. Assumptions

Table 6 provides an overview of the assumptions underlying three different cases that differ in their degree of conservativeness. The base case will be used for comparing the different eligibility scenarios in chapter 3.1.4. The conservative and optimistic cases are calculated in chapter 3.1.3 and only serve the purpose of illustrating the sensitivity of the general model for the Pipeline supply.

Table 6 – Cases and assumptions for the general model of the Pipeline CER supply

	Conservative case	Base case	Optimistic case
Viability	If CER price > expected future costs and required profit margin		
Cut-off dates	Post-registration w/o issuance: considered if start of the crediting period is after 30.04.2010 Pre-validation: considered if start of the period for comments is after 30.04.2010		
Costs	High	Medium	Low
Prices	EUR 0.15 – EUR 15.00		
Profit margin	15% of CER price (minimum EUR 0.50)	10% of CER price (minimum EUR 0.40)	5% of CER price (minimum EUR 0.30)
Renewal	Depending on viability, but potentially 70%	Depending on viability, but potentially 85%	Depending on viability, but potentially 100%
Implementation status[6]	65% on-going[7], 35% given up	75% on-going[8], 25% given up	85% on-going[9], 15% given up
Earliest generation of ER	Implemented: 2016 Non-implemented: 2017	Implemented: 2015 Non-implemented: 2016	Implemented: 2014 Non-implemented: 2015
Issuance level	Yearly average of PDD value * (failure rate until registration, if applicable) * issuance success		

All assumptions displayed in Table 6 are explained and discussed in detail in the following sections.

Viability and cut-off dates

It has been assumed that the projects under consideration will be pursued under the CDM if the assumed CER price exceeds the following costs plus a required profit margin. Additionally, projects without any issuance yet were only taken into consideration after a specific cut-off date. These conditions are shown in Table 7.

[6] Implementation has been defined as the technical construction of the project and the installation of a monitoring system. It has been assumed that all projects Pre-validation have not started implementation yet and that all projects Post-registration w/ issuance are fully implemented.
[7] For projects Post-registration w/o issuance, this means 55% implemented, 10% non-implemented.
[8] For projects Post-registration w/o issuance, this means 70% implemented, 5% non-implemented.
[9] For projects Post-registration w/o issuance, this means 80% implemented, 5% non-implemented.

Table 7 – Viability and cut-off date conditions of projects for Pipeline CER supply

Project status	Abatement costs	CDM upfront costs	CDM verification/ issuance costs	CDM renewal costs[10]	Profit margin	Cut-off date
Post-registration w/ issuance			●	●	●	n/a
Post-registration w/o issuance (implemented)			●	●	●	Start of crediting period 30.04.2010
Post-registration w/o issuance (non-impl.)	●		●	●	●	Start of crediting period 30.04.2010
Pre-validation (non-impl.)	●	●	●	●	●	Start of period for comments after 30.04.2012

Prices

The following price levels for CERs have been defined in the quantitative modelling[11]:

1. EUR 0.15
2. EUR 0.30
3. EUR 0.50
4. EUR 1.00
5. EUR 2.00 (given by KfW)
6. EUR 5.00 (given by KfW)
7. EUR 10.00 (given by KfW)
8. EUR 15.00 (given by KfW)

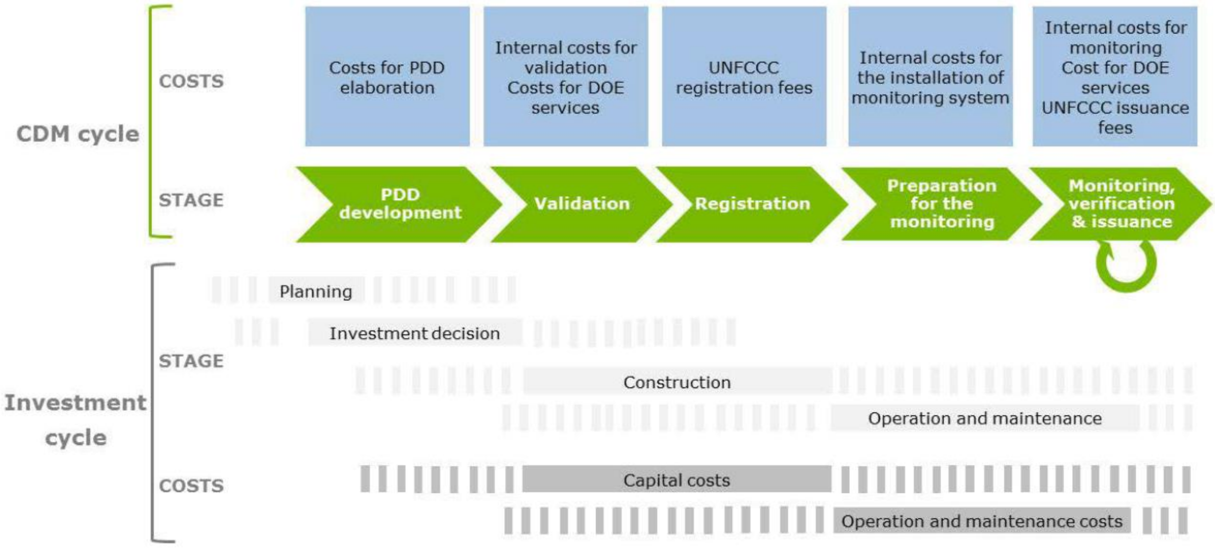
As a consequence, the demand for CERs until 2030 has been considered as being given.

Costs

Being a market-based mechanism to reduce GHG emissions, the estimated costs and expected revenues of any CDM project are decisive whether a CDM project will start the CDM process, be technically implemented and finally willing to issue CERs. In a simplified view, for each CDM project costs for the investment cycle (technical abatement costs) and costs for the CDM cycle (CDM specific transaction costs) can be generally distinguished. This is also illustrated by Figure 2.

[10] Only projects with crediting periods of =<7 or 20 years were considered for the possibility of renewal.
[11] Price levels 5-8 have been given by KfW. Price levels 1-4 have been additionally introduced for illustration purposes.

Figure 2 – Abatement costs and CDM costs over the standard project cycle[12]



Based on these two general cost distinctions four different cost sub-categories have been differentiated for the purpose of the current report.

1. Investment costs
    a) Technical abatement[13]
2. CDM Transaction costs[14]
    b) Transaction costs for upfront[15]
    c) Transaction costs for verification/issuance[16]
    d) Transaction costs for renewal of crediting period

For each CDM project in the Pipeline, these four cost types have been calculated in EUR/tCO_2e. While the technical abatement costs have been assumed to be proportional to the actual project size[17], the CDM transaction costs have been individually calculated for each project depending on the actual project size and depending on the assumed issuance interval[18].

The technical abatement costs have been mainly based on cost estimates made by Warnecke et al. (2013). The values indicated in that report have been cross-checked, discussed and refined by additional studies and expert views, wherever deemed necessary and appropriate. It has been assumed that these technical abatement costs must only be covered once to start and issue over the first crediting period.

12 Warnecke, Klein, Perroy & Tippmann (2013).
13 incl. capital costs, operation and maintenance.
14 In the CDM, the UNFCCC registration fee that is part of the upfront costs represents already the first UNFCCC issuance fee. In order to avoid double counting, it has not been considered for the calculation of the CDM upfront costs.
15 incl. PDD elaboration, validation internal costs, validation DOE services, registration UNFCCC fee, installation monitoring system.
16 incl. monitoring internal costs, verification DOE services, but not UNFCCC issuance fee.
17 in expected CERs per year, with estimated annual PDD values adjusted for issuance success.
18 It has been assumed that high-issuance projects (yearly issuance >50 tCO_2e) issue every year and low-issuance projects (yearly issuance <=50 tCO_2e) bi-annually. However, this assumption was only made for the calculation of relative costs and not for the actual issuance forecast (see also chapter 3.1.6).

The CDM transaction costs have been exclusively based on the findings of Wanecke et al. (2013). However, the current report has only used the absolute cost ranges (e.g. PDD elaboration Hydro large-scale: kEUR 6-15) and recalculated the relative cost ranges (e-g. PDD elaboration Hydro large-scale with 30 ktCO_2e per year and 7 years' crediting period: EUR/tCO_2e 0.03-0.07) based on the raw data. This enables to account for the large range of different project sizes in the Pipeline.

Considering that costs are usually only indicated in ranges, a low cost case (lower limit of defined range), high cost case (upper limit of defined range) and medium scenario (average of limits) have been foreseen in the model. In the base case scenario against which the four different eligibility scenarios will be assessed, a medium cost scenario has been assumed.

A full overview of all cost assumptions as well as additional information on the filling of data gaps can be found in Annex 3.

Profit margin

In the context of a market-based mechanism, it seems obvious that project owners will not be sufficiently satisfied by simply covering their costs. They also want to see a certain profit margin in order to pursue their CDM project. Assuming this profit margin is very difficult and depends on numerous factors such as opportunity costs and financial constraints faced by the project owner, specific size and location of the project, current market prices for CERs etc. Nevertheless, in a base case scenario, the following assumptions have been made to reflect the general requirement for a profit margin:

A. EUR 0.40 per CER (if CER price below or equal to EUR 4.00[19])
B. 10% of CER price (if CER price above EUR 4.00)

These profit margins are consistent with the analysis of snap sample of 66 projects Post-registration w/o issuance (see Annex 5). Within this sample, the majority of the project owners indicated that they would require a CER price of at least 0.50-0.60 EUR in order to start issuing CERs. Considering that very high-issuance projects (> 100 tCO_2/year) face average verification/issuance costs of about 0.24 EUR/CER[20], these average costs of 0.24 EUR/CER plus the assumed profit margin of 0.40 EUR/CER add up to the order of magnitude found in the sample.

Renewal

Even if the renewal of the crediting period is profitable from a pure economic point of view, there can be manifold reasons why a project might not seize this opportunity to renew a crediting period. This refers for example to CDM projects whose technical setup has become less compatible with the CDM requirements over time or to CDM projects that consider the option of leaving the CDM in order to qualify as an offset provider in one of the emerging national ETS (e.g. CCERs in China).

[19] The threshold of 4 EUR has been chosen as it reflects the minimum price required that was assumed by the World Bank in 2004 in order to mobilize capital for low-cost CDM projects.
[20] Based on an analysis of the Pipeline model where the average of verification/issuance costs was calculated for all projects (independently from their status) with more than 100 tCO_2e expected issuance per year

According to Melum and Kolos (2014), the renewal rate of CDM projects has decreased considerably from 78% in 2008 to 51% in 2012 and 31% in 2013. However, this decrease seems to be mainly due to the falling market price over the same period. Furthermore, while the overall renewal rates do not differ much between different project types (currently around 50% for the major project types); they vary greatly from one country to the other (e.g. Mexico 80%, China 54% and Philippines 14%). Yet, Melum and Kolos (2014) argue that it has to be kept in mind that the CDM picked up at different moments in different countries. For example, Mexico's high renewal rate can be partly explained by the few projects that were early starters and came to renewal when prices were still higher.

Thus, it is barely impossible to draw conclusions that are universally valid. Nevertheless, it has been assumed that, in a base case, out of all projects for which a renewal can be considered economically viable, 85% will seize the opportunity of renewal. This renewal probability applies as a simple factor (i.e. * 85%) for each second crediting period that is started by a renewal after 2014 and as a double factor (i.e. * $85\%^2$) for each third crediting period that is initiated through a renewal after 2014.

Implementation status and earliest generation

Based on a snap sample (see Annex 5) and discussion with experts, assumptions have been made with regard to construction and advancement in the CDM process. In a base case, the implementation statuses as well as the corresponding years of earliest generation of emission reductions – as displayed in Table 8 - have been determined.

Table 8 – Implementation status and earliest issuance of projects for Pipeline CER supply

Project status	implemented	Earliest generation if implemented	Non-built	Earliest issuance if non-impl.	Given-up
Post-registration w/ issuance	100%	instantly	n/a	n/a	n/a
Post-registration w/o issuance	70%	2015	5%	2016	25%
Pre-validation	0%	n/a	75%[21]	2016	25%

Yearly generation level

The yearly generation level of emission reductions by each project was calculated as follows: Base PDD value of estimated average yearly emission reductions in current crediting period * (registration/validation failure rates, if applicable) * issuance success.

As indicated in Table 9, the following factors have been used in the calculation process:

[21] In order to facilitate the calculations, it has been assumed that all projects Pre-validation have not disbursed any financial resources for the CDM yet. Consequently, the CER price would have to cover the full range of abatement as well as CDM transaction costs (incl. PDD elaboration etc.) and a possible profit margin.

Table 9 – Calculation of issuance levels of projects for Pipeline CER supply

<table>
<tr><th>Project status</th><th>Base (PDD values)</th><th>Registration/validation failure rates</th><th>Issuance success</th></tr>
<tr><td>Post-registration w/ issuance</td><td>Estimated average yearly ERs of CP1 or CP2, depending on most recent Pipeline entries</td><td rowspan="2">n/a</td><td>Historical issuance success of project</td></tr>
<tr><td>Post-registration w/o issuance</td><td rowspan="2">Estimated average yearly ERs of CP1</td><td rowspan="2">Average historical issuance success of project type[22]</td></tr>
<tr><td>Pre-validation</td><td>Technology-specific failure rates</td></tr>
</table>

In order to simplify the technical modelling process, a constant level for the generation of emission reductions over the possible crediting period has been assumed. First, this disregards the slope, i.e. the variability of yearly ER generation levels that can be observed in some projects types (e.g. afforestation, reforestation, landfill gas etc.). Second, this ignores the possibility that PDD values will change from one crediting period to the other. As described by Melum and Schjolset (2014), this depends on various factors such as methodology revision, change in Global Warming Potential (GWP) potential etc. As a consequence, projects differ in their PDD values between different crediting periods according to their project types (e.g. from CP1 to CP2: on average +4% for N_2O adipic acid, but -27% for renewables). Nevertheless, the general average of 94% for all project types justifies the assumption of the issuance level remaining constant from one crediting period to the other.

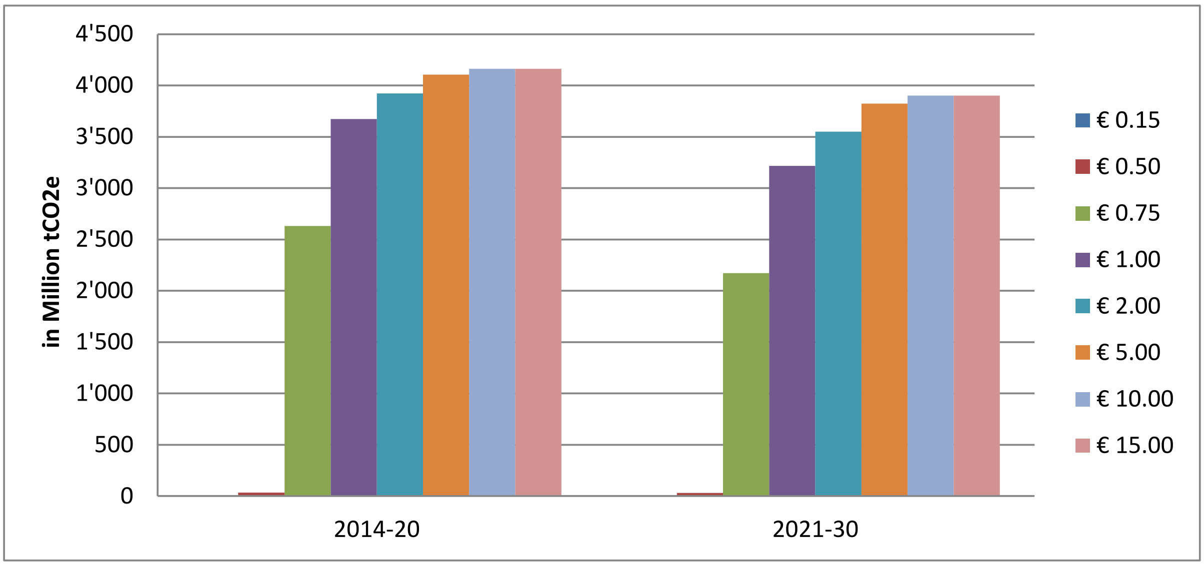
To facilitate the reading of the following chapters, the concept of generation emission reduction has been considered as equal to the concept of issuing CERs though the timing might be different and the second can only happen after the first. Thus, the terminology can and will be used interchangeably. This specific limitation is further discussed in chapter 3.1.6 (see "year of generation vs. year of issuance").

3.1.3. CER supply with full eligibility

This section will provide an estimate for the CER supply from initiated CDM projects given full eligibility, i.e. that all CERs independently of their country of origin or environmental integrity will be considered. If not indicated otherwise, all graphs depict the base case and its underlying assumptions described in chapter 3.1.2. Cases with more conservative or more optimistic assumptions are made explicit.

[22] If no project of a specific project type has had any issuance yet (this only concerns agriculture and biogas), then the average historical issuance success of all project types had been used.

Figure 3 – Pipeline CER supply with full eligibility until 2020/2030 according to price levels

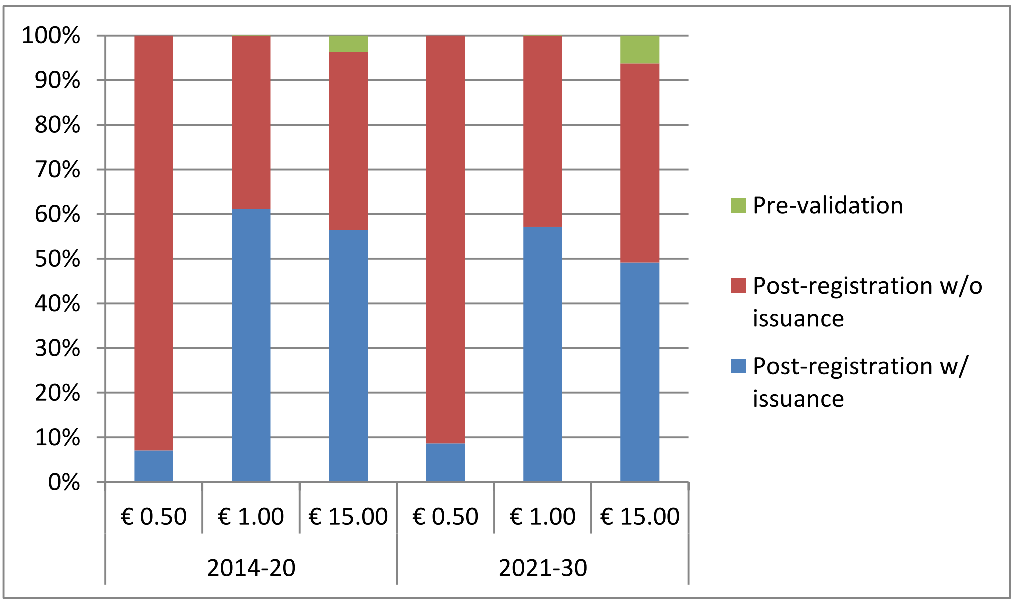


As shown by Figure 3, a price increase from EUR 0.50 to EUR 1.00 might already result in an enormous supply of CERs by the CDM. This is due to the large number of projects Post-registration w/ issuance and Post-registration w/o issuance (implemented) that are supposed to issue as soon as they feel able to cover their verification/issuance costs and the profit margin. At a CER price level of EUR 0.50, hardly any projects will issue, but already at a price level of EUR 0.75 the supply of CERs can be estimated at 2.5 billion CERs and 2.0 billion CERs for 2014-2020 and 2021-2030 respectively. This supply even increases to 3.5 billion CERs and 3.0 billion CERs if a CER price of EUR 1.00 is assumed. For price levels higher than EUR 1.00, the supply is supposed to increase only marginally.

The expected non-issuance of CERs under price levels of EUR 0.50-0.75 is consistent with current forecasts by analysts. Assuming price ranges of EUR 0.10-0.20 until 2020 because of insufficient demand, Melum and Schjolset (2014) for example does not expect any issuance where the issuance decision was based on pure price reasoning. They argue that the expected 0.3 billion additional CERs from the current Pipeline will also be issued because of other reasons. They refer for instance to market imperfections (e.g. quality restrictions in different ETS, specific buyers' preferences), CDM related features (e.g. UNFCCC registration fee already represents an upfront payment for the first batch to be issued) and expectations of project owners (e.g. use of CERs in emerging ETS, voluntary cancellation of CERs).

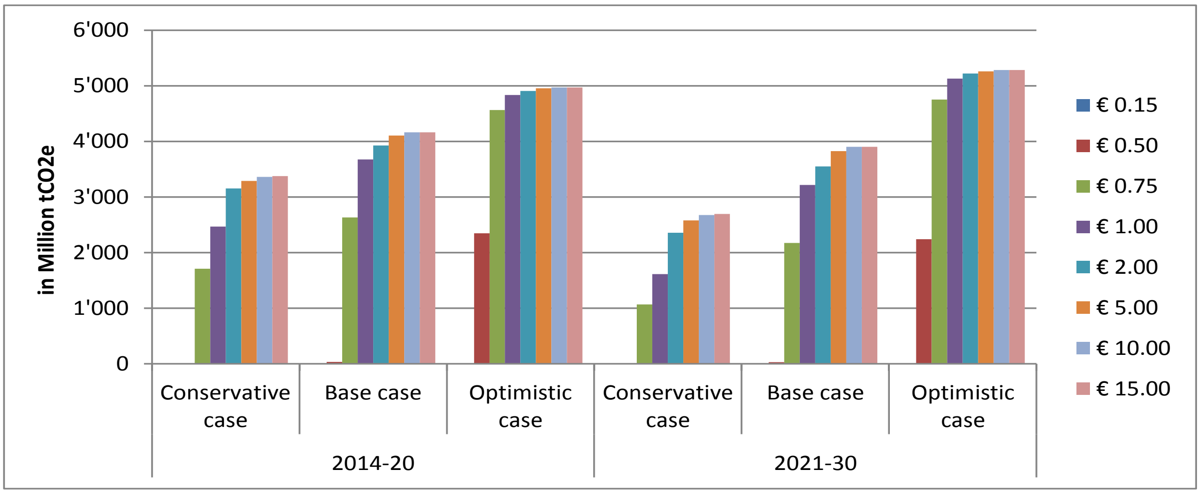
Figure 4 displays which projects – distinguished by their status - will be issuing at different price levels. At EUR 0.50, the picture is not really representative as only eight projects are supposed to issue. All of them are large-scale hydro with low verification/issuance costs due to the project size and they are all located in LDCs what releases them of paying the UNFCCC fee for issuance. At price levels of EUR 1.00 and EUR 10.00, the distribution of projects reflects much better the realities of the current Pipeline. Up to 60% of the future supply can be expected from registered projects with previous issuance; about 40% will come from registered projects that have not issued yet. Projects that are currently Pre-validation will only play a minor role in the supply.

Figure 4 – Pipeline CER supply with full eligibility until 2020/2030 according to project status



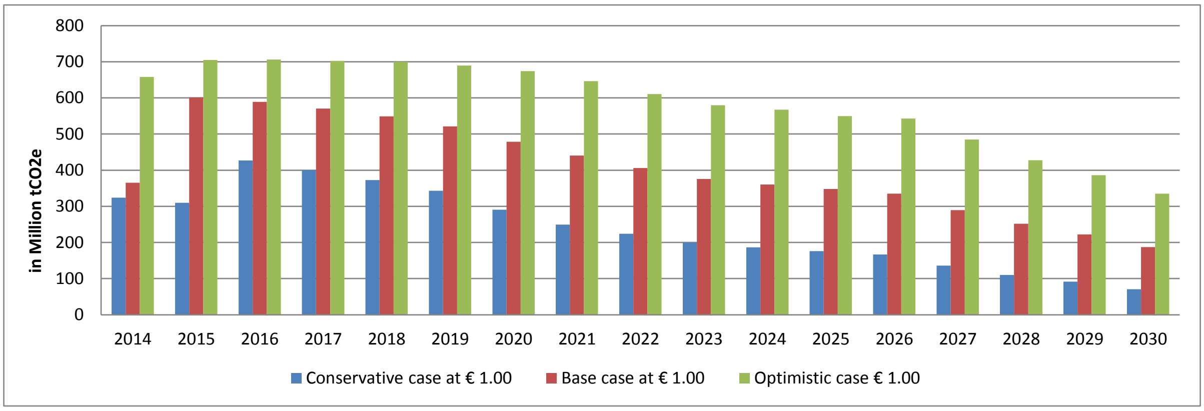
In order to show an indicative range of possible supply by 2020 and 2030, Figure 5 – Pipeline CER supply with full eligibility until 2020/2030 according to conservativeness of assumptions distinguishes between different cases that vary with regard to the degree of conservativeness for the underlying assumptions (see chapter 3.1.1). It becomes evident that only in an optimistic case a significant supply of CERs can already be expected at a price level of EUR 0.50. It can also be seen that the model is the most sensitive to price changes between EUR 0.50-2.00 independently from the case selected. Assuming a price level of EUR 1.00, a CER supply of 2.5 billion, 3.5 billion and 5 billion in 2014-2020 can be expected in a conservative, base and optimistic case respectively. For 2021-2030, the CERs to be issued will amount to 1.5 billion, 3 billion and 5 billion depending on the case. In the conservative and base cases, the expected supply by 2020 will always be higher than the supply by 2030 while for the optimistic case the supply will even increase till 2030. This is due to the assumed renewal probabilities lower than 100% in the conservative and base case.

Figure 5 – Pipeline CER supply with full eligibility until 2020/2030 according to conservativeness of assumptions



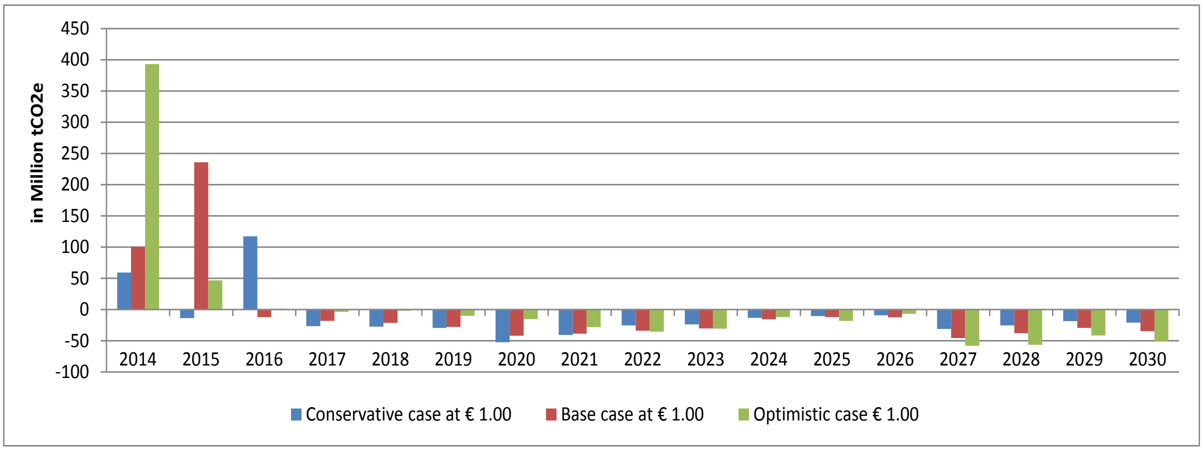
In a last step, Figure 6 presents on a yearly basis the expected issuance levels over time. The assumption for the CER price is EUR 1.00. Depending on the conservativeness of the assumptions, the issuance from the current Pipeline will peak in the years 2015-2017. Afterwards, issuance levels are supposed to decrease gradually. The more conservative the assumptions of the respective case have been taken, the faster the amount of yearly CERs will fall over time. The reason for the surprising decrease in the optimistic case where the assumption of 100% renewal probability has been taken is that from 2019/2020 onwards many projects will reach their limit for maximum crediting period.[23]

Figure 6 – Pipeline CER supply (yearly supply) with full eligibility until 2020/2030 over time according to conservativeness of assumptions



As a final visualization, Figure 7 shows the yearly change in supply compared to the previous year. Here, it can be concluded that the peak increase will happen between 2014 and 2016 when the projects that are currently registered, but have not issued yet will start generating CERs. Afterwards, the decrease in supply will mainly happen in the years 2020-2023 and 2027-2030 when many projects will be required to decide about renewing their expiring crediting period.

Figure 7 – Pipeline CER supply (yearly change in supply compared to previous year) with full eligibility until 2020/2030 over time according to conservativeness of assumptions



[23] In the case of renewable projects, this means that the 3rd crediting period expires. In the case of non-renewable projects, projects will simply reach the end of the single 10/30 years' crediting period.

3.1.4. CER supply in eligibility scenarios 1-4

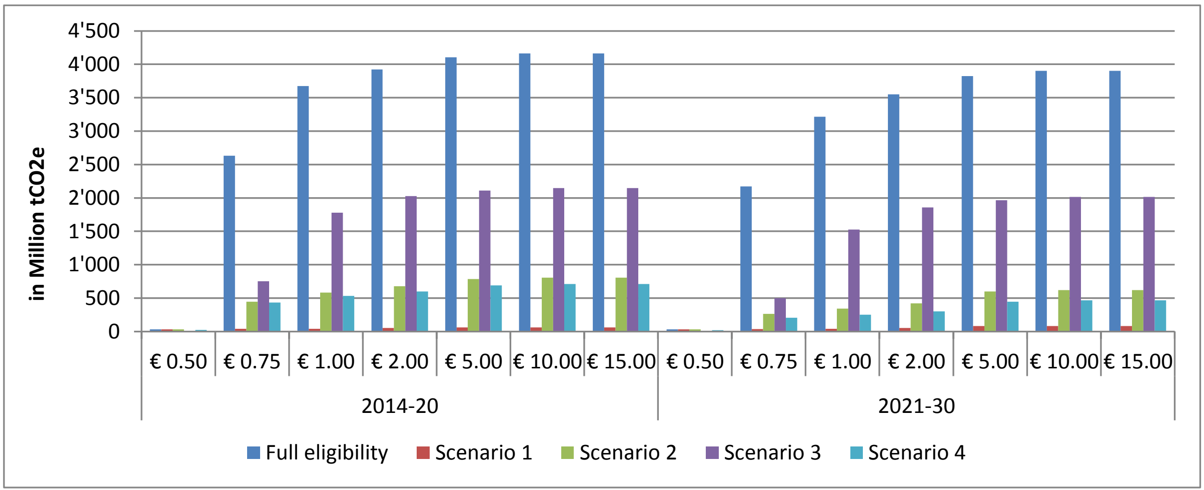
The following section will provide an estimate for the CER supply from initiated CDM projects in four different eligibility scenarios which are described in detail in chapter 2.2:

- Scenario 1: "LDCs only"
- Scenario 2: "Common but differentiated responsibility and respective capacity"
- Scenario 3: "Sustainable development and environmental integrity"
- Scenario 4: "Climate change responsibility"

If not indicated otherwise, all graphs depict the base case (see chapter 3.1.2) and an extreme price level of EUR 15.00 has been assumed in order to trigger as many CDM projects as possible so that the impacts of the eligibility scenarios 1-4 can be easily illustrated.

Figure 8 shows the supply of CERs with full eligibility and in all four different scenarios. It can be observed that applying eligibility criteria according to the scenarios will reduce the expected output on average by -50% to -85% depending on the assumed price level.

Figure 8 – Pipeline CER supply in Scenarios 1-4 until 2020/2030 according to price levels

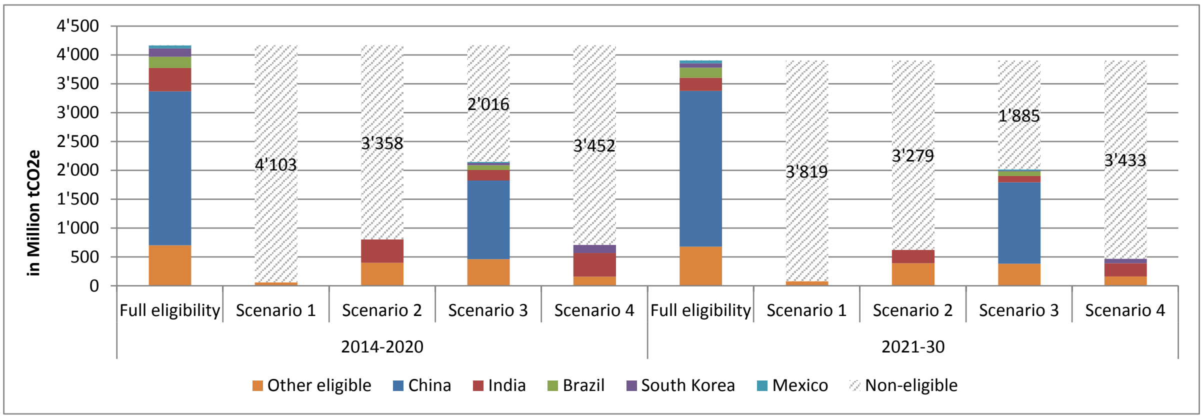


The reduction in CER supply is very high for Scenario 1 where – depending on the price level - only about 30-60 million CERs and 30-80 million CERs can be expected in 2014-20 and 2021-30 respectively. For Scenarios 2+4, the reduction impact turns out to be high, too, but not as extreme anymore. At the price levels from EUR 2.00 onwards, these scenarios are supposed to issue between 0.6-0.8 billion CERs and 0.3-0.6 billion CERs in 2014-2020 and 2021-30 respectively. For Scenario 3, the impact can be considered as medium. Assuming once again price levels of EUR 2.00 and above, about 1.9-2.0 billion CERs and 1.7-1.9 billion CERs are expected to be issued by 2020 and 2030 under Scenario 3. Scenario 3 is also particular with regard to the aspect that it requires higher price levels to get close to its full issuance potential. This is mainly due to the fact that it excludes HFC, N_2O adipic acid and large-scale projects (>100 MW) that have usually rather low transaction costs.

Focus on volumes becoming ineligible

The next two figures will set a focus on the CER potential to become ineligible in different scenarios. Within this scope, Figure 9 analyzes the reduced volumes from a country point of view.

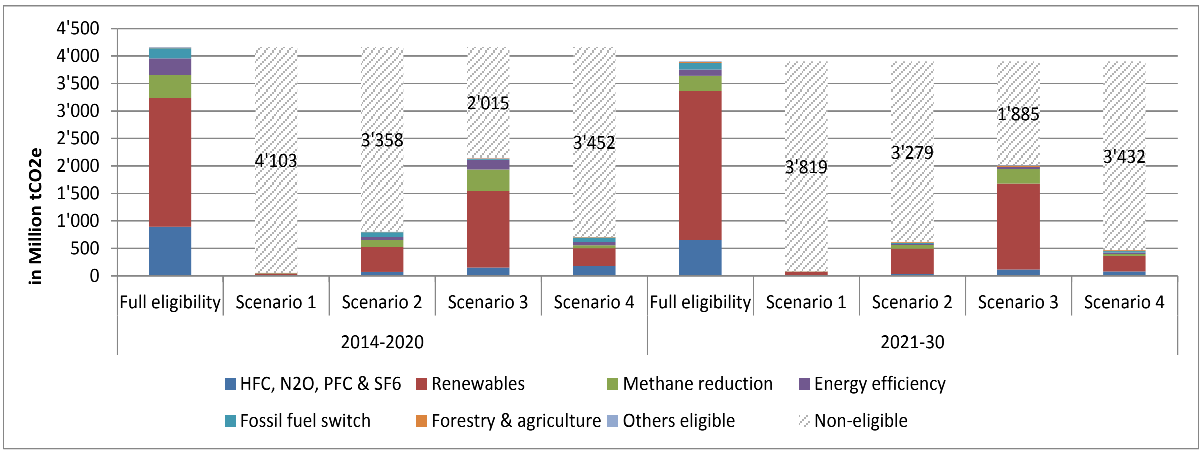
Figure 9 – Pipeline CER supply in Scenarios 1-4 until 2020/2030 with a focus on ineligible host countries



It can be seen that whenever China as a host country remains eligible (Scenario 3 that excludes only project types and technical features of the projects), the CER potential is reduced, but still reaches a significant amount. Other currently dominant countries in the CDM such as India, Brazil, South Korea and Mexico cannot compensate for the absence of China even if they remain eligible in some scenarios (e.g. India in Scenario 2+4 and South Korea in Scenario 4). In general, it can be said that applying the eligibility criteria of Scenario 3, the CER supply from dominant countries is roughly cut by half.

Figure 10 analyzes the reduction impact under a technology angle. This means that it is assessed which project types will be impacted the most in different scenarios 3.

Figure 10 – Pipeline CER supply in Scenarios 1-4 until 2020/2030 with a focus on ineligible project features

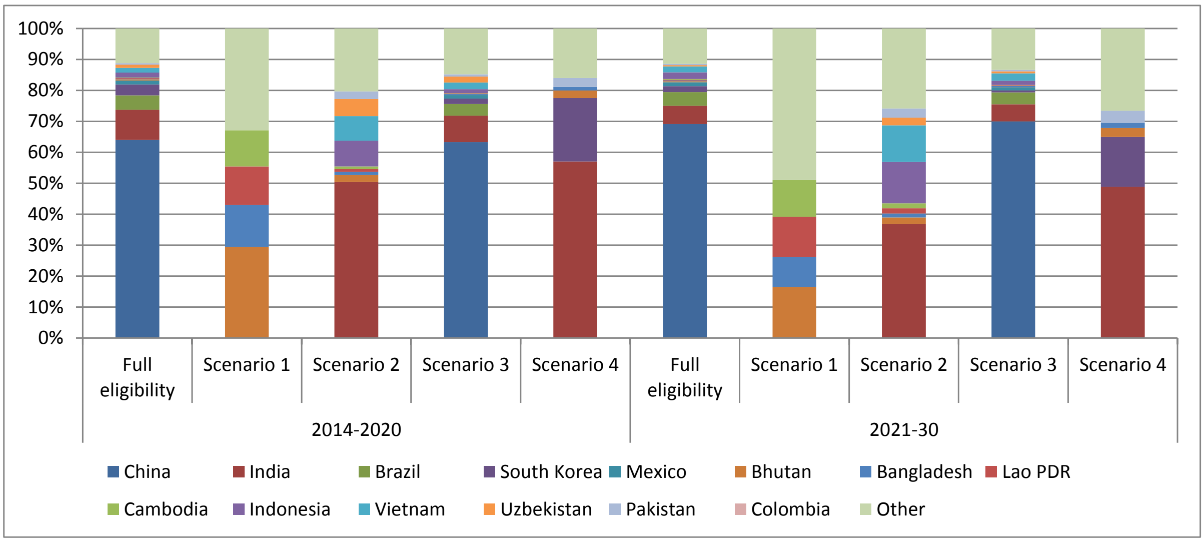


It becomes evident that major industrial gas projects (HFC and N_2O adipic acid) do not account for any significant amount of CER supply in any of the four eligibility scenarios. This results from the fact that they are either explicitly excluded (Scenario 3, due to reasons related to environmental integrity) or do not appear in the supply forecast anymore as most of their host countries are excluded (Scenario 2+4, mainly because of the non-consideration of China, but also of South Korea and Brazil). Apart from industrial gas projects, renewables and methane play an important role in the CDM. Both get considerably reduced in terms of expected CER supply. However, Figure 10 gives an indication that the reduction impact might be stronger for renewables than for methane projects. For Scenario 1+2, this is due to the exclusion of predominantly developed countries where renewable energy projects might be implemented more than in underdeveloped countries due to the better infrastructure of the electricity grids. For Scenario 3, methane projects remain almost fully eligible as they have often no power generation installed and rarely more than 100 MW.

Focus on volumes remaining eligible

Shifting the focus from the ineligible volumes to the volumes that will remain eligible under the different scenarios, Figure 11 examines which countries will be the (new) leaders depending on the scenario selected.

Figure 11 – Pipeline CER supply in Scenarios 1-4 until 2020/2030 with a focus on eligible host countries

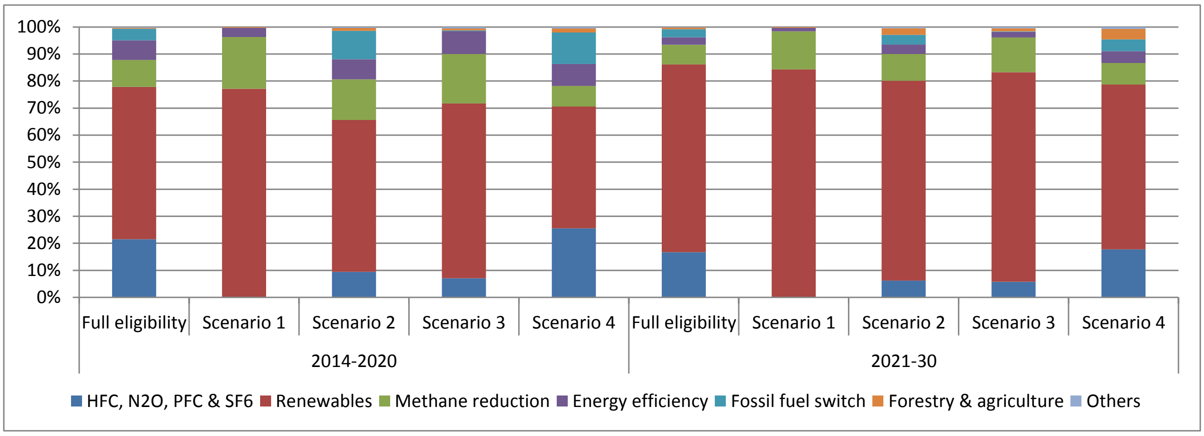


For Scenario 1 with "LDCs only", Bhutan with its large hydro power plants will take over the lead. It is followed by Bangladesh, Lao PDR and Cambodia. Nevertheless, it should be kept in mind that the total volumes will be very low as presented above. In Scenario 3, China will hold on to its dominant role as the country hosts a huge variety of CDM projects, not only related to industrial gas. In general, it can be concluded that the country distribution will hardly change compared to the setting with full eligibility.

In Scenario 2, India will become the "new China" accounting for more than half of the expected CER supply in 2014-20 and still for one third in 2021-30. This is not surprising as all other important competitor countries will not be considered anymore. It will be followed by Indonesia, Vietnam and Uzbekistan though these countries altogether will not account for more than 20%. The same dominant role of India is true in Scenario 4. However, here South Korea alone will represent the runner-up accounting for up to 20% of the expected supply.

Figure 12 also assesses the supply remaining eligible by applying a technological focus. The objective is to identify the leading project types for the different eligibility scenarios.

Figure 12 – Pipeline CER supply in Scenarios 1-4 until 2020/2030 with a focus on eligible project features



It is evident that renewables will always account for the largest share in the expected CER supply. However, their share depends mainly on the exclusion or inclusion (either by host country or project type criteria) of industrial gases. As shown by

Figure 12 for Scenario 1, renewables can be responsible for up to 75% of the expected supply. However, this share decreases to 45%-65% as long as the industrial gases still play a role in the scenario. This is true for the Scenarios 2-4). The strong role of industrial gases under Scenario 4 is mainly due to the fact that South Korea, an important host country of such projects, remains eligible.

The most surprising aspect concerns the role of fossil fuel switch. Almost irrelevant in a setting with full eligibility and non-existing in Scenario 1, their importance increases to a market share of more than 10% in Scenarios 2+4. This might be partly due to the potential of replacing emission-intensive fuels in less developed countries (Scenario 2) and the general trend for less emission-intensive fuels in countries which are assuming their responsibility with regard to climate change (Scenario 4).

3.1.5. Interim conclusions

Based on the observations made in the chapters 3.1.3 and 3.1.4, the following preliminary conclusions can be drawn with regard to the supply of CERs from initiated CDM projects.

- Depending on the conservativeness of the assumed case, in the range of price levels between EUR 0.50 and 1.00 small price shifts can trigger high volumes of CERs to be issued.
- After a price level of EUR 5.00, the CER supply will increase only marginally independently from the case assumed.

- At price levels of EUR 1.00 and higher, projects Post-registration w/ issuance and w/o issuance have a more or less equal share in the expected issuance. Projects Pre-validation will only contribute at high price levels and not account for a share higher than 10% in the common issuance.
- Depending on the case, the expected issuance 2014-2030 is expected to peak over the years 2015-2017.
- The amount of CERs expected in Scenario 1 will not be more than 30-60 million CERs and 30-80 million CERs in 2014-2020 and 2021-2030 respectively. This is insignificant with regard to the potential 4 billion under full eligibility.
- In other scenarios, the amounts will be reduced by about -80% (Scenarios 2+4) and about -50% (Scenario 3).
- India will become the dominant host country in Scenarios 2+4. Only in Scenario 4, South Korea can represent a serious runner-up with about 20% market share.
- Whenever China remains eligible, it keeps on playing the dominant role (more than 60% market share in Scenario 3) despite the exclusion of HFC and N_2O adipic acid as well as large-scale projects.
- Renewables and methane projects will be the predominant technology in LDCs (Scenario 1). Methane projects can also be considered as over proportionally important in Scenario 3.
- In Scenarios 2+4, the project type fossil fuel switch becomes finally really relevant.

3.1.6. Explanatory potential and limitations

The results of the quantitative modelling process with regard to the Pipeline provide unique indications for the supply of CER to be issued until 2020 and 2030. It allows drawing manifold conclusions regarding the following major aspects:

- Issuance: Issuance level of CERs to be expected over the next 16 years
- Price: Price ranges required to trigger different levels of issuance
- Time: Time moments when CERs can be expected to be generated

Nevertheless, the findings should always be put in perspective by keeping in mind that the every model has its inherent limitations to reflect reality. The main limitations of the pipeline model under discussion refer to the underlying assumptions as well as to the technical restrictions. The limitations of the assumptions deal with uncertainty with regard to market features, the limitations due to technical restrictions are due to the trade-off between usability and accuracy of the model.

- Underlying assumptions:
  - **Constant CER price:** As discussed beforehand with KfW, the model will apply different CER price levels. However, all of them have been assumed to be constant over the entire time period up to 2030. This implies that the demand level is seen as given, i.e. a demand level that will ensure the price to remain at a constant level. This constant price represents one of the main reasons why the results of current report differ may differ from other CER supply forecasts that usually work with dynamic prices.

  - **Large ranges for abatement costs:** As already clearly stated by Warnecke et al. (2013), the assumptions about technical abatement costs vary greatly, not only between different project types, but also between projects of a same project type. This is due to the inevitable heterogeneity of CDM projects (size, location etc.) as well as to the different methodologies used in different studies. By reviewing individual studies and meta-studies, discussing values with experts and using in-house experience with the project development under the CDM, the current study has made efforts to base the model on cost ranges that are as realistic as possible. Though, they will never truly reflect the reality of each specific CDM project.
  - **Non-consideration of economies of scale:** Usually, the more a technology enters the mainstream and gets applied on a large-scale basis, the more abatement costs will decrease over time. However, these possible economies of scale have not been taken into consideration in the context of the current study. As a consequence, abatement costs have been assumed to remain constant over time.
  - **Ignorance of implementation status**: Given that in most cases project owners have no obligation to make the current status of their projects public, it is extremely difficult to estimate which projects in the Pipeline still pursue the CDM and which technical implementation status can be assumed for them (e.g. built vs. non-built). Currently, the German Federal Ministry for the Environment has mandated a study to investigate the implementation status of various CDM projects (Ecofys 2013). However, the final results are not expected before 2015.
  - **Ignorance profitability/opportunity costs**: The ignorance of the implementation status is closely related to the lack of information with regard to the financial situation of each project. For example, the profit margins required by different project owners may vary greatly depending on the project size, project location or the opportunity costs that the project owner might face.
  - **No discounting**: Costs and revenues have not been discounted due to the impracticability of this approach given the insufficient data available with regard to timing of costs and revenues, heterogeneous national discount rates etc.
- Technical restrictions:
  - **Timing:** The model clearly faces its most important limitations with regard to the time factor. The variability over time is extremely difficult to model. A trade-off had to be made in order to reflect reality as much as possible without compromising the technical implementation and manageability of the model. As a consequence, the following aspects have been significantly simplified:
    - *Year of generation vs. year of issuance*: The Pipeline model provides the amount of CERs for the years when they are expected to be generated. This moment does not necessarily coincide with the year when they will be issued. Many projects might bundle several yearly vintages of CERs in order to lower parts of the verification costs (e.g. DOE services) in relative terms. This is especially true for periods with low prices and for small-scale projects. However, considering the long-term view of this current report (until 2030), time lags of 1-2 years might be of minor relevance.

- *Issuance intervals only as full years:* As a simplification, issuance levels have always been calculated for full years only. This implies that a project, whose credit start is in October 2015, will be considered from January 2015 onwards. Consequently, given a 10 years' crediting period, it will be disregarded after December 2024.
- *Slope and dynamic issuance levels*: Some CDM project types (e.g. forestry and landfills) are well known for dynamic issuance levels that might increase or decrease over time. This is usually indicated by the slope in the Pipeline. However, integrating the slope into the model would not have been possible due the complexity of the calculations. Additional, these differences equal out over a longer period. Considering the long-term view of this current report (until 2030), they might be therefore of minor relevance.
- *Non-consideration of ERs generated, but not issued as CERs before 2014*: Given the current low prices, the current Pipeline might include a lot of CERs that have been monitored, but have not been issued yet. Due to this generation view, the Pipeline model does not consider any CERs that were generated before 2014 and that might be issued at a later point of time. However, disregarding this supply can be seen as a conservative attitude.
- *CDM upfront payments*: Some of the UNFCCC fees are closely linked to each other. This is especially true for the UNFCCC registration fee that can be considered as an upfront payment for the first batch of CERs to be issued. As a consequence, the registration fee was not taken into consideration for calculating the CDM upfront costs. However, considering this upfront payment in the future verification/issuance costs would have been too complex and unpredictable due the varying issuance patterns of the projects.

3.2. Future CDM Projects from 2014 (Non-Pipeline supply)

3.2.1. Specific approach

Modeling the CER supply from future CDM projects, i.e. projects that have not been initiated yet and are therefore not listed in the current Pipeline, can basically be done by either a top-down or a bottom-up approach. Both approaches would have to fulfill the filter requirements provided by the eligibility scenarios. This means that it must be possible to filter the Non-Pipeline supply at least according to host countries (Scenarios 1, 2 and 4) and project types (Scenarios 3). Additional filter possibilities with regard to project size or methodology used (Scenario 3) have been considered as optional.

Keeping these requirements in mind, a bottom-up approach would analyze the potential for future CDM projects worldwide. Such an analysis requires the analysis of the national greenhouse gas inventory and country profile of each country, the prioritization of the identified mitigation options, the documentation of CDM opportunities and the (theoretical) development of a preliminary portfolio of potential CDM projects as described by Dang et al. (2006). For CDM projects related to renewable energy, this might be possible by taking into account factors such as emission intensity of the national electricity grids, available hydro, wind and solar maps and recent deployment rates. However, already for renewables, this data can only easily be accessed for larger countries and is not available for all states. Moreover, further input data required for CDM projects other than renewables (e.g. methane projects) is sparsely available for most of the countries worldwide.

Given these incomplete and insufficient data sets as well as the essential filter requirements, the idea of a bottom-up approach has finally been disregarded. As a consequence, a top-down approach has been favored that aims at estimating the CER supply from future CDM projects based on historical growth rates under the CDM. The underlying assumptions are explained in detail in chapter 3.2.2.

3.2.2. Assumptions

Table 10 provides an overview of the assumptions underlying three different cases that differ in their degree of conservativeness. The base case will be used for the comparison of the different eligibility scenarios in chapter 3.2.4. The conservative and optimistic cases are calculated once in chapter 3.2.3 and only serve the purpose of illustrating the sensitivity of the general model for the Non-Pipeline supply.

Table 10 – Cases and assumptions for the general model of the Non-Pipeline CER supply

	Conservative case	Base case	Optimistic case
Viability	If CER price > expected future costs and required profit margin		
Costs	High	Medium	Low
Prices	EUR 5.00 – EUR 15.00		
Profit margin	15% of CER price (minimum EUR 0.50)	10% of CER price (minimum EUR 0.40)	5% of CER price (minimum EUR 0.30)
CDM Projects	Only combinations of host countries and project types that are included in the current CDM Pipeline are possible		
Starting point	2016		
Initial base supply	Expected generation level of CERs in 2015 based on Pipeline supply (if not applicable, yearly issuance in 2015 according to PDD values risk-adjusted for validation/registration failure and issuance success of respective project type)		
Growth rates	Compound annual growth rate of 2008-2011: +31.94%		
Slope	S-curve with growth rates that are normally distributed for 2016-2030		
Price influence	Full growth only at EUR 15.00, discount factors for EUR 10.00 and 5.00		

All assumptions displayed in Table 10 are explained and discussed in detail in the following sections.

CDM Projects: Potential host countries and project types

Given the lack of other reliable data, it has been assumed that future CER supply will only come from a combination of host country and project type that can currently already show at least one initiated

CDM project of this specific country/type combination in the CDM Pipeline (UNEP Risø 2014). As a consequence, Belize which currently hosts only one single project related to landfill gas will – in the Non-Pipeline model – not be able to host any other project types in the future. However, the CER supply from landfill gas in Belize can grow over the period up to 2030 by additional projects to be initiated. This decision assumes that the CDM has successfully identified the most promising potential for greenhouse gas abatement measures in each country through the development of at least one project of this type in the country.[24]

Additionally, it has been assumed that all CDM opportunities related to the abatement of industrial gases (HFC, N_2O adipic acid and nitric acid, PFC & SF_6) have been exploited already. This assumes that the CDM has worked as an effective and efficient search engine to identify low-cost abatement technologies and that these GHG emission sources might be regulated through other mechanisms in the future (e.g. under the Montreal Protocol). With regard to industrial gases, this view is clearly shared by Shishlov (2014a). Consequently, there should not be any low-hanging fruits anymore and, taking a conservative view, all combinations of host countries with those project types mentioned above are not able to further increase their supply of CERs.

Starting point and initial base supply

Future CDM projects are supposed to start generating CERs from 2016 the earliest. This assumes a technical implementation time and a CDM registration time of 1.5 years minimum. Concerning the initial base supply, i.e. the initial levels of CERs to which the growth rates are applied, three possible options have been discussed:

1. Historic issuance level in 2013
2. Estimated level of emission reductions to be generated in 2015 based on PDD values
3. Expected generation level of CERs in 2015 based on Pipeline supply (see chapter 3.1)

The historic issuance level in 2013 (option 1) might not be an appropriate initial base supply. The issuance level of that year reflects the current low CER price. Provided that the price levels in the current report are considered as given and can rise to EUR 15.00 per tCO_2e, the issuance might not be representative for the model as many more projects would currently issue if prices were only slightly higher. The estimated level of emissions reductions in 2015 (option 2) might not be appropriate either as it would be based on simple PDD values that have not been risk-adjusted (validation failure, registration failure, issuance success). Therefore, it has been decided to select the expected generation level of CERs in 2015 based on the Pipeline model (option 3).

This expected generation level can be applied to the majority of country/type combinations, i.e. for all combinations for which the Pipeline model expects any generation of CERs in 2015. Though, there are some particular combinations of host countries and project types for which the Pipeline model did not calculate any issuance level. This is mainly due to the fact that these combinations are rare and that the Pipeline model considers the sample project(s) as given up. This happens when a project shows a long time of inactivity in the Pipeline (implicit termination, see cut-off dates in Table 7, p. 29) or when a project has been ended due to a negative validation, rejection or withdrawal (explicit termination). One example for such a case is small-scale hydro in Albania. In these cases, the initial base supply is supposed to be the yearly generation in 2015 according to PDD values that has been

[24] Theoretically, there could be 3'317 possible combinations (107 host countries * 31 project types). Applying the combination approach as described above leads to 657 country/type combinations in the Non-Pipeline model.

risk-adjusted for the average validation/registration failure and issuance success of the respective project type.

Prices

The price levels of the quantitative modeling of the Non-Pipeline supply ought to be consistent with the price levels used for modeling the Pipeline supply. However, based on experience and expert assessment, it can be assumed that EUR 4.00 per tCO_2e must be considered as a minimum price to trigger completely new projects. As a consequence, the following CER price levels remain applicable:

1. EUR 5.00 (given by KfW)
2. EUR 10.00 (given by KfW)
3. EUR 15.00 (given by KfW)

Growth rates

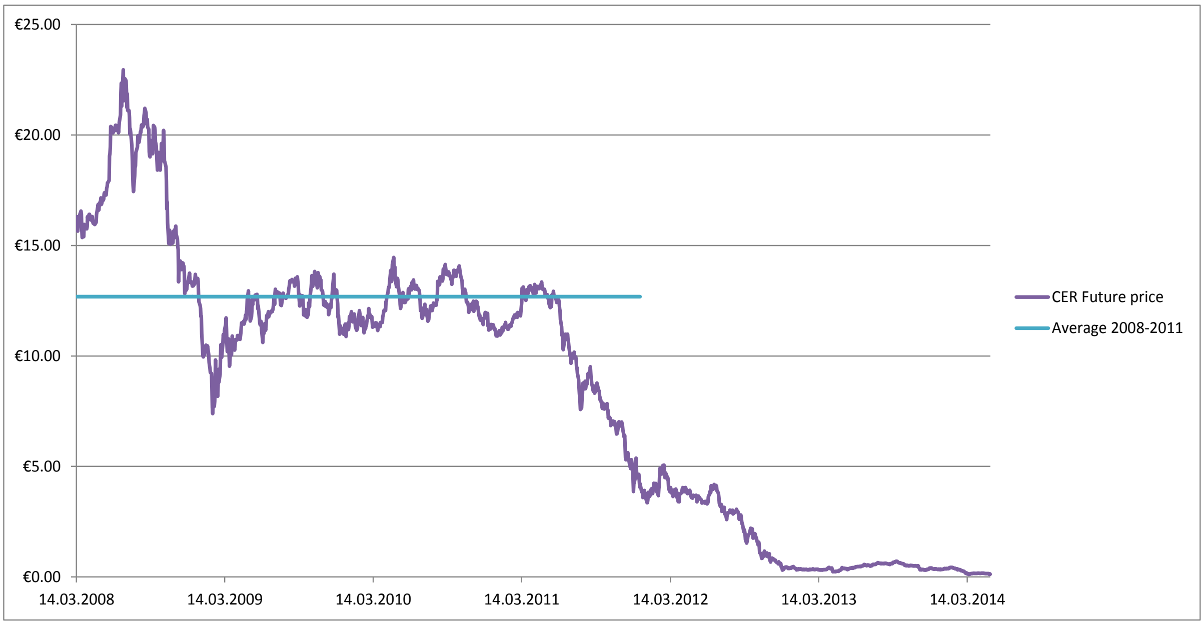
In order to determine a realistic growth rate, historical growth rates in the CDM have been analyzed. First, it has been important to choose an appropriate indicator. Simply considering the number of projects that have entered the pipeline might be misleading due to the (unknown) failures that these projects might have experienced after having been listed. Therefore, it has been decided to select the number of project registrations per quarter.[25]

Second, a representative time window had to be selected. For the following reasons, it has been decided to choose the time period 2008-2011. The year 2012 has been excluded as it would not be representative due to the registration rush in the light of the eligibility deadline under the EU ETS.[26] The year 2008 has been selected as the start of the time window to be considered as it can be considered as the first year when the CDM has become mature (e.g. the trade with futures for CERs started in March 2008) and almost all project types were represented by at least one initiated project (except for afforestation, agriculture, PFC and SF_6). Furthermore, the CER price had always been at reasonably high levels (on average between EUR 12.00-13.00 per tCO_2e) over the entire period before progressively falling down to current low levels as illustrated by Figure 13.

[25] These figures reflect already the usual validation and registration failures under the CDM.

[26] From 2013 onwards, CERs have had to fulfil certain criteria to be eligible under the EU ETS. One of these criteria requires the CDM project to be registered before 2013 as long as it is not located in an LDC.

Figure 13 – CER price for continued future from 2008-2014[27]



Third, it had to be assessed whether technology-specific growth rates or general growth rates for the CDM as a whole should be used. However, the analysis of technology-specific growth rates indicates quickly that these rates differ extremely among different project types. They range from 0%-10% for tidal, CO_2 usage, energy efficiency (EE) services, HFC, mixed renewables and N_2O adipic acid up to 150%-300% for EE households, energy distribution, reforestation and solar. Thus, it has become clear that a general growth for the entire CDM had to be calculated.

As a conclusion, the compound annual growth rate from the beginning of Q1 2008 to the end of Q4 2011 over all registered CDM projects amounted to +31.94% per year. The selection of this growth rate has been supported by the fact that the compound annual growth rate from Q1 2009 to Q4 2011 and Q1 2010 to Q4 2011 are in a similar range (+32,56% and +30,06% respectively).

Slope and price influence

As it would not be realistic to expect a linear growth of +31.94% over the whole time period from 2014-2030, it has been decided to introduce a simplified slope as well as a simplified price influence. Within this regard, the essential assumption has been that a full growth could only be observed in the assumed peak year (2023) of the new wave of future CDM projects and at the highest price level (EUR 15.00).

In order to model a common growth in form of an S-curve[28], a normal distribution[29] has been assumed in order to adjust the growth rates before and after the peak year. This means that in the years before or after the assumed peak year (2023) the maximum growth rate of +31.94% will not be reached yet or anymore, respectively. These “time discount” factors can be seen in the second row of Table 11. To account for the potential influence of prices on the growth, additional “price discount” factors have been introduced. These are displayed in the second column of Table 11.

[27] EEX data via Point Carbon on 9 May 2014.
[28] This implies a low derivative in the beginning and in the end, a medium derivative after the beginning and before the end and a high derivative in the mid-part.
[29] A normal distribution with mean = 8 (1-15 for years 2016-2030) and standard deviation = 8/3.

Table 11 – Discount factors of growth rate for slope and price influence in Non-Pipeline CER supply

32%		2016	2017	2018	2019	2020	2021	2022	***2023***	2024	2025	2026	2027	2028	2029	2030
		3%	8%	17%	32%	53%	75%	93%	***100%***	93%	75%	53%	32%	17%	8%	3%
<5 €	0%	0%	0%	0%	0%	0%	0%	0%	***0%***	0%	0%	0%	0%	0%	0%	0%
5 €	40%	0%	1%	2%	4%	7%	10%	12%	***13%***	12%	10%	7%	4%	2%	1%	0%
10 €	80%	1%	2%	4%	8%	14%	19%	24%	***26%***	24%	19%	14%	8%	4%	2%	1%
15 €	***100%***	***1%***	***3%***	***6%***	***10%***	***17%***	***24%***	***30%***	***32%***	***30%***	***24%***	***17%***	***10%***	***6%***	***3%***	***1%***

The yearly growth rates resulting from the time and price discount factors have been applied to the initial base supply explained above. In order to model a proper S-curve growth, the initial base supply has been the same for each year (Expected generation level of CERs in 2015 based on Pipeline supply) and has been multiplied with the growth rates Table 11 of respectively.[30]

[30] As a consequence, the growth has been assumed to be non-exponential.

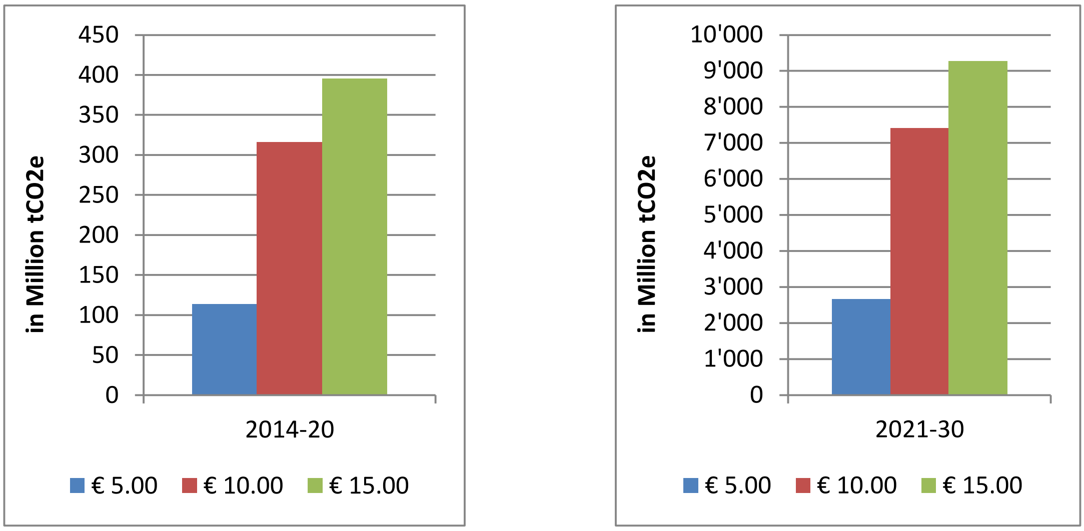
Price filter

Finally, as in the Pipeline model, a price filter has been applied to the Non-Pipeline model. This price filter ensures that each combination of host country and project type can only grow if the assumed price level exceeds the estimated project costs over the lifetime of the project plus a possible profit margin. As a consequence, new solar projects would never be initiated in a medium- or high-cost scenario. Assumptions for these lifetime costs including technical abatement costs as well as CDM transaction cost are presented in Annex 6.

3.2.3. CER supply with full eligibility

This section will provide an estimate for the CER supply from future CDM projects given full eligibility, i.e. that all CERs independently of their country of origin or environmental integrity will be considered. If not indicated otherwise, all graphs depict the base case and its underlying assumptions described in chapter 3.2.2. Cases with more conservative or more optimistic assumptions are made explicit.

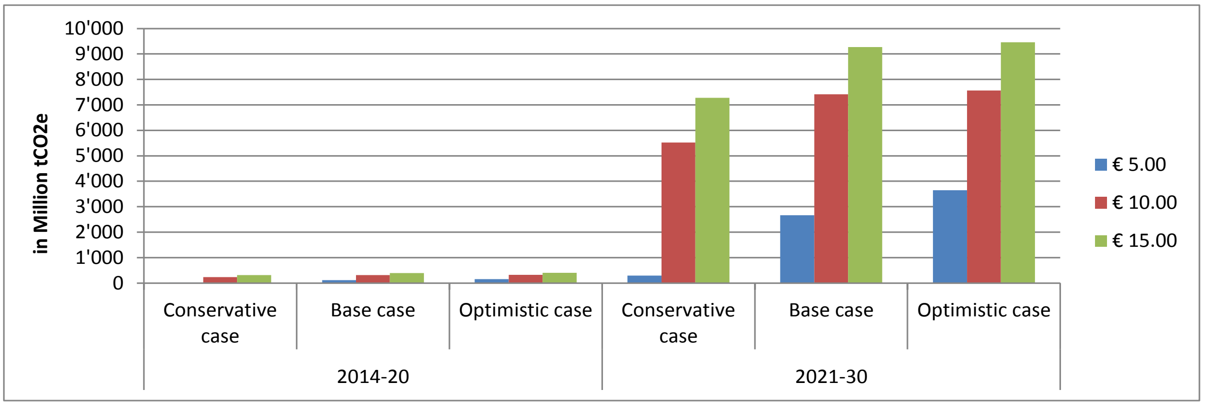
Figure 14 – Non-Pipeline CER supply with full eligibility until 2020/2030 according to price levels



As shown by Figure 14, the CER volumes from future CDM projects that can be expected until 2020 are rather small with 0.4 billion CERs maximum. However, for the time period 2020-2030, depending on the price levels, more than 2 billion, 7 billion and 9 billion CERs can be expected at price levels of EUR 5.00, EUR 10.00 and EUR 15.00 respectively. A major volume increase can be observed if the CER prices rises from EUR 5.00 to EUR 10.00 (below EUR 5.00, no future CDM projects are expected to be started). At the next price level of EUR 15.00, the increase in volume would still be significant, but much smaller. This observation corresponds to the fact that most CDM projects face technical abatement costs and CDM transaction costs between EUR 5.00 and EUR 10.00 per tCO_2e (Warnecke et al. 2013).

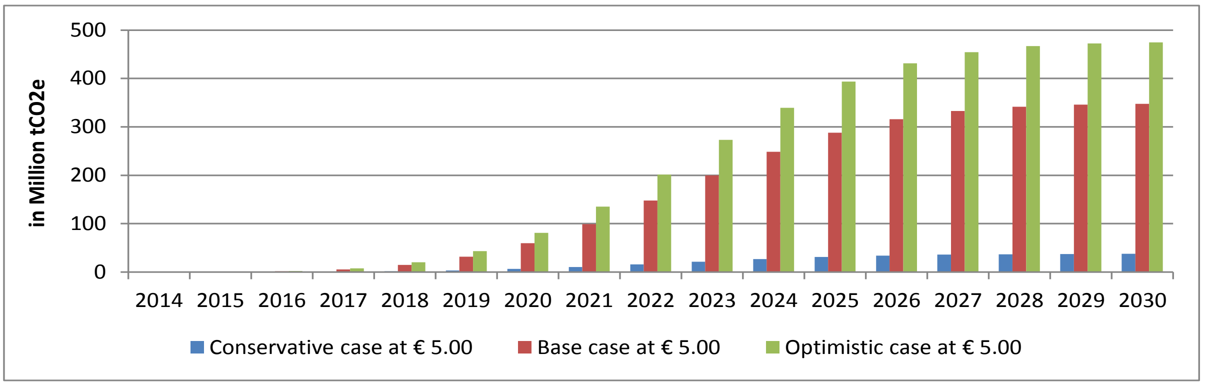
In order to provide an indicative range of possible supply by 2020 and 2030, Figure 15 distinguishes between different cases that vary with regard to the degree of conservativeness for the underlying assumptions (see chapter 3.2.2). It becomes evident that the case consideration is especially relevant for the conservative and base cases. Here a shift from conservative to base assumptions with regard to costs and profit margins lead to an increase in the expected CER volume 2021-2030 of about 2 billion. In return, a further shift from a base case to an optimistic case does not impact the CER supply that much. In relative terms, this is particularly relevant for the CER supply from future CDM projects 2021-2030 at a price level of EUR 5.00 which amounts to only 0.3 billion CERs in a conservative case, but rises to 2.7 billion CERs in a base case. This sensitivity is due to the high variability of abatement costs which depending on the assumptions taken can be below or above the important price threshold of EUR 5.00.

Figure 15 – Non-Pipeline CER supply with full eligibility until 2020/2030 according to conservativeness of assumptions



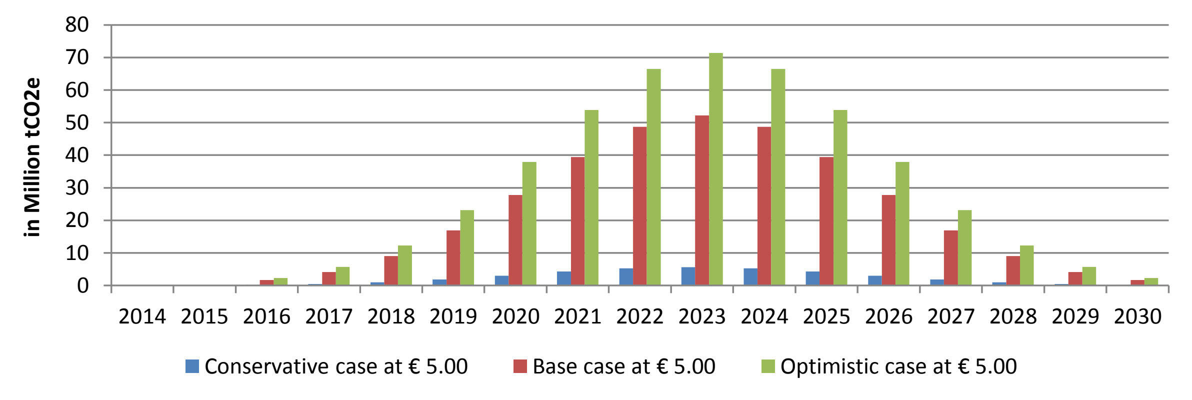
In a final step, Figure 16 presents the expected generation levels over time on a yearly basis. The assumption for the CER price is EUR 5.00. Independent from the conservativeness of the assumptions, the CER generation in the Non-Pipeline model will peak in the year 2030. However, this does not come as a surprise. As aimed at in the modeling process, the cumulative volumes should describe a common S-curve. Furthermore, the assumption has been taken that all future CDM projects will have 7 years' crediting periods that are to be renewed. As a consequence, once a future CDM will have been started, it will not stop generating CERs before the end of its lifetime of 21 years (see limitations in chapter 3.2.6).

Figure 16 – Non-Pipeline CER supply (yearly supply) with full eligibility until 2020/2030 over time according to conservativeness of assumptions



In return, the yearly increase in additional CER volumes will peak in 2023 as shown by Figure 17. This is also due to the growth rates that have been assumed to be normally distributed (see 3.2.2).

Figure 17 – Non-Pipeline CER supply (yearly change in supply compared to previous year) with full eligibility until 2020/2030 over time according to conservativeness of assumptions



3.2.4. CER supply in eligibility scenarios 1-4

The following section will provide an estimate for the CER supply from future CDM projects in four different eligibility scenarios which are described in detail in chapter 2.2:

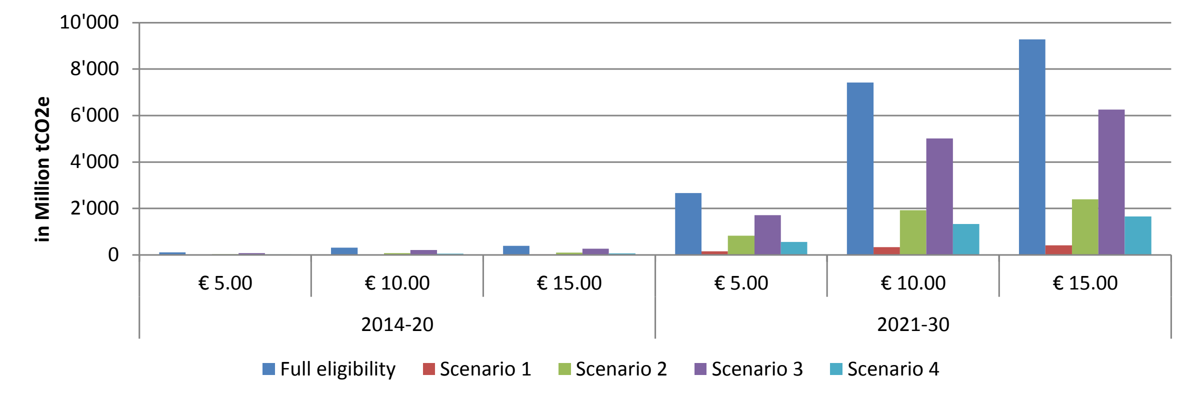
- Scenario 1: “LDCs only”
- Scenario 2: “Common but differentiated responsibility and respective capacity”
- Scenario 3: “Sustainable development and environmental integrity”[31]
- Scenario 4: “Climate change responsibility”

If not indicated otherwise, all graphs depict the base case (see chapter 3.2.2) and an extreme price level of EUR 15.00 has been assumed in order to trigger as many CDM projects as possible so that the impacts of the eligibility scenarios 1-4 can be easily illustrated.

Figure 18 shows the supply of CERs with full eligibility and in all four different scenarios. It can be observed that applying eligibility criteria according to the scenarios will reduce the expected output on average by -30% to -95% depending on the assumed price level.

[31] In contrast to the Pipeline model, several provisions of Scenario 3 could not be directly applied (e.g. exclusion of projects >100 MW and of projects using AMS-II.B or ACM7 as stand-alone methodology). Due to the assumptions of combinations consisting of host country and project type, it was impossible to say whether a combination would be >100 MW or use one of the blocked methodologies. In order to accommodate for this special situation, discount factors have been calculated for each project type. They take into account the share of projects per project type in the current CDM Pipeline that have >100 MW installed and/or use one of the blocked methodologies. As a consequence, the expected CER generation of each combination has then been discounted under Scenario 3.

Figure 18 – Non-Pipeline CER supply in Scenarios 1-4 until 2020/2030 according to price levels



Once again, the reduction in CER supply is very high for Scenario 1 where – depending on the price level - only about 5-20 million CERs and 150-400 million CERs can be expected in 2014-20 and 2021-30 respectively. For Scenarios 2+4, the reduction impact turns out to be much lower. At the price levels from EUR 10.00 onwards, these scenarios are supposed to issue about 55-100 million CERs and 1.5-2.5 billion CERs in 2014-2020 and 2021-30 respectively. For Scenario 3, the impact can still be considered as significant, but relatively low compared to the other scenarios. Assuming once again price levels of EUR 10.00 and above, about 200-250 million CERs and 5.0-6.5 billion CERs are expected to be generated by 2020 and 2030 under Scenario 3. Considering that industrial gases do not play any role in future CDM projects anyways (see chapter 3.2.2), the reduction impact of Scenario 3 turns out to be less strong in the Non-Pipeline supply (-30%) than in the Pipeline model (-50%, see chapter 3.1.4).

Focus on volumes becoming ineligible

The next figures will set a focus on the CER potential to become ineligible in different scenarios. Within this scope, Figure 19 and Figure 20 analyze the reduced volumes 2014-2020 and 2021-2030, respectively, from a country point of view.

Figure 19 – Non-Pipeline CER supply in Scenarios 1-4 until 2020 with a focus on ineligible host countries

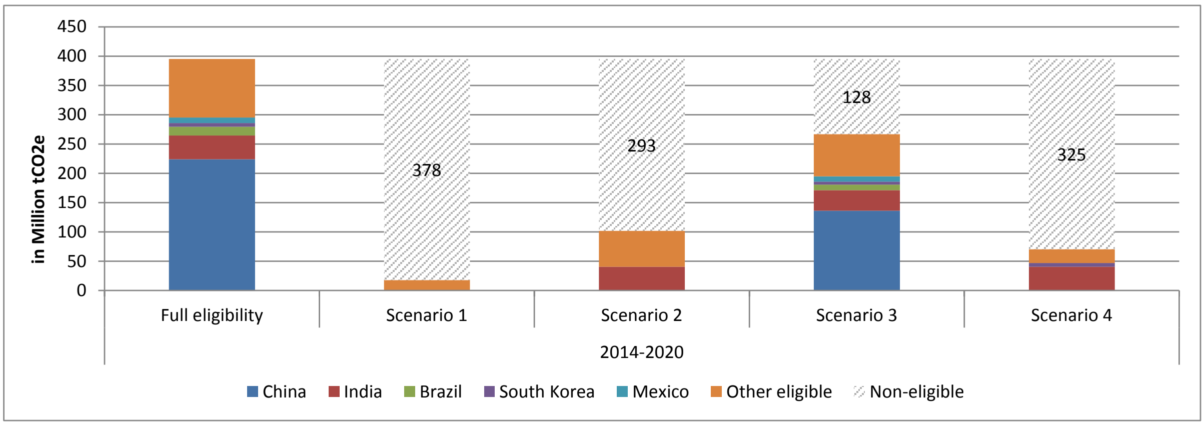
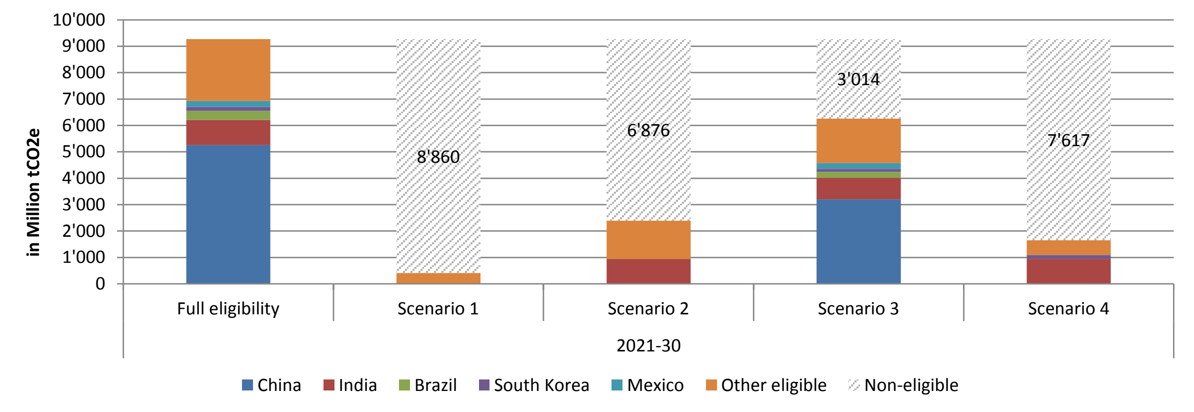


Figure 20 – Non-Pipeline CER supply in Scenarios 1-4 until 2030 with a focus on ineligible host countries



As already observed in the Pipeline supply, it can be seen that whenever China as a host country remains eligible (Scenario 3 that excludes only project types and technical features of the projects), the CER potential is only slightly reduced. Other currently dominant countries in the CDM such as India, Brazil, South Korea and Mexico can never compensate for the absence of China even if they remain eligible in some scenarios (e.g. India in Scenario 2+4 and South Korea in Scenario 4). In general, it can be said that applying the eligibility criteria of Scenario 3, the CER supply is roughly cut by one third.

Figure 21 and Figure 22 analyze the reduction impact under a technology angle. This means that it is assessed which project types will be impacted the most in different scenarios.

Figure 21 – Non-Pipeline CER supply in Scenarios 1-4 until 2020 with a focus on ineligible project features

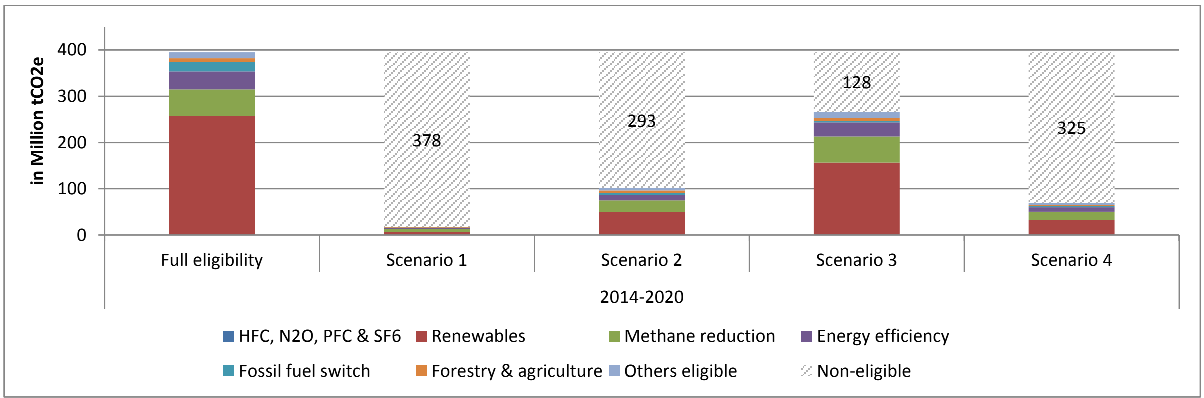
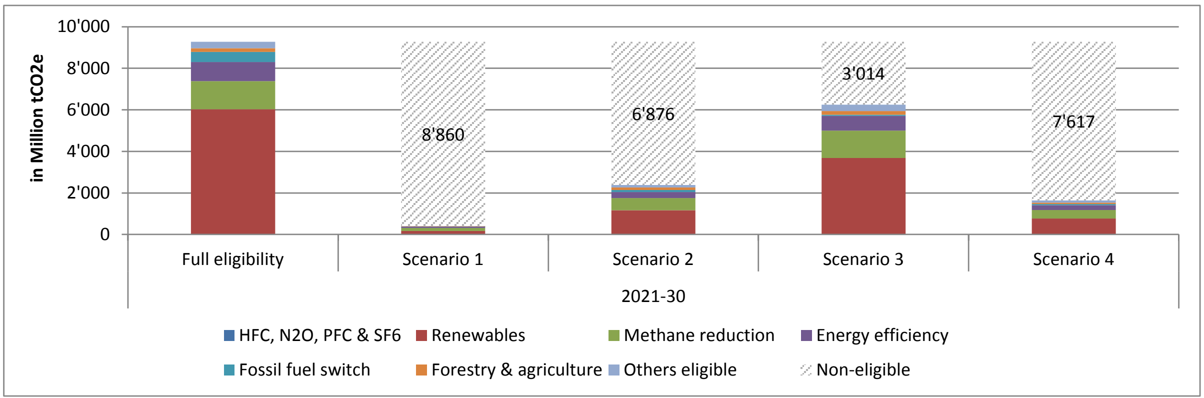


Figure 22 – Non-Pipeline CER supply in Scenarios 1-4 until 2030 with a focus on ineligible project features

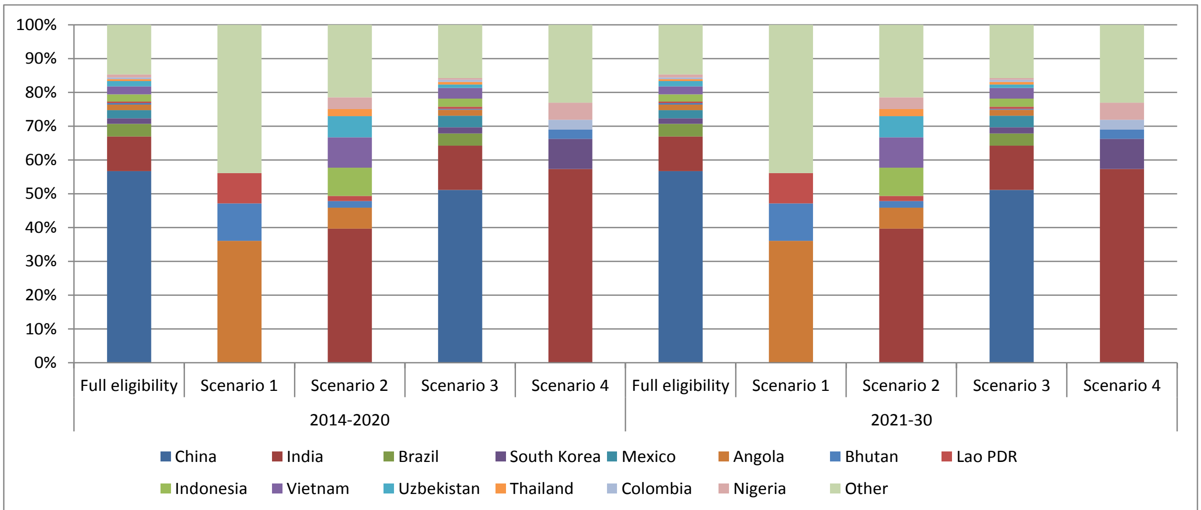


Considering that industrial gas projects are not supposed to grow further in the context of future CDM projects, they turn out to be irrelevant for these considerations. In the absence of this major project type, renewables play the most important role accounting for more than 50% of the expected supply in a full eligibility scenario. Methane plays the role of the runner-up though its share is very small compared to renewables. Both get considerably reduced in terms of expected CER supply. However, Figure 21 and Figure 22 give an indication that the reduction impact might be stronger for renewables than for methane projects. As in the Pipeline model, this might mainly be true because renewable energy projects are rather located in countries with good grid infrastructure that allow for an easy connection. However, these more developed countries are often the first ones to be excluded in the different scenarios. Under Scenario 3, another reason applies. Here methane projects remain almost fully eligible as they have often no power generation installed and rarely more than 100 MW.

Focus on volumes remaining eligible

Shifting the focus from ineligible volumes to the volumes that will remain eligible under different scenarios, Figure 23 examines which countries will be the (new) leaders depending on the scenario.

Figure 23 – Non-Pipeline CER supply in Scenarios 1-4 until 2020/2030 with a focus on eligible host countries

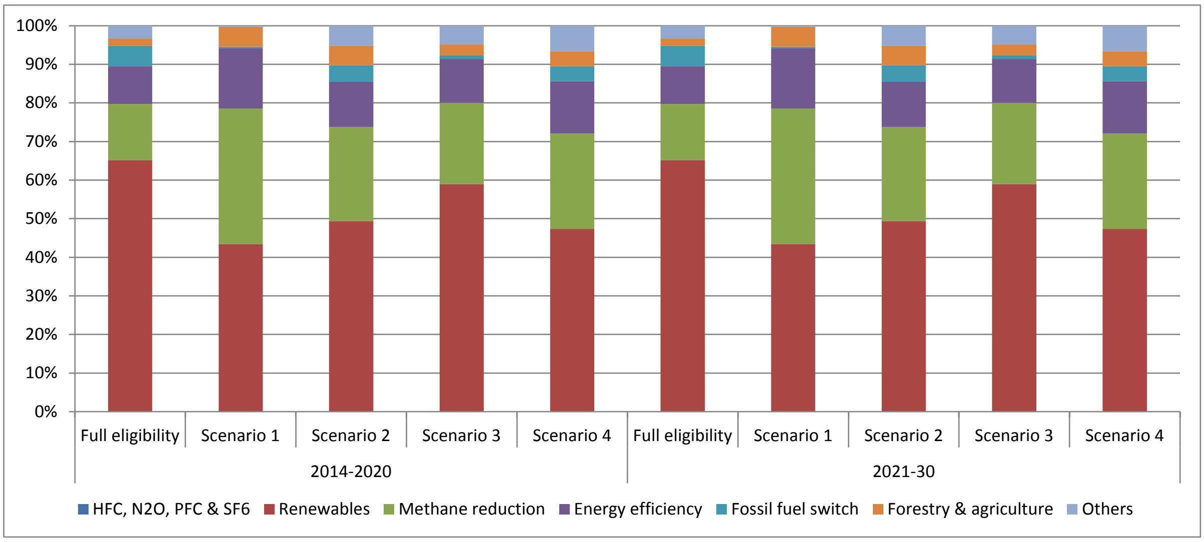


For Scenario 1 with “LDCs only”, Angola clearly takes the lead. This is due to the country’s favorable country/type combinations with fugitive and large-hydro technologies foreseen. In the current CDM Pipeline, the underlying samples for these combinations are still at validation and due to the cut-off date not considered for the Pipeline supply. However, in the Non-Pipeline supply these combinations imply a large potential for future CERs. Behind Angola, two candidates already known from the Pipeline model can be found: Bhutan with its large hydro power plants and Lao PDR. Nevertheless, it should be kept in mind that the total volumes coming from these LDCs will be very low as presented above. In Scenario 3, China will only lose a small market share due to the exclusion of industrial gas projects. But, it will definitely hold on to its dominant role as the country hosts a huge variety of CDM project types. In general, it can be concluded that, in Scenario 3, the country distribution will hardly change compared to the setting with full eligibility.

In Scenario 2, India will become once again the “new China” although in a less dominant way than in the Pipeline model. With about 40%, India’s share will clearly remain below the 50% of the expected CER supply in 2014-20 from initiated CDM projects. Once again, this dominance is not surprising as all other main competitor countries such as China, Mexico or Brazil will not be considered anymore. India will be followed by the usual suspects from the Pipeline model - Vietnam, Indonesia and Uzbekistan - although these countries altogether will not account for more than one quarter of the supply. The same dominant role of India is true in Scenario 4. However, here South Korea will represent the runner-up, but only accounting for 10% of the expected supply (compared to 20% in the Pipeline supply).

Figure 24 also assesses the supply remaining eligible by applying a technological focus. The objective is to identify the leading project types for the different eligibility scenarios.

Figure 24 – Non-Pipeline CER supply in Scenarios 1-4 until 2020/2030 with a focus on eligible project features



It is evident that renewables will always account for the largest share in the expected CER supply. While in the Pipeline model, their share depends mainly on the exclusion or inclusion (either by host country or project type criteria) of industrial gases, this aspect is not relevant for the Non-Pipeline supply. In the Pipeline model, renewables can be responsible for up to 75% of the expected supply under Scenario 1. However, this is in clear contrast to the picture painted by the Non-Pipeline model. In this setting, renewables will not provide more than about 40% of the expected CER supply under Scenario 1 – the lowest share observed in all scenarios. A possible explanation might be that in the light of low prices more renewable energy projects with additional revenues through electricity sales might have been pursued than methane projects. As a consequence, those inactive methane projects have not been considered for the Pipeline supply, but can now become relevant again in the Non-Pipeline model.

Together methane and energy efficiency projects account for a share of 35%-50% depending on the selected scenario, while the project type fossil fuel switch, not fully unimportant in the Pipeline setting, becomes almost irrelevant. This initial impression that the second wave of CDM projects at a price level of EUR 15.00 might – in the absence of industrial gas projects – also gives a chance to currently underrepresented project types is also supported by the fact that the types of forestry and agriculture as well as others finally become visible in Figure 24.

3.2.5. Interim conclusions

Based on the observations made in the chapters 3.2.3 and 3.2.4, the following preliminary conclusions can be drawn with regard to the supply of CERs from future CDM projects.

- A price shift from EUR 5.00 to EUR 10.00 will trigger additional high volumes of CERs to be generated.
- Depending on the conservativeness of the case assumed, the expected volumes at EUR 5.00 will change significantly (e.g. for the time period 2021-2030, 0.3 billion CERs and 3.6 billion CERs in a conservative case and in an optimistic case, respectively).
- With a further price shift from EUR 10.00 to EUR 15.00, the CER supply will increase only marginally independently from the case assumed.
- The expected annual CER generation between 2016 and 2030 will constantly increase until 2030. However, the yearly increase is assumed to peak in 2023.
- The amount of CERs to be expected in Scenario 1 will not be more than 5-20 million CERs and 150-400 million CERs in 2014-2020 and 2021-2030 respectively. This is insignificant with regard to the potential 400 million and 9 billion under full eligibility.
- In other scenarios, the amounts will be reduced by about -80% (Scenarios 2+4) and about -30% (Scenario 3).
- As in the Pipeline model, India will become the dominant host country in Scenarios 2+4. In contrast to the Pipeline supply, South Korea (with only 10% market share) does not really represent an important runner-up under Scenario 4 anymore.
- Considering exclusively Scenario 1, i.e. LDCs only, Angola (instead of Bhutan as in the Pipeline model) would take the lead.
- Whenever China remains eligible, it keeps on playing the dominant role (about 50% market share in Scenario 3) despite the non-consideration of all industrial gas projects as well as large-scale projects above 100 MW.
- Renewables and methane projects will be the predominant technologies in all scenarios.

- However, other project types such as energy efficiency projects – currently underrepresented in the Pipeline model – might finally play a role with a market share of 10%-15%.

3.2.6. Explanatory potential and limitations

Modelling the CER supply from future CDM projects (Non-Pipeline supply) is even more difficult than modelling it for CDM projects that have already been initiated (Pipeline supply). Consequently, its final results should always be put into perspective and considered as outcomes of a modelling process where many input variables are unknown.

Even if the majority of methodological problems could be solved, the Non-Pipeline model still suffers from the following limitations whose resolution would go beyond the scope of this study:

- Major limitations
    - **Unknown abatement potential**
        - As discussed in chapter 3.2.1, a top-down approach has been selected as much input data for a bottom-up approach is not available. An important part of this input data refers to the abatement potential per country. Most of the time, this potential is not known. If it is known, the data might not be publicly available. If it is known and publicly available, it would have to be processed again in order to make it suitable for an analysis according to standard CDM project types. This ignorance of the abatement potential in each country implies the risk that for some combinations of host country and project type, the expected CER generation from future CDM projects might exceed the actual technical potential. Nevertheless, the inexistence of such a limiting technical cap had to be accepted in the current setting.
    - **Initial base supply**
        - Basically, the Non-Pipeline supply represents the mathematical product of the initial base supply and the yearly growth. As a consequence, each of both factors is decisive for the final outcome. Using the expected generation level of CERs in 2015 based on Pipeline supply as the initial base supply, it should be kept in mind that this essential figure comes itself from a modeling process with its inherent limitations (see chapter 3.1.6).
    - **Growth rates and their application and adjustment**
        - The same is true for the assumed growth rates. Even if they do not stem from a modelling process, they have been deducted from a very short time window (2008-2011) that might not be fully representative for the long time period 2014-2030. Nevertheless, these growth rates represent the best available data. Concerning its mathematical application as well as its adjustments with time and price discount factors, it has been decided that the applied approach is the most suitable one in the context of the current study. Obviously, other application modes that would clearly change the final could also be imagined though.
- Minor limitations

- **Crediting periods**
  - Usually, CDM projects have either a renewable crediting period of seven years or a non-renewable one of 10 years. Given that the Non-Pipeline model is not based on specific projects, but on country/type combinations, it was difficult to assign the right crediting period lengths. A solution would have been to analyse the crediting period mostly used for a specific project type. However, the model does not foresee any possibility to define in which year a certain project starts. As a consequence, it has been decided to assume a renewable[32] 7 years' crediting period for all combinations. This was also due to the fact that a 10 years' crediting period would have only impacted the few combinations starting in 2016-2020.

Finally, many of the limitations that already applied to the Pipeline model (see chapter 3.1.6) are also true for the Non-Pipeline model. This is especially true for the assumptions with regard to the costs of CDM projects (e.g. no discounting, no economies of scale etc.) that are usually highly variable as well as for the time factors (e.g. moment of generation vs. moment of issuance etc.)

3.3. All CDM projects (Pipeline and Non-Pipeline supply)

3.3.1. Specific approach

The Combined supply of CERs by 2020 and 2030 from all CDM projects, i.e. initiated CDM projects and future CDM projects, has been modeled as the aggregated results from the two individual Pipeline and Non-Pipeline models. The description of the specific approaches applied for the initiated CDM projects (Pipeline supply) and for the future CDM projects (Non-Pipeline supply) can be found in the chapters 3.1.1 and 3.2.1 respectively.

3.3.2. Assumptions

Being based on a simple aggregated representation, the assumptions underlying the aggregated model (Combined supply) fully correspond to the assumptions made for the individual models that serve as input. They can be found for the Pipeline model in chapter 3.1.2 and for the Non-Pipeline model in chapter 3.2.2.

3.3.3. CER supply in base case scenario

This section will provide an estimate for the CER supply from both initiated as well as future CDM projects given full eligibility, i.e. that all CERs independently of their country of origin or environmental integrity will be considered. If not indicated otherwise, all graphs depict the base case. Cases with more conservative or more optimistic assumptions are made explicit.

[32] With prices of EUR 5 and above, two renewals can be assumed as the renewal costs are insignificantly small compared to these price ranges.

Figure 25 – Combined CER supply with full eligibility until 2020/2030 according to price levels

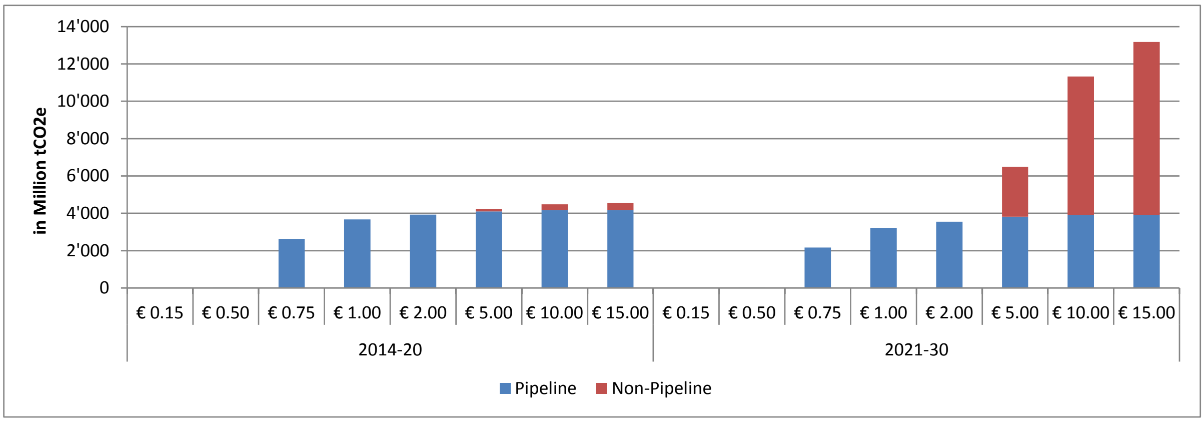


Figure 25 shows that the combined CER supply will exclusively rely on the Pipeline supply for any price levels below EUR 5.00. Even for price levels of EUR 5.00, the contribution of the Non-Pipeline supply will be only marginal in 2016-2020. This picture changes in the time period 2021-2030 when CERs from future CDM projects will make a much bigger contribution to the overall supply than CERs from initiated projects. This does not come as a surprise: Over the time, despite of moderate or high CER prices, more and more initiated CDM projects will reach the end of their maximum crediting periods. Whereas, future CDM projects are supposed to grow steadily as long as prices are at EUR 5.00 or above.

In general, a combined CER supply of about 2-4 billion CERs can be expected for 2014-2020 and 2021-2030 each, as long as prices range between EUR 0.75 and EUR 2.00. From EUR 5.00 onwards, the combined CER supply does not change much in 2014-2020, but could rise up to 6-13 billion in 2021-2030.

This is also reflected by Figure 26 which shows that the conservativeness of the assumptions can heavily influence the combined CER supply. When focusing on the important price trigger thresholds of EUR 0.75-2.00 for initiated CDM projects and EUR 5.00-10.00 for future CDM projects, it can be observed that the conservativeness of the underlying assumptions can increase or decrease the expected CER output by up to +/- 2 billion CERs per time period.

Figure 26 – Combined CER supply with full eligibility until 2020/2030 according to conservativeness of assumptions

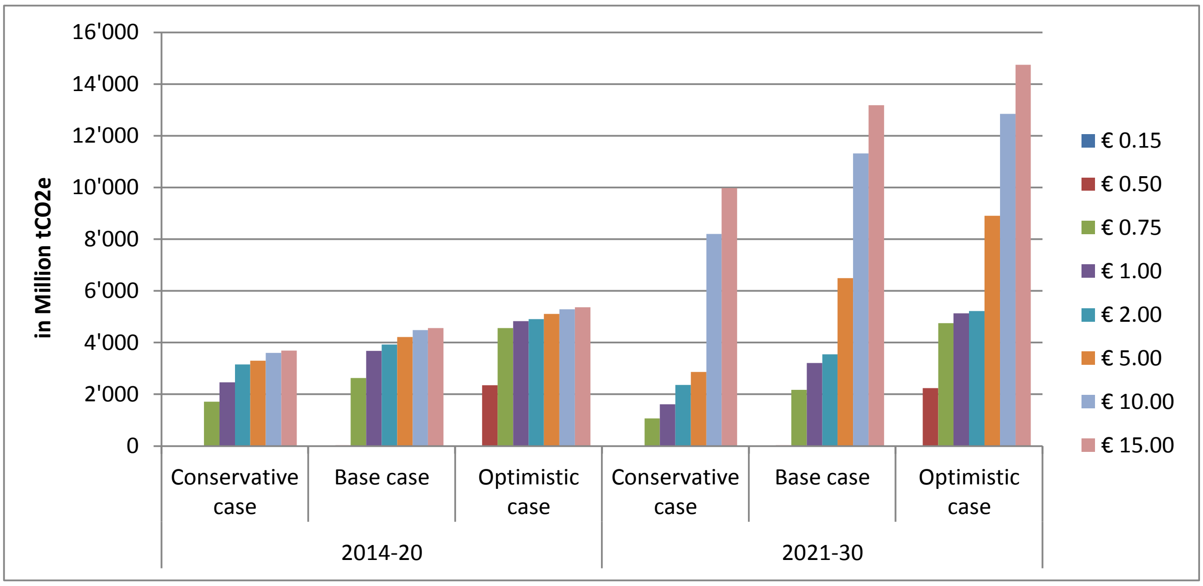
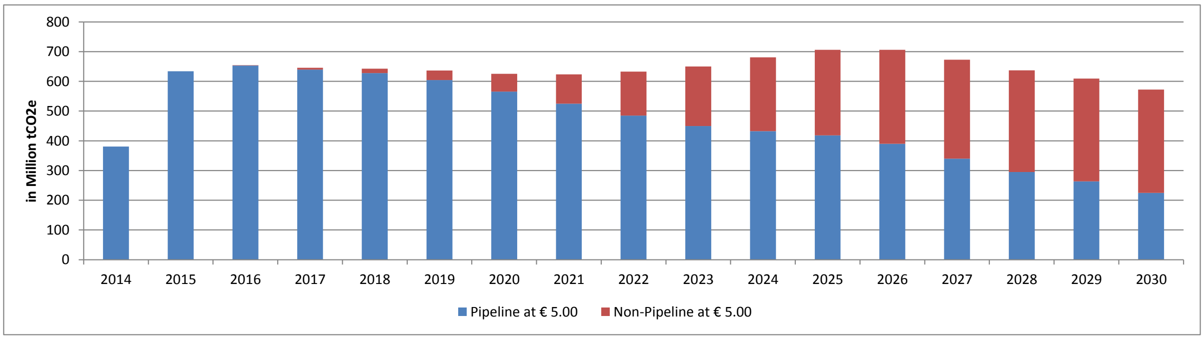


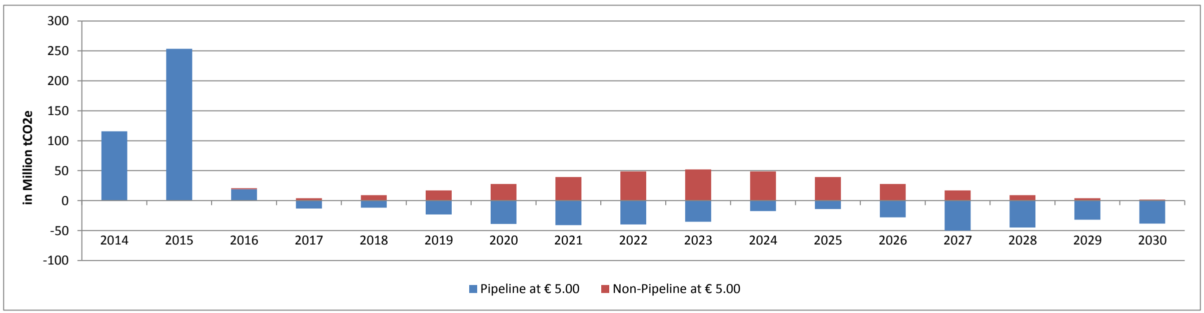
Figure 27 provides an overview of the yearly supply to be generated from initiated and future CDM projects at the price level of EUR 5.00. It becomes obvious that in a combined view a rather constant supply of CERs can be expected until 2030. While the CER supply from initiated CDM projects decreases over time due to the expiring crediting periods, this decrease could be compensated by the increasing output of CERs from future CDM projects. As a consequence, the combined supply of CERs will not decrease on a steady basis before 2027.

Figure 27 – Combined CER supply (yearly supply) with full eligibility until 2020/2030 over time according to conservativeness of assumptions



This compensatory effect is also illustrated by Figure 28 showing the yearly change in supply. It can be seen that in the time period 2019-2026 the yearly increase in the Non-Pipeline supply will be able to compensate or even overcompensate for the reduction in CER supply from Pipeline projects. However, from 2027 onwards, a general decrease will be inevitable according to the underlying forecast models.

Figure 28 – Combined CER supply (yearly change in supply compared to previous year) with full eligibility until 2020/2030 over time according to conservativeness of assumptions



3.3.4. CER supply in eligibility scenarios 1-4

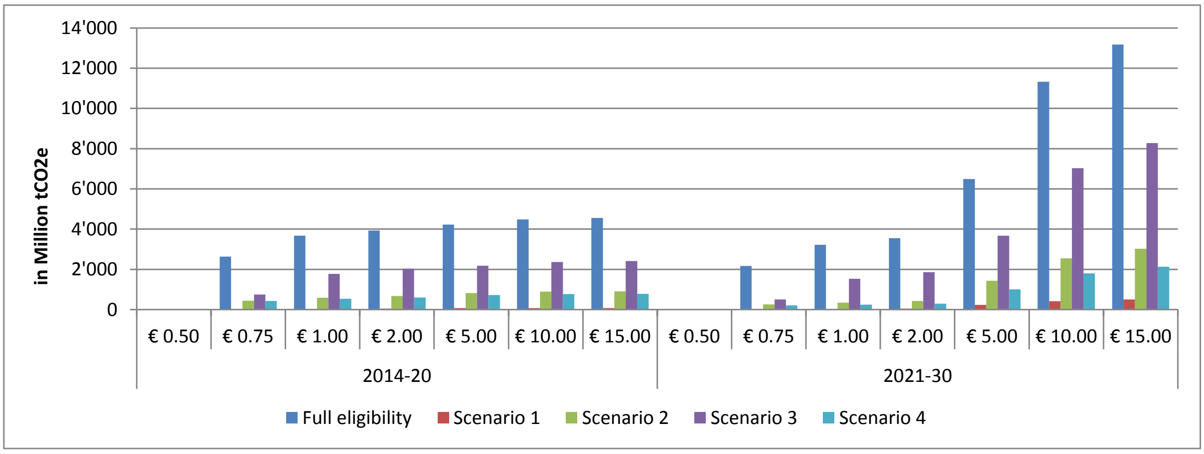
The following section will provide an estimate for the combined CER supply from initiated and future CDM projects in four different eligibility scenarios which are described in detail in chapter 2.2:

- Scenario 1: "LDCs only"
- Scenario 2: "Common but differentiated responsibility and respective capacity"
- Scenario 3: "Sustainable development and environmental integrity"
- Scenario 4: "Climate change responsibility"

If not indicated otherwise, all graphs depict the base case and an extreme price level of EUR 15.00 has been assumed in order to trigger as many CDM projects as possible so that the impacts of the eligibility scenarios 1-4 can be easily illustrated.

Figure 29 shows the Combined supply of CERs with full eligibility and in all four different scenarios. It can be observed that applying eligibility criteria according to the scenarios will reduce the expected output on average by -50% to -95% depending on the assumed price level.

Figure 29 – Combined CER supply in Scenarios 1-4 until 2020/2030 according to price levels

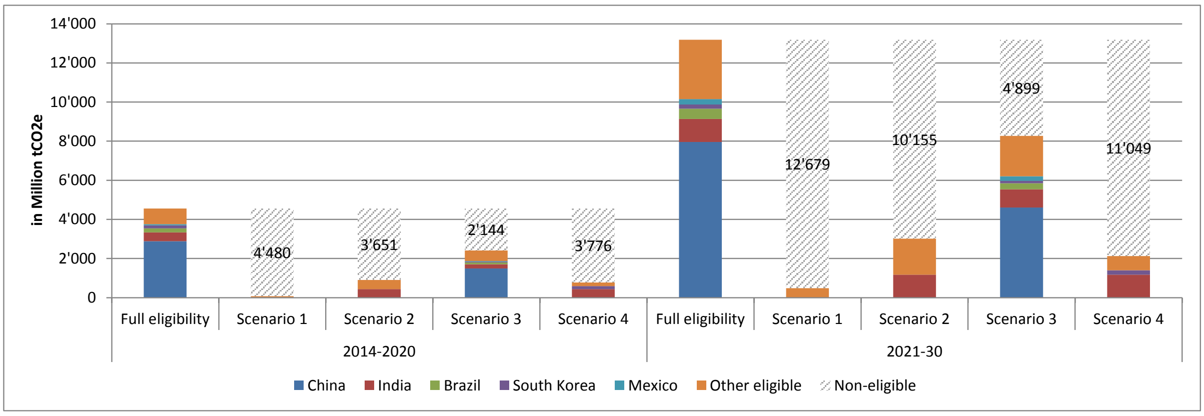


As already depicted in the individual scenario analysis for the Pipeline model and the Non-Pipeline model respectively, the reduction impact is expected to be the strongest in Scenario 1 (up to -95%). For Scenarios 2+4, a reduction in volume of up to -80% can be expected. Under Scenario 3, the supply will be cut by half approximately.[33]

Focus on volumes becoming ineligible

The next two figures will set a focus on the CER potential to become ineligible in different scenarios. Within this scope, Figure 31 analyzes the reduced volumes from a country point of view.

Figure 30 – Combined CER supply in Scenarios 1-4 until 2020/2030 with a focus on ineligible host countries

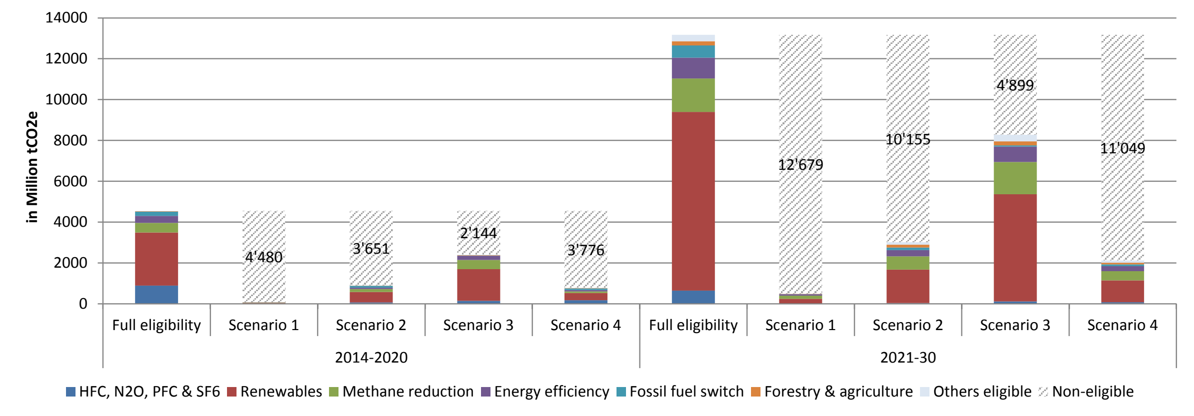


The general picture of the Pipeline and Non-Pipeline analysis remains valid. The dominant role of China in a setting of full eligibility also continues in Scenario 3. In Scenarios 2+4, India acquires the largest market share. The volumes remaining eligible in Scenario 1 are too small that any leader country could be clearly identified in the current illustration. This analysis will be done in Figure 33 below.

Figure 31 analyzes the reduction impact under a technology angle. This means that it is assessed which project types will be impacted the most in different scenarios.

[33] Please refer to the chapters 3.1.4 and 3.2.4 for a discussion of the reasons that could be identified.

Figure 31 – Combined CER supply in Scenarios 1-4 until 2020/2030 with a focus on ineligible project features

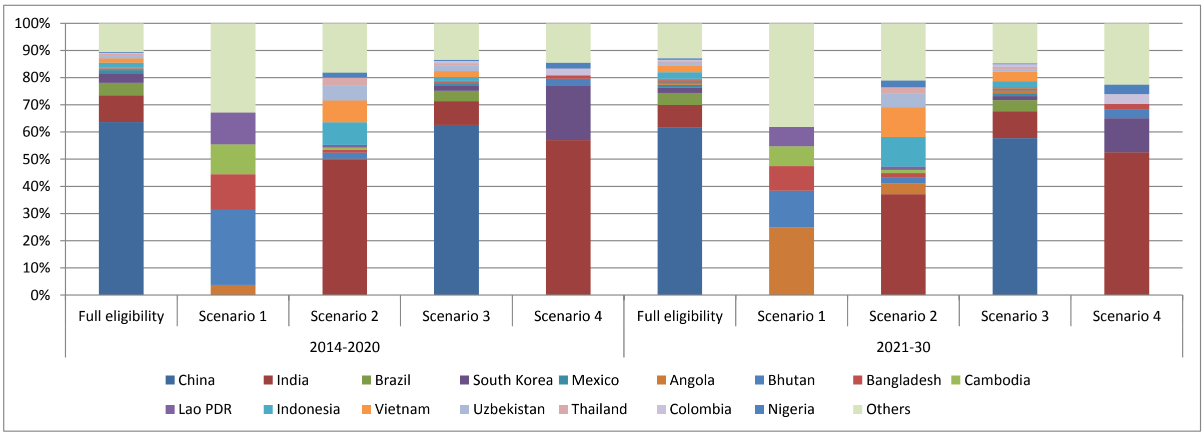


The combined view shows once again that the eligibility criteria of the four different scenarios either fully (Scenario 1+3) or almost fully (Scenarios 2+4) eliminate HFC and N_2O adipic acid CERs from the supply. This happens either implicitly through a specific host country selection (e.g. Scenario 1: no such project type is located in an LDC, Scenarios 2+4: major host country China excluded) or explicitly through the ban of these technologies (e.g. Scenario 3: no HFC or N_2O adipic acid allowed). However, in contrast to the Pipeline model, the reduction impact on HFC and N_2O adipic acid projects is less significant in the Combined model. This is mainly due to the fact that industrial gases do not play any role in the Non-Pipeline supply anyways and therefore see their market share automatically reduced in the Combined supply. Additionally, methane projects become over proportionally important in Scenario 3 what is linked to the exclusion of CDM projects >100 MW which mainly deal with renewable energy.

Focus on volumes remaining eligible

Shifting the focus from the ineligible volumes to the volumes that will remain eligible under the different scenarios, Figure 32 examines which countries will be the (new) leaders depending on the scenario selected.

Figure 32 – Combined CER supply in Scenarios 1-4 until 2020/2030 with a focus on eligible host countries



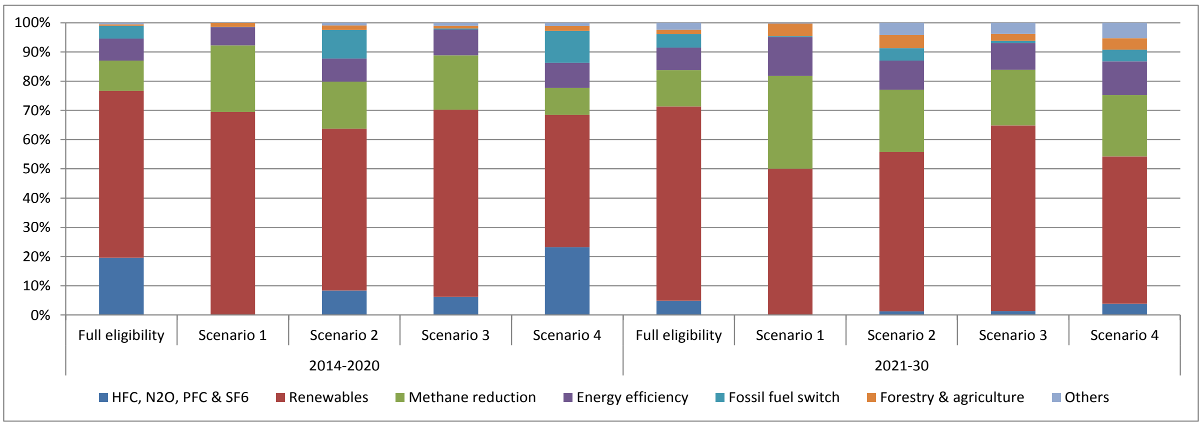
For Scenario 1 with "LDCs only", it can be shown that more than 60% of the Combined supply will come from four to five different countries only. Within this scope, Bhutan with its large hydro power plants will play a dominant role being responsible for more than one quarter of the total supply. The runner-ups will be Bangladesh, Lao PDR and Cambodia supplying each about 10% of the total amount. Surprisingly, after 2020, Bhutan will lose the leader role to Angola which – thanks to its fugitive and large-hydro power projects that might be developed further in the context of the Non-Pipeline model – will produce more than 20% of the total supply in 2021-2030. Nevertheless, it should be kept in mind that the total volumes will be very low as presented in Figure 31.

In Scenario 3, China also will hold on to its dominant role in the combined view of Pipeline and Non-Pipeline supply. For sure, the exclusion of industrial gas projects might hit the country a little bit stronger than its competitors. However, thanks to its wide variety of different project types, it can easily maintain its role as the world's leading supplier. The picture does not change much either by considering the time periods 2014-2020 and 2021-2030 separately.

In Scenarios 2+4, India will take over this leading role (more than 50% in 2014-2020). This pole position is even stronger in Scenario 2 than in Scenario 4 because of the additional exclusion of some runner-up competitors such as Indonesia, Vietnam and Uzbekistan (about or less than 10% each) and despite the re-inclusion of South Korea (between 10%-20%). It is also surprising to see that while the time periods 2014-2020 and 2021-2030 do not make a big difference for Scenario 4, time matters a lot for Scenario 2. With regard to the transition to the second time period considered, India will lose about -15% market share from 2014-2020 to 2021-2030. This might be explained by the current failure of its competitors (e.g. Indonesia, Vietnam, Uzbekistan and others) to currently host many registered CDM projects. This failure could be corrected by the competitors until 2030 through the expected second wave of the CDM in the context of the Non-Pipeline supply.

Finally, Figure 33 assesses the supply remaining eligible by applying a technological focus. The objective is to identify the leading project types for the different eligibility scenarios.

Figure 33 – Combined CER supply in Scenarios 1-4 until 2020/2030 with a focus on eligible project features



It is evident that renewables will always account for the largest share in the expected CER supply –

independently from a Pipeline, Non-Pipeline or combined view. Industrial gases will lose in importance in all scenarios except for Scenario 4 (slight increase from about 20% under full eligibility to 23% in Scenario 4) in the time period 2014-2020. This surprising increase of industrial gas CERs in 2014-2020 under Scenario 4 is due to two factors: First, South Korea, a major host country for industrial gas projects, remains eligible. Second, the Non-Pipeline supply that does not assume any additional inflow of industrial gas projects will still be very weak in 2014-2020. However, in 2021-2030, their importance will also vanish under Scenario 4 due to the upcoming inflow of CERs from future CDM projects that are not supposed to stem from industrial gas technologies anymore.

Furthermore, it can be shown that methane, in particular, but also energy efficiency projects will increase their market shares in all scenarios as well as over time. With regard to the scenario impact, this might be explained by their attractiveness as they do not require – in contrast to many renewable energy projects – a well-developed electricity grid infrastructure. With regard to the time impact, it can be concluded that their relatively high validation and registration failure rates might improve in the context of the second wave of CDM projects 2021-2030.

3.3.5. Conclusions

Based on the interim conclusions and additional observations made in the chapters 3.3.3 and 3.3.4, the following conclusions can be drawn with regard to the supply of CERs from initiated as well as future CDM projects.

- The combined CER supply for 2014-2020 is expected to range between 2-4 billion CERs at price levels of EUR 0.75 and above. For 2021-2030, the CER supply will amount to 2-4 billion CERs at price levels between EUR 0.75-2.00 and to 6-13 billion CERs at price levels of EUR 5.00 and above.
- The following price ranges have been identified as extremely sensitive to small price shifts. They can be considered as so-called price trigger thresholds that can trigger large volumes of additional CERs to be supplied to the market:
    - EUR 0.75-2.00 for initiated CDM projects
    - EUR 5.00-10.00 for future CDM projects
- For the time period 2014-2020, only the CER supply from the Pipeline will be relevant. The role of the Non-Pipeline supply will still be marginal. In 2021-2030, the Non-Pipeline supply will become relevant, too. At CER price levels of EUR 10.00 and above, CERs from future CDM projects will even play the dominant role.
- Over the entire time period 2014-2030, the Non-Pipeline supply can compensate or even overcompensate for the gradual reduction in volumes from Pipeline supply due to the expiration of many crediting period limits.
- Depending on the eligibility scenario selected, the reduction impact compared to full eligibility will be of -50% (Scenario 3) to -95% (Scenario 1).
- As long as projects from China remain eligible, China will uphold its dominance. In the absence of China (and other main competitors such as Mexico and Brazil), a rise of India will be inevitable.
    - Scenario 1: In 2014-2020, Bhutan will be the clear leader of all LDCs with regard to market shares under the CDM. From 2021 onwards, this picture might change due to

the increasing importance of Angola. Other relevant, but far less important LDCs, will be Bangladesh, Cambodia and Lao PDR.

  - Scenario 2+4: India will become the new “China” and dominate the market with a market share of over 50%. The degree of dominance depends on the inclusion of some main competitors that remain eligible as host countries (e.g. Indonesia, Vietnam and Uzbekistan in Scenario 2 and South Korea in Scenario 4). Over time, i.e. from 2014-2020 to 2021-2030, India will lose up to -15% of its market share due to the increasing supply of future CDM projects.
  - Scenario 3: China will remain the clear market leader even if certain project types or features might be excluded due to environmental integrity concerns. This is due to the country’s wide and varied base of different CDM project types.

- In general, the in- or exclusion of specific project types or features seems to have a lower impact on the country mix or the technology mix than the in- or exclusion of specific host countries under the CDM.
  - Renewables will continue to play the dominant role among the CDM projects.
  - The importance of industrial gases depends on the eligibility scenario selected, but clearly vanishes in the time period 2021-2030.
  - Other project types such as methane and energy efficiency will gain in importance over time (2014-2020 compared to 2021-2030) as their currently high validation and registration failure rates could improve thanks to increasing learning curves.
  - Under scenario 1, methane projects have the highest market share here compared to all other scenarios. This might be explained due to the non-required grid connectivity. However, all in all, the CER volumes generated in this scenario are extremely low.

3.3.6. Explanatory potential and limitations

The aggregated model allows estimating the CER supply by 2020 and 2030 from all CDM projects that might generate CERs over this time period. This means that it takes into consideration initiated as well as future CDM projects. The specific limitations of the underlying individual models (Pipeline supply, chapter 3.1.6) and (Non-Pipeline supply, chapter 3.2.6) remain valid for the aggregated model.

Comparing the two individual models with regard to the robustness of their assumptions as well as their inherent limitations, it should be kept in mind that the Pipeline model’s supply forecast can be considered as more reliable than the supply estimated by the Non-Pipeline model. This is due to the fact that the Pipeline model could be built on a larger data basis (in particular the UNEP Risø CDM Pipeline) where more information (e.g. usual costs and revenues) was available. In contrast, the Non-Pipeline model had to be based on many more assumptions for the future (e.g. growth rates) that are extremely difficult to predict given a dynamic, volatile and politically-driven market such as the one for climate change mitigation in general or the CDM in particular.

In conclusion, it should never be forgotten that the entire modeling process primarily served an illustration purpose to evaluate the impact of different eligibility criteria. Providing a realistic quantification of the CER supply to be expected until 2020 and 2030 represented rather a secondary objective.

4. Assessment and discussion of CER discounting approaches

Instead of limiting access to CERs from specific project types or host countries, a higher degree of environmental integrity or contribution to global emissions reduction can be achieved by discounting of CERs, i.e. that one t of emissions reductions from a CDM project would yield less than one CER. Discounting has first been proposed by Greenpeace (2000). It was formally introduced into the UNFCCC negotiations by South Korea in 2007 (Chung 2007) to serve as contribution of developing countries to global emission reductions without having to resort to country-specific commitments and has subsequently been assessed by Schatz (2008), Bakker et al. (2009), Michaelowa (2009), Schneider (2009) and Butzengeiger-Geyer et al. (2010).

The short-term price that would have to be paid in terms of economic efficiency would be a differentiation of marginal abatement cost of CDM projects according to the discount rate. If for example, for one host country CERs are discounted by 50% whereas in another one not at all, the marginal abatement cost curve of the first country would shift upwards by a factor of two, while of course the actual marginal abatement costs would not change.

Generally, discounting could easily be done “at source” by tasking the CDM registry to only issue the amount of CERs to project developers that is the product of the verified emission reductions during a monitoring period and the discount factor applicable to the host country or project type during this monitoring period. The precedent is the current retaining of 2% of CERs for the Adaptation Fund.

Alternatively, buyers of CERs could be required to send an amount of CERs equivalent to the discount to their cancellation account in the Kyoto registry (see discussion by Schneider 2009). The advantage of this approach would be that it links to the ADP discussion and therefore may be able to ride on the current political momentum. In addition, it could be seen as an advantage in terms of MRV to have it explicit how many CERs are cancelled, i.e. net mitigation has been achieved.

4.1. Assessment of CER discounting options

Principally, discounting can be done according to the parameters specified in Chapter 2, i.e. according to country- or project specific criteria. The impacts of such discounting are discussed in comparison to our standard scenario.

Country-type specific discounting could take the following forms:

- The discount factor depends on one or several indicators
- Pre-defined discount factors are differentiated according to groups of countries

Project-specific discounting could take the following forms:

- The discount factors depend on indicators specific to projects
- Pre-defined discount factors are differentiated according to project types

4.2. Country-specific discount factors based on responsibility and capability indicators

For the first option, indicators should take into account the principles of the UNFCCC, such as “common but differentiated responsibilities and respective capability”. Options for these have been discussed in Chapter 2 in the development-related indicator category 1. A discount factor that increases with the level of per capita emissions as well as the level of development of a country would reflect this principle. A simple responsibility and capability index can be defined as a combination of per capita income (measured in inflation-adjusted purchasing power parity) and per capita emissions thresholds, which captures both ability to pay and the ‘polluter pays’ principle. Each criterion should get the same weight as both principles are equally important and are not directly correlated. If both figures are weighted with 50%, we get the results shown in Table 12. The world average for GDP per capita (10105 $ in 2011) and CO_2 eq. per capita (4.5 t in 2011) are equal to the index value 1 for the respective component (data are taken from IEA 2013).

To illustrate calculation of the index we use the example of Qatar. It has annual per capita emissions of 38.2 t CO_2 (responsibility index component = 8.5) and a GDP of 76,740 $ per capita (capability index component = 7.6). The index of Qatar reaches 8.1 and is shown in the first line of Table 12. If we start discounting from an index of 1 that reflects world average, emission reductions from CDM projects in Qatar would be discounted by a factor of 8.1.

Table 12: Discounting CERs according to responsibility and capability index for selected countries starting at world average

Country	Responsibility and capability index	1 t CO_2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
Qatar	8.1	0.12	-10.39
Saudi Arabia	2.9	0.35	-0.98
South Korea	2.7	0.37	-90.99
Israel	2.3	0.44	-3.85
Malaysia	1.4	0.69	-8.22
Argentina	1.3	0.79	-5.27
Iran	1.3	0.76	-4.72
South Africa	1.3	0.78	-7.65
Chile	1.2	0.80	-9.10
Mexico	1.1	0.91	-4.77
China	1.0	1	-
Thailand	0.8	1	-
Brazil	0.7	1	-
Indonesia	0.4	1	-
India	0.3	1	-

Note: CER reductions estimated as per the methodology specified in Chapter 3

The responsibility and capability index can of course be used for different degrees of discounting, i.e. that more countries get a discount and the discount becomes steeper. For example, many industrialized countries have argued that China should participate in the global mitigation effort. However, if discounting starts at global average, China will not be covered as it has an index level of 1.0, i.e. exactly at the global average. To cover China, discounting could start from an index level of 0.5. The outcome is shown in Table 13. India and Indonesia would still be exempt.

Table 13: Discounting CERs from on the basis of a responsibility and capability index starting at half of the global average

Country	Responsibility and capability index	1 t CO2 eq. reduction gives x CERs	Reduction in 2013-2020 CERs from projects in the pipeline (million)
Qatar	8.1	0.06	-11.13
Saudi Arabia	2.9	0.17	-1.25
South Korea	2.7	0.19	-118.18
Israel	2.3	0.22	-15.24
Malaysia	1.4	0.35	-17.40
Argentina	1.3	0.39	-15.15
Iran	1.3	0.38	-12.10
South Africa	1.3	0.39	-21.05
Chile	1.2	0.40	-27.56
Mexico	1.1	0.45	-28.12
China	1.0	0.48	-1376.10
Thailand	0.8	0.65	-8.23
Brazil	0.7	0.68	-62.44
Indonesia	0.4	1	-
India	0.3	1	-

Note: CER reductions estimated as per the methodology specified in Chapter 3

A purely responsibility-based approach would be to base the discount factor purely on per capita emissions. Table 14 shows discounting based on per capita emissions starting again from the global average.

Table 14: Discounting CERs based on per capita emissions

Country	Per capita emissions (multiple of world average)	1 t CO2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
Qatar	8.5	0.12	-1.40
Saudi Arabia	3.6	0.28	-0.42
South Korea	2.6	0.38	-55.46
Israel	1.9	0.52	-6.83

Country	Per capita emissions (multiple of world average)	1 t CO2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
South Africa	1.6	0.62	-21.35
Iran	1.5	0.65	-12.60
Malaysia	1.5	0.67	-17.81
China	1.3	0.76	-2027.68
Argentina	1.0	1	-
Chile	1.0	1	-
Mexico	0.9	1	-
Thailand	0.8	1	-
Brazil	0.5	1	-
Indonesia	0.4	1	-
India	0.3	1	-

Note: CER reductions estimated as per the methodology specified in Chapter 3

4.3. Pre-defined discount factors for country groups

In contrast to an indicator-based approach, discounting could be simplified in the following form: For a group of countries, a discount factor is defined ex ante. Groups can be defined according to institutional characteristics or broad groupings according to income. LDCs, and possibly other low-income country groups dependent on criteria used in the scenarios, would remain exempt. An approach could for example look like:

Table 15: Discounting CERs according to country groups

Country group	1 t CO_2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
OECD	0.25	-187.27
High income countries	0.33	-151.81
Upper middle income countries	0.5	-1577.93
Lower middle income countries	0.67	-244.97
LLDCs; low income countries	0.75	-29.34
LDCs	1	-

This approach can be varied almost indefinitely, adding country groups and playing with the discount factors. In theory, one could even imagine raising the discount factor above 1 for project types with very high sustainable development benefits in low-income countries, in order to increase the economic incentives to implement desirable project activities. However, this theoretical option would run counter to the ambition to contribute to net mitigation in flexible market mechanisms, and will therefore not be considered here.

4.4. Discount factors depending on project-specific indicators

Repeatedly, criticism of CDM projects has been linked to the size of projects, with large projects drawing more criticism. So the discount factor could increase with project size. This would be akin to a progressive taxation of CDM projects. While this could be done linearly, a simplified version with tiers is shown in Table 16.

Table 16: Discounting CERs according to project size

Project size categories (CERs per year)	1 t CO_2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
> 10 million	0.25	-174.80
1 million < x < 10 million	0.33	-861.37
0.5 million < x < 1 million	0.5	-252.84
0.1 million < x < 0.5 million	0.67	-412.13
50,000 < x < 0.1 million	0.75	-190.46
< 50,000	1	-

4.5. Pre-defined discount factors according to project type

As discussed in Chapter 2, sustainable development impacts and environmental integrity can differ according to project types. Discount factors can be differentiated according to the generic evaluation of a project type. A simple version of this is shown in Table 17 based on our discussions of sustainable development benefits in Chapter 2, with project types that have high sustainable development co-benefits not being discounted, those with medium sustainable development co-benefits having a discount factor of 0.75 and those with low co-benefits applying a discount factor of 0.5.

Table 17: Discounting CERs according to project type

Project type categories	1 t CO_2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
Afforestation	0.75	-0.23
Agriculture	0.75	-0.01
Biomass energy	1	-
Cement	0.75	-0.82
CO_2 usage	0.5	-0.05
Coal bed/mine methane	0.75	-28.17
Energy distribution	1	-
EE households	1	-
EE industry	0.75	-2.50

Project type categories	1 t CO_2 eq. reduction gives x CERs	Reduction in 2014-2020 CERs from projects in the pipeline (million)
EE own generation	0.5	-77.84
EE service	0.75	-0.16
EE supply side	0.5	-38.02
Fossil fuel switch	0.5	-90.48
Fugitive	0.75	-24.51
Geothermal	1	-
HFCs	0.5	-251.26
Hydro	0.75	-296.38
Landfill gas	0.75	-34.46
Methane avoidance	0.75	-16.60
Mixed renewables	0.75	-0.38
N_2O	0.5	-186.86
PFCs and SF_6	0.5	-9.88
Reforestation	0.75	-3.39
Solar	1	-
Tidal	0.5	-0.81
Transport	1	-
Wind	0.75	-228.50

This approach could be further refined by also taking into account conservativeness of the baseline methodologies used for each project type. This could be done applying a methodology conservativeness multiplier.

A combination of project-type and scale-specific discount factors would also be possible, leading to a project-type / size matrix of discount factors.

4.6. Pre-defined discount factors according to additionality characteristics

Butzengeiger et al. (2010) discuss differentiation of discount factors according to project characteristics that have an impact on additionality. They propose to differentiate projects in three categories:

- Projects without economic benefits other than CERs, not being discounted
- Projects with economic benefits other than CERs and considerable CER impact on project economics, being discounted significantly
- Projects with other economic benefits than CERs and small CER impact on project economics, being discounted massively.

Given the currently subdued CER price, differentiation according to CER impact on project economics is not really possible.

4.7. Discussion of CER discounting options

As discussed by Butzengeiger et al. (2010), higher discount factors for countries that have a high level of development and/or responsibility for climate change could provide an incentive for these countries to take an emissions target as a reduction below a target would generate 100% allowances for international emission trading compared to discounting CERs for the same reduction. For example, Qatar taking up a target would be able to account for 100% of reductions achieved on its territory whereas under a responsibility / capability index it could only get credit for 6% of the reductions.

Low or no discounting for poor countries would provide enhanced economic incentives to develop CDM projects in these countries but it is unclear whether these incentives would be sufficient to overcome non-monetary barriers (Castro and Michaelowa 2010). Discounting by host country will not improve additionality on the project level. On an aggregated level, discounting seems to improve the environmental integrity of the CDM (Schneider 2009). The overall impact of discounting on the number of non-additional projects entering the CDM is uncertain. The discounting of CERs would lower the number of CERs per GHG reduction achieved but increase the CER price due to the reduced CER supply (see the detailed graphical analysis by Schneider 2009). Depending upon the relationship between these two variables the number of non-additional projects may decline or even increase. An increase would happen when the number of non-additional projects (that would enter the CDM regardless of the level of CER prices) is higher than the number of additional projects mobilized by the increased CER price. The effects of discounting according to project types on environmental integrity and sustainable development benefits will depend on what criteria are chosen. There may be tradeoffs that are difficult to reconcile. Favoring sustainable development benefits may lead to penalizing additional projects and favoring non-additional ones, as most bluntly shown in the context of industrial gas projects that are obviously additional but have low sustainable development benefits. The stronger the differentiation of discount factors, the less efficient the market will become, as marginal abatement costs are distorted.

Discounting can be a very effective tool to reduce CER supply, and is versatile enough to be designed in a way that reaches a certain level of supply. Discounting also is a very effective tool to "wean off" countries from the CDM and make them take up emissions commitments. Discounting is less effective in improving the environmental integrity of the CDM, at least during a phase of low CER prices. While there is a possibility to develop a matrix of discount factors taking into account a number of different criteria, negotiating such a matrix will be more challenging than a very simple approach. Therefore, country-category specific discounting is most likely to be acceptable.

5. CDM Transformation Options

This chapter builds on the findings of the previous chapters, and expands the explanatory scope by assessing how innovative elements of the CDM's institutional framework can be utilized for scaled-up and more complex market mechanisms such as (credited) NAMAs or sectoral crediting and/or trading mechanisms under the NMM/FVA. In a first step, we establish conceptual differences between the CDM and new market mechanisms, and also identify which innovative CDM elements can serve as useful building blocks for the design and evolution of new mitigation instruments (5.1). In a second step, we assess the suitability of standardized baselines with a high likelihood of continued relevance in light of likely CER limitation scenarios as defined above. Third, we assess a range of possible transformation options which include a continued role of a strongly reformed "CDM+", how CDM elements could be integrated in NMM and FVA, as well as synergies between carbon market and climate finance instruments. These analytical steps are aligned with the research interest of the indicators, methodology, scenario results, and discounting discussion which have been the subject of the preceding chapters.

In order to allow for a consistent approach, this assessment will differentiate between **institutional, technical** and **political** dimensions in order to establish relevant analytical categories. Furthermore, we distinguish between different typological **levels of governance** and **stakeholder groups**, namely the UNFCCC (global level), host country governments (national level), as well as market participants (PPs, investors, intermediaries, both global and national level). This analysis seeks to draw attention to broader CDM reform directions rather than a detailed analysis of specific aspects. Therefore, our analysis will remain on a relatively high level of aggregation, and specific sector or country case studies serve mainly illustrative purposes. A more detailed analysis of key CDM reform processes and their potential for new market mechanisms can be found in Dransfeld et al. (2014).

5.1. Identification of innovative CDM elements and difference to new market mechanisms

5.1.1. Key innovative CDM elements with potential for new mitigation mechanisms

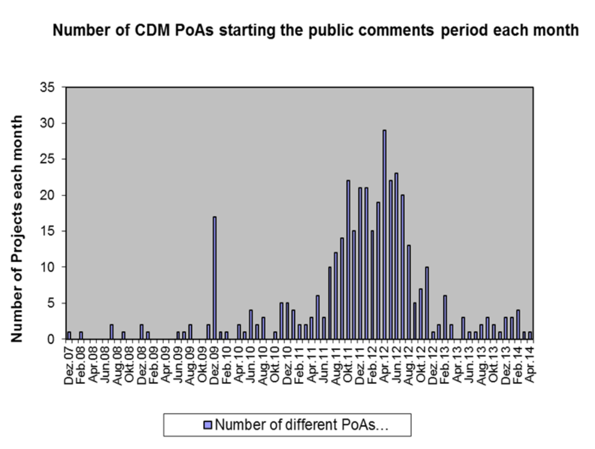
In this section, we identify key CDM elements and reform directions which can serve as building blocks for new mitigation mechanisms. We focus specifically on CDM Programme of Activities, standardization, as well as governance design and market infrastructure. These three themes serve to draw attention to the evolution that has recently taken place in the CDM, partly in response to earlier criticisms. The key objective of this exercise is to assess whether these elements of the CDM's methodological toolkit and/or institutional design can be utilized for or be transferred to new mitigation mechanisms, and to arrive at a tentative conclusion whether recent innovations within the CDM may already meet some of the political demands for the design of new mitigation instruments. Therefore, the assessment will not be comprehensive, but focus on key elements that provide the most relevant lessons.

Programme of Activities

Already in 2005, the CMP guidance relating to the CDM – shortly after the CDM became formally operational – allowed to aggregate individual activities under a PoA (UNFCCC 2006). The PoA concept originated from the idea to lower transaction costs by combining many individual CDM activities under one ‘umbrella’ (Figueres 2006). Making this concept work in practice, however, continues to require ongoing regulatory evolution. In terms of practical implementation, initially PoA uptake had been very slow until the EU ETS deadline for CDM activities from non-LDC host countries triggered significant levels of PoA inflow and registration success before the end of 2012. As of May 2014, there are now 252 registered PoAs, although only six of these have actually received issued CERs (URC 2014b). As a first observation, PoAs have therefore evolved from a theoretical concept to fully operational approach. Still, it is important to recognize that PoAs in practice nonetheless remain a rather new instrument, whose effectiveness can only be tentatively assessed. Yet, the dynamics in the PoA portfolio provide clear evidence of both a significant move beyond the individual project level in the CDM, as well as the vulnerability of the CDM to political mitigation ambition.

Figure 34: Status and evolution of PoA Pipeline

Status of PoAs	Number
At validation	**134**
Request for registration	2
Request for review	2
Correction requested	
Under review	
Total in the process of registration	**4**
Withdrawn	2
Rejected by EB	3
Validation negative by DOE	
Validation terminated by DOE	36
Registered, no issuance of CERs	246
Registered, CER issued	6
Total registered	**252**
Total number of different PoA-DDs	431
Replaced PDDs	23
Total number of PoA-DDs submitted	454



Source: UNEP Risø Centre (URC) 2014b

Regarding its **institutional dimensions,** the PoA concept is closely built on the project-based CDM, and operates within the existing modalities, procedures, and governance structures. Most actors largely fulfil very similar roles, for instance, the role of the CMP (political direction and authoritative guidance), Executive Board (regulatory oversight), the Executive Board (EB) support structure (technical advice), and DNAs (LoA) remain virtually unchanged. An important innovation is the role of the Coordinating/Managing Entity (CME), which is responsible for the entire PoA, as well as individual project component activities (CPA), which implement the mitigation activities and can be spread out across multiple countries. This evolution from a single project participant to more complex structures creates new challenges related to MRV, CER issuance, and general modalities (see technical dimensions). Regarding third-party auditing, the question of Designated Operational Entity (DOE) liability for erroneous inclusion of CPAs has long held back PoA implementation, and has therefore been included in the ongoing review of the CDM modalities and procedures (see 5.3.1). As new market mechanisms and NAMAs are anticipated to operate at larger scales than the CDM, this early PoA experience provides important lessons for mechanism design. However, the stronger role of the host country and a possibly more decentralized governance arrangement raises new challenges for new instruments that require further consideration.

Regarding **technical dimensions,** the distinct characteristics of PoAs have raised new challenges, for which solutions are beginning to be found. For instance, MRV procedures have improved eligible approaches for sampling data for PoA types with a large number of small appliances such as e.g. improved cook stoves (ICS) or solar water heating (Feige and Marr 2012). A related remaining barrier is that verification can take place only for all CPAs of an entire PoA at the same time (synchronized verification). However, CPAs may be implemented at different speeds which makes this rule impractical. Regarding eeligibility, CPAs for registered PoAs can bypass some validation requirements, and the beginning introduction of positive lists through either top-down standardization e.g. for small and micro-scale electricity generation, or bottom-up SBs, contribute to further lowering transaction costs.

PoAs generally rely on the same approved methodologies than single CDM project activities, although some small and in particular micro-scale activities have been enabled only by PoAs. The CDM methodology panel has initiated a process to remove remaining restrictions by assessing the most widely used methodologies for PoAs (CDM Methodology Panel 2012). Importantly, even large scale methodologies e.g. for grid-connected renewable power generation can be used for PoAs. This can be interpreted as an important step towards “sectoral” approaches within the CDM (Dransfeld et al 2014). Further methodological innovation streamlining PoA relevant methodologies is an important element of the current CDM EB work plan (CDM EB 2014). These trends can be taken further towards the objectives of both CDM reform and new market mechanisms by strengthening methodological consolidation in order to eventually allow for a modular application of CDM methodologies to a wider range of technologies within the same PoA Design Document (PoA-DD), which could lower transaction costs by removing redundancies.

With respect to the **political dimensions,** introducing PoAs can be seen as a major early response to address key criticisms of the CDM relating to scaling up emission reduction activities by reducing transaction costs, while promoting a more equitable geographical distribution of the benefits of the CDM (Dransfeld et al. 2014). At least some of the so-called “under-represented” countries, notably African countries and LDCs, appear to have much more success with attracting PoAs than with the conventional CDM project activities. With regard to scope, (sub)sectors and technologies with associated high sustainable development benefits (e.g. energy efficiency, waste management and solar), are being taken up much more strongly than under the project-based CDM (URC 2014b). Therefore, the concept of scaling up mitigation activities through aggregated activities in PoAs enjoys broad support, and is widely considered a critical step towards new and scaled up mitigation instruments (Dransfeld et al. 2014, Füssler 2012, KfW 2011).

CDM Standardization

Following prominent mandates from CMP 6 and 7, standardization has emerged as one of the most important CDM reform programmes, which intends to simplify key elements of CDM methodologies, thereby lowering transaction costs for project participants. Although standardized baselines are most often discussed, standardized approaches also comprise other methodological elements such as additionality and MRV aspects. A critical distinction is between **top-down** and **bottom-up standardization**. Top-down standardization refers to efforts to standardize methodologies or baselines that have been developed or commissioned by the UNFCCC (i.e. on a global level - therefore top-down). These are typically not country-specific approaches, but globally applicable CDM methodologies with a high degree of standardization such as AMS-I.L[34]. The CDM EB 2014/2015 work plan includes detailed outputs such as the development of three SBs as well as the simplification of 20 methodologies, and is therefore a key priority. Bottom-up standardization refers primarily to sector-specific SBs, which can be applicable either to only one or multiple countries. A common trade-off is that top-down standardized baseline values are typically relatively conservative due to their broad applicability, while bottom-up SBs may be able to better reflect the specific practices and circumstances of individual countries.

Regarding the **institutional dimensions** of CDM standardization, all processes still operate fully within the Kyoto Protocol architectures. Standardization can be seen as another regulatory response, to criticisms of the CDM regarding methodological complexity, lack of data availability, and unequal geographical distribution of CDM benefits. A critical new element of standardized baselines compared to both the project-based CDM and PoAs is the stronger responsibility of the host country Designated National Authority (DNA). DNAs need to assume responsibility for the integrity of SB development and submit quality control reports. This raises entirely new capacity challenges for DNAs. This development is the strongest regulatory engagement of host country government institutions in the CDM so far, and will therefore generate valuable lessons for new mitigations instruments, which also foresee a greater role of the host country. It is important to realize that transactions costs are therefore potentially lower for Project Participants (PPs) when working with SBs, but that these simplifications also require upfront investment in terms of staff time and potentially travel and auditing costs.

A proliferating set of procedures and guidance instruct the **technical dimensions** of SB development. An SB may reduce transaction costs for project developers significantly, as key elements of the required project documentation such as default factors for baselines or project emissions are made readily available, and therefore eliminate the problem of data availability. Due to these simplifications, it is important to safeguard the environmental integrity of SBs as the resulting CERs can still be used as offsets. Environmental integrity can be positive in case of “ambitious baselines” (Prag and Briner 2012), and even result in net emission reductions, even though these are currently not made visible, as this is not the mandate of the CDM. The above-mentioned quality control checks by DNAs require them to implement systems for quality assurance and quality control (QA/QC). This is the most demanding aspects of the new role of DNAs in the SB development process, and represents a significant shift from the traditional DNA role to the stronger responsibility

[34] AMS-I.L “Electrification of rural communities using renewable energy” introduces default baseline emission factors of 6,8 – 1,3 – 1,0 tCO_2e/MWh for different categories of end-users (e.g. households) for off grid or mini-grid applications, provided certain eligibility conditions are met. See Annex 8 for a selection of rural electrification CDM methodologies with a high degree of standardization.

in new market mechanisms. SBs are valid only for a period of normally up to three years, and can be updated after that, but can also be revised top-down by the EB anytime if necessary. Third-party auditors (DOEs) are involved by compiling an assessment report (AR) on the quality of the DNA's QA/QC system, which is similar to a validation process, although the first three SBs in underrepresented countries can omit the AR. A multi-country SB is submitted by one DNA but all DNAs must approve the SB by issuing Letters of Approval (LoA).

SBs need to be based on approved methodologies or tools, and are subject to an expanding set of procedures and guidance, which have been more complex than originally expected (Schneider et al. 2012). Still, the regulatory framework needs to be considered as being at an early stage of maturation, and some "teething" problems always need to be expected in the design of new approaches. Additionality can also be standardized through the SB procedures, for instance by defining positive lists for certain technologies, or other eligibility criteria. Some technologies are now automatically additional on a global level, but these must be considered as exceptions with comparably high costs (solar, off-shore wind, marine renewable energy), or only at micro- or pico-scale. This concept is at an early stage, although it is discussed prominently both in the CDM reform debate and for new mechanisms such as the Japanese Joint Crediting Mechanism.
Key **political** objectives of standardization include equity (by broadening access to the CDM for under-represented countries), efficiency (by reducing transaction cost reductions for project developers), as well as effectiveness (as high-quality SBs may strengthen the integrity of baselines and additionality). It can be seen as a merit of the multilateral architecture of the CDM that standardization aims at addressing such concerns that have long challenged the legitimacy of the CDM. A remaining open question is whether the use of SBs should be mandatory or voluntary once approved, which may create winners and losers (Spalding-Fecher and Michaelowa 2013). Some developing countries took issue with this perceived intrusion into their national sovereignty by this provision. However, as standardized baselines always have to be initiated and submitted by host country institutions (DNAs), this conflict seems resolvable once a better familiarity with SBs will evolve over time. Regarding potential net mitigation impacts of PoAs, just like for single CDM project activities, all resulting CERs can potentially be used as offsets, but could in principle also be retired and thus create net mitigation benefits.

Appropriate levels of aggregation and suitability of benchmarks

Standardization cannot be upscaled indefinitely. The right level of aggregation depends on the sector (Schneider et al. 2012). While sectors that have globally traded products and technologies might be able to apply global benchmarks, most project types under the CDM do not fall into that category. In most cases, differences in the policy framework as well as the cost structure of manufacturing, as well as the availability of inputs vary significant on the national level. The attempts by the UNFCCC Secretariat to force universal technology penetration benchmarks therefore have failed, and the appetite of the CDM EB to accept the Secretariat's related recommendations has faded appreciably. In order to assess the right degree of aggregation, in-depth studies of all relevant sectors would have to be undertaken.

Governance design and "market infrastructure"

A key issue in the design of market mechanisms is the design of regulatory competences and related accountability relationships, in order to ensure a high degree of environmental integrity, as well as alignment with the overarching objectives of the climate regime. The CDM has generated considerable experience that can be applied to how to govern market-based emission reduction activities.

Regarding **institutional dimensions**, the CDM is governed in a centralized manner, although it has been explicitly designed to invite bottom-up initiatives for methodology development and project development according to the relevant procedures. The CMP provides political direction and authoritative guidance, and has initiated the high-impact reforms such reforms PoAs and standardization. The EB fulfils the role of the regulatory body that implements the strategic direction set by the CDM. It can rely on an elaborated support structure (Secretariat and working groups) which consists of the respective apparatus in the UNFCCC Secretariat, as well as a range of expert working groups for a range of topics (small scale WG, afforestation / reforestation WG, etc). On the national level, the DNA had traditionally been restricted to approving the sustainable development contribution of a prospective CDM project, although SB development procedures have begun to shift this role (see above), which is an important first step towards possible host country responsibilities in new mechanisms. A key element of the CDM's checks and balances are third-party auditor DOEs. Due to the current prolonged carbon market crisis, auditing capacity is breaking away, which could become a problem if demand improves again should mitigation ambition be strengthened through a new climate agreement, perhaps as early as the Conference of the Parties (COP) 21 in Paris at the end of 2015. A new developing in the CDM's institutional architecture are the newly established CDM Regional Collaboration Centres (RCC), which intend to contribute to a more balanced geographical distribution of the CDM's benefits, e.g. by support DNAs in underrepresented countries in developing SBs.

Regarding **technical dimensions** of the CDM, there are currently five sets of modalities and procedures for the CDM (large-scale, small-scale (SSC), afforestation/reforestation (A/R), SSC A/R, carbon capture and storage (CCS)), which form the basis for the CDM's operational rules. A scheduled review process is currently ongoing as part of the broader review of the Kyoto Protocol after the end of its first commitment period. The EB has developed an elaborate and complex regulatory framework for mitigation actions in a broad range of sectors, including technical standards, procedures and guidance and its support structure (working groups and secretariat). As NMM and/or FVA are expected to operate under the Convention rather than the KP, a political decision would need to establish whether PoAs, SBs or any other related methodological element can be integrated under another mechanism. Due to the vagueness of emerging mechanisms such as NAMAs, SBs and other CDM tools can relatively easily be included in a NAMA framework, as long as no offset credits are generated. This could mean that e.g. a Grid Emission Factor (GEF) is calculated to establish the baseline for a renewable energy feed-in-tariff (REFIT) policy, if there is a desire to MRV emission reductions in such a scheme.

On the national (host country) level, DNAs issue LoAs, but are not required to get actively involved in CDM projects and PoAs. By contrast, project participants have to be able to cope with the higher complexity of managing a PoA compared to a single project activity.

The CDM registry is a crucial tool that can help to prevent double-counting and potentially also achieve net mitigation benefits by offering the option to retire CERs in dedicated account which is an important element for achieving transparency. However, the transition to a more complex landscape of market mechanisms also raises new challenge to which the CDM needs to find answers, such as the issue of de-registering projects from the CDM. There are no procedures for this step, which some Chinese projects want to do as the CCER scheme currently offers more value for carbon credits. If this issue is not resolved soon, it may lead to a situation in which the same project may be registered under both the CDM and the CCER scheme, which could lead to double-counting[35].

This last issue draws attention to the **political dimensions** of the CDM. The political uncertainty around the pre- and post-2020 architecture of the climate regime and the persistent lack of mitigation ambition translates into a lack demand for CERs. In part due to a looming oversupply but also due to reputational concerns with specific sectors of the CDM (industrial gases, large scale power), the EU ETS has drastically restricted CER imports after 2012, which demonstrated how vulnerable the CDM is to political decisions by buyer countries and Annex I mitigation ambition. For the CDM, a number of public sector initiatives that extend a lifeline to high quality CDM activities have emerged in response to the carbon market crisis such as the KfW PoA Support Programme, the World Bank Carbon Initiative for Development (Ci-DEV), and bilateral Scandinavian purchasing programmes. Yet, it is clear that no market mechanism will be able to function properly in the absence of sufficient levels of demand, as long as demand-supply balances and price-finding is not more strongly regulated.

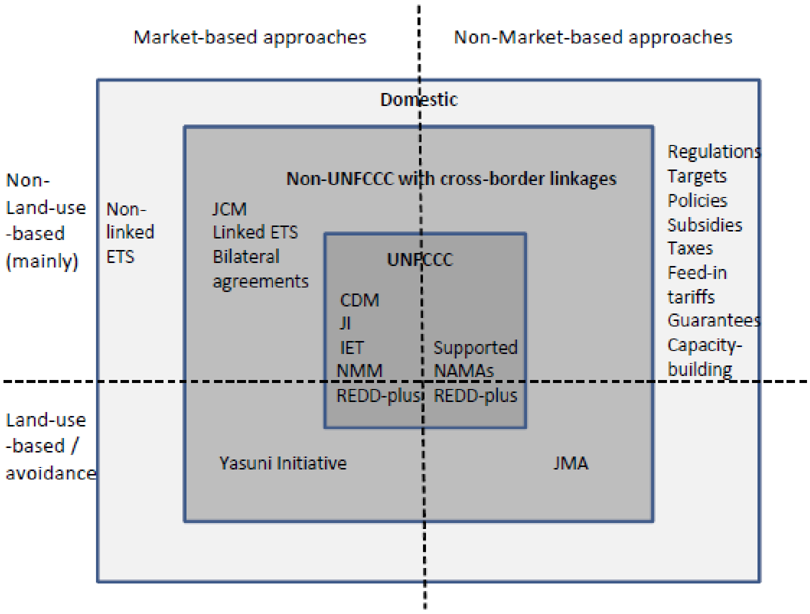
5.1.2. Key differences between CDM as project-based offsetting mechanism and new mechanisms with the following features

After having looked at options to use the CDM for new mechanism design, we now assess key differences between the CDM and new mechanisms, by looking at three cases. When discussing the role of market mechanisms in the future climate regime, one needs to put particular emphasis on the distinction between the existing CDM and evolving concepts for new market mechanisms, which could serve as complements or successors to the CDM. Such future market mechanisms have been debated for several years amongst policy makers, businesses, donors, academia and non-governmental organizations (NGOs). One of the main drivers for new mechanisms is the perceived need to shift market-based mitigation measures to a broader scale, i.e. away from individual standalone projects towards a sectoral or national programme or policy. Importantly, new mechanisms are anticipated to increase domestic mitigation ambition in host countries, which means that not the entire mitigation volume can generate offset credits. This means that the bipolar distinction between Annex I and developing countries in the Kyoto context will be more diffused, and possibly be based on a range of criteria that reflect CBDRCCC, as exemplified in scenario 2 and 4. When COP 17 defined the NMM, the shell for such attempts was established, even though Parties struggle to fill the NMM with life. The most prominent concepts to be accommodated under the NMM are sectoral approaches, including trading and crediting. In addition, Parties are discussing a bottom up FVA, which will be designed according to host country needs, which for instance could cover the Japanese JCM. The state of the negotiations on NMM and FVA was summarized by the UNFCCC

[35] There are currently five sets of modalities and procedures for the CDM (large-scale, small-scale (SSC), afforestation/reforestation (A/R), SSC A/R, carbon capture and storage (CCS)), although a review process of these is currently ongoing as part of the broader 2013/2014 review of the Kyoto Protocol.

Secretariat in two technical synthesis papers of parties' submissions (UNFCCC 2013a, b). Figure 35 below provides a good overview on the scope of approaches being considered relevant in the UNFCCC negotiations over the past years.

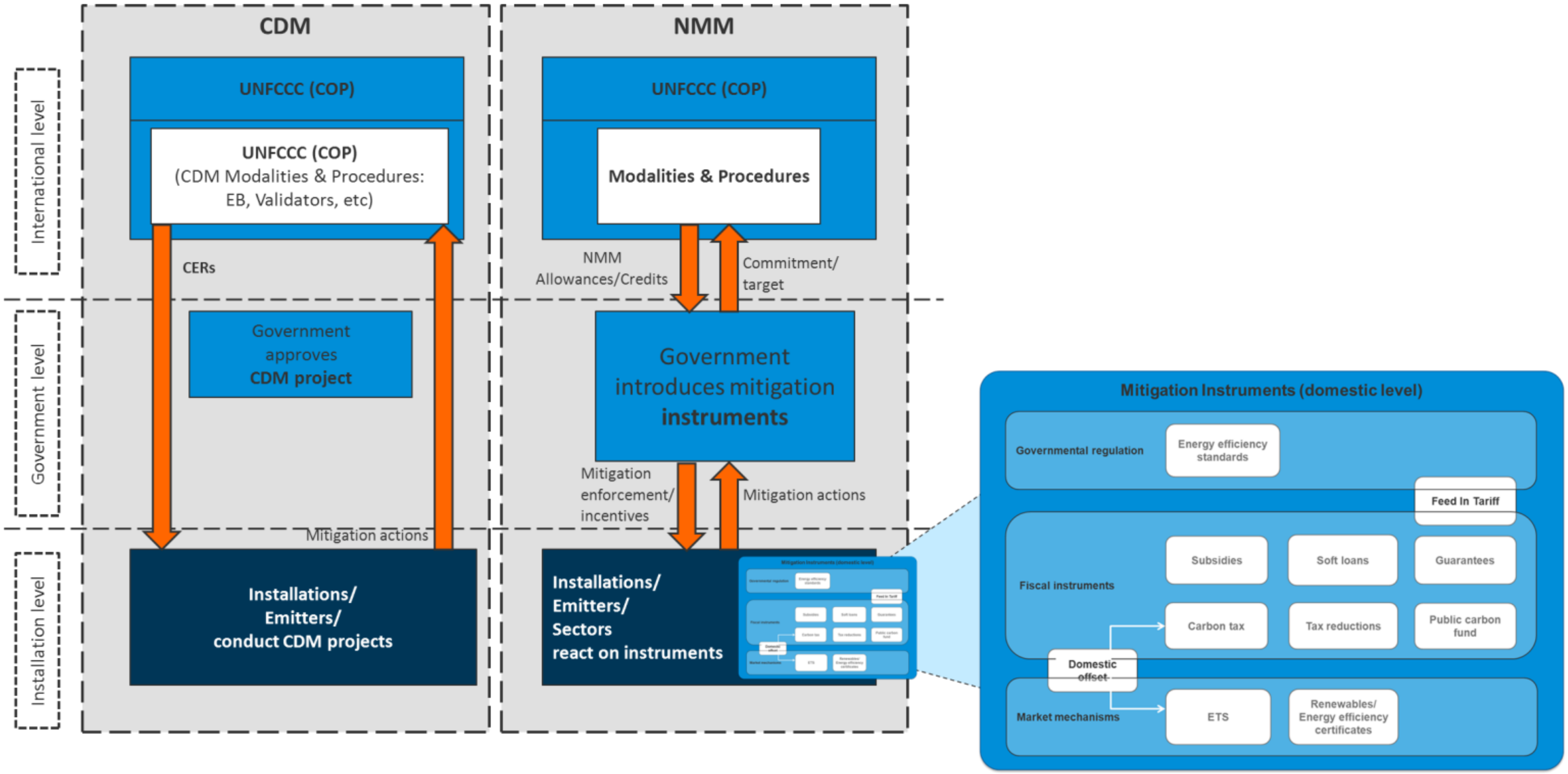
Figure 35: Illustrative scope of approaches under future market mechanism



Source: UNFCCC (2013b)

However, the Warsaw COP in late 2013 revealed fundamentally diverging views concerning the development of NMM and FVA between Annex I and developing parties. Therefore, one needs to be cautious whether the upcoming SB 40 in June 2014 in Bonn or COP 20 in Lima, Peru, in December 2014 will be able to make progress on the further elaboration of NMM and FVA as future market based mechanisms under the Convention. One option that is gaining some momentum is the crediting of emission reductions induced by sectoral or national policies and measures, so called "policy crediting" (or sectoral / NAMA crediting), even though this concept has not been yet been officially accepted as a viable option in the UNFCCC negotiations. In the context of this study, the future evolution of new mechanisms raises questions regarding their co-existence with the CDM, the general impact on the CDM´s portfolio and relevance. A general aspect concerning the evolving future mechanisms is the level that the respective mechanism operates at, and with this the actors it shall incentivize – emitters level, national government or international fora. For mechanisms with high levels of aggregation, different country and sector-specific circumstances need to be taken into account. While under the CDM and project-based mechanisms in general, incentives accrue to emitters, the NMM envisages incentivizing governments. Here, national governments can choose various policy instruments on the domestic level to incentivize mitigation action by emitters, for example regulation, carbon taxes or mandatory emission caps. Figure 36 contrasts the different layers of decision making under CDM and NMM.

Figure 36: Different levels of decision making for mechanisms and instruments



Source: Perspectives GmbH

In order to further illustrate this complex setting, we subsequently sketch three cases of possibly co-evolution of the CDM and its interplay with future mechanisms. First, it is assumed that a country may only allow domestic activities for meeting domestic ambition, but would also utilize domestic offsetting for making the compliance burden more flexible. In a second case, the use of international offset credits would be eligible to a limited extent (such as a limited scope of project types, possibly based on criteria such as those in scenario 3). In a more hypothetical variation, we consider that international (not only domestically generated) CERs could also be as utilized by Non-Annex I countries for the same purpose of flexibility, meaning that emerging markets would be able to compete for CERs and foster demand for credits. Third, credits originating from policies and measures in host countries, which may be combined with regulatory measures, would arise as an alternative to project-based crediting, such as in the case of NAMA crediting.

Case I: Purely domestic ambition and differences to the CDM

Purely domestic ambition refers to the case where no international trade of emission reduction units is involved, meaning that a purely domestic carbon market approach is chosen. The most likely scenario is a domestic offsetting scheme, where credits from domestic activities could be imported into a mandatory carbon pricing system. The most common combination would be an ETS that allows the use of certified emission reductions for compliance, such as in China where pilot ETS schemes enable offsetting with so called CCDM activities (former CDM activities). Furthermore, even a carbon tax regime can utilize carbon credits, as the recent proposal for a carbon tax in Mexico shows, which envisages alleviating the tax burden through cancellation of CERs from Mexican CDM activities.[36]

Politically, the establishment of domestic offsetting can be regarded as a positive development, as it indicates mitigation commitment within a NAI country. Although such a “closed” system is also a move away from the multilateral approach of an international offsetting mechanism. This would in particular undermine the idea of utilizing the economic opportunities of an international market mechanism, as well as the standards and integrity an international agreed approach can offer. Also the aspects of cross border accountability and fungibility of credits are relevant. A variety of existing domestic schemes would thus signal progress in developing carbon markets in developing countries (in times of dire straits for carbon markets). On the other hand, as more countries turn towards new domestic schemes and leave the CDM, the less likely becomes the sustainable role of the CDM as a “guiding” mechanism. Regarding the **institutional** perspective, the modalities and procedures of offsetting activities would be determined by the national government, most likely by the entity which has formerly been serving as the CDM DNA. Hence, there is a possibility that no international or multilateral supervision would be ensured anymore, which could lead to a reduction of environmental integrity in the offset mechanism. **Technically**, the CDM is a fully operational mechanism that continues to develop and improve its standards and rules. The progress – of which some key aspects are briefly sketched in 5.1.2 – makes it a likely blueprint for domestic schemes, e.g. concerning the use of methodologies or established procedures such as the demonstration of additionality. A real

[36] Under its carbon tax on fossil fuels scheme that became effective on January 2014, Mexico allows for offsetting tax burden through domestic CERs. As the tax is 2.2 Euros per tonne, the carbon market option is a clear driver for domestic offsetting activities. Mexico is planning to introduce an economy wide ETS in the near future and is being supported by the PMR in this plans (Semarnat 2014).

world example is the “Chinese CDM” that strongly builds its procedures upon the CDM (Partnership for Market Readiness (PMR) 2014a).

In the light of this study the impact on CER availability would most likely correspond with the scenarios 2 “CBDR and respective capacity”, and 4 “Climate Change Responsibility”, as it is assumed that only emerging developing countries such as Brazil, Chile, China, Korea, Mexico, etc. are introducing respective measures. Under scenario 2, most of these countries would not be eligible to export CERs anymore. Yet, for these countries that CDM has laid an important foundation on which the country can introduce a domestic offsetting scheme which contributes to making carbon pricing or regulation instruments more palatable and efficient. However, existing CDM projects in the relevant sectors that foreseen to be eligible for domestic offsetting in the host country will either be transferred into domestic offsetting projects, or need to be “de-registered” with the UNFCCC, which hints at new technical challenge currently under discussion within the CDM Executive Board.

Case II: Combination of domestic ambition and external crediting

A combination of domestic ambition and external crediting refers to a case where a host country is adopting emission reduction targets (either at the national level, or even pledged internationally) for certain sectors, and would introduce domestic regulation for the concerned scope. Outside of this scope it would be still feasible to conduct CDM activities. The Korean CDM serves as a good example; projects not implemented by Korean entities are excluded from domestic offsetting and thus remain eligible under the CDM. A potential option under this case would be a NAI host country allowing the use of external (i.e. international) credits for compliance with a national target. Basically this would be widening the principles of the KP (Annex I world buys CERs from Non-Annex I world) to all interested countries, where for instance Brazilian buyers could acquire CERs for compliance with a (fictitious) Brazilian domestic target from any CDM activity. In theory and in the context of parties discussing the revision of the bi-polar world order under the UNFCCC (Annex I vs. Non-Annex I), such a setting could be attractive as it would see emerging market countries being able to use CERs and foster demand for credits. However, the current experience makes it seem unlikely that emerging markets would allow for external CERs as offsets, and rely on their domestic potential instead (as e.g. Korea, China or Mexico have done).

Politically, the partial shift of CDM projects into domestic regulation or schemes does not differ much from case I – it is a good signal for global ambition if Non-Annex I parties progress regarding ambition, but it can potentially be a setback for a multilateral mechanism such as the CDM. Allowing NAI countries to utilize CERs for compliance would require a COP decision. On the **institutional** level DNAs would need to be capable of differentiating between national and international offsets, in particular as it will probably the same units dealing with both sorts of carbon projects. Of course, the overarching regulatory or carbon pricing scheme for which the offset credits are intended requires even stronger capacity questions, which makes it likely that such approaches may be most relevant in countries that could possibly be excluded from the anyways. In this context, on a **technical** level registries will need to be adjusted and aligned procedures for enhanced transparency of domestic projects would be required for retaining the CDM quality standards.

Regarding **the impact on CER availability**, case II would most likely address the above defined scenarios 2 “CBDR and respective capacity”, and 4 “Climate Change Responsibility”, but potentially also scenario 3 “Sustainable Development and Environmental Integrity”. Existing CDM projects in the relevant sectors foreseen to be eligible for domestic offsetting or introducing regulation will either be transferred into domestic offsetting projects, or need to be “de-registered” with the UNFCCC (see case I). In case compliance actors in NAI countries would start purchasing CERs, this could up the demand for credits.

Case III: Combination of political regulation and market aspects

Under a case that combines political regulation with market aspects, the government would start introducing domestic regulation that covers parts of the existing CDM scope within the country. Hence, the national government would take existing and future CDM activities out of the market, for instance by introducing specific standards for efficient coal power plants or vehicles. In addition, the host country government could enable so called “policy crediting”, i.e. CERs that are directly caused by a certain policy (e.g. introduction of a national efficient buildings programme). The most relevant approaches discussed in the literature and the UNFCCC negotiations are the concept of sectoral crediting, as well as credited NAMAs.

Besides putting forward the respective domestic regulation, transferring CDM activities into non-market approaches requires the national government to deal with the already fixed emission reduction purchase contracts of the credit owners, which constitute monetary value. A transitioning agreement, which e.g. foresees the phase out of the CDM after the current crediting period of a specific activity, and immediate adoption of the regulation thereafter, could build a bridge for the project developers and credit owners. Alternatively, a “buyout” of the CDM into the regulation by the government could convince the project owners to shift away from CDM before the crediting period ends.

Concerning policy crediting it appears attractive to generate revenues from selling carbon credits that accrue under a certain policy. However, this is not possible as of yet due to several technical reasons. For instance, the concept includes uncertainty on methodological issues, and the attributability of emission impacts to some policy instruments. Röser and de Vit (2012) state that “policy crediting is unlikely to be feasible due to the difficulties of setting boundaries and baselines”. On the other hand, the use of approved baseline and monitoring methodologies could allow generating additional emission reductions with a reasonable degree of MRV-ability, and should thus be expected to enjoy a high degree of legitimacy among Parties. In particular if structured as a Results-based finance (RBF) scheme (see chapter 5.3.3 below) that retires credits and thus uses them as “receipts” (Raab 2012), rather than offsets, such an approach could gain broader acceptance in the future.

The impact on CER availability in this case III would most likely address the above defined scenarios 2 “CBDR and respective capacity”, and 4 “Climate Change Responsibility”, but potentially also scenario 3 “Sustainable Development and Environmental Integrity”, as the more ambitious development of strong environmental policies is anticipated to rather work in countries that fall into those scenarios. Thus, certain CDM activities would be integrated into a domestic regulation over time, while others could remain accessible for the CDM. An interesting case would be the host country putting forward policy crediting, which could provide an alternative supply of credits besides the CDM (although with questionable quality).

Conclusions. The fact that the PoA portfolio has already produced discernible differences to the single project CDM clearly indicates that regulatory reforms and capacity building can have an actual impact on implementation. Still, PoAs have so far not managed to penetrate a number of sectors such as forestry, agriculture and transportation, which have traditionally been underrepresented in the CDM. These sectors continue to be held back by methodological problems regarding e.g. the permanence of resulting emission reductions, baselines and leakage.

5.2. Suitability of standardized baselines with high likelihood of CDM eligibility

In the following section, we assess specific examples for standardized baselines with a high likelihood for continued relevance in scenarios for restricted CDM eligibility based on the criteria and scenarios developed in chapter 2 and 3. CDM standardization can take different directions, although these can usually be distinguished between either simplifying applicability or by increasing CER yield. The former approach aims at reducing transaction costs by removing the need for project specific data collection and processing, e.g. by establishing default values. The latter may aim at raising the sometimes very conservative default values in globally applicable approved CDM methodologies, based on country-specific circumstances and data. We focus on the former type of standardization (simplifying applicability) for two reasons. First, higher CER yields potentially run counter to the broader political objective to increase the net mitigation contribution of market mechanisms. Second, in the current market situation, higher CER yields may improve the incentives to develop a CDM activity only marginally. By contrast, easing applicability of CDM methodologies and thereby lowering transaction costs for CDM project developers may have a stronger impact on the continued implementation of sustainable development activities with support from the CDM. As section 5.1.2 explains, CDM standardization is a relatively new reform programme, which is only beginning to shift from theory to practice, with currently four approved sector-specific SBs, as well as a larger number of revised CDM methodologies which include a broad range of standardized elements.

The following selection includes both project types and technologies that have already seen first SB development pilot activities in individual countries (improved cook stoves, sustainable charcoal, grid emission factors, cement), as well as other technologies which have received less attention, but offer nonetheless high potential for both mitigation and sustainable development benefits in geographical contexts that are likely to remain eligible for the CDM (e.g. rural electrification, methane avoidance, demand-side management for household appliances, waste management). Finally, we touch briefly on sectors with a very low penetration within the CDM (transport sector and buildings), but with increasing relevance for NAMAs, and perhaps also in a reformed CDM+ or NMM. The forestry sector is not considered here, as the current rules on CERs virtually exclude the use of A/R CERs in most ETS.[37] Still, the forestry remains important sector due to its high mitigation potential, potential adaptation benefits, as well as the fact that it is the only sector for which sector-specific SB development guidance has already been published (CDM EB 2012). However, more fundamental

[37] It is important

reforms related to the permanence of CERs are required to increase the relevance of forestry sector within the CDM (see also section 5.3.1.).

For each of the potential SBs, we apply a checklist that covers the most important aspects which determine whether the respective project type offers further standardization potential. This checklist includes the rationale and likelihood of continued CDM eligibility of the respective project type, the applicable methodology on which the SB would be based, a brief indication of the current level of standardization, further standardization potential, as well as the feasibility (including data quality, access and other barriers) and environmental integrity of the potential SB.

1.) <u>Improved cook stoves (ICS)</u>

- ✓ **Rationale:** High mitigation potential due to dominant use of biomass energy in particular for lower income country households**.** Significant human health and adaptation co-benefits.
- ✓ **Likelihood of continued CDM eligibility:** Project type applies to low-income countries with high likelihood of continued CDM eligibility. Even in middle-income countries, this project type is unlikely to be transitioned to an ETS, although CDM activities could at least in theory also be replaced by non-market approaches (RBF). Primary biomass still provides a vast share of the energy which is consumed in underrepresented countries with a high likelihood of CDM eligibility.
- ✓ **Applicable methodology:** An ICS SB can be based on the CDM methodologies **AMS-.I.E** (Switch from non-renewable biomass for thermal applications by the user) and **AMS-II.G.** (Energy efficiency measures in thermal applications of non-renewable biomass).
- ✓ **Current level of standardization:** Key parameters that already offer UNFCCC-approved standardized values include efficiency of baseline cook stoves, fraction of non-renewable biomass (fNRB), and wood to charcoal conversation rate (see Blodgett and Hoch 2014). There is not yet an approved or proposed SB for improved cook stoves.
- ✓ **Further standardization potential:** Medium, as many parameters are already standardized, however, a country-specific SB could establish standardized values for wood fuel consumption per capita, penetration of improved cook stoves (see Blodgett and Hoch 2014).
- ✓ **Feasibility**: Possible, but difficult, as data often varies greatly between studies on the same country or region, which indicates low data reliability and validity on usage of ICS in households in many countries with continued relevance in the CDM, in particular in rural areas. This makes it hard to strike a balance between reasonable conservativeness and adequate consideration of local circumstances.

2.) <u>Grid-connected renewable electricity generation (Grid emission factor)</u>

- ✓ **Rationale and likelihood of continued CDM eligibility:** Grid-connected renewable energy and energy efficiency project types are by far the most widely implemented CDM activities, and comprise more than 70% of the portfolio of registered CDM projects (UNEP Risoe, 2014a) In addition, nine out of twelve proposed SBs which have been developed are GEFs; two of which have already been approved (for the Southern African Power Pool and the Republic of Uzbekistan).

- ✓ **Likelihood of continued CDM eligibility:** High, as energy is one of the sectors with the highest mitigation potential, relevant in virtually all countries, and also important in the emerging NAMA Pipeline, for which there are as of yet not specific methodological tools for baseline establishment.
- ✓ **Applicable methodology: "***Tool to calculate the emission factor for an electricity system, v.3.0.0".*
- ✓ **Current level of standardization:** Medium (some provisions for LDCs, including inclusion of offgrid power plants), relatively few parameters to consider.
- ✓ **Further standardization potential:** Country-specific establishment of GEF as SB in order to avoid project-by-project transaction cost, incorporation of suppressed demand, better consideration of circumstances of hydro-dominated electricity systems in LDCs.
- ✓ **Feasibility**: Typically good data availability, which is usually available from utilities as it data is gathered independently of CDM activities.

3.) <u>Rural electrification with renewable energy</u>

- ✓ **Rationale:** Vast segments of the populations of lower income countries still lack access to modern energy services such as electricity, with rates being as low as 20 % in some cases. Furthermore, there has been a lot of recent progress in relevant CDM methodologies.
- ✓ **Likelihood of continued CDM eligibility:** High, as it is most relevant for the poorest segments of the population in countries that remain underrepresented in the CDM. These countries will likely not be asked for significant own contributions to global efforts to mitigate climate change, and therefore are likely to be able continue to certify emission reductions as offsets (compare scenarios 1, 2).
- ✓ **Applicable methodologies: AMS-I.L** ("Electrification of rural communities using renewable energy")**, AMS.III-BB** ("Electrification of communities through grid extension of construction of new mini-grids")**, AMS-III.AR** ("Substituting fossil-fuel based lighting with LED/CFL lighting systems")**, AM0103** ("Renewable energy power generation in isolated grids").
- ✓ **Current level of standardization:** high, but important parameters still need to be measured and monitored (e.g. project emissions, consumer groups, leakage). Most default values are restricted to a restricted set of household level applications (e.g. lighting), and a broader range of service provisions, at higher levels of aggregation can be standardized.
- ✓ **Further standardization potential:** Medium, as important parameters are already standardized. However, further technologies, as well as project emissions, leakage, consumption patterns can be standardized. In addition, country-specific calculations of suppressed demand and minimum service levels for various usage patterns may be more adequate than globally established default values.
- ✓ **Feasibility:** There is very little recognized research on Municipal Street Lighting (MSL) beyond household consumption at existential levels (e.g. household lighting), even though communal and commercial usage types are critical for low-carbon development pathways. Further research may be needed to establish default values for higher levels of aggregation.

4.) Solid Waste Management, including composting

- ✓ **Rationale**: High GHG emission reduction potentials, sufficient experience in CDM portfolio.
- ✓ **Likelihood of continued CDM eligibility:** CDM eligibility may be restricted to previously underrepresented host countries. However, related standardized methodologies elements may also be relevant for NAMA frameworks, especially as the waste sector has been a key sector in the early NAMA pipeline, in part due to typically strong public sector involvement. Composting has higher likelihood of continued CDM eligibility due to higher relevance for underrepresented countries.
- ✓ **Applicable methodologies: ACM0022** (Alternative waste treatment processes), **AMS-III.F** (Avoidance of methane emissions through composting).
- ✓ **Current level of standardization:** medium for solid waste management, as there is some limited use of default factors. High for composting, due to use of default values for MSL in baseline.
- ✓ **Further standardization potential:** Default factor for waste composition (fraction of different waste types, organic waste), low for composting.
- ✓ **Feasibility**: feasible but country specific data collection required.

5.) Transportation

- ✓ **Rationale:** Urban mass rapid transit (LRT, Bus) offers high mitigation potential and associated sustainable development benefits. In addition, the sector has been identified by the CDM EB as a priority sector, with a view to develop sector-specific guidelines for SB development.
- ✓ **Likelihood of continued CDM eligibility:** Medium, as this project type has not been taken up at scale due to methodological issues related to the dispersed emissions profile of the sector.
- ✓ **Applicable methodology:** ACM0016 "Baseline methodology for mass rapid transit projects".
- ✓ **Current level of standardization:** low, as key parameters still need to be determined on a project-by-project basis (see standardization potential).
- ✓ **Further standardization potential:** Baseline scenario: number of passengers transported (distance and mode of transport), project scenario: fuel consumption, occupancy rates and travelled distances of different modes of transport.
- ✓ **Feasibility**: Further standardization is possible, but relatively complex due to extensive data collection needs and context dependency.

6.) Cement Production:

- ✓ **Rationale:** The cement sector offers large mitigation potential with proven technologies, but has in some instances been criticized for weak additionality. However, due to a typically small number of large point-source emissions, the sector is among the likely candidates for new market mechanism pilots and/or sectoral approaches, which may also integrate CDM SBs into their MRV framework.
- ✓ **Likelihood of continued CDM eligibility:** Low (except for in underrepresented countries) due to low sustainable development benefits and sometimes weak additionality in some contexts.

- ✓ **Applicable methodology:** ACM0015 “Consolidated baseline and monitoring methodology for project activities using alternative raw materials that do not contain carbonates for clinker production in cement kilns”.
- ✓ **Current level of standardization**: Low, as key parameters still need to be determined on a project-by-project basis.
- ✓ **Further standardization potential**: Establishing country-specific default values for raw material and process emission factors in historical clinker production, default value for electricity consumption.
- ✓ **Feasibility**: High, due to good data availability.

Further sectors and project types offer high standardization potential. Some sectors such as agriculture and A/R have not been considered due to slow progress on improving persistent methodological barriers such as permanence of carbon sequestration within the CDM. Further in-depth research is needed on SBs for individual technologies, in particular through practical piloting of SBs in sectors in which no SB has yet been developed. The incentive structure of SB development suggests that private sector project participants have limited incentives of developing SBs, as their competitors would also be able to benefit from readily available SBs. However, as SBs can significantly lower CDM transaction costs and improve certainty on CER yields, the public sector should continue to support SB development, thereby lowering barriers for private sector investment in CDM activities, as well as providing methodological elements that can be integrated into NAMAs.

5.3. Assessment of CDM transformation options

This final step in our analysis offers a range of perspectives which illustrate possibilities for how the evolution of methodological innovations and institutional design elements in the CDM may gradually transform towards stronger domestic mitigation impacts and/or a transition to new mitigations mechanisms in some sectors and countries, in line with the scenarios elaborated above. These options include a reformed CDM+, the use of CDM elements in NMM/FVA approaches, as well as synergies between carbon market and climate finance instruments in the UNFCCC context. These transformation options represent ideal-type pathways, which may evolve in parallel, or in various combinations of the respective key elements in real-world developments. We continue to distinguish between institutional, technical and political dimensions to structure our assessment.

5.3.1. CDM+

This transformation pathway describes a possible continued relevance of combining various aspects of incremental CDM reform (SB, PoA, MRV, Modalities and Procedures). It is improbable that the CDM will ever reassert its previous role as the dominant mitigation policy instrument for developing countries again. Still, the substantial reforms which align with political demands allow for the possibility that the CDM may continue to play a more important role – as one mechanism in a broader portfolio of mitigation policy instruments – than some observers currently expect. Importantly, an improved CDM could play various roles in countries at different stages of development. This means that some of the more advanced countries, and also project types, could be gradually transitioned away from even an improved CDM to other mitigation instrument such as domestic ETS or STMs, or be subject to discounting approaches. Other countries and sectors may continue to generate CERs, in part for domestic use, in part for export. This pathway therefore goes beyond the “LDCs only” scenario, at least for certain project types.

Regarding **institutional dimensions,** this transition pathway assumes a continued relevance of the centralized governance architecture of the Kyoto Protocol, even though it may be completed or partly replaced by more decentralized institutions and organizational structure in a hybrid future climate governance architecture. The accountability relationship between the CMP and EB continues, although some of the more administrative functions (project registration and issuance) of the EB could evolve towards a role that is more strictly focused on regulatory oversight. The roles of the various actors in the project cycle (EB, DNAs, DOEs, PPs) are not really challenged, and are therefore likely to remain largely similar, even though some adjustments - such as the new role of DNAs in SB development procedures – can be expected. As a CDM+ can be expected to complement or even compete with other mechanisms, which could be non-market mechanisms or market mechanisms such as the JCM that operate outside of the centralized Kyoto structure, rules that provide cohesion in a more fragmented landscape. The CDM’s regulatory framework could possibly evolve as the “Gold Standard” in terms of environmental integrity among other carbon standards, but may also lose relevance if important buyer countries continue to push for other standards to replace the CDM.

The **technical dimensions** that underlie this pathway can only be touched upon here, but include the following aspects:

Further standardization and automatization. The reform processes that have been identified in 5.1.2. (aggregation through PoAs and standardization) can be expected to continue to ease applicability, and therefore allow for scaling up mitigation actions if the political conditions allow for it. Already in 2012, the CDM Policy Dialogue’s final report concluded that “there are no inherent barriers to reforming the CDM to pursue sectoral approaches. Indeed, the combination of standardized baselines and programmatic CDM […] suggests that the apparatus for pursuing such approaches is already operative, if unused. Perhaps the largest barrier faced by such approaches is one of demand,” (p.27). This draws attention to the potential of the CDM beyond LDCs only, even though some elements of the CDM may in the future operate outside of the CDM, as an increasing number of developing countries are establishing carbon pricing schemes for key sectors. Still, it can be expected that countries with lower climate change responsibility and capacity remain eligible for the CDM, and that even some project types in middle income countries could remain eligible. Standardization has focused on these sectors until today, which ensure a continued relevance.

Further important steps towards a reformed CDM+ are potentially **changes to CDM modalities and procedures,** which are currently under discussion.[38] CMP9 has tasked the UNFCCC Secretariat to prepare a technical paper on the following options and their implications (EB membership, DOE liability, PoAs, length of crediting periods, role of DNAs, and simplification of project cycle for certain project categories (UNFCCC 2014). Most of these aspects have been dealt with under the previous sections already (PoAs, simplification, DNAs), although it is worth noting that some proposals, e.g. regarding DOE liability contain innovative proposals such as creating a CER reserve which be fed from a levy on issued CERs and would act as a “self-insurance” against significant deficiencies (UNFCCC 2014).

Taking this concept of a CER reserve one step further than the technical paper does, an additional possible function of such an instrument would be to act as a buffer account for afforestation and reforestation activities (or possibly even a wider use of LULUCF project types). This concept is widely used in voluntary carbon standards, and has therefore emerged as an alternative to the current temporary nature of A/R CERs in the CDM. Temporary CERs are not eligible for the EU ETS, and are generally considered less attractive, which is why the A/R sector has largely been taken up by voluntary standards. Linkages to the emerging REDD+ Framework could be possible as the currently envisioned RBF approach for Reducing Emissions from Deforestation and Degradation (REDD) requires a form of accounting and generation of units (for carbon sequestration or other outputs), although this remains speculative at this stage.

It has been demonstrated above that the CDM, and in fact all carbon market instruments are much more contingent on political decisions that other tradable commodities, as no “natural demand” for emission reduction credit exists. Therefore, the **political dimensions** of a CDM+ are crucial. In a most ambitious development, this would also include **market stabilization measures:** A critical measure for any carbon market mechanism is an increase in global mitigation ambition, which then translates into demand for carbon market units/offsets. However, as the experience with the CDM demonstrates, the price volatility and prolonged price depression is a strong deterrent for investment certainty, and the mobilization of investment into mitigation action. Importantly, while the generation of CERs is highly regulated through the CDM’s regulatory and institutional framework, the market for trading the resulting CERs is almost entirely unregulated – with some exceptions regarding CER import restrictions such as in the EU ETS. This is unlike virtually any other market e.g. for currencies, commodities and other tradeable goods. To some extent this situation is caused by an institutional vacuum on a global level, which results from the short time in which carbon credits have been generated and traded (Dransfeld et al 2014). Possible measures include bilateral stabilization measures, e.g. by CER purchasing programmes through bi- and multilateral actors. However, approaches with potentially higher effectiveness include institutional and regulatory measures. These could take place through linkages with the Green Climate Fund (GCF) – which have already been introduced to the negotiations at COP19, although they were eventually rejected). As the EU seems set to introduce a market stability reserve that responds to demand and supply imbalances, and thus mitigate price volatility at least to some extent, such measures could in theory also be applied to the CDM. The CER reserve option in the technical paper on the reform of the CDM’s modalities and procedures could actually be a first seed that points in this direction. Importantly, however, there is currently neither the mandate nor the capacity to operate such a vehicle in the climate regime.

However, there are examples of publicly operated offset purchasing programs (e.g. the Pacific Carbon Trust in British Columbia, Canada) that provide some tentative early lessons.

The ambition to enhance net mitigation through market mechanisms in the UNFCCC process is evident, although within the CDM, Annex I attempts to introduce net mitigation has been rejected at the last COPs. However, there are already a range of factors such as the principle of conservativeness, ambitious baselines, and shorter crediting periods than technology lifetimes that lead to indirect net mitigation effects. It is important to recognize that the CDM does not have the mandate to lead to net mitigation, therefore, a more transparent approach to account for net mitigation e.g. through ambitious baselines can be expected to become more important in other mechanisms than the CDM. Another way of achieving net mitigation through the CDM is **CER cancellation.** This issue has become increasingly prominent in the ADP negotiations track as a key measure of strengthening pre-2020 mitigation ambition. This highlights the often under-appreciated strength of the CDM that CERs can, but do not have to be used as offset credits. Instead, they could also be used as “receipts” (Raab 2012) for performance-based mitigation instruments such as results-based financing. This would mean that the CDM’s methodological toolkit and governance infrastructure would serve to provide the MRV framework for non-market mitigation instruments. , and there are important linkages with efforts to phase out project types with low SD impacts and very low abatement costs (industrial gases) out of the CDM. Finally, as discussed in chapter 4, discounting approaches could be used to provide incentives to developing countries to gradually transition away from the CDM. More stringent rules on **E- policies** are another approach to limit supply and strengthen the environmental integrity that does not rely on the limiting CER imports. The issue has been discussed for many years, and a robust resolution could eliminate many non-additional projects - and therefore lower CER supply -, that also benefit from domestic non-CDM incentives such as REFITs.

Use of CDM for domestic offsetting in NAI countries. The increasing spread of carbon pricing even to developing countries offers new options for utilizing the CDM. CERs can make more ambitious domestic mitigation action more politically palatable as they provide flexibility for both ETS (China, Korea), and carbon tax systems (Mexico, British Columbia, Alberta). Until today, both in Annex I and non-Annex I countries, domestic politics have led to protectionist decisions that only allow domestically generated offset credits to be used in carbon pricing systems. From the perspective of environmental integrity, relying on the CDM is highly desirable due to the high level of accuracy in CDM methodologies. For developing countries with carbon pricing systems, use of offsetting is likely to focus on CDM project types with high sustainable development benefits and technical barriers that prevent them from being integrated into an ETS (such as transport or small appliances). This raises new challenges as can already be seen in the case of de-registration from the CDM, which is a requirement for eligibility in the CCDM system.

5.3.2. CDM and the New Market Mechanism

Besides the development of a reformed CDM+ as discussed above, the CDM, or certain CDM elements could also be integrated into activities under the NMM. Core differences to CDM activities are the NMM requirement of achieving net emission reductions, as well as different roles for actors, especially host country governments. While the host country government is free to introduce any kind of instrument or measure for reducing GHG emissions on the domestic level, it can also build such measures on CDM activities. As action under the NMM is often referred to as covering activities beyond the project level[39], i.e. comprises a sectoral scope or "broad segment of the economy", we subsequently focus on possible transitions between the current CDM and sectoral mitigation approaches, which may emerge under the NMM. Dransfeld et al. (2014) categorize sectoral approaches into the following three ideal types:

- **Sector-oriented approaches**, which take into account entire (sub)sectors, for instance by developing mandatory SBs or introducing a sectoral crediting mechanism, and approaches still operate on a crediting basis, which may include projects, programmes, and even policies. According to their voluntary nature, these approaches do not necessarily cover all emitters in a country or sector.
- **Sector-wide approaches**, which refer to approaches scaling up mitigation action by covering entire (sub)sectors, e.g. by relying on PoA approaches, and reach complete coverage within the respective subnational, national or regional contexts due to their mandatory character. Likely early examples could include a trading approach that is targeting e.g. emissions-intensive industries.
- **Sector-specific approaches**, which refer to mechanisms designed specifically for (sub)sector or even a single technology with highly idiosyncratic features, e.g. REDD, HFCs, aviation, shipping, and may comprise multiple countries. This approach can imply broader definitions of sectors (energy, forestry), or also narrower subsectors (HFCs as subsector of industrial gases, coal power as subsector of industrial EE). A potentially high degree of net mitigation could be achieved if these mechanisms can be transitioned away from offsetting.

We subsequently discuss how these two tracks for the NMM, a crediting and a trading track, can build on design elements from the CDM in countries that graduate from the full offsetting approach. These options were introduced to the UNFCCC negotiations by the European Union, and as they are envisaged to cover a sectoral scope we refer to them as Sectoral Crediting Mechanism (SCM) and Sectoral Trading Mechanism (STM) (EUC 2013). These approaches are introduced in the following, and anticipate relying on temporary support for host country governments for scaling up domestic mitigation ambition.

Sector oriented and sector wide approaches

A Sectoral Crediting Mechanism (SCM) addresses emission reductions within a sectoral scope and credits those reductions beyond an ambitious target (e.g. below BAU). It can be based on a voluntary or "no-lose" target, but can also feature mandatory targets. In the case emissions are reduced below the target, the difference between the emission level and the target will be credited ex-post. Credits

[39] Although some parties such as China or Saudi Arabia explicitly want the NMM to comprise projects. Also, the EU does not exclude projects from the NMM per se – in its September 2013 submission on the NMM the EU states that "a project specific basis may be used in the NMM but only where it stimulates mitigation across broad segments of the economy. As such, projects would need to be included in a crediting or trading approach that covers a broad segment of the economy as described, with a degree of own contribution, achieving a net decrease and/or avoidance of global greenhouse gas emissions. Further technical consideration on the integration of such a project-specific activity in a crediting or trading scheme for broad segments of the economy is needed" (see EUC 2013).

could be sold on the international carbon market and provide international finance for mitigation. In a situation where domestic and international finance can be blended, the host country could initially contribute to mitigation through domestic measures below the business-as-usual (BAU) scenario but above the non-binding target. This could allow harvesting mitigation actions with the lowest abatement costs, whereas for activities that address reductions beyond the non-binding target international finance should be accessible. However, the incentive for emitters to meet or even over-achieve the non-binding target is clearly weaker than under a trading mechanism with mandatory reduction obligations.

Such a **Sectoral Trading Mechanism (STM)** implies that sanctions would apply to a host country in case of non-compliance with an underlying commitment. In a top-down regulatory situation, an amount of allowances corresponding to the sector's target would be allocated to the country ex-ante, based on agreement on the global UNFCCC level. Given the binding nature of such a mechanism, the government would pass the reduction responsibility on to the emitters in the respective sector, either by setting up an ETS or by imposing mandatory mitigation policies and measures. Any shortfall of allowances would have to be filled by acquiring allowances from abroad; consequently any surplus of allowances could be sold.
We subsequently discuss the implications for CDM projects regarding the establishment of a crediting track with sectoral scope (SCM) or a trading track (STM) under the NMM.

With respect to the **scope of mechanisms**, a wide range of instruments can fall under a SCM, especially those covering small, highly dispersed emissions. To reduce transaction costs easy-to-monitor/calculate emissions are more practical, but at the same time moderate to high abatement potential and moderate to expensive abatement costs ("low and high hanging fruits") are important as well. Typical sectors could be demand side energy efficiency (residential or commercial buildings or manufacturing and production industry) and transport. The CDM has provided an operational approach that even allows small scale activities to be developed as PoAs. Regarding the overall CDM pipeline, the CDM has had relatively limited success in sectors that are appropriate for a SCM. While the CDM can still contribute to a setup of the SCM, the synergies remain relatively constrained and learning from the implementation of mitigation instruments in industrialized countries will play a larger role for SCM set up.

Sectors that qualify for a STM require a sufficient number of emitters / participants, large point sources and not too many small emitters as well as easy-to-monitor/calculate emissions (easy processes). While the nature of sectors varies from country to country, typical candidates are the power sector, heavy industry (such as steel, iron and aluminum), emission intensive industries (cement, pulp and paper production) but also large buildings or air transport. For the CDM this translates mainly to large scale CDM activities in those sectors. It can be expected that STM approaches will most likely be developed in countries that will gradually lose their CDM eligibility as defined e.g. in scenario 2 and 4.

From an **institutional perspective**, **integration or coverage of the respective CDM activities** can either address the CDM activities inside or outside the SCM or STM boundary. For **CDM activities**

that fall within the scope of the SCM or STM**,** the time when emission reductions actually occurred is important. Depending on their age and expected future lifetime the CDM activities inside the SCM/STM scope need to be accounted as part of the baseline scenario. If the baseline scenario for the SCM/STM builds on historic emissions data, and the respective vintages date back to a time when the CDM project was already operational, the CDM related emission reductions need to be accounted for. If the CDM project was not operational during the baseline vintages, and had started issuing credits just recently, then the reductions do not affect the baseline. To achieve a net mitigation benefit, a variety of measures is possible, including discounting, retiring credits, ambitious baselines, or shortened crediting periods. Another option is to buy the remaining credits ex-ante and retire them (accountable as reduction measure under the SCM/STM, and potentially with climate finance support). Measures such as introducing a grace period for CER issuance or a sunset clause for CER owners can be introduced to foster the transition. **CDM activities outside the SCM/STM boundary** will in the first place continued as CDM activities, with potential for the government to gradually expand the SCM towards those activities. Under a STM those remaining CDM activities could also be used for domestic offsetting, which can be open for almost any project type outside the STM sector scope[40], see also section 5.3.1 on CDM+ above.

However, the lack of progress in the UNFCCC negotiations currently prevents compliance-grade pilot action under the NMM. As discussed above, the current market situation and political conditions do not provide sufficient certainty on credit or allowance revenues to raise a lot of appetite for experiments, although there are some initiatives going on within the WB supported Partnership for Market Readiness (PMR). An additional barrier is the lack of awareness and capacity of domestic government agencies, in particular among countries that do not have comprehensive CDM experience. More comprehensive **capacity needs** are occurring for government **institutions**, particularly regarding awareness and engagement with global developments regarding an emerging NMM regime and technical expertise for establishing a SCM or STM (regulators, facility level experts, consultants, market enablers). The establishment of a MRV system and determination of baseline and caps will require technical expertise (though synergies with the CDM´s QA/QC-system are likely), as well as gathering data, , building up or elaborating considerable knowledge on regulating markets for commodities and capital markets and ensuring the proper oversight bodies for tradable commodities and financial products.

Depending on the share of CDM activities in the future SCM/STM sector, various CDM elements can serve as **blueprints**, which broadly supported by parties in the UNFCCC negotiations (UNFCCC 2013a,b). On an institutional level, the DNAs may expand certain responsibilities regarding the SCM/STM introduction. This means that technical know-how that was gained from the CDM can inform future SCM/STM design processes.

For instance, a SCM could be structured as similarly to a PoA that covers significant shares of a sector/the whole sector. In the CDM, PoAs require a higher level of capacity of the CME, but not necessarily the host country government – all the data collection and coordination is done by the

[40] Assuming an STM covers the power sector, then domestic offsetting would certainly not cover emission reduction action within the power sector.

CME, the DNA merely approves contribution of sustainable development to host country without getting involved in data collection or even auditing. In an NMM approach, it is likely that the host country government will need to take responsibility for accounting systems, registries, allocation, issuance, and auditing – all functions that have previously been part of the global CDM project cycle, with regulation on the global level. These responsibilities may devolve only partially, e.g. auditing services could still be provided by globally accredited auditors, or auditors that are nationally accredited according to global standards.

On a **technical level**, CDM experience in baseline **determination and monitoring of emissions** can serve as a basis for the SCM/STM introduction. Data gathered in the existing CDM projects can inform the baseline determination, or the methodological approaches available in the respective CDM methodologies can be adjusted for applicability on a sectoral level. The development of standardized baselines is already a step towards a stronger sectoral orientation (Dransfeld et al 2013).

Activities currently progressing under the **Partnership for Market Readiness** explore the possibilities of introducing sector- or economy-wide market-based mechanisms, which explore crediting opportunities. For instance, Thailand proposed a number of market-based initiatives for PMR support (Thailand Voluntary Emission Reduction (T-VER) program, Thailand Carbon Offsetting Program (T-COP), a Low Carbon City program (LCC) that would also generate credits for the T-VER program as well as an Energy Performance Certificate (EPC) Scheme). In its final proposal, the T-VER and T-COP initiatives were left aside, and Thailand now concentrates on the EPC and LCC. The EPC program targets energy-intensive industrial units and commercial buildings. Here, an MRV system is to be developed and explore possible incentives for voluntary participation in the certificate scheme and potential sources of funding for the scheme and related expenses, and in particular check opportunities to build upon CDM methodologies. This program is to be developed with a view of transitioning to an ETS in the future. (PMR 2014c).These activities illustrate how a more advanced developing country with a significant CDM portfolio can gradually transition to more ambitious domestic mitigation instruments. Such developments provide evidence that a graduation from pure offsetting instruments in advanced Non-Annex I countries is possible, which is an important precondition for the applicability of CER limitation scenarios.
With respect to the **CER eligibility scenarios** developed in this study, introducing sectoral mechanisms that partially cover the CDM scope would make respective CDM activities unavailable for the CDM and thereby reduce CER supply. The scope and design of an SCM would match with CDM activities that fall into the range of scenario 2 “CBDR and respective capacity”, as here host countries can be assumed to being able to engage in limited mitigation actions. The STM on the other hand would rather correspond with the scenario 4 “Climate Change Responsibility”, assuming that here host countries are further developed and more progressive regarding mitigation ambition. Hence, the portfolio under scenarios 2 and 4 would be in danger of partially falling out of the CDM´s eligibility.

Sector-specific approaches

For **specific sectors** or even individual **technologies,** tailor-made mitigation measures need to be found, which can have specific repercussions on the CDM portfolio. This applies primarily to sectors or technologies with highly idiosyncratic characteristics, and would be implemented in multiple countries. One example is the emerging REDD+ framework, or possibly also industrial gases, and international transport. REDD+ has already moved towards practical implementation in voluntary carbon markets, but has been essentially blocked in the UNFCCC arena due to controversies on reference levels, safeguards, MRV, and financing. In 2013, COP19 decisions saw REDD+ in the UNFCCC arena currently drifting away from a market-based approach towards a results-based finance mechanism (RBF, see 5.3.3 below). Methodological linkages with the CDM may potentially include A/R SBs, and also a broader set of project types provided a solution for the permanence problem can be found.

The destruction of industrial gases is a particular interesting example, due to the political momentum for mitigating climate impacts of HFCs within US-China relations, but also the EU and G20. Although the CDM has been intensely criticized for the dominance of HFC-CERs in the initial years, it is clear that the market-based design of the CDM has played a decisive role in identifying the climate impacts of HFCs. The current political momentum is now pointing towards an exclusion of HFCs from the carbon market, which raises the question how alternative mechanisms can be designed. One strand of discussion is to transition HFCs entirely into the Montreal Protocol regime, although there is some resistance by developing countries. Even if HFCs would remain within the UNFCCC, they could be taken out of the CDM, and the CDM's methodological and regulatory foundations could still provide direct building blocks for a new sector-specific mechanism for HFC destruction.. For instance, creating a dedicated RBF mechanism for HFCs could achieve a significant net mitigation impact, which could be based to varying degrees directly on CDM methodologies and the project cycle for MRV. The simplest structure for such a mechanism could be to create a specific cancellation account in the CDM registry, and establish a funding window either within the GCF or in a dedicated platform. This would allow relying on the fully operational CDM framework, while transitioning an entire subsector away from offsets to net mitigation, in line with scenario 3, as well as ADP discussion regarding CER cancellation. As the modelling results for scenario 3 show, even the phase-out of relatively few project types already has significant effect on CER supply (see section 3.3.4). If financial or political constraints prevent the establishment of such a RBF mechanism that directly builds on the CDM, a more complex approach that would rely on a stronger institutional linkage between the ozone and the climate regime could e.g. transition the RBF dimension to the Montreal Protocol Fund, while the MRV responsibility could remain under the UNFCCC.

In aviation and shipping market-based mechanisms are being discussed and designed under ICAO/IMO. Regarding aviation, a market-based mechanism that strongly relies on offset credits, possibly from the CDM, seems to be the area of convergence, although no significant developments in this regard can be expected before the next ICAO assembly in 2016.

With respect to the **CER eligibility scenarios of this study**, introducing a specific sectoral approach that targets HFC emissions would result in a certain range of the respective CDM activities not being available anymore for the CDM and with this for interested buyers (in this case HFC projects). The scope and design of such a HFC mechanism would solely cover HFC projects, which probably can be identified in the scenarios 2 and 4. Although HFC credits are treated special (e.g. not eligible for compliance within the EU), the portfolio of HFC certificates under scenarios 2 and 4 would be in danger of partially falling out of the CDM´s eligibility.

5.3.3. Synergies between carbon markets and climate finance

In the subsequent section linkages between carbon market and climate finance instruments are elaborated. Hereby we focus on results-based finance (RBF) and NAMA crediting.

Results-based finance

RBF is an approach that has been gaining increasing attention in the environmental and energy space following its application in the health care/pharmaceuticals sector. For example, a recent high level study group found that RBF could play an important role in promoting investment in methane projects around the world (World Bank 2013). However, beyond some pioneering initiatives including Energy+, the Energising Development (EnDev) Programme, and Ci-DEV, practical experience to date with using RBF schemes for climate change mitigation and energy access is relatively limited. One interesting example for a de-facto RBF scheme is the GETFIT programme in Uganda (see Textbox 1).

Textbox 1: Uganda Feed In Tariff Program (GET FIT)

The GET FIT programme introduced above is currently beginning to be piloted in Uganda, financed by the German Kreditanstalt für Wiederaufbau (KfW) and the British Department of Energy and Climate Change (DECC). Barriers to be overcome are the low pre-existing FIT level in Uganda, a liquidity crisis at the state electricity utility that led to electricity providers requiring off-taker guarantees, and generally expensive debt finance. GET FIT targets small scale renewable electricity generation from hydro, biomass, and bagasse and is expected to leverage 300 million € which enable to add roughly 125 MW of renewable generation to the nation's grid within the next 3 – 5 years. GET FIT pays 1-2 USDct/kWh for hydro between 1-20MW, biomass, bagasse for 20 years, organizes MIGA guarantees and provides a Deutsche Bank-led debt facility. 50% of the net present value of the FIT subsidy will be paid up-front, the rest in subsequent instalments every five years (KfW 2012). The blend of output-based payments with grant components is an excellent example for how a pilot FIT activity can be financially structured in low-income countries.

Importantly, the CDM relies strongly on a results-based approach, even though this feature is only beginning to be highlighted more strongly in, first initiatives such as the World Bank's Carbon Initiative for Development (Ci-Dev). It aims to couple the CDM with RBF, so-called "CDM RBF", by purchasing CERs at a price that is high enough to encourage private sector investment in energy access projects and subsequently retiring the a large share of the resulting CERs (see Textbox 2). In the future, using CERs in a RBF-like fashion through reverse auctioning has also been envisioned by the Private Sector Facility of the Green Climate Fund, although this vehicle is not operational yet.

Textbox 2: The World Bank's Carbon Initiative for Development (Ci-Dev)

The World Bank's Carbon Initiative for Development (Ci-Dev) was launched with the objective to support household energy projects with social and environmental benefits and to make the CDM more accessible to the poor than has been the case in the past. Ci-Dev supports low-carbon investments in least developed countries, using payments-for-performance linked to the reduction of carbon emissions. It is currently in the process of developing a pipeline of projects that improve and increase access to energy, making it possible for low-income countries to make use of clean and efficient technologies. Projects could include rural electrification, water filtration (which will save on electricity because households do not have to boil water for nutrition purposes), and cleaner and more efficient stoves, including biogas stoves, which can save households money, improve indoor air quality and free-up time for women and children traditionally tasked with collecting firewood. As with the World Bank's other carbon funds, Ci-Dev uses RBF by building on the CDM infrastructure. RBF is an efficient way to use public money, one that is strongly supported by the Initiative's donor governments, which include the Swedish Energy Agency, the Swiss Cent Foundation, the UK Department for International Development and the UK Department of Energy and Climate Change. Ci-Dev's work is in line with the general focus of the World Bank Group on clean and sustainable sources of energy. See also: www.ci-dev.org.

For the charm of CDM RBF is that it offers tested approaches for calculating emission reductions, and make use of the possibility to not use CERs as offsets, but simply as receipts for performance. In times of low to zero demand for credits the threat of losing the achievements built with the CDM is real[41]. RBF can be a viable option in particular for supporting certain CDM activities which are in line with the political objectives of the UNFCCC. This means that targeted approaches can support activities with high-sustainable development impacts in lower-income countries. However, as the HFC-example in the previous section demonstrates, CDM RBF can also be applied to industrial process in advanced developing countries. It can therefore, depending on the design and the respective technology be applied to a broad range of contexts, and is therefore an important instrument in the gradual transition away from the CDM for countries and project types that may become ineligible for the offset-based CDM in the future. More important than keeping the CDM however, is the idea that RBF is a concept that essentially retires CERs, and thus effectively can pilot a transition of the CDM from an offset to a performance-based payments scheme (which could potentially be integrated under the NMM as described in 5.3.2 above).

With respect to the **scenarios for CER eligibility** designed in the earlier work packages of this study, RBF could be an attractive option for gaining momentum of scenario 1 "LDCs only". Ci-Dev for instance focusses only on LDC´s. However, once other RBF schemes arise they might as well focus on other specific scopes, and for instance reward highly sustainable projects under Scenario 3 "Sustainable Development and Environmental Integrity".

NAMA crediting

A final aspect of possible transitions away from the CDM is to providing financial incentives for NAMAs in the form of carbon credits. This concept has been proposed early on (Republic of South

[41] see for instance interview with Axel Michaelowa in JIQ 2014.

Korea 2008) but until today, only unilateral and supported NAMAs have been recognized by the UNFCCC. As discussed above, an important factor that has prevented the concept of NAMA crediting to gain further traction, is the uncertainty around methodological issues. Nevertheless, recent developments under the PMR indicate that countries are interested in exploring policy crediting options.[42] A "credited NAMA" mechanism in this context could be envisaged under which supported NAMAs could choose to seek co-financing for certain elements via the generation and sale of emission credits for emission reductions achieved (Okubo et al. 2011). A more immediate version of credited NAMAs could also refer to a “framework approach” in which a CDM PoA is blended with additional upfront finance and other forms of technical support, e.g. with regard to setting technical appliance standards.

An additional source of finance could be provided by the private sector, as is often highlighted by Annex-I countries. Experience on how to leverage private sector finance for NAMA implementation is insufficient to date, and a lot more foundational work needs to be done (Michaelowa 2012). The most promising avenues seem to be RBF approaches (as discussed above), but further varieties with upfront finance components are conceptually possible.

Given their still widely open scope, NAMAs have so far drawn heavily on building blocks from established mechanisms in order to design actions that credibly cause measurable, reportable and verifiable emissions reductions. NAMAs have drawn on approved CDM methodologies for baseline and emission reductions estimates as well as MRV design. Given the currently low CER prices, it may also become attractive to transform existing CDM or PoA activities into a supported NAMA based on RBF as described above. Technology goals or standards are another element of the discussion on a sectoral CDM that has been applied in NAMAs. For instance, technology-based sectoral NAMAs for energy-intensive sectors such as cement, iron and steel could be based on technology choices which would allow for simple MRV systems.

Although some sectors with strong NAMA uptake have also been strong CDM sectors (e.g. power, waste), some CDM sectors with very little uptake have also seen NAMA development (e.g. transport) (URC 2014). Strong linkages between conceptual elements of existing mechanisms can be utilized. For instance, CDM baselines can be established based on the CDM, e.g. for accounting of emission reductions through renewable energy feed-in tariffs (Michaelowa and Hoch 2013, see also GET FIT Uganda example in RBF section above). As a side effect of slow NMM negotiation and CDM evolution towards results-based financing approaches, the concept of NAMA crediting may eventually become more popular again. For some European delegations, NAMA crediting seems to be not perceived as such the taboo issue it used to be even a year ago.

Introducing credited NAMA schemes would impact the national CDM portfolio on similar lines as the introduction of a SCM (see discussion in 5.3.2 above). Depending on the scope of the NAMA crediting component, CDM activities would either be within or outside the NAMA. For CDM activities inside the credited NAMA scope, ideally the CDM activities would constitute the backbone of the NAMA crediting, e.g. in form of a PoA. However, it could also be the case that the host country would put forward rules that require transformation of CDM activities into domestic crediting measures,

[42] For instance Colombia that is assessing the potential of NAMA crediting (PMR 2014b).

meaning that in that case the activities would fall out of the CDM eligibility. For a more detailed discussion please refer to the section on SCM in 5.3.2 above.

Concerning the **CER eligibility scenarios of this study**, introducing NAMA crediting could result in a certain range of the covered CDM activities not being available anymore for the CDM and with this for interested buyers. The scope and design of credited NAMAs would most probably match with CDM activities that fall into the range of scenario 2 “CBDR and respective capacity”, as here host countries are assumed to be capable of limited mitigation ambition; potentially also scenario 4 “Climate Change Responsibility” could suit, assuming that more progressive host countries such as Korea would also be interested in NAMA crediting. Hence, the CDM portfolio under scenarios 2 and 4 could be affected, i.e. partially become ineligible for the CDM.

6. Conclusions

The CDM has mobilized a huge pipeline of mitigation activities in host countries with no formal obligation to reduce GHG emissions. The mechanism has continued to evolve in response to criticisms but it continues to suffer from policy uncertainty regarding the future architecture of the climate regime, and most importantly, from a lack of demand due to lack of mitigation ambition which is worlds away from the level of mitigation ambition which latest IPCC reports urgently advises to reach. In part, there is a huge uncertainty how the previous cleavage between Annex I and non-Annex I can be bridged. The climate regime is moving towards a hybrid and fragmented governance architecture, in which countries with different responsibilities and capacities will be expected to engage in a broader spectrum of “contributions” than in the Kyoto Protocol. One consequence of these emerging arrangements is that some developing countries are likely to graduate from the CDM’s pure offsetting approach and adopt more ambitious domestic mitigation instruments. In addition, certain project types and technologies may be phased out from the CDM, and transitioned to other policy instruments. In order to contribute to steering these developments towards a high level of environmental integrity and ambition, ETS systems can set appropriate incentives by restricting CER imports from some regions and project types, while allowing others.

This study has provided a robust methodological foundation for designing such incentive structures, both for weighing further limitations of CDM eligibility and further evolution of the CDM itself. The identified indicators and scenarios allow for a robust definition of analytical options on which to base CDM eligibility, and shed light on key reform processes and transformations of the CDM. First, we have defined a set of indicators, which allowed us to structure relevant data in four categories, related to development, responsibilities for climate change, and contribution to global mitigation efforts by countries, as well as the relevant project type and technology related criteria. While these indicator categories have proven to allow for a comprehensive assessment of CDM eligibility related issues, the contribution of a country to global mitigation efforts has been extremely difficult to operationalize. Although data on the CDM is available and transparent, virtually all other climate policy and finance instruments offer only extremely patchy data, in part because most countries are just beginning to formulate mitigation policies and relevant instruments are not well-tested and researched yet.

Based on these criteria, we have defined four scenarios:

- Scenario 1: “LDCs only”, which is strongly based on the current EU ETS policy
- Scenario 2: “Common but differentiated responsibility and respective capacity”, based on CBDRRC criteria
- Scenario 3: ”Sustainable Development and Environmental Integrity”, which consider SD benefits, as well as conservativeness of baselines and abatement costs of the most widely used CDM project types
- Scenario 4: “Climate Change Responsibility”, which considers country emissions profiles

For these scenarios, we have developed a model that allows to quantitatively calculate the expected CER supply from each CDM project for each year until 2030. This model takes into account the current project status, the project type as well as historical failures and issuance successes, considers complex policy dynamics such as the emergence of the Chinese CCER scheme, as well as different CER price levels ranging from EUR 0.15-15. Both CDM activities in the current pipeline and supply from future projects have been considered. The results offer key insights into the effectives of price ranges, e.g. that a shift up to EUR 1.00 can trigger high volumes of CERs to be issued, although after a price level of EUR 5.00, the CER supply will increase only marginally. The expected issuance 2014-2030 is expected to peak over the years 2015-2017. In Scenario 1, the amount of CERs to expected will not be more than 30-60 million CERs and 30-80 million CERs in 2014-2020, and 2021-2030 respectively. In other scenarios, the amounts will be reduced by about -80% (Scenarios 2+4) and about -50% (Scenario 3). Regarding geographical distribution, in Scenarios 2+4 India will become the dominant host country. Only in Scenario 4, South Korea can represent a serious runner-up with about 20% market share. Whenever China remains eligible, it keeps on playing the dominant role (more than 60% market share in Scenario 3) despite the exclusion of HFC and N_2O adipic acid as well as large-scale projects. Renewables and methane projects will be the predominant technology in LDCs (Scenario 1). Methane projects can also be considered as over proportionally important in Scenario 3.

These quantitative assessments are put in perspectives by assessing alternative approaches to limiting CER supply. Discounting of CERs can be designed according to various approaches. The most objective one, which also would give a good incentive to take up national mitigation commitments, has been found to be an application of a responsibility and capacity index for host countries and reduce supply by about 150 million CERs if started at the world average of the index. If it starts at 50% of the world average, about 2 billion CERs would be reduced. A pure per capita emissions based discounting starting at the world average would yield a supply reduction very close to the latter, as would an approach that bluntly differentiates according to country groups or a project size-specific differentiation. Discounting according to sustainable development benefits would yield a supply reduction of about 1.4 billion CERs.

The elaboration of transformation options for the CDM has drawn attention to the significant CDM reform efforts that have already translated into implementation most notably for PoAs and standardized baselines. As many authors have demonstrated before, these methodological tools represent key bridges to future mechanisms – both an improved CDM+, with continued relevance for certain regions and project types, but also new areas of application such as domestic offsetting in developing country carbon pricing systems, including ETS and carbon taxes. An important achievement of the CDM is to have come up with a robust methodological framework for measuring emission reductions and converting them into units that can either be traded and be used as offsets, or used to measure the performance of non-market climate finance instruments such as RBF schemes. The example of HFCs, which could potentially be also extended to other sectors such as methane avoidance, shows that the true potential of the CDM extends far beyond providing flexibility by generating offset credit - by providing a robust framework for net mitigation approaches. The study offers some first indications of targeted CDM reform such as standardization and linkages with climate finance instruments can be designed in harmony with approaches to limit CDM eligibility.

In sum, this study shows that options exist to set strong incentives that strengthen the positive developments in the CDM, and to further align the mechanism with the political objectives of the UNFCCC process. Such measures could contribute to unlocking the CDM's full potential, through smart eligibility restrictions, adjusted uses of the CDM through innovative uses of offset credits, as well as through new applications of its methodological toolkit. The political feasibility of implementing such eligibility restrictions needs to be seen in the context of the political developments in the

UNFCCC process, and are therefore related to and contingent on CDM-external issues such as the level of ambition on mitigation (both by Annex I, and other non-Annex I countries) and finance. Furthermore, important domestic developments such as the rise of ETS in developing countries, facilitated by the view that climate action can be economically beneficial and/or increasing societal well-being, contribute to the acceptance of such initiatives. A more proactive use of such limitation and reform options, however, can clearly contribute to closing the ambition gap both in the global climate change regime, both before and after 2020.

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Annexes

Annex 1: Country eligibility in scenarios 1, 2, and 4

Scenario 1 (31/110)	Scenario 2 (67/110)	Scenario 4 (53/110)
Angola	Angola	Albania
Bangladesh	Bangladesh	Armenia
Burkina Faso	Belize	Azerbaijan
Burundi	Bhutan	Bahamas
Buthan	Bolivia	Bangladesh
Cambodia	Burkina Faso	Bhutan
Chad	Burundi	Burkina Faso
Congo DR	Cambodia	Burundi
Ethiopia	Cameroon	Cape Verde
Gambia	Cape Verde	Colombia
Haiti	Chad	Costa Rica
Lao PDR	Congo DR	Côte d'Ivoire
Lesotho	Côte d'Ivoire	Cuba
Liberia	Egypt	Ethiopia
Madagascar	El Salvador	Fiji
Malawi	Ethiopia	Gabon
Mali	Fiji	Gambia
Mozambique	Gambia	Georgia
Myanmar	Ghana	Guyana
Nepal	Guatemala	Haiti
Niger	Guyana	India
Papua New Guinea	Haiti	Iraq
Rwanda	Honduras	Jamaica
Senegal	India	Jordan
Sierra Leone	Indonesia	Kenya
Sudan	Iraq	Kyrgyzstan
Tanzania	Jordan	Lesotho
Togo	Kenya	Macedonia
Uganda	Kyrgyzstan	Malawi
Yemen	Lao PDR	Mali
Zambia	Lesotho	Mauritius
	Liberia	Moldova
	Madagascar	Montenegro
	Malawi	Morocco
	Mali	Myanmar
	Moldova	Nepal

Scenario 1 (31/110)	Scenario 2 (67/110)	Scenario 4 (53/110)
	Mongolia	Niger
	Morocco	Nigeria
	Mozambique	North Korea
	Myanmar	Pakistan
	Namibia	Philippines
	Nepal	Rwanda
	Nicaragua	Senegal
	Niger	Sierra Leone
	Nigeria	South Korea
	Pakistan	Sri Lanka
	Papua New Guinea	Sudan
	Paraguay	Swaziland
	Philippines	Syria
	Rwanda	Tajikistan
	Senegal	Uganda
	Sierra Leone	Vanuatu
	Sudan	Yemen
	Swaziland	
	Syria	
	Tajikistan	
	Tanzania	
	Thailand	
	Togo	
	Turkmenistan	
	Uganda	
	Uzbekistan	
	Vanuatu	
	Vietnam	
	Yemen	
	Zambia	
	Zimbabwe	

Annex 2: Comparison of country eligibility across scenarios 1, 2, and 4

Host CDM country/region	Scenario 1	Scenario 2	Scenario 4
Latin America			
Argentina			
Bahamas			X
Belize		X	
Bolivia		X	
Brazil			
Chile			
Colombia			X
Costa Rica			X
Cuba			X
Dominican Republic			
Ecuador			
El Salvador		X	
Guatemala		X	
Guyana		X	X
Haiti	X	X	X
Honduras		X	
Jamaica			X
Mexico			
Nicaragua		X	
Panama			
Paraguay		X	
Peru			
Trinidad and Tobago			
Uruguay			
Asia & Pacific			
Bangladesh	X	X	X
Bhutan	X	X	X
Cambodia	X	X	
China			
Fiji		X	X
India		X	X
Indonesia		X	
Lao PDR	X	X	
Malaysia			
Mongolia		X	
Myanmar	X	X	X
Nepal	X	X	X

Host CDM country/region	Scenario 1	Scenario 2	Scenario 4
North Korea			X
Pakistan		X	X
Papua New Guinea	X	X	
Philippines		X	X
Singapore			
South Korea			X
Sri Lanka			X
Thailand		X	
Vanuatu		X	X
Vietnam		X	
Europe & Central Asia			
Albania			X
Armenia			X
Azerbaijan			X
Bosnia and Herzegovina			
Cyprus			
Georgia			X
Kyrgyzstan		X	X
Macedonia			X
Malta			
Moldova		X	X
Montenegro			X
Serbia			
Tajikistan		X	X
Turkmenistan		X	
Uzbekistan		X	
Africa			
Algeria			
Angola	X	X	
Burkina Faso	X	X	X
Burundi	X	X	X
Cameroon		X	
Cape Verde		X	X
Chad	X	X	
Congo DR	X	X	
Côte d'Ivoire		X	X
Egypt		X	
Equatorial Guinea			
Ethiopia	X	X	X
Gabon			X

Host CDM country/region	Scenario 1	Scenario 2	Scenario 4
Gambia	X	X	X
Ghana		X	
Kenya		X	X
Lesotho	X	X	X
Liberia	X	X	
Libya			
Madagascar	X	X	
Malawi	X	X	X
Mali	X	X	X
Mauritius			X
Morocco		X	X
Mozambique	X	X	
Namibia		X	
Niger	X	X	X
Nigeria		X	X
Rwanda	X	X	X
Senegal	X	X	X
Sierra Leone	X	X	X
South Africa			
Sudan	X	X	X
Swaziland		X	X
Tanzania	X	X	
Togo	X	X	
Tunisia			
Uganda	X	X	X
Zambia	X	X	
Zimbabwe		X	
Middle East			
Iran			
Iraq		X	X
Israel			
Jordan		X	X
Kuwait			
Lebanon			
Oman			
Qatar			
Saudi Arabia			
Syria		X	X
United Arab Emirates			
Yemen	X	X	X

Annex 3: Costs of CDM projects

Project types	Key figures		Investment costs		CDM transaction costs															
			Technical abatement		CDM upfront costs									CDM ongoing costs					CDM renewal costs	
	Average annual emission reductions (ktCO2e/ year)	Median of crediting period years (years)	Abatement costs (EUR/tCO2e)		PDD elaboration (kEUR)		Validation internal costs (kEUR)		Validation DOE services (kEUR)		Registration UNFCCC fee (kEUR)	Installation monitoring system (kEUR)		Monitoring internal costs (kEUR)		Verification DOE services (kEUR)		Issuance UNFCCC fee (kEUR)	Total fixed renewal costs (kEUR)	
			low	high	low	high	low	high	low	high		low	high	low	high	low	high		low	high
Afforestation		30	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00	costs have been specifically calculated for each project (see cdm.unfccc.int)	0.00	11.00	3.00	10.00	15.00	25.00	costs have been specifically calculated for each project (see cdm.unfccc.int)	20.00	65.00
Agriculture		7	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Biogas		7	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Biomass energy	79	10	0.00	3.90	10.00	50.00	10.00	61.00	25.00	40.00		0.00	15.00	5.00	10.00	15.00	29.00		20.00	65.00
Cement		10	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
CO2 usage		10	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Coal bed/mine methane	510	7	0.50	2.00	10.00	50.00	10.00	61.00	35.00	70.00		0.00	15.00	5.00	10.00	20.00	30.00		20.00	65.00
Energy distribution		10	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
EE households	26	10	0.00	3.90	6.00	50.00	10.00	61.00	25.00	40.00		0.00	15.00	3.00	10.00	15.00	30.00		20.00	65.00
EE industry		10	0.00	7.58	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
EE own generation	197	10	0.00	5.30	6.00	15.00	8.00	16.00	25.00	35.00		0.00	7.00	3.00	10.00	15.00	27.00		20.00	65.00
EE service		10	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
EE supply side		10	3.79	10.12	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Fossil fuel switch	491	10	0.00	6.46	6.00	15.00	8.00	16.00	30.00	35.00		0.00	3.50	3.00	10.00	20.00	25.00		20.00	65.00
Fugitive		10	0.00	1.47	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Geothermal		7	0.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
HFCs		7	0.20	0.40	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Hydro large-scale	208	7	0.00	3.90	6.00	15.00	8.00	16.00	25.00	30.00		0.00	3.50	3.00	10.00	15.00	15.00		20.00	65.00
Hydro small-scale	29	7	0.00	7.00	6.00	15.00	8.00	16.00	20.00	29.00		0.00	3.50	3.00	10.00	15.00	23.00		20.00	65.00
Landfill gas	160	7	0.00	3.90	10.00	50.00	10.00	61.00	25.00	35.00		0.00	15.00	5.00	10.00	20.00	28.00		20.00	65.00
Methane avoidance	58	10	0.00	3.90	10.00	50.00	10.00	61.00	25.00	35.00		0.00	15.00	5.00	10.00	15.00	29.00		20.00	65.00
Mixed renewables		7	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
N2O nitric acid	289	7	0.50	0.75	10.00	50.00	10.00	61.00	35.00	35.00		10.00	15.00	5.00	18.00	25.00	25.00		20.00	65.00
N2O adipic acid	7'284	7	0.30	0.60	10.00	50.00	10.00	61.00	35.00	35.00		10.00	15.00	5.00	18.00	25.00	25.00		20.00	65.00
PFCs and SF6		10	1.00	3.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Reforestation		20	2.00	5.00	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Solar	30	7	7.80	31.13	6.00	15.00	8.00	16.00	20.00	27.00		0.00	7.00	3.00	10.00	10.00	21.00		20.00	65.00
Tidal		9	7.58	7.58	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Transport		10	7.58	7.58	6.00	32.50	9.00	38.50	25.00	35.00		0.00	11.00	3.00	10.00	15.00	25.00		20.00	65.00
Wind large-scale	120	7	0.00	15.00	6.00	15.00	8.00	16.00	25.00	30.00		0.00	3.50	3.00	10.00	15.00	22.00		20.00	65.00
Wind small-scale	15	10	0.00	10.00	6.00	15.00	8.00	16.00	25.00	28.00		0.00	3.50	3.00	10.00	15.00	21.00		20.00	65.00

Source: Warnecke, Klein, Perroy & Tippmann (2013), enhanced by own calculations and assumption considering received raw data from Shishlov (2014) and expert input by Michaelowa

Note: When no data was available for a specific project type, the median of all project types with available data has been assumed as default value.

Annex 4: Correspondence of project status between this study and UNEP Risø pipeline

Report status of initiated projects	Pipeline status of initiated projects
Non-relevant	Validation negative Validation terminated Rejected Withdrawn Replaced At Validation Replaced Validation Negative Replaced Validation Terminated
Pre-validation	At Validation
Pre-registration	Reg. request Request review
Post-registration w/o issuance	Registered (but no issuance yet)
Post-registration w/ issuance	Registered (at least one issuance so far)

Annex 5: Non-issuing registered projects in China

To find out why a number of projects in the pipeline which have already completed the whole registration process successfully have not yet issued any CERs, the owners of a sample of 66 such CDM projects in China were interview by phone. The results are more qualitative than quantitative in nature, yet most answers were indicative of a general trend regarding a given project type. The findings have been compiled into the following table:

Project type (sample size)	Minimum required CER price (EUR)	Other findings
Hydro (17)	0.5 – 0.8	- most project owners reluctant to disclose reasons for non-issuance or minimum required CER price
Wind (16)	(a) 0.5 – 1 (b) > 10.5	- most projects in eligible regions would prefer to delist and enter Chinese carbon markets instead - some projects fear political risk if issuance of CERs happens at a price below CCER floor price (~ EUR 10.50)
Landfill gas (7)	0.4 – 1	- most projects in eligible regions would prefer to delist and enter the Chinese carbon markets instead
EE own generation (6)	0.5 – 0.6	
Biomass (5)	0.5 – 1	At least one project would change to CCER if possible
Coal bed/mine methane (4)	0.5 – 1	
EE supply (3)	0.5	Projects would rather issue CCERs
Fossil fuel switch (3)	?	Various reasons for non-issuance, reluctance to commit to price expectations in interviews
Solar (3)	1	one PO has been unable to sell CERs from a similar project at all, therefore no further issuance
Methane avoidance (2)	?	

Annex 6: PoAs with more than one CPA

ID	Title	Host country	Coordinating Entity	Status	PoA-Type	Method ology	PoA lifetime start	2012 ktCO2	2020 ktCO2	Number of CPAs
PoA0002	Methane capture and combustion from Animal Waste Management System (AWMS) of the 3S Program farms of the Sadia Institute	Brazil	Sadia	Registered	Methane avoidance	AMS-III.D.	29-Okt-09	2,365.116	10,616.011	1050
PoA0059	Sichuan Rural Poor-Household Biogas Development Programme	China	Chengdu Oasis Science and Technology Co.	Registered	Methane avoidance	AMS-III.R.+AMS-I.C.	10-Dez-10	1.000	7,226.530	73
PoA0012	CFL lighting scheme – “Bachat Lamp Yojana”	India	Bureau of Energy Efficiency	Registered	EE households	AMS-II.J.	30-Mai-10	1,946.370	17,490.580	50
PoA0184	PoA for the Reduction of emission from non-renewable fuel from cooking at household level	Madagascar	Green Development AS	Registered	EE households	AMS-I.E.	01-Okt-12	0.000	18,527.981	41
PoA0013	Promotion of Biomass Based Heat Generation Systems in India	India	Thermax Sustainable Energy Solutions	Registered	Biomass energy	AMS-I.C.	01-Dez-10	147.544	4,717.560	32
PoA0004	CUIDEMOS Mexico (Campana De Uso Intelegente De Energia Mexico) – Smart Use of Energy Mexico	Mexico	Cool nrg Carbon Investments	Registered	EE households	AMS-II.C.	01-Jun-09	74.872	6,070.750	25
PoA0001	Installation of Solar Home Systems in Bangladesh	Bangladesh	Infrastructure Development Company Limited	Registered	Solar	AMS-I.A.	22-Jun-07	12.142	4,149.184	13
PoA0055	Than Thien Small Hydropower Programme of Activities Managed by INTRACO	Vietnam	Investment and Trade Consultancy Company (INTRACO)	Registered	Hydro	AMS-I.D.	01-Jul-12	1.693	1,304.750	13
PoA0170	Green Power for South Africa	South Africa	The Standard Bank of South Africa	Registered	Hybrid renewables	ACM2	18-Nov-11	0.000	12,333.620	11
PoA0005	Uganda Municipal Waste Compost Programme	Uganda	National Environmental Management Authority (NEMA)	Registered	Landfill gas	AMS-III.F.	12-Apr-10	136.847	837.010	9
PoA0031	Efficient Lighting Initiative of Bangladesh (ELIB)	Bangladesh	Infrastructure Development Company	Registered	EE households	AMS-II.J.	02-Feb-10	43.338	1,243.480	9
PoA0008	Solar Water Heater Programme in Tunisia	Tunisia	Agence Nationale pour la Maîtrise de l'Energie (ANME)	Registered	Solar	AMS-I.C.	23-Jan-07	15.719	417.630	8
PoA0071	First Solar PoA in India by SENES Consultants	India	SENES Consultants	Registered	Solar	AMS-I.D.	04-Feb-11	16.000	1,044.277	8
PoA0045	SASSA Low Pressure Solar Water Heater Programme	South Africa	Solar Academy of Sub Saharan Africa	Registered	Solar	AMS-I.C.	29-Jan-11	166.262	3,258.350	7
PoA0124	National Solar Power Development Programme, India	India	Emergent Ventures	Registered	Solar	AMS-I.D.	21-Okt-10	3.113	440.282	7
PoA0053	The programme to promote efficient lightings in local areas	South Korea	KEMCO	Registered	EE service	AMS-II.C.	27-Okt-09	0.028	6.370	6
PoA0064	Malaysia Biogas Projects	Malaysia	GenPower Carbon Solutions	Registered	Methane avoidance	AMS-III.H.	23-Nov-11	75.968	2,532.330	6
PoA0063	Improved Cooking Stoves for Nigeria Programme of Activities	Nigeria	Developmental Association for Renewable Energies	Registered	EE households	AMS-II.G.	29-Mrz-11	11.181	990.740	5
PoA0130	Sustainable Small Hydropower Programme of Activities (PoA) in Viet Nam	Vietnam	Vietnam PoA JSC	Registered	Hydro	ACM2	23-Dez-09	0.000	567.274	5
PoA0384	Standard Bank Low Pressure Solar water heater Programme for South Africa	South Africa	Standard Bank	Registered	Solar	AMS-I.C.	01-Apr-11	200.000	2,012.640	5
PoA0007	Masca Small Hydro Programme	Honduras	Hidromasca	Registered	Hydro	AMS-I.D.	01-Sep-11	5.845	283.201	4
PoA0018	SGCC In-advance Distribution Transformer Replacement CDM Programme	China	State Grid Corporation of China	Registered	Energy distribution	AMS-II.A.	01-Jan-11	62.699	993.980	4

ID	Title	Host country	Coordinating Entity	Status	PoA-Type	Method ology	PoA lifetime start	2012 ktCO2	2020 ktCO2	Number of CPAs
PoA0029	Punjab State Electricity Board: High Voltage Distribution System for Agricultural Consumers in the Rural Areas of the Punjab	India	Punjab State Electricity Board (PSEB)	Registered	Energy distribution	AMS-II.A.	25-Okt-07	1.413	1,245.990	4
PoA0185	Improved Cooking Stoves Programme of Activities in Africa	Kenya	Envirofit International	Registered	EE households	AMS-II.G.	13-Dez-11	0.565	1,428.140	4
PoA0243	Enlightened Solar PoA	Israel	Tricorona Carbon Assessment Management	Registered	Solar	AMS-I.D.	01-Okt-12	0.000	341.403	4
PoA0016	Egypt Vehicle Scrapping and Recycling Program	Egypt	Ministry of Finance	Registered	Transport	AMS-III.C.	11-Mai-11	0.030	212.460	3
PoA0159	CDM Africa Wind and Solar Programme of Activities for South Africa	South Africa	CDM Africa Wind/ Solar	Registered	Hybrid renewables	ACM2	26-Okt-11	0.000	5,078.870	3
PoA0186	African Improved Cooking Stoves Programme of Activities	Ghana	Envirofit International	Registered	EE households	AMS-II.G.	13-Dez-11	0.645	1,064.739	3
PoA0211	Côte d'Ivoire and Cameroon Efficient Cookstoves Program	Côte d'Ivoire	Envirofit International	Registered	EE households	AMS-II.G.	03-Dez-11	0.000	818.002	3
PoA0256	South Africa Renewable Energy Programme (SA-REP)	South Africa	Standard Bank	Registered	Hybrid renewables	AMS-I.D.	27-Feb-12	0.000	448.133	3
PoA0308	Fuel Efficient Stoves in Zambia	Zambia	3 Rocks Ltd.	Registered	EE households	AMS-II.G.	22-Dez-10	0.000	908.981	3
PoA0028	Methane recovery and combustion with renewable energy generation from anaerobic animal manure management systems under Land Bank of the Philippines Carbon Finance Support Facility	Philippines	Land Bank of the Philippines (LBP)	Registered	Methane avoidance	AMS-III.D.	01-Jun-12	40.370	707.343	2
PoA0050	AWMS Composting Project	Brazil	AMBIO	Registered	Methane avoidance	AMS-III.F.	16-Jul-10	0.000	55.701	2
PoA0070	Efficient Cook Stove Programme: Kenya	Kenya	co2balance UK	Registered	EE households	AMS-II.G.	21-Mrz-12	42.132	824.130	2
PoA0104	Programme of Activities (PoA) for Sustainable Renewable Energy Power Generation in Papua New Guinea (PNG)	Papua New Guinea	PNG Power	Registered	Hydro	AMS-I.F. +AMS-I.D.+ AMS-I.A.	30-Sep-12	0.000	178.341	2
PoA0126	Barefoot Power Lighting Programme	Kenya	Barefoot Power Pty Limited	Registered	Solar	AMS-III.AR.	09-Dez-11	4.875	177.140	2
PoA0133	Small-Scale Renewable Energy PoA in Thailand	Thailand	Carbon Coordination and Managing Entity Ltd	Registered	Hybrid renewables	AMS-I.D.	14-Sep-11	3.959	130.109	2
PoA0377	The programme to introduce renewable energy system into Seoul	South Korea	Seoul Metropolitan Government	Registered	Solar	AMS-I.F.	07-Jun-10	0.000	18.780	2
PoA0395	Energy Efficient Stoves Program (EESP)	Ethiopia	Standard Bank Plc	Registered	EE households	AMS-II.G.	05-Sep-12	10.499	849.359	2
PoA0405	Paradigm Sub Saharan Africa Cook Stove Programme	Ethiopia	The Paradigm Project (TPP)	Registered	EE households	AMS-II.G.	01-Jan-13	0.000	497.362	2
PoA0406	Improved Cook Stoves programme for Rwanda	Rwanda	atmosfair gGmbH	Registered	EE households	AMS-II.G.	15-Mai-11	9.948	730.930	2

Source: Perspectives GmbH, based on UNEP Risø Center 2014a

Annex 7: Procedures and Guidance for sector-specific standardized baselines

SB-specific CDM EB procedures and guidance documents	▪ Standard: Determining coverage of data and validity of standardized baselines, version 01.0 (EB 77, Annex 05) ▪ Procedure: Development, revision, clarification and update of standardized baselines. Version 03.0 (EB 75, Annex 33)* ▪ Guidelines for Quality Assurance and Quality Control of Data used in the Establishment of Standardized Baselines. Version 01.0. (EB 66, Annex 49) ▪ Guidelines for the Establishment of Sector Specific Standardized Baselines. Version 02.0. (EB 65, Annex 23) ▪ Establishment of standardized baselines for afforestation and reforestation project activities under the CDM Version 01.0 (EB 70, Annex 10)
Further relevant CDM EB procedures and guidance which contribute to standardization	▪ Guidelines for determining baselines for measures. Version 1.0 (EB 69, Annex 21) ▪ Guidelines on the demonstration of additionality of small-scale project activities. Version 09.0. (EB 68, Annex 27) ▪ Guidelines on the consideration of suppressed demand in CDM Methodologies. Version 02.0. (EB 68, Annex 2) ▪ Development, revision and clarification of baseline and monitoring methodologies and methodological tools (EB 70, Annex 36)

Source: Perspectives GmbH, based on CDM website

Annex 8: Selected standardized CDM methodologies for rural electrification

CDM Methodology	Degree of standardisation	Eligibility conditions	Country-specific standardisation potential	Number of Projects / PoAs
AMS-I.L. **Electrification of rural communities using renewable energy**	Default baseline emission factors of 6,8 – 1,3 – 1,0 tCO_2e/MWh for different categories of end-users (e.g. households) for off grid or mini-grid	75% of end-users shall be households End-users are not electrified, supplied with efficient lighting, Equipment meets quality standards	Default factors considering suppressed demand Country-specific end-user weighting	0/1
AMS-III.BB **Electrification of communities through grid extension or construction of new mini-grids**	Baseline emissions are the sum of emissions associated with new and existing consumers. Same default values as in AMS-I.L.	Limited to communities with no access to a national or regional grid At least 75% of the end-users (by number) shall be households.	Default factors considering suppressed demand Project emissions and leakage	0/1
AMS-III.AR **Substituting fossil fuel based lighting with LED/CFL lighting systems**	Default values for baselines emissions (lamp emission factor, fuel use rate, utilization rate, annual utilization, fuel emissions factor), resulting in emission reductions per lamp of 0,092tCO2/lamp). Crediting period dependent on performance standards	Lamp life must be certified by manufacturer (5,000/10,000h), which affects crediting period (2 or 7 years) Max. 5 lamps per household	Higher level of suppressed demand, minimum service level, fuel emissions factor.	1/13
AM0103 **Renewable energy power generation in isolated grids**	Emission factor of the isolated grid (t CO_2/MWh), based on the composition of the isolated grid, if data are available	Use of one of the following sources: hydro, wind, geothermal, solar, wave or tidal power. Specific conditions for hydro power apply.	Limited	0/0

Source: Perspectives GmbH