Global Climate Change Policy Tracker

Continued Progress on Mandates, but the Emissions Challenge Remains

April 2012

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Executive Summary

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Key Conclusions

- **Our new consistent historical analysis of maximum potential[1] policy impact on abatement shows continued improvement since the major impact of the Copenhagen Accord.**

- **On the best case global outlook, emissions peak in 2016 in line with economic growth in emerging economies and decline slowly to 2020 but still leave a 5.8Gt "gap" compared to a 450ppm stabilization pathway.**

- **China and other emerging and developing economies have played a key role in new abatement policies. However, China still remains the dominant emitter in 2020 even if all policy goals are achieved, and China's lead climate negotiator has been recently reported to have discussed an extension of the timeline to meet its carbon intensity target[2]. Nevertheless, China's energy intensity target (i.e. efficiency) remains the largest source of abatement globally.**

- **The phase out of nuclear power in Germany will most likely negatively impact emissions out to 2020 on its own, but in context of all policies Germany still reduces emissions substantially and achieves their emissions targets. Although a phase out of nuclear power in Japan is not yet mandated it will certainly pose a challenge in terms of controlling emissions.**

- **The recession has slowed emissions growth in Europe and the US in the past few years, where economic growth will be moderate in coming years. Our BAU shows a more noticeable slowing after 2015 when we see economic growth in emerging markets moderate more.**

- **Clean Energy Ministerial (CEM) countries remain the dominant drivers of BAU emissions and thus have the greatest potential to reduce them.**

- **Our best in class policy analysis which looks at the strength of supporting policies in investor terms of TLC, now includes a "traffic light" view of how likely countries are to achieve their mandates.**

- **We believe that out of the CEM countries China, Germany, Brazil and many of the Nordic countries have strong policy regimes in place to meet their mandates, whilst the rest of the EU and other emerging economies' policy regimes remain mixed. The US and Italy in particular remain challenged in meeting their clean energy mandates. However, in terms of emissions, an aggressive coal to gas switch can have a valuable effect in the US.**

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[1] The trajectory of maximum potential abatement, measured in Giga or Mega tonnes of CO2e (GtCO2e or MtCO2e), is obtained by choosing the set of policies (emissions reduction targets or mandates) that has the greatest impact for each individual country
[2] "China gives itself five more years to reduce emissions intensity", Bloomberg, April 18 2012

Executive Summary

It has long been our mantra that countries with more 'TLC' – transparency, longevity and certainty – in their climate policy frameworks will attract more investment and thus build new, clean industries, technologies and create jobs faster than their policy lagging counterparts. This is particularly evident in countries such as Germany and China, who have emerged as global leaders in low carbon technologies and investment in the past decade.

At a global level, the international UN Climate Change Conference in Durban in December 2011 presented some positive steps made toward laying the foundations for an all-encompassing binding 2020 agreement and developing country funding through the Green Climate Fund. China did indicate its openness to a deal in 2015 that would potentially include carbon caps for the developing world starting in 2020. However, a recent report indicates that China itself is thinking of extending its timeline for its 2020 carbon target[3]. At a regional level, the EU continues to strive to meet its legally binding target of a 20% reduction in carbon emissions from 1990 levels by 2020. And at the national level, the US Environmental Protection Agency has recently moved to tighten pollution restrictions on coal – though EPA carbon regulations are still pending –, and Australia passed its legislation setting a fixed carbon tax starting in July, 2012, and moving to an emissions trading scheme in 2015.

Yet the past year has also seen remarkable political and economic volatility. Japan's earthquake and tsunami and subsequent nuclear crisis, the European sovereign debt crisis, and vast current and projected growth in demand for energy from emerging economies have all combined to impact markets in fundamental ways. In addition fiscal constraints imposed by the ongoing economic slowdown have also caused a slow-down – or stabilization – in political support for cleaner energy technology incentives in many countries in 2011 and into 2012, notably at the US Federal level, and in Spain and Italy. Of particular importance is that given the US' current political gridlock and the need to reduce its debt, retroactive or proactive extension of several of its key renewable energy tax programs (the Loan Guarantee Program, Treasury Grant Program and Production Tax Credits) is at best uncertain and at worst highly unlikely, leaving the US renewable energy industry in a considerable state of uncertainty with substantial implications for emerging clean technology industries.

Thus despite some positive developments in pockets of countries there is a growing recognition that limiting global climate change to just 2 degrees Celsius may be increasingly difficult to achieve. We present this "Global Climate Change Policy Tracker" document to assess this and analyze the impact of current emission targets and mandates on global emission abatement. The Clean Energy Ministerial (CEM) is a high-level global forum to promote policies and programs to advance clean energy technology and to encourage the transition to a global clean energy economy. The 23 governments participating in the CEM are the focus of this tracker update report, as together the nations they represent account for ~80% of global greenhouse gas (GHG) emissions and ~90% of global clean energy investment[4].

Although we have tracked global climate policy since 2009, previously we used the most recent data on energy and economic growth rates, making comparison between our reports difficult. So, in this document we present a new approach to the impact of Mandates and Emission Targets on global carbon abatement potential. We will look at a **time-series to show the impact of targets in 4 time points from our starting base date of 2008: October 2009 (pre-Copenhagen), March 2010 (post-Copenhagen), January 2011 and February 2012.** In effect the time-series presents snapshots in time of the global political landscape around climate and renewables policy. This shows the following:

- **After Copenhagen, based on the maximum potential abatement, the gap relative to a 450ppm stabilization pathway fell from 11.5 GtCO2e to 7.7 GtCO2e.**
- **Between January 2011 and February 2012 the gap fell from 7.3 GtCO2e to 5.8 GtCO2e.**
- **China played a significant role in this. While the very recent uncertainty over its carbon intensity plans is unhelpful, China's energy intensity target currently remains unchanged, and is the key to maximum potential abatement.**

[3] "China gives itself five more years to reduce emissions intensity", Bloomberg, April 18 2012
[4] Clean Energy Ministerial http://www.cleanenergyministerial.org/about/index.html

Executive Summary

- **Brazil also played a key role due to its deforestation focus.**
- **The US administration's commitment to reduce greenhouse gas emissions by 17% will need strong underlying support from a coal to gas switch.**

We also continue to focus on our '**Best-in Class'** analysis of countries and states according to their policy landscapes, as well as taking a new look at **whether these nations are actually likely to meet their clean energy and emission targets** with these policy structures – a way of testing whether a policy regime is aligned to a country's mandates. This shows that since October 2009, the leading countries and states in climate policy have continued to maintain their position, while others have lagged behind or moved backwards:

- **Of major emitting nations, China, Germany and Brazil have the most robust policy regimes to achieve their mandates, although a great deal rides on China continuing to reduce its energy intensity.**
- **The Nordic countries (Sweden, Denmark, Norway and Finland) all look set to achieve their mandates.**
- **In the EU the UK, France and Spain all currently face an uphill task in deploying enough clean energy capacity to meet their mandates, but it is not impossible. This is also the case in Australia.**
- **Italy looks unlikely to be able to meet its 2020 clean energy mandates.**
- **Japan, Indonesia and Canada may need to strengthen their policy regimes to meet their mandates. Japan faces the added issue of how to move forward with regard to its nuclear power industry.**
- **India, South Africa, Mexico and Russia all struggle to achieve their mandates**
- **The US remains challenged by stop-start policy at the federal level. A major coal-to-gas switch may be the key to lower emissions shorter term as an aggressive switch would significantly contribute to the abatement from state mandate policies and could come close to meeting the abatement from the US emissions target[5].**

In terms of the impact on carbon abatement in February 2012, 612 emission targets and mandates are modeled globally, 15 of which are newly enacted since January 2011. Throughout the time series of emission abatement the key impacts on potential abatement through time comes from targets enacted in just a few key regions: China and the EU, with China being the main contributor to increasing emission abatement since October 2009. What is important to note here though is that although China continues to push for very ambitious policy targets for renewable energy and energy consumption, the country's Business As Usual (BAU) emissions in 2020 are a magnitude higher to the next biggest emitter, the US, and so China's policy response is inevitably likely to reflect this and the need to use energy more efficiently and derive it from more diverse sources.

In total the maximum potential abatement of modeled policy initiatives as of February 2012, assuming that these are implemented, will reduce global emissions compared to the BAU by ~11 GtCO2e in 2020 to reach global emissions of 49.8 Gt/y in 2020. In the CEM simulation (which only consider the federal level policies and only CEM nations), the abatement from mandates in 2020 is 7.1 GtCO2e and the abatement from emissions targets is 6.7 GtCO2e.

[5] The Administration's 17% emissions target equates to a reduction in emissions of 908 MtCO2e by 2020. All state and federal mandates achieve a 665 MtCO2e reduction. An aggressive coal to gas switch could reduce emissions a further 275 MtCO2e.

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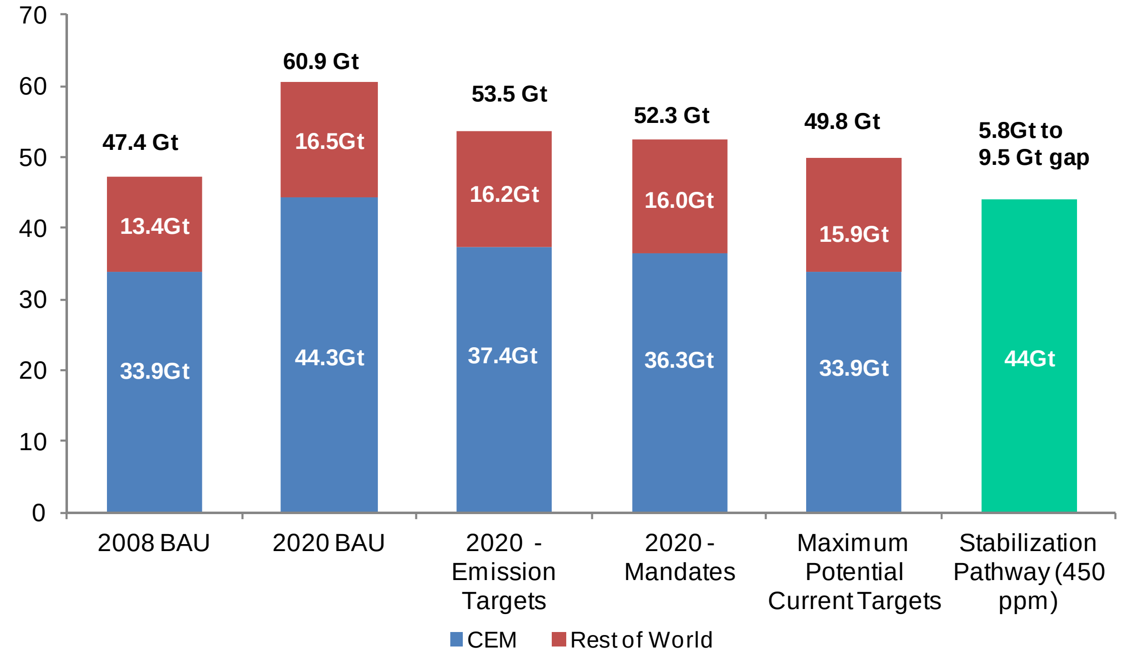
Of particular importance is that we find that the current global maximum potential abatement scenario (in the scenario capturing all world policies) of 49.8 GtCO2e is still 5.8Gt higher than the 44 Gt/y target for emission stabilization in 2020 (the 450ppm pathway) as set by the United Nations Environmental Programme. This represents an improvement in the gap between stabilization pathway and maximum potential compared to previous time points (as shown in the chart below), however the remaining 5.8 GtCO2e of emission reduction needed to achieve the emission stabilization target is roughly equivalent to total US emissions in 2009 and shows that a very significant challenge still lies ahead.[6]

Key Paper Exhibits

The 2020 Estimated Outcome based on Current Targets (February 2012), Global and CEM



Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012. Totals may not sum due to rounding.

[6] CCC Analysis, 2012

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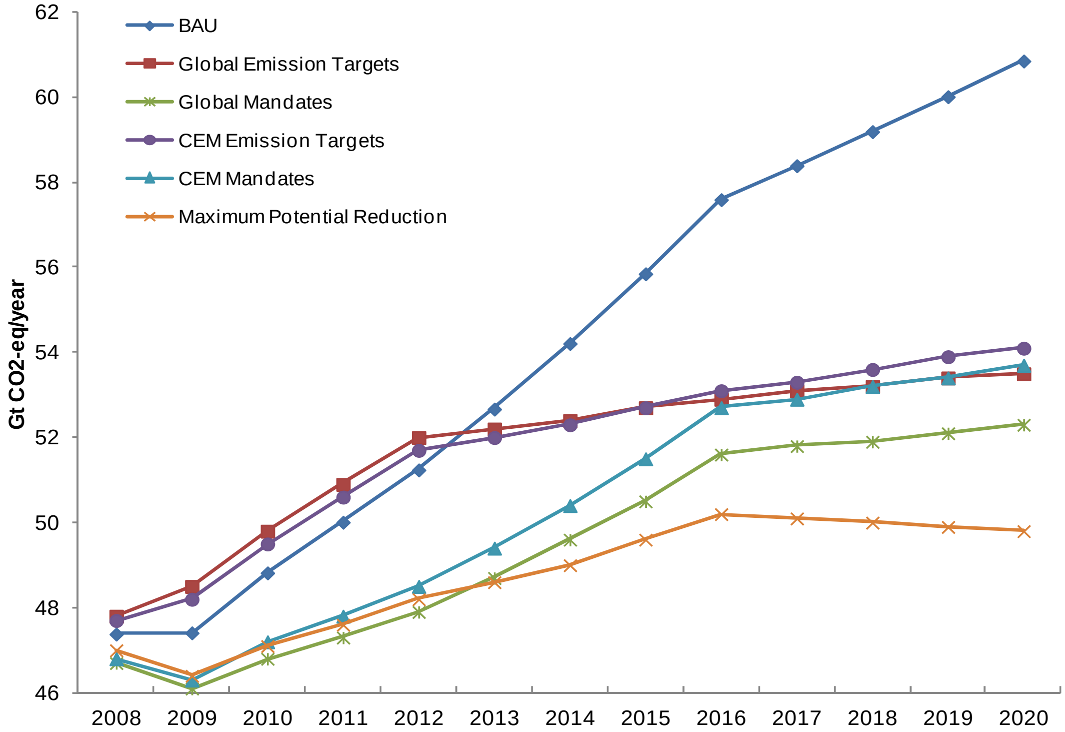
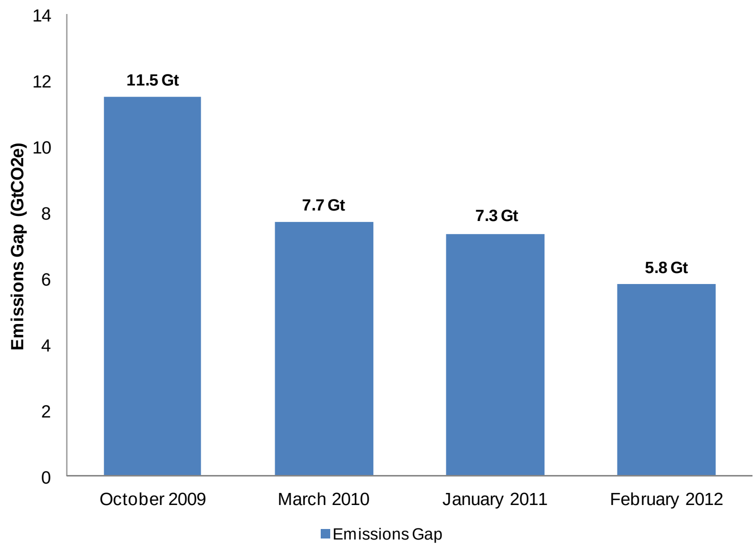
Global Emission Abatement Impact of Current Climate Policy



Source: CCC, DBCCA analysis 2012. Results consist of targets in place as of February 2012.
** Range of 450 ppm pathways – Recent analyses (The Emissions Gap Report, UNEP (2010), p.10) propose 39-44 Gt/y level as the 2020 target for stabilization (UNEP, 2011).*

The Time-Series of the Global Gap between Maximum Potential of Targets and the 44 Gt Stabilization Pathway (includes national and state targets)



Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012

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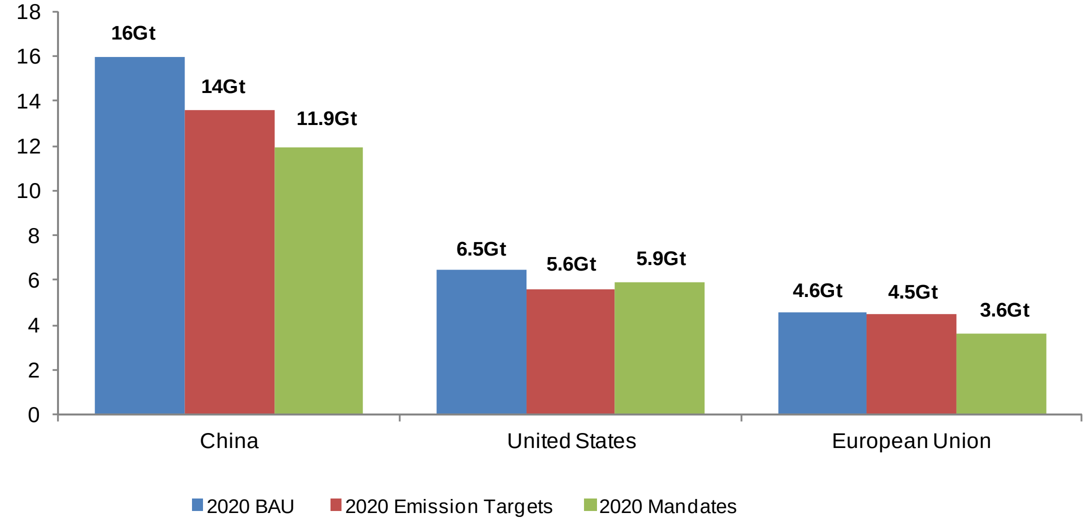
Top 10 targets by Abatement Potential used in the Maximum Potential Calculation (Mt, 2020)

Country	Policy	Abatement Potential by 2020* (Mt)	Policy Type
China	Reduce energy intensity 20% from 2005 levels by 2010 and 18% reduction from 2010 levels by 2015	3424	Mandate
Brazil	80% reduction in deforestation by 2020 compared to historic levels	1097	Mandate
United States	17% reduction from 2005 levels of GHG emissions in 2020	908	Emission Target
Indonesia	26% reduction in emissions from BAU levels by 2020	883	Emission Target
European Union	20% of primary energy to come from renewable sources by 2020	665	Mandate
Russia	40% reduction in energy intensity per unit of GDP from 2007 levels by 2020	518	Mandate
European Union	21% electricity from renewable sources in total electricity consumption by 2010	477	Mandate
China	200 GW installed wind capacity by 2020	444	Mandate
European Union	Reduce primary energy consumption by 20% by 2020 through energy efficiency measures	416	Mandate
Japan	Reduce emissions by 25% from 1990 levels by 2020	367	Emission Target

Source: Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012.
** The base date for abatement potential in the calculations is 2008.*

2020 BAU Emissions Compared to Emissions when Emission Targets and Mandates are Applied in China, US and the EU (including states)



Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012

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Best-in-Class Policy Table for the CEM Countries

Country	Emissions Control			Financial Support				Long-term Grid Improvement Plan	Risks	Deployment		Likelihood of meeting **mandates**
	Binding/ Account-able Emission Target	Renew-able Electricity Standard	Long-term Energy Efficiency Plan	Feed-in Tariff	Long-term Govt-based 'Green Bank'	Tax Benefits	Long-term funding programs		Budget strength (deficit as % of GDP in 2011)	Capital Investment ($mn) 2009-2011	GDP 2011 (Official Exchange Rate $tn)	
Germany	✓C	✓	✓	✓	✓	✓	✓	✓	-1.7%	52687	$3.63	
China	✓ C regional	✓	✓	✓	✓	✓	✓	✓	-1.2%	191222	$6.99	
United Kingdom	✓C	✓	✓	✓	✓	✓	✓	✓	-8.8%	46904	$2.48	Low base
Finland	✓C	✓	✓	✓	X	✓	✓	✓	-1.7%	2608	$0.27	
Denmark	✓C	✓	✓	✓	X	✓	✓	✓	-2.8%	8108	$0.33	
Australia	✓C	✓	✓	State-level	✓	✓	✓	State-level	-2.5%	10977	$1.51	Low base
Norway	✓	✓	✓	✓	X	✓	✓	✓	+13.5%	5246	$0.48	
Japan	✓	✓	✓	✓	X	✓	✓	✓	-8.5%	15770	$5.86	Nuclear phase-out
Brazil	✓	✓	✓	X	✓	✓	✓	✓	-3.1%	51714	$2.52	
France	✓C	✓	✓	✓	✓EIB	✓	✓	✓	-5.8%	19912	$2.80	Reliant on nuclear – low base
Italy	✓C	✓	✓	✓	✓EIB	✓	✓	✓	-3.6%	25439	$2.25	FiT changes
Spain	✓C	✓	✓	✓	✓EIB	✓	✓	✓	-6.5%	81220	$1.54	Incentive freeze
South Korea	⏳COP Acc	✓	✓	✓	X	✓	✓	✓	+2.2%	4447	$1.16	
Sweden	✓C	✓	✓	X	X	✓	✓	✓	+0.6%	7101	$0.57	

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Country	Emissions Control			Financial Support				Long-term Grid Improvement Plan	Risks	Deployment		Likelihood of meeting **mandates**
	Binding/ Account-able Emission Target	Renew-able Electricity Standard	Long-term Energy Efficiency Plan	Feed-in Tariff	Long-term Govt-based 'Green Bank'	Tax Benefits	Long-term funding programs		Budget strength (deficit as % of GDP in 2011)	Capital Investment ($mn) 2000-2011	GDP 2011 (Official exchange rate $ tn)	
Canada	✓	State-level	✓	State-level	X	✓	✓	State-level	-3.8%	25363	$1.76	[orange]
Indonesia	⌛COP Acc	✓	✓	✓	X	✓	✓	X	-1.2%	2501	$0.83	[orange]
India	⌛COP Acc	✓	✓	State-level	X	✓ (red)	✓	✓	-5.0%	41229	$1.84	[orange/red]
Mexico	⌛COP Acc	✓	✓	X	X	✓	✓	State-level	-2.4%	5207	$1.19	[red]
United States	⌛COP Acc	State-level	State-level	State-level	⌛	✓	State-level	State-level	-8.9%	219498	$15.06	[orange/red]
South Africa	⌛COP Acc	✓	✓	✓ (red)	X	X	✓	⌛	-5.2%	374	$0.42	[orange/red]
UAE	X	State-level	✓	X	X	⌛	State-level	State-level	+5.0%	918	$0.36	N/A
Russia	✓	✓	⌛	X	X	X	X	✓	+0.4%	895	$1.79	[red]

*Source: DBCCA Analysis, 2012.GDP and Budget Strength data: CIA World Factbook; Capital Investment by country: Bloomberg NEF. *note: Does not include small scale projects, corporate or government R&D for adjustments for reinvested equity.*

Key to Likelihood of Meeting Mandates Ratings

[green]	There is a strong likelihood that the country/region will meet its clean energy mandates– policies are aligned to the targets and progress to date is good.
[orange]	There is a moderate likelihood that the country/region will meet its clean energy targets – policies are not perfectly aligned to the targets and there is some progress to date.
[red]	There is a strong likelihood that the country/region will not meet its clean energy targets – policies are either not in place or do not align at all to the targets and there is little or no progress to date.

A Focus on the Clean Energy Ministerial (CEM)

In this report on the impact of mandates and emission targets on global CO2 abatement we continue to focus on the 23 Clean Energy Ministerial (CEM) countries and key US states, modeling a simulation of these countries at the federal level in addition to the global all policies scenario. The CEM is a high-level global forum born out of the UNFCCC conference in Copenhagen in December 2009 and designed to bring countries together to accomplish more towards advancing clean energy and transitioning to a global clean energy economy than by working alone. It includes the world's major economies (MEF countries) as well as a select number of smaller nations that are leading in various areas of clean energy (Spain, UAE, Sweden, Norway, Denmark and Finland). Together the CEM nations account for ~80% of global GHG emissions and ~90% of investments in clean energy, thus providing a comprehensive account of global trends.

Policy Collection and Verification

We monitor and collect climate policies which are either legally binding (law passed by a legislature) or are accountable announcements (an official government goal or strategy with strong intention and which is measurable, including policies submitted to the Copenhagen Accord). **We do not model or count proposals**. These policies are used to assess best in class regimes and to model abatement potential.

While we are confident in our policy list, some target policies for some countries/states may not have been captured owing to limitations of data in the available public domain. The model database contains policies announced up to and including January 2012. While additional targets may have been implemented between this date and publication, the constraints imposed by modeling the emissions pathways have not allowed us to capture these.

To collect the policies detailed in the paper we regularly screen reliable, third-party published sources including:

- Government websites from environment and energy departments;
- Research from Multilateral Development Banks;
- Mainstream news sources including The Wall Street Journal, The Financial Times and The Times;
- Climate and clean energy subscription research websites including Bloomberg New Energy Finance and Ren21.

Policy Methodology

Policy regimes contain a variety of interrelated elements, and in the case of climate change, policies are set with the goal of reducing emissions, increasing the penetration of renewables, boosting efficiency, or transforming an industry or sector. In the model we separate emission reduction target policies from mandate policies based on the scope of the policy. Economy-wide reduction goals, without specifying a sector, are classified as emission targets. If the policy is specified as reducing energy use or increasing renewable share, then the energy matrix will be affected and these policies are thus categorized as mandates.

Emissions targets aim to reduce greenhouse gas emissions by a specified level by a set year. These targets can be supported by carbon pricing, either through carbon taxes or cap-and-trade regimes.

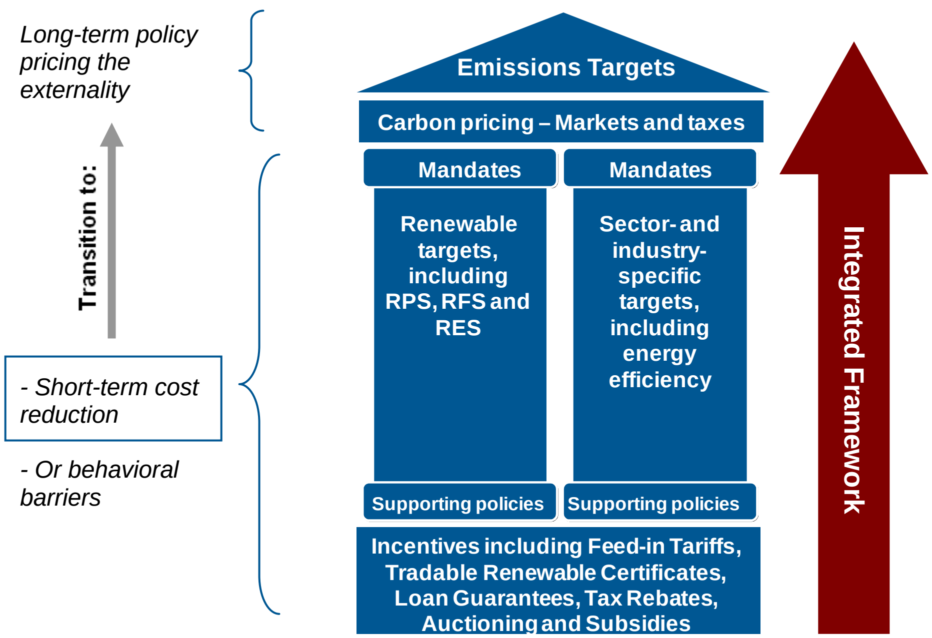
We include **"greenhouse gas (GHG) emissions intensity and carbon intensity"** targets as emissions targets, as they are overarching goals without specific industry or sector measures attached. These intensity targets aim to reduce the ratio of GHG emissions relative to GDP. For these policies, the emissions target is estimated from the target intensity and the GDP of the target year and then used to estimate the emission reduction impact.

A Focus on the Clean Energy Ministerial (CEM)

Mandated renewable, industry and sector targets support emissions targets in that they may require a minimum proportion of renewables in fuel pool or electric power mix, stipulate increased industrial efficiency, or mandate other actions, such as reduced deforestation or the phase-out of inefficient appliances. We classify **"energy intensity**" targets in the mandate targets, as they aim to reduce energy consumption per unit of GDP. Also emission reduction targets for particular sectors or regions of the economy, such as Regional Greenhouse Gas Initiative (RGGI) targets in the US for the power sector are classified as mandates as they are not overarching economy-wide emission reduction targets.

As the abatement model, based on emission targets and mandates, has become more advanced and energy data more readily available, we are now able to include some more sector specific mandates. Thus the increase in number of targets modeled compared to the March 2010 Global Climate Change Policy Tracker[7] is attributed partly to this as well as new targets captured in the year March 2010-April 2011. There are noticeably fewer new emission target policies compared to the March 2010 model as that period captured the Copenhagen Summit, a period of unprecedented climate policy action regarding emission targets.

Figure 1: Stylized current policy structure and relationships



Source: DBCCA analysis, 2011.

Separately, underlying all of the targets described above are **supporting policy mechanisms** that help drive overall achievement. While not in the abatement model, they are used in our momentum and best in class policy regime analysis. As a means to execute a mandate, and thus to reduce emissions, supporting policy mechanisms are put in place to help developers overcome cost and behavioral issues in order to adhere to these mandates. A range of mechanisms that support overarching emissions targets and mandates are currently in place, with financial incentives being critical to taking technologies down the cost curve when in a commercial scale-up development phase. Incentive schemes can range across feed-in tariffs, markets for tradable renewable energy certificates (RECs), reverse auctioning for renewable capacity, tax credits, loan guarantee schemes and government-backed funds. Still other policies, such as net metering and grid interconnection laws, are also key enablers for target achievement.

[7] Access this document at: http://www.dbcca.com/dbcca/EN/investment-research/investment_research_2296.jsp

A Focus on the Clean Energy Ministerial (CEM)

DBCCA maintain that investments in the renewable energy sector are frequently driven by government policy and are subject to policy risk. **Transparent, long-lived and certain policies**, 'TLC,' provide investors with the framework to mobilize capital. However when energy policy lacks TLC there is increased risk and reduced transparency to these investments. Regulatory policy currently remains the core to renewable energy investing and carbon mitigation. Policies are characterized by traditional regulation, carbon pricing and innovation policies. To date, the layering of traditional mandates and standards backed up by innovation policy incentives have been the key drivers for investors and will continue to be so for many years to come. It will take a long time for carbon markets to mature enough to become hedgeable and fungible, absent of supportive policies.

We now look at these policies in terms of:

- Abatement model results and historical time series results.
- Best in class policy regime assessment

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

February 2012 Global Results

We now turn to modeling the abatement potential of the emission targets and mandates. Below we compare the aggregate impact of policies on global emissions for 4 periods of time for all policies globally and for the CEM Simulation at the federal level only: **October 2009; March 2010; January 2011 and February 2012. These represent snapshots in time pre-Copenhagen (October, 2009); post-Copenhagen (March, 2010); and then annual updates, which correspond to the timing of previous Tracker publications.** The model results differ only with regards to new emission targets and mandates enacted over time and/or changes to existing targets, as this study uses the same energy data to model BAU and the same economic growth data. Thus all time points have the same BAU emissions scenario for consistency in comparing policy impacts. For a comparison with previous Tracker models please see Appendix 1.

In the February 2012 time period, projected world BAU emissions reach 60.9 Gt in 2020. There are no new significant impacts from economic growth expectations. The trajectory of maximum potential abatement is obtained by choosing the set of policies (emissions reduction targets or mandates) that has the greatest impact for each individual country.

Since January 2011, 15 mandates have been **newly** enacted globally and thus added to the model as shown in Figure 2 below. The mandated phase out of German nuclear power required us to model the energy mix that would replace it. In total we still expect Germany to reduce overall emissions by 212 MtCO2 due to its mandates by 2020 and also achieve its national emission targets. In addition to this there have been various changes to existing targets, both of which will impact overall emission abatement in February 2012 compared to January 2011. A key change to note is the insertion of an interim deadline to China's energy intensity target (formerly to reduce energy intensity by 20% from 2005 levels by 2020) to reduce energy intensity levels by 18% from 2010 levels by 2015. This has an additional incremental abatement effect of 1.3 GtCO2e in the February 2012 model run compared to January 2011.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Figure 2: New Mandates added to the February 2012 Model compared to January 2011

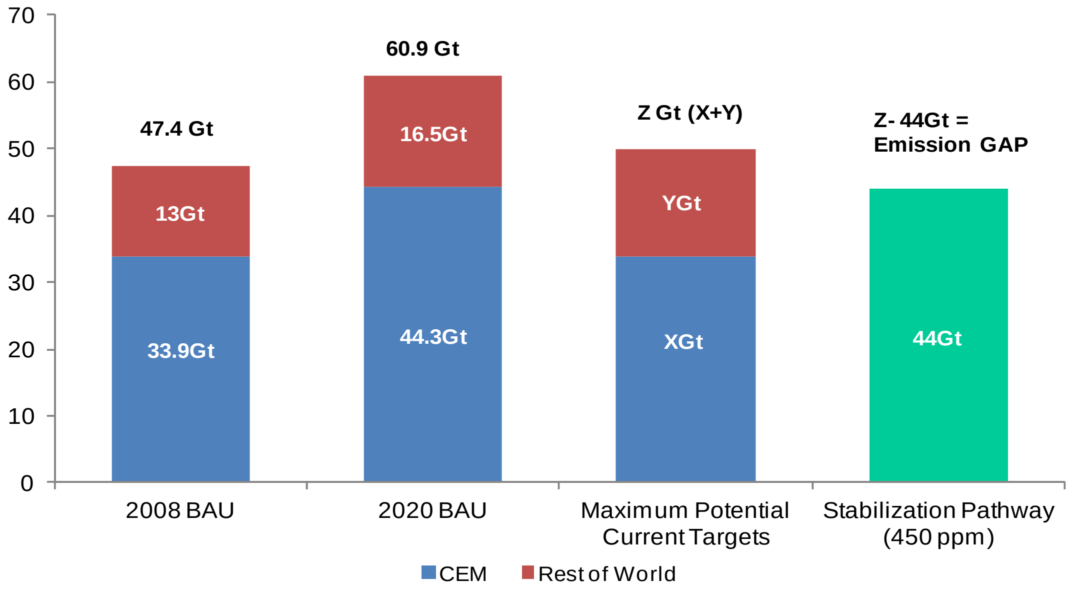
Country	Mandate Policy	Stand-alone target abatement impact $MtCO_2e$
Germany	Reach 52 GW installed solar capacity by 2020	68.1
Denmark	Phase out coal-fired power stations by 2030	16.5
Taiwan	Reach a total of 6,390 MW installed renewables capacity by 2020	14.1
Denmark	Source 50% of power from wind sources by 2020	6.4
Vietnam	Source 4.5% of power from renewables by 2020	6.3
Kuwait	Source 10% of power from renewable sources by 2020	5.8
Israel	Source 10% of power from renewables by 2020	5.4
Pakistan	Reach 1,500 MW of installed wind power by 2013	3.1
Chile	Increase hydropower's contribution to Chile's energy supply from 34% to 45% by 2020.	2.0
Mexico	Phase out incandescent light bulbs by 2021	1.4
Malaysia	5.5% renewables in final energy by 2015	0.6
Norway	Source 67.5% of domestic power from renewable sources by 2020	0.0
United States: Indiana	Source 10% of energy from renewable sources by 2025 based on 2010 levels	0.0
Vietnam	Reduce energy intensity (ratio of growth of energy consumption and growth rate of GDP) from 2 to 1.5 in 2015 and 1 in 2020.	0.0
Germany	Phase out Germany's 12 nuclear power plants by 2022	-82.3*

Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012
** Germany's emission abatement from the phase out of nuclear is derived by assuming equal split of the current energy mix to fill the gap in 2020.*
*** In some cases no additional abatement effect will be gained by the addition of a target; this may be because the country/state already exceeds the target or because the impact in 2020 is so negligible*

The modeled global emissions pathway under business-as-usual (BAU) is compared with those assuming full compliance of policies. While the sets of mandates; emission target or maximum potential target policies reduces emissions considerably, in various combinations they still lead to emission levels exceeding the stabilization levels of 44Gt/y in 2020. This is known as the Emission Gap, as explained in Figure 3 which uses the maximum potential pathway as an example.

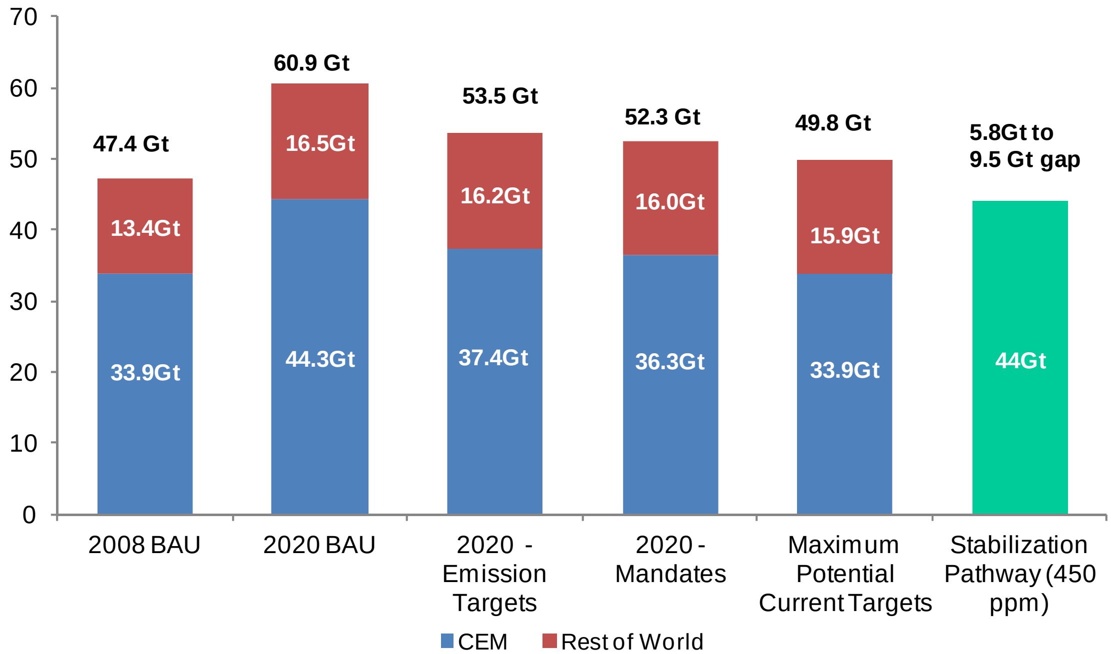
Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Figure 3: What we mean by the Emission Gap between Maximum Potential and the Stabilization Pathway



Source: Columbia Climate Center Analysis & DBCCA Analysis 2012

Figure 4: The 2020 Estimated Outcome based on Current Targets (February 2012), Global and CEM



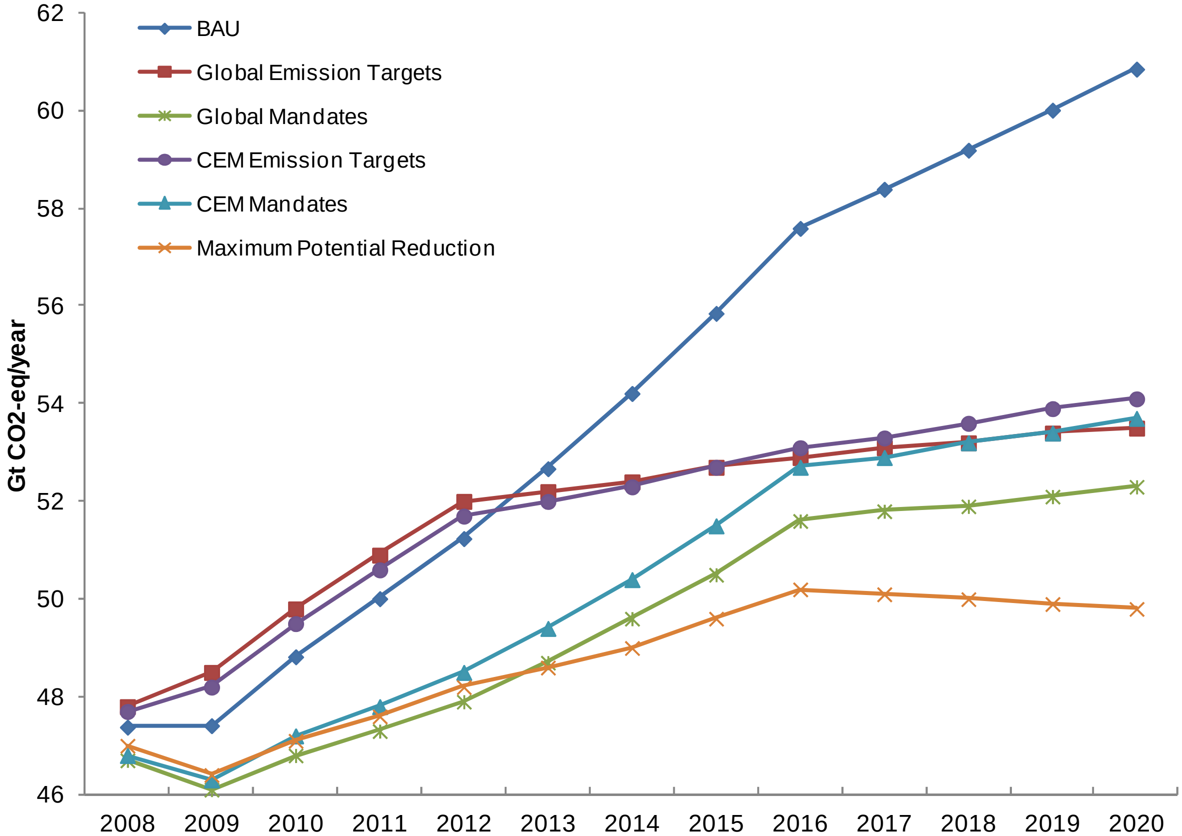
Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012. Totals may not sum due to rounding.

In February 2012 the Emission Gap is between **5.8 Gt and 9.5 Gt** as shown in Figure 4 above.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

However, in terms of our maximum potential abatement, Figure 5 below shows a peak in emissions in 2016 and the start of a gradual decline.

Figure 5: Global Emission Abatement Impact of Current Climate Policy



Source: Columbia Climate Center & DBCCA analysis 2012. Results consist of targets in place as of February 2012.
** Range of 450 ppm pathways – Recent analyses (The Emissions Gap Report, UNEP (2010), p.10) propose 39-44 Gt/y level as the 2020 target for stabilization (UNEP, 2011).*

In both the annual February 2012 update and the time-series analysis two main simulations were carried out: 1) all policies in the database at that time including state-level targets at a global level; and 2) federal-only targets for the Clean Energy Ministerial countries including the European Union as a block.

In each simulation the abatement achieved by the policy suite was compared against a stabilization target, which describes the emissions level needed in 2020 to have a 'likely' change of limiting climate change to less than 2 degrees by 2100. The pathway described in the 2010 United Nations Environmental Programme report is used, which finds that global emissions should reach 39-44 GtCO2e/y by 2020 in order to achieve this stabilization target.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Summary of Quantitative Global Results for February 2012

- At a global level, we modeled 616 emission targets and mandates, of which 15 mandates were newly enacted since the January 2011 time series run.
- BAU emissions start at ~47 GtCO2e in 2008 and rise steadily to 2016 when the world aggregate growth rate weakens slightly due to slower emerging economy growth. Emissions in 2020 are around 60.8 GtCO2e.
- Global Emission targets (including all national and state policies) in place in February 2012 on their own, if fully achieved, would reduce emissions by **~7.4 GtCO2e** in 2020 from BAU levels, **<u>of which 296 MtCO2e comes from countries with a carbon market</u>.**
- Global Mandate targets in place in February 2012 on their own, if fully achieved, would reduce emissions by **~8.6 GtCO2e** in 2020 from BAU levels.
- Therefore enacted mandate policies are more effective than emission targets at lowering emissions on a global basis in February 2012.
- The emissions trajectory assuming **maximum potential abatement** – the trajectory of maximum potential abatement is obtained by choosing the set of policies (emissions reduction targets or mandates) that has the greatest impact for each individual countr**y of world policy targets is ~49.8 GtCO2e/y in 2020**; thus this strongest combination of mandates and emission targets would reduce emissions by 11 GtCO2e.
- Projected emissions under this new maximum potential abatement still **exceed the 44 Gt stabilization pathway of 450 ppm by ~5.8 Gt**. Current mandates and emission targets thus still fail to close the gap in reducing emissions.

Countries with the Highest Potential Abatement by 2020 used in Global Maximum Potential Calculations, February 2012

- As Figure 6 below shows, China carries the greatest impact from a single policy with the 3.4 GtCO2e reduction achieved by its energy intensity policy. Note here that energy intensity targets are considered as mandates which means that for countries such as Russia and China their overall contribution of abatement is highest from mandates, as shown in the table below.
- As a result, mandates dominate in the maximum potential pathway for many countries. In China, although its emission target results in a large abatement figure (~2 GtCO2e), it is the sum of the abatement from the mandates in February 2012 that is greater (China's combined abatement for all mandates, including overall renewable energy capacity, installed biomass, solar and wind capacity exceed 4 GtCO2e).
- Following on from China, the European Union and Brazil make up a large portion of total abatement in the current maximum potential calculation. Brazil's target to cut emissions by 36.1% to 38.9% below BAU levels by 2020 carries an abatement potential of 1Gt, but mirroring the case in China, Brazil's mandates hold greater potential owing to the large deforestation reduction mandate which was added to the database in March 2010.
- For the European Union the case is interesting as although each member state has emission targets set by the EU, it is still mandates that carry the most overall potential abatement in the bloc, as they are simply more ambitious than emission targets.
- Importantly, we do include the US Administration's Copenhagen Accord commitment to a 17% reduction in emissions (from 2005 levels) by 2020 as an emission target.

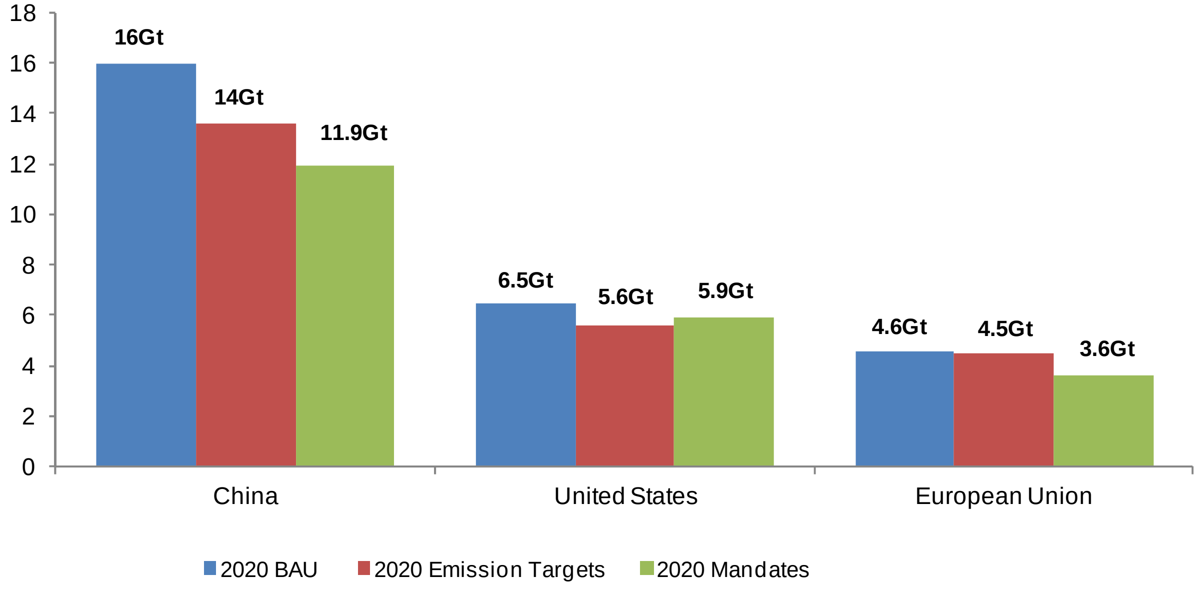
Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Figure 6: Top 10 targets by Abatement Potential used in the Maximum Potential Calculation (Mt, 2020)

Country	Policy	Abatement Potential by 2020* (Mt)	Policy Type
China	Reduce energy intensity 20% from 2005 levels by 2010 and 18% reduction from 2010 levels by 2015	3424	Mandate
Brazil	80% reduction in deforestation by 2020 compared to historic levels	1097	Mandate
United States	17% reduction from 2005 levels of GHG emissions in 2020	908	Emission Target
Indonesia	26% reduction in emissions from BAU levels by 2020	883	Emission Target
European Union	20% of primary energy to come from renewable sources by 2020	665	Mandate
Russia	40% reduction in energy intensity per unit of GDP from 2007 levels by 2020	518	Mandate
European Union	21% electricity from renewable sources in total electricity consumption by 2010	477	Mandate
China	200 GW installed wind capacity by 2020	444	Mandate
European Union	Reduce primary energy consumption by 20% by 2020 through energy efficiency measures	416	Mandate
Japan	Reduce emissions by 25% from 1990 levels by 2020	367	Emission Target

Source: Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012.
**The base date for abatement potential in the calculations is 2008.*

Figure 7: 2020 BAU Emissions compared to Emissions when Emission Targets and Mandates are applied in China, US and the EU (in global policy scenario including state policies)



Source: DBCCA Analysis 2012; Columbia Climate Center analysis 2012

China's emission targets reduce its emissions compared to BAU by 2.32 Gt, whereas its mandates reduce emissions by 4.3 Gt compared to BAU. However scale is the critical point here as Figure 7 demonstrates. Whilst China contributes significantly terms of global abatement potential of its enacted targets, the anticipated BAU emissions associated with increased energy use by 2020 are very large (16 Gt). By comparison the US' expected BAU emissions (including both federal and individual state policies) are less than half that of China by 2020, at 6.5 Gt, and the EU's are smaller still at 4.6 Gt.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

February 2012 CEM Simulation Results

In the CEM simulation (considering only the federal level policies of CEM nations), the abatement from mandates in 2020 is 7.1 GtCO2e and the abatement from emissions targets is 6.7 GtCO2e.

Figure 8: Rank Order of CEM countries in CEM Simulation Maximum Abatement Potential 2020 (Mt) (at the federal level only)

Ranking	Country/Region	Maximum Abatement Potential 2020 (Mt)	Policy Type used for Maximum Potential pathway*
1	China	**4071**	**Mandates**
2	Brazil	**1127**	**Mandates**
3	European Union	**1054**	**Mandates**
4	United States	**908**	**Emission Target**
5	Indonesia	**883**	**Emission Target**
6	Russia	**569**	**Mandates**
7	Japan	**367**	**Emission Target**
8	Mexico	**271**	**Emission Target**
9	South Korea	**247**	**Emission Target**
10	South Africa	**219**	**Emission Target**
11	Germany	**212**	**Mandates**
12	United Kingdom	**171**	**Mandates**
13	Canada	**148**	**Emission Target**
14	France	**119**	**Mandates**
15	Australia	**117**	**Emission Target**
16	India	**116**	**Emission Target**
17	Spain	**81**	**Mandates**
18	Italy	**65**	**Mandates**
19	Sweden	**32**	**Mandates**
20	Denmark	**29**	**Mandates**
21	Norway	**25**	**Emission Target**
22	Finland	**22**	**Mandates**
23	UAE	**0**	**N/A**

Source: CCC, DBCCA analysis 2012. Results consist of targets in place in the CEM nations as of February 2012 at the federal level only.
**As a reminder the Maximum Potential abatement for a particular country is taken as the higher of the sum of Mandates or Emission targets.*

As Figure 8 above shows China dominates in the rank order of abatement potential in the CEM contributing ~4Gt to global abatement of emissions in 2020. Brazil is second owing to its ambitious targets for reducing deforestation. The EU-27 and the US each contribute ~1 Gt in 2020 followed by 0.9Gt from Indonesia and 0.6 Gt from Russia.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Time Series Analysis for Emission Abatement

Figure 9: Time Series 2020 Emission Target Impact (Gt)

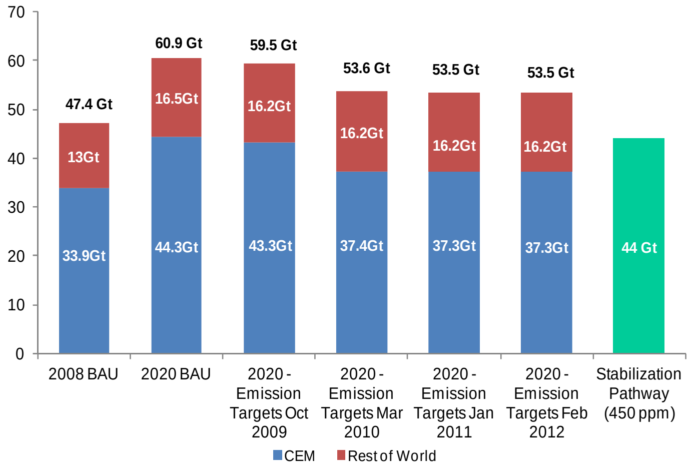


Figure 10:Time Series 2020 Mandate Impact (Gt)

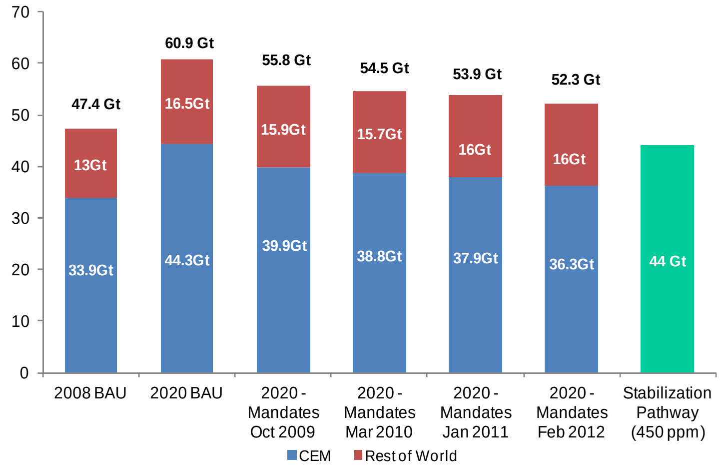


Figure 11: Time Series Maximum Potential (Gt)

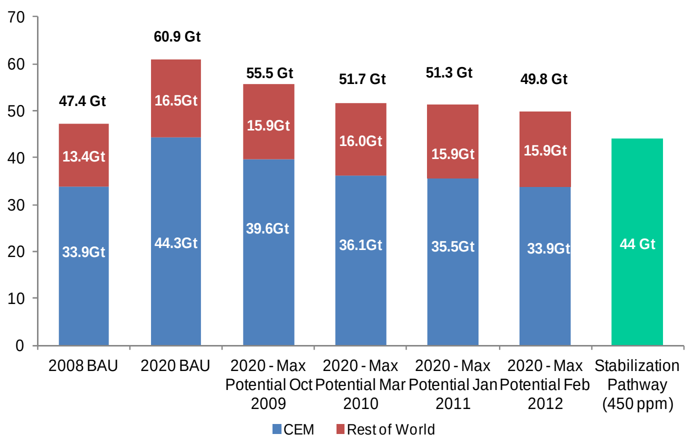
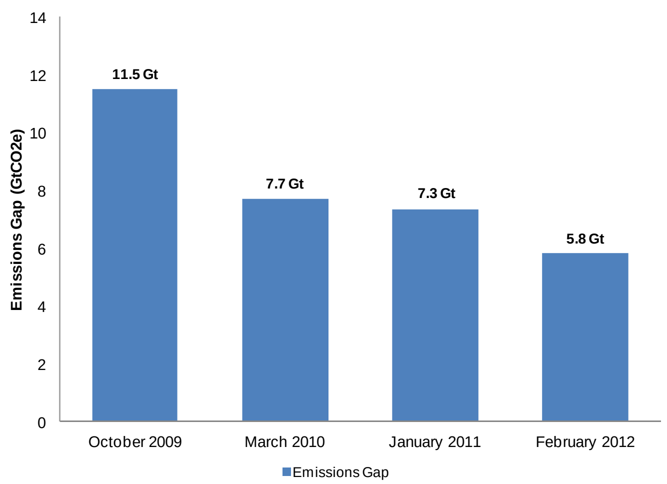


Figure 12: The corresponding time series of the gap between maximum potential of targets and the 44 Gt stabilization pathway



Source: Columbia Climate Center, DBCCA analysis 2012. Results consist of targets in place globally as of December 2009; March 2010; January 2011 and February 2012 respectively.

A Comparison of the Evolution of Abatement through Time

- To conduct the time-series analyses four databases were built at four distinct points in time, roughly to correspond to today as well as our three previously published Global Climate Change Policy Tracker papers (in 2009, 2010 and 2011)[8], so that the abatement potential achieved by each policy suite could be calculated. As the four simulations are

[8] Access these papers at http://www.dbcca.com/dbcca/EN/investment_research.jsp

internally consistent, the results can be easily compared to construct a timeline of how the CEM's abatement potential has evolved over time. This is what distinguishes this methodology over the previous publications; the database is in effect far more consistent through time. (For a comparison of the results of the time series compared to our historical model publications see Appendix I).

- All simulations use the same energy data, underlying assumptions and modeling methods and therefore all the time points have the same BAU level in 2020 (60.8 GtCO2e). Similarly the emission reductions achieved by the policy suite is compared to the same stabilization pathway target of 44 GtCO2e in 2020. In this way it is possible to say that changes in the gap between abatement achieved through policies and the 44 GtCO2e target result solely from changes in the policy suites through time and thus represent the evolution of political will towards renewable energy and climate change through time.
- Using this tool we can see from Figures 11 and 12 above that maximum potential abatement in the global "all policies" run increased significantly after the UNFCCC Copenhagen summit in December 2009 that produced the Accord (by comparing October 2009 to March 2010 model results) and has continued as new targets have been enacted over time, albeit at a slower rate in later years.
- Although some targets have been scaled back (such as Canada's termination of its Kyoto Protocol commitment) and some will increase emissions (such as Germany's nuclear phase out announced in 2011 which causes an additional 80 Mt of emissions by 2020 as energy is replaced by all other sources, including fossil fuels), the net impact of policy making is toward increasing abatement.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Time-Series Analysis in the CEM (federal level only)

Figure 13: Time-Series of Abatement Potential from Mandates and Emission Targets (ET) in the CEM Simulation (federal only)

	October 2009		March 2010		January 2011		February 2012	
	Mandates (MtCO2e)	ET (MtCO2e)	Mandates (MtCO2e)	ET (MtCO2e)	Mandates (MtCO2e)	ET (MtCO2e)	Mandates (MtCO2e)	ET (MtCO2e)
Australia	38.9	0.0	38.9	116.9	38.9	116.9	38.9	116.9
Brazil	3.0	0.0	1100.6	1006.9	1127.4	1006.9	1127.4	1006.9
Canada	7.3	213.9	7.3	148.0	7.3	148.0	7.3	148.0
China	2292.4	0.0	2292.4	2326.8	2543.2	2326.8	4070.8	2326.8
Denmark	14.1	3.4	14.1	3.4	14.1	3.4	28.9	17.2
EU-27	666.7	160.0	666.7	160.0	1054.0	160.0	1054.0	160.0
Finland	22.0	0.0	22.0	0.0	22.0	0.0	22.0	0.0
France	119.3	0.0	119.3	0.0	119.3	0.0	119.3	0.0
Germany	227.0	176.8	227.0	176.8	251.3	176.8	211.6	176.8
India	39.5	0.0	70.3	115.8	70.3	115.8	70.3	115.8
Indonesia	4.4	0.0	4.4	883.1	4.4	883.1	4.4	883.1
Italy	64.5	0.0	64.5	0.0	64.5	0.0	64.5	0.0
Japan	108.3	134.4	108.3	367.2	121.1	367.2	121.1	367.2
South Korea	102.6	0.0	113.0	246.8	113.0	246.8	113.0	246.8
Mexico	9.0	132.0	9.0	271.0	24.2	271.0	24.2	271.0
Norway	0.0	4.5	0.0	24.9	0.1	24.9	0.1	24.9
Russia	568.6	0.0	568.6	-61.2	568.6	-61.2	568.6	-61.2
South Africa	9.5	0.0	9.5	218.6	9.5	218.6	9.5	218.6
Spain	53.5	16.7	53.5	16.7	81.0	16.7	81.0	16.7
Sweden	32.3	0.0	32.3	0.0	32.3	0.0	32.3	0.0
UAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UK	170.9	105.8	170.9	105.8	170.9	105.8	170.9	105.8
US	75.4	0.0	75.4	908.2	231.1	908.2	231.1	908.2
World	3962.5	644.9	5101.3	6733.0	5614.4	6733.0	7117.1	6733.0

Source: Columbia Climate Center & DBCCA Analysis 2012; results are from mandates and emission targets enacted at the time points at the federal level only.

The main conclusion from the time series of abatement, shown in Figure 13 above using the CEM simulation, is that as we move forward in time, the gap between what we expect to achieve in 2020 with the given suite of policies and the stabilization pathway target of 44 GtCO2e closes.

Below we look at each time series in turn and compare it to the previous one to give an indication of historical change, highlighting key changes from CEM nations only.

It must be noted that when looking at these tables comparing changes in the time-series that the figures listed are the impact of each additional target in isolation. A sum of the individual policy abatement effects will exceed their impact on the country level because a direct sum would often imply double counting. In addition the overall difference in abatement of 3.7 GtCO2e between the October 2009 model and March 2010 is derived from the difference between the world maximum potential of targets enacted at the time and the 44 GtCO2e stabilization pathway and therefore does not include all mandates and emission targets as the maximum potential scenario takes the higher sum of the abatement potential of either emission targets or mandates for each country.

On top of this, the maximum potential for a given country can be the aggregate emission targets in one year and the aggregate mandates in another, depending which is largest. Thus adding up the impact of individual policies will not match the actual gap improvement. The improvement in abatement between the years of the time-series is thus a very complex number, but the targets described in the following tables are the most important contributing targets to the changes over time.

Time-series Analysis October 2009 to March 2010 – Global and CEM

- The largest improvement in the time series occurs between October 2009 and March 2010, a reflection of the pledges to the Copenhagen Accord.
- Global All Policies Impact: In October 2009 the world's collective abatement exceeds the stabilization pathway of 44 GtCO2e by 11.5 GtCO2e. In March (post-Copenhagen) the gap drops to ~7.7 GtCO2e, thus the gap is closed by ~3.8 GtCO2e between these periods in time.
- CEM Simulation Impact: The difference in the impact of **emissions targets** for CEM nations between October 2009 and March 2010 is ~6 GtCO2e. This large increase in abatement comes from the Copenhagen pledges added to the March 2010 model and targets carrying the greatest abatement change between these two periods for the CEM are shown in Figure 14 below.
- It is notable that Non Annex I CEM developing countries (excluding targets) contributed ~80% of this reduction from the Copenhagen Accord, with pledges contributing ~4.9 Gt to emission target abatement in March 2010 compared to October 2009.

Figure 14: Key Emission Targets in the CEM contributing to the March 2010 Abatement compared to October 2009 Abatement

October 2009-March 2010		
Country	**Emission Target**	**New Abatement Impact 2020 (March 2010)**
China	Reduce carbon intensity 40-45% below 2005 levels by 2020	2326.8
Brazil	Reduce emissions by 36.1%-38.9% below BAU by 2020	1006.9
United States	Reduce emissions by 17% from 2005 levels by 2020	908.2
Indonesia	Reduce emissions by 26% below BAU levels by 2020	883.1
Japan	Reduce emissions by 25% below 1990 levels by 2020	367.2
South Korea	Reduce emissions by 4% below 2005 levels by 2020	246.8
Mexico	Reduce emissions by 30% below BAU levels by 2020	271.0

Source: DBCCA and Columbia Climate Center analysis 2012.

- There is also an important increase in abatement between October 2009 and March 2010 as a result of new **mandate** policies (~1.14 GtCO2e) in the CEM. This mainly comes from the addition of Brazil's deforestation target and small contributions from India and South Korea, as shown in Figure 15. This again shows that the Brazilian deforestation mandate in effect drives the emission target and is larger in terms of maximum potential.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

Figure 15: Key Mandates in the CEM contributing to the March 2010 Abatement compared to October 2009 Abatement

October 2009-March 2010		
Country	**Mandate**	**New Abatement Impact 2020 (March 2010)**
Brazil	Reduce deforestation by 80% by 2020 compared to historic levels	1097.7
South Korea	Source 10% of electricity generation from renewables in 2022	38.1
India	20 GW installed solar capacity by 2022	30.8

Source: DBCCA and Columbia Climate Center analysis 2012

Time-series Analysis March 2010 to January 2011 – Global and CEM

- Between these two time periods abatement continues to improve, although at a less dramatic pace.
- Global All Policies Impact: Between March 2010 and January 2011 the gap between maximum potential of targets and the stabilization pathway narrows from 7.7 GtCO2e to **7.3 GtCO2e**, an improvement of around **0.4 GtCO2e**.
- CEM Simulation Impact: There are no major new emission policy impacts in the January 2011 model run compared to the March 2010 run. The only two modifications are an addition by the Netherlands and a policy for the state of Victoria in Australia (but these are not counted in the CEM run as they constitute state not national targets or are not CEM members).
- The difference between the abatement from mandate targets in January 2011 compared to March 2010 is in the order of 400 MtCO2e in 2020. This mainly comes from new policies in China, the EU and the US and a change to a German target as shown below in Figure 16 below. Again, note that the sum of the individual policies will exceed their impact on the country level (and subsequently the world aggregate) because we avoid double counting, and a simple addition of the abatement cannot be done to reconcile the actual change in overall maximum potential abatement.

Figure 16: Key Mandates in the CEM contributing to the January 2011 Abatement compared to the March 2010 Abatement

March 2010 – January 2011		
Country	**Mandate**	**New Abatement Impact (January 2011)**
China	30 GW of installed biomass capacity by 2020	248.64
European Union	20% reduction in primary energy consumption by 2020 through energy efficiency	416.18
United States	Fleet average of 35.5mpg for vehicles by 2016	155.63
Germany	35% share of power generation from renewables by 2020	27.5*

Source: DBCCA and Columbia Climate Center analysis 2012.

** Germany's target in the March 2010 model was 30% renewables in power generation by 2020 providing 72 MtCO2e abatement and in February 2012 the abatement was 99.5 so the incremental effect of this is 27.5 Mt CO2e in the January 2011 model.*

Time-series Analysis January 2011 to February 2012 – Global and CEM

- In the next time series, the gap between maximum potential of targets and the stabilization pathway narrows again noticeably.
- Global All Policies Impact: By February 2012 the maximum potential scenario of the world puts emissions at ~49.8 GtCO2e, representing a gap of **5.8 GtCO2e** between our estimated best case scenario and the 450ppm stabilization pathway. This represents a closing of the gap since the January 2011 time run by **1.5 GtCO2e**.

Tracker Model Results for Emission Abatement & Historical Time Series Analysis

- CEM Simulation Impact: There is no difference in abatement from emission targets between the two time points as there are no newly enacted or amended targets at the federal level in the CEM countries.
- The improvement between these two time periods is mainly a result of new or enhanced mandate targets in the EU, China and US as shown in Figure 17 below.
- The phase out of nuclear power in Germany results in an increase in emissions when the policy is taken as a standalone effect. However when all other mandates are considered the net effect is that emission levels will still decrease substantially.
- Again, note that the sum of the individual policies will exceed their impact on the country level (and subsequently the world aggregate) because we avoid double counting, and a simple addition of the abatement cannot be done to reconcile the actual change in overall maximum potential abatement.
- The table below highlights this case. In absolute terms, China's energy intensity target contributes 3.4 Gt of abatement in February 2012. However, when comparing the January 2011 and February 2012 runs this policy cannot be translated as an improvement of 3.4 Gt as the policy was already contributing 2.06 Gt of abatement in January 2011. Therefore, changes to this policy represent a contribution of 1.36 Gt *relative* to what it was doing in January 2011.

Figure 17: Key Mandates in the CEM contributing to the February 2012 Abatement compared to the January 2011 Abatement

	January 2011 – February 2012	
Country	**Mandate**	**New Abatement Impact 2020 (February 2012)**
China	Reduce energy intensity by 20% from 2005 levels by 2010 by and 18% from 2010 levels by 2015	1364
China	200 GW installed wind by 2020	241.5*
China	30 GW installed solar capacity by 2020	14.3**
Germany	Phase out nuclear power by 2022	-82.4

Source: DBCCA and Columbia Climate Center analysis 2012.
**In January 2011 model run this target was only 100GW; **In January 2011 model run this target was only 20GW by 2020*

Finally, China's lead climate negotiator and vice-Chairman of the NDRC, Xie Zhenhua, is reported to have said at the recent Major Economies Forum on Energy and Climate that China could stretch implementation of its carbon intensity target from 2020 to 2025[9]. If formally announced this has a significant impact (see Figure 18 below), although it does not change the maximum potential abatement as this is "trumped" by the energy intensity mandate in our model.

Figure 18: Key Emissions Target in the CEM contributing to the February 2012 Abatement compared to the January 2011 Abatement

	April 2012	
Country	**Mandate**	**New Abatement Impact 2020 (April 2012)**
China	Stretch carbon intensity target of 40-45% (below 2005 levels) from 2020 to 2025	-1800

Source: DBCCA and Columbia Climate Center analysis 2012.

To conclude this section, although it is positive that world governments have become increasingly more ambitious and effective at reducing emissions since 2009, we still face a 5.8 GtCO2e gap between emission levels under the global all policies best case policy scenario for 2020 and where we need to be in order to avert dangerous climate change. A significant challenge thus still lies ahead.

[9] China gives itself five more years to reduce emissions intensity", Bloomberg, April 18 2012

Best-in-Class Policy Assessment for the CEM

Climate change policy regimes vary by region and country, and often need to be assessed within their own context. Policy support and risks will thus vary by region, country or state.

Policy regimes contain a variety of interrelated elements, and in the case of climate change, there are different types of targets set with the goal of reducing emissions, increasing the penetration of renewables, boosting energy efficiency or transforming an industry or sector. The most attractive areas for investors in renewable energy will be those that offer the most robust policy regimes, combining all of the above elements. Such regions offer the most 'TLC' to investors.

We continue to use our 'best-in class' policy approach to assess whether a country has a low, moderate or high risk policy regime for investors, with the lowest risk countries appearing higher up in a matrix, as detailed further below. However for this paper we also expand the assessment of countries to provide a color-coded marker depicting the **likelihood of a country actually meeting set mandates and emission targets**. This, in effect, provides an indication of how well aligned the policy regime is to the country's targets, regardless of whether it offers a low risk policy regime for investors. **For instance a country/state may have all the right policies in place to attract investment, but have clean energy and climate targets that we believe are too ambitious to actually be met.**

To help us develop the Best-In Class master matrix we monitor key developments/changes in terms of emission targets and mandates – the inputs to the previously discussed emission abatement model – as well as **supporting policies** in the Clean Energy Ministerial countries such as feed-in tariffs and tax incentives. **See Appendix III for Key Policy Developments in 2011-2012** which have been used to help develop our Best-In Class master, Figure 19 (below).

Developing the Best-in-Class Matrix

Using the mandates and targets we have in the emission abatement model and our knowledge of supporting policy, such as that discussed previously, we develop the best-in-class risk policy. Investors can use this to evaluate which countries/regions exhibit the strongest elements of 'TLC,' versus those with variable and unstable regimes.

Each country is assessed according to 6 criteria:

Emission Controls
- A binding emission target
- A renewable electricity standard
- A long-term energy efficiency plan

Financial Support
- Feed-in Tariffs
- Long term government-based 'Green Bank'
- Tax benefits
- Long-term funding programs

Long-term grid improvement plan

Best-in-Class Policy Assessment for the CEM

Key to Best-in-Class Ratings

✓ (green)	The policy exists at a national level and generally displays TLC
✓ (red)	The policy exists at a national level, but has been negatively modified/proposals are in place to negatively modify - creating greater investor uncertainty
X	No policy exists
C	A carbon market exists – tax or cap and trade or hybrid
State-Level (green)	The policy exists at a sub-national level only
State-Level (red)	The policy exists at a sub-national level only, but is only present in a minority of states and/or has been negatively modified/proposals are in place to modify negatively - creating greater investor uncertainty
⌛	The policy is only in tentative or planning stages or is dependent on certain provisions such as a legally binding agreement or funding
⌛COP Acc	The policy is a submission to the Copenhagen Accord and is not a national binding target

We also show the level of the budget deficit in each country as a potential barometer on government policy, especially where subsidies run directly through the budget. Red indicates a deficit over 5% of GDP.

In addition we show the actual amount of clean energy investment over the last decade and the latest level of GDP to see how significant this level of investment is relative to the national economy.

Key to Likelihood of Meeting Mandates Ratings

(green)	There is a strong likelihood that the country/region will meet its clean energy mandates– policies are aligned to the targets and progress to date is good.
(orange)	There is a moderate likelihood that the country/region will meet its clean energy targets – policies are not perfectly aligned to the targets and there is some progress to date.
(red)	There is a strong likelihood that the country/region will not meet its clean energy targets – policies are either not in place or do not align at all to the targets and there is little or no progress to date.

Best-in-Class Policy Assessment for the CEM

Figure 19: Best-In-Class: Driving Transparency, Longevity and Certainty (TLC)

	Emissions Control			Financial Support					Risks	Deployment		
Country	Binding/ Account-able Emission Target	Renew-able Electricity Standard	Long-term Energy Efficiency Plan	Feed-in Tariff	Long-term Govt-based 'Green Bank'	Tax Benefits	Long-term funding programs	Long-term Grid Improvement Plan	Budget strength (deficit as % of GDP in 2011)	Capital Investment ($mn) 2009-2011	GDP 2011 (Official Exchange Rate $tn)	Likelihood of meeting **mandates**
Germany	✓C	✓	✓	✓	✓	✓	✓	✓	-1.7%	52,687	$3.63	
China	✓ C regional	✓	✓	✓	✓	✓	✓	✓	-1.2%	191,222	$6.99	
United Kingdom	✓C	✓	✓	✓	✓	✓	✓	✓	-8.8%	46,904	$2.48	Low base
Finland	✓C	✓	✓	✓	X	✓	✓	✓	-1.7%	2,608	$0.27	
Denmark	✓C	✓	✓	✓	X	✓	✓	✓	-2.8%	8,108	$0.33	
Australia	✓C	✓	✓	State-level	✓	✓	✓	State-level	-2.5%	10,977	$1.51	Low base
Norway	✓	✓	✓	✓	X	✓	✓	✓	+13.5%	5,246	$0.48	
Japan	✓	✓	✓	✓	X	✓	✓	✓	-8.5%	15,770	$5.86	Nuclear phase-out
Brazil	✓	✓	✓	X	✓	✓	✓	✓	-3.1%	51,714	$2.52	
France	✓C	✓	✓	✓	✓EIB	✓	✓	✓	-5.8%	19,912	$2.80	Reliant on nuclear – low base
Italy	✓C	✓	✓	✓	✓EIB	✓	✓	✓	-3.6%	25,439	$2.25	FiT changes
Spain	✓C	✓	✓	✓	✓EIB	✓	✓	✓	-6.5%	81,220	$1.54	Incentive freeze
South Korea	⌛COP Acc	✓	✓	✓	X	✓	✓	✓	+2.2%	4,447	$1.16	
Sweden	✓C	✓	✓	X	X	✓	✓	✓	+0.6%	7,101	$0.57	

Best-in-Class Policy Assessment for the CEM

Country	Emissions Control			Financial Support				Long-term Grid Improvement Plan	Risks	Deployment		Likelihood of meeting **mandates**
	Binding/ Account-able Emission Target	Renew-able Electricity Standard	Long-term Energy Efficiency Plan	Feed-in Tariff	Long-term Govt-based 'Green Bank'	Tax Benefits	Long-term funding programs		Budget strength (deficit as % of GDP in 2011)	Capital Investment ($mn) 2000-2011	GDP 2011 (Official exchange rate $ tn)	
Canada	✓	State-level	✓	State-level	X	✓	✓	State-level	-3.8%	25,363	$1.76	(orange)
Indonesia	⌛COP Acc	✓	✓	✓	X	✓	✓	X	-1.2%	2,501	$0.83	(orange)
India	⌛COP Acc	✓	✓	State-level	X	✓	✓	✓	-5.0%	41,229	$1.84	(orange/red)
Mexico	⌛COP Acc	✓	✓	X	X	✓	✓	State-level	-2.4%	5,207	$1.19	(red)
United States	⌛COP Acc	State-level	State-level	State-level	⌛	✓	State-level	State-level	-8.9%	219,498	$15.06	(orange/red)
South Africa	⌛COP Acc	✓	✓	✓	X	X	✓	⌛	-5.2%	374	$0.42	(orange/red)
UAE	X	State-level	✓	X	X	⌛	State-level	State-level	+5.0%	918	$0.36	N/A
Russia	✓	✓	⌛	X	X	X	X	✓	+0.4%	895	$1.79	(red)

*Source: DBCCA Analysis, 2012.GDP and Budget Strength data: CIA World Factbook; Capital Investment by country: Bloomberg NEF. *note: Does not include small scale projects, corporate or government R&D for adjustments for reinvested equity.*

Key Observations of the CEM Nations from an Investor Perspective

Here we assess the investment attractiveness of countries according to whether there are key policy structures in place:

- **China, Germany and the UK** exhibit the strongest elements of 'TLC' in their clean energy policy regimes, all with a binding emission target supported by a carbon market (except for China, although pilot schemes are in place) and renewable electricity standard along with strong supporting incentives to support and meet those targets. The UK, although having all the key elements of 'TLC' in its clean energy policy, currently has some uncertainties surrounding its support structure for larger projects and costs associated with its feed-in tariff for heat technologies. Clarifying these mechanisms should be a priority in 2012 to ensure the long-term growth of the country's renewable energy markets.
- A second group of countries/states – **Norway, Finland, Denmark, Japan, France and Brazil** – possess many of the key climate policy elements, but other than Brazil do not have, or plan to implement, a green investment bank. Finland, Denmark and France's emission targets are supported by the European Emissions Trading Scheme (ETS) and all of these countries areas are considered to be leaders in the renewable energy market. In January 2012 France announced that a 10% premium will be added to rates paid through the FiT for solar PV when 60% of the value of the PV modules used are representing European manufacturing. Brazil does not currently deploy Feed-in Tariffs, but has mandated deployment of a significant amount of investment via its development bank, BNDES, is playing a significant role. The real issue is whether the rainforest can be protected.
- **Australia** scores highly as it has every element of TLC in its policy, however its Feed-in Tariffs and long-term grid improvement plan are only present at the state-level. Importantly Australia's emission target is to be supported by a carbon tax scheme from July, 2012 and the country is also setting up a green investment bank.

- **South Korea** has all of the key climate policies in place, bar a green investment bank. However the country does not have a legally binding emission target, just a pledge to the Copenhagen Accord. There has been much recent debate and delays surrounding plans for a national carbon market in South Korea.
- **Italy, Spain and Sweden** lack a Green Bank and either lack a Feed-in Tariff or have negatively revised them, with associated market impacts in 2012.
- **Indonesia, India, and Mexico** have a mixture of more than two policies absent and only non-binding emissions targets at the Copenhagen Accord level.
- **Canada** only has renewables targets at the provincial level, with no federal mandate. Similarly the support structures for renewables are predominantly at the state-level only and there is some uncertainty around some of the provincial level FiTs. The country has also backtracked on national emission targets under Kyoto recently, although its 2020 emission target under the Copenhagen Accord remains in place.
- **Indonesia, India, and Mexico** have a mixture of more than two policies absent and only non-binding emissions targets at the Copenhagen Accord level. They have only submitted a national emission target to the Copenhagen Accord, and these are not legally binding India has recently stopped its accelerated depreciation for wind power so policy changes are still causing uncertainty here.
- **The US, South Africa, the UAE and Russia** generally have fewer national-level policies or are in the process of reversing them. In particular the US has backtracked considerably on its tax incentives for renewable energy creating a high degree of uncertainty for renewables projects in 2012.

Key observations on the likelihood that CEM nations will meet their clean energy mandates

Here we turn to assess whether countries are actually likely to meet their targets for renewable energy despite key policy structures being present or not.

- Though the **UK** possesses all the elements of 'TLC' in its policy landscape to attract investment as discussed above and seen from Figure 19, it is starting off from a very small renewable energy base and an initially slow rate of growth towards its very ambitious clean energy targets. Large growth in offshore wind is planned, requiring ambitious financing and planning arrangements which could hamper developments and undermine the country's targets further[10]. There is also a current need for clarification of the mechanism of the new feed-in tariff with contract for difference (CfD) support scheme for larger renewables projects, in replacement of the previous renewable obligation. Although overall we view the FiT CfD as having more 'TLC' and being a positive regulatory step, the final working details are yet to be decided and it is integral that these are transparent and not face any delays in implementation that could further risk the future development of key renewables projects. The UK's groundbreaking Renewable Heat Incentive for heat technologies is also facing some changes in 2012 in light of a recently launched government review on costs to ensure the schemes long-term future. And finally, the solar FiT in the UK has been amended early in 2012 and from April, 2012 the FiT for systems under 4kW will be set at 21p/kWh; and any installations made between December 12th 2011 and March 3rd 2012 will get the previous higher rate of 43.3p/kWh. Anyone who installed between March 3rd and April 1st would get the higher rate for a few weeks and then drop to the 21p rate in April. The tariff is due to be reduced again in July and will then be reduced every 6 months in line with the continuing fall in installation prices and to regulate how much is being paid out via the FiT. Owing to the current uncertainty surrounding the above changes, the UK gets an amber/green color against the likelihood of meeting its 2020 clean energy targets, despite having the necessary policy structures in place to attract investments.
- **France** has seen high growth in its solar PV capacity in recent years, but industry groups caution that overall renewables scale-up is needed from a relatively low base as the country has traditionally relied heavily on nuclear power. Feed-in tariffs in France have changed on a regular basis and such changes cause some degree of uncertainty in the sector, although recent positive FiT announcements for solar are a positive sign.

[10] See our November 2011 research note on UK offshore wind at: http://www.dbcca.com/dbcca/EN/investment-research/investment_research_2400.jsp

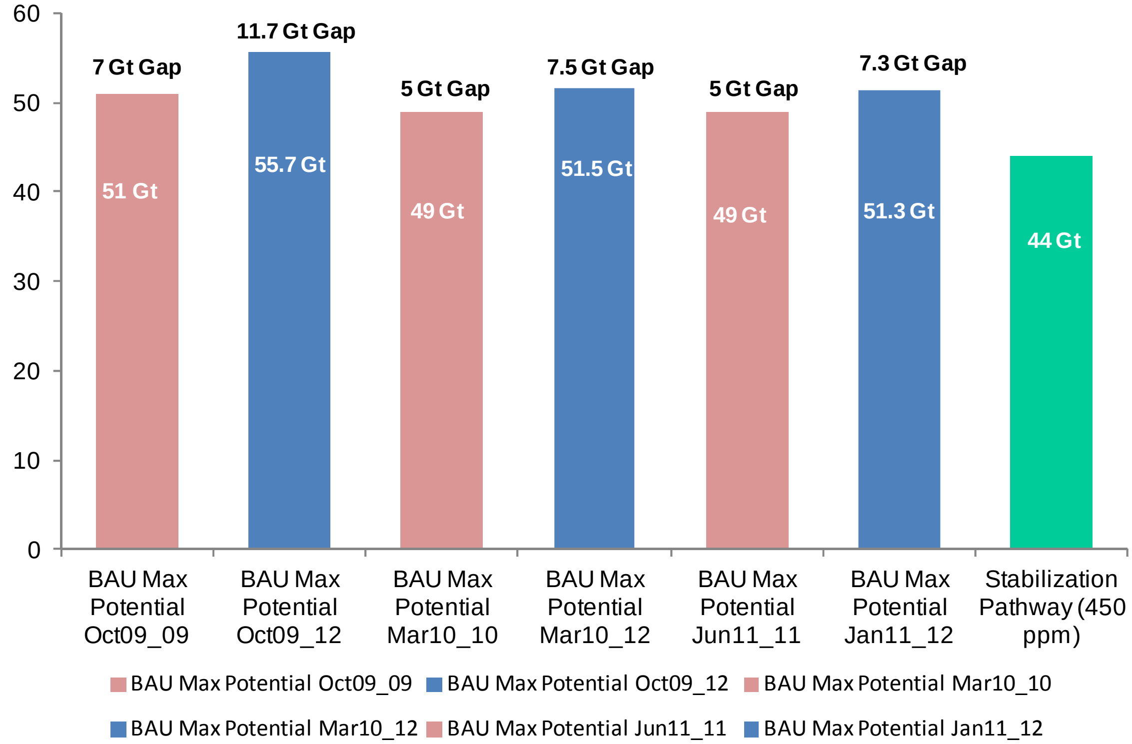
- **Denmark** already has ~20% of final energy from renewables (2008) and targets 30% by 2020. Finland has high aims for increasing its renewable energy share, relying predominantly on wood products to meet more than 35% of its target.
- Within the second group of countries in the best in class table from investment perspective there are stark differences between actual progress towards targets. **Norway** is already a leader in the renewable energy space and in early 2012 it's government set an ambitious target to source more than 60% of its power from renewables by 2020.
- **Japan**, although possessing many elements of TLC in their renewables policy, is faltering on actually meeting its binding clean energy mandates compared to counterparts with similar policy regimes; predominantly for fiscal reasons. Japan's budget deficit has worsened from 7.4% of GDP in FY2010 to 8.2% in 2011. This macro-economic situation has been exacerbated by the disruption arising from the March 2011 earthquake and related Fukushima Dai-ichi nuclear meltdowns. For the 11 months from March 2011 through February 2012, Japan has reduced electricity consumption by 5.7% Y/Y. Although electricity savings measures following Fukushima serve to also reduce emissions, Japan must now manage the challenging task of rebuilding the electricity system, not just quickly, but also in a low carbon manner. The tension between sustained conservation measures, rapid rebuilding, low-carbon generation expansion and grid overhaul make forecasting Japan's ability to follow through on previous commitments very difficult**.**
- Meeting clean energy mandates in **Brazil** is highly dependent on controlling deforestation in the Amazon, a vast challenge, but one that seems to be being addressed. In December, 2011 the National Institute for Space Research reported an 11% drop in Amazon deforestation rates. However it remains to be seen whether a new Forest Code that was passed at the end of 201,1 reducing the size of buffer zones around rivers and weakening the amount of land that owners must leave forested, will have a detrimental impact on meeting the longer-term deforestation target.
- Although **Italy** already has ~7% of final energy from renewables compared to its target of 17% by 2020, the government is finding it politically difficult to increase feed-in tariffs for renewables and the gap between its renewable energy ambition and the reality of delivering on it is becoming increasingly large.[11] Italy is expected to be one of 6 countries in EU that will not meet their 2020 renewables targets. In order to meet its target it is foreseen that the country will have to import renewable energy from neighboring countries. The EU has already had to take out infringement proceedings against Italy for not meeting interim clean energy targets.
- **South Korea and India** have non-binding emission targets, limiting the government's ability to enforce them. As previously discussed India has suspended key support tax incentives for the wind industry in April 2012 which is expected to greatly impact the growth of the market and thus progress towards its clean energy goals in the near-term. Delays around South Korea's much anticipated emission trading scheme due to resistance from industry will greatly impact any progress to meeting the country's GHG emission reduction target by 2020.
- Although **Sweden** lacks a feed-in tariff or Green Investment Bank, the country's renewables market is expanding, particularly with regard to wind and is progressing well towards its targets. The country already had 45% of final energy from renewables in 2008 and estimates an overall renewables contribution of 52.2% in 2020, exceeding its 49% target.
- In contrast **Spain**, although currently possessing high renewable power installed capacity and ambitious growth plans, suspended regulatory support in early 2012 and it's fiscal constrains mean that longer-term 2020 targets could be particularly difficult to meet. The Spanish government is being criticized for a lack of political will to truly support renewables, finding it politically difficult to justify higher feed-in tariffs. Owing to high renewable power capacity already installed Spain may still be able to meet its 2020 target if the current incentive freeze is lifted.
- Wind power is expected to play the most important role in future growth of renewables capacity in **Australia**. Yet low Renewable Energy Credits (RECs) prices, the main incentive for renewable wind power, are making it hard to facilitate the level of investment needed in the sector to meet the target of 20% renewable power by 2020. The key is how prices will react in the 2014-15 timeframe, and whether this will be enough to drive deployment when combined with the new carbon tax and emissions trading system and green bank. Currently around 10% of power demand in Australia is derived from renewable sources, so in a similar way to the UK the starting point is low and the challenge may be scale-up in time even though good policy is in place. In addition to this the wholesale electricity prices are very low in the country, further placing the country at risk of missing its clean energy target.

[11] Renewable Energy Europe, "A special report on the National Renewable Energy Action Plans outlining goals and measures to boost renewable energy use," September, 2010

Appendix I: Comparison of Current Model to Historic Model Results

Comparison of Historical Results

Comparison of Maximum Potential in Historical Models compared to the New Time-Series Model



Source: DBCCA and Columbia Climate Center analysis 2012

Comparing the New Time-Series Results with Previous Results

There are some differences in the emissions gap between the maximum abatement potential and the stabilization target of 44 Gt when we compare previously published tracker results to the current time series, as the chart above shows.

The largest of these discrepancies lies between the October 2009 results published in 2009 (we will call this Oct09_09), compared to the October 2009 results in this current 2012 time series (we will call this Oct09_12).

The reasons for these differences are two-fold: one is the change in the underlying data (which will shift the BAU baseline that each run used) and the other is a discrepancy between the exact targets used in each of the models.

For instance for the difference between Oct09_09 and Oct09_12 most can be explained by the differences in the baselines and the differences between the two databases and the targets contained within them:

Differences in the Baselines

As shown in the above chart, in Oct09_09 the *absolute* gap between stabilization at 44 Gt in 2020 and the maximum potential abatement is ~ 7 Gt; whereas the gap in Oct09_12 is ~ 11 Gt. Part of this difference is that the BAUs have changed (the 2020 BAU number is higher in Oct09_09 than in Oct09_12) because updated data for GDP growth rates and

Appendix I: Comparison of Current Model to Historic Model Results

IEA energy consumption were applied. Because of this, comparing the *absolute* gaps distorts the difference. In Oct09_09, the BAU amount in 2020 was ~ 59 Gt, whereas in Oct09_12, the BAU in 2020 is ~ 61 Gt.

If we look at the percent reduction between BAU and maximum potential abatement, we will see the reduction that the policies achieve relative to BAU. This gives a clearer picture of what we thought the world looked like in 2009 vs. our perspective of the world in 2012. This gets more directly to the question of how effectively policies are achieving abatement and how close we are to reaching the constant stabilization pathway (If we think of the pathway relative to BAU).

In Oct09_09, the maximum potential abatement resulted in 51 Gt, meaning that emissions decreased by ~ 13.6% relative to BAU. In the Oct09_12, maximum potential abatement resulted in 55.7 Gt, meaning emissions decreased by ~ 8.7% relative to BAU.

Differences in Databases

There are also important differences in the policies that were included in the Oct09_09 version and the Oct09_12 version. The total abatement differences primarily arise from high-abatement policies that were included in the Oct09_09 run, but which were **NOT** in the Oct09_12 run: instead, these policies were included in the March 2010 (Mar10_12) database because of the actual enactment date of the targets and the cut-off date for the time series.

When creating the time series, if we identified a date for a target as November 2009, that policy was included in the March 2010 database and not the October 2009 database. But in some instances that policy had actually been included in the previous Oct09_09, resulting in the original Oct09_09 run getting a higher abatement than the time series Oct09_12. The following table highlights some of the important targets that were included in Oct09_09 but not in Oct09_12; these targets were instead put in the March 2010 database. It can be seen that very similar individual impacts were attained when these policies were run in the March 2010 database. Most of the important policies causing this difference are Copenhagen Accord pledges (US, Indonesia, South Korea, etc). As there was a lot of 'noise' around these targets during the summer and early fall of 2009, they were included in the original Oct09_09 model even before they *officially* were submitted to UNFCCC during COP15. But in running the new time series in 2012 and checking for the dates of enactment of targets many of these actually now come after October 2009 and thus are placed in the March 2010 (post-Copenhagen) run.

The below table demonstrates this difference more clearly for some specific targets causing the greatest abatement difference:

Comparison of Targets between Previously Published Tracker Results and Current Time-series Results

Country	Policy	Oct09_09 Impact (Mt)	Oct09_12 Impact (Mt)	Mar10_12 Impact (Mt)
United States	17% reduction in GHG emissions from 2005 levels by 2020	**966**	**0**	**908**
United States	Fleet average of 35.5mpg by 2016	**169**		**156**
Indonesia	26% reduction in GHG emissions from the BAU by 2020	**879**	**0**	**883**
Brazil	**72% reduction in deforestation by 2017 compared to 2006 levels**	**439**	**0**	**1097***
Total		**2453**	**0**	**3044**

Source: DBCCA and Columbia Climate Center analysis 2012

* The difference big difference between abatement here when comparing Oct09_09 to Mar10_12 is due to a modeling error in October 2009.

** NB this table is not representative of ALL policies that were included in Oct09_09 but not in Oct09_12, but rather a list of the most important in terms of abatement potential.

Appendix I: Comparison of Current Model to Historic Model Results

If we take the ~ 3 Gt number shown above and add it to the reported maximum potential Oct09_12 abatement of 55 Gt (i.e. if we calculate abatement as if we had included these policies in Oct09_12) we come up with a number of ~ 52 Gt, bringing the gap to 7-8 Gt which is much closer to what we would expect from modeling these same policies.

From the analysis above it is clear that a fundamental issue behind the discrepancies in the 'gaps' between previously published data and the 2012 time-series comes from how targets are defined and what the policy world looked like in Oct09_09 and how we chose to define October 2009 today.

Appendix II: Detailed Results by CEM Country

Detailed February 2012 Model Results of CEM countries

February 2012 Results

Detailed CEM Simulation Results (federal level only)

CEM Country	Base (Mt CO2e)	No Policy BAU Emissions (Mt CO2e)		Impact of Mandated Targets (Mt CO2e)		Impact of Emissions Targets (Mt CO2)		GDP (purchasing power parity)	Capital Investment ($mn) to Clean Energy
	2008	2012	2020	2012	2020	2012	2020	2011 ($bn)	2000-2011
Australia	550	560	600	0	38.9	-20	116.9	1.51	10977
Brazil	2,380	2,440	2,580	0	1,127	0	1,007	2.52	51714
Canada	760	760	820	0	7.3	0	148	1.76	25363
China	8,650	11,140	15,970	0	4,070	920	2,327	6.99	191222
Denmark	60	60	60	0	28.9	0	17.2	0.33	8108
Finland	70	70	70	0	22	-10	n/a	0.27	2608
France	510	490	510	0	119.3	-40	n/a	2.80	19912
Germany	920	890	890	0	211.6	-20	176.8	3.63	52687
India	2,070	2,650	3,640	0	70.3	20	115.8	1.84	41229
Indonesia	3,160	3,220	3,400	0	4.4	110	883.1	0.83	2501
Italy	520	470	470	0	64.5	-10	n/a	2.25	25439
Japan	1,310	1,240	1,250	0	121.1	130	367.2	5.86	15770
Mexico	730	780	900	0	24.2	140	271	1.19	5207
Norway	50	50	50	0	0.1	10	24.9	0.48	5246
Russia	2,040	2,050	2,290	0	568.6	-900	-61.2	1.79	895
South Africa	530	560	640	0	9.5	0	218.6	0.42	374
South Korea	640	720	790	0	113	40	246.8	1.16	4447
Spain	380	340	350	0	81	20	16.7	1.54	81220
Sweden	60	60	60	0	32.3	-10	n/a	0.57	7101
UK	610	550	570	0	170.9	10	105.8	2.48	46904
US	6,190	5,950	6,550	0	231.1	-430	908.2	15.06	219498
UAE	180	190	230	0	0	0	0	0.36	918
EU Bloc	4,730	*4,480*	*4,610*	*0*	*1,050*	*-670*	*160*	-	-
CEM TOTAL (excluding EU Bloc)	42,660	46,770	56,240	0	7,117.1	240	6,733	55.64	819339

*Source: Source: DBCCA and Columbia Climate Center analysis 2012; GDP and Budget Strength data: CIA World Factbook; Capital Investment by country: Bloomberg NEF. *note: Does not include small scale projects, corporate or government R&D for adjustments for reinvested equity.*
NB: The EU has an overall target to reduce GHG emissions by 20% by 2020 from 1990 levels applied across its member states. Some nations also have their own more stringent emission targets. Where they do not and only rely on the EU target the 2020 abatement from emissions is left as n/a in the table above.

Appendix III: Policy Developments, 2011-2012

Policy Developments, 2011-2012

Key Positive Policy Developments in CEM Countries, 2011-2012

- **China** has continued to demonstrate leadership in the climate and renewable energy world. This comes from China's efforts to create a low carbon economy and improve its energy security through ambitious goals backed up by strong incentives encouraging the development of green industries and jobs. China's 12th Five Year Plan announced in March, 2011 provides clear evidence that China's low-carbon policies remain globally best-in-class. The 12th FYP established energy intensity and emissions reduction goals for 2015 in addition to many of the 2020 targets already announced. Another key component of the 12th FYP was the identification of 7 "Strategic Emerging Industries" (SEIs) including clean energy, clean energy vehicles, energy conservation and environmental protection, offering further evidence that China's government is placing heavy strategic importance on decarbonizing the nation's economy. The 12th Five Year Plan allocates RMB 3 trillion to be spent through 2015. This is approximately 60% of the total investment budgeted through 2020.
- In May, 2011 **Germany's** Parliament voted to completely phase out the country's 12 nuclear plants by 2022 – as a direct result of the nuclear accident in Japan –, and in July passed the latest revisions to its Renewable Energy Sources Act (EEG). The revised EEG, which took effect on January 1, 2012, raises the renewable energy feed-in tariffs (FiTs) for several technologies and sets a new target of 35-40% renewable energy in the electricity supply by 2020. Germany has also announced a 75% increase in clean energy investment research. However, our model results find that owing to the gap from nuclear power being filled by all energy sources including fossil fuels, the nuclear phase out will actually increase emissions in the short term until renewables further fill the gap.
- At the end of 2011 **California** announced a comprehensive summary of its Advanced Clean Cars regulation package, setting tough new emissions standards for cars and light trucks from 2015 through 2025. The package maintains the state's role in developing ground breaking standards for vehicles. The standards mean that vehicles sold in 2025 will cut fuel costs by at least 40% along with a 50% reduction in the quantity of GHG emissions. The package is designed to deliver a 47% reduction in GHG emissions by 2025 compared to today's levels; a further 75% reduction in smog-forming emissions by 2025; one in seven cars sold in 2025 will be zero-emission or plug-in hybrid vehicles; a total of 1.4 million zero-emission and plug-in hybrid vehicles to be on the road by 2025.
- Despite **US** Federal policy setbacks the Obama Administration, through the Environmental Protection Agency (EPA), has moved to restrict Hazardous Air Pollutants from coal via the Cross-State Air Pollution Rule (CAPR) and the Maximum Available Control Technology (MACT) regulations. These very important regulations were issued by the EPA in 2011, although in December 2011 the US Appeals Court in Washington granted a stay on the EPA rule, with a hearing in April 2012, and a decision later in the year. It therefore remains to be seen to what degree this Court decision will impact timing and enforcement of this rule. In terms of regulating carbon emissions, the EPA released its proposed New Source Performance Standards (NSPS) in March 2012[12], which are aimed primarily at carbon emissions from new coal-fired power plants and require the use of carbon capture and sequestration (CCS) on all new plants after a brief phase-in. These EPA regulations are expected to vastly change the economics of natural gas and renewables relative to coal in the US, with new coal-fired plants becoming very costly to install and many existing plants requiring costly retrofits[13].
- In 2011 **Brazil's** electricity procurement process moved decisively from the feed-in tariff model to the one using reverse auctions complimented by state-sponsored financing. 5.1 GW of capacity were awarded thorough reverse auctions of which 3 GW represented wind power. Complimenting the reverse auction process, Brazil's National Development Bank (BNDES) has taken the lead role in providing debt financing for wind projects. BNDES, through a state-sponsored soft loans program offers debt that is substantially (500bp-750bp) less expensive than market-priced debt. Combining Brazil's excellent wind resources with the competitive pressure of reverse auctions and low cost soft loans has resulted in substantial 63% reductions in the price of wind power in Brazil compared to earlier feed-in tariff

[12] The EPA is allowing 60 days for comment on this rule
[13] Report available at http:www.dbcca.com/dbcca/EN/investment-research/investment_research_2395.jsp

Appendix III: Policy Developments, 2011-2012

methods. We attribute 23 percentage points of this reduction directly to the lower cost soft loans. We see Brazil's policy of using reverse auctions and state-subsidized financing to elicit from the market the lowest achievable prices as key positive steps in 2011.

- In December, 2011 the **UK** Government announced a technical update to its Electricity Market Reform White Paper setting out the decision to legislate for a capacity mechanism in the form of a Capacity Market, designed to ensure consumers continue to enjoy reliable electricity supplies and avoid higher prices that could result from tight capacity margins; giving more detail on arrangements for Renewable Obligation Certificates from 2017 onwards; and setting out the next steps for the Electricity Market Reform process. The government intends to introduce electricity market reform legislation in the second session of this Parliament starting in May, 2012 and for legislation to reach the statute book by the end of next session (spring 2013) so that the first low carbon projects can be supported from around 2014. There are still some uncertainties about the detailed structure of the FiT CfD for offshore wind, but it should provide greater certainty over revenue and as it is considered to be more efficient in terms of costs should help to encourage longevity.
- In October, 2011 **Australia's** Parliament passed the Clean Energy Bill 2011 that will set a carbon tax that will force around 500 of the country's largest polluters to pay for each ton of CO2 they emit. The tax is expected to come into force on July 1, 2012 and will then evolve into an emissions trading scheme in 2015.

Key Neutral Climate Policy Developments in CEM Countries, 2011-2012

- As a result of high growth of solar in the **UK** due to the feed-in tariff (FIT) in February, 2011 the Government announced the first comprehensive review of the FiTs and confirmed a planned reduction in tariffs from August, 2011. The first phase of the consultation on FiTs was due to run until 23rd December, 2011 but the Government announced intended changes to FiTs from 12th December, prior to the end of the consultation. Nearly 30,000 solar PV installations were registered with the FiT in December, 2011 as a result of the Government's proposed cut off date of 12th December. However industry backlash led to a ruling by the High Court that the government had acted unlawfully in prematurely trying to lower rates and resultantly rates until April, 2012 were left in place as previously scheduled. In January 2012 the government published its response to part of the Comprehensive Review confirming new tariff rates from 1 April, 2012 for solar PV installations with an eligibility date on or after 3 March, 2012. It is expected that anyone who installed between December 12th and March 3rd will get the higher 43.3p/kWh rate; and anyone who installed between March 3rd and April 1st 2012 will get the higher rate for a few weeks and then drop to a 21p/kWh rate in April. The tariff is then intended to be reduced again in July and then every 6 months in line with falling cost of installing solar systems and to regulate spending under the FiT. It remains to be seen whether the impending changes to the UK's solar FiT will have an undesirable effect on the fast growing – yet still relatively nascent – solar market that has developed over the past two years.
- In March, 2011 **France's** Government set out an order for a new solar PV FiT scheme further to the suspension of the power purchase obligation. The new scheme limits installed capacity to 500 MW per annum. There were also FiT reductions for residential building integrated plants, commercial building integrated plants and ground plants. The tariffs will be adjusted quarterly on the basis of grid application volumes made during the previous quarter. The revision is viewed as neutral as it still allows for the additional installation of capacity that had received construction permits in 2010, which industry analysts estimate could result in 2011-2012 capacity additions in the region of 1.5 GW.[14]

Key Negative Climate Policy Developments in CEM Countries, 2011-2012

- In 2011 **Canada's** Government made the decision to exit from the Kyoto Protocol, thus eliminating the nation's former target to reduce GHG emissions by 6% between 2008-2012. The termination of this policy reduces the potential contribution to global emission abatement from Canada by 66 MtCO2e but does not change the net effect of increasing abatement in our global and CEM emission model.

[14] DBCCA: "2011: The Good, the Bad, and the Ugly," January, 2012

Appendix III: Policy Developments, 2011-2012

- The **US** renewable energy loan guarantee program expired in September 2011, and has since been weighed down by the highly politicized controversy over failed US solar panel manufacturer Solyndra, which received a $535 million loan guarantee in September 2009 and in August, 2011 filed for bankruptcy. The failure of Solyndra has raised suspicion among skeptics over the entire US clean energy industry and its federal policy support mechanisms. As a result, any similar program is extremely unlikely to be enacted.
- The **US** 1603 Treasury Grant Program, which reimburses renewable energy project developers in cash for 30% of a project's costs, expired at the end of 2011 and has not been extended. Congress was wary about extending the program due to the associated estimated costs of an extension. Retroactive extension also seems highly unlikely at this point.
- The **US** Production Tax Credit, a critical policy support mechanism for the US wind industry, is set to expire at the end of 2012 and its extension is currently highly uncertain. If extended, this is not likely to occur until the end of the year in the "lame duck" session of Congress, or even retroactively in 2013. Without this incentive the US wind industry would receive no federal support in 2013, and as a result future growth prospects for the industry rely solely on state RPS' and competitive pricing.
- At the end of 2010 **Spain's** government ratified a decree that reduced revenues to existing solar PV plants. These retroactive cuts severely impacted investor confidence in 2011. Furthermore in October, 2011 Spain announced that it is preparing to reduce the power price utilities must pay to new wind parks; regulation that is due to take effect in January, 2013 – doing little for the country's wind sector in 2012. Furthermore in January, 2012 Spain halted subsidies for renewable energy projects to help curb its budget deficit, passing a decree that stops subsidies for new wind, solar, co-generation or waste incineration plants. The suspension will not however affect operating plants or projects that have already been approved for subsidies.
- **Italy**'s Council of Ministers signed a bill in May, 2011 that progressively reduces FiT rates for solar PV from June, 2011. There will be bi-annual reductions in 2012 and 2013, after which a new FiT mechanism will be introduced. The decree included rate cuts ranging from 4-14% for projects installed between June and August 2011.
- In April 2012, as part of **India**'s FY2012 final budget, the pre-existing accelerated depreciation benefit available to wind power developers was eliminated. This provision, prior to elimination, permitted wind power developers to write off 80% of the project costs in the first year of operation. The accelerated depreciation benefit had been in place since the 1990's. India has also declined to commit to any further GHG emission cuts beyond what it made at the 2009 Copenhagen summit until after 2020, and even then this would be dependent on funding from the West.

In addition to these binding changes to targets and supporting policy over the past year, it is also useful from an investor perspective to assess upcoming proposals likely to influence renewable markets. Below we look at some key proposals currently on the table in the CEM nations.

Key Climate Policy Proposals in CEM Countries for 2012

- **South Korea** continues to push forward with plans to start an emission trading scheme in 2015, despite setbacks throughout 2011 due to opposition from industry. In February, 2012 lawmakers voted to impose GHG limits on the country's largest companies, overruling industry opposition. A special committee of the National Assembly on climate change passed legislation to establish a cap-and-trade scheme in 2015 and the bill moved to the nations Legislation and Judiciary Committee. However in a further setback to the proposed scheme, the National Assembly's Legislative and Judiciary Committee put off the vote for at least a month at the end of February. South Korea is now working to reschedule the vote, with a target of April or May. The main parties have agreed that emission trading will reduce GHGs linked to climate change.
- At the end of 2011 the **Australian** Minister for Climate Change and Energy Efficiency and **New Zealand's** Minister for International Climate Change Negotiations announced progress on plans to link the countries emissions trading schemes. Officials are identifying a number of areas where it would be important to work through efficient and practical ways of linking the schemes, noting that linking could commence in 2015 at the start of the flexible pricing period of Australia's carbon pricing mechanism.

Appendix III: Policy Developments, 2011-2012

- In 2011 the **US** made a proposed or Notice of Intent for new fuel efficiency standards from 2017-2025. These new standards result from the EPA's authority to regulate GHG emissions, combined with the Department of Transport's ability to set new mileage standards. This is not therefore from an Energy Law, nor is it mandated by Congress, and is a new and unusual basis for a fuel efficiency standard. It originated due to the Obama Administration instructing the EPA and Department of Transport to coordinate and work out a new, consistent standard in order to try and rein in emissions and meet geopolitical goals. The result was a 54.5mpg target by 2025 that is yet to be formulated into law, but does currently have the stated support of major US auto-makers

Special Focus: Proposed New US CAFE Standard

Current US fuel standards, known as CAFE standards, are amongst the lowest in the world, particularly among OECD countries – far lower than the EU and Japan for example. Starting in 2012 at 30.1mpg, they increase to require 35.5mpg by 2016, relative to around 47mpg by 2016 in the EU and Japan.

From a legislative perspective existing CAFE standards are robust as legally mandated by Congress under the 2007 Energy Law. Post 2016 however there are currently no further legislated fuel efficiency standards in the US so 35.5mpg will remain the standard unless further legislation is enacted.

In 2011, however, the US made some substantial progress towards new CAFE standards beyond 2015 with a Notice of Intent for new standards from 2017-2025. These new standards result from the EPA's authority to regulate GHG emissions, combined with the Department of Transport's ability to set new mileage standards. This is not therefore from an Energy Law, nor is it mandated by Congress, and is a new and unusual basis for a fuel efficiency standard. It originated due to the Obama Administration instructing the EPA and Department of Transport to coordinate and work out a new, consistent standard in order to try and rein in emissions and meet geopolitical goals. The result was a 54.5mpg target by 2025. Although still far lower than the EU standard of 64.8mpg by 2020 it is nonetheless significant progress.

The proposed standard has been widely cited in the media as an official target, in large because it was tentatively agreed to by automakers. However the robustness of this new standard is questionable for the following reasons:

- It is not yet finalized as an official rule in the legal Registry. Rather it is at the 'announced proposed rule' stage and still requires public comment and official legal submission;
- Given the fact that this is an election year in the US – and due to its enactment under a GHG provision, which is a highly politicized topic – there may well be legal challenges;
- There is a lack of time to get the rule finalized prior to the 2012 election. And due to its unusual foundation in the EPA/DOT it can be repealed by a new president if elected;
- It is also questionable as to whether Congress would ever agree to such an aggressive standard if it is not passed in the current manner.

It is thus unclear as to whether this new fuel efficiency standard will actually become law. We have however run the effect of the 2011 proposed 54.5mpg CAFE standard for vehicles in the US. The abatement effect of this standard is **240 Mt**, compared to **156 Mt for the current 35.5mpg by 2020**, thus if this standard is enacted it would reduce emissions by a further **84 Mt in the US** by 2020.

Appendix IV: Energy Emissions Methodology

Energy Emissions Methodology

As the starting point for measuring the impact of the policies identified in this document, we have worked with the Columbia Climate Center at the Earth Institute, Columbia University to calculate a business-as-usual (BAU) scenario based on projected growth in energy demand, beginning with 2007, 2008, and 2009 data from the IEA (Energy Balances 2011) and using the following key assumptions:

- Annual real GDP growth projections on a country-by-country basis for 2007-2016 (IMF *World Economic Outlook*, September 2011). Growth rates for 2017-2020 are not projected by the IMF, so for these years we use the average regional growth rates assumed by the IEA in its *World Energy Outlook 2010*.

- A global 1.5% annual decrease in energy intensity (measured as energy/RealGDP), which is equivalent to a 1.52% annual increase in energy productivity (RealGDP/energy). This reflects the assumption of autonomous efficiency improvement that is common in many energy-forecasting models (Lackner and Sachs, 2006). We have modeled this assumption slightly differently than McKinsey in its greenhouse gas mitigation cost curve, as they assume a 1.2% annual improvement in carbon productivity, or RealGDP/carbon (McKinsey Version 2 GHG Mitigation Cost Curve, 2009 p. 24). Given that we are modeling energy demand, it seems more accurate to assume an improvement in energy – rather than carbon – productivity.

- Energy data for the years 2007 and 2008 came directly from the IEA (*Energy Balances* 2010), while energy for the 2009-2020 period was based on a calculated projected growth in energy demand.

To illustrate this calculation, energy (measured as total primary energy supply) in France in 2020 is calculated as:

$$(\text{Energy}_{\text{France,2009}})*(1-.015)\text{^}11*(1 + \text{GDPgrowth}_{\text{France,2010}})* \ldots *(1+ \text{GDPgrowth}_{\text{France,2011}})*\ldots(1+\text{GDPgrowth}_{\text{France,2020}})$$

Note that this approach to project future energy maintains the energy mix in business-as-usual. This implies growth in renewables at the same rate as the entire economy. This likely overestimates penetration of renewables and underestimates the impact of policies for increasing renewable energy.

Next, we estimate the corresponding CO2 emissions using:

- The country-specific fuel mix from 2009 (the most recent year available in the IEA Energy Balances), assuming constant proportions in future years; and

- Carbon emissions factors in terms of MtCO2/Mtoe for OECD and non-OECD countries in 2006 from the IEA (WEO 2008, pp. 508-509, 522-523). For OECD countries, these are 3.86 for coal, 2.53 for crude oil, and 2.32 for gas. For non-OECD countries, they are 3.80 for coal, 2.57 for crude oil, and 2.20 for gas. The IEA Energy Balance data separates total primary energy supply estimates for petroleum products from estimates for crude oil. We assume here that all petroleum products are produced from crude oil and thus share the same carbon emissions factor. We assume that biomass has a net zero impact on carbon emissions, which is an acknowledged oversimplification of a complicated issue.

We considered using the reference case for CO2 emissions from the IEA's *World Energy Outlook* as the "business-as-usual scenario" against which to measure the impact of potential emissions reductions. The IEA reference scenario includes the impacts of oil prices and other factors on emissions, providing a level of complexity and robustness that we cannot replicate. However, it also includes the "effects of those government policies and measures that were enacted or adopted by mid-2008"

(IEA WEO 2008, p. 59). Thus, using it as a baseline to assess the impacts of the policies in the database would result in a misestimate of the impact potential emission reductions.

This analysis is also different from the IEA's biannual *Energy Technology Perspectives* report, which analyzes the energy and emissions impact of many different future technology scenarios. For example, they estimate the emissions profile of a future where carbon capture and technology is widely deployed and nuclear energy is more prevalent than today. In contrast, our business-as-usual scenario is exactly that – business as usual. The relative energy mix in each country is exactly the same as it was in our base year (2009).

Energy Data

The model is built around the "energy matrix" of each country. This matrix is obtained from the energy balances published by the International Energy Agency (IEA). In accordance with their data, the energy matrix distinguishes sources of energy (products) and uses of energy (flows).

The matrix has eight main products (Coal & Peat, Crude Oil, Petroleum, Gas, Nuclear, Hydro, Geothermal, Solar and Wind, Biomass) and two byproducts (Electricity and Heat). These eight main products and two byproducts are distributed across 21 flows (Transfers; Statistical differences; Electricity plants; CHP plants; Heat plants; Gas works; Petroleum refineries; Coal transformation; Liquefaction plants; Other transformation; Own use; Distribution losses; Industry sector; Domestic aviation; Road; Rail; Other transport; Residential; Commercial and public services; Other sectors; Non-energy use).

The structure of the energy matrix allows us to distinguish between policies that are applied to the Total Primary Energy Supply (TPES) and policies that call for a reduction or shift in Total Final Consumption (TFC). We modify all flows when evaluating policies that apply to TPES. We only modify the nine consumption flows (Industry sector; Domestic aviation; Road; Rail; Other transport; Residential; Commercial and public services; Other sectors; Non-energy use) when evaluating the impact of policies that target TFC.

By modifying the energy matrix as a result of applying a policy we are able to assess successive policies within a country without double-counting. For example a biofuel mandate policy interacts with renewable energy standards. One of the largest differences between our previous model studies and the current one is the systematic transformation of the energy matrix and the successive evaluation of the criteria to apply each policy.

CO_2e Emissions

We estimate projected emissions from non-CO2 Kyoto greenhouse gases – CH4, N20, HFCs, PFCs, and SF6 – by using data assembled by the U.S. EPA (Global Anthropogenic non-CO2 GHG Emissions, 1990-2020). This dataset, used by both McKinsey and WRI, includes actual emissions for 1990, 1995, 2000, and 2005, and projected emissions for 2010, 2015, 2020. We assume that intervening years are a simple linear interpolation of the surrounding years. We note two potential concerns with this dataset:

1. The EPA projections incorporate regional GDP growth rates estimated by the Energy Information Agency in 2001. These rates are obviously different from the October 2010 IMF country-specific growth rates we use to estimate CO2 emissions from energy. We do not have enough information about the EPA model to re-parameterize their estimates based on more recent GDP growth projections.
2. The EPA data use the Global Warming Potential (GWP) conversion factors for other greenhouse gases into CO2 equivalents (CO2e) from the earlier IPCC reports. We have updated the CH4 and N2O projections of CO2e emissions using the GWPs from the IPCC AR4. The EPA does not report disaggregated data for the other Kyoto gases, so these are still projected using the older GWPs.

Appendix IV: Energy Emissions Methodology

Greenhouse gases regulated by the Montreal Protocol are included in the estimate provided by the Greenhouse Gas Counter we launched on June 18, 2009 in Times Square, New York City. It is reasonable to include these gases in the stock of climate-forcing gases currently in the atmosphere - which is what the counter monitors - but since they are generally no longer emitted, we have not included them in our estimate of BAU greenhouse gas emissions. In addition, none of the other common inventories or projections (McKinsey & Co, WRI, etc.) include the Montreal gases in their CO_2e emissions datasets.

Land-use Change and Forestry Emissions

The IPCC AR4 summarizes the range of estimates for Land Use, Land Use Change and Forestry (LULUCF) (WG3, ch.9, table 9.2) and concludes that: "The picture emerging from Table 9.2 is complex because available estimates differ in the land-use types included and in the use of gross fluxes versus net carbon balance, among other variables. This makes it impossible to set a widely accepted baseline for the forestry sector globally. Thus, we had to rely on the baselines used in each regional study separately (Section 9.4.3.1), or used in each global study (Section 9.4.3.3). However, this approach creates large uncertainty in assessing the overall mitigation potential in the forest sector. Baseline CO2 emissions from land-use change and forestry in 2030 are the same as or slightly lower than in 2000 (see Chapter 3, Figure 3.10)." This suggests that there is no definitive study and that existing studies have different methodologies and wildly different estimates, ranging from 3 to 9 GtCO2 per year worldwide between 1990 and 2005.

Here we use data from Houghton, 2003, (whose estimates are included the IPCC table 9.2) and assume that the amount of deforestation in 2000 continues at the same level through 2020. The Houghton data are readily available, internally consistent (unlike the IPCC range of estimates from various sources), and are used by McKinsey and the World Resources Institute's Climate Analysis and Information Tool.

Houghton's 2003 dataset is available via the WRI website and represents emissions through 2000, allocated to individual countries. In the data documentation (http://cait.wri.org/downloads/DN-LUCF.pdf), Houghton states that "The errors associated with the regional estimates of carbon flux are substantial. The errors for individual countries are even larger because of the methods used to distribute the regional totals." This is a strong warning about spurious precision in interpreting LUCF estimates. Global emissions in 2000 are estimated at 7.6 GtCO2. Houghton has a more recent dataset (2008) with somewhat lower estimates, but these data are not available on a country-by-country basis and are thus not applicable to this project.

Finally, current emissions from peat bogs (rather than from peat combustion – which is included in the IEA's coal category) are estimated by Hoojier et al 2006 (and included by McKinsey, assuming constant future emissions). We have not investigated peat datasets, since there are no policies aimed at peat emissions in the tracker. Given the overall level of uncertainty with regard to terrestrial emissions (and the relatively small contribution from peat, estimated at 2.0 GtCO2 per year, relative to 3-9 GtCO2 range of land-use and forestry emissions in the IPCC AR4), we have excluded peat emissions.

Cement Process Emissions

Cement emissions must be incorporated in a BAU scenario. The IEA dataset includes the energy emissions associated with the production of cement, but does not include the emissions produced by the cement calcination process.

Oak Ridge National Lab's Carbon Dioxide Information Analysis Center (CDIAC) provides estimates of emissions from the cement calcination process for every country through 2006 (Marland, G., T.A. Boden, and R.J. Andres, 2008). This dataset is included in the World Resources Institute's Climate Analysis and Information Tool dataset. In McKinsey & Co's work, the CDIAC data was used to build proprietary cement estimates assembled from a number of additional sources, including the World Business Council on Sustainable Development (WBCSD)'s Cement Sustainability Initiative, the IPCC, the IEA, and the

Appendix IV: Energy Emissions Methodology

European Cement Research Academy. The advantage of the CDIAC dataset is that it is transparent and easy to disaggregate by country and year.

Using the CDIAC data, we assume that cement process emissions grow at the level of GDP growth in countries that remained below $15,000 in GDP-PPP in the IMF's forecast time period (2007-2014). In countries where GDP-PPP is projected to be above $15,000 through 2015, we assume a constant level of process emissions. Finally, in those countries that are projected to hover around $15,000 for most of the years between 2007 and 2014, we assume that process emissions grow at half the rate of GDP growth. These assumptions are obviously very simple, especially since they do not allow countries to move between the three groupings. In addition, we also ignore GDP-PPP growth after 2014. We think, however, that these assumptions allow us to estimate the approximate trend of cement process emissions (WWF-LaFarge Partnership, *Blueprint for a Climate-friendly Cement Industry*, 2008).

450 ppm CO_2e Stabilization Scenario

In two of our previous studies we showed a reference CO2e emissions stabilization pathway to reach 450 ppm of CO2e. This pathway is from the *OECD Environmental Outlook to 2030* (2008, p. 140) and was generated using the Netherlands Environmental Assessment Agency's FAIR model. The values for 2005, 2010, 2015 and 2020 are 46.7, 48.1, 49.1, and 45.6 GtCO2e, respectively. These values fall within the range of stabilization scenarios developed in recent years as reported in the IPCC AR4 report. *The Emissions Gap Report,* UNEP (2010) is a comprehensive analysis of whether the Copenhagen Accord pledges can place the world on a pathway that restricts global temperature rise to 2^{o}C or towards 450ppm. They recommend emissions in 2020 between 39 and 44 Gt CO2e/y (p. 10). Here we compare projected emissions with that 44Gt/y reference value.

Policy Targets: Emissions Reduction and Mandate Targets

There are two general categories of targets: emissions reductions and mandates. The criterion to distinguish whether a policy is an emissions reduction versus a mandate target is scope. Economy-wide reduction goals, without specifying sector (such as the Kyoto Protocol reductions), are classified as emission targets. If the policies aim to reduce energy use or to increase the renewable share, they are categorized as mandate targets. Thus, the Regional Greenhouse Gas Initiative, which limits emissions of power plants through efficiency measures, is a mandate target because energy demand is reduced as a consequence of applying the policy.

To model the impact of emissions reduction policies, we calculated the difference between emissions in the baseline year (e.g.,1990 for most of the Kyoto targets) and those in the target year (e.g., 2012 for the Kyoto targets). For baselines not in our dataset (e.g., a 10% reduction from 2000), we used World Resources Institute data (as our dataset closely follows their methodology).

A variant of emission reduction targets are greenhouse gas (or carbon) intensity targets. These intensity targets aim to reduce the ratio of greenhouse gas emissions and the real GDP. Since realGDP and emissions do not grow identically (because of the autonomous increase in efficiency), a 10% GHG intensity target leads to different target emissions than a 10% emissions reduction target. For these policies, the emissions target is estimated given the target intensity and the realGDP of the target year and then used to estimate the emission reduction impact. Carbon intensity targets assume that only energy-related carbon dioxide will be affected. This excludes CO2 change from land use as well.

Mandate targets in our database aim to reduce emissions from energy use, either by reducing demand through efficiency measures – which can be applied to a specific industry, buildings, or vehicles, or by switching to low carbon emission fuel sources. Some policies target energy use while others target electricity. Economy-wide efficiency is addressed via energy intensity targets. Energy intensity is defined as the Total Primary Energy Supply (TPES) per unit of realGDP. As already noted, energy and realGDP have different growth rates because of the model's built in increase in efficiency. Energy intensity targets are estimated by calculating the target TPES required to meet the target intensity for the realGDP of the target year and then reducing all energy flows accordingly.

Estimates of Target Impact

Target impact is calculated as the difference between business-as-usual emissions in the reported year and emissions assuming full compliance of the policy. A negative impact, hot air, occurs when the target represents higher emissions than what is projected for business-as-usual.

We report the impacts of emission target policies for two target years, 2012 and 2020, reflecting the prevalence of the 2008-2012 and 2013-2020 periods in emissions targets. In some cases, policies specify a target year beyond 2020, such as a 60-80 percent reduction by 2050. For these targets, we down-scaled the target what would be attained by 2020. When a single emissions policy has two targets with different target dates, we divide it into two periods to be consistent with the two periods in emissions targets.

In contrast, mandate target policies do not follow these two periods, so we consistently report the impact for 2020. When a single mandate policy has multiple targets for different years, we assume that they are related and only model the one with the end date closest to 2020. If the only end year is after 2020, we downscale the goal to 2020.

In the case of both emissions and mandate targets, if the end date is before 2020, the energy or emissions in that year are applied the business-as-usual growth rate.

Mandate Modeling Assumptions

Mandate targets are applied by modifying the country's energy balance. After a policy is applied, and the energy balance is altered, the associated emissions for each energy product are then calculated as described above. To calculate the impact of each mandate, the energy emissions are added to the emissions from non-CO2 Kyoto greenhouse gases, and LUCF, and are then compared to the business-as-usual scenario.

As mentioned above, our model assumes that only energy derived from fossil fuel-based sources, which include coal, crude oil, petroleum, and gas, emit carbon dioxide. Solar, wind, hydro, geothermal, and biomass are considered "renewable" and are assumed to contribute no CO2 emissions. Nuclear is not considered a renewable source in this study, but is assumed to contribute zero emissions.

For mandates calling for changes in *electricity*, calculations are based on the electricity generation numbers of each country published by the IEA. To model these policies, we alter the contribution of each energy product, while keeping the total electricity generation constant (unless a policy asks for a cut in production). Given that electricity generation is a by-product of energy use, after a policy is applied, the new electricity generation mix is converted into TPES, using the corresponding thermal efficiencies for each energy product. The thermal efficiencies used in the model are derived from the country's 2009 energy portfolio. The value for *electricity plants* in the energy matrix is then modified to balance changes in the electricity generation mix.

Below we outline the logic and primary assumptions behind our modeling of the mandate targets:

Appendix IV: Energy Emissions Methodology

Renewable Portfolio Standard (RPS) Electricity Targets

For RPS-electricity targets, we calculated the impact of additional renewables from the business-as-usual level of renewables in the country's electricity output data. As for the case of energy mandates, we assumed displacement of coal first and then reduce the use of other fossil products until the energy has been fully transferred. Unless specified within the wording of the policy, nuclear is not considered a renewable product; for those policies that specify nuclear, it is included.

When the policy calls for installed capacity of renewable power, these targets are applied prior to a more generic increased proportion of renewables. The capacity factors applied to renewable electricity are 1 for geothermal and biomass, 0.4 for hydro, 0.29 for wind, and 0.17 for solar power. Since the IEA energy data set does not distinguish between solar and wind energy we assume that the mix is 90% wind and 10% solar).

Energy Efficiency Mandate Targets

When applying efficiency mandates, we lower the energy, or electricity use, across the relevant products for the country. Energy intensity targets lower the energy supply throughout the economy. Several mandate policies represent efficiency standards, such as bans on incandescent bulbs, efficiency of televisions or of lighting. In these cases we make assumptions regarding the proportion of the targeted sector within electricity consumption.

Transportation Mandate Targets

Unless specified within the wording of the policy, we assume that mandates regarding transportation target the road sector of each country. This assumption is based on the fact that the road component represents a substantial fraction of the energy use of most countries. Furthermore, international aviation and shipping make up a large portion of total aviation and shipping, but they are not included in the national energy balance published by the IEA.

Transportation policies include both efficiency (such as Corporate Average Fuel Economy Standards) and renewable fuel standards (mainly mandated reliance on biofuel or biodiesel).

For <u>RPS-fuel mandates</u> we calculated the impact of adding biofuels above the existing level of biomass consumed by a country's road sector. We assumed that biofuel displaced energy in proportion to the existing mix from fossil fuel products within the road sector. In most cases, fuel displaced in road came from petroleum. For policies that increase ethanol or biodiesel use, we assume these fuels are interchangeable because the energy data set does not distinguish them. Our assumption of biomass emitting no carbon is optimistic but it provides a maximum impact estimate for biofuel policies. The true emissions associated with biofuels requires a lifecycle analysis for each type of biofuel (corn-based ethanol, sugar cane based fuels, etc) and nation. While a full analysis is outside the scope of this study, a low emission factor for road biofuels could be incorporated into future versions of the model.

For all mandates calling for a <u>fuel efficiency standard</u>, we computed the difference between the old fuel standard and the new standard, and decreased the energy usage in the road flow for petroleum and gas by this corresponding factor. To accurately estimate the impact of the mandate targets, energy consumption in the road sector was scaled on a country-by-country basis to reflect the portion of the fleet that the policy applies to (e.g. cars, trucks, or heavy-duty vehicles). We represent the transition that would take place in the application of such a policy by assuming that each car in the fleet has a life of 10 years. That is, 10% of the fleet each year will have the new fuel standards, such that the fleet turns over completely in 10 years.

Appendix V: Impact of State/Provincial Targets

State-Level Impacts to the Emission Abatement Model

The table below shows that when state-level targets are also considered for the US, Canada and Australia the rank order of potential abatement changes, with Canada moving up from 13th place at the federal level to 8th including state-level targets. Similarly Australia moves up slightly from 15th place when only considering federal targets to 14th when factoring in state-level targets.

For the US the inclusion of state-level targets does not impact its 4th place in the rank order of countries (compared to its federal only policy rank), but an additional 80 Mt of potential emission reduction is realized through its state-level targets.

A combination of state and federal policies achieves a greater abatement than federal policies alone, highlighting the importance of state level mandate policies. In the US federal mandates alone lead to an abatement of 204 MtCO2e, whereas federal and state mandates combined almost triple the impact (665 MtCO2e in 2020). (However, it is the emission abatement is used in the global maximum potential calculation for the US as the federal and state impact of emissions is 987 Mt CO2e, thus greater than the mandates.)

The US' federal emissions target policies are complemented by emission targets from 22 states and the impact of the state emission targets is driven by the magnitude of their BAU emissions and by their ambition. Among high emitting states, California achieves a reduction of 60MtCO2e through its WCI commitment; New York achieves an abatement of 48MtCO2e through its state target to cut emissions by 10% from 1990 levels; and Illinois reduces 34MtCO2e through its policy for 2020 emissions to return to 1990 levels.

Rank order of CEM in the February 2012 maximum abatement potential 2020 (Mt) including state-level targets

Ranking	Country/Region	Maximum Abatement Potential 2020 (Mt)
1	China	**4071**
2	Brazil	**1127**
3	European Union	**1054**
4	United States	**987**
5	Indonesia	**883**
6	Russia	**569**
7	Japan	**367**
8	Canada	**317**
9	Mexico	**271**
10	South Korea	**247**
11	South Africa	**219**
12	Germany	**212**
13	United Kingdom	**171**
14	Australia	**136**
15	France	**119**
16	India	**116**
17	Spain	**81**
18	Italy	**65**
19	Sweden	**32**
20	Denmark	**29**
21	Norway	**25**
22	Finland	**22**
23	UAE	**0**

Source: CCC, DBCCA analysis 2012. Results consist of targets in place in the CEM nations as of February 2012 at the federal and state level.

Appendix V: Impact of State/Provincial Targets

For Australia, emission targets at the federal level only reduce emissions by 117 MtCO2e in 2020, but with the addition of state targets this rises to 136 Mt CO2e. Mandates at the federal level in Australia have the potential to reduce emissions by 39 MtCO2e in 2020, and with the addition of state level mandates this rises to 60 MtCO2e.

In Canada, emission targets at the federal level only reduce emissions by 148 MtCO2e in 2020, but with the addition of provincial targets this rises to 317 MtCO2e. Mandates at the federal level in Canada have the potential to reduce emissions by 7 MtCO2e, but there is a significant increase with the addition of provincial mandates, bringing the potential abatement to 136 MtCO2e. For both emission targets and mandates it shows that provincial policies in Canada are far more ambitious than federal policies. The increase in abatement with the addition of state emission targets is mainly attributed to the four Canadian provinces that participate in the Western Climate Initiative. Canada lacks a national renewable energy target, so relies heavily on the six provinces that have mandate targets (Alberta, British Columbia, Manitoba, Nova Scotia, Ontario and Quebec). The largest impact is achieved by Ontario's target to close coal-fired power plants (111 MtCO2e of abatement).

Best In Class Assessment for Key US States

	Emissions Control			Financial Support					Risks	Deployment	
Country	Binding/ Accountable Emission Target	Renew-able Electricity Standard	Long-term Energy Efficiency Plan	Feed-in Tariff	Long-term Govt-based 'Green Bank'	Tax Benefits	Long-term funding programs	Long-term Grid Improvement Plan	Budget strength (deficit as % of GDP in 2011)	GDP 2011 (Official Exchange Rate $tn)	Likelihood of achieving targets
California	✓	✓	✓	✓	X	✓	✓	✓	-0.46%	$1.96	
New Jersey	✓	✓	✓	X	X	✓	✓	✓	-2.1%	$0.50	
Texas	X	✓	✓	X	X	✓	✓	✓	-1.9%	$1.14	

Source: DBCCA Analysis, 2012; GDP and Budget Strength data: CIA World Factbook

Above we have extended our best-in class assessment to look at 3 key states in the US. We can see from this that California is a leader in climate policy, possessing all the key elements of 'TLC' in its climate policy aside from a green investment bank and the state is also a leader in renewable energy deployment and is expected to meet its renewable energy targets.
Our model shows that California's emission targets have the greatest potential to reduce emissions with a cumulative reduction of 100 MtCO2e by 2020. The state's mandates are also aggressive and have potential abatement of 97.5 MtCO2e.

New Jersey also fares well in terms of the investor assessment of its climate policy, however it lacks any feed-in tariff structure to support the take-up of renewable energy. New Jersey's emission target holds 23.5 MtCO2e abatement potential. The state's mandates would reduce emissions by 21.7 Mt CO2e in 2020.

Texas' climate policy is not supported by an overarching emission target, lacks a feed-in tariff and a green investment bank. Although the state has wind energy targets the abatement potential of these is limited as there is already a high capacity of wind deployed in Texas. The main target in terms of abatement potential in Texas is its target that utilities must offset 25% of growth in power demand through efficiency by 2012; and 30% by 2013. This carries 80 MtCO2e emission abatement potential.

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