Global climate change policy tracker: Efficiency mandates drive abatement impact

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In April 2012 we published our Global Climate Change Policy Tracker[1] documenting the abatement potential of global emission targets and mandates in 2020. Building on this, in this short note we look more closely at the mandates in our model and analyze which types of these are most important and which countries and sectors hold the largest potential to reduce emissions. We distinguish between 1) Efficiency mandates 2) Renewable mandates and 3) 'Other' mandates. **Mandates** either change the energy supply/demand mix (such as by increasing renewables) or change emissions of a specific sector of energy use (such as improving efficiency from vehicles). Therefore, energy intensity targets are a subset of mandates because they reduce energy use per unit of GDP.

- As concluded in our April 2012 Global Climate Policy Tracker, if fully implemented, **mandate policies will have more impact than emission targets at lowering emissions** (mandates would reduce emissions by ~8.6GtCO_2e where as emission targets would reduce emissions by ~7.4 GtCO_2e in 2020) on a global basis in February 2012.
- Disaggregating these mandates into the key three categories, in our February 2012 database, there were a total of 499 mandates: 286 were renewable mandates, 204 were efficiency mandates and 9 were 'other' mandates.
- The greatest abatement comes from the efficiency mandates (dominated by energy intensity mandates), with net reduction in 2020 emissions of ~**5Gt compared to BAU**. Although there are more renewable mandates in the model, they lead to emission reductions of ~2.6 GT, almost half that of the efficiency mandates. 'Other' mandates lead to a ~1Gt reduction in emissions.
- Our comparison of abatement from mandates between October 2009 and February 2012 shows that for all 3 mandate categories the abatement impact in February 2012 compared to October 2009 has increased in the order of 1-1.5Gt owing to an increase in the absolute number of mandates and/or their scope.
- Efficiency mandates show the largest improvement in abatement impact over time, rising from 3.4Gt abatement impact in October 2009 to 5Gt impact in February 2012 compared to BAU in 2020.
- Mandates to reduce emissions can be applied to the entire energy system or to specific sectors of the economy. The following 6 specific sectors can be distinguished in the model: the entire energy system; the power sector; transportation; buildings; land use; and multiple sectors.
- Mandates applicable to the entire energy system have the greatest abatement potential as demonstrated by the energy intensity mandate in China (3.4 Gt) and the 2020 renewable energy mandate in the EU (665Mt).[2] This is followed by mandates applicable to the power sector (3.1 Gt) then land use (1Gt). Transportation accounts for a significant ~690Mt of abatement whilst buildings account for ~360Mt. Mandates applicable to multiple sectors account for 315 Mt of abatement.

[1] DBCCA Global Climate Change Policy Tracker, April 2012: http://www.dbcca.com/dbcca/EN/investment-research/investment_research_2410.jsp
[2] For details on the Chinese and EU mandates, see Figure 5 below.

Emission Abatement & Historical Time Series Analysis of Mandates

For the purpose of this analysis, we split the mandates in the model in 3 categories to better assess which policies hold the most abatement potential globally:

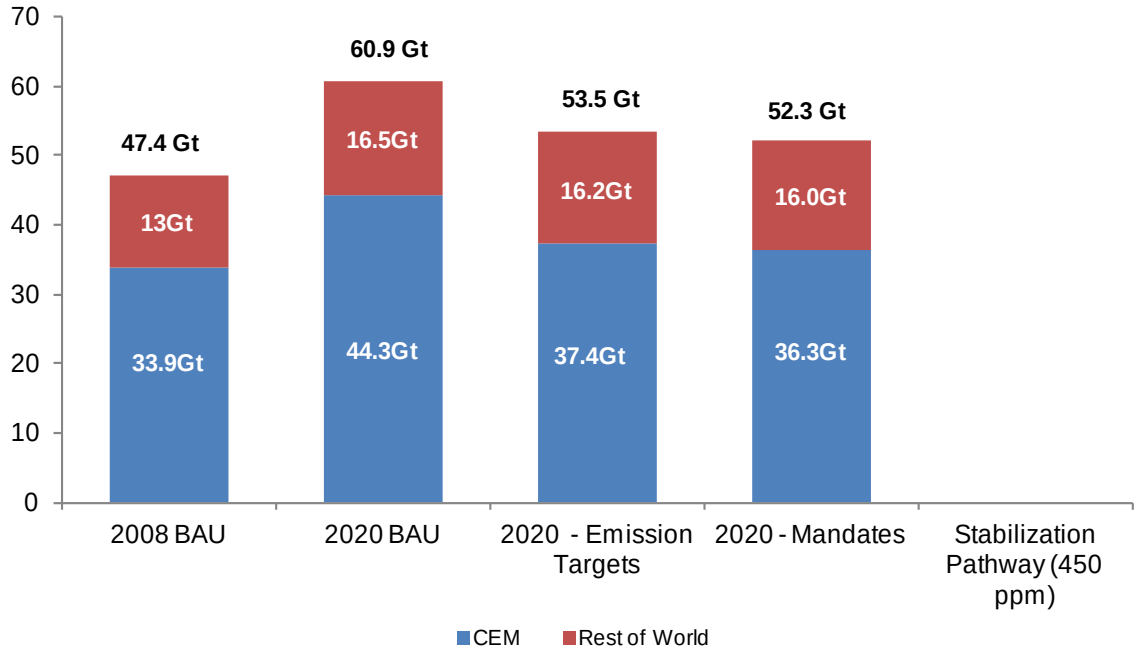
- **Renewable targets aim to increase the contribution of renewable sources to a country's energy portfolio** (e.g. UK's target for 15% of gross final energy consumption from renewable sources by 2020; and Germany's target to source 35-40% of its electricity generation from renewable sources by 2020). These can address the power sector, buildings (through heating and cooling primarily), or transportation through biofuel mandates.
- **Efficiency mandates reduce energy use**, either by specifying an improvement in sector efficiency, capping emissions for a specific sector, improving the fuel efficiency of vehicles, or reducing power use in buildings through appliance or lighting regulations. Energy intensity targets mandate a reduction in energy intensity, the ratio between energy supply or demand and GDP (e.g. China's target to reduce energy intensity by 18% from 2010 levels by 2015). Countries aim to minimize energy intensity by streamlining industrial processes, improving the built environment, transport and consumer appliances.
- **Other mandates** do not address either renewable sources or efficiency directly (e.g. Brazil's mandate to reduce deforestation by 80% by 2020; and Ontario and Denmark's mandates to phase out coal-fired power plants).

Below, we compare the current (February 2012) aggregate impact of mandate policies overall and then according to the policy types listed above. We then compare this to the mandates and types of mandates that were effective in October 2009 to see what has changed over the past two years. The October 2009 run represents a pre-Copenhagen snapshot in time and is thus ahead of increased international efforts to control climate change.

Emission Abatement Results

As documented in our April 2012 Global Climate Change Policy Tracker, BAU emissions start at ~47 $GtCO_2e$ in 2008 and rise steadily to 2016 when the world aggregate growth weakens slightly due to slower emerging economy growth. Emissions in 2020 are around 60.8 $GtCO_2e$. Global emission targets (including all national and state policies) as of February 2012, if fully achieved, would reduce emissions by **~7.4 $GtCO_2e$** in 2020 from BAU levels. Global mandates as of February 2012, if fully achieved, would reduce emissions by **~8.6 $GtCO_2e$** in 2020 from BAU levels as shown in Figure 1. Therefore, we concluded that **mandate policies could prove more effective, if implemented successfully,** than emission targets at lowering emissions on a global basis in February 2012. We do not tackle the issue of implementation in this note.

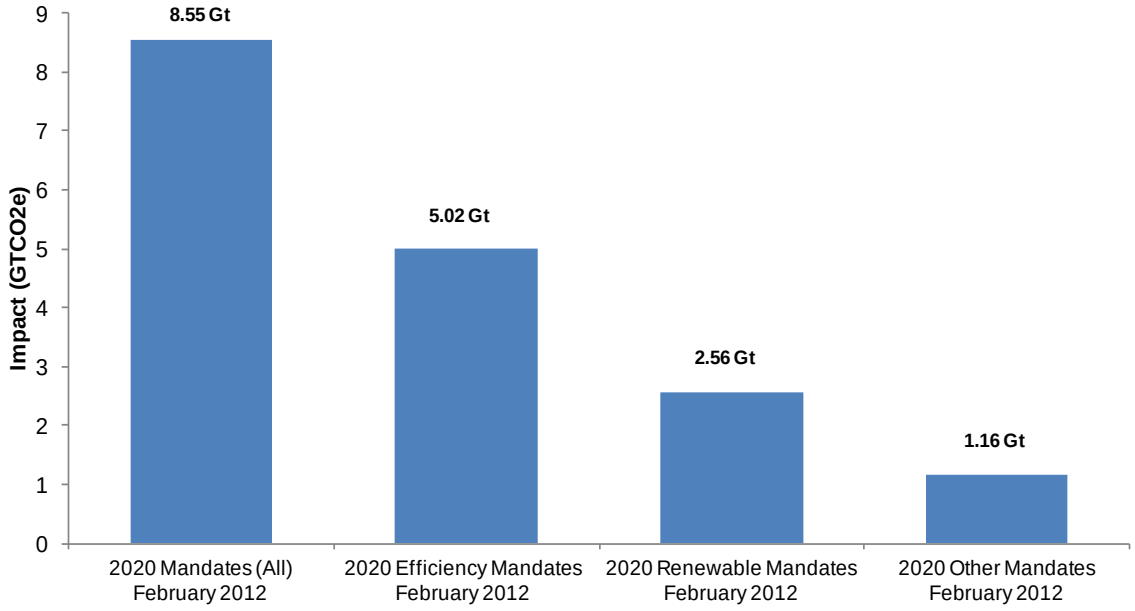
Figure 1: The 2020 estimated emission outcome based on global mandates and emission targets in February 2012



Source: Adapted from DBCCA Global Climate Change Policy Tracker: Continued Progress on Mandates, but the Emissions Challenge Remains, April 2012

Now looking in more detail, we evaluate whether efficiency, renewable or 'other' mandates have the greatest abatement potential. **In our February 2012 database, there were a total of 499 mandate policies: 286 were renewable mandates, 204 were efficiency mandates and 9 were 'other' mandates.** Figure 2 shows that the greatest abatement comes from the efficiency mandates, with net reduction in 2020 emissions of 5Gt compared to BAU. While numerically there are more renewable mandates, they lead to emission reductions of 2.6 GT. The lowest abatement is seen for the 'other' mandates, for total emission reduction of 1.2GT.Gt. Since all three types of mandates interact when they are applied together, global emission reductions for all mandates total 8.6GTGt, slightly less than the sum of the abatements in each category.

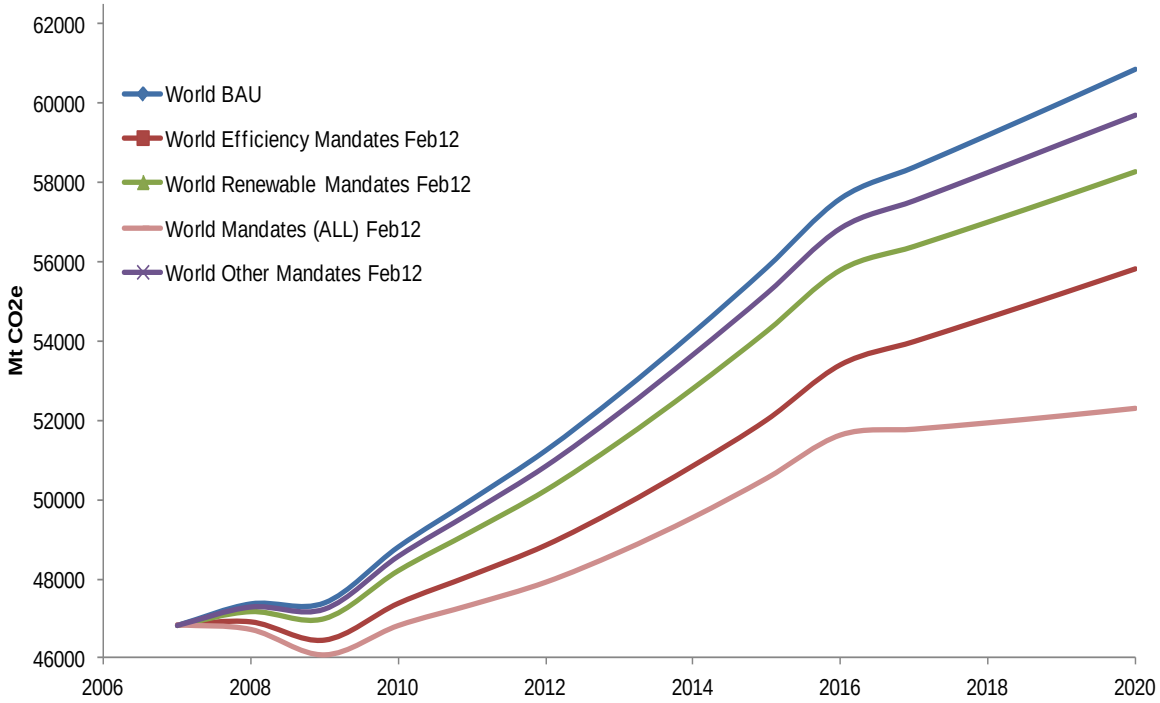
Figure 2: The 2020 estimated abatement impact of current global mandates in February 2012 compared to BAU (Gt)



Source: DBCCA Analysis 2012; Columbia Climate Center Analysis 2012.

Figure 3 shows the trajectory of emissions for the policy database of February 2012. The sum of mandates has the greatest impact, followed by the subset of efficiency mandates. On their own, if fully implemented, the sum of mandates could produce a plateau in emissions in 2016, assuming emerging market economic growth slows at that time.

Figure 3: Global emission abatement Impact of Current Mandates



Source: DBCCA Analysis 2012; Columbia Climate Center Analysis 2012

Individual Country Analysis

Although efficiency mandates have the greatest abatement on a global level, this is not the case for individual countries as shown in Figure 4. Brazil is the only country to have its greatest abatement among the 'other' mandates, due to its aggressive deforestation mandate (~1Gt abatement). Efficiency brings the greatest abatement for China, the EU-27, Japan, Russia, South Korea and the US. By contrast the individual EU countries that have the largest emissions (such as Germany, the UK, France, Italy and Spain) attain a greater abatement through renewable mandates. While this could be interpreted as a trend of efficiency for nations that are growing or overhauling their energy and industrial systems, a detailed look at the relevant mandates is needed.

Figure 4: Abatement from efficiency, renewable and 'other' mandates for CEM countries, EU-bloc and the world (Gt).[1] The type of mandate that gives the most abatement for an individual country/region is **highlighted in blue.**

	February 2012			October 2009		
	Efficiency (Mt)	Renewable (Mt)	Other (Mt)	Efficiency (Mt)	Renewable (Mt)	Other (Mt)
Australia	5.1	**41.9**	0.0	5.1	**41.9**	0.0
Brazil	3.0	29.7	**1097.7**	**3.0**	0.0	0.0
Canada	0.0	26.3	**111.0**	0.0	19.1	**111.0**
China	**3424.4**	723.7	2.0	**2060.4**	229.1	0.0
Denmark	7.1	**14.7**	16.5	7.1	**8.2**	0.0
Finland	9.4	**14.9**	0.0	9.4	**14.9**	0.0
France	33.8	**98.9**	0.0	33.8	**98.9**	0.0
Germany	95.3	**208.9**	-82.4	95.3	**171.1**	0.0
India	0.0	**70.3**	0.0	0.0	**39.5**	0.0
Indonesia	0.0	**4.4**	0.0	0.0	**4.4**	0.0
Italy	25.3	**43.3**	0.0	25.3	**43.5**	0.0
Japan	**121.1**	16.0	1.3	**108.3**	16.0	0.0
Norway	0.0	0.1	0.0	0.0	0.0	0.0
South Africa	0.0	**9.5**	0.0	0.0	**9.5**	0.0
South Korea	137	**100.8**	0.0	13.7	**90.3**	0.0
Mexico	1.4	**24.2**	0.0	0.0	**9.0**	0.0
Russia	**518.4**	49.9	0.0	**518.4**	49.9	0.0
Spain	13.6	**71.4**	0.0	13.6	**43.1**	0.0
Sweden	12.1	**33.1**	0.0	12.1	**33.1**	0.0
UAE	0.0	0.0	0.0	0.0	0.0	0.0
United Kingdom	38.9	**134.6**	0.0	38.9	**134.6**	0.0
United States	**390.7**	240.7	4.8	**193.9**	169.8	4.8
World	**5017.2**	2563.4	1157.6	**3414.6**	1594.1	116.7
Note:						
EU-wide[1]	**735.0**	569.8	0.0	340.8	**569.8**	0.0

Source: DBCCA Analysis 2012; Columbia Climate Center Analysis 2012. [1]Note: The EU-bloc shows only the impact of EU-wide policies; it does not include the impact of non EU-specific policies of its member nations.

Certain mandates have significant abatement or are responsible for the greater impact of efficiency or renewable mandates in a given country, as shown in Figure 5.

- The large abatement of efficiency mandates is driven by the energy intensity policies in our database; these are found in countries that are developing rapidly or undergoing systematic overhauls (China, Russia, Taiwan and Vietnam). Full compliance of China's energy intensity mandate has the greatest potential abatement in the database (3.4 $GtCO_2e$) as a result of the ambition of the policy and of the considerable 2020 BAU emissions. Russia's energy intensity policy also has considerable abatement (518 $MtCO_2e$). Other prominent efficiency mandates are those that aim to increase vehicle efficiency standards or to cap emissions of the power sector. Japan's emissions cap on the power sector (84Mt) leads to larger abatement of efficiency mandates than renewable mandates; a less stringent cap on EU power plants abates 140Mt. In the US the maximum mandate abatement comes from the average fuel economy standard. Lighting standards in the database, including phasing out of incandescent light bulbs can represent abatement as high as 70-150Mt.
- Although there are many more renewable mandates in the database, their aggregate abatement is not as large as that of the efficiency mandates because of the large impact of China's energy intensity mandate discussed above. In fact, in the absence of China's policies, the two policy categories have a very similar total abatement of around 1.6 to 1.8 Gt.

Figure 5: Top mandates overall in February 2012 in terms of abatement potential (Mt, 2020) plus select policies for key countries

Country	Policy	Abatement Potential by 2020* (Mt)	Mandate Type	Sector
China	Reduce energy intensity 20% from 2005 levels by 2010 & by 18% from 2010 levels by 2015	3,424	Energy Efficiency	All energy
Brazil	80% reduction in deforestation by 2020 compared to historic levels	1,097	Other	Land use
European Union	20% of primary energy to come from renewable sources by 2020	665	Renewable	All energy
Russia	40% reduction in energy intensity per unit of GDP from 2007 levels by 2020	518	Energy Efficiency	All energy
European Union	21% electricity from renewable sources in total electricity consumption by 2010	477	Renewable	Power sector
China	200 GW installed wind capacity by 2020	444	Renewable	Power sector
European Union	Reduce primary energy consumption by 20% by 2020 through energy efficiency measures[3]	416	Energy Efficiency	All energy
United States	Fleet average of 35.5 mpg by 2016[4]	156	Energy Efficiency	Transportation
European Union	Phase out incandescent light bulbs by 2012	151	Efficiency	Buildings
Canada (Ontario)	Close existing coal-fired power plants by 2014	111	Other	Power sector
Taiwan	Reduce energy intensity by 20% over 2005 levels by 2015 and 50% by 2025	101	Efficiency	All energy
Japan	Electric power sector to cut emissions to 73% of 2008/2009 level by the business year 2020/2021	84	Efficiency	Power sector
United States (Texas)	Utilities to offset 25% growth in electricity demand with efficiency measures by 2012, and 30% in 2013	81	Efficiency	Power sector

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

[3] The EU mandate to reduce energy consumption by 20% by 2020 via energy efficiency measures is dependent on the Energy Efficiency Directive's final text, currently being debated by the Council of Ministers & EU Parliament. It is hoped a final agreement on the Directive will be met ahead of the new EU Presidency taking over on July 1st. The mandate to reduce energy consumption by 20% represents a reduction of 202 Mtoe & the Directive is seen as the main tool to achieve this. The text proposed by the Council of Ministers is estimated to reduce primary energy consumption by ~58.1 Mtoe – short of what is needed to meet this mandate. This would represent only 38% of savings foreseen in the original text. Parliament's more ambitious version of the Directive represented 130% of the Commissions initial text.

[4] In 2011 the Obama administration instructed the EPA and Department of Transport to coordinate and work out a new CAFE standard. The result was a 54.5mpg target by 2025. This target is still only a proposal and it is thus unclear as to whether this will actually become law.

- Globally 'other' mandates abate ~1Gt, due almost solely to the deforestation policy in Brazil. This category, which has significantly fewer mandates than the other two, includes mandates that target non-renewable sources without explicitly shifting to renewable, such as closing coal or nuclear plants or mandating clean coal. A significant other mandate is the policy to close coal plants in the Canadian province of Ontario by 2014.
- Although federal mandates are critical for significant abatement, two sub-national mandates have noteworthy impact in Canada and the US: the previously mentioned closure of coal power stations in Ontario and the power demand reduction mandate in the US state of Texas. Both Texas and Ontario contribute significantly to national emissions due to their size and energy mix

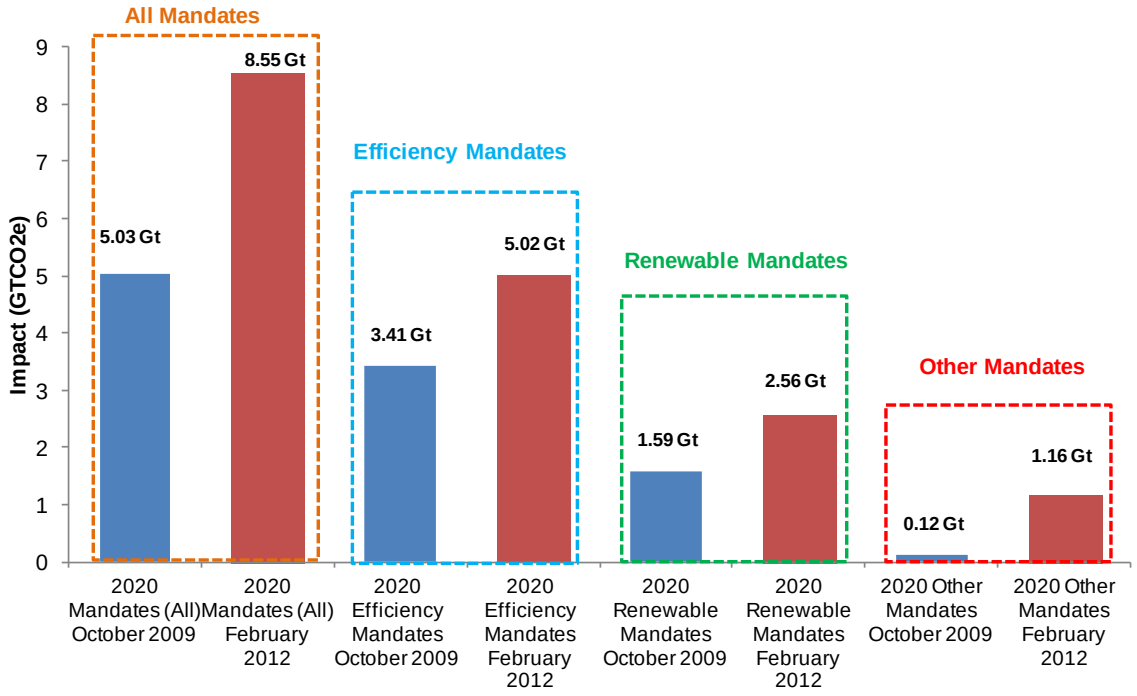
Historical Time Series Results

As documented in greater detail in our April 2012 Global Climate Change Policy Tracker, we have built different databases at distinct points in time to conduct a time-series analysis and to calculate the abatement potential achieved by each policy suite. As the simulations are internally consistent, the results can be easily compared to construct a timeline of the evolution of abatement potential over time. 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 $GtCO_2e$).

We compare the February 2012 policy scenario with that of October 2009, prior to the UNFCCC Conference of Parties in Copenhagen and the subsequent energetic policy development.

- As in February 2012, efficiency mandates abate more than renewable in the October 2009 run: 3.4 Gt versus 1.6 Gt in 2020. The estimated abatement from the different mandate types for the two snapshots in time is summarized in Figure 6.
- This shows that the increase in number of mandates or their scope led to increased abatement of the order of 1 to 1.5Gt in each category of mandates with the greatest improvement between October 2009 and February 2012 shown in the energy efficiency mandate category, followed by renewable mandates, and then 'other' mandates.
- The overall greater abatement potential in February 2012 compared to October 2009 for all mandate types results from an increase in the number of policies and an increased ambition such as China's energy intensity mandate.

Figure 6: Historical comparison of the 2020 abatement impact of current mandates estimated impact compared to BAU (Gt)



Source: DBCCA Analysis 2012; Columbia Climate Center Analysis 2012. Results consist of mandates in place globally as of October 2009 and February 2012

When looking more closely at the difference between October 2009 and February 2012 in the largest abatement mandate category energy efficiency, the two mandates in China that have the greatest impact in efficiency and renewable were less ambitious in 2009 compared to February 2012 and thus help to explain the lower abatement potential in October 2009. In addition, after October 2009 the EU-27 increased its impact in efficiency, while Germany, Spain and Denmark increased their renewable mandates. Canada, Japan and the US increased their abatement from efficiency mandates.

Sector Analysis of Mandates

Mandates to reduce emissions can be applied to the entire energy system or to specific sectors of the economy. Here we look at the number of mandates targeting different sectors and their potential impact. The following 6 sectors can be distinguished in the model:

- Entire energy system
- Buildings
- Multiple sectors
- Power sector
- Transportation
- Land use

Figure 7: Targeted sectors in mandates in February 2012

	Renewable Mandates		Efficiency Mandates		Other Mandates	
	Number of mandates	Impact ($MtCO_2e$) 2020	Number of mandates	Impact ($MtCO_2e$) 2020	Number of mandates	Impact ($MtCO_2e$) 2020
Entire energy	52	1,384	11	4,573	0	0
Buildings	6	72	38	288	0	0
Multiple sectors	0	0	29	315	0	0
Power sector	157	2428	64	638	6	57
Transportation	71	418	61	266	2	3
Land use	0	0	0	0	1	1,098

Source: DBCCA Analysis 2012; Columbia Climate Center Analysis 2012. Results consist of mandates applying a particular sector in place globally as of February 2012

Figure 7 above shows the breakout of policies by sector and the approximate abatement for each sector. The aggregate abatement in Figure 7 is an overestimate as there are interactions between sector policies have not been evaluated for this sector analysis.

- Renewable mandates primarily apply to the power sector (157 such mandates), with less than half that many in the transportation sector (71 mandates). Efficiency mandates are distributed more widely among sectors, with almost half of them spread between power (64 mandates) and transportation (61 mandates) sectors and the rest in buildings, multiple sectors and entire energy sectors. Most 'other' mandates also pertain to the power sector, although the most important 'other' mandate in terms of abatement is Brazil's deforestation mandate addressing land use.
- It would be expected that mandates applicable to the entire energy system would have the greatest abatement potential. This is proven to be the case for energy intensity mandates in China and Russia and for the

renewable and efficiency mandates in the EU (see Figure 4). The greatest potential abatement (4.57 Gt) is seen in efficiency mandates for the entire energy system.

- A large impact would also be expected for mandates that apply to the power sector given its importance in developed nations. This notion is supported by the abatement potential for power sector mandates: renewable: 2.4Gt and efficiency 638Mt as shown in Figure 7.
- Beyond these generalizations, however, the abatement potential cannot be simply predicted by number or sector scope of mandates. This is particularly clear for the significant abatement of the single land use mandate and for that of the relatively small number of transportation sector mandates for renewable energy. The number of efficiency mandates within a sector is not closely matched by the abatement potential. Specifically the power sector has more than twice the impact of the transportation sector but has a smaller number of mandates.

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