CO2 White Paper: Proposed Mobile Sector Greenhouse Gas Emission Targets

Introduction

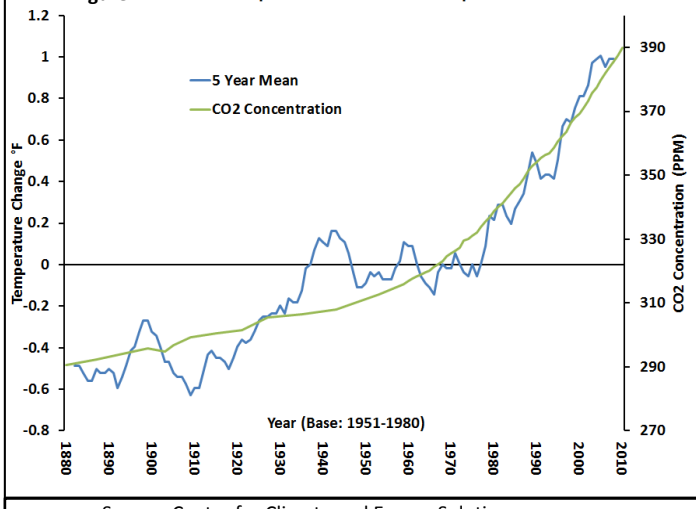
This White Paper provides background context for the establishment of greenhouse gas emission reduction targets for the metropolitan Washington region's mobile sector and discusses the gap between projected future emissions and regional greenhouse gas emission reduction goals. Specific measures and strategies for achieving these reductions will be discussed in the "2014 Plan" being developed as part of the "Special Project" on Long-Range Environmental Benchmarks for Transportation Planning.

Background

An overwhelming body of scientific evidence indicates that the earth's climate is changing, and that human influence is the dominant cause of the changes (IPCC 2013a, 9). The Intergovernmental Panel on Climate Change (IPCC), the National Academy of Sciences, and other scientific organizations say, unequivocally, that warming global temperatures since mid-20th century have been accelerated by the dramatic increase in man-made greenhouse gases.

While there is natural variability in temperature cycles, the IPCC has concluded that a warming trend in the global climate is indisputable (IPCCa 2013, 2). Over the last century, the accumulation of greenhouse gases in the atmosphere is estimated to have raised average global temperatures by more than 0.74°C (or 1.3°F). Figure 2 shows this observed warming alongside the dramatic rise in global carbon dioxide (CO2) emissions since 1880. Scientists warn that an additional 2°C (3.6°F) rise in average global temperature will result in dramatic and irreversible changes to the environment (IPCC 2013b, 71).

Figure 1: Global Temperature Trend and Atmospheric CO2



Source: Center for Climate and Energy Solutions
Available at: http://www.c2es.org/facts-figures/trends/co2-temp

It should be noted that all projections of future conditions are subject to uncertainty. Models used to project future climate conditions are based on the best available data for a large number of factors including historically observed conditions biogeochemical processes. Each factor may be subject to uncertainty, particularly if looking at short time-scales. To minimize the potential for error, the IPCC uses dozens of peer-reviewed models. Because each model uses its own methodology, IPCC estimates are given as a range of possible outcomes.

Under various international growth scenarios, greenhouse gas emissions will grow to 50–75 GtCO2e/year globally by 2030, an approximate 25–90 percent increase from 2000 levels. There is consensus between IPCC and U.S. scientists that to keep temperature increase below 2°C, greenhouse

gas concentrations must stabilize around 450 parts per million (ppm) carbon dioxide equivalent (CO2e) (Tyndall 2013). Since 2009, policymakers around the world have generally embraced 450ppm as the goal for an international climate agreement (Grantham 2009). At present atmospheric greenhouse gas concentrations are around 392ppm. Factoring in projected growth scenarios, the IPCC estimates that emissions must be reduced 50–85 percent below 1990 levels by 2050 in order to avoid the most dire consequences of global warming.

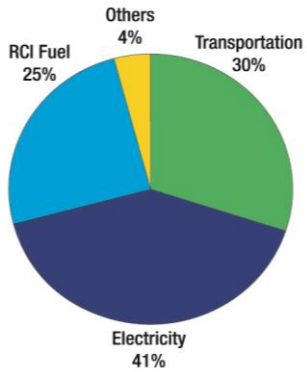
Warming is already causing severe impacts to human and natural communities around the globe. According to the IPCC, many changes observed in the global climate since 1950 are unprecedented over decades to millennia, and have been proceeding at a faster rate than previously predicted (IPCC 2013a, 2). Impacts of climate change include more frequent and intense extreme weather events such as heat waves, drought, heavy precipitation, hurricanes and cyclones, all of which may have severe human and economic costs.

Early Action Needed

Early action is critical to reduce the buildup of greenhouse gases in the atmosphere. In 2005, the National Academy of Sciences called for prompt action, saying it is needed to "lessen the magnitude and rate of climate change" (NAS 2005). Early reductions are critical because peak warming is linearly correlated to cumulative emissions. Therefore, even though it may possible to defer reductions and make steeper cuts later to achieve the same emissions level, the cumulative emissions may be too great to avoid dangerous temperature increases (Grantham 2009, Bowerman et al. 2010, Stocker 2012). The timing of reductions also affects the cost and therefore the probability of success. If action is delayed, much steeper reductions will be needed, which may be prohibitively expensive (Denelzen et al. 2007, Grantham 2009). More information on the timing of greenhouse gas emission reductions, implications for warming and economic feasibility is included in Appendix 1.

Metropolitan Washington Region Greenhouse Gas Emissions and Reduction Targets

Figure 2:
Metropolitan Washington Greenhouse Gas Emissions: 2005



Notes:
RCI fuel includes residential, commercial, and industrial natural gas, home heating oil, nonroad diesel, and aviation fuel. Other sources include methane from wastewater treatment and landfills, as well as high global-warming-potential gases used as refrigerants and solvents.

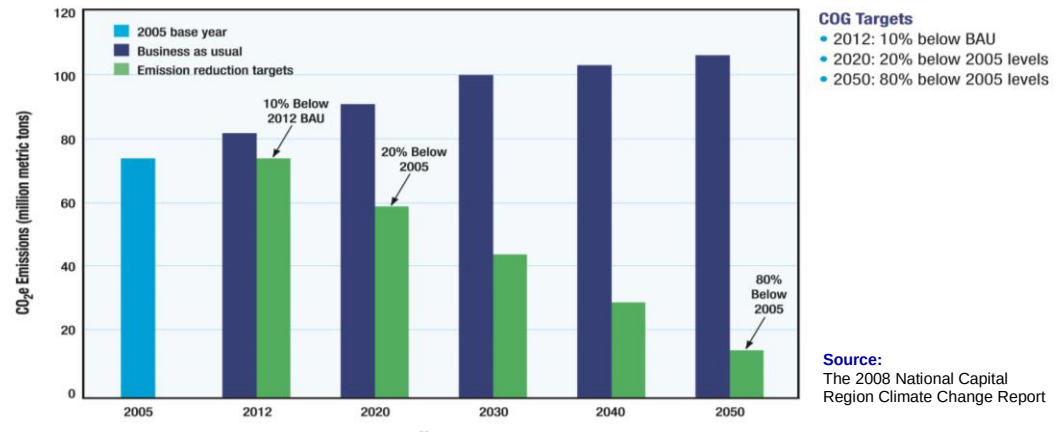
Source: 2008 National Capital Region Climate Change Report

In the metropolitan Washington region, state and local governments recognize the urgency of addressing climate change to protect their citizens and economies. The National Capital Regional Climate Change Report, which was adopted by the Metropolitan Washington Council of Governments (MWCOG) Board of Directors in November 2008, included a baseline greenhouse gas inventory and set regional emission reduction goals. The greenhouse gas inventory was completed for 2005 to establish a historical basis for setting emissions targets and developing an action plan. In 2005, total regional emissions were 82 million tons. The breakdown of emissions by sector is shown in Figure 2.

Projections of future population and economic growth indicate that regional emissions are likely to increase significantly in the absence of reduction measures. According to MWCOG's Round 8.2a Population and Employment Forecasts completed in 2013, the region will gain 1.3 million new residents and 1.1 million new jobs by 2040. Business-as-usual projections indicate that total regional emissions could increase as much as 35 percent by 2030 and 43 percent by 2050.

The 2008 National Capital Regional Climate Change Report set regional greenhouse gas reduction goals for short-term, intermediate, and long-term targets consistent with international scientific consensus. The regional goals are: to reduce greenhouse gas emissions by 10 percent below BAU levels by 2012, 20 percent below 2005 levels by 2020, and 80 percent below 2005 levels by 2050, as shown in Figure 3. These greenhouse gas emission reduction goals are also Sustainability Target Two of the Region Forward Vision, which was endorsed by the Council of Governments, local jurisdictions, businesses, nonprofits, and other civic groups in 2010.

Figure 3:
Recommended Regional Greenhouse Gas Emission Reduction Targets Compared to Regional Greenhouse Gas Emissions Under BAU: 2005–2050



State and Local Greenhouse Gas Reduction Targets

States and localities in the region have been on the forefront in setting greenhouse gas reduction goals, and several have established their own targets comparable to the MWCOG goal. The District of Columbia is a signatory to the U.S. Mayors Climate Protection Agreement and in 2010 released a climate action plan, Climate of Opportunity: A Climate Action Plan for the District of Columbia, to build upon this previous commitment. The District has pledged to reduce emissions from government operations 10 percent by 2012, 30 percent by 2020, and 80 percent by 2050 compared to a 2006 baseline, and is striving to meet the MWCOG emission reduction goals on a community-wide basis.

In 2009 the Maryland legislature passed the *Greenhouse Gas Emissions Reduction Act*, which requires the state to reduce emissions 25 percent below 2006 levels by 2020 and 90 percent below 2006 levels by 2050. The state also set noncompulsory interim goal to reduce emissions 10 percent by 2012 and 15 percent by 2015, relative to 2006 levels. The *Maryland Greenhouse Gas Reduction Plan* released in 2013 lays out a series of strategies, policies and programs that Maryland will undertake to achieve these emission reduction targets.

The Commonwealth of Virginia has set a goal to reduce greenhouse gas emissions by 30 percent (relative to BAU levels) by 2025, approximately equating to a return to 2000 emission levels. The Governor's Commission on Climate Change released its *Climate Change Action Plan* in 2008 to recommend measures for reaching the state's target.

Fairfax, Arlington, Montgomery, and Prince George's counties have signed onto the Cool Counties agreement, committing to halt the growth of greenhouse gas emissions by 2010 and to reduce emissions 80 percent below 2006 levels by 2050. In 2000, the City of Takoma Park published a *Local Action Plan for Reducing Greenhouse Gas Emissions*, under which the City pledged to reduce greenhouse gas emissions 20 percent below 1990 levels by 2010. Frederick County's *Sustainable Action Plan for County Operations* commits the County to reduce greenhouse gas emissions 25 percent by 2025 compared to 2007 levels. A complete table of local greenhouse gas emission targets can be found in Appendix 2.

Mobile Sector Greenhouse Gas Emissions and Reduction Targets

Transportation Planning Board (TPB) has not yet formally adopted greenhouse gas reduction targets for the sector. However, the TPB Vision includes several objectives related to environmental protection, and the Region Forward vision establishes greenhouse gas reduction targets as a priority for the region. The 2010 "What Would It Take" scenario report prepared for the TPB assumed that the region's transportation sector would adopt the reduction targets recommended by the MWCOG Board of Directors to reduce emissions 20 percent by 2020 and 80 percent by 2050.

Greenhouse gas reductions from the transportation sector will be important for achieving the region's emission reduction goals. In 2005, greenhouse gas emissions from the transportation sector accounted for 30 percent of total regional emissions, or approximately 24.5 million tons CO2e. Recent data show that annual emissions from the transportation sector have increased by almost one million tons since 2005, overshooting the MWCOG 2012 goal to reduce greenhouse gas emissions 10 percent below business as usual levels by 3 million tons.

TPB's Constrained Long-Range Transportation Plan (CLRP) for 2013 includes a Performance Analysis section which projects future emissions from the transportation sector based on current trends and policies. Forecasted population growth of 24 percent and employment growth of 36 percent between 2014 and 2040 will significantly increase transport demand (TPB 2013). Despite a projected decrease in the share of single-driver trips and an increase in carpooling and non-motorized travel, under the CLRP, total vehicle miles traveled (VMT) are expected to increase 23 percent between 2014 and 2040.[1] Due to these and other factors, the CLRP projects that mobile sector greenhouse gas emissions will decline slightly between 2014 and 2020 but begin to rise about 1% per year after 2020. Using the 2013 CLRP Performance Analysis estimates, by 2050 greenhouse gas emissions from the transportation sector will be around 28 million tons per year, 16 percent greater than 2005 levels.

Table 1: Emission Reductions Necessary to Meet the MWCOG Goals (million tons CO2e)

Year	2020	2030	2040	2050
Current Estimates	24.4	24.8	26.5	28.1
MWCOG Goal	19.3	14.5	9.6	4.8
Gap	5.1	10.3	16.9	23.3
Current Estimates based on data from 2013 CLRP Performance Analysis:				

[1] CLRP projections are based on the assumption that Metrorail ridership will be constrained to 2020 levels due to the lack of identified funding for WMATA's future rehabilitation and maintenance needs beyond 2020. When this constraint on Metrorail trips is lifted, there are an additional 32,000 transit work trips in 2040, a 3 percent increase.

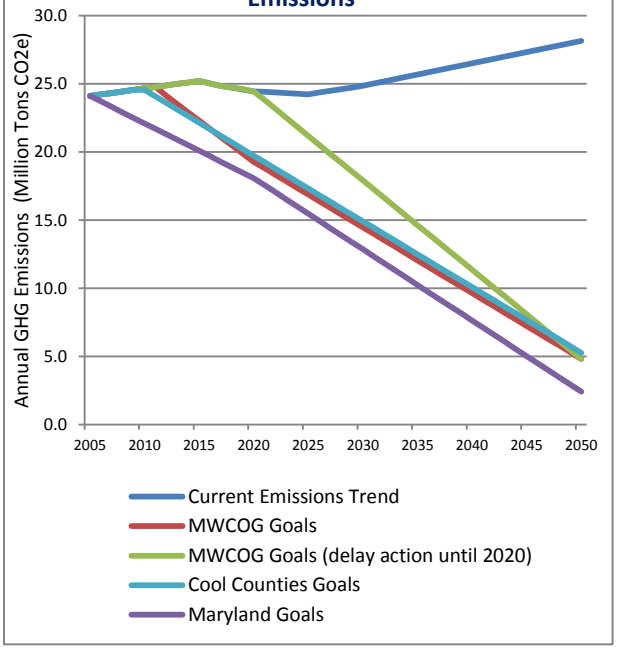
Gap Analysis

http://www.mwcog.org/clrp/performance/air_quality.asp

The 2013 CLRP Performance Analysis compares projected regional transportation emissions to the MWCOG goal, and uses straight line interpolation of the MWCOG goal for other milestone years where required. According to the most recent estimate, there will be an approximate 5.1 million ton shortfall in required greenhouse gas emissions reductions in order for the transportation sector to meet the 2020 MWCOG goal, growing to more than 23 million tons by 2050, as shown in Table 1.

Figure 4 illustrates regional transportation sector emissions under current emissions trends (based on the 2013 CLRP Performance Analysis estimates), compared to the trajectories recommended by the MWCOG plan, the Cool Counties plan and the Maryland plan. The MWCOG 2012 target (return to business as usual levels) has already been overshot by approximately 3 million tons. Thus, we include a hypothetical trajectory that achieves the MWCOG 2050 target even if action is delayed until 2020. Following the MWCOG plan, regional mobile sector greenhouse gas emissions would be 4.8 million tons in 2050, compared to 5.3 million tons under the Cool Counties plan or 2.4 million tons under the Maryland plan. The MWCOG and Cool Counties plans both require emissions reductions of 2 percent per year after 2020. Delaying action just 8 years under the MWCOG goal increases the rate of necessary annual emissions reductions to 2.7 percent – an additional 200,000 tons per year. To reach Maryland's 2050 goal of 90 percent reduction, regional transportation emissions would need to drop, on average, 2.2 percent per year after 2020.

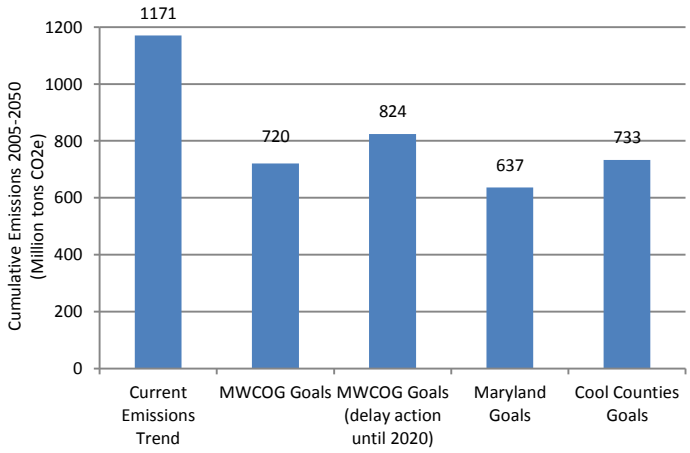
Figure 4: Regional Mobile Sector Emissions



Current emissions trends are based on CLRP Performance Analysis estimates using the best available data for a large number of factors including regional population, employment, infrastructure changes, transit capacity, fuel composition, pricing, regulations and policies. Each factor is subject to uncertainty. Unexpected changes, such as large-scale fleet turnover, a spike in gasoline prices or a lack of policy implementation could result in an actual emissions trajectory quite different from the projection used in this paper.

As previously noted, early reductions are essential to limit the accumulation of greenhouse gases in the atmosphere and may help prevent dangerous global warming. As shown in Figure 5, the MWCOG plan would result in cumulative regional emissions of approximately 720 million tons from 2005–2050. The delayed action scenario increases cumulative

Figure 5: Cumulative Mobile Sector Emissions 2005-2050



emissions more than 14 percent over this time period. This may escalate the probability of exceeding recommended warming thresholds and increase the risks of near-term climate change impacts.

Conclusion

Given the projected increase in greenhouse gas emissions under current emission estimates, aggressive measures will be necessary in order for the mobile sector to meet regional greenhouse gas emission reduction goals. MWCOG and TPB have developed several publications that could be referenced when considering potential emissions reductions in the transportation sector, including the "What Would It Take" scenario report and the "Regional Transportation Priorities Plan." The forthcoming "2014 Plan" will examine strategies proposed by these plans as well as other measures to reduce the region's mobile sector greenhouse gas emissions. As a first step, climate, air quality and transportation officials in the region should come together to determine greenhouse gas reduction goals for the transportation sector that are both practical and effective to meet environmental goals.

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Appendix 1:
Greenhouse Gas Emission Reductions: Timing, Implications for Warming and Economic Feasibility

Scientists estimate that in order to prevent the worst impacts of climate change, temperature rise must be limited to 2°C. Since 2009, policymakers have generally embraced this level as the goal for an international climate agreement.[2] Keeping global warming below 2°C will require stabilizing atmospheric greenhouse gases at or below 450 parts per million,[3] which means reducing global emissions 50% below 1990 levels by 2050.[4]

Both scientific and economic analyses urge earlier action to reduce emissions. Peak warming is linearly correlated to cumulative emissions, so it is theoretically possible to achieve the 450ppm cap with any number of emission reduction trajectories. However, delaying action, i.e. by setting less ambitious targets early on, decreases the scientific certainty that warming stays below 2°C: studies suggest that to have a 50% likelihood of success, global emissions must peak before 2020.[5] Additionally, delayed action would require much greater rates of reduction later on. For example, an emissions peak in 2020 would require average emissions reductions of about 4% per year, whereas a peak in 2025 would require annual emissions reductions of about 8.5%.[6] Importantly, reducing emissions at a rate greater than 5% per year is unlikely to be politically feasible or economically viable.[7]

Early emissions reductions may also avert the most drastic climate change impacts and help communities to adapt. This is because the rate of warming will determine how quickly adaptation responses are required. Scientists have shown that the maximum rate of warming is closely correlated to peak rate of emissions.[8] Thus, it behooves policymakers concerned about near-term climate impacts to pursue earlier action to slow and reverse the rate of emissions.

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[2] Grantham Research Institute and Centre for Climate Change Economics and Policy. "Mitigating Climate Change through Reductions in Greenhouse Gas Emissions: The Science and Economics of Future Paths for Global Annual Emissions." London School of Economics, 2009. Accessed Dec. 4 2013. http://www.lse.ac.uk/GranthamInstitute/publications/Policy/docs/PBMitigatingBowenRangerDec09.pdf

[3] Tyndall Center for Climate Research. "Can We Limit Climate Change to 2°C?" http://www.tyndall.ac.uk/adamproject/2-degrees

[4] Vuuren, et al. "Stabilizing Greenhouse Gas Concentrations at Low Levels: An Assessment of Reduction Strategies and Costs." Climatic Change 81.2 (2007): 119-59. http://link.springer.com/article/10.1007%2Fs10584-006-9172-9

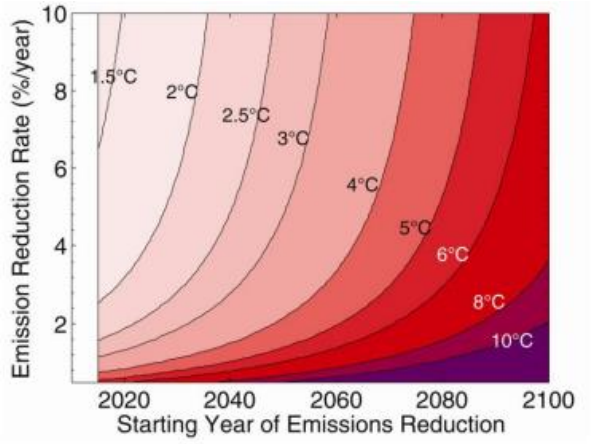
[5] Grantham Research Institute, p. 14.

[6] Grantham Research Institute, p. 19.

[7] Denelzen, Meinshausen, and D. Vanvuuren. "Multi-gas Emission Envelopes to Meet Greenhouse Gas Concentration Targets: Costs versus Certainty of Limiting Temperature Increase." Global Environmental Change 17.2 (2007): 260-80. Accessed Dec. 4 2013. http://www.sciencedirect.com/science/article/pii/S0959378006000835

[8] Bowerman, Niel, et. al. "Cumulative Carbon Emissions, Emissions Floors and Short-term Rates of Warming: Implications for Policy." Philosophical Transactions of the Royal Society. N.p., 29 Nov. 2010. Accessed Dec. 4 2013. http://rsta.royalsocietypublishing.org/content/369/1934/45.full

Figure 1: Starting Year of Emissions Reduction and Peak Warming

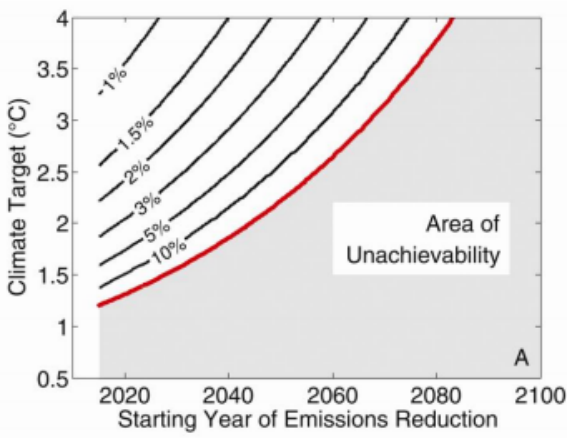


Contours of peak warming. Contours of peak CO_2-induced warming (as given by Eq. 3 in Box 1) as a function of the starting date of the Global Mitigation Scheme and the implemented reduction rate of emissions. Parameters are C_0 = 530 GtC, E_0 = 9.3 GtC per year, β = 2°C (TtC)$^{-1}$, and r = 1.8% per year. The later the Global Mitigation Scheme starts, the higher the required emission reduction rate is for a given peak warming.

From: Stocker 2012, p. 4. http://www.climate.unibe.ch/~stocker/papers/stocker12scix.pdf

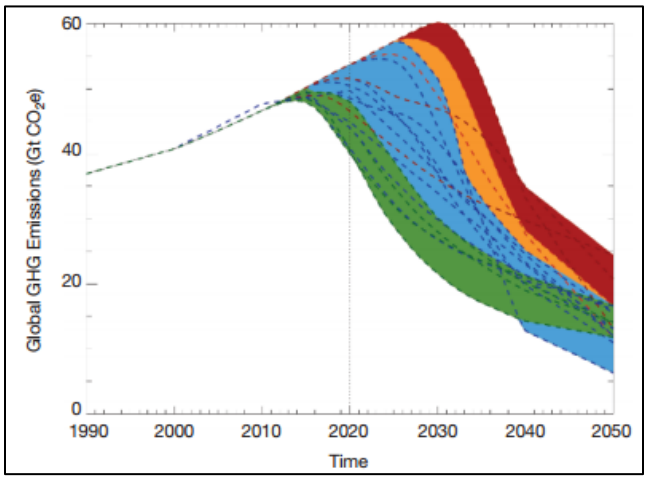
Figure 2: Starting Year of Emissions Reduction and Required Reduction Rate

A closing door. (**A**) Contours of required emission reduction rate s (% per year), derived from Eq. 3, as a function of the starting date of the Global Mitigation Scheme and the desired climate target. The red line indicates the achievable minimum climate target as a function of the starting date as given by Eq. 4. Climate targets increase exponentially with later starting years of the Global Mitigation Scheme and become unachievable in the gray shaded area. Parameters are as in the first figure. (**B**) Achievable minimum climate target for three values of the peak response to cumulative emissions, β, and the rate of emission increase used in the first figure (solid curves, r = 1.8 % per year), and a lower emission rate roughly representative of the past 10 years, r = 1.5% per year (dashed curves). Higher values of β imply higher peak warming.



From: Stocker 2012, p. 4. http://www.climate.unibe.ch/~stocker/papers/stocker12scix.pdf

Figure 3: Simulated Emissions Paths to Keep Warming Under 2.2°C by 2100.



Colored regions illustrate emissions paths that result in a median estimate of global temperature warming in 2100 as follows:

Green	≤ 1.9°C warming
Blue	≤ 2.0°C warming
Orange	≤ 2.1°C warming
Red	≤ 2.2°C warming

From Grantham 2013, p. 17.
http://www.lse.ac.uk/GranthamInstitute/publications/Policy/docs/PBMitigatingBowenRangerDec09.pdf

Appendix 2: State and Local Emissions Reduction Targets

Jurisdiction	Baseline	Short-term target	Intermediate target	Long-term target
MWCOG	2005	10% by 2012	20% by 2020	80% by 2050
Washington, DC	2006	10% by 2012	20% by 2020	80% by 2050
Maryland	2006		25% by 2020	90% by 2050
Charles County				
Frederick County	2007		25% by 2025	
City of Frederick				
Montgomery County	FY 2005	Stop increases by 2010	10% reduction every 5 years	80% by 2050
City of Rockville	1990	7% by 2012		
City of Takoma Park	1990	20% by 2010		
Prince George's County	2008	Stop increases by 2010	10% reduction every 5 years	80% by 2050
City of Bowie	2007	10% by 2015	20% by 2020	
City of College Park				
City of Greenbelt	2005	10% by 2012	20% by 2020	80% by 2050
Town of Bladensburg				
Virginia	Business as usual		30% by 2025 (equivalent to 2000 emission level)	
Arlington County	2007			~75% by 2050
Fairfax County	2006	Stop increases by 2010	10% reduction every 5 years	80% by 2050
Loudon County	2007			

Prince William County				
City of Alexandria	2006	10% by 2012	20% by 2025	80% by 2050
City of Fairfax	2005	10% by 2012	20% by 2025	80% by 2050
City of Falls Church	2003	10% by 2012	20% by 2025	80% by 2050
City of Manassas				
City of Manassas Park				