MEMORANDUM

To:	Jared Patton and Kristin Ihnchak, CMAP
From:	Emily Golla, Rich Walter, and Cory Matsui, ICF
Date:	April 17, 2018
Re:	UPDATED: Potential ON TO 2050 Emission Targets (Contract No. C-18-0026)

This memorandum provides a summary of potential emission targets for CMAP's ON TO 2050 report. This memorandum serves as an updated to the memorandum delivered on February 1, 2018, which included a qualitative assessment of potential emission targets. The memorandum includes a quantitative assessment of potential emission targets and is organized as follows:

- Background on Target Setting
- GO TO 2040 Emission Targets
- Potential Targets for ON TO 2050

Please contact Emily Golla at (202) 862-1246 with any questions or comments.

I. Background on Target Setting

Greenhouse Gas Reduction Target Fundamentals

The foundation for a greenhouse gas (GHG) emissions reduction target consists of three components:

- A **base year** that serves as a point of comparison for evaluating the trajectory of future emissions. A base year is a one-year period most commonly in the recent (e.g., 2015) to distant past (e.g., 1990), and GHG emissions typically increase in the years that follow the base year in the absence of any action to reduce emissions.[1] A base year can also be a one-year period in the future. For a base year in the future, such as 2020 for example, the emissions reductions achieved in 2020 are compared to the GHG emissions that would occur in the absence of any action to reduce GHG emissions in 2020 (i.e., a business-as-usual, or BAU, scenario).
- A **target year**(s) that establishes a timeframe that the GHG reduction goal should be achieved by. To achieve a GHG reduction goal with a target year in the distant future (e.g., 2050), jurisdictions typically choose multiple target years in the interim period to guide the path of emissions downward to the long-term goal (e.g., 2020, 2035, 2040).
- A **reduction amount** that identifies the magnitude of GHG emissions that will be reduced relative to the base year and before or during the target year.

The GHG emissions reduction target can take several distinct forms. There are three primary types of reduction targets:

- A **mass emissions target** is an absolute amount of emissions that needs to be reduced and does not depend on any past year (e.g., reduce GHG emissions by 500,000 $MTCO_2e$ relative to the BAU scenario by 2020). This type of target may be chosen if a GHG emissions inventory for a past year (i.e., 1990) are unknown.
- A **per capita emissions target** is a goal to reduce the rate of emissions relative to the population. This type of target may or may not include a base year and does not necessarily result in an absolute decrease in total emissions (e.g., reduce per capita GHG emissions by 40 $MTCO_2e$ per person by 2020). This type of target may be chosen if a jurisdiction is anticipating substantial population growth, as it allows for an increase in the absolute amount of GHG emissions so long as the rate of emissions per capita is reduced sufficiently to meet the target.
- A **percent reduction target** is the most commonly adopted type of target and defines the reduction goal in terms of emissions reductions relative to the base year (e.g., 20% below 2010 GHG emissions). This type of target is consistent with recommendations by regulating bodies to reduce future GHG emissions levels to previously occurring levels.

Precedents in Greenhouse Gas Reduction Target Setting

Cities, counties, regional agencies, transportation districts and other governing bodies worldwide have adopted GHG reduction targets in various forms. The call for action that sparked the widespread adoption of GHG reduction targets was the outcome of computer modeling conducted by climate researchers that concluded that worldwide GHG emissions in developed counties must be reduced to 80% below 1990 levels by 2050 in order to constrain global temperature increases to no more than 2

[1] GHG emissions typically increase with time as population and economic activity increase within a jurisdiction. A scenario in which no actions to reduce GHG emissions are taken is known as a business-as-usual (BAU) scenario.

degrees Centigrade to avoid the more catastrophic effects of global warming. Consequently, the trajectory of GHG emissions required to meet the 2050 target came to be known as the climate stabilization path.

A number of cities and states in the United States have adopted GHG reduction targets. For example, the City of Chicago adopted a target of 25% below 1990 levels by 2020. In California, the legislature mandated a reduction to 1990 levels by 2020 and 40% below 1990 levels by 2030.[2] Worldwide, over 90 cities have adopted GHG reduction targets through the C40 agreement. The majority of these cities have adopted percent-reduction targets consistent with the climate stabilization path that aim to reduce either city-wide or sector-specific emissions by a certain percentage. The GHG reduction targets adopted by some of the C40 cities are presented in Attachment A.

II. GO TO 2040 Emission Targets

In CMAP's comprehensive regional plan, GO TO 2040, GHG reduction targets were identified for three years: 2015, 2020, and 2040. These targets, also based on the climate stabilization path, are shown below in Table 1 along with the region's GHG emissions in 1990, 2000, 2005, and 2010.

Table 1: GO TO 2040 Inventory Estimates (2000-2010) and Emission Targets (2015-2040)

Year	1990	2000	2005	2010	2015	2020	2040
Total Emissions and Reduction Targets ($MMTCO_2e$)	93.2	118.5	131.2	126.3	*119.0*	*104.6*	*47.0*
Per Capita Emissions ($MTCO_2e$/person)	12.8	14.5	15.8	15.2	*13.7*	*11.5*	*4.3*

Sources: GO TO 2040 Update Appendix: Indicator Methodology, January 2015 (Years 2000-2040); The Chicago Region Greenhouse Gas Baseline Inventory and Forecast, December 2009 (Year 1990); 1990 Census.

III. Updated Regional Inventory Results and Projections

ICF has prepared and updated the regional GHG inventory emissions estimates for 2010 and 2015. The emissions results, which serve as the basis for GHG emissions projections to future years, are summarized in Table 2.

Table 2: Regional Inventory Update Estimates, 2010-2015

Emissions Metric	2010	2015
Total Emissions ($MMTCO_2e$)	127.6	119.8
Per Capita Emissions ($MTCO_2e$/person)	15.1	14.1

Future year emissions are necessary for determining a BAU-based reduction target and for assessing the quantity of emissions reductions that will be needed to meet a future year target. However, forecasting GHG emissions presents a challenge because future year emissions are often the result of unpredictable economic forces, and an emissions trend in the past is not always a reliable indicator of how emissions will change in the future. Additionally, the magnitude and effectiveness of emissions-reducing steps taken in the past by a local or regional government may change in the future.

[2] California's 2020 goal to reduce emissions to 1990 levels is a near-term target interpolated based on the 80% below 1990 levels by 2050. In 2016, California adopted Senate Bill 32, which establishes a GHG target of 40% below 1990 levels by 2030. The SB 32 reduction goal is also an interpolation of the 2050 target.

Using the 2010 and 2015 regional GHG inventory estimates (presented in Table 2 above), ICF has developed three different scenarios to forecast future year emissions to show how emissions may change in the future. The three scenarios are described below.

- **Scenario 1:** The first scenario is a BAU scenario that assumes no change in GHG efficiency per capita from 2015 in all future years. In other words, under this scenario, emissions increase at the rate of population growth in the region.
- **Scenario 2:** The second scenario is an alternative BAU scenario that assumes in the future GHG efficiency per capita improves at the same rate as that between 2010 and 2015. Based on the per capita values in Table 2, per capita emissions decreased by 7% between 2010 and 2015. This scenario assumes that, every five years, per capita emissions will decrease by roughly 7%.
- **Scenario 3:** The third scenario assumes more aggressive improvements in GHG efficiency per capita. This scenario assumes that the 7% decrease in per capita emissions that were realized from 2010-2015 will double and be achieved every 5 years (i.e., per capita emissions will decrease by 14% every 5 years).

The results of the GHG emissions forecast analysis for all three scenarios are presented in Table 3.

Table 3: Regional Inventory Projections, 2020-2050

Scenario/Emissions Metric	2020	2025	2030	2035	2040	2045	2050
Scenario 1: No Change in GHG Efficiency after 2015							
Total Emissions ($MMTCO_2e$)	126.07	130.90	135.43	139.83	144.05	148.04	152.16
Per Capita Emissions ($MTCO_2e$/person)	14.05	14.05	14.05	14.05	14.05	14.05	14.05
Scenario 2: Change in GHG Efficiency Based on 2010-2015 Trend							
Total Emissions ($MMTCO_2e$)	117.05	112.84	108.39	103.91	99.39	94.83	90.49
Per Capita Emissions ($MTCO_2e$/person)	13.05	12.12	11.25	10.44	9.70	9.00	8.36
Scenario 3: Change in GHG Efficiency Double of 2010-2015 Trend							
Total Emissions ($MMTCO_2e$)	108.03	96.12	85.22	75.40	66.56	58.61	51.62
Per Capita Emissions ($MTCO_2e$/person)	12.04	10.32	8.84	7.58	6.49	5.56	4.77

IV. Potential Targets for ON TO 2050

Overall Emission Targets

ICF has identified three potential GHG reduction target options for CMAP's consideration for the ON TO 2050 report. The potential targets, which vary in their aggressiveness, are described below, summarized in Table 4 on a mass emissions and per capita emissions basis, and graphically depicted in Figure 1.

Option 1 – Climate Stabilization Path: Reduce GHG emissions to 80% below 1990 levels by 2050, or 86% below 2005 levels

Option 1 aligns with the scientific consensus regarding the level of emissions necessary in developed countries (e.g., United States, Europe, and Japan) to stabilize the climate with a global temperature increase of no more than 2 degrees Centigrade. This target is the outcome of extensive climate modeling conducted by researchers and is consistent with many cities' GHG reduction targets worldwide. While this target is considered to be critical to climate stabilization, it may be difficult to explicitly demonstrate a feasible path for the region to achieve this level of reduction in the absence of large scale commitments at the local, state, and federal level. Although many jurisdictions have 2050 targets, few have developed climate action plans outlining strategies to meet those targets. As such,

Option 1 would represent an ambitious but potentially challenging target for the CMAP region. It does however, represent an aspirational goal.

As part of its Climate Action Plan, in 2008 the City of Chicago adopted a goal to reach an 80% reduction in GHG emissions from 1990 levels by 2050. However, in the City's 2015 GHG inventory report, the City of Chicago identified its intention to revise its target base year from 1990 to 2005 because of the inherent difficulties in preparing a 1990 inventory. The City has indicated that they intend to keep the same ambitious level of emissions reductions as committed to in their 1990 target but will discuss the regional target in terms of a 2005 base year rather than 1990.[3] Therefore, to be consistent with Chicago's long term reduction goal, CMAP could similarly use 2005 as a base year rather than 1990.

Based on the 1990 GHG emissions level calculated by the Center for Neighborhood Technology (CNT) in the December 2009 GHG inventory and forecast, 1990 emissions for the CMAP region were 93.2 $MMTCO_2e$.[4] A reduction goal of 80% below this 1990 level is equal to 18.6 $MMTCO_2e$. This level of emissions would be 86% below the region's 2005 levels. Although the target level of emissions for 2050 would be the same (18.6 $MMTCO_2e$), framing the reduction goal with the same base year as the City is recommended as it will ease coordination and progress tracking between the City and the region.

Option 2 – Enhanced Per Capita GHG Reductions

Option 2, a per capita-based reduction target, may be a more demonstrably feasible approach to establishing a target for the region's GHG emissions, because it is derived from the region's per capita emissions reductions already achieved. This option is consistent with Scenario 3 of the emissions forecast, which uses the rate of decline in per capita emissions between 2010 and 2015 and doubles it to determine the reduction achieved every 5 years. As discussed above, the region's per capita emissions have been calculated to decrease by 7% between 2010 and 2015; thus, with this target approach, per capita emissions would need to decrease by 14% every 5 years out to 2050. As shown in Table 3, this would result in 2050 emissions of 51.6 $MMTCO_2e$ and per capita emissions of 4.8 $MMTCO_2e$/person, which would correspond to a 57% reduction in overall GHG emissions and a 65% reduction in GHG emissions per capita relative to 2015.

This per capita reduction target has the advantage of providing a conceptualization of the level of effort needed to meet the target. CMAP can infer the magnitude of action required by assessing what actions were taken in the 2010-2015 period, and, roughly speaking, doubling the level of effort of those actions. This target would be less climate-protective than the stabilization path discussed for Option 1, however, and may be considered too limited by some individuals or organizations. Few jurisdictions have developed plans outlining a strategy to achieve a 2050 target, and, within this context, a less ambitious but feasible path to a 2050 target could be an appropriate option. Further, 2050 is more than 30 years in the future, and the state and federal climate action landscape could change in that timeframe to reduce the burden of action on municipal governments.

[3] Based on input from the City, there has been no formal change to the 2050 emissions target presented in the Chicago Climate Action Plan.

[4] The CNT 1990 emissions estimate was prepared in 2009 with current data at the time, but it is now over 9 years old, and the estimate used different methodologies than ICF has used for the most recent regional GHG inventory. Consequently, ICF recommends that CMAP prepare an updated 1990 emissions estimate so that the reduction goal and forecast are consistent and based on the same general methodology. ICF recommends an inventory analysis for 1990 using what data may be available and 'back-casting' from the 2010 and 2015 emissions estimates on a sector-by-sector basis, as feasible.

Option 3 – Chicago Climate Action Plan Achievable Reductions

The third potential GHG reduction target utilizes the percentage of reduction expected by the City of Chicago through the implementation of the City's 2010 Climate Action Plan (CAP). The strategies to reduce emissions in the City's CAP are comprised of individual actions in the following four areas: building energy, renewable energy resources, transportation, and waste. The City identified a fifth strategy in the area of adaptation that would not result in any direct emissions reductions. GHG emissions reductions achieved in 2020 through the four strategies would reduce the City's BAU emissions in 2020 by approximately 38%. Under Option 3, CMAP would adopt a reduction target based on the effectiveness identified in the City's CAP, which would be expected to result in a roughly similar reduction in emissions relative to a BAU scenario. Although the City's CAP identified a 38% reduction from 2020 BAU, the reduction for the region needs to be adjusted to account for differences in forecasting methods. The City's CAP used a higher population estimate for its forecast than ICF's emissions forecast for the City; as such, the percentage reduction in emissions was adjusted to account for the discrepancy. The adjusted reduction percentage in BAU emissions is 35%.

ICF expects that the individual actions in the City's CAP to reduce GHG emissions would largely be applicable to the CMAP region. Some actions would require commitment at the level of each jurisdiction, such as retrofitting buildings and updating energy codes. Other actions would likely require a regional commitment, such as investing in more transit. Overall, the region would be expected to attain approximately the same percentage reduction in GHG emissions as attained by the City.

Table 4: Three Options of Target Recommendations for ON TO 2050

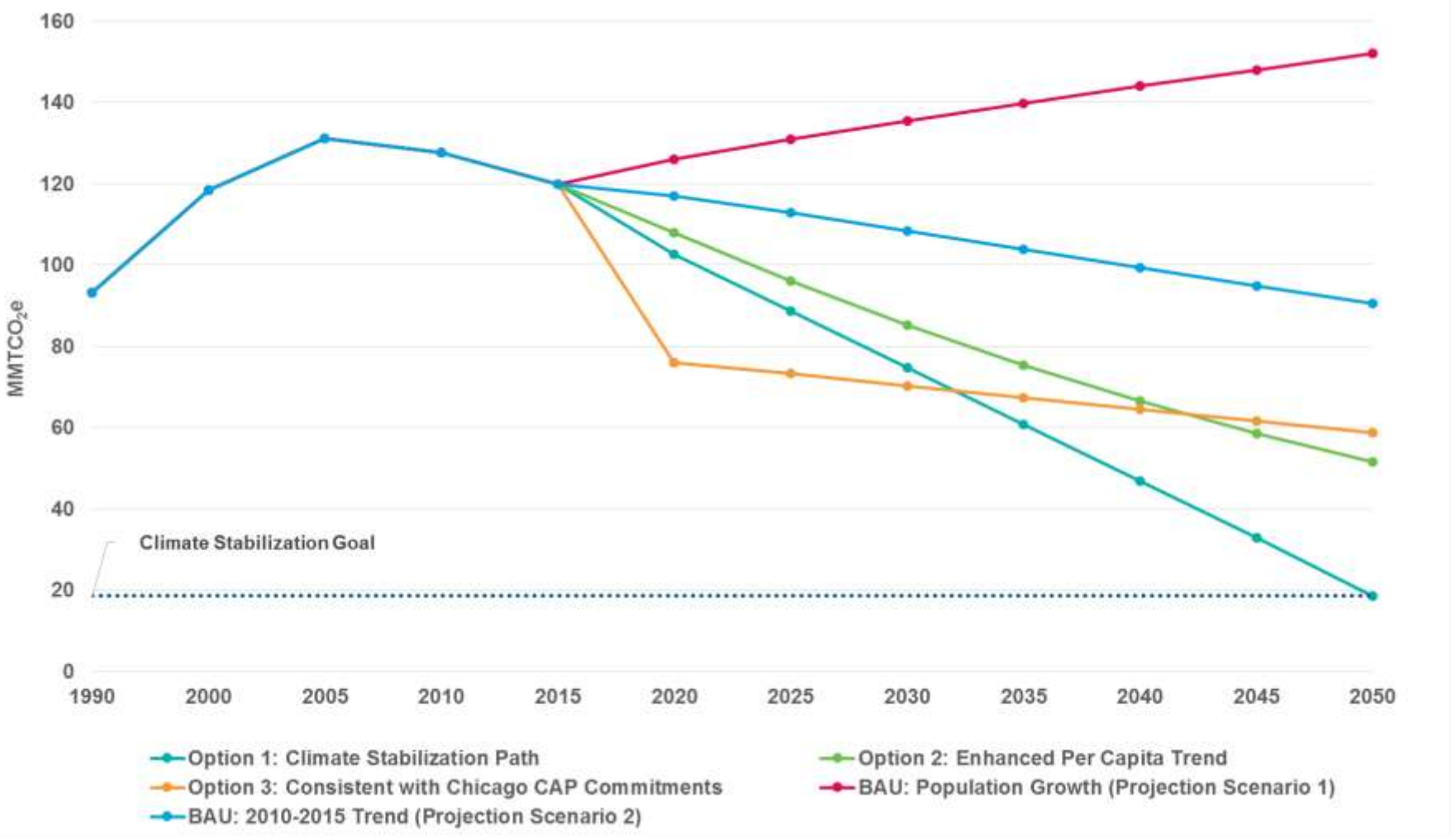
Scenario/Emissions Metric	Option 1[a]		Option 2[b]		Option 3[c]	
	2025	2050	2025	2050	2025	2050
Total Emissions ($MMTCO_2e$)	88.68	18.60	96.12	51.62	84.96	98.75
Per Capita Emissions ($MTCO_2e$/person)	9.5	1.7	10.3	4.8	9.1	9.1

[a] Based on CNT 1990 estimate of 93.2 MMT and Climate Stabilization goal of 80% below 1990 by 2050 (and 5% below 1990 by 2025). This is also equivalent to a goal of 86% below 2005 levels.

[b] Based on doubling of 2015-2010 per capita trend.

[c] Based on City of Chicago CAP reductions.

Figure 1: Future Emissions Trajectory: BAU, Option 1, Option 2, and Option 3



Attachment A - Greenhouse Gas Reduction Targets Adopted by C40 Cities

City	Reporting Year	Baseline Year	Baseline Emissions (metric tonnes CO2e)	Percentage Reduction Target	Target Date	Target Description	GHG sources to which the target applies	Target Date Category
Amsterdam	2015	1990	4,134,000	40%	2025		citizens, companies, transport, own organisation	Short term
Austin	2015	2010	14,500,000	90%	2050	net zero by 2050	All residential, commercial, and industrial sources including transportation, landfills, electricity generation, heating, cooling, water treatment, wastewater treatment, all.	Long term
Boston	2015	2005	7,440,000	25%	2020		total community emissions	Short term
Buenos Aires	2015	2008		30%	2030	After a thorough analysis of the different mitigation measures, and after evaluating their emission reduction potential, the City of Buenos Aires set as a global goal to avoid 30% of the GHG emissions projected for 2030, in a business as usual scenario.	The target applies for the energy, transport and waste sector, from both private and public areas. The reduction goal was set as a whole but it's important to take into consideration that as Local Government's emissions are considerably lower than the Community emissions, so is the reduction goal.	Short term
Cape Town	2015	2007	20,550,172	10%	2012	The current target was included in the City's Energy and Climate Action Plan (ECAP) and is currently being reviewed and updated as part of the City's Energy 2040 vision and ECAP update process, to be finalised by end 2015. Updated targets will be provided in the 2016 CDP submission. Current electricity consumption levels city-wide are below 2007 levels.	Primarily applies to electricity generation. Cape Town's electricity is supplied through the national energy utility, Eskom. 95% of Eskom's electricity is coal-generated. The City therefore aimed to decrease its emissions by focusing on decreasing electricity consumption by 10% off a "business-as-usual" baseline by 2012.	Short term
Changwon	2015	2005	7,501,126	30%	2020	The total reduction amount will be reached 3,102,145tCO2eq.	Carbon Reduction Ratio by GHG Sources Industria (30.7%), Domestic (14.8%), Commercial (5.8%), Transportation (20.9%), Wastes (1.5%), Agriculture, Livestocks (6.2%), Others (20.2%).	Short term
Chicago	2015	1990	32,300,000	80%	2050		Scope 1 and 2 emissions	Long term
Chicago	2015	1990	32,300,000	25%	2020		Scope 1 and 2 emissions	Short term
Copenhagen	2015	2010	2,240,000	100%	2025		All sources	Short term
Copenhagen	2015	2005	2,541,000	20%	2015		All sources	Short term
Durban	2015	2006	21,413,906	24.50%	2020	The target of 24.5% is articulated in the municipal energy strategy (2008). However, a climate change adaptation and mitigation strategy for the city is currently being developed which will revise these targets to align with the national climate change policy.	CO2	Short term
Hong Kong	2015	2005	42,000,000	55%	2020	Hong Kong has set out a carbon intensity reduction target of 50% - 60% by 2020 as compared with 2005 level. If the target is achieved, our carbon intensity level will be reduced to 0.012 - 0.015 kg CO2-e/HK dollar GDP in 2020. The GHG emissions level in Hong Kong is also expected to reduce from 42 million tonnes in 2005 to 28 to 34 million tonnes in 2020. Hong Kong has been working with the international community in combating climate change. Alongside other member economies of the Asia-Pacific Economic Co-operation (APEC), Hong Kong adopted the 2011 APEC Leaders' Declaration, and is committed to achieving the APEC target to reduce energy intensity by at least 45% before 2035 (with 2005 as the base year). In May 2015, Hong Kong set a new target on energy intensity reduction by 40% by 2025 using 2005 as the base.	CO2 - Energy (Electricity Generation, Transport, Other end use of fuel); Waste; Industrial Processes and Product Use; Agriculture, Forestry and Other Land Use	Short term
London	2015	1990	45,000,000	60%	2025	Interim targets are also in place for 2015 and 2020	CO2	Short term
Los Angeles	2015	1990	54,100,000	45%	2025	1990 baseline subject to revision to align with forthcoming national GHG accounting protocols.	All	Short term
Madrid	2015	1990	12,653,000	20%	2020		Total	Short term
Madrid	2015	2011	2,367,000	20%	2020		Road transport	Short term
Madrid	2015	2005	11,527,000	35%	2020		Total	Short term
Melbourne	2015	2009	4,934	100%	2020	We have a Zero Net Emissions by 2020 Strategy for the municipality.	Electricity, Gas, Transport, Waste	Short term
Mexico City	2015	2000		50%	2050			Long term
Mexico City	2015	2012	2,010,083	0.01%	2020	Emissions generated by the consumption of electricity and fuel use in malls and service	Comercial	Short term
Mexico City	2015	2012	12,620,635	3.90%	2020	Emissions from motor vehicles on roads and used by the community to be transported; in addition to those generated by vehicles not driven on roads, as the operation of buses within the bus stations, locomotives, aircraft and agricultural machinery and construction	Transport	Short term
Mexico City	2015	2012	4,028,724	6.40%	2020	Emissions from electricity consumption and use of fossil fuel (LPG and natural gas) in different types of housing	Residential	Short term
Moscow	2015	1990	63,443,619	25%	2020	In accordance with overall Russian Federation target (President Law No.752 from 30.09.2013)	Scope 1 GHG emissions within the current boundaries of Moscow	Short term
New York	2015	2006	59,180,000	30%	2030	NEW YORK—Mayor de Blasio announced today that New York City is committing to reducing its greenhouse gas emissions by 80 percent over 2005 levels by 2050, starting with One City, Built to Last: Transforming New York City's Buildings for a Low-Carbon Future – a sweeping plan to retrofit public and private buildings to dramatically reduce the city's contributions to climate change, while spurring major cost savings and creating thousands of new jobs for New Yorkers who most need them. This makes New York the largest city to commit to the 80 percent reduction by 2050, and charts a long-term path for investment in renewable sources of energy and a total transition from fossil fuels. Nearly three quarters of New York City's greenhouse gas emissions come from energy used to heat, cool, and power buildings, making building retrofits a central component of any plan to dramatically reduce emissions. The City is poised to make direct investments to increase the efficiency of its public buildings, including schools and public housing, reducing the government's contribution to climate change and generating operational savings for New York City taxpayers. Every single city-owned building with any significant energy use – approximately 3,000 buildings – will be retrofitted within the next ten years, by 2025, with interim goals along the way.	Buildings and streetlights Fugitive Emissions Transportation	Short term

New York	2015	2006	59,180,000	35%	2025	Global climate change is the challenge of our generation. The stakes are high—for New Yorkers and for the world. In the coming years, New York City will face rising sea levels, increased temperatures and heat waves, and an increasing frequency of the most intense storms. These risks are not remote nor distant. They are here today. The damage caused by Hurricane Sandy in 2012 provided vivid evidence of these risks. Almost two years later, we are still recovering. Globally, climate change is having a devastating impact on people's lives as rising sea levels flood coastlines, droughts disrupt livelihoods, and storms, hurricanes, and other extreme weather events threaten security and economic development. For this reason, New York City is committed to reducing its greenhouse gas (GHG) emissions by 80 percent by 2050—the level the United Nations projects is needed to avoid the most dangerous impacts of climate change—and will chart a long-term course for a total transition away from fossil fuels to renewable sources of energy. We have developed an action plan for our buildings sector to reach a 35% energy reduction by 2025.	Buildings and streetlights Fugitive Emissions Transportation	Short term
Oslo	2015	1991	1,200,000	100%	2050		CO2, CH4, N2O,	Long term
Oslo	2015	1991	1,200,000	50%	2030		CO2, CH4, N2O,	Short term
Paris	2015	2004	25,000,000	25%	2020	To respect the European objectives by 2020 and to decrease overall emissions by 75% in 2050 compared with 2004	all sources all scopes	Short term
Philadelphia	2015	1990	21,059,039	20%	2015		Scopes 1&2.	Short term
Philadelphia	2015	2006	22,837,228	20%	2015		Scopes 1&2	Short term
Portland, OR	2015	1990	8,989,460	80%	2050		Scope 1 (except fugitive emissions), Scope 2 and "waste disposal"	Long term
Portland, OR	2015	1990	8,989,460	40%	2030		Scope 1 (except fugitive emissions), Scope 2 and "waste disposal"	Short term
Quito	2015	2011	5,164,946	30%	2025	5% reduction per year of the projected growth rate of emissions, starting 2019	Transport	Short term
Rio de Janeiro	2015	2005	11,933,280	20%	2020	Measurement of carbon dioxide, methane and nitrous oxide.	Road Transportation, Railway, Residential, Commercial, Public Sector, fugitive emissions and other, Forest and land use, Urban Solid Waste, wastewater.	Short term
Rio de Janeiro	2015	2005	11,933,280	16%	2016	Measurement of carbon dioxide, methane and nitrous oxide.	Road Transportation, Railway, Residential, Commercial, Public Sector, fugitive emissions and other, Forest and land use, Urban Solid Waste, wastewater.	Short term
Roma	2015	2003	3,593,877	15%	2020		Residential	Short term
Roma	2015	2003	4,174,937	23%	2020		Transport	Short term
San Francisco	2015	1990	6,201,949	80%	2050	The City of San Francisco has completed a third party emissions verification during January 2015. The City has met it's year 2012 emission reduction target by reducing it's community-wide emissions approximately 23.3% below 1990 levels.	Residential, Commercial/Industrial, Transportation, Waste.	Long term
San Francisco	2015	1990	6,201,949	40%	2025	The City of San Francisco has completed a third party emissions verification during January 2015. The City has met it's year 2012 emission reduction target by reducing it's community-wide emissions approximately 23.3% below 1990 levels.	Residential, Commercial/Industrial, Transportation, Waste.	Short term
San Francisco	2015	1990	6,201,949	25%	2017	The City of San Francisco has completed a third party emissions verification during January 2015. The City has met it's year 2012 emission reduction target by reducing it's community-wide emissions approximately 23.3% below 1990 levels.	Residential, Commercial/Industrial, Transportation, Waste.	Short term
San Francisco	2015	1990	6,201,949	20%	2012	The City of San Francisco has completed a third party emissions verification during January 2015. The City has met it's year 2012 emission reduction target by reducing it's community-wide emissions approximately 23.3% below 1990 levels.	Residential, Commercial/Industrial, Transportation, Waste.	Short term
Seattle	2015	2008	3,647,000	100%	2050	Our long-term goals are: 58% reduction by 2030 Zero net emissions by 2050.	Road transportation Building energy Waste	Long term
Seoul	2015	2005	49,467,000	25%	2020	One Less Nuclear Power Plant	Transportation, Citizen's cultural place etc.	Short term
Shenzhen	2015	2010	80,000,000	21%	2015	Refer to "Shenzhen Medium-to- Long-term Low-carbon Development plan (2011-2020)", our main methods include upgrading industrial structure, saving energy in the fields of industries, buildings, transportation, developing low-carbon energy, and increasing carbon sink.	major sources of Shenzhen, such as: Industries, Traffice, Building, living etc.	Short term
Singapore	2015	2020	77,200,000	11%	2020	7 to 11% reduction (unconditional) from 2020 Business-as-usual (BAU) emissions; 16% reduction (conditional of global deal) from 2020 Business-as-usual (BAU) emissions	Total GHG (nation-wide)	Short term
Stockholm	2015	1990	3,668,000	100%	2040	Stockholm has a goal that by 2020 our GHG per capita should be down to 2,3 ton 2020 per person.	CO2, CH4, N20 and Energy for heating and cooling, electricity use and Energy for transport	Long term
Stockholm	2015	1990	3,668,000	24%	2020	Stockholm has a goal that by 2020 our GHG per capita should be down to 2,3 ton 2020 per person.	CO2, CH4, N20 and Energy for heating and cooling, electricity use and Energy for transport	Short term
Sydney	2015	2006	52,972	70%	2030	Cities have a critical role in reducing greenhouse gas emissions because although they cover only two per cent of the Earth's land surface, they have more than 50 per cent of the population and cause 75 per cent of the world's emissions. The City is working to reduce carbon emissions by 70 per cent by 2030, one of the most ambitious targets set by any government in Australia. We are: • installing energy efficient street and park lights • rolling out Australia's largest building-mounted solar panel project • carrying out energy efficient retrofits of major buildings • reducing emissions and energy bills through energy efficiency programs • reducing emissions and energy bills through energy efficiency programs For more on the City's plans visit www.cityofsydney.nsw.gov.au	Scope1-2	Short term

Tokyo	2015	2000	61,800,000	25%	2020	TMG also sets the energy consumption reductiojn target 20% reduction from the 2000 level by the year 2020. This 20% reduction almost refers to 20 % reduction of GHG. The rest 5% reduction will be acheived by supply side (electricity companites)	All sectors (Industry, Commercial, Residential and Transportation)	Short term
Toronto	2015	1990	27,051,617	80%	2050	6% by 2012 and 30% by 2020 below 1990 levels for the urban area; we also baselined 2004 due to inherent inadequacy of some of the 1990 data.	Applies to all Toronto (community) electricity, natural gas, transportation and solid waste emissions	Long term
Vancouver	2015	2007	2,805,000	33%	2020	See the Greenest City Action Plan for details. Baseline was calculated in 2014 due to change in GWP of CH4 per IPCC AR4 (2007).	All buildings, transportation and solid waste from the community	Short term
Venice	2015	2005	1,418,344	22.90%	2020	SEAP action "free-01 - extimated CO2 reduction by 2020: 1072t" SEAP action "free-02 - extimated CO2 reduction by 2020: 292t" SEAP action "free-06 - extimated CO2 reduction by 2020: 997t" SEAP action "free-07 - extimated CO2 reduction by 2020: 22946t" SEAP action "free-08 - extimated CO2 reduction by 2020: 4347t" SEAP action "free-09 - extimated CO2 reduction by 2020: 97t" SEAP action "free-10 - extimated CO2 reduction by 2020: 772t" SEAP action "free-11 - extimated CO2 reduction by 2020: 132t" SEAP action "free-12 -extimated CO2 reduction by 2020: 166t" SEAP action "free-13 - extimated CO2 reduction by 2020: 477t" SEAP action "free-14 [1/2]- extimated CO2 reduction by 2020: 13702t" SEAP action "free-15 - extimated CO2 reduction by 2020: 3941t" SEAP action "free-16 - extimated CO2 reduction by 2020: 19020t" SEAP action "free-17 - extimated CO2 reduction by 2020: 168t" SEAP action "pure-03 - extimated CO2 reduction by 2020: 38238t" total extimated CO2 reduction by 2020: 106367t"	Total inventory	Short term
Venice	2015	2005	524,145	13.10%	2020	total extimated CO2 reduction by 2020: 106367t"	Residential buildings	Short term
Venice	2015	2005	512,859	29.10%	2020	total extimated CO2 reduction by 2020: 106367t"	Tertiary (non municipal) buildings, equipment/facilities	Short term
Venice	2015	2005	381,340	39.20%	2020	total extimated CO2 reduction by 2020: 106367t"	Private and Commercial Transport	Short term
Warsaw	2015	2007	12,952,984	20%	2020	Climate change is a fact but not everybody is aware of this. Warsaw treats this issue with care. Cities are responsible for 80% of so-called 'anthropogenic' CO2 emission. Climate is one of the most important factors in terms of the functioning of whole ecosystems, economies, and most importantly, of societies. Therefore Warsaw treats sustainable development as a priority in all areas of the City's activities. Only through coordinated and harmonised activities we can achieve the aim of carbon dioxide emissions reduced by 20% by 2020 in accordance with the Covenant of Mayors signed by Warsaw. In the light of the research conducted, carbon dioxide emission per capita in Warsaw stands at 6.29 tons a year. Compared to 1990, it has increased by 15.5%.	all sources of CO2 emissions	Short term
Washington DC	2015	2006	10,101,168	80%	2050		Building energy use (residential, commercial, government), transportation (VMTs), solid waste, transit.	Long term
Washington DC	2015	2006	10,101,168	50%	2030		Building energy use (residential, commercial, government), transportation (VMTs), solid waste, transit.	Short term
Washington DC	2015	2006	10,101,168	20%	2020		Building energy use (residential, commercial, government), transportation (VMTs), solid waste, transit.	Short term
Washington DC	2015	2006	10,101,168	10%	2015		Building energy use (residential, commercial, government), transportation (VMTs), solid waste, transit.	Short term
Yokohama	2015	2005	19,540,000	80%	2050		all of greenhouse gas	Long term
Yokohama	2015	2005	19,540,000	24%	2030		all of greenhouse gas	Short term
Yokohama	2015	2005	19,540,000	16%	2020		all of greenhouse gas	Short term