Setting a science-based target for Hong Kong

Submission from CarbonCare InnoLab to Council for Sustainable Development on Hong Kong's long-term decarbonisation

Many of the submissions to the public engagement phase of the Hong Kong government's long-term decarbonisation planning are calling for a science-based approach to target setting.

As part of its Paris Watch programme CarbonCare InnoLab has been working on this question for over two years.

The concept of science based targets was first developed for companies. In short, the formula is to divide the company's GHG footprint by its contribution to GDP, as measured by gross profit divided by world GDP, and approximate growth rates through 2050 using analyst or internal financial forecasts to derive the Carbon Intensity Reduction Rate. The concept has been refined in order to apply it more accurately for different business sectors.

In 2016, C40 Cities, one of the leading city-level climate action organizations, along with the consultants ARUP, published a report entitled 'Deadline 2020' in which they examined the role of the world's megacities in contributing responsibly to the achievement of the Paris Agreement goals.

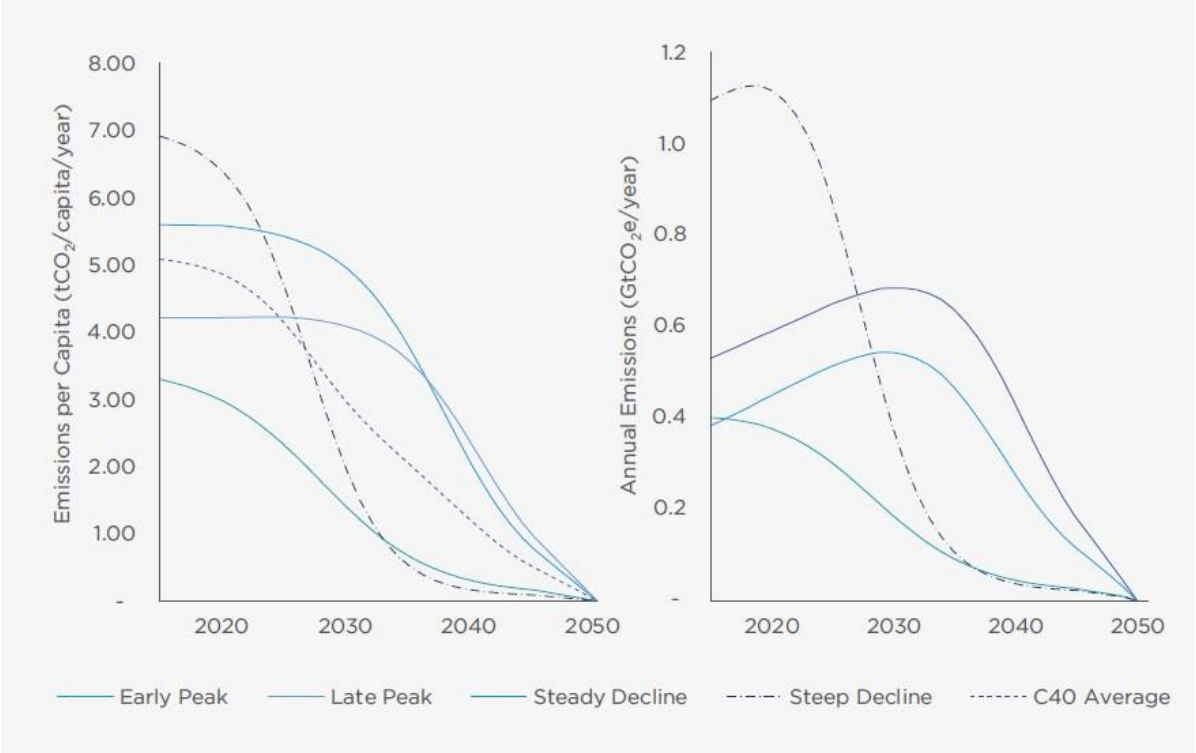
The following principles applied:

1. Cities with different GNPs per capita and different current emission levels are required to take different pathways of emissions reduction in order that wealthier cities do more, earlier. This is in line with the UNFCCC principle of 'common but differentiated responsibilities' which requires that more developed countries must take more ambitious climate action sooner than less-developed countries.

2. The target for Deadline 2050 was net zero emissions by 2050. But if we accept the science that the planet has a finite carbon budget then targets for 2030 and 2040 also remain important because they determine the amount of the carbon budget used up during the trajectory to 2050. Setting out the reduction pathway (the curve on the graph) is an important aspect of responsible climate action by cities.

Exhibit One: Deadline 2020 typologies for city level GHG reductions

(right) for the four typologies under the 1.5 degree scenario.



Source: C40 Cities / ARUP. 2016. Deadline 2020: How cities will get the job done

Exhibit Two: Typology for different cities

Table 2: 'Deadline 2020' projected emissions

TYPOLOGY	DESCRIPTION	PROJECTED AVERAGE EMISSIONS (TCO2/CAPITA)		
		2018	2030	2050
Early Peak	High GHG/capita, low GDP/capita	c.5.6	c.5.4	0
Late Peak	Low GHG/capita, low GDP/capita	c.4.2	c.4.4	0
Steady Decline	Low GHG/capita, high GDP/capita	c.3.1	c.1.3	0
Steep Decline	High GHG/capita, high GDP/capita	c.6.8	c.2.3	0

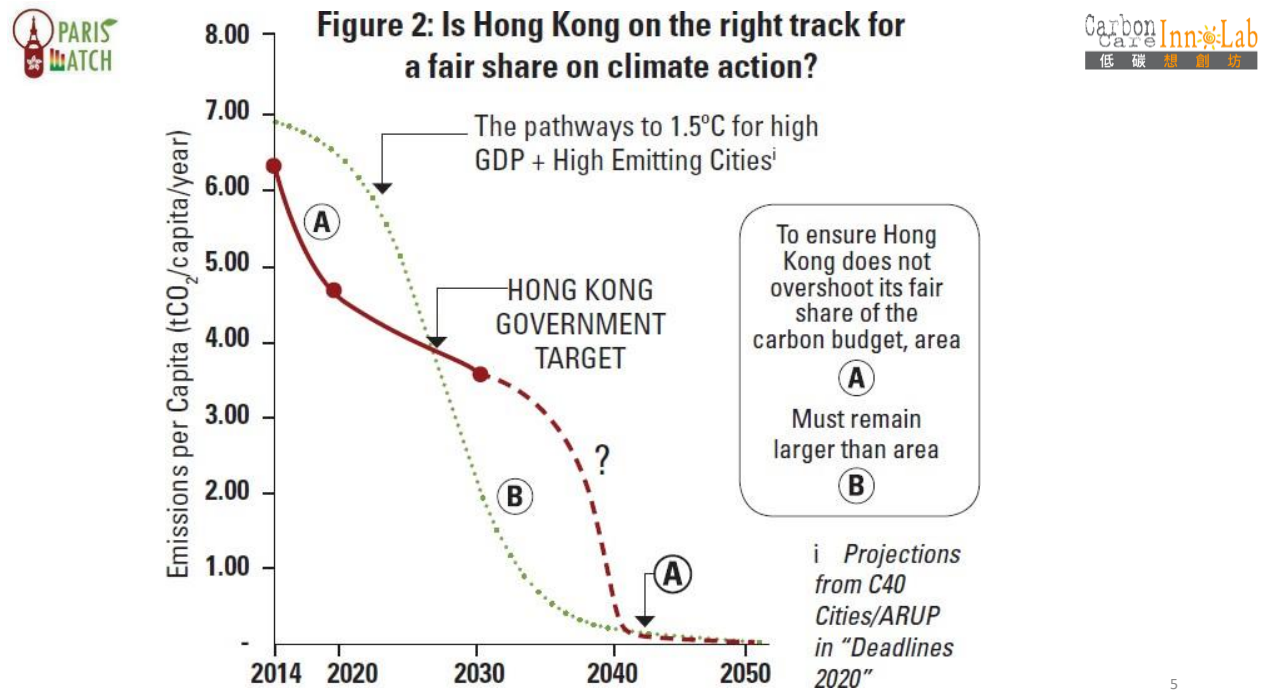
Source: WWF. 2019. One Planet City Challenge: Updated Assessment Framework

Hong Kong's target according to Deadline 2020

Taking up the Deadline 2020 methodology, CarbonCare InnoLab made calculations in 2018. Hong Kong clearly falls into C40 Cities / ARUP definition of 'high GDP per capita, high emissions' city. As such, the target for 2030 per capita emissions stood at 2.3 tCO_2e.

This contrasts with the HK Government's stated target of 3.3-3.8 tCO_2e stated in 'Hong Kong's Climate Action Plan 2030+' published by the Environment Bureau in 2017.

Exhibit Three: Comparing Deadline 2020 and HK Government reduction targets.



Source: Carbon Care Asia. 2018. Paris Watch Climate Action Report: Hong Kong's contribution to the Paris Agreement goals

2019: Science Based Targets for Cities Further Developed

In 2019, ARUP, working with the Worldwide Fund for Nature (WWF) further refined the science-based targets for cities as part of their One Planet City Challenge programme. The advisory panel for this research included the three most important city-level coalitions: **C40 Cities** (of which Hong Kong is a Steering Committee member) **ICLEI Local Governments for Sustainability** and the **Global Covenant of Mayors for Climate and Energy**. Together these associations include around 10,000 cities as members. The advisory panel also included the scientists group that underlies the Paris Climate Agreement; the **Intergovernmental Panel on Climate Change** (IPCC), the leading GHG emissions measurement organization **CDP** and leading environmental research and action groups **World Resources Institute** and **WWF**. As such, we believe this is the leading and most authoritative initiative offering science-based targets for cities.

The One Planet City Challenge Assessment Framework offered the following principles:

1. The science and recommendations of the IPCC 1.5C report are incorporated to ensure GHG reduction targets are up to date.

2. The GDP per capita measure was replaced with the UN Human Development Index which takes account of average years of schooling and life expectancy as well as GDP per capita in determining the level of social development and therefore which cities should be ready to do more, sooner on climate action, and which cities require a longer time frame to focus on social goals alongside climate goals.

Exhibit Four: Methodology selected for OPCC science-based city-level targets

Selected Methodology

Several alternative approaches were developed and considered, then presented to the Advisory Panel. Following feedback and further analysis, the following methodology was selected for the pre-screening targets assessment.

2030 TARGET	2050 TARGET
50% reduction against 2018 per capita emissions (Scope 1 and 2), adjusted using country HDI weighting	Zero emissions (Scope 1 and 2)
ADVANTAGES	**DISADVANTAGES**
• Easily communicated and tested • Relative to 2018 emissions, so largest emitters have largest targets in absolute terms • Clear link to referenceable IPCC data • Larger reductions from more developed nations • Requires all cities to continue to act	• Less transparent to the general public • HDI may not accurately represent city development • No consideration of hard-to-measure Scope 3 emissions

Source: WWF. 2019. One Planet City Challenge: Updated Assessment Framework

The One Planet City Challenge (OPCC) is usually a voluntary initiative for city-level administrations, who are able to benchmark their performance and to compete for awards. Hong Kong government is unfortunately not a part of this initiative. This does not, however, prevent environmental organizations from using the methodology to calculate science-based targets for Hong Kong.

Adopting the OPCC methodology, CCIL's Paris Watch programme has concluded that **Hong Kong's science based 2030 target stands at 2.03 tCO2e.**

Appendix One: Calculating a science based target for Hong Kong

Below we explain the data and calculations used in determining Hong Kong's science-based target:

The One Planet City Challenge proposes the following steps:

Step I: Create an annual population series (1990-2100)

Step 2: Estimate the population in 2018, 2030 and 2050

Step 3: Create an annual GDP growth series (1990-2025)

Step 4: Estimate 2018 emissions

Step 5: Calculate the total emissions based on city targets

Step 6: Calculate the HDI reduction factor and science-based 2030 emissions

Step 7: Calculate per capita emissions for city targets

Step 8: Test the city targets against the science-based 2030 / 2050 emissions

Step 1 & 2 Create a population series and estimate population in 2018, 2030 and 2050

As the Hong Kong Census and Statistics Department prepare population growth estimates for the years in question, we have used these figures.

表 1 （續） 主要統計摘要
Table 1 (Cont'd) Key summary statistics

乙. 人口增長的組成部分
B. Components of population growth

千人
Thousands

統計時點（年中） Reference time-point (Mid-year)	居港人口 Hong Kong Resident Population	常住居民 Usual Residents	流動居民 Mobile Residents	與上一統計時點比較 Compared with the previous reference time-point: 人口增長 Population growth	由上一統計時點至本統計時點 From the previous reference time-point to this reference time-point: 出生 Births	死亡 Deaths	淨遷移（流入減流出） Net movement (inflow *less* outflow)
2016 (註釋 Note)	7 336.6	7 116.8	219.8	45.3	59.8	46.7	32.2
2017	7 389.5	7 173.0	216.5	52.9	59.6	45.3	38.6
2018	7 450.5	7 233.0	217.5	61.0	61.2	49.6	49.3
2019	7 502.6	7 285.3	217.2	52.1	60.8	50.4	41.7
2020	7 558.1	7 340.1	218.0	55.5	60.3	51.3	46.5
2021	7 608.4	7 389.5	219.0	50.3	59.8	52.1	42.6
2022	7 657.7	7 437.5	220.2	49.3	59.2	53.0	43.1
2023	7 705.4	7 484.7	220.7	47.8	58.5	53.8	43.1
2024	7 748.4	7 527.0	221.4	43.0	57.7	54.7	39.9
2025	7 788.7	7 565.9	222.9	40.3	56.8	55.5	39.0
2026	7 825.2	7 600.5	224.8	36.5	55.8	56.4	37.1
2027	7 859.6	7 632.5	227.1	34.4	54.6	57.4	37.2
2028	7 895.2	7 665.4	229.8	35.6	53.3	58.6	40.8
2029	7 930.5	7 697.9	232.6	35.3	52.1	59.7	43.0
2030	7 963.8	7 728.8	235.0	33.2	50.7	61.0	43.5
2031	7 996.2	7 759.1	237.1	32.4	49.5	62.3	45.2
2032	8 028.0	7 789.3	238.7	31.8	48.4	63.6	47.0
2033	8 060.0	7 819.8	240.2	32.0	47.6	65.0	49.5
2034	8 090.2	7 849.7	240.6	30.2	46.9	66.6	49.9
2035	8 117.2	7 878.1	239.1	27.0	46.4	68.1	48.7
2036	8 141.7	7 903.8	237.9	24.5	46.3	69.8	48.1
2037	8 163.5	7 926.4	237.1	21.8	46.4	71.8	47.1
2038	8 182.0	7 947.6	234.4	18.6	46.7	73.9	45.7
2039	8 196.2	7 964.1	232.0	14.1	47.3	76.0	42.9
2040	8 207.0	7 976.8	230.1	10.8	48.0	78.2	41.0
2041	8 213.8	7 985.3	228.5	6.8	48.8	80.5	38.6
2042	8 217.1	7 990.1	227.0	3.3	49.4	82.8	36.7
2043	8 218.5	7 993.1	225.4	1.4	50.0	85.1	36.6
2044	8 217.6	7 993.7	224.0	-0.9	50.3	87.4	36.2
2045	8 213.7	7 991.3	222.4	-3.9	50.4	89.6	35.3
2046	8 207.2	7 986.3	221.0	-6.5	50.3	91.7	35.0

註釋： 基期的人口估計。 Note : Base period population estimates.

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2047	8 197.1	7 977.6	219.5	-10.1	50.0	93.8	33.7
2048	8 185.0	7 967.0	218.0	-12.1	49.6	95.6	34.0
2049	8 170.0	7 953.3	216.6	-15.1	49.1	97.3	33.1
2050	8 152.3	7 936.9	215.3	-17.7	48.5	98.7	32.4
2051	8 131.4	7 917.3	214.0	-20.9	47.9	99.8	31.0
2052	8 108.6	7 895.7	212.9	-22.8	47.3	100.7	30.6
2053	8 083.9	7 872.1	211.8	-24.7	46.7	101.4	30.0
2054	8 058.1	7 847.3	210.8	-25.8	46.2	102.0	30.0
2055	8 031.4	7 821.5	209.9	-26.7	45.7	102.4	30.0
2056	8 004.0	7 794.9	209.1	-27.4	45.3	102.6	30.0
2057	7 976.0	7 767.6	208.4	-28.1	44.8	102.6	29.7
2058	7 948.0	7 740.3	207.7	-28.0	44.4	102.5	30.0
2059	7 919.3	7 712.3	207.0	-28.7	44.0	102.1	29.4
2060	7 890.7	7 684.4	206.3	-28.6	43.7	101.7	29.4
2061	7 862.2	7 656.6	205.6	-28.5	43.3	101.1	29.4
2062	7 833.1	7 628.3	204.9	-29.1	42.9	100.5	28.5
2063	7 804.8	7 600.7	204.1	-28.4	42.6	100.0	29.1
2064	7 777.6	7 574.5	203.2	-27.1	42.3	99.4	30.0
2065	7 750.3	7 548.2	202.2	-27.3	42.0	98.7	29.5
2066	7 723.2	7 522.1	201.1	-27.1	41.7	98.0	29.2

Source: Census and Statistics Department. 2017. Hong Kong Population Projections 2017-2066

https://www.statistics.gov.hk/pub/B1120015072017XXXXB0100.pdf

2018 7,450,500

2030 7,963,800

2050 8,152,300

Step 3: Create an annual GDP growth series

The HK government has also created GDP estimates to 2018 which are used in the calculation:

2016 = US$320.9 billion

2017 = US$341.4 billion

2018 = US$360.31 billion (nominal estimate)

Growth forecast 2018 is 3.2%. Paper for LegCo FA Panel. 2018.12

https://www.legco.gov.hk/yr18-19/english/panels/fa/papers/fa20181218cb1-309-2-e.pdf

Government forecast growth for 2019 is 2-3%

http://hong-kong-economy-research.hktdc.com/business-news/article/Market-Environment/Economic-and-Trade-Information-on-Hong-Kong/etihk/en/1/1X000000/1X09OVUL.htm

Step 4: Estimate 2018 Emissions

Figures from HK Government run to 2017 (provisional) as updated 2019 07.

https://www.climateready.gov.hk/page.php?id=23&lang=1

Estimate 2018 emissions = 40,700,000 tCO_2e (2017 HK government provisional figure) x 1.032% (3.2% growth rate) = 42,002,400 tCO_2e

按排放源劃分的香港溫室氣體排放量
Greenhouse Gas Emissions in Hong Kong by Sector

年份 Year	溫室氣體排放量 (千公噸二氧化碳當量) Greenhouse gas emissions (in kilotonnes CO_2-e)						
	能源 Energy			廢棄物 Waste	工業過程及產品使用 Industrial Processes and Product Use	農業、林業及其他土地利用 Agriculture, Forestry and Other Land Use	總數+ TOTAL+
	發電# Electricity Generation#	運輸 Transport	其它燃料耗用@ Other End Use of Fuel@				
1990	22,900	6,160	4,300	1,550	215	139	35,200
1991	25,600	6,720	3,970	1,610	638	121	38,700
1992	29,200	7,110	4,050	1,660	651	100	42,800
1993	29,700	7,210	3,670	1,760	724	87	43,100
1994	21,900	7,520	3,480	1,770	830	76	35,600
1995	23,000	7,430	3,210	1,940	935	84	36,600
1996	21,800	7,410	3,040	1,910	952	85	35,200
1997	20,000	7,590	2,920	2,010	1,060	74	33,700
1998	22,100	7,690	2,660	1,550	977	69	35,100
1999	20,100	7,840	2,740	1,120	1,020	83	32,900
2000	21,200	7,470	2,460	1,130	977	76	33,300
2001	21,600	7,260	2,250	1,260	862	83	33,300
2002	23,500	7,540	1,960	1,490	503	80	35,000
2003	26,500	7,610	2,020	1,810	543	73	38,600
2004	26,400	7,610	1,990	2,010	636	66	38,700
2005	28,600	7,490	1,970	2,240	867	72	41,200
2006	28,700	7,580	2,200	2,160	1,380	73	42,100
2007	29,600	7,490	2,160	2,190	1,350	51	42,800
2008	28,000	7,440	2,300	2,170	1,590	29	41,500
2009	29,100	7,400	2,170	2,220	1,380	25	42,300
2010	27,400	7,310	2,270	2,200	1,600	33	40,800
2011	29,600	7,190	2,090	2,290	1,380	32	42,500
2012	29,400	7,130	2,290	2,340	1,670	30	42,900
2013	30,300	7,240	2,330	2,530	1,720	32	44,200
2014	31,200	7,230	2,230	2,520	1,640	31	44,900
2015	27,700	7,420	2,290	2,430	1,720	30	41,500
2016	27,900	7,370	2,290	2,470	1,660	30	41,700
2017*	26,600 (65.4%)	7,230 (17.8%)	2,280 (5.6%)	2,810 (6.9%)	1,740 (4.3%)	30 (0.1%)	40,700 (100%)

備註 Remarks:

* *數字有待修訂*
Provisional figures subject to revision

\# *包括煤氣生產，佔2017年香港總溫室氣體排放量約0.75%*
Including GHG emissions arising from Towngas production which accounts for about 0.75% of the total GHG emissions in Hong Kong in 2017.

@ *包括在商業、工業及住宅中耗用的燃料*
Including use of fuel for combustion in commercial, industrial and domestic premises

\+ *由於採用四捨五入法，有關百分比相加總和不一定等於100*
May not add up to 100 due to rounding

數值以三個有效數字表示
Numbers are rounded to three significant figures

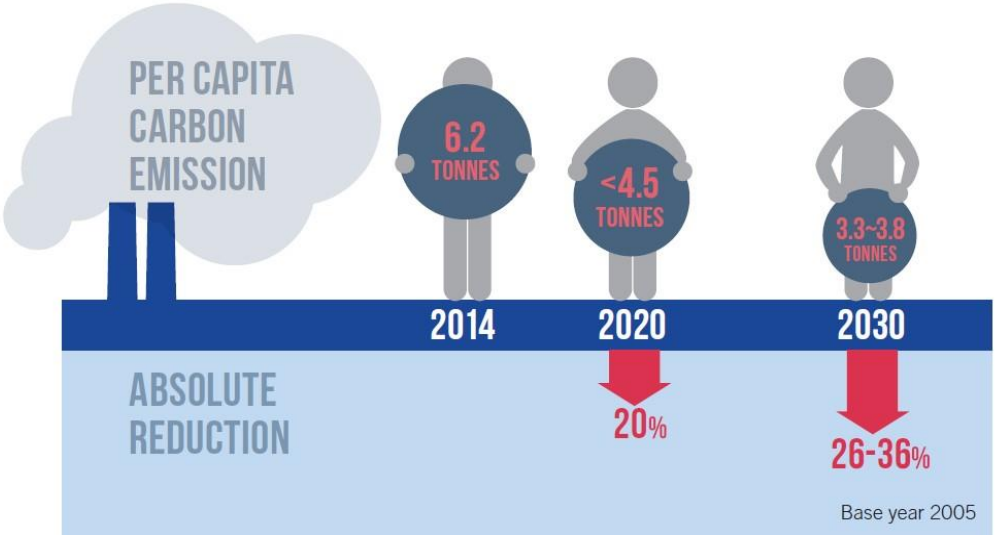
更新日期 Updated: 2019/07

Step 5: Calculate the total emissions based on city targets

The Hong Kong Climate Action Plan 2030+ contains the current city targets:

FIGURE 4

HONG KONG'S EXPECTED ABSOLUTE CARBON EMISSIONS REDUCTION AND PER CAPITA CARBON EMISSIONS LEVEL IN 2020 AND 2030



Environment Bureau. 2017. Hong Kong's Climate Action Plan 2030+

2005 emissions = 41,200 kilotonnes CO_2e. 2030 total emissions target is therefore:

41,200 x (1 – 26%) = 30,488 kilotonnes CO_2e

41,200 x (1 – 36%) = 26,368 kilotonnes CO_2e

For comparing city targets with science-based targets, we can use the HK government's published per capita emissions target for 2030, and therefore do not need to calculate this on the basis of total emissions targets divided by population projections.

Step 6: Calculate the HDI reduction factor and science-based 2030 emissions

The United Nations Development Programme (UNDP) also produces an HDI rating for Hong Kong separate from mainland China, which we used in calculating the HDI reduction factor as follows:

HDI reduction factor for Hong Kong

$$1 - 0.5 * \left(1 - \left(\frac{HDI_{NATION} - HDI_{WORLD}}{HDI_{WORLD}}\right)\right) = \text{HDI-ADJUSTED TARGET}$$

$$1- 0.5 * \left(\frac{\quad}{\quad} \right)$$

1- (0.5 x (1- (0.933-0.728) / 0.728))) = 0.64

Note: Hong Kong HDI 2017 = 0.933; World average HDI 2017 = 0.728

Source: http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf

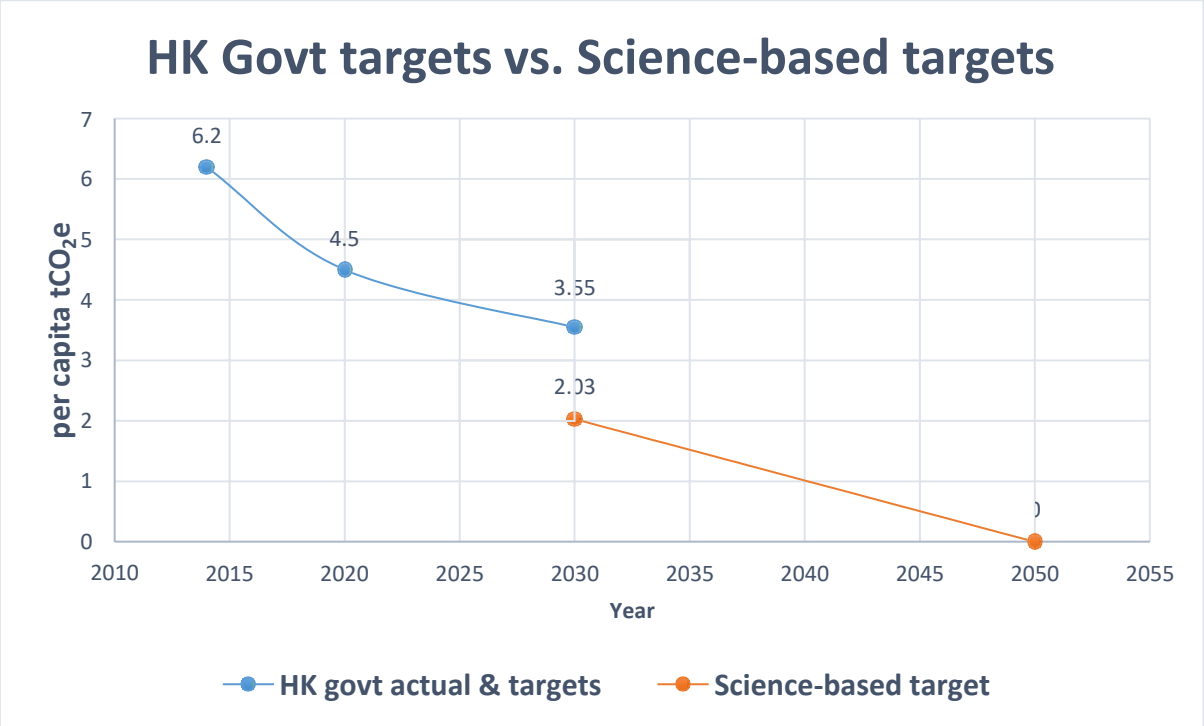
Step 7: Calculate per capita emissions for city targets

Step 7: Calculate per capita emissions for cities

2018 Estimated Emissions		2018 Estimated Population		HDI Reduction Factor		Science-based 2030 emissions
42,002,400 tCO_2e	/	7,450,500	x	(1 - 64%)	=	2.03 tCO_2e per capita

Conclusion: science-based 2030 emissions targets for Hong Kong = 2.03 tCO_2e / per capita

Step 8: Test city targets against the science based 2030 /2050 emissions



CarbonCare InnoLab 2019.09.16

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