THE CLIMATE MOMENT: A Systems-Approach to National Emission Reductions

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INTRODUCTION

Since the Paris Climate Conference in 2015, we have developed a model of country progress towards emission reduction targets set at COP21. Unlike similar efforts, our model tracks not only progress towards nationally determined contributions (NDCs) but also the system-wide relationship of these reductions to energy markets, investment flows and employment.

As we approach the 5-year anniversary of the COP21 in Paris, the system that we live in is showing serious cracks. The global coronavirus pandemic may be exposing these cracks most vividly at the moment, but the system-wide instability linked to global climate change, environmental stress and social inequities was showing significant strain before 2020. The value of systems analysis is increasingly evident.

Our work around these topics provides one model for thinking about some of the challenges ahead in the 2020s: how can we understand the linkages between carbon emissions, energy markets, investment and employment in terms of past performance and the future opportunities to reshape them? This paper presents recent outputs from our work related to the 11 countries tracked through our modeling:

- What progress has each country realized between 2015 and 2018 and what are the levels of future ambition required to reach 2030 NDCs?
- What improvements has each country made in the emissions intensity of their economy between 2015 and 2018 and how must these efforts evolve considering future GDP growth in the 2020s to reach 2030 NDCs?
- What are the unique challenges and opportunities in each country in the 2020s and what are the policy and market interventions that can further progress?

This paper and the model that underlies it are one step in the process of gaining a nuanced, market-specific understanding of these challenges for the 2020s. Together, we bring over a decade of experience working globally with policymakers, institutions and private firms on these issues and look forward to hearing your feedback.

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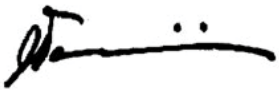

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SUMMARY

The following pages present country profiles for the 11 markets tracked by our model: Brazil, Canada, China, Germany, India, Indonesia, Japan, Korea, Mexico, United Kingdom, and the United States. For each country, we report the estimated emissions mitigation potential between 2015-2018 and the actual emissions mitigation during the same period.

The estimated mitigation potential refers to what we projected the country could achieve in the time period by implementing policy and market-based interventions designed to decarbonize the national economy. This projection is referred to as the **low carbon scenario** throughout the paper. This low carbon scenario differs from the **business as usual scenario** (referred to as BAU throughout this paper), which is the "natural" increase or decrease in national emissions anticipated without these targeted policy and market-based interventions.

Each country profile also includes a new indicator: the **GDP Carbon Intensity Ratio**. This value expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). GDP Carbon Intensity values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015. Considerations are made in each country profile as to whether emissions are being decoupled from GDP growth. A summary of these values for each country is as follows:

Country	GDP Carbon Intensity Ratio
Japan	2.52
Mexico	2.38
Brazil	1.69
Germany	1.48
Korea	1.47
China	1.21
United Kingdom	1.16
Canada	1.04
India	1.02
United States	.91
Indonesia	.66

COVID-19 is undoubtedly having an impact on economic growth and energy consumption. On the other hand, we explicitly do not consider it in this study, as it would skew the assessment of progress made so far and possibly lead to the underestimation of the scale of the challenge ahead, should a V-shape economic recovery materialize.

BRAZIL

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
+ .45%	- 4.1%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that Brazil's carbon emissions would increase by 2018 in both the BAU scenario (+ 2.05%) and low carbon scenario (+ .45%). Instead, carbon emissions declined by 4.1%, suggesting more success than one might assume at reducing emissions. Possible explanations for this divergence: Brazil's GDP increased by a slower rate than expected (-2.3% compared to the 2015 forecast). Lower economic growth results in lower energy demand and emissions. At the same time, solar and wind power generation capacity increased considerably: solar PV went from 23 MW in 2015 to 2,296 MW in 2018; wind went from 7,633 MW in 2015 to 14,401 MW in 2018.

1.69

1.41

(average of the 11 countries covered in our study)

Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). Brazil's Ratio is 1.69, better than the average of the 11 countries covered in our modeling. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, Brazil's GDP grew by 3.77% while emissions declined by 4.1%. Brazil's emissions per unit/GDP declined by around .95% annually in the years since the Paris Climate Agreement and this value must decline by 38% to achieve Brazil's NDC target of decreasing emissions by 12.14% by 2030, compared to 2018 levels, assuming GDP growth around 39% by 2030.

Insights from the 2010s – Brazil

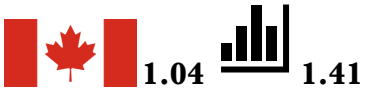
- ✓ The election of President Bolsonaro and the rise of climate denialism disrupted Brazil's progress related to targets set at the Paris Climate Agreement
- ✓ Sharp reversal in land-based emissions trends, with progress made at reducing forestry emissions over the past decade eroding amidst increased deforestation
- ✓ Tension between recent success of renewable energy at auction and plans to also significantly expand new capacity from new fossil-fuel exploration
- ✓ Progress in decarbonization of the transport sector through biofuels but limited adoption of electric vehicles compared to other countries in this study
- ✓ No evidence of focus on green sectors in Covid-19 related economic stimulus

CANADA

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
- 7.57%	- .42%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that Canada's carbon emissions would increase by 2018 in the BAU scenario (+ .53%) while declining in the low carbon scenario (- 7.57%). Instead, carbon emissions declined by .42%, basically in line with the BAU scenario and suggesting missed opportunities at deeper reductions. The ambition has been missed primarily due to slow progress in improving energy efficiency (per capita energy demand has declined only by 0.4% per year between 2015 and 2018) and in the installation of solar and wind power generation capacity. Solar capacity increased on average only by 7.35% per year, and wind by 4.56% per year. These values are well below the progress observed for the countries analyzed in this study.



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). Canada's Ratio is 1.04, confirming that Canada's performance in this regard has basically been flat and that far greater efforts will be required a begin a serious decoupling of emissions from GDP growth. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, Canada's GDP grew by 10.02% while emissions declined by .42%. Canada's emissions per unit/GDP declined by around 2.08% annually in the years since the Paris Climate Agreement and this value must decline by 56% in 2030 to achieve Canada's NDC target of decreasing emissions by 27.96% by 2030, compared to 2018 levels. GDP is expected to increase steeply by 63.21% in the same period.

Insights from the 2010s – Canada

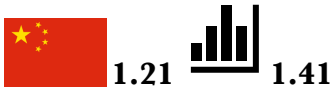
- ✓ Despite political will at the federal level, Canada's diverse provincial energy portfolios has impeded greater progress around goals set at the Paris Climate Agreement
- ✓ Plan to phase-out coal-fired electricity by 2030 should lead to significant reduction in emissions from the electricity sector
- ✓ Imposition of country-wide carbon pricing with targeted exemptions for industries facing intense trade-related competition
- ✓ Some progress in the transport sector with targets around low-emission vehicles but greater adoption rates will be needed
- ✓ Rollout of a "strings attached" Covid-19 bailout could promote greater climate-related transparency from Canadian companies

CHINA

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
+ 9.46%	+ 4.86%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that China's carbon emissions would increase by 2018 in both the BAU scenario (+ 16.97%) and low carbon scenario (+ 9.46%). Instead, carbon emissions increased by only 4.86%, indicating success at containing more rapid increases. The reduction in emissions can be explained by the improvement of energy efficiency, with energy demand per capita increasing only by 2.41% per year (against GDP growth of 6.74% per year). At the same time, solar and wind power generation capacity increased considerably: solar PV went from 43,552 MW in 2015 to 175,032 MW in 2018 (with an average annual growth rate of 60.2%); wind went from 131,048 MW in 2015 to 184,696 MW in 2018 (with an average annual growth rate of 12.12%). This improvement has been enabled, among other factors, by the national energy transition strategy and air pollution policies (Climate Transparency, 2018).



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). China's Ratio is 1.21, revealing that China has been successful at improving the emission intensity of its overall economy, even if this value is lower than the average of the 11 countries in this study. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, China's GDP grew significantly by 19.08% while emissions increased by 4.86%. China's emissions per unit/GDP declined by around 4.72% annually in the years since the Paris Climate Agreement and this value in 2030 must be 51% lower than 2018 levels to achieve China's NDC target of increasing emissions by only 2.40%, assuming GDP by 2030 more than doubles by 109.34%.

Insights from the 2010s – China

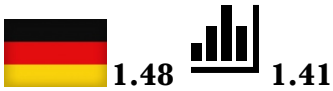
- ✓ Significant new renewable energy capacity and continued investment in domestic and international coal-fired electricity plants
- ✓ Implementation of renewable energy targets for provinces yet removal of some helpful subsidies for renewable energy development
- ✓ Sharp increase in electric vehicle penetration of transport market despite plans to phase out subsidies
- ✓ Persisting political commitment to the Paris Climate Agreement with opportunity to assume important leadership role through more ambitious 2030 NDC target

GERMANY

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
- 10.10%	- 4.52%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that Germany's carbon emissions would increase by 2018 in the BAU scenario (+ 5.99%) while decreasing by 10.10% in the low carbon scenario. Germany's actual performance saw emissions decrease by 4.52%, approximately between the BAU and low carbon scenarios. Possible explanations for this result: Germany's GDP has grown at the same level as forecasted in 2015, being 0.47% higher on average between 2015 and 2018 when compared to the BAU scenario. The reduction in emissions can be further explained by the improvement of energy efficiency, with energy demand per capita decreasing by -0.07% per year against GDP growth of 1.99% per year. Also, solar capacity increased by 5.41% per year, and wind by 10.08% per year. While this increase in renewable energy generation capacity has contributed to emission reductions, it hasn't been as marked as forecasted in the low carbon scenario simulated in 2015.



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). Germany's Ratio is 1.48, in line with the average of the 11 countries in the study of 1.41. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, Germany's GDP grew by 17.52% while emissions declined by 4.52%. Yet despite Germany's emissions per unit/GDP declining by around 3.51% annually in the years since the Paris Climate Agreement, this value will need to decrease by 49% in 2030 (compared to 2018 levels) to achieve its NDC of reducing emissions by 34.99%. Given a projected GDP increase of 26.99% by 2030, Germany will need to build upon policy interventions from the 2010s significantly.

Insights from the 2010s – Germany

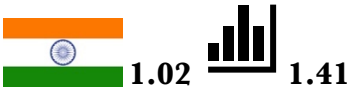
- ✓ New wind and solar capacity slowed down significantly in the 2010s, with the coal phase out schedule too slow to meet goals set at the Paris Climate Agreement
- ✓ More jobs were lost in the solar and wind industries in the 2010s than the total employed in the coal sector (Climate Action Tracker, 2020)
- ✓ Recent introduction of a carbon price for the building and transport sectors could have impact if increased in the 2020s
- ✓ Failure to fully reconcile the post-Fukushima nuclear phase out with ambitious climate targets linked to the Energiewende
- ✓ Promising signs of green stimulus focused on clean energy sectors

INDIA

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
+ 11.30%	+ 10%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that India's carbon emissions would increase by 2018 in the BAU scenario (+ 16.66%) and the low carbon scenario (+ 11.30%). India's actual performance saw emissions increase by 10%, approximately in line with our low carbon scenario. India's GDP has grown as expected between 2015 and 2018 (forecast +7.53%, actual growth +7.54%). The trend of emissions can be explained by the improvement of energy efficiency, with energy demand per capita increasing by 4.30% per year (against GDP growth of 7.54% per year). At the same time, solar and wind power generation capacity increased considerably: solar PV went from 3,518 MW in 2015 to 17,873 MW in 2018 (achieving a 72.5% increase year on year between 2015 and 2018); wind went from 25,088 MW in 2015 to 35,288 MW in 2018 (recording a 12.1% increase year on year for the period 2015-2018). These achievements show emissions being at par with the low carbon scenario simulated in 2015, but nevertheless result in increased emissions. This is consistent with the National Electricity Plan (NEP) and the NDC target, which allow India to increase total emissions, but at a slower rate compared to a BAU scenario.



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). India's Ratio is 1.02, noticeably lower than the average of the 11 countries in the study of 1.41. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, India's GDP grew by 29.24% while emissions increased by 10%. While India's emissions per unit/GDP declined by around 3.87% annually in the years since the Paris Climate Agreement, this value will need to decrease by only 11% in 2030 (compared to 2018 levels) to achieve its NDC of increasing emissions by 110.62%. Given a projected GDP increase of 137.29% by 2030, India must significantly build upon policy interventions to decouple emissions from GDP growth.

Insights from the 2010s – India

- ✓ Significant investment in renewable energy coupled with significant investment in coal-fired electricity production
- ✓ Implementation of a carbon tax for coal at the source coupled with continued subsidies for the coal industry
- ✓ Unclear policy guidance related to transport sector and electric vehicles
- ✓ Progress in private sector with critical mass of companies adopting internal carbon price
- ✓ Covid 19 related stimulus could accelerate the phase out of coal-fired electricity production amidst declining energy demand

INDONESIA

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
+ 4.87%	+ 9.82%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that Indonesia's carbon emissions would increase by 2018 in both the BAU scenario (+ 13.15%) and low carbon scenario (+ 4.87%). Instead, carbon emissions increased in between these two scenarios by +9.82%, indicating that some actions have improved on the BAU scenario but that additional effort is required. Additional observations: Indonesia's GDP has grown at a similar rate, but lower than expected, being 0.59% lower on average between 2015 and 2018 when compared with the BAU scenario. Lower economic growth results in lower energy demand and emissions. Further, as a second factor resulting in emissions being lower than the BAU scenario, Indonesia's energy demand per capita has increased only by 2.71% per year (against GDP growth of 5.04% per year). We have no data about solar and wind power generation capacity. However, despite increases in generation from renewables, Indonesia is still mainly relying on fossil fuels, being the 10th largest country for total coal capacity in the world in 2018 (Dunne, 2019).

Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). Indonesia's Ratio is .66, one of the lowest results of the 11 countries covered in our modeling, suggesting that Indonesia has a long way to go in decoupling emissions from GDP growth. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, Indonesia's GDP grew by 18.79% while emissions grew by 9.82%. Yet despite Indonesia's emissions per unit/GDP declining by around 1.82% annually in the years since the Paris Climate Agreement, Indonesia has not currently pledged to reduce their emissions by 2030 as they are set to nearly double (+ 98.15%) in the next decade, with GDP also projected to double. This means that Indonesia's emissions per unit/GDP can remain unchanged, making the country a significant outlier in the study.

Insights from the 2010s – Indonesia

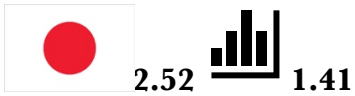
- ✓ Political leadership should face pressure to increase the ambition associated with their NDC for 2030
- ✓ Continued reliance on coal-fired power generation with little sign that investment in future coal power plants is being shifted to renewable sources of energy
- ✓ Forest clearance for palm oil remains a significant contributor to land-based emissions, with growing impacts on air quality domestically and for Indonesia's neighbors
- ✓ Need for government policies to reinforce more ambitious renewable targets in the 2020-2024 5-year plan

JAPAN

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
- 11.24%	-3.86%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that Japan's carbon emissions would decrease by 2018 in both the BAU scenario (- 9.34%) and low carbon scenario (- 11.24%). Instead, carbon emissions declined more modestly by – 3.86%, indicating less success than what was simulated in our low carbon model. Japan's GDP has grown at a similar rate than expected, being 0.33% higher on average between 2015 and 2018. This would lead to slightly higher energy demand and emissions than BAU forecasts. In addition, energy demand per capita has increased slightly between 2015 and 2018, with a growth of 0.27% per year, further increasing emissions above the BAU scenario, which forecasted a stronger improvement of energy efficiency. Contributing to emission reduction instead, solar and wind power generation capacity have increased by 17.64% and 9.26% per year during the period 2015-2018. An additional cause can be identified for the emissions being higher than forecasted, and this is the continued reliance on fossil fuels for power generation after the discard of nuclear power (Timperley, J., 2018). After the Fukushima event Japan announced a new climate target in 2013, which is an increase in carbon emissions by +5% compared to 1990 levels, while the precedent goal was to reduce emissions by -25%. Despite this, Japan has seen a GDP growth rate of 1.15% in the period 2015-2018 and at the same time has recorded an emission reduction of 3.86% in the same period.



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). Japan's Ratio is 2.52, the best result of the 11 countries covered in our modeling, suggesting that Japan is beginning to decouple emissions from GDP growth. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, Japan's GDP grew by 13.27% while emissions declined by – 3.86%. Yet despite Japan's emissions per unit/GDP declining by around 2.39% annually in the years since the Paris Climate Agreement, they will need to be 37% lower in 2030 (compared to 2018) to achieve Japan's 2030 target to reduce emissions by 15.04%. This will require significant policy interventions to achieve, given that our modeling projects a 34.88% increase in Japan's GDP by 2030.

Insights from the 2010s – Japan

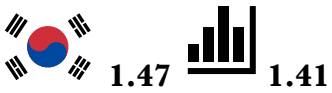
- ✓ Climate policy in the wake of the Fukashima nuclear disaster relied heavily on carbon capture and storage (CCS) technology that doesn't yet exist at scale
- ✓ Coal powered around a third of Japan's electricity in the 2010s with 30 new coal-fired power plants at the stage of planning or construction
- ✓ Lack of public pull-back from foreign investment in coal projects, despite some progress from the private sector

KOREA

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
+ 2.88%	-0.41%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that South Korea's carbon emissions would increase by 2018 in both the BAU scenario (+ 8.28%) and low carbon scenario (+2.88%). Instead, carbon emissions declined slightly by .41%, indicating success beyond what was simulated in our low carbon model. Possible explanations for this divergence: South Korea's GDP increased by a slower rate than expected: -0.63% per year on average between 2015 and 2018 when compared to the 2015 forecast. This results in lower energy demand and emissions. Further, energy demand per capita increased only by 1.43% per year against GDP growth of 2.90% per year. Finally, solar and wind power generation capacity increased considerably: solar PV went from 3,613MW in 2015 to 7,862MW in 2018 (a 29.7% year on year increase between 2015 and 2018); wind went from 847 MW in 2015 to 1,311 MW in 2018 (a 15.9% year on year increase between 2015 and 2018). Furthermore, South Korea has invested heavily in other renewable energy technologies, such as biomass (Climate Transparency, 2019a).



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). South Korea's Ratio is 1.47, suggesting that South Korea is beginning to decouple emissions from GDP growth. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, South Korea's GDP grew by 17.38% while emissions declined by -.41%. Yet despite South Korea's emissions per unit/GDP declining by around 2.38% annually in the years since the Paris Climate Agreement, they will need to decline by 38% in 2030 relative to 2018 levels to achieve South Korea's 2030 target to reduce emissions by 23.87% between 2018 and 2030. This will require improvement on policy and market trends in South Korea in the 2010s (see below), given that our modeling projects a 32.94% increase in GDP by 2030.

Insights from the 2010s – Korea

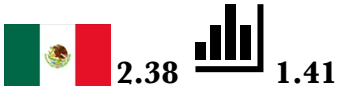
- ✓ Minimal government support for feed-in tariff as compared to some OECD countries resulted in tepid growth in large-scale renewable energy projects
- ✓ The 3rd Energy Master plan does not commit to a complete phase out of coal-fired power plants, despite plans to increase the share of renewable electricity production to 20% by 2030
- ✓ Entrenched belief in "more is better" energy consumption failed to improve energy efficiency at rates needed to significantly reduce carbon emissions
- ✓ One of the first countries to embrace a "Green New Deal" policy response to the Covid-19 pandemic, which could accelerate renewable energy, a carbon tax, and coal phase-out

MEXICO

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
+ 3.01%	+ 10.36%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that Mexico's carbon emissions would increase by 2018 in the BAU scenario (+ 9.69%) and the low carbon scenario (+ 3.01%). Mexico's actual performance saw emissions increase by 10.36%, above even the BAU scenario, the only case in the 11-country study where this occurred. Mexico's pace of reducing the emissions intensity of its overall economy over the past decade has been quite slow, despite some improvement in the years since the Paris Climate Agreement. Mexico's GDP grew by a slower rate than expected (-0.82% per year on average between 2015 and 2018 when compared to the 2015 forecast). This should have resulted in lower emissions relative to the BAU scenario, but the data show the opposite. Energy demand per capita declined only slightly, by -0.73% per year on average (against GDP growth of 2.58% per year) and primarily due to a stronger reduction in the year 2018 only. Further, solar capacity went from 173 MW in 2015 to 2,555 MW in 2018, while wind capacity went from 3,271 MW in 2015 to 4,875 MW in 2018. This is a strong increase year on year, but the total installations remain a small percentage of total capacity and power generation. Renewables still produced about 15% of total power generation in Mexico in the years considered (Climate Transparency, 2017).



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). Mexico's Ratio is 2.38, noticeably higher than the average of the 11 countries in the study of 1.41. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, Mexico's GDP grew by 4.4% while emissions increased by 10.36%. While Mexico's emissions per unit/GDP declined by around .86% annually in the years since the Paris Climate Agreement, this value will need to decrease by 29% in 2030 (compared to 2018 levels) to achieve its NDC of increasing emissions by 7.4%. Given a projected GDP increase of 52.29% by 2030, Mexico must significantly build upon policy interventions to decouple emissions from GDP growth.

Insights from the 2010s – Mexico

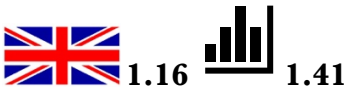
- ✓ New López Obrador administration has shown limited support for ambitious climate action, failing to announce a climate action plan
- ✓ Indicated preference for fossil fuel projects with cancelling of electricity auctioning rounds that have helped to increase renewable energy adoption and a further delay in carbon markets
- ✓ Delayed stimulus announcement related to the Covid-19 pandemic with no evidence of a focus on green sector development

UNITED KINGDOM

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
- 13.83%	-9.45%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that the United Kingdom's carbon emissions would decrease in the BAU scenario (- 1.69%) and the low carbon scenario (- 13.83%). The United Kingdom's actual performance saw emissions decrease by 9.45%, slightly below the level our modeling defined as the mitigation potential. However, the United Kingdom has the highest rates of reducing the emission intensity of its economy of the 11 countries in the study, even if this rate has not improved significantly since the Paris Climate Agreement. The UK's GDP grew -0.52% per year on average between 2015 and 2018 when compared to the 2015 forecast. This pushes emissions lower than the BAU case. A more relevant reduction in emissions is due to energy efficiency: energy demand per capita decreased by 1.07% per year (against GDP growth of 1.84% per year). At the same time, solar and wind power generation capacity increased considerably: solar capacity increased by 11.31% per year, and wind by 15.09% per year during the period 2015-2018. Notwithstanding, fossil fuels still represent around 80% of the UK's energy mix, which could help to explain why the country hasn't fully achieved the low carbon scenario forecasted in 2015.



Our GDP Carbon Intensity Ratio above expresses the carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). The United Kingdom's Ratio is 1.16, slightly lower than the average of the 11 countries in the study of 1.41. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, the United Kingdom's GDP declined by 2.36% while emissions decreased by 9.45%. While the United Kingdom's emissions per unit/GDP declined by an impressive 4.83% annually in the years since the Paris Climate Agreement, this value will need to decrease by 38% in 2030 (compared to 2018 levels) to achieve its NDC of reducing emissions by 22.61%. Given a projected GDP increase of 24.84% by 2030, the United Kingdom must significantly build upon policy interventions to decouple emissions from GDP growth.

Insights from the 2010s – United Kingdom

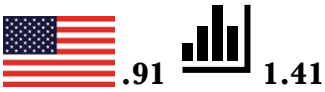
- ✓ Success at phasing out coal-fired electricity production stands out as one of the most notable achievements of the past decade
- ✓ First economy to legislate a net-zero 2050 emissions target and parliament to declare a climate emergency
- ✓ Upcoming COP26 in Scotland will test UK climate leadership in a post-Brexit global economy and ability to foster increased EU and global ambition

UNITED STATES

Estimated Mitigation Potential (2016-18)	Actual Emissions Trajectory (2016-18)
- 2.97%	-.29%

Both values represent the increase/decrease in carbon emissions in 2018 compared to 2016.

At the time of the 2015 Paris Climate Agreement, our modeling projected that the United States' carbon emissions would increase in the BAU scenario (+ 1.08%) while decreasing in the low carbon scenario (-2.97%). The United States' actual performance saw emissions decrease by .29%, right in between the two. Possible explanations for this underperformance: slow improvement in the lowering of the overall emissions intensity of the economy and slower shift to low carbon fuels amidst the climate denialist administration of President Trump. Specifically, the US' GDP grew 0.34% less per year on average between 2015 and 2018 when compared to the 2015 forecast. This would imply that energy demand and emissions would be lower than in the BAU case. Energy demand per capita increased over time, by 0.60% per year on average (against GDP growth of 2.46% per year). Both the underperformance of GDP and the increase in energy consumption per capita show little progress in reducing emissions. On the other hand, solar and wind power generation capacity increased by 30.57% and 9.14% per year respectively. Despite this improvement, the reliance on fossil fuels is still predominant.



Our GDP Carbon Intensity Ratio above expresses the ratio of carbon emissions per unit GDP since the Paris Climate Agreement (2016-2018) compared to the prior decade (2005-2015). The United States' Ratio is .91, noticeably lower than the average of the 11 countries in the study of 1.41. (*Values greater than 1 imply that more efforts have been made to decouple emissions from GDP growth; values less than 1 mean that less effort has been recorded in recent years relative to the period 2005-2015 and that emissions are not being decoupled from GDP growth*).

During the same period 2016-2018, the United States' GDP increased by 7.09% while emissions decreased by .29%. While the United States' emissions per unit/GDP declined by 2.34% annually in the years since the Paris Climate Agreement, this value will need to decrease by 39% in 2030 (compared to 2018 levels) to achieve its NDC of reducing emissions by 12.79%. Given a projected GDP increase of 23.74% by 2030, the United States must lower emission intensity faster and find new ways to replace mitigation efforts in the absence of federal action.

Insights from the 2010s – United States

- ✓ Reversal of Obama administration government climate change policies targeting utilities (Clean Power Plan) and transport
- ✓ Intention by President Trump to withdraw from the Paris Climate Agreement
- ✓ Increased subnational and non-governmental pledges, if fully committed, could bring U.S. close to 2025 NDC target of lowering emissions 17-24% below 2005 levels (Data Driven Yale, 2019)

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ABOUT

Dual Citizen LLC is a US-based consultancy providing data analytics and research to promote sustainable development and green growth. Dual Citizen works with governments, institutions and private clients globally. To support this work, Dual Citizen publishes the Global Green Economy Index (GGEI), measuring how 130 countries perform in the global green economy. The 10-year anniversary edition of the GGEI in 2020 will analyze green progress in these countries through the GGEI methodology. Jeremy Tamanini, the founder of Dual Citizen, also provides climate change research and supports new work at the intersection of the green economy and artificial intelligence. For more information, please visit www.dualcitizeninc.com

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