Major Economies and Climate Change Research Group

Russia, Japan, Canada & Australia

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RELEVANT ACRONYMS AND ABBREVIATIONS

ACCUs	Australian Carbon Credit Units
AFOLU	Agriculture, Forestry, and Other Land Use
ARENA	Australian Renewable Energy Agency
B.C.	British Columbia
CAIT	Climate Analysis Indicators Tool (World Resources Institute)
CCPI	Climate Change Performance Index
CCS	Carbon Capture and Sequestration
CEFC	Clean Energy Finance Corporation
CFI	Carbon Farming Initiative
CO_2	Carbon Dioxide
CO_2/kWh	Carbon Dioxide Emissions per Kilowatt Hour
COAG	Council of Australian Governments
EDGAR	Emissions Database for Global Atmospheric Research
EIA	Energy Information Association (U.S.)
ERF	Emissions Reduction Fund
EVs	Electric Vehicles
FIT	Feed-in Tariffs
GHG	Greenhouse Gas
$GtCO_2e$	Giga-tons of Carbon Dioxide Equivalent
GW	Giga Watts
IEA	International Energy Agency
kWh	Kilowatt Hour
LNG	Liquefied Natural Gas
LULUCF	Land use, land use change and forestry
METI	Ministry of Economy, Trade, and Industry (Japan)
$MtCO_2e$	Megatons of Carbon Dioxide Equivalent
NGOs	Non-governmental Organizations
NRA	Nuclear Regulation Authority (Japan)
OECD	Organisation for Economic Co-operation and Development
RD&D	Research, Development, and Demonstration Projects
RET	Renewable Energy Target
SGER	Specified Gas Emitters Regulation
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

Japan and Australia's policies and pledges to reduce greenhouse gas (GHG) emissions are in question, due to safety concerns surrounding nuclear power generation in Japan and the recent shift in Australia's climate change policies. Russia and Canada have made substantial commitments to reduce their GHG emissions. However it is unclear whether Canada will be able to meet its target as emissions from its oil sands production continue to grow rapidly. Russia should be able to meet its GHG mitigation target, since its baseline emissions figures were set prior to the economic and industrial collapse following the dissolution of the USSR.

Russian Federation

The most important prospects for Russian mitigation activities lie in the energy production and energy efficiency sectors. Russian mitigation activities will likely include the expansion of nuclear power generation; improvement of efficiency in oil and gas and power and heat production; and the improvement of energy efficiency in industry and residential and commercial buildings.

- Economically attractive mitigation in energy production can abate 159 $MtCO_2e$ in 2030, and energy efficiency measures can abate 242 $MtCO_2e$ in 2030.

Primary Barriers:

- Changing the way Russian consumers are charged for energy and heat use, such as a shift to metering, could be met with stiff resistance.
- Availability of financing for efficiency improvement projects will determine if the full potential for energy savings and GHG mitigation is achieved.

Key Recommendations:

- **Liberalize energy prices:** Energy prices should be more market-based to incentivize efficiency.
- **Clarify regulatory trajectory and provide financing:** Clear regulations and financing are required to overcome uncertainty and volatility and incentivize investment in the replacement of aging capital.

Japan

Japan's potential to maintain the GHG mitigation path it was on came into question after the 2011 Fukushima nuclear reactor accident and subsequent deactivation of all of its nuclear reactors. If fossil fuel power generation capacity is constructed, it must be high-efficiency and low carbon-intensity technology. Energy efficiency measures should be prioritized to prevent the need for construction of additional fossil fuel generation capacity that can be avoided.

Primary Barriers:

- Costs and delays associated with applying to restart nuclear power plants could make it uneconomical for most of Japan's reactors to be restarted.
- Efforts to reduce the cost of electricity, at the behest of consumers and businesses, reduce pressures to improve the efficiency of energy use.

Key Recommendations:

- **Provide assistance to cover costs associated with nuclear shutdown:** Nuclear plant upgrades should be subsidized for plants with significant life-span remaining.
- **Reduce demand for electricity:** Energy conservation and efficiency programs should be pursued before shifts to cheaper and dirtier fuels, or other cost-reductions.

Canada

The combination of Canada's recent lackluster federal climate policies and growing emissions from oil sands production requires immediate abatement measures in the sectors with the most potential: energy production and transportation. Several abatement measures include the introduction of federal oil and gas regulations, continued investment in CCS and renewable technologies, and increased incentives for electric vehicles (EVs).

Primary Barriers:

- Canada's economic priorities, which benefit greatly from production of the oil sands, take precedence over taking strong action to reduce emissions in this sector.
- Canadians are highly dependent on their personal vehicles, and there is little coordination among provincial transportation emissions policies.

Recommendations:

- **Strengthen regulations:** The federal government should introduce its long-awaited oil and gas regulations, and Alberta should consider adopting a revenue-neutral carbon tax, similar to that of British Columbia, to replace its current carbon-pricing levy.
- **Promote CCS and EVs:** The federal government should increase its support of CCS development and more provinces should adopt EV incentive programs.

Australia

Recent changes to Australia's federal policies have caused widespread skepticism regarding its continued commitment to strong climate change action. In an effort to rectify this, the federal government should pursue mitigation measures in the sectors with the highest emissions and abatement potential: energy production and agriculture, forestry and other land use (AFOLU).

Primary Barriers:

- Emissions reductions under the Direct Action Plan are projected to be insufficient.
- A significant cost is associated with avoided deforestation and afforestation efforts.

Key Recommendations:

- **Increase collaborative efforts:** State, territory, and local-level governments and NGOs should work to strengthen their collaborative climate change mitigation efforts.
- **Expand the Carbon Farming Initiative:** Priority should be given to projects that focus on enteric fermentation, avoided deforestation, and afforestation.

RUSSIAN FEDERATION

RATIONALE

Russia is one of the largest GHG emitters in the world, currently. While its share of total global emissions—5% in 2010[1]—has been falling, this is due to growing global emissions and fairly flat GHG emissions generated by Russia. Russia's annual GHG emissions, taking all gases into account, remained between 2.5 and 2.7 $GtCO_2e$ since 1995.[2] Russia's emissions rebounded slightly from the post-recession low of 2.48 $GtCO_2e$ to 2.51 $GtCO_2e$ in 2010.[3] However, according to the emissions inventory Russia submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2012, Russia's total emissions (excluding LULUCF) in 2010 were 2.21 $GtCO_2e$.[4] This discrepancy, of 300 $MtCO_2e$, is not insignificant, and its source is unclear.

More importantly, Russia's reported GHG emissions including LULUCF, which Russia has conditioned its emissions reductions commitments upon being accounted for, were 1.56 $GtCO_2e$ in 2010.[5] By Russia's accounting, which was reviewed and approved by the UNFCCC, its emissions in 2010 were more than 45% lower than its 1990 base-year emissions. Clearly, Russia will be under no serious pressure to engage in costly GHG mitigation activities. As Figure 1 below illustrates, Russia's GHG emissions have remained below the pledged reduction level—25% of 1990 baseline emissions—since 1994. International legal obligations will not be the primary motive for Russia to reduce its GHG emissions; economic competitiveness will be.

Fortunately, most of the mitigation potential in Russia—87.9%—is achievable by increasing the efficiency of Russia's energy use.[6] All together, the total amount of economically attractive mitigation potential in Russia amounts to over 567 $MtCO_2e$ per year.[7] The total abatement potential in Russia is just over 1.4 $GtCO_2e$, almost three times the economically attractive mitigation.[8] Unfortunately, it seems the best that can be hoped for is full implementation of money-saving mitigation projects. However, the expansion of Russia's nuclear power generation base that is planned could contribute additional GHG mitigation to the 567 $MtCO_2e$ possible through cost-saving measures alone.

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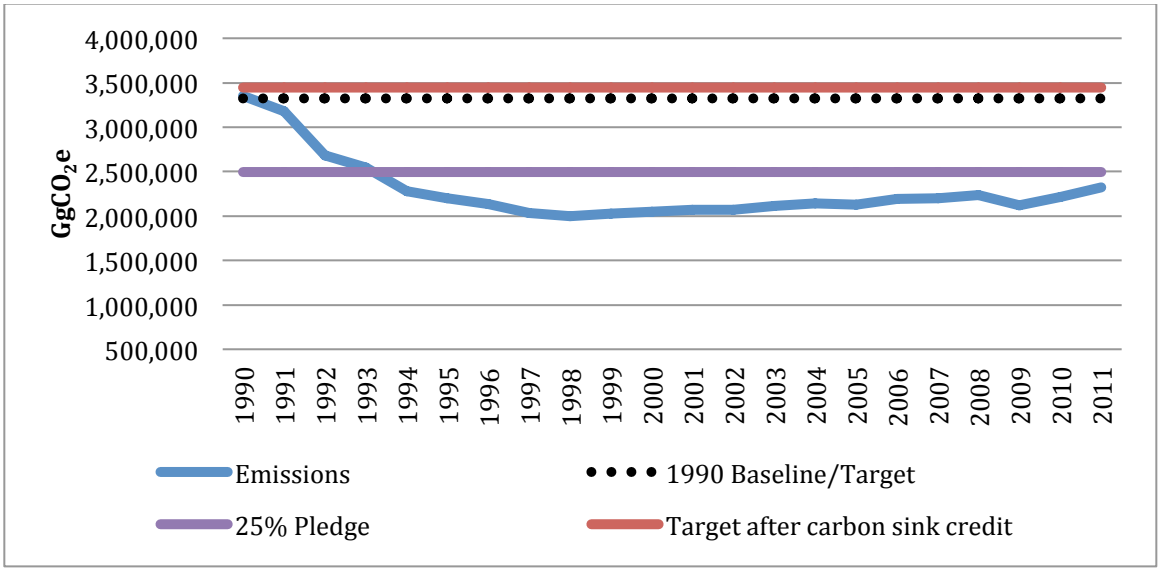
[1] EDGAR, 2010.
[2] Ibid.
[3] Ibid.
[4] UNFCCC, 2013.
[5] Ibid.
[6] McKinsey, 2009, p.12.
[7] Ibid., p. 19.
[8] Ibid., p. 19.

Figure 1: Russian Federation Emissions and Pledged Reductions



Source: IGES GHG Emissions Data, 2013

SECTORS OF IMPORTANCE

ENERGY PRODUCTION

The bulk of Russian GHG emissions—approximately 59% of the 2010 total[9]—are made by the energy production sector. This is not surprising due to Russia's sizeable extractive industry. Roughly 40% of Russia's total 2010 emissions were made by the energy industries, 16% came from fugitive oil and gas emissions, and just over 2% of total emissions were fugitive emissions from solid fuels (coal).[10] These emissions are much lower than the 1990 base-year figures, and were driven down by the economic collapse following the breakup on the Soviet Union, as well as extensive fuel switching in electricity and heat generation—from coal to natural gas.[11] McKinsey estimates the annual abatement attributable directly to the switch from coal to gas in Russia stands at around 70 $MtCO_2e$, despite a 2.2% annual increase in power generation.[12] This does not mean that additional abatement potential from fuel switching is unattainable.

Diversification of the Russian fuel mix is one of the priorities that Russia's government set to achieve its goal of reducing the energy intensity of the economy by 40% between 2007 and 2020.[13] 90% of Russia's primary energy consumption depends on fossil fuel sources, with 56% or Russia's energy coming from natural gas, based on 2011 figures.[14] Shifting from heavy to light-industry and services, and improving the energy efficiency of Russia's major end-use subsectors,

[9] UNFCCC, 2013.
[10] Ibid.
[11] Ibid.
[12] McKinsey, 2009, p.15.
[13] Ibid., p. 17.
[14] U.S. Energy Information Administration (EIA), 2014.

are other means by which Russia hopes to achieve this goal.[15] With regard to the energy production sector, fuel mix diversification and energy efficiency improvements are the key strategies. By replacing aging energy production infrastructure with higher efficiency, lower carbon-intensity options, Russia can reduce the amount of energy it is consuming, thereby reducing its energy intensity, while continuing to enable the economic growth it sees as a priority. Russia also has plans to dramatically increase its installed nuclear power generation capacity, despite being the third-largest generator of nuclear power worldwide.[16] Russia has greatly improved the efficiency of its nuclear power generation since the 1990s, and is a world leader in fast neutron technology—which Russia plans to invest 60.7 billion rubles ($1.7 billion) in by 2020—an attractive technology for export.[17] These efforts to diversify and modernize the energy production sector in Russia can provide a substantial reduction of GHG emissions.

Russian energy production industries remain highly centralized, due to the nature of these industries, as well as their Soviet origins. Most of the major energy production companies are still state-owned, as is the power grid.[18] The age of most of the physical capital used by these industries, and lack of maintenance, is largely to blame for their inefficiency. The power and heat generation industry, for instance, "was designed with efficiency in mind, but lack of investment has led to losses big enough to supply a country like Poland."[19] The extensive cogeneration of power and heat in Russia should be an enhancement to its overall energy efficiency, but due to the age of much of this infrastructure and lack of maintenance, Russia's energy losses in electric and heating grids—12% and 15% respectively—are among the highest in the world.[20] McKinsey attributes this mismanagement to the fact that after the collapse of the Soviet Union, the supply of thermal power far exceeded demand.[21] In the extractive industries, losses are also problematic, with Russia alone flaring 27% of the total global gas volume burned due to this wasteful practice.[22] Russia's pipelines also leak 22% more gas, and burn 44% more gas for pumping per unit, than pipeline systems in the United States.[23]

The abatement potential of the mitigation activities with positive returns for the petroleum and gas industries alone is 99 $MtCO_2e$ in 2030.[24] Power and heat industries contribute another 60 $MtCO_2e$ of economically attractive abatement.[25] Together these energy production activities contribute 28% of the total economically attractive abatement that Russia could be expected to undertake. The prospects for action on energy efficiency measures and fuel switching that reduces the carbon intensity of the Russian economy are good.

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[15] McKinsey, 2009, p. 17.
[16] EIA, 2014.
[17] World Nuclear Association, 2014.
[18] McKinsey, 2009, p. 57.
[19] Ibid., p. 47.
[20] Ibid., p. 48.
[21] Ibid., p. 48.
[22] EIA, 2014, p. 11.
[23] McKinsey, 2009, p. 62.
[24] Ibid., p. 62.
[25] Ibid., p. 47.

BARRIERS

Political:

Russia's political climate is highly uncertain, due to the recent annexation of Crimea and continuing tensions with Ukraine. As Russian politicians and citizens increasingly focus their attention on security issues, their concern for making the reforms and investments necessary to achieve greater energy efficiency or GHG mitigation will wane. Sanctions that other world governments have threatened to enact in response to Russia's actions would make it even more difficult for Russia to achieve meaningful GHG emissions reductions. The World Bank has already forecast a contraction of 1.8% in the Russian economy for 2014, without accounting for any effects of sanctions.[26]

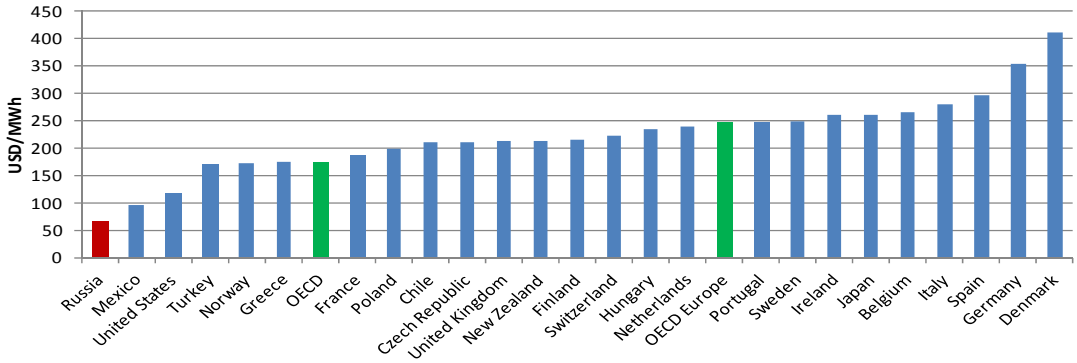
The cooperative programs that the Russian government is involved in with international agencies and other states, such as the Arctic Council or United States Environmental Protection Agency's arctic black carbon mitigation initiatives, could be ended due to escalating tensions. Perhaps more importantly, the willingness of foreign companies to invest in Russia or develop partnerships with Russian firms could be diminished if the political risk continues to increase. This would seriously hamper the ability of Russian firms to access new technologies that could lower Russian GHG emissions.

Market:

Uncertainty surrounding market reforms, such as electricity market liberalization, are negatively impacting the ability to attract investors.[27] Efforts to privatize the power generation industry will rest upon the ability of the Russian government to plan and implement policies in a more predictable fashion. Additionally, the pricing for heat, which is assessed per square meter or per person basis, provides no incentive for conservation. The heavy subsidization of energy consumption eliminates much of the pressure for consumers to conserve or invest in more efficient technologies. The following figures illustrate the low level of Russian electricity prices in relation to other countries.

[26] World Bank, 2014.
[27] McKinsey, 2009, p. 56.

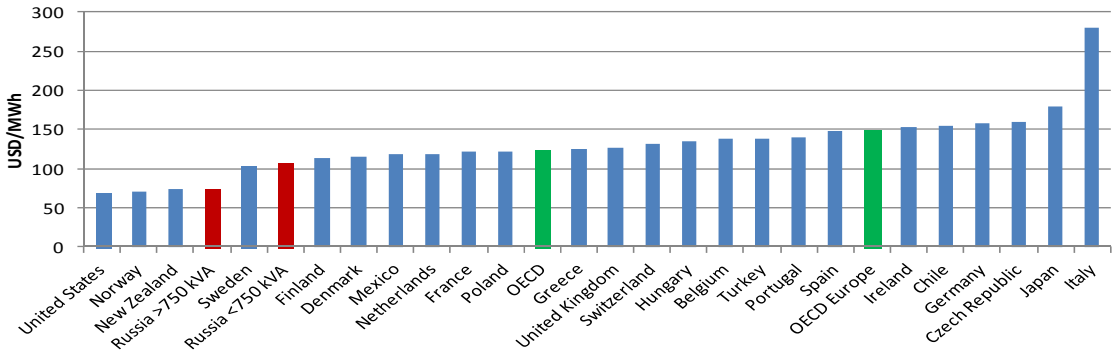
Figure 2: Residential end-user electricity prices in 2011



Note: Prices excluding taxes and charges for the United States.

Source: IEA 2013

Figure 3: Industrial end-user electricity prices in 2011



Note: Prices excluding taxes and charges for the United States.

Source: IEA 2013

Cultural/Social:

Because most of the mitigation activities in the energy production sector are performed by private businesses or government entities, individual behavior shaping is not a major determinant of success. There should be no cultural or social barriers to implementing fuel-switching or energy efficiency measures in energy production. The primary concern should be resistance to switching to metering systems for heat and gas utilities or rolling back energy subsidies, because the expectation that energy will be provided at a low cost, based on area or number of residents, has become engrained in Russian society. Table 1 outlines the scale of Russia's energy subsidies, which make encouraging efficiency difficult.

Table 1: Russian energy subsidies

Russia

	2012
Average subsidisation rate	19.4%
Subsidy ($/person)	325.5
Total subsidy as share of GDP	2.3%

Fuel Subsidy (billion dollars, real 2012)

Fuel	2010	2011	2012
Oil	0	0	0
Gas	20.1	21.3	24.6
Coal	0	0	0
Electricity	27.6	18.8	21.6

Source: IEA World Energy Outlook 2013 Data

Financial:

Financial barriers are perhaps the most significant that must be overcome for Russia to be able to reduce its GHG emissions. The varying forms of uncertainty make it difficult to attract foreign or domestic private investment. 27% of Russian GHG emissions reduction potential in 2030 is generated through investments in economically attractive projects.[28] This means that by making these investments, Russia would realize a net benefit as opposed to incurring a cost. The challenge is that the upfront investments of billions of dollars would be recovered over a period of decades. Consumers and businesses would find it difficult to make investments with such distant time horizons.

Technical:

The only major technical barrier to Russia's adoption of fuel-switching and energy efficiency measures is the lack of experience Russian technicians have with these new technologies. The technologies that Russia would need to implement, to mitigate just the GHG emissions that are cost-effective, have proven successful and are widely used in other industrialized countries. As an industrialized country with a well-developed education system, Russia should be able, relatively easily, to overcome the skill gap that is present, but having access to international partnerships with firms accustomed to using the latest energy production technologies would accelerate this process.

[28] Ibid., p. 19.

RECOMMENDATIONS

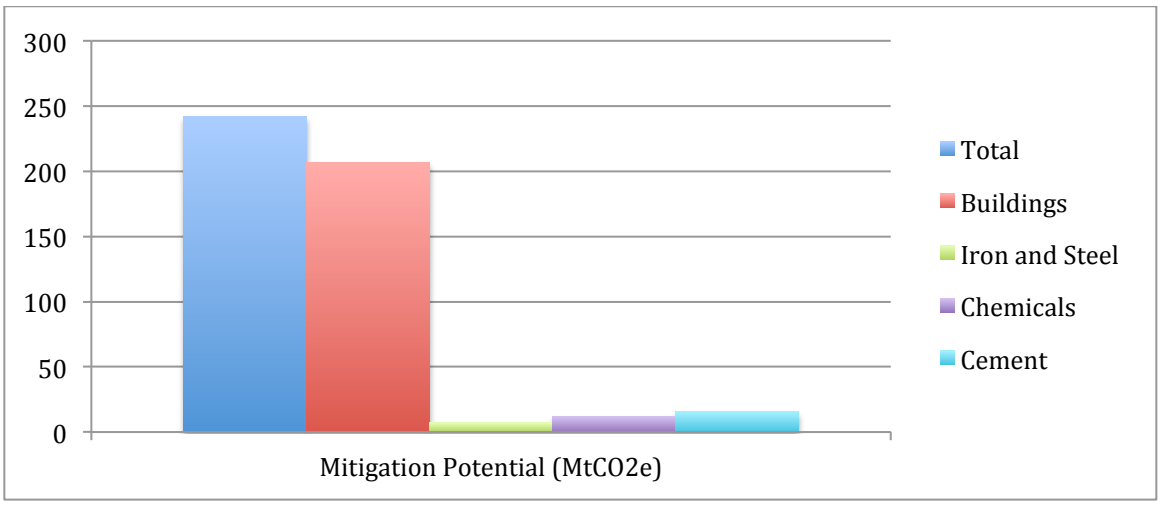
1. **Liberalize energy pricing:** To ensure that energy production efficiency measures are implemented and achieve their full potential, several actions can be taken by the Russian government. Energy prices should be more market-based. In 2012, Russian electricity subsidies amounted to $26.1 billion, or just over 1% of GDP. Rolling back subsidies would also allow for the use of meters to incentivize consumers and distributors to change behaviors and invest in more efficient energy use.

2. **Encourage investments with long payback periods:** Clear regulations and financing are also required to overcome the uncertainty and volatility in Russian energy industries and incentivize investment in the replacement of aging capital and infrastructure with more efficient updated technology.

3. **Replace old reactors and expand nuclear power generation:** Russia's plans to increase nuclear generation capacity while replacing outdated reactors should remain a priority. Because these plans are ambitious, they will be difficult to achieve, but will contribute significantly to Russia's energy security and goals to reduce its economy's carbon intensity.

ENERGY EFFICIENCY

Figure 4: Energy efficiency mitigation with net-negative costs by 2030



Source: McKinsey, 2009

Energy efficiency is central to the Russian government's focus on improving the competitiveness of Russian industry. In order to reach their goal of a 40% reduction in energy intensity by 2020, energy must be conserved and used efficiently in sectors other than energy production. The end-use subsectors that have major mitigation potential are buildings, iron and steel, chemicals,

and cement. Buildings alone contribute 207 $MtCO_2e$ by 2030, with the other three contributing 35 $MtCO_2e$ worth of economically attractive abatement.[29] All together this is over 42% of all cost-effective abatement potential.

Buildings in Russia were largely constructed to be inexpensive, not energy efficient, and the price pressure of energy use has historically been suppressed. These factors encouraged the construction of buildings that are poorly insulated. These buildings do not usually have thermostats regulating heat delivery either, which leads to loss of much of the energy consumed by buildings.

Iron and steel production is highly inefficient in Russia, requiring 25% more energy than in China, and twice the energy used by Japanese or American companies.[30] Russian iron and steel manufacturers are using outdated technology that others abandoned in favor of more efficient methods. The size of the cost-effective emissions reduction potential is not enormous, only 7 $MtCO_2e$, but it should be easy to realize.

Chemicals production is another end-use subsector that could benefit from investment in energy efficiency measures. Fuel switching is also a potential strategy to reduce emissions associated with chemical production, which has proven effective in energy production. All together, the mitigation potential in the chemicals subsector is 12 $MtCO_2e$ by 2030.[31]

Russian cement makers are again prime targets for energy efficiency reforms. The economically appealing mitigation measures can abate 16 $MtCO_2e$ in 2030.[32] The larger size of mitigation potential from the cement industry is partly due to the current inefficiency of Russian techniques and partly due to projected increases in demand for cement to build new commercial and residential buildings in the coming years. In addition to efficiency measures, substitution of feedstocks and fuels in the cement industry would produce emissions savings.

BARRIERS

Political:

Political pushback is likely to occur if energy efficiency measures are not implemented in a coordinated fashion, specifically utility metering and energy subsidy reform. Consumers will either lack incentives to adopt meters or thermostats, or pushback against reforms that drive up their energy costs without providing support to prepare in advance of energy cost increases. In addition, the political risks associated with Russia's confrontation with Ukraine could make it more difficult to institute reforms aimed at improving energy efficiency, due to the time and planning required.

[29] Ibid., p. 39.
[30] Ibid., p. 67.
[31] Ibid., p. 71.
[32] Ibid., p. 75.

Market:

With the Russian energy market so skewed by subsidies, it is difficult to make meaningful advances toward greater energy efficiency. Russians use twice the energy on average for heating as Scandinavians, per square meter.[33] In addition, Russia plans to increase the average size of housing accommodations, while the number of housing units will also be increasing. In the absence of reforms aimed at improving the energy efficiency of buildings, and incentivizing the use of more efficient technologies by consumers, Russia's building emissions are projected to grow 40% by 2030, over the 2010 base.[34]

Cultural/Social:

Many building efficiency measures require behavioral changes on behalf of individuals. This is a problem since the decision making is so diffuse and it is difficult to coerce changes in behavior that increase the efficiency of energy use. McKinsey suggests information campaigns to spur adoption of the mitigation strategies improving building efficiency, which have short enough payback times.[35] This strategy is unreliable, and the full energy efficiency improvement potential will not likely be realized. The increased appetite for larger residential spaces could also undermine efforts to decrease energy consumption in residential buildings. Strong energy efficiency commitments will be necessary to ensure that the growth in the size of Russian residences does not overcome the energy savings from efficiency upgrades, and lead to a net increase in building emissions.

Financial:

Some of the least expensive energy efficiency measures, which would save consumers from excessive energy expenditures, have short enough payback times to be implemented rather easily. These are only a small proportion of overall energy efficiency mitigation potential, however. The energy efficiency measures with higher initial investments required, that take longer to recoup, will not be adopted without support. In addition, the low cost of energy in Russia makes measures that would otherwise be attractive uneconomical.

Technical:

There should be no technical barriers to achieving the bulk of energy efficiency improvements in Russia. Most of the economically attractive solutions are being used in other countries with track records of success. Feedstock switching for industrial processes may be problematic because there may not be adequate supply of materials with proper specifications. Even this barrier could be overcome relatively easily if the demand for such alternative feedstocks existed. Perhaps the biggest challenge is modernizing industries that were born during the Soviet era, and incorporating the latest, most energy efficient, practices and technologies.

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[33] Ibid., p. 39.
[34] Ibid., p. 40.
[35] Ibid., p. 42.

RECOMMENDATIONS

1. **Liberalize energy pricing:** Energy subsidy rollbacks tied to installation of meters must be undertaken in order to incentivize efficient use of energy by consumers in residential, commercial, and industry sectors.

2. **Encourage investments with long payback periods:** Public funding will be required to ensure that energy efficiency improvements with long payback periods are implemented.

3. **Improve access to information:** Information campaigns that educate consumers about planned changes, and direct them to strategies to save on energy expenditures will be necessary.

4. **Set standards for energy efficiency of consumer goods:** It may be most effective to set standards for consumer electronics, lighting, and appliances that improve energy efficiency, rather than rely on changes in consumer preferences.

5. **Phase out carbon-intensive industrial practices:** Efforts need to be made to replace outdated industrial facilities and practices with newer energy-efficient technology. This should be accomplished by instituting regulations in line with the Russian government's goal of reducing carbon and energy intensity, and heavy industry's share of the economy.

JAPAN

RATIONALE

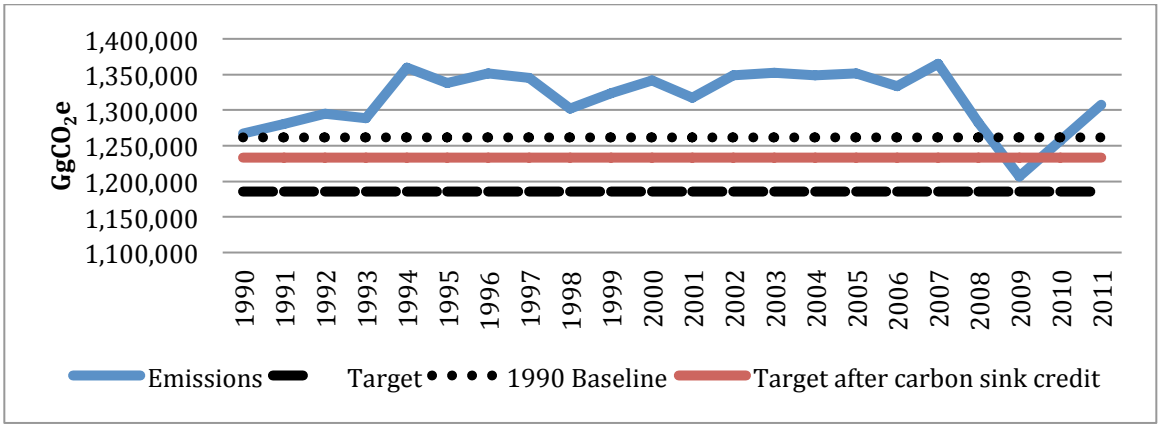
Japan is the largest liquefied natural gas (LNG) importer, the second largest coal importer, and the third largest importer of oil in the world.[36] Because Japan lacks the natural resource endowments to power its economy, Japan takes its energy security very seriously. After the 2011 earthquake and tsunami that caused a meltdown in the notorious Fukushima Daiichi nuclear power plant, Japan shut down all of its nuclear generation capacity.[37] Since Japan only produces 15% of its energy using domestic sources, the loss of nuclear power—8% of total energy consumption—exacerbated Japan's energy security problems.[38]

Japan's nuclear power generation capacity—49 GW or 17% of total electricity generation capacity[39]—played a key role in ensuring reliable base power supply before the Fukushima accident. This clean source of energy has since been replaced with oil and LNG fuelled power generation, leading to increases in Japan's GHG emissions. Prior to the 2013 Conference of Parties meeting in Warsaw, the Japanese Minister of the Environment announced that Japan's

[36] EIA, 2013.
[37] Ibid.
[38] Ibid.
[39] Ibid.

GHG emissions target would have to be changed due to the suspension of nuclear power generation—the 25% reduction on 1990 emissions by 2020 would become a 3.1% increase, or a 3.8% reduction on 2005 levels.[40] Part of Japan's strategy for mitigating GHG emissions involved reducing the carbon-intensity of its power generation to an average of 334 g CO_2/kWh between 2008 and 2012, but the increased use of fossil fuels in 2012 led to a 39% increase in carbon-intensity over 2011 levels to 487 g CO_2/kWh.[41] Clearly, energy production will be key to Japan's ability to reduce its GHG emissions, or at least slow their growth. Figure 5 below illustrates Japan's trouble in reaching emissions reductions targets.

Figure 5: Japan Emissions and Kyoto Pledge Target



Source: IGES GHG Emissions Data, 2013

Serious questions remain surrounding the future of nuclear power in Japan. However, Japan's energy plan, revised during the end of 2013 and adopted in April 2014, calls for nuclear power to remain a contributor to base-load power generation. The economic impact of the nuclear shutdown is estimated to be approximately $34.9 billion per year, in increased costs of electricity generation and fossil fuel imports.[42] Business interests in Japan pushed strongly for the new Basic Energy Plan to include use of nuclear reactors to reduce energy costs. Domestic opposition to nuclear power is strong, but most Japanese citizens—53% polled in 2013—take a realistic view and realize that nuclear power must be used in the short-term, but want to see reliance on it reduced.[43] Following the reorganization of Japan's nuclear regulatory regime in the wake of Fukushima, it appears that this is indeed the strategy—to reactivate limited numbers of nuclear power plants that meet newly strengthened safety standards, and eventually phase out nuclear power generation altogether.

Japan's GHG emissions are primarily generated through use of energy for various purposes. As an industrialized nation, it is not unusual that 89% of Japan's 2009 emissions came from energy production and consumption.[44] The greatest share of Japan's energy related emissions,

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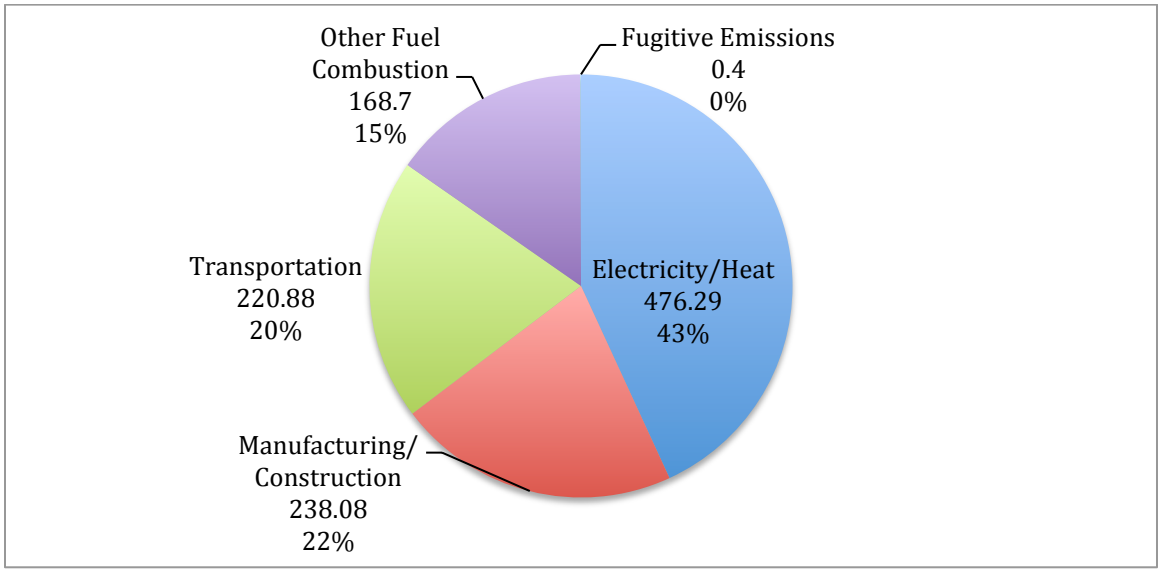
[40] World Nuclear Association, 2014.
[41] Ibid.
[42] Ibid.
[43] Ibid.
[44] World Resources Institute: CAIT 2.0, 2009

produced by electricity and heat generation, amounted to 476 $MtCO_2e$ in 2009.[45] Manufacturing and construction and transportation emissions in Japan totaled 238 and 220 $MtCO_2e$ in 2009, respectively.[46] Figure 6 shows the breakdown of energy emissions sources.

Figure 6: Japan Energy Emissions (MtCO2e)



Source: CAIT 2.0, 2009

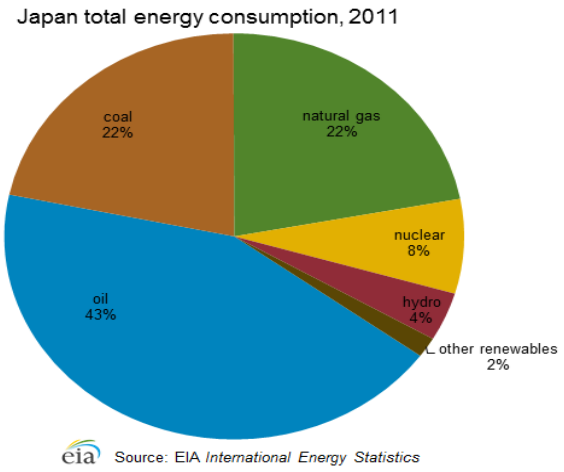
SECTORS OF IMPORTANCE

ENERGY PRODUCTION

Japan's domestic production of energy resources is limited. Japan's domestic oil reserves are only 44 million barrels as of 2013.[47] This is only 10 days or so of supply based on Japan's 4.7 million barrels per day average consumption in 2012.[48] Japan's natural gas reserves are similarly insignificant. Japan agreed to engage in joint exploration with China for natural gas and oil resources in the South China Sea, but territorial disputes and continued unilateral action by both countries have hampered cooperation. Japan will continue to rely on imported oil and LNG for the foreseeable future. Figure 7 depicts the sources of Japan's energy prior to the Fukushima accident—with 86% coming from fossil fuels.

[45] CAIT 2.0, 2009.
[46] Ibid.
[47] EIA, 2014.
[48] Ibid.

Figure 7: Japan Energy Consumption, 2011



Source: EIA, 2014

Due to the limited scale of Japan's domestic extractive industry, the largest source of emissions in the energy production sector comes from generation of electricity and heat. Power and heat production accounted for 43% of Japan's total energy related emissions and 3.6% of global electricity and heat production emissions in 2009.[49] After the Fukushima accident, nuclear power was replaced by LNG and oil fueled power generation. As a result, energy production related emissions increased, further complicating Japan's efforts to achieve GHG emissions reduction targets. The excessive costs associated with importing LNG and oil at spot prices, rather than the long-term supply contracts Japan typically relies on, has driven business interest groups to pressure the government intensely to reactivate nuclear power plants.

In the wake of the Fukushima meltdown, Japan completely reformed its nuclear regulatory regime. The Nuclear Regulation Authority (NRA) was established to oversee the safety assessment, reopening, and oversight of Japan's nuclear power plants.[50] The NRA was designed to be a more independent regulator than the organizations that preceded it, the Nuclear Safety Commission and the Ministry of Economy, Trade, and Industry's Nuclear and Industrial Safety Agency. Influence of electric utilities operating nuclear power plants over regulators was cited as a contributing factor to the Fukushima accident. The guidelines for reopening and operating nuclear power plants in Japan are being strengthened to assuage public concerns about nuclear safety.

One of the changes the NRA is making is a 40-year life-span for all Japanese nuclear power plants.[51] Additionally, nuclear plants located near major fault lines will not be restarted, plants must pass rigorous stress tests, and safety upgrades must be made to meet new guidelines.[52] Restart application review times are projected to be 6 months for each plant, and the costs of

[49] CAIT 2.0, 2009.
[50] World Nuclear Association, 2014.
[51] EIA, 2014.
[52] Ibid.

upgrades are estimated to run between $700 million and $1 billion per unit.[53] The NRC has plans to increase its staff size to reduce restart application review times, but the process will be lengthy in any event. The following table outlines the nuclear power generation capacity that will be retired by 2020, 2030, and 2040—showing that all of Japan's existing nuclear reactors will have to be retired by the year 2040. If no additional reactors are constructed, this would mean the end of Japan's nuclear power industry.

Table 2: Nuclear Reactor Phase-out

Life-span status of existing plants	Capacity (Mwe)	Cumulative Capacity (Mwe)	% of total	Cumulative %
40 year limit reached	3,659	3,659	8.59%	8.59%
Limit reached by 2020	4,618	8,277	10.84%	19.43%
Limit reached by 2030	15,893	24,170	37.32%	56.75%
Limit reached by 2040	18,419	42,589	43.25%	100%

Source: World Nuclear Association, 2014

In anticipation of this phase-out of nuclear power in Japan, additional fossil fuel based generation capacity is already being constructed, and more is planned. Two coal-fired plants with a total capacity of 1.6 GW were brought online in northern Japan in the beginning of 2013.[54] Japan is encouraging the construction of new coal-fired plants by alleviating regulatory burdens on construction of such plants and burning of coal.[55] Japan is also reportedly exploring the use of clean-coal technologies to limit the GHG emissions growth from increased coal consumption.[56] In addition to coal, 7 GW of combined-cycle gas power and 3.4 GW of additional gas generating capacity is expected to begin generating power by 2016.[57] The rush to build new coal and gas generation capacity is in large part due to the high cost of burning crude and heavy fuel oil that Japan has used as a stop-gap while nuclear plants have been offline. Crude oil and heavy fuel oil consumption increased 230% and 180% on average from 2010 to 2012.[58] Oil-fueled power generation began falling back to typical levels as coal capacity came online and electricity demand fell in 2013.

In order for Japan to avoid regression to a more carbon-intensive economy, fossil fuel sources cannot be the only replacement for lost and retired nuclear generation capacity. The Japanese government has approved substantial feed-in tariffs (FIT) to encourage the build-up of renewable generation capacity. The FIT for solar PV power is approximately $0.40 per kWh, large-scale wind power is $0.23 per kWh, and wind power generation under 20 kW is set at $0.56 per kWh.[59] These guaranteed prices for renewable energy also apply to other renewable

[53] Ibid.
[54] Ibid.
[55] Ibid.
[56] Ibid.
[57] Ibid.
[58] Ibid.
[59] Ministry of the Environment (Japan), 2013.

sources such as hydro, geothermal, and biomass. The installed capacity of renewable energy generation had reached 7,470 MW by 2011, but in the first 7 months of FIT implementation 7,370 MW of additional renewable power generation capacity was approved.[60]

These companies also control the distribution infrastructure. Japan's current government, under Prime Minister Abe, has developed plans to disaggregate generation, transmission, and distribution operations and is also attempting to provide the opportunity for electricity consumers to choose their power supplier.[61] The goal is to increase competition among power companies to reduce electricity prices. There is a danger, though, that a focus on reducing electricity prices could cause increased use of less expensive fossil fuel power sources, like coal.

BARRIERS

Political:

Public opposition to nuclear power generation is a serious impediment to GHG mitigation in Japan. Prime Minister Abe's government, backed by strong support from the business community, has put together a plan to bring nuclear reactors back online, under a reformed regulatory regime. Public dissatisfaction with energy shortages and rising electricity prices following the suspension of Japan's nuclear power generation is pressuring the government to relax environmental regulations that inhibit the construction and use of fossil fuel generation capacity. Energy security concerns, which are especially acute in Japan, should prevent heavy reliance on any one source of energy—especially imported fossil fuel sources.

Market:

Electricity market reforms are currently planned to increase competition and lower electricity prices in Japan. These reforms could have the unintended consequence of undermining the government's support for lower carbon or renewable energy production. If customers are selecting an energy provider based upon price alone, the most popular providers could end up being those with the lowest generation costs, which means that dirtier fuels, like coal, would be incentivized. FITs have had a substantial impact on the interest in renewable energy production, but as the experience in European countries has shown, generous price guarantees for renewable power can quickly grow to unsustainable levels. Government plans to restructure energy markets could also make it more difficult to produce major change in the energy production sector, especially if the sector becomes more fragmented and difficult to regulate.

Cultural/Social:

Fortunately, the Japanese public is generally supportive of environmental regulation. Climate change is a priority issue in Japanese politics and the differences of opinion are usually over how

[60] Ibid.
[61] Ibid.

to achieve substantial mitigation, especially after the Fukushima accident. Due to the growing public sentiment that nuclear power should be used temporarily and ultimately phased out in Japan, the government is having to alter its energy planning. As far as the planned joint energy exploration in the South China Sea, public support for the project will hinge upon the ability of the Japanese and Chinese governments and business organizations to build confidence in each other's intentions and overcome historical tensions and rivalries.

Financial:

Costs of making necessary upgrades to nuclear power plants, and the fossil fuels that have been purchased to replace the energy nuclear generation used to produce, have placed a heavy strain on Japan's utility companies. $16 billion has already been spent on nuclear plant upgrades, but that may only allow for one third of the existing nuclear power plants to be approved for reactivation.[62] The estimated $50 billion in losses that utilities have already incurred has already driven two utilities to seek government support.[63] Even if Japan is able to accelerate nuclear restart application processing, it may not make economic sense for operators to continue to make the investments needed to ensure their plants are approved for use, especially for older nuclear reactors that will need to be retired when they reach the age of 40.

Technical:

The structure of Japan's electricity distribution system, consisting of two power grids with limited interconnection, could limit the flexibility and resilience of Japan's energy supply overall. Power cannot be shifted from areas with excess capacity to those reaching the limits of their generation ability as readily. Especially when demand peaks during summer months, the flexibility to shift power would prevent the need for building too much excess capacity.

RECOMMENDATIONS

1. **Reduce demand for energy:** Japan was successful at encouraging electricity demand reduction and conservation in the wake of the Fukushima accident, making up for much of the lost nuclear generation capacity.[64] Efforts to encourage reduced electricity use and conservation should be continued, and expanded if possible.

2. **Carbon accounting for utilities:** Reforms aimed at increasing competition among utilities can reduce energy costs for consumers, but information about the carbon intensity of the various options should be advertised along with price. This way, consumers can make informed decisions, and will not shop based upon price alone.

3. **Build enduring support for revised energy plan:** Japanese culture values sustainability and living in harmony with nature, which should be the frame used to increase

[62] Reuters, 2014.
[63] Ibid.
[64] Phillips, 2014.

buy-in for the new Basic Energy Plan—which would bring back limited nuclear power until it is phased out in 2040. Generating wide public support for the new energy strategy will ensure that the implementation of GHG emissions reductions continues despite any future changes of government.

4. **Provide assistance to cover losses from nuclear shutdown:** Support must be provided to utilities suffering losses due to the nuclear power moratorium. Plant upgrades that are economically justifiable, based on the remaining life span of the plant, should also be subsidized. In addition, the nuclear plants that were already under construction or planned should be completed to extend the time window during which Japan can enjoy the low-cost and clean energy nuclear power provides.

5. **Connect Japan's power grids:** Japan's power grids should be further integrated to allow for greater flexibility in how demand for energy is met, which can prevent the buildup of too much excess capacity.

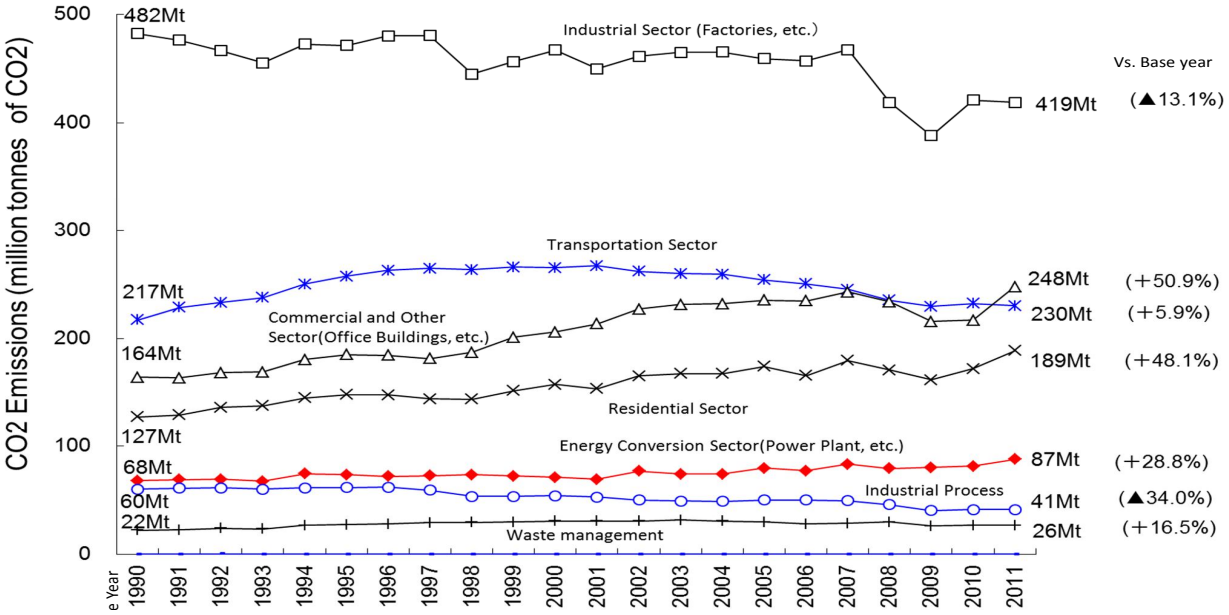
ENERGY EFFICIENCY

While Japan has already made substantial progress in implementing energy efficiency measures, more can and must be done. The above average costs for electricity in Japan provide strong incentives for energy efficiency measures. While building coal and LNG power plants will lower electricity costs, it will also increase GHG emissions. In the effort to reduce the cost of utilities facing households and businesses, energy efficiency measures provide the most environmentally friendly strategy. Energy efficiency measures in industry and residential and commercial buildings can chip away at the GHG emissions of 69% of Japan's total emissions—856 $MtCO_2e$, all together.

Energy consumption by Japanese industry produced 419 $MtCO_2e$ in 2011, while commercial buildings produced 248 $MtCO_2e$ and residential buildings produced 189 $MtCO_2e$.[65] While industry emissions were 13% lower than the 1990 base year, commercial and residential emissions were both over 48% higher than those in the base year. This is largely due to the increase in the number of Japanese households—31.6% from 1990 to 2010—and the increase in commercial building area—42.7% from 1990 to 2010.[66] Following the 2011 Fukushima crisis, electricity demand in eastern Japan was reduced by 16% from the previous year.[67] While this may be an extreme example of possible demand reduction, this occurred without major changes in the buildings and consumer products that households and businesses were using. By implementing aggressive energy efficiency measures, greater reductions in demand for electricity are possible. Figure 8 shows the trends in Japanese emissions from 1990 to 2011.

[65] Ministry of the Environment (Japan), 2013.
[66] Ibid.
[67] Ibid.

Figure 8: Emissions Trends by Sector



Source: METI, 2013

The Nippon Keidanren, or Japanese Business Federation, has taken the initiative to reduce GHG emissions on a voluntary basis. The actions they have pledged cover 80% of industrial and energy conversion emissions, and about 50% of emissions across all sectors.[68] Annual progress is reviewed in conjunction with the Japanese government, and these voluntary pledges made by the private sector are an important component of Japan's national GHG emissions reduction strategy. In addition to the voluntary pledges offered up by businesses, Japanese businesses have been improving the energy efficiency of their products. Table 3 shows some examples of energy efficiency improvements in common consumer products.

Table 3: Improved Efficiency of Consumer Products

Improvement of energy efficiency	
Equipment	**Improvement rate of average energy efficiency**
magnetic disk	85.7%(2001→2007)
electronic calculator	80.8%(2001→2007)
air conditioner※	67.8%(1997→2004) 16.3%(2005→2010)
refrigerator	55.2%(1998→2004) 43.0%(2005→2010)
light※	35.7%(1997→2005)
television	29.6%(2004→2008)
freezer	29.6%(1998→2004) 24.9%(2005→2010)
toilet seat	14.6%(2000→2006)

※ criteria based on performance per energy
not ※ criteria based on Consumption

Source: METI, 2013

[68] Ibid.

Japan's current energy efficiency policies include a "Top Runner System" that encourages continuous improvement of products and factory processes by setting standards based upon the previous year's most efficient examples and a grant program used to promote energy-saving products.[69] Japan also hopes to accelerate the adoption of more efficient technologies by subsidizing product lease programs and interest for residential and commercial building improvements.[70] While no estimates for the GHG emissions reductions attributable to or possible because of these programs is available, all of these programs have a part to play in Japan's overall push for greater energy efficiency.

The household and commercial building and industry sectors are highly decentralized, and the number of actors in each of these spaces is very large. The Japanese Business Federation's willingness to engage in voluntary GHG emissions reductions is fortunate for the Japanese government, because trying to regulate and monitor the emissions of so many disparate actors would be extremely difficult.

BARRIERS

Market:

Japanese businesses and consumers are, understandably, concerned about the high costs they pay for energy. The Japanese government is attempting to reduce the prices for energy in Japan by building out more low-cost generation capacity and reforming the industry. Unfortunately, this means increasing carbon-intensive coal fired generation. Shifting ownership of the country's power grid from the utilities to separate distributors will also reduce incentives to adopt smart-grid technologies, which could improve efficiency and ease the integration of upcoming renewable generation capacity. While minor reductions in Japanese energy prices will not completely relieve the pressure driving businesses and consumers to pursue energy efficiency improvements, it will ultimately reduce the overall rate of adoption of these measures, especially the most expensive options. Due to the decentralized structure of the key targets for energy efficiency improvements, especially in the residential and commercial buildings space, top-down regulation and enforcement of energy efficiency standards is extremely difficult. The price signals consumers receive from their energy consumption decisions are a much stronger policy tool.

Financial:

Perhaps the most significant barrier to adoption of energy efficiency measures in Japanese buildings, industry, and consumer goods is access to financing. Japan has developed some innovative interest subsidy and lease programs to promote adoption of energy efficient technologies, but adequate funding resources must be sustained for these programs. The lack of subsidies for extremely capital-intensive energy efficiency measures, especially those in industry

[69] Ibid.
[70] Ibid.

and buildings—such as high efficiency boilers—will limit adoption to only the most economically attractive options.

RECOMMENDATIONS

1. **Ensure coal is last resort:** Japan's government should delay investments in new coal fired power plants as long as possible. Only generation capacity that is absolutely necessary should be fast-tracked through approval processes.

2. **Maximize energy efficiency:** Japan should first take advantage of the pressure that high energy prices exert on households and businesses to maximize the efficiency of their energy consumption. If the effect of energy efficiency driven demand reduction is large enough, it may not be necessary to construct as much fossil fuel powered generation capacity as would be otherwise.

3. **Find and fill financing gaps:** To ensure that energy efficiency is maximized, access to affordable financing must be a central concern for the Japanese authorities. Building on the eagerness of Japan's businesses to reduce GHG emissions voluntarily, the government should consult with the private sector to determine what financial shortfalls exist. Similarly, the Japanese government should explore opportunities for the many civic associations or local government organizations to identify financing shortfalls and develop strategies to maximize energy efficiency at the local level.

CANADA

RATIONALE

According to the Emissions Database for Global Atmospheric Research (EDGAR), Canada in 2010 ranked eleventh globally in terms of its total greenhouse gas (GHG) emissions. Its 2010 emissions totaled 764.14 $MtCO_2e$[71], which amounted to approximately 1.5% of total global GHG emissions. While seemingly insignificant when compared to top emitters such as the China and the United States (11,181.38 $MtCO_2e$/21.97% and 6,713. 34$MtCO_2e$/13.19%, respectively), Canada's emergence as a major energy exporter (due to the expansion of its oil sands) warrants a closer examination of its current and projected GHG emissions. Moreover, Canada continues to be one of the highest per-capita emitters among OECD countries and has higher energy intensity than any other IEA country.[72] The combination of these factors underscores the need for continued progress toward reducing GHG emissions from government leaders at the federal, provincial, and territorial level.

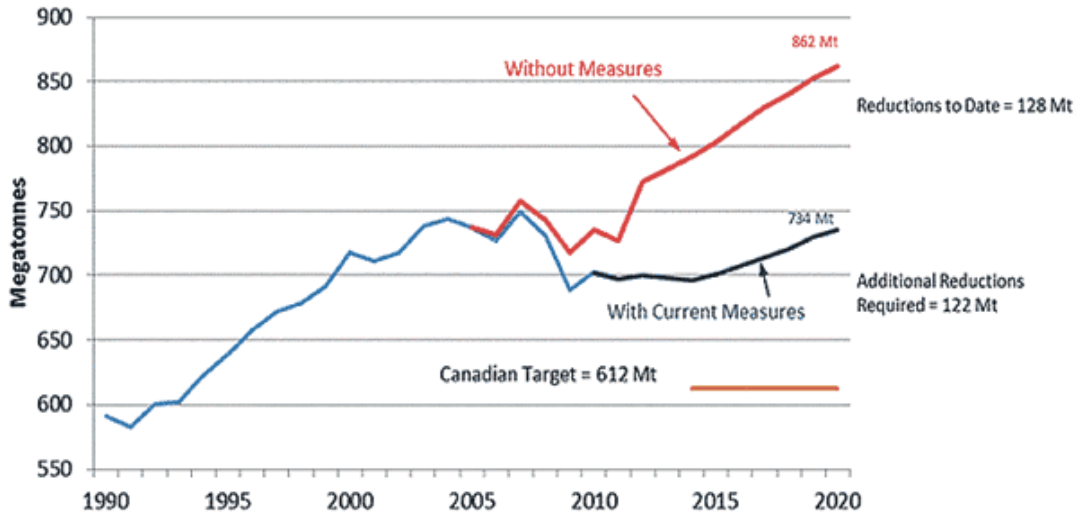
[71] It should be noted that the Canadian government reported total country emissions of 699 $MtCO_2e$ in 2010 (this discrepancy is likely due to different GHG accounting measures).
[72] IEA, 2009.

As a whole, Canadians are aware of the dangers posed by climate change and are committed to the sustainable development of their country's natural resources.[73] Government leaders within Canada's ten provinces and three territories share this commitment and are working to strengthen their individual and collaborative efforts. Environment Canada, the lead federal agency on greenhouse gas and air pollutant emissions, notes that the federal government is taking a sector-by-sector approach to the issue and has already implemented regulations in two of the sectors with the highest levels of emissions: transportation and electricity.[74] Also, Canada remains a Party to the United Nations Framework Convention on Climate Change (UNFCCC), and is committed to reducing its emissions to 17% below 2005 levels by 2020 under the non-binding Copenhagen Accord (which Canada signed onto in December 2009).[75]

However, the remaining 122 Mt emissions gap Canada must fill in order to meet its 2020 target, couple with stalled progress at the federal level on the release of its oil and gas regulations, have led many to question the federal government's continued commitment to climate change mitigation efforts.[76] Compounding the issue is Canada's decision to formally withdraw from the Kyoto Protocol in 2011, which relieved the country of any binding obligations to reduce its GHG emissions. Existing concerns regarding Canada's recent lackluster federal climate policy were exacerbated by Prime Minister Stephen Harper's statement of support for the Australian government's plan to repeal its carbon tax. This dearth of action on federal climate change policy resulted in Canada ranking poorly in the most recent Climate Change Performance Index (CCPI), an instrument that compares the climate protection performance of the world's top 58 emitting countries.[77]

[73] Ibid.
[74] Environment Canada, 2013.
[75] Ibid.
[76] Sawyer et. al., 2014; Environment Canada, 2013.
[77] Germanwatch, 2014, 6-7.

Figure 9: Canada's Historical Greenhouse Gas Emissions and Projections to 2020



Source: Environment Canada (2013). Canada's Emissions Trends 2013

The preceding setbacks at the federal level were partially counterbalanced in 2013 by actions taken by Canada's provinces. Under the authority afforded by the Constitution Act of 1867, oversight of the provinces' ground resources rests in the hands of the individual provincial governments. Specifically, provincial leaders"... have primary responsibility for shaping policies implemented in their jurisdictions."[78]

Several recent climate policy achievements made at the provincial level include the rollout of Quebec's cap-and-trade system; Ontario's phase-out of coal-fired thermal activity; British Columbia's decision to keep its carbon tax after undergoing thorough review in 2012; Alberta's plan to raise its fine for heavy emitters after its Specified Gas Emitters Regulation (SGER) was set to expire in September 2014; and, Saskatchewan's ongoing plans to adopt SGER-style regulations in 2015.[79] These successes are particularly notable given the fact that the provinces above have the highest GHG emissions levels of all of Canada's provinces (Alberta and Ontario top the list at 249.3 $MtCO_2e$/36% of total emissions, and 166.9 $MtCO_2e$/24% of total emissions, respectively).[80]

Despite these advancements, however, experts predict that Canada will fail to meet its 2020 emissions reduction goal without swift regulatory action aimed at reducing emissions from the oil and gas sector (a subsector of energy production).[81] Canada's electricity sector (also a subsector of energy production) as well as its transportation sector, continue to produce a significant portion of the country's total GHG emissions. Further discussion of these sectors' current and projected emissions, as well as their 2030 abatement potentials, is included in the sections that follow.

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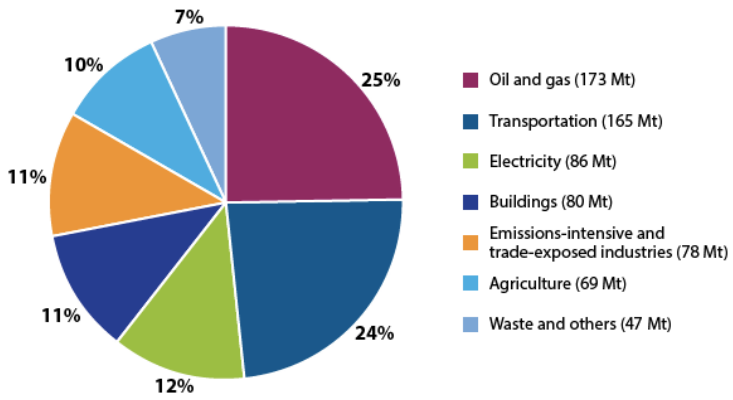
[78] IEA, 2009, 9.
[79] Sawyer et. al., 2014, 3-5.
[80] Environment Canada, 2014.

ENERGY PRODUCTION: OIL & GAS AND ELECTRICITY

Figure 10: Distribution of GHG emissions by economic sector, Canada, 2012



Source: Environment Canada, www.ec.gc.ca/indicateurs.indicators

Current & Projected Emissions

As can be seen from the chart above, Canada's oil and gas sector and electricity sector, both subsets of the energy production sector, account for approximately 37% of the country's total GHG emissions. The oil and gas sector is responsible for 173 $MtCO_2e$ and the electricity sector produces 86 $MtCO_2e$.[82] Canada's oil sector emissions can be further divided into conventional oil production, natural gas production, and the oil sands.

Between 2005 and 2011, overall emissions from both Canada's conventional oil production and natural gas production and processing decreased. Emissions from conventional oil production dropped from 32 $MtCO_2e$ in 2005 to 30 $MtCO_2e$, as did emissions from natural gas (56$MtCO_2e$ to 47 $MtCO_2e$). On the other hand, emissions from the oil sands increased significantly, rising from 34 $MtCO_2e$ in 2005 to 55 $MtCO_2e$ in 2011. Additionally, 2011 emissions from the oil sands account for 34% of the oil and gas sector GHG emissions and 8% of Canada's total emissions.[83]

Despite their currently significant contribution to the country's overall GHG emissions, emissions from Canada's electricity sector are projected to drop from 121 $MtCO_2e$ in 2005 to 82 $MtCO_2e$ in 2020. This is predominately due to Canada's success in introducing natural gas and hydropower as alternatives to coal fired generation.[84] The electricity sector is also

[82] Environment Canada, 2014.
[83] Environment Canada, 2013, 25.
[84] Ibid., 21.

significant due to its emissions abatement potential, which is estimated to be 81 $MtCO_2e$ in 2030 (19% of total cross-sector abatement potential).[85]

In contrast, emissions from the oil and gas sector are projected to increase significantly, resulting in a difference of 38 $MtCO_2e$ between 2005 (162 $MtCO_2e$) and 2020 (200 $MtCO_2e$).[86] Thus, the oil and gas sector's contribution to Canada's overall emissions is expected to increase to 27% by 2020. Driving this increase in sector emissions is the rapid expansion of Canada's oil sands, which requires a significantly more energy-intensive and carbon-intensive extraction and processing methods than those used with conventional oil.

GHG emissions from the oil sands are projected to nearly double in the next six years, resulting in approximately 101 $MtCO_2e$ by 2020.[87] By that time, it is projected that Canada's oil sands emissions will account for slightly more than 50% of emissions within the oil and gas sector and nearly 14% of the country's total GHG emissions.[88] It should also be noted that the oil and gas sector's 2030 abatement potential is expected to be relatively significant at 52 $MtCO_2e$ (12% of total abatement potential).[89] However, actual abatement within this sector will depend largely on the deployment of clean technologies and stronger regulation at the provincial and federal levels.

Current Regulation of the Oil Sands

Alberta's carbon pricing system, known as the Specified Gas Emitters Regulation (SGER), currently serves as the primary regulating body of the oil sands emissions. Under SGER, heavy emitters are forced to reduce their emissions intensity by up to12% relative to their baseline level of production. If firms are unable to meet this target, they are given the option of purchasing carbon offset credits or paying a fine of $15 per ton. While SGER provides some financial incentive for major firms to reduce their emissions, its requirements lack the stringency needed to significantly reduce emissions throughout the province.

Given that Alberta is responsible for significantly more GHG emissions than the other provinces (the second highest-emitting province, Ontario, trails by 82.4 $MtCO_2e$), it faces considerable pressure to strengthen the effectiveness of its carbon pricing system. Adding to this pressure is the continued absence of federal of oil and gas regulations. Alberta's leaders are aware of the urgency of the situation and are considering adopting a more stringent carbon levy when the SGER expires at the end of 2014.

Conclusion

In short, current figures indicate that Canada is making headway in its effort to reduce GHG emissions from the electricity sector. However, the sharp rise in emissions in the oil and gas sector, due to the expansion of the Alberta oil sands, will require stronger mitigation efforts at

[85] Abatement potential determined through use of the McKinsey & Company Climate Desk analysis tool.
[86] Environment Canada, 2013, 21.
[87] Ibid., 25
[88] Ibid., 21, 25
[89] Use of McKinsey & Company Climate Desk analysis tool.

the federal and provincial level. Barriers to progress in this arena, as well as potential steps forward, are discussed below.

BARRIERS

Economic: A significant barrier to reducing emissions from the oil sands comes from Canada's overriding desire to strengthen its economic development. This is due to the fact that the oil sands have strengthened Canada's energy security and positioned it as a major international energy exporter. While Canadian officials are aware of the environmental risks posed by the sector's rapidly increasing GHG emissions, economic development is likely to continue to take precedence over timely implementation of more stringent climate policies.

Technological: A second barrier is the currently limited deployment potential of significant technological alternatives, such as nuclear power and carbon capture and sequestration (CCS). There are also concerns regarding both the scale and typical lead-time for nuclear projects and the potential effectiveness of CCS in this arena. Despite this, however, the Alberta government continues to invest a significant amount of funding in CCS research, development, and demonstration (RD&D) projects.[90]

Political: A third barrier to reducing oil sands emissions has to do with currently nonexistent federal regulations and inadequate provincial regulations. As previously mentioned, the federal government has yet to deliver on the long-awaited set of oil and gas sector regulations. Moreover, Alberta's current carbon pricing system has proven ineffective in effectively incentivizing emissions reductions from the oil sands.

RECOMMENDATIONS

1. **Strengthen Alberta's Carbon Price Mechanism:** In reassessing its GHG emissions regulatory approach, Alberta should consider implementing a carbon tax similar to that of British Columbia (B.C.), which requires heavy emitters to pay $30 per ton of CO_2. In contrast to Alberta's current regulatory system, which applies to only a small portion of emissions, a carbon tax would be levied on all emissions, resulting in significantly lower emissions overall.

2. **Increase Technological Investment:** Assuming Alberta increases its current carbon levy for heavy emitters, it should invest any additional revenue in carbon emissions technologies that would yield faster results than CCS and/or nuclear power. Given the fact that Canada is committed to reducing its emissions to 17% below 2005 levels by 2020, more immediate emissions reductions are essential. Examples of such technologies include

[90] Levi, 2009, 35-37.

renewable energy projects and energy efficiency programs.[91]

3. **Implement a National Carbon Tax:** In addition to delivering on its promise of regulations for Canada's oil and gas sector, the federal government should consider implementing a countrywide carbon tax. While the Harper government is staunchly opposed to such a measure, there is considerable support for a carbon tax from leaders within the oil sands industry. Oil sands producers believe a carbon tax could provide increased access to international markets and more predictable costs for the export industry.[92] In short, if Canada's emissions continue to rise in the coming years at the rate at which they are now, drastic measures will need to be taken at the federal level and a carbon tax could be part of the solution.

TRANSPORTATION

Current & Projected Emissions

Due to geographic, cultural, and economic factors, Canadians have developed a significant dependence on their personal vehicles. Furthermore, Canada's high levels of domestic and international trade have created a widespread need for commercial and freight transport.[93] As a result, Canada's transportation sector currently accounts for the second greatest portion of the country's overall GHG emissions (24% or165 $MtCO_2e$).[94] In addition, emissions from the transportation sector increased slightly between 2005 and 2011, from 168 $MtCO_2e$ to 170 $MtCO_2e$.[95]

In tracking Canada's transportation sector emissions, Environment Canada divides the sector into three subcategories: passenger transport (cars, trucks, motorcycles, bus, rail and domestic aviation); freight transport (heavy-duty trucks, rail, domestic aviation and marine); and, "other" (recreational, commercial, and residential). Between 2005 and 2011, emissions from passenger transport remained constant at 96 $MtCO_2e$, while emissions from freight transport increased slightly from 57 $MtCO_2e$ to 61 $MtCO_2e$. Additionally, emissions from vehicles included in the "other" category declines from 14 $MtCO_2e$ in 2005 to 13 $MtCO_2e$ in 2011.[96]

Emissions from the transportation sector are projected to increase slightly over the next several years, resulting in a total of 176 $MtCO_2e$ by 2020. Based on these estimates, the transport sector's contribution to Canada's overall GHG emissions is projected to remain steady at approximately 24% (between 2011 and 2020).[97]

Individual contributions to the sector's increase in emissions are expected to vary by transport type. Emissions from passenger transport (cars, trucks, motorcycles, bus, rail and domestic

[91] Pembina Institute, 2013, 12.
[92] Bloomberg, 2013.
[93] Public Policy Forum, 2013, 4.
[94] Environment Canada, 2014.
[95] Environment Canada, 2013, 23.
[96] Ibid.
[97] Ibid., 21.

aviation) are projected to decrease from 96 $MtCO_2e$ in 2005 and 2011 to 90 $MtCO_2e$ in 2020. In contrast, it is anticipated that emissions from freight transport (heavy-duty trucks, rail, domestic aviation and marine) will increase from 57 $MtCO_2e$ in 2005 and 61 $MtCO_2e$ in 2011 to 70 $MtCO_2e$ by 2020. Also, emissions from modes of transportation included in the "other" category (recreational, commercial and residential) are expected to increase slightly from 14 $MtCO_2e$ in 2005 and 13 $MtCO_2e$ in 2011, to 15 $MtCO_2e$ in 2020.[98]

The transportation sector (specifically road transport) holds an estimated 2030 abatement potential of 129 $MtCO_2e$ (30% of total abatement potential).[99] In contrast to the oil and gas sector, whose abatement potential largely depends primarily on strengthened regulations and significant investments in nascent technologies, Canada's transportation sector holds several readily available emissions reduction opportunities. Examples of such opportunities include increased investment in and support of domestic innovation efforts; greater coordination among federal, provincial, and local policies; and, increased investment in infrastructure that allows for multi-modal transportation systems.[100] There is also significant abatement potential in pursuing behavioral changes among users of light-duty passenger vehicles.[101]

Current Regulation of the Transportation Sector

As previously mentioned, the Canadian government has taken notable steps to reduce the country's transportation sector emissions through the implementation of various regulations. In November 2012, the Harper government added to existing regulations intended to reduce GHG emissions of light-duty passenger cars and trucks (model years 2011-2016) by introducing standards for model years 2017 to 2025. Furthermore, the government introduced emissions standards for heavy-duty vehicles in February 2013. The Canadian government anticipates that these regulations will result in a 50% reduction in emissions from 2025 light-duty passenger cars and trucks (compared to 2008), and as much as a 23% emissions reduction from heavy-duty vehicles in 2018.[102]

Conclusion

High demand for various modes of transportation in Canada ensures that emissions from this sector are likely to remain significant in the coming years. While it is clear that the federal government is committed to reducing emissions in the transportation sector through increased regulations, it is important to note that these alone will not suffice. Additional measures are discussed below, as are various barriers to implementation.

[98] Ibid., 23.
[99] Use of McKinsey & Company Climate Desk analysis tool.
[100] Canada's Public Policy Forum, 2013, 8-9.
[101] McKinsey & Company, 2009, 94-101.
[102] Government of Canada, 2014.

BARRIERS

Political: Despite the existence of various federal-level policies, a primary barrier to achieving emissions reductions in Canada's transportation sector is the fragmentation of provincial policies. This can be seen in the wide range of fuel standards, with some provinces focusing on low carbon standards and others on the increased use of biofuels. This lack of coordination results in missed opportunities for greater abatement potential from Canada's provinces.[103]

Cultural: A second barrier to reducing emissions in the transportation sector is Canadians' high dependence on personal vehicles.[104] While stricter regulations are expected to result in lower emissions from the passenger vehicles in the coming years, additional measures (such as increasing ridership in public transportation) will be necessary to realize even more significant emissions reductions in this sector.

Financial: While demand for electric vehicles (EVs) in Canada continues to grow, cost remains a barrier to significantly increasing their market share. It is important to note that there are costs associated with both the purchase of such vehicles, as well as the required infrastructure (such as charging stations) to allow for the widespread uptake of EVs.

RECOMMENDATIONS

1. **Increase Provincial Policy Coordination:** Provincial government leaders should make a concerted effort to more effectively align their transportation sector emissions policies. A collective understanding of the gaps and opportunities for improvement in provincial-level transportation sector policies is essential to achieving GHG emissions reductions countrywide. However, there is currently limited incentive to do so, given the lack of a coordinated national approach to carbon pricing.[105] Furthermore, the federal government's current approach to achieving emissions reductions focuses on emissions by sector rather than by areas of origin. Hence, it is possible that political changes at the federal level (and subsequent changes to emissions reductions approaches) could make an increase in provincial emissions policies more feasible.

2. **Support Multi-modal Transport:** The federal and provincial governments should increase targeted investment in infrastructure that allows for multi-modal transportation systems in urban areas. Such an investment, which would also require substantial coordination between urban planners and transportation experts, would inevitably result in emissions reductions through increased use of low or zero-emission modes of transport (e.g., public transit, walking, or biking). Strategic public awareness campaigns that promote the benefits of alternative modes of transportation could also help in the shift toward lower-emission methods of commuting.

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[103] Canada's Public Policy Forum, 2013, 6.
[104] Ibid., 4.
[105] National Round Table on Environment and the Economy, 2009, 26.

3. **Increase Incentives for EVs:** Given that the primary barrier to increasing the number of electric vehicles (EVs) in Canada is financial, the provinces of Ontario and Quebec should continue to offer their current purchase incentive programs. The other provinces should adopt similar incentive programs, as well as increase investment in infrastructure that allows for the spread of EVs (e.g. charging stations in public spaces).[106] In addition to incentive programs at the provincial level, the federal government should develop alternative programs or campaigns to promote the spread of EVs.

AUSTRALIA

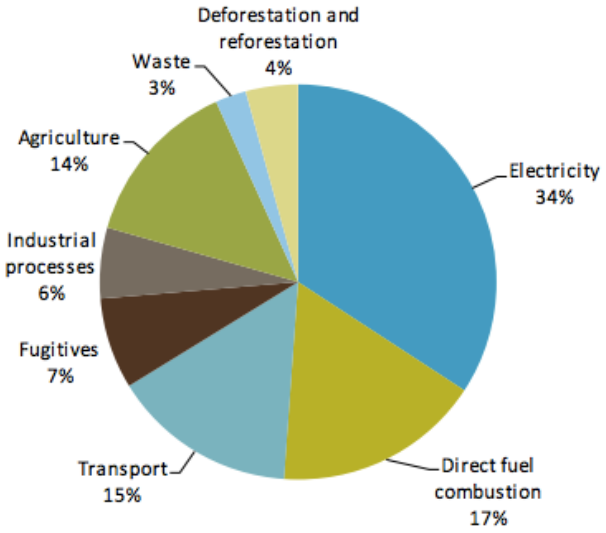
RATIONALE

In terms of its overall GHG emissions, Australia ranked 10th globally in 2010. That year, EDGAR reported Australia's GHG emissions to be 782.1 $MtCO_2e$, accounting for approximately 1.54% of total global emissions.[107] However, what is likely due to different accounting methods, the Australian government reported its 2010 emissions at 543 MtCO2e (excluding LULUCF).[108] The government reports that Australia's emissions have since declined, totaling 538.4 $MtCO_2e$ in December 2013.[109] Despite its relatively small contribution to global GHG emissions, Australia's per capita CO_2 emissions continue to exceed those of any other developed country.[110] This is particularly notable, given the fact that Australia's emissions intensity halved during the period between 1990 and 2012. Emissions levels were roughly the same in both years, despite a doubling in the size of Australia's economy during that period.[111]

As can be seen from the chart below, the majority of Australia's GHG emissions in 2011 came from the energy production sector (electricity, fugitives, and direct fuel combustion), followed by the agriculture, forestry, and other land use (AFOLU) sector.[112]

[106] Green Car Reports, 2013.
[107] EDGAR, 2010.
[108] Australian Government, 2011, 4.
[109] Australian Government, 2013, 6.
[110] Australian Government, n.d.
[111] Climate Change Authority, 2014, 7.
[112] Australian Government, 2012, 9.

Figure 11: National Greenhouse Gas Inventory, 2011



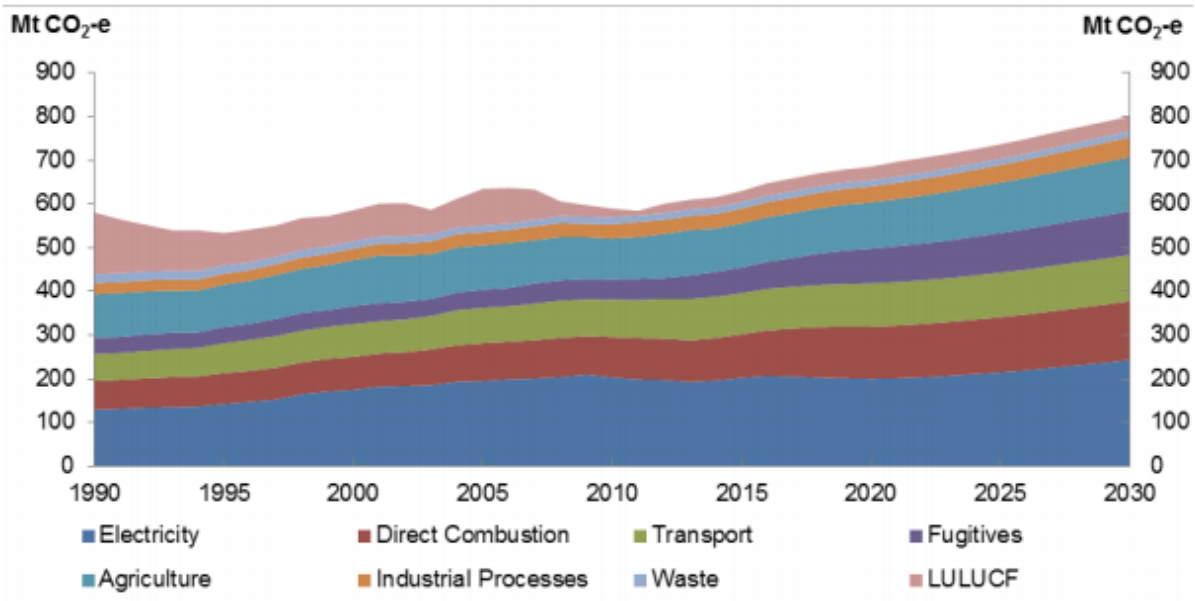
Source: Quarterly Update of Australia's Greenhouse Gas Inventory: December 2011, released 2012

Among Australia's six states and ten territories, those with the highest GHG emissions levels in 2011 (excluding LULUCF) included New South Wales (148.9 $MtCO_2e$/ 27% of total country emissions), followed by Queensland (134.5 $MtCO_2e$/ 25%), Victoria (129.4 $MtCO_2e$/ 24%), and Western Australia (75.9$MtCO_2e$/ 14%). While stationary energy was responsible for the majority of each of these regions' total GHG emissions, the transport sector accounted for the second largest portion of emissions in New South Wales and Victoria. Furthermore, the AFOLU sector accounted for a significant portion of Queensland and Western Australia's total GHG emissions.[113]

At the national scale, Australia's emissions are projected to reach 801 $MtCO_2e$ in 2030, an increase of 216 $MtCO_2e$ since 2000 (586 $MtCO_2e$).[114] It should also be noted that a rise in emissions of 43 $MtCO_2e$ in the electricity sector would be the primary driver behind the country's overall projected emissions increase.[115] It thus follows that the greatest emissions abatement potential rests in the energy production sector, which is projected to account for 39% of the country's total abatement potential in 2030. The technologies best able to unlock this potential include carbon capture and sequestration (CCS), onshore wind, and geothermal.[116]

[113] Australian Government, 2014, 4, 6-8.
[114] Projections do not include estimated abatement from federal measures and regulations.
[115] Australian Government, 2013, 6.
[116] McKinsey & Company, 11.

Figure 12: Australia's Emissions from 1990 to 2030



Source: the Treasury and DIICCSRTE, 2013

Under the Kyoto Protocol's second commitment period, Australia is formally committed to limiting its average annual GHG emissions to 99.5% of 1990 levels between 2013 and 2020. This calculation is based on the country's unconditional commitment to reduce its GHG emissions by 5% below 2000 levels by 2020. Depending on the activity of other nations, Australia is conditionally committed to increasing its emissions reduction to between 15% and 25%, and more broadly aims to reduce its emissions by 80% below 2000 levels by 2050.[117] It should also be noted that Australia successfully met its initial commitment under the Kyoto Protocol, which required the country to limit its emissions between 2008 and 2012 to an average of 108% of 1990-level emissions (its emissions averaged 105% of 1990-level emissions during this period).

Despite Australia's previous success in and continued efforts to meet its international emissions obligations, there is growing concern surrounding its emissions reduction target of 5% for 2020. In a report released in 2014, the Climate Change Authority, an independent advisory body to the federal government, states that the 5% emissions reduction target is inadequate. In order to effectively contribute to the international goal of keeping global warming at or below two degrees Celsius, the Authority found that Australia must set its emissions target at a minimum of 15% below 2000 levels by 2020. If Australia's Kyoto Protocol commitments were factored in, the emissions reductions target would increase to19%.[118]

Recent changes to Australia's federal climate change policies have triggered widespread skepticism regarding the country's ability to achieve significant emissions reductions by 2020. Australia's federal government, led by Prime Minister Tony Abbott, faces considerable criticism

[117] Australian Government, n.d.
[118] Climate Change Authority, 2014, 10.

from climate change experts and country leaders worldwide for repealing the country's carbon tax in 2014. The government replaced the current carbon pricing mechanism with its Direct Action Plan (DAP), an incentive-based scheme that centers on the establishment of an Emissions Reduction Fund (ERF).

The ERF is designed to support CO_2 emissions projects undertaken by business and industry, with funding amounts allocated through a series of "reverse auctions." Under this model, businesses would be assigned individual baselines based on their emissions history. If a business's emissions were to fall below its baseline, it would have the opportunity to sell its abatement to the government. Businesses who keep their emissions at baseline would not be affected by the ERF, but those who exceed their baseline levels would be forced to pay a fine.[119]

A recent report released by an Australian Senate committee determines the Direct Action Plan to be "fundamentally flawed." Several of the shortcomings identified in the report include the fact that the ERF lacks sufficient funding to achieve adequate abatement levels; the plan excludes a legislated limit on Australia's emissions that would align with the country's emissions reductions goals; and, the plan fails to include access to international emissions credits.[120] Additionally, a poll conducted in 2013 by the Climate Institute revealed that while 37% of Australians approve of the federal government's plan to abolish the carbon tax, only 19% view the proposed Direct Action Plan as a viable alternative. The poll also revealed that 46% of Australians would prefer to keep some form of carbon pricing or trading scheme rather than do away with such policies entirely.[121]

In addition to climate change action at the federal level, leaders within Australia's states and territories are taking steps to reduce their individual emissions levels. Specific examples of climate change action at the state level include the introduction of land clearing regulations in New South Wales and Queensland, which has resulted in a significant reduction in deforestation in these areas since 2003; as well as the implementation of the New South Wales Greenhouse Gas Reductions Scheme in 2003 and the Queensland Gas Scheme in 2005, which contributed to the share of gas in electricity production in Australia increasing from 8% to 19% between 2000 and 2012.[122] Additionally, specific state- and territory-level emissions targets include the following:

- Australian Capital Territory – achieve 40% reduction of 1990 levels by 2020 and 80% by 2050;[123]
- New South Wales – reduce emissions to 2000 levels by 2025 and 60% below 2000 levels by 2050;[124]
- Tasmania – reduce emissions by at least 60% of 1990 levels by 2050; and,
- Western Australia – reduce emissions to 26 $MtCO_2e$ by 2050.[125]

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[119] RepuTex Carbon Analytics, 2013,10.
[120] Parliament of Australia, n.d.
[121] The Climate Institute, 2013, 7,18.
[122] Climate Change Authority, 2014, 75,77.
[123] ACT Government, n.d.
[124] New South Wales Greenhouse Office, 2005, 5.

While continued efforts at the state and territory level will undoubtedly contribute to Australia's overall success in meeting its emissions targets, strong action at the federal level is imperative to the country's ability to effectively reduce its emissions. It is therefore essential that the federal government strengthen its own climate policies while continuing to engage with state and territory leaders through intergovernmental forums, such as the Council of Australian Governments (COAG).

In sum, emissions across all of Australia's sectors are expected to continue to increase steadily over the next several years, primarily driven by emissions from the electricity sector. The impact of the federal government's decision to abolish the carbon tax in favor of its Direct Action Plan is unclear, but preliminary analysis suggests that it will hinder Australia's ability to meet its GHG emissions targets.[126] Furthermore, continued efforts at the state and territory level will be essential to reducing emissions countrywide, creating a need for increased intergovernmental dialogue and collaboration.

SECTORS OF IMPORTANCE

ENERGY PRODUCTION

Current & Projected Emissions

The energy production sector (electricity, stationary energy excluding electricity, and fugitive emissions) accounts for the greatest portion of Australia's total GHG emissions. As of December 2013, the energy production sector accounted for 314.4 $MtCO_2e$ emissions (approximately 58% of Australia's total emissions).[127] A breakdown of the emissions sources within the energy production sector is provided below.

[125] Council for the Australian Federation, 2009, 7.
[126] Milman, 2014.
[127] Australian Government, 2013, 6.

Table 4: National Greenhouse Gas Inventory, 'unadjusted' emissions by sector, years to December 2012, 2013

Sector	Annual emissions (Mt CO_2-e)		
	Year to December 2012	Year to December 2013	Change (%)
Energy – Electricity	185.8	176.6	-5.0%
Energy – Stationary energy excluding electricity	91.3	92.2	0.9%
Energy – Transport	92.0	92.5	0.6%
Energy – Fugitive emissions	42.8	45.6	6.7%
Industrial processes	30.5	30.2	-0.9%
Agriculture	88.6	89.6	1.1%
Waste	11.7	11.7	-0.3%
National Inventory Total (excluding LULUCF)	**542.7**	**538.4**	**-0.8%**

Source: Quarterly Update of Australia's National Greenhouse Gas Inventory, December 2013

Within the energy production sector, the electricity sector has experienced the largest growth in emissions over the last two decades, increasing by 47 $MtCO_2e$ (36%) between 1989-90 and December 2013. Additionally, emissions from stationary energy and fugitive emissions grew by 41.8% and 43% respectively.[128] Furthermore, Australia continues to be highly dependent on fossil fuels to meet its energy consumptions needs. In 2009, coal consumption resulted in the greatest portion of the sector's emissions (53%), followed by oil consumption (30%), and natural gas consumption (17%).[129] It should be noted, however, that in 2011, oil comprised the largest portion of Australia's energy consumption (36%), followed by coal (33%), natural gas (25%), and renewables (6%).[130]

Emissions from Australia's energy production sector are projected to increase from 291 $MtCO_2e$ in 2000 to 477 $MtCO_2e$ by 2030. This figure is based on the assumption that electricity emissions will grow to 243 $MtCO_2e$ by 2030, emissions from direct combustion will increase to 134 $MtCO_2e$, and fugitive emissions will increase to100 $MtCO_2e$.[131] Furthermore, fugitive emissions from thermal coal production are projected to increase to 57 $MtCO_2e$ in 2020, driven primarily by export demand from China and India.[132]

In addition to accounting for the highest portion of Australia's GHG emissions, energy production also holds the greatest abatement potential among all sectors. A report released by McKinsey & Company estimates that Australia's energy production sector (power sector) holds a 2020 abatement potential of 93 $MtCO_2e$ and a 2030 abatement potential of 221 $MtCO_2e$. As previously mentioned, the most significant abatement opportunities reside in carbon capture and sequestration (CCS) for coal-fired power generation, onshore wind, and geothermal.[133]

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[128] Ibid., 7.
[129] IEA, 2012, 35.
[130] U.S. Energy Information Administration, 2013.
[131] Australian Government, 2013, 5.
[132] Ibid., 13.
[133] McKinsey & Company, 11.

Key Initiatives within the Energy Production Sector

Several significant initiatives within the energy production sector include the Australian Renewable Energy Agency (ARENA), the Clean Energy Finance Corporation (CEFC), and the Renewable Energy Target (RET). ARENA is a renewable energy investment fund that helps to increase the competitiveness of Australia's renewable technologies by providing financial support. The CEFC is a clean energy investment fund that provides financial support for emissions reduction projects within the private sector.[134] Despite the notable achievements of both ARENA and the CEFC, the federal government attempted to dismantle both funds in 2014, though those efforts were blocked in the Australian Senate.

Introduced in 2001, the Renewable Energy Target (RET) is responsible for the majority of investments made in Australia's renewable energy market. Operated in two parts, including the Small-scale Renewable Energy Scheme and the Large-scale Renewable Energy Target, the scheme is designed to meet the 2020 goal of having 20% of Australia's energy be provided by renewable sources. Between 2001 and 2012, the RET delivered AU $18.5 billion of investment in renewable energy infrastructure, and is expected to deliver an additional AU $18.7 between 2012 and 2030.[135] However, concern regarding the RET's potentially adverse effect on Australia's power prices has spurred the federal government to conduct a thorough review of the scheme in 2014. The results of this review are likely to dictate the fate of the RET.

BARRIERS

Economic: As of 2012, Australia ranked fourth globally in terms of its total coal production (421 Mt) and second in terms of its total coal exports (301 Mt).[136] Given the high demand for coal imports in countries such as Japan and China (and Australia's ability to meet this demand), coal production is likely to remain a significant contributor to the country's overall GHG emissions in the coming years.

Financial: While there is significant potential for emissions reductions in Australia's energy production sector through the use of Carbon Capture and Sequestration (CCS), the high cost of retrofitting existing coal production power plants remains a barrier to reaping the benefits of such technology. Despite the fact that new coal plants can be designed to incorporate energy efficient technologies at a relatively low cost, demand for retrofitting existing plants is expected to remain high.

Political: A second barrier to achieving emissions reductions in Australia's energy production sector through increased renewable energy is the country's high fossil fuel subsidies (AUD $10 billion per year). For example, while the federal government provides limited funding to further

[134] Climate Change Authority, 2014, 81.
[135] Sinclair Knight Mertz, 2012, 1.
[136] World Coal Association, n.d.

the development of solar energy, it is not nearly enough to create incentives to expand the market.[137]

RECOMMENDATIONS

1. **Promote CCS Development:** The federal government should continue invest in CCS technologies, as well as promote the uptake of such technologies through increased tax incentives or subsidies in the coming years. The federal government should also work with state and territory governments to increase their adoption of CCS technologies and find new and creative ways to overcome any current barriers to implementation. Furthermore, the government should ensure that any new coal plants are designed to maximize energy efficiency.

2. **Increase Funding for Renewables:** The federal government should increase its funding for the development and deployment of renewable energy technologies, such as solar and onshore wind. A first step in doing this would be to continue funding of the Australian Renewable Energy Agency, the Clean Energy Finance Corporation, the Renewable Energy Target, and the Million Solar Roofs rebate program. Additionally, the government should consider reducing current fossil fuel subsidies to allow for an increased market presence of the renewable technologies.

AGRICULTURE, FORESTRY, AND OTHER LAND USE

Current & Projected Emissions

Australia's agriculture, forestry, and other land use sector (AFOLU) accounts for 104.1 $MtCO_2e$ (19%) of the country's total 2013 GHG emissions (agriculture, 89.6 $MtCO_2e$, and LULUCF, 14.5 $MtCO_2e$). Deforestation accounts for 33.7 MtCO2e, while afforestation and reforestation efforts account for a net sink of approximately 19.2 MtCO2e.[138] Between 1990 and 2011, emissions from the LULUCF sector declined due to reductions in land clearing and removals from afforestation/reforestation efforts.[139] Between 1990 and 2010, emissions from deforestation alone decreased by 68% due to economic conditions within the farm sector and regulatory changes in domestic vegetation management frameworks.[140] Future emissions from land clearing will depend heavily on the farmers' terms of trade, which is "…defined as the ratio of an index of prices received by farmers to an index of prices paid by farmers."[141] In other words, higher prices for agricultural products would likely result in farmers increasing their land clearing efforts to allow for greater levels of production.

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[137] The Conversation, 2012.
[138] Australian Government, 2013, 11.
[139] Climate Change Authority, 2013, 2.
[140] Ibid., 5.
[141] Ibid., 8.

In 2010, the majority of emissions within Australia's agriculture sector came from enteric fermentation (68%), followed by agricultural soils (17%), savanna burning (11%), manure management (4%), field burning of agricultural residues (0.4%), and rice cultivation (0.2%).[142] Under the current carbon tax and Carbon Farming Initiative, emissions from the agriculture sector are projected to be 91 $MtCO_2e$ in 2020. In the absence of a carbon price, agriculture sector emissions are projected to increase to 92 $MtCO_2e$ in 2020. Under this scenario, livestock emissions (enteric fermentation and manure management) are projected to continue to account for the majority of the sector's emissions (67 $MtCO_2e$, or approximately 73%). Cropping (agricultural soils, field burning of agricultural residues, and rice cultivation) is projected to account for15 $MtCO_2e$ (16% of total sector emissions), followed by savanna burning, which is expected to contribute 10 $MtCO_2e$ (11% of total sector emissions).[143]

While the abatement potential within Australia's agriculture sector is relatively small (14 $MtCO_2e$ in 2020 and 25 $MtCO_2e$ in 2030), the abatement potential within the forestry sector (a subset of LULUCF) is significant. Possible emissions reductions in the forestry sector are projected to be 109 $MtCO_2e$ in 2020 and 172 $MtCO_2e$ in 2030. However, the agriculture sector holds more cost-effective abatement solutions than the forestry sector, specifically with regard to emissions reductions from livestock.[144]

Key Initiatives Within the AFOLU Sector

As previously mentioned, the implementation of regulations to restrict land clearing in New South Wales and Queensland has resulted in a steep decline in deforestation in those areas since 2003. However, revisions made to regulations in these areas (as well as in Western Australia) could impact future emissions reductions.[145] According to the Climate Change Authority, New South Wales's revisions allow for increased clearing of isolated paddock trees and native vegetation; Queensland's revisions allow farmers to more easily pursue land-clearing efforts for farmland expansion; and Western Australia's revisions ease the permit requirements for land clearing.[146]

Additionally, a primary financing mechanism within Australia's AFOLU sector is the Carbon Farming Initiative (CFI), a voluntary carbon offset scheme that enables farmers and land managers to earn Australian Carbon Credit Units (ACCUs) through GHG sequestration and mitigation projects.[147] In order to be eligible to receive these credits, projects must pass the "additionality" test, proving that they will go beyond business-as-usual approaches to provide extra reductions in GHG emissions.[148] As of January 2014, approximately 4.2 million ACCUs had been issued, amounting to 4.2 $MtCO_2e$ of avoided missions.[149]

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[142] Australian Government, 2012, 2.
[143] Ibid., 2012, 8.
[144] McKinsey & Company, 11.
[145] Climate Change Authority, 2014, 82.
[146] Ibid.
[147] Australian Government, n.d.
[148] Ibid.
[149] Climate Change Authority, 2014, 81.

BARRIERS

Political: A primary barrier to achieving further reductions in Australia's AFOLU stems from the Abbott government's climate change policies. There is significant uncertainty surrounding the impact of the government's abolition of the country's carbon tax in favor of the Direct Action Plan. Furthermore, Abbott's plan to seek removal of approximately 74,000 hectares of forest from the Tasmanian World Heritage Wilderness Area runs counter to Australia's recent efforts to reduce countrywide deforestation. While afforestation is a component of Abbott's proposed Direct Action Plan (20 million trees are to be planted by 2020), it is widely believed that such an effort will have little to no impact on reducing Australia's GHG emissions.

Financial/Technological: A second barrier to reducing emissions in Australia's AFOLU sector, specifically the agriculture sector, is the difficulty of reducing methane emissions from enteric fermentation. Demand for dairy and beef products is likely to remain high over the coming years, resulting in significant emissions from enteric fermentation. While there is potential to reduce emissions through improving dairy and beef production efficiency, there must be adequate incentives for farmers to invest in the required technologies.

Financial: A barrier to reducing emissions in Australia's forestry sector is the relatively high cost of the associated abatement measures. The abatement cost of both avoided deforestation and afforestation of cropland is estimated to be AU $50 per ton of CO_2e.[150] Furthermore, profitability incentives within the agricultural and logging industries run counter to avoided deforestation and afforestation efforts, resulting in a lack of incentive to invest in such abatement measures.

RECOMMENDATIONS

1. **Increase the Efforts of Other Parties:** Given the uncertainty surrounding the Abbot government's commitment to genuine action on climate change issues, there is room for state, territory, and local-level actors (governments, NGOs, etc.) to help fill the void. State and territory governments and NGOs should increase their collaborative efforts to reduce emissions across all sectors. Additionally, the governments of New South Wales, Queensland, and Western Australia should carefully monitor the impact of their revised land-clearing policies on emissions reductions in light of policy changes at the federal level. Furthermore, during meetings of the Council of Australian Governments (COAG), state and territory representatives should pressure the federal government to strengthen its anti-deforestation efforts and other climate change-related policies that directly impact their regions.

2. **Expand the Carbon Farming Initiative:** The Abbott government should follow through on its plans to expand the Carbon Farming Initiative (CFI) under the Direct Action

[150] McKinsey & Company, 14.

Plan, given the fact that it will remain an essential tool in reducing GHG emissions in Australia's AFOLU sector. The CFI should provide additional incentives to farmers who plan to take on projects that will reduce emission from enteric fermentation, given that it is responsible for the greatest portion of current and projected emissions in the agriculture sector. Furthermore, priority should also be given to projects that center on avoided deforestation or afforestation, given that the CFI's potential to help landowners overcome the associated financial barriers.

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