

KEY POINTS

- Bhutan takes pride in being the only carbon-neutral country in the world and emphasizes green development at all times. The government acknowledges the huge potential for reducing greenhouse gas emissions in the transport sector, which has become a serious concern.
- The country's *Transport Integrated Strategic Vision 2040* includes a regulation strategy that emphasizes using more energy-efficient transport modes, improving transport choices, utilizing cleaner fuels and technologies, applying information technology, and introducing incentives for fuel-efficient, green vehicles.
- This policy brief discusses five core policy interventions that will be important for vehicle emission reduction in Bhutan: (i) import low-sulfur fuels, (ii) update the vehicle emission standards, (iii) upgrade the vehicle emission inspection system, (iv) restrict diesel cars and light-duty vehicles, and (v) promote low-carbon vehicles.

Bhutan Vehicle Emission Reduction Road Map and Strategy, 2017–2025

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Bhutan takes pride in being the only carbon-neutral country in the world. However, accelerated economic activities in the last decade have led to a number of environmental issues. Increasing greenhouse gas (GHG) emissions and other air pollutants have become serious concerns, posing risks to people's health and the environment. If no action is taken, emission levels will likely triple by 2030, causing severe air pollution.

A national policy and vision to maintain a pristine environment is in place and Bhutan is undertaking steps to significantly reduce its environmental footprint. These present exciting opportunities toward achieving a resource-efficient, resilient, equitable, and greener economy in line with the country's overall goal of happiness for all.

This policy brief is an output of activities on "Building Institutional Capacity to Reduce Emissions from Motor Vehicles in Bhutan" that the National Environment Commission (NEC) implemented from January 2017 to March 2018 under the regional technical assistance project "Action on Climate Change in South Asia" of the Asian Development Bank (ADB).

BACKGROUND

Bhutan is one of the fastest-growing economies in South Asia, with economic growth averaging 7.5% a year over the past 3 decades and poverty rate going down from 23% in 2007 to 8% in 2017.¹ The country's Eleventh Five-Year Plan, 2013–2018 aims to achieve "self-reliance and inclusive green socioeconomic development" by concentrating on (i) self-reliance, (ii) inclusive social development, and (iii) green development that will ensure carbon-neutral development at all times.²

¹ ADB. 2019. *Asian Development Bank and Bhutan: Fact Sheet*. Manila.

² Government of Bhutan, Gross National Happiness Commission. 2013. *Eleventh Five-Year Plan, 2013–2018*. Thimphu. As cited in ADB. 2014. *Bhutan Country Partnership Strategy 2014–2018*. Manila.

Over the past decades, GHG emissions from the transport sector in Bhutan have been increasing significantly. The country’s Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 2011 reported that GHG emissions from the transport sector accounted for about 20% of the country’s total emissions in 2000.³ By the end of 2012, the sector’s percentage share increased to about 30% of the total emissions. In the coming years, GHG emissions from the transport sector are expected to grow further as vehicle ownership is increasing at an average rate of 15% per annum.

The Government of Bhutan acknowledges the huge potential for GHG emission reduction in the transport sector, as well as its multiple cumulative benefits. The government has been taking necessary interventions to reduce such emissions. Fewer cars and a switch to renewable energy would ease local traffic congestion and improve local air quality while reducing threats to human health from pollution.⁴ The biggest emission reduction can be achieved by promoting electric and hybrid cars and improving the efficiency and frequency of mass transport services. At the strategic level, with support from ADB and the Australian Agency for International Development (AusAID), Bhutan has prepared the *Transport Integrated Strategic Vision 2040*, which incorporates all existing transport-related plans, policies, initiatives, and actions to create a

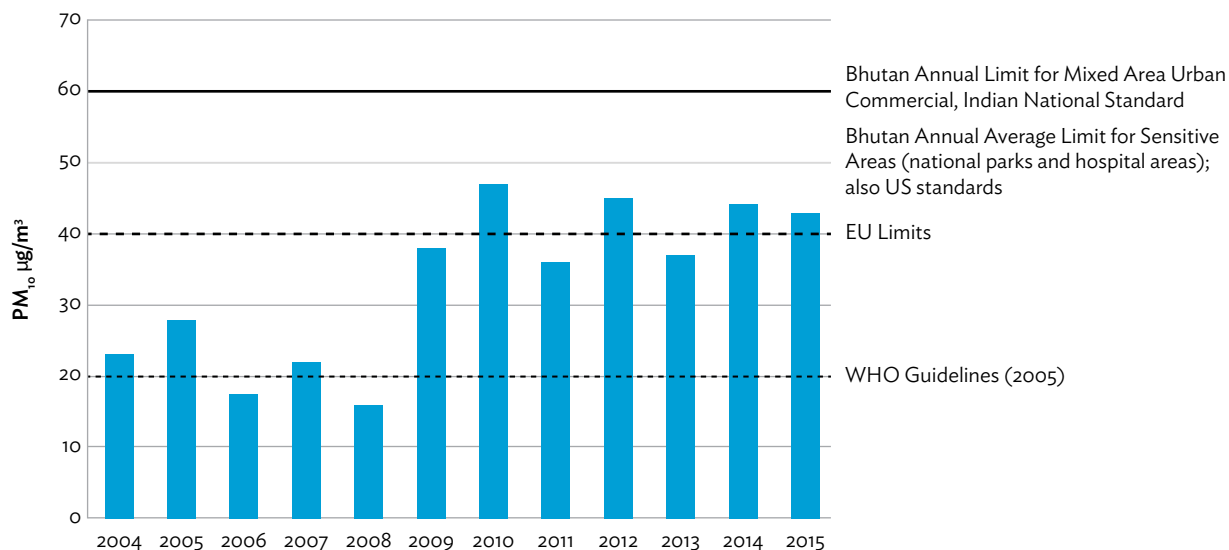
long-term comprehensive strategy for the country.⁵ It covers both the implementation of transport infrastructure (e.g., roads and aviation) and execution of institutional and management functions associated with the delivery of transport services (e.g., regulatory tasks, bus services, and institutional reforms).

In line with the above national strategy, the NEC requested ADB’s technical and financial support to implement activities related to the initiative “Building Institutional Capacity to Reduce Emissions from Motor Vehicles in Bhutan.” This policy brief synthesizes two reports produced from the ADB-supported country initiative.

VEHICLE EMISSION LEVELS AND TARGETS

Emission Levels. Emissions of air pollutants and GHGs are among the most pressing environmental challenges that Bhutan faces. In the country’s growing urban areas, particulate matter (PM) and nitrogen dioxide (NO₂) pose a major public health concern. In Thimphu, for example, the annual average level of PM₁₀, or particulate matter with a diameter of 10 micrometers or less, has been increasing. Since 2009, PM₁₀ levels have consistently been higher than the standards set by the World Health Organization (Figure 1).

Figure 1: Annual Average Particulate Matter (PM₁₀) Levels in Thimphu, 2004–2015



EU = European Union, µg/m³ = microgram per cubic meter, PM₁₀ = particulate matter with a diameter of 10 micrometers or less, US = United States, WHO = World Health Organization.

Note: Data for Thimphu were taken at the National Environment Commission Secretariat Station.

Source: Government of Bhutan, National Environment Commission. 2016. *Bhutan State of the Environment Report* (Figure 34). Thimphu.

³ Government of Bhutan, NEC. 2011. *Second National Communication from Bhutan to UNFCCC*. Thimphu. November.

⁴ Government of Bhutan, NEC. 2012. *National Strategy and Action Plan for Low Carbon Development, 2012*. Thimphu. Final report prepared by Ea Energy Analyses (Copenhagen) and COWI (Lyngby), Denmark, of a Danida-funded short-term technical assistance (104.Bhutan.806-200).

⁵ ADB. 2013. *Bhutan Transport 2040 Integrated Strategic Vision*. Manila.

The major sources of air pollutants are passenger cars and heavy-duty vehicles (HDVs), including diesel-powered large and medium-sized trucks and buses. In June 2015, these already accounted for a combined 73% of the total number of vehicles in Bhutan based on the Road Safety and Transport Authority Annual Report 2014–2015. In the same year, HDVs were responsible for about 70%–90% of local pollutants and nearly 60% of GHGs in the country (Table 1).

Based on current trends of vehicle acquisition and fuel import standards, and without any policy interventions, vehicle inventory in Bhutan may increase from around 84,000 units in 2016 to 180,000 units by 2030. With this, emissions from the domestic transport sector (i.e., excluding Indian vehicles, called re-export) may reach 660,000 tons carbon dioxide equivalent (tCO₂e) in 2030.

Emission Targets. Bhutan envisions a future that maintains its pristine environment. The country has internationally committed to remain carbon-neutral or even be carbon-negative. Thus, government measures to keep the country’s air quality standards at healthy levels include those aimed at significantly minimizing emissions from the transport sector (Box).

PROPOSED KEY POLICY INTERVENTIONS

From the long list of prospective measures assessed under this ADB technical assistance project, and based on potential emission reductions, technical feasibility, and cost-benefit analysis, five core policy interventions will be important for vehicle emission reduction in Bhutan (Figure 2). Proven effective in other countries, these core policies can reduce emissions significantly and have been shown as economically beneficial. The economic

Box: Vehicle Emission Reduction Targets Recommended for Bhutan

- By 2025, reduce average annual levels of all air pollutants to better than World Health Organization standards.
- By 2030, achieve 65%–95% reduction from 2015 levels in emissions of sulfur dioxide, nitrogen dioxide, and particulate matter from vehicles.
- By 2030, attain transport sector carbon dioxide emission levels that are 25% lower than under a business-as-usual scenario.

Source: ADB.

benefits from better human health and sustained pristine environment far outweigh the financial costs of adopting and implementing the policies.

1. Import Low-Sulfur Fuels

Sulfur is a pollutant and its presence in fuels prevents the adoption of major pollution control technologies such as diesel particle filters, particulate filters, and nitrogen oxide (NO_x) absorbers. Reducing the sulfur content of fuels is necessary in reducing vehicle emissions in Bhutan.

Bhutan has no fuel refineries and imports all its fuels from India, thus adhering to the originating country’s fuel standards. India is working on lowering the sulfur content of its fuels to as little as 50 parts per million (ppm) by 2018 and 10 ppm by 2021. This means that current sulfur dioxide (SO₂) emissions in Bhutan could go down by as much as 80% by 2018 and 95% by 2021 (Figure 3).

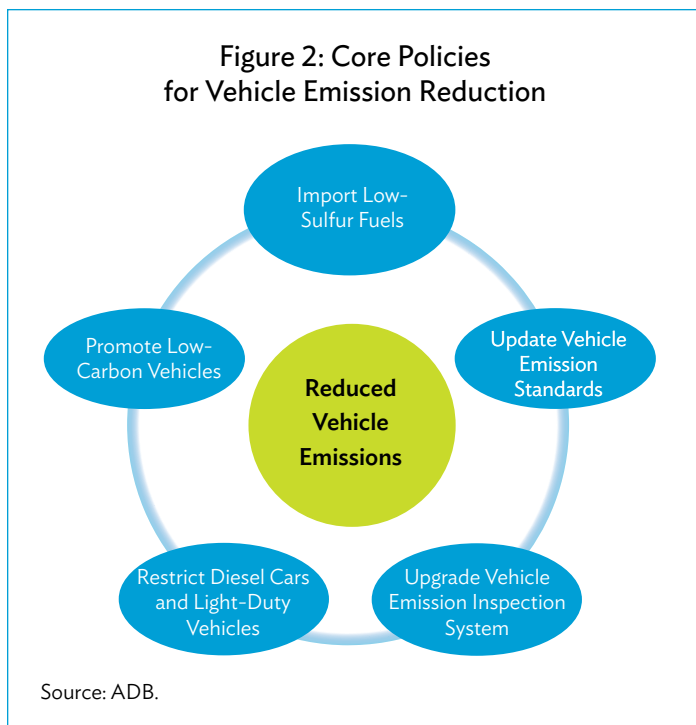
Table 1: Estimated Vehicle Emissions, 2015

Vehicle Category	Air Pollutants			Greenhouse Gases	
	Particulate Matter (PM)	Nitrogen Dioxide (NO ₂)	Sulfur Dioxide (SO ₂)	Carbon Dioxide (CO ₂)	CO ₂ plus Black Carbon
	(tons)			(tons CO ₂ e)	
Passenger cars	9.5	174	12	80,399	86,988
Taxis	0.9	29	2	17,315	17,886
Motorcycles	0.1	13	0	4,542	4,575
Heavy-duty vehicles	28.3	1,509	30	135,868	152,438
Total	38.9	1,724	45	238,125	261,887
As Percentage of Total (%)					
Passenger cars	24.4	10.1	26.7	33.8	33.2
Taxis	2.3	1.7	4.4	7.3	6.8
Motorcycles	0.3	0.8	0.0	1.9	1.7
Heavy-duty vehicles	72.8	87.5	66.7	57.1	58.2

CO₂e = carbon dioxide equivalent.

Note: Numbers may not sum precisely because of rounding. Similarly, percentages may not total 100% because of rounding.

Source: ADB.



The annual direct economic benefit from reduced SO₂ emissions in Bhutan is estimated at \$100,000–\$200,000. On top of this, there are indirect benefits such as the introduction of new vehicle emission control technologies, fuel savings, and reductions in PM and NO₂ emissions.

Bhutan does not need to take steps to reduce the sulfur content in fuels which incurs no direct cost. However, the price of fuel will increase by \$0.01–\$0.02 (Nu1–Nu2) per liter at pump stations.

It is recommended that Bhutan (i) issues a regulation that requires all fuels imported from India to comply with the originating country’s fuel standards, (ii) continues testing fuel quality to help ensure compliance, and (iii) upgrades its fuel quality testing procedures.

2. Update Vehicle Emission Standards

Bhutan implements Euro 2 as its emission standard. Although tighter emission standards have a marginal effect on fuel efficiency and GHG emissions, they do reduce pollutants and are beneficial to the overall goal of cleaner air.

India is the main source of vehicles in Bhutan and has introduced measures to implement standards equivalent to Euro 4 by 2018 and Euro 6 by 2021. To avoid becoming a dumping ground for vehicles that do not adhere to these standards, Bhutan will need to upgrade its vehicle emission standards in line with India.

Implementing this policy will lower PM emissions by 65% and NO_x emissions by 40% in Bhutan by 2030 compared to 2015 levels, and GHG emissions will be reduced with less black carbon emissions. All these combined will reduce transport emissions by

around 60,000 tCO₂e in 2030, compared to a business-as-usual (BAU) scenario.

The economic benefits of reduced health and pollution costs are greater than the anticipated slightly higher cost of vehicles that will use the new technology to comply with the stricter emission standards. The cumulative net economic benefit of this policy is calculated at \$12 million (Nu800 million) by 2030, or around \$1 million annually.

3. Upgrade Vehicle Emission Inspection System

Emission controls ensure that the vehicles in use remain compliant with the original emission standards for which they were certified. A vehicle emission inspection system confirms compliance by encouraging regular vehicle maintenance, identifying high emitters, and obliging them to carry out repairs that would restore the vehicles’ capacity to conform to the standards.

Bhutan’s vehicle emission inspection system should be upgraded in line with the planned improvement in fuel quality and emission standards. The proposed upgrades were based on an analysis of emission levels of vehicles in circulation in Bhutan as well as experiences in other countries (Table 2).

Table 2: Proposed Maximum Vehicle Emission Levels

Vehicle Registration Period	Gasoline-Fueled Vehicles (% volume of carbon monoxide)	Diesel-Fueled Vehicles (Hartridge Smoke Unit)
Prior to March 2008	4.5	70
March 2008–March 2018	1.5	65
After March 2018	0.5	50

Source: ADB.

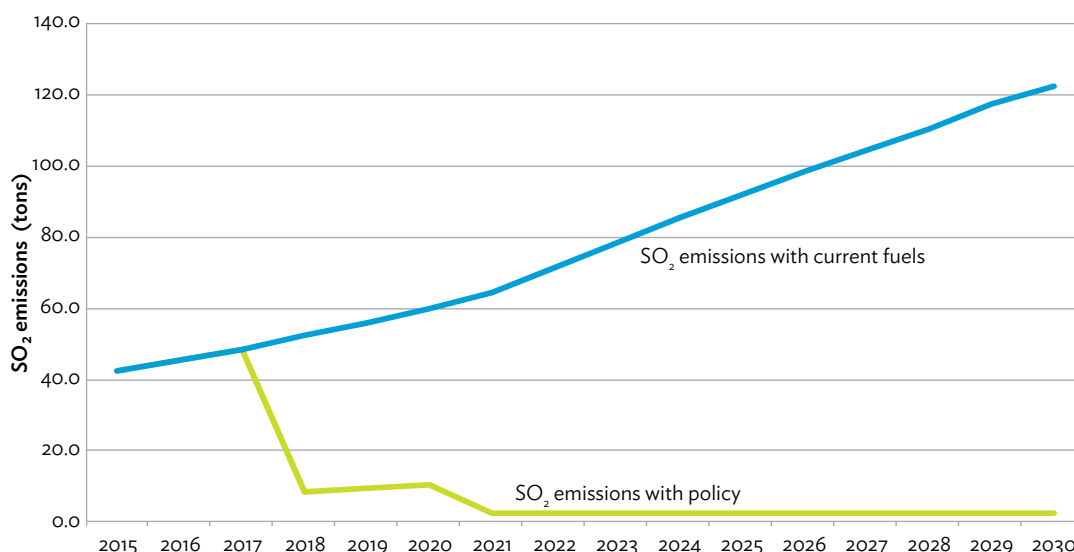
It would also be necessary for Bhutan to improve its regulations, strengthen enforcement, and enhance the testing procedures and execution to minimize errors and prevent high-emitting vehicles from passing the vehicle emission inspection test.

The introduction of new vehicle technologies such as onboard diagnostics in new vehicles will also help simplify the emission inspection system in the midterm that will lead to a remote sensing system in the long term. But for a small developing country like Bhutan, a more sophisticated vehicle inspection system may appear costly with limited positive environmental impacts.

4. Restrict Diesel Cars and Light-Duty Vehicles

Even with the best available diesel technologies, the real-world performance of diesel engines results in high PM and NO₂ emissions, contributing to environmental problems (air pollution) and human health issues. In Bhutan, diesel vehicles comprise only 40% of the total number of vehicles in use, yet they are the largest polluters, contributing 98% of PM, 95% of NO₂, and 87% of SO₂ emissions in the country. Diesel-powered passenger cars and taxis

Figure 3: Sulfur Dioxide Emissions from Vehicles, Current Fuels vs. Low-Sulfur Fuels



SO₂ = sulfur dioxide.
Source: ADB.

account for around 60% of urban PM and SO₂ emissions, and one-third of NO₂ emissions. The number of diesel vehicles must be significantly reduced to have cleaner air and to preserve the pristine environment of the country.

This core policy aims to limit the use of diesel to large trucks, buses, and mobile machinery only. It disallows the registration and use of diesel passenger cars, taxis, and light vehicles with a gross vehicle weight of less than 3.5 tons. The policy does not apply to diesel vehicles that have already been registered.

The implementation of this policy could lower Bhutan’s urban air pollution from PM and SO₂ emissions by half, and NO₂ emissions by one-third, by 2030. The positive economic impact of restricting the use of diesel-powered cars and light vehicles in Bhutan clearly surpasses the additional cost the vehicle owner bears (Table 3).

Table 3: Economic Profitability of Restricting the Use of Diesel Vehicles, 2018–2030

Parameter	Cumulative Benefit or Cost (\$ million)
PM, NO ₂ , and SO ₂ reduction	8.3
GHG reduction	6.5
Additional cost of vehicles (investment and operations)	(9.0)
Balance	5.9

GHG = greenhouse gas, NO₂ = nitrogen dioxide, PM = particulate matter, SO₂ = sulfur dioxide.
Source: ADB.

5. Promote Low-Carbon Vehicles

Hybrid, plug-in hybrid, and electric cars emit far lower CO₂ throughout their life spans compared to diesel- and gasoline-powered vehicles.

The small domestic market, high diversity of vehicles, and generation of all electricity from renewable energy in Bhutan make low-carbon vehicles an ideal long-term action toward its thrust of cleaner air. Although the government has already taken initial steps toward promoting low-carbon vehicles by reducing taxes on hybrid and electric cars, this has not been sufficient to promote widespread usage. More substantial incentives are required to encourage the switch to low-carbon vehicles.

With plans to tap international climate finance, the government has been developing a low-carbon commercial vehicle strategy, favoring electric mobility and focusing on taxis, buses, and urban freight vehicles. These vehicles circulate in urban areas, making recharging simple and convenient; replacing them will have the largest impact on air quality due to their high annual mileage. Below are the key features of the proposed 5-year strategy for low carbon commercial vehicles:

Taxis:

- (a) Reduce the number of taxis and increase the number of public transport buses.
- (b) Promote electric taxis with provision of limited subsidies.

Buses:

- (a) Develop a modern and safe public transport system based on standard and medium-sized battery-powered electric buses.

- (b) Promote the use of hybrid interurban buses by providing incentives to reduce or eliminate the differential incremental investment compared to a conventional unit.

Trucks:

- (a) Establish small freight consolidation centers that operate with electric trucks, which could be leased to private operators.
- (b) In the medium and long terms, with further battery development, use long-range electric trucks for interurban cargo transport.

The five core policy options presented here align with Bhutan’s national objectives. It is estimated that, relative to the BAU scenario, these core policies combined would reduce (i) urban emissions by at least 90%, (ii) urban air pollution caused by the transport sector by 60%–90%, and (iii) CO₂ and black carbon emissions by 24% by 2030. The realization of the proposed policies is an exciting challenge that will also present opportunities toward a resource-efficient, resilient, equitable, and greener economy in Bhutan. The immediate impact of reduced vehicle emissions in Bhutan will be cleaner air and a more pristine environment. More importantly, the long-term impact will be better health, well-being, and gross national happiness of the people. These targets may be deemed ambitious but can serve as a model of a sustainable society across the world.

CONCLUSION

Transport-related GHG emissions in Bhutan are lower compared to those in other countries in South Asia. However, the emissions level in the landlocked country could triple by 2030 under a BAU scenario based on projected vehicle growth rate.

Overall, Bhutan is poised for reduced vehicle emissions and a low-carbon vehicle strategy. It is one of a few countries in the world with a zero-emission grid based on renewables. The Government of Bhutan is proactive with a sincere focus on sustainable development and long-term protection of the environment and natural resources. The country’s *Transport Vision 2040* emphasizes using more energy-efficient transport modes, improving transport choices, utilizing cleaner fuels and technologies, applying information technology, and introducing incentives for fuel-efficient and green vehicles as a regulation strategy.

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