Decarbonising Transport: Beyond Cars and Internal Combustion Engines

Anumita Roychowdhury
Sayan Roy, Anannya Das, Shubham Srivastava and Shantanu Gupta

Centre for Science and Environment

December 17, 2020
Grim reminder

UNEP Emissions Gap Report 2020:

• Pandemic-linked economic slowdown to cause 7% drop in CO2 emissions this year. Translates to a 0.01°C reduction of global warming by 2050.

• Insignificant impact on the Paris Agreement goal of limiting global warming to well below 2°C, and pursuing 1.5°C.

• Need green recovery to reduce upto 25% emissions in 2030 with unconditional implementation of nationally determined contributions (NDCs) under the Paris Agreement –to be closer to the 2°C pathway.

• Otherwise heading for a 3.2°C warmer world by the end of this century…
Climate change threat is real

And the need for action is urgent
Climate change is real; impacts are catastrophic
World needs effective, ambitious and equitable actions

Transport sector – a special challenge
The question: is the world doing enough?
CO2 emissions from transport sector: Obstinate

Source: ourworldindata.org
Transport: Business-as-Usual CO2 Emissions (2050)

Source: Slocat 2016
Bullish despite improvement

Tracking Transport 2020 – IEA:

• Global transport emissions increased by less than 0.5% in 2019 (compared with 1.9% annually since 2000)

• Global transport sector energy intensity (total energy consumption per unit of GDP) dropped by 2.3% in 2019 after falling an average 1.4% per year between 2000 and 2018. But still close to a quarter of direct CO2 from fuel combustion

• **But energy intensity must drop by 3.2% on average annually from 2020 to 2030** – more than double the annual average rate of decrease since 2000

• Road vehicles account for **nearly three-quarters of transport CO2 emissions**

• Emissions from aviation and shipping continue to rise. Need international policy focus on these hard-to-abate subsectors.
Growth rate vs absolute

Growth in number of vehicles per 1000 people (2005-15)

Percentage change (2005-15)

Source: Based on Slocat 2016
Effects of COVID-19 on global CO2 emissions:

From: Near-real-time monitoring of global CO2 emissions

COVID-19 causes the largest annual decrease of CO2 emission since 1900.
Pandemic and transport CO2: Nose dives; but recovers
Emissions Gap report 2020

EMISSIONS COULD BE 7% LOWER IN 2020 DUE TO COVID-19
But in the long-term, this year’s dip means only a 0.01°C reduction of global warming by 2050

www.downtoearth.org.in

Source: Emissions Gap Report, 2020 | UNEP
Inflexion point: Scenario for future cut (2000-2030)
How will world address this challenge?
Legacy challenge of car locked world

Motor vehicle ownership per 1000 population

Data available for 2014.

Data Source: OurWorldInData  Map prepared by CSE
Global transport energy intensity

Energy intensity: Total energy consumption per unit of GDP.

Boeː barrels of oil equivalent

Data Source: IEA, 2019
Map prepared by CSE

Transport Sector Energy Intensity, 2019
boe / 1000 USD

- 0.06 - 0.09
- 0.09 - 0.12
- 0.12 - 0.15
- 0.15 - 0.19
- 0.19 - 0.23
Not many NAMAs with transport focus

- 31 NAMAs that include transport strategies
- 22 NAMAs only on transport

Transport NAMA includes projects related to BRT, Railway development, Low carbon strategies, TOD, Electric mobility, fuel efficiency etc.

Data Source: UNFCCC NAMA Registry Map prepared by CSE
Technology pathways

- Ambitious target for fuel efficiency
- Electrification and going beyond IC engines
- Action on international transport
Global status 2018:
Passenger light duty vehicles CO2 emissions values in gram per km
Reflects fuel efficiency targets set by different countries

Source: Map prepared by CSE based on data from ICCT Reports
How countries are moving forward CO2 emissions targets by country

Fuel efficiency targets (g CO2 / km):
- No Data
- 0 - 60
- 60 - 100
- 100 - 120
- 120 - 135
- 135 - 150

Data Source: ICCT, 2020
Map prepared by CSE
Europe leveraging tighter CO2 emissions norms to push electrification

Fuel efficiency data for Canada, data available for 2016; for Mexico, 2016; for Brazil, 2017; and for the rest, 2018.

Data Source: IEA, 2019 and ICCT, 2020
Map prepared by CSE
The race: Targets
CO2 equivalent fuel economy standards for light duty vehicles

Source: ICCT

Updated May 2020
The EV race

<table>
<thead>
<tr>
<th>Country</th>
<th>EV Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>55.93%</td>
</tr>
<tr>
<td>Iceland</td>
<td>22.60%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>15.14%</td>
</tr>
<tr>
<td>Sweden</td>
<td>11.43%</td>
</tr>
<tr>
<td>Finland</td>
<td>6.90%</td>
</tr>
<tr>
<td>Portugal</td>
<td>5.67%</td>
</tr>
<tr>
<td>China</td>
<td>4.94%</td>
</tr>
<tr>
<td>Germany</td>
<td>3.01%</td>
</tr>
<tr>
<td>Canada</td>
<td>2.96%</td>
</tr>
<tr>
<td>UK</td>
<td>2.85%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>2.82%</td>
</tr>
<tr>
<td>France</td>
<td>2.77%</td>
</tr>
<tr>
<td>US</td>
<td>2.05%</td>
</tr>
<tr>
<td>Japan</td>
<td>0.90%</td>
</tr>
<tr>
<td>Chile</td>
<td>0.12%</td>
</tr>
<tr>
<td>India</td>
<td>0.07%</td>
</tr>
</tbody>
</table>

Till date, the penetration of EV is less than 5% in big global vehicle markets.

70% of EVs in in few countries.
Many developed nations like Norway, UK, France, Germany has already set up 100% EV transformation targets.
Challenge of developing countries
Emissions standards and fuel quality roadmap continues to improve

Diesel fuel quality in Africa

2020: India -- BSVI emissions standards
Asia in varying stages

Africa:
2015 - 2019: East Africa Community (EAC) adopted low sulphur diesel fuel standards (of 50 parts per million or less). Also adopted low sulphur petrol fuels (also 50ppm)

2020, ECOWAS: From January 2021 only used vehicles meeting Euro IV standards will be permitted in 15 Ecowas countries following their adoption of new fuels and vehicle standards
Discussing electric mobility

Source: Anon. 2015, Vehicles in-use 2015 data, International Organization of Motor Vehicle Manufacturers (OICA)
Source: UNEP
India’s challenge

Need high ambition for electrification – set target, zero emissions mandate, FAME III for well structured longer term incentives and state level action

Aggressive improvement in fuel efficiency – Need stronger targets across vehicle segments – light and heavy duty and two wheelers

Decarbonise transport fuels

How can we build ambition to ensure green recovery?
Agenda: clean vehicles but also less vehicles on road

Mobility transition

Transportation and vehicle restraint strategies

Are we getting there?
**Efficiency is not sufficiency:** Fuel efficiency improved 16%; same period distance travelled increased 7%; gains lost

Lesson from the US

Source: CSE: Capitan America
• Need to understand peak travel trend in developed and developing countries

• Possible for LDV travel per capita in OECD countries to peak around 2035 (IPCC)

• Non-OECD countries: likely continue to increase dramatically from a very low average today.
Global commuting pattern
More walking and cycling in developing world

Source: UITP Mobility in Cities Database
Global pattern in sustainable mode share (Public transport+walk+cycle)

Data Source: Multiple sources compiled by CSE

Map prepared by CSE
Global approaches changing to promote sustainable alternatives to car travel + EV promotion
Mobility demand in India

Increase in passenger km per annum and by mode in business-as-usual scenario

- Passenger km is expected to increase more than 3 times by 2050.
- Trip length and rate will also increase as city size and income increase.
- Demand for different mode of transport will increase over time. Without adequate public and para transit, private transport will overtake public transport mode share by 2040.

Source: UNEP, 2015
How can India rebuild bus transport?

Bus ridership declining in major cities of India

Combined Daily Bus Ridership in Indian Cities
(Ridership of 17 major cities in India)

Ridership loss in between 2013-18

Between 2013 - 18, 12 cities have lost combined ridership of 40.8 lakhs

NTDPC report: Passenger traffic will grow by 15-16 times over a economic growth of 7-9% per annually; India needs to invest 8-10% of GDP in transport infrastructure

Source: RTI filed by CSE, 2019
STUs: Growing financial burden

Between 2010 and 2017, average annual loss per STU has increased more than 1.5 times, as fuel cost and manpower cost have increased.

India: Massive economic impact on bus transport

Impact of COVID-19 lock down on total cost and traffic revenue compared to Normal operations (in INR Billion) - 2020-21

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost (INR Billion)</th>
<th>Traffic Revenue (INR Billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-17</td>
<td>804.59</td>
<td>503.58</td>
</tr>
<tr>
<td>2020-21 (w/o COVID)</td>
<td>773.34</td>
<td>264.38</td>
</tr>
<tr>
<td>2020-21 (COVID)</td>
<td>69% increase</td>
<td>48% reduction</td>
</tr>
</tbody>
</table>

When the cost reduced by 4%, the traffic revenue reduced by 48%. This created a 69% increase in the annual VGF requirement of bus transport agencies in India.

Impact of COVID-19 lock down on Annual VGF requirement* (In INR Billion) in 2020 values- 2020-21

<table>
<thead>
<tr>
<th>Year</th>
<th>VGF Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-17</td>
<td>69</td>
</tr>
<tr>
<td>2020-21 (w/o COVID)</td>
<td>301</td>
</tr>
<tr>
<td>2020-21 (COVID)</td>
<td>508.96</td>
</tr>
</tbody>
</table>

* Estimated for period from March 2020 to February 2021 considering regular operations from May 2020

Source: GIZ
Availability of mass transit services in India
(service length per million population):

Note: Vishakhapatnam, the bus system is not exactly a BRT system, but a system of buses running on dedicated lanes.
*Delhi Metro covers the metro lengths of both Noida and Gurgaon and they are a subset of DMRC.

Data Source: Multiple data sources
Map prepared by CSE
Emerging strategies on vehicle restraint & electric vehicle programme

1. Amritsar
   - Renovation of Golden Temple area as no-car zone

2. Shimla
   - No car zones on mall road - pedestrian tourism
   - 75 EV buses deployed for long distance operations

3. Fazlai, Chandigarh
   - e-cabs program - community based dial-a-rickshaw service

4. Delhi
   - TOD amendment in master plan
   - Bus fleet augmentation and route rationalisation
   - EV policy 2020
   - Phase III metro approved
   - Pedestrianisation of Ajmal Khan, Road, Chandni Chowk

5. Jaipur
   - PBS through smart city programme
   - ITMS for traffic management
   - EV policy formulation underway

6. Noida - Ghaziabad
   - DMRC card integration - last mile connectivity
   - E-rickshaws for last mile

8. Mumbai
   - AC Bus fleet augment in 2019
   - EV fleet induction in 2020

10. Hubli-Dharwad
    - Proposal in 2019 to replace all ICE buses with EVs

12. Bangalore
    - Convert 7000 buses through “soot free urban bus fleet”
    - EV fleet induction in 2018
    - Dedicated bus priority corridors in 2019

13. Puducherry
    - Pedestrianisation of streets - no parking zones, street furniture
    - Proposed 10.3 km cycle track

14. Kolkata
    - Vehicle restraint by regulating-parking
    - AC trams introduced in 2019
    - 80 EV buses launched in 2019

15. Aizwal
    - No car zones and pedestrianisation by street design in central city area

16. Gangtok
    - Vehicle restraint by regulating-parking

9. Nanded
   - City beautification to promote pedestrian traffic

11. Mysuru
    - PBS system - 52 docking stations across city

16. Gangtok
    - No car zones and pedestrianisation by street design in central city area
## Case for green recovery: National transport projects approved in India (in past 5 years)

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>List of approved projects/ initiatives</th>
<th>Estimated project cost in Lakh Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Regional transport improvement projects</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Regional railway services improvement</td>
<td>6.39</td>
</tr>
<tr>
<td>2</td>
<td>Bharatmala project</td>
<td>6.92</td>
</tr>
<tr>
<td>3</td>
<td>Sagarmala Project</td>
<td>3.55</td>
</tr>
<tr>
<td>4</td>
<td>Jal Marg Vikas</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>Solar toll plazas</td>
<td>0.05</td>
</tr>
<tr>
<td>6</td>
<td>Green Highways</td>
<td>0.07</td>
</tr>
<tr>
<td>7</td>
<td>RRTS development</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td><strong>Sub total</strong></td>
<td><strong>17.91</strong></td>
</tr>
<tr>
<td>B</td>
<td>Urban transport improvement projects</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>NMT infrastructure development under AMRUT fund</td>
<td>0.01</td>
</tr>
<tr>
<td>2</td>
<td>Transport development under Smart city fund</td>
<td>0.51</td>
</tr>
<tr>
<td>3</td>
<td>Metro development (after release of metro policy 2017)</td>
<td>0.97</td>
</tr>
<tr>
<td>4</td>
<td>Electric vehicle – FAME funding</td>
<td>0.11</td>
</tr>
<tr>
<td>5</td>
<td>Improvement of Mumbai Suburban Rail Network</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td><strong>Sub total</strong></td>
<td><strong>1.96</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>19.87</strong></td>
</tr>
</tbody>
</table>

High Powered Committee has recommended to invest approx. Rs 22.92 lakh crores on urban transport and associated infrastructures, over the 20 years (2011-2030) – or, more than Rs 1 lakh crore investment per year.
How will India raise ambition on electric mobility

If India has to fulfil its objective of 40% EV of all new registered vehicles (i.e. approx. 40 million) by 2030, then EV fleet has to double every alternate year…
Urban form and CO2 lock-In

Advantage of developing countries

• Developing countries have better opportunity in high-density, mixed-use urban forms

• IPCC: Transport activities may plateau at lower GDP level in non-OECD countries due to high urban densities and greater infrastructure constraint

• Transport sector inertia due to large scale infrastructure funding – needs to be addressed

• Prevent car-dependent, spatial planning – India’s TOD policy, National Habitat Standards, guideline for smart cities etc

• Bridge the gap with implementation
High density compact urban form allows more sustainable travel
(Percentage share of sustainable modes vs urban density)

Source: Multiple sources compiled by CSE
Opportunity in Africa and India
Our inherent strength

Majority walk, cycle and use public transport

Urban Mobility

PT and NMV based, MTW majority personal vehicles

60-30% carbon neutral trips
Increase in PT will increase carbon

Transport modal share of the cities

Based on: International Association of Public Transport (2010) "Major Trends and case studies"
Scale of change still small

Restructuring Ajmal Khan road

22 streets in Delhi identified for pedestrianisation

Restructuring Chandni Chowk
Africa doing this right: NMT policy; infrastructure despite pandemic
Europe: Rediscovering walking and cycling

Pop up bike lanes
CO2 mitigation strategies from transport in India

Source: Dhar & Shukla, 2015
UNEP Global emission gap report: India has overachieved its NDC target by more than 15%.

Report suggests to strengthen the emission targets by enhancing ambitions:

- Expand public transit system
- Develop domestic electric vehicle targets working towards 100 per cent new sales of zero-emission cars.
Towards net zero goals

Fear of rebound and retaliatory emissions post pandemic
• Emissions during lockdown reduced due to halting of travel and economic activity. Not due to structural changes

Need green recovery for:
Technology pathways:
• Support for zero-emissions technologies (electrification and go beyond internal combustion engines)

Mobility transition
• Low-carbon transport and infrastructure
• Manage travel demand to reduce frequency and distance as well as dependence on high-energy-intensity modes
• Shift travel to most efficient modes
Finally

All need to do more; Much more

• Need ambition and effective reduction in advance countries – Mobility transition has to be part of the game
• India and developing countries need to build on the advantage of their baseline of high share of sustainable modes while cleaning up technologies and fuels
• Need real and measurable change