Policy Options for Improving Vehicle Fuel Economy

Alvin Mejia
Dhaka, Bangladesh
April 23, 2019
Transport and climate change

Climate change mitigation by sector

- Transport needs to contribute 18% to global carbon emission reductions to reach a 2DS
- Most of the vehicle fleet growth will take place in non-OECD countries
- Climate targets cannot be reached without contribution from developing & transitional countries

Source: ETP 2016 (IEA 2016)
Transport accounts for:

- More than half of global NO\textsubscript{x} emissions
- More than a quarter of all CO emissions
- Almost a quarter of volatile organic compounds emissions
- Substantial shares of SO\textsubscript{2} and PM emissions

*Fig. 4: Selected primary air pollutants and their sources, 2015*

Global Fuel Economy Initiative
Doubling the efficiency of the global car fleet by 2050
Doubling the efficiency of the global car fleet by 2050

- Slowing improvement in OECD countries
- Increasing improvement in non-OECD but not enough
- Still far from meeting the GFEI target

<table>
<thead>
<tr>
<th></th>
<th>Average fuel economy (Lge/100km)</th>
<th>Annual improvement rate (% per year)</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>-2.3% -2.8% -1.6% -1.3% -0.5%</td>
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<td></td>
<td><strong>Non-OECD average</strong></td>
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<td>-0.1% -0.3% -1.4% -1.2% -1.6%</td>
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<td><strong>Global average</strong></td>
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<td>-1.8% -1.6% -1.3% -1.3% -1.1%</td>
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GFEI target

- Required annual improvement rate (% per year)
  - **2005 base year**: -2.8%
  - **2015 base year**: -3.7%

Source: IEA/GFEI, 2017
Focus on Developing Countries

Baseline Light-Duty Vehicle Fuel Economy and Trends

Liters per 100 kilometers (L/100km) normalized to NEDC Test Cycle

Year | Non-OECD Average | Global Average | Bangladesh Average
--- | --- | --- | ---
2005 | 8.5 | 8.8 | 8.98
2008 | 8.5 | 8.3 | 8.01
2010 | 8.4 | 8.1 | 7.04
2012 | 8.2 | 7.8 | 7.43
2014 | 8 | 7.6 | 7.5
2015 | 7.9 | 7.6 | 7.07

Progression: Bangladesh

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-OECD Average</th>
<th>Global Average</th>
<th>Bangladesh Average</th>
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<tbody>
<tr>
<td>2005</td>
<td>8.5</td>
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<td>2015</td>
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</table>
What is fuel economy?

• Vehicles use energy, and fuel economy measures energy per unit of vehicle travel. It is the RATE of energy use.
  – Litres per 100km (Europe)
  – Km per litre (Japan)
  – Miles per gallon (United States)

• Fuel economy, fuel efficiency, fuel intensity are all fairly interchangeable terms. But fuel economy always refers to fuel use relative to distance travelled.

Source: Lew Fulton, UC Davis ITS
Fuel economy policies can work!

**Baseline Light-Duty Vehicle Fuel Economy and Trends**

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**CO₂ saved by achieving GFEI target**

- Yearly: 0.5 Gt/year by 2025, 1.5 Gt/year by 2050
- Cumulative: 33 Gt in total by 2050

**$ saved by achieving GFEI target**

- Yearly: $400 billion/year in 2050
- Cumulative: $8 trillion net saving by 2050

**Barrels of oil saved by achieving GFEI target**

- Yearly: 3 billion barrels of oil a year by 2050
- Cumulative: 54 billion barrels of oil in total by 2050

# Fuel Economy Policy Options

<table>
<thead>
<tr>
<th>Category</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VEHICLE FUEL EFFICIENCY STANDARDS</strong></td>
<td>• Introduce and regularly strengthen mandatory standards</td>
</tr>
<tr>
<td></td>
<td>• Establish and harmonize testing procedures for fuel efficiency measurement.</td>
</tr>
<tr>
<td><strong>FISCAL MEASURES</strong></td>
<td>• Fuel taxes and vehicle taxes to encourage the purchase of more fuel-efficient vehicles.</td>
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<td></td>
<td>• Infrastructure support and incentive schemes for very fuel-efficient vehicles.</td>
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<tr>
<td><strong>MARKET-BASED APPROACHES</strong></td>
<td>• Voluntary programs such as U.S. SmartWay and other green freight programs</td>
</tr>
<tr>
<td><strong>INFORMATION MEASURES</strong></td>
<td>• Vehicle fuel economy labels</td>
</tr>
<tr>
<td></td>
<td>• Improving vehicle operational efficiency through eco-driving and other measures.</td>
</tr>
</tbody>
</table>

Source: ICCT
Import Restrictions

- Algeria - imported secondhand vehicles must be less than 3 years old.
- Imports of used automobiles into Brazil are not allowed under any circumstances, with special authorization required for the import of used parts. Brazil also has a ban on diesel passenger car imports.
- Argentina is also currently considering a similar ban on imports and production of diesel passenger cars.
- South Africa does not allow the import of used vehicles.
- In Jordan, imported secondhand vehicles must be less than 5 years old.
Economic Instruments

• Feebates
• Taxes
  – Acquisition
  – Ownership
  – Motoring
• Penalties
CO2-based Feebate Scheme in Mauritius

- Feebate scheme in 2011 = fee on cars above 158 CO2g/km starting from 55$ per g/km to 137$ per g/km for cars over 290 CO2 g/km and a rebate starting from 27$ per g/km for cars with CO2 ratings from 91 to 158 CO2g/km and 82$ for cars from 90 CO2g/km and below

- From 7l/100km in 2005 to 5.8l/100km in 2014 and rapid increase of new hybrid vehicle sales from 337 in 2011 to 1418 in 2013

THE EXCISE (AMENDMENT) BILL
(No. XVIII of 2011)

Explanatory Memorandum

The main object of this Bill is to amend the Excise Act to provide, in addition to the excise duty chargeable on motor cars, for a CO2 levy on motor cars or for the granting of a CO2 rebate from the excise duty payable on motor cars, as the case may be, and for related matters.

P. K. JUNGAUTH
Vice-Prime Minister, Minister of Finance and Economic Development

8 July 2011
Acquisition tax

- Austria - fuel consumption tax is levied on the purchase price (net) or commercial leasing fee of new passenger cars and motorcycles and on passenger cars and motorcycles not yet registered nationally.
- South Africa has established an emission tax rate based on CO$_2$ emissions.
- In Belgium, different schemes apply based on the region. In the Flemish region, the tax is calculated as a function of vehicle’s specific CO2 emissions, fuel types.
Excise Taxation in Sri Lanka

- Hybrid and electric cars in 2014 was 56% of the total number of cars
- Hybrid-petrol, petrol and diesel vehicles attract 58%, 253% and 345%, respectively, in excise tax
- Fully electric vehicles are levied at 25%
- Revised excise tax focused on cc and kwh car ratings by 2018
Ownership Taxes

- Singapore

<table>
<thead>
<tr>
<th>Engine Capacity (EC) in cc</th>
<th>6-Monthly Road Tax Formula (From 1 August 2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC ≤ 600</td>
<td>S$200 x 0.782</td>
</tr>
<tr>
<td>600 &lt; EC ≤ 1,000</td>
<td>[S$200 + S$0.125(EC - 600)] x 0.782</td>
</tr>
<tr>
<td>1,000 &lt; EC ≤ 1,600</td>
<td>[S$250 + S$0.375(EC - 1,000)] x 0.782</td>
</tr>
<tr>
<td>1,600 &lt; EC ≤ 3,000</td>
<td>[S$475 + S$0.75(EC - 1,600)] x 0.782</td>
</tr>
<tr>
<td>EC &gt; 3,000</td>
<td>[S$1,525 + S$1(EC - 3000)] x 0.782</td>
</tr>
</tbody>
</table>

- If the car is not Euro IV, Euro V or JPN2009 compliant, the Special Tax is:
  = ($372 x 6) - S$50
  = S$2,232 - S$50
  = S$2,182

Therefore the total 6-monthly Road Tax and Special Tax payable for this car is:
= S$372 + S$2,182
= S$2,554

- If the car is Euro IV compliant, the Special Tax is:
  = (1,600cc x S$0.625) - S$50
  = S$1,000 - S$50
  = S$950

Therefore, the total 6-monthly Road Tax and Special Tax payable for this car is:
= S$372 + S$950
= S$1,322

ROAD TAX SURCHARGE (FOR VEHICLES OVER 10 YEARS)

For vehicles of more than 10 years old, a Road Tax surcharge is payable in addition to the Road Tax.

<table>
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<tr>
<th>Age of Vehicle</th>
<th>Annual Road Tax Surcharge</th>
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<tr>
<td>More than 10 years</td>
<td>10% of Road Tax</td>
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<tr>
<td>More than 11 years</td>
<td>20% of Road Tax</td>
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<tr>
<td>More than 12 years</td>
<td>30% of Road Tax</td>
</tr>
<tr>
<td>More than 13 years</td>
<td>40% of Road Tax</td>
</tr>
<tr>
<td>More than 14 years</td>
<td>50% of Road Tax</td>
</tr>
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</table>

Source: LTA website
Fuel Taxation

• Fuel taxes can provide incremental incentives to purchase more efficient vehicles
• Fuel taxes can provide revenues to pay for infrastructure costs and can be instrumental to provide funding aimed to the development of sustainable transport
• However, as fuel economy standards become more stringent and governments mandate higher fuel efficiency levels from their national vehicle fleets, fuel tax revenues which help to fund the maintenance of vast transportation infrastructure will decrease.
• Options: mileage-based taxes (pay per mile)
Fuel Economy Labelling

• The “fuel economy label” referring information that is displayed about the car in the showroom, online or through other media
• Enables other fuel economy related policies (e.g. feeebates)
Historical Timeline Fuel Economy Labelling

Source: ICCT 2015
Effectiveness of Vehicle Labelling

- influenced by the way that information is presented and how well the consumer can absorb and act on it
- label effectiveness will increase when consumers can compare motor vehicles in the same category on a fair and equitable basis
- finding an appropriate balance between sufficient information and label attractiveness to consumers is always essential for policymakers

Source: ICCT 2015
Components of a Vehicle Fuel Economy Labelling Program

http://www.theicct.org/apec-vehicle-fuel-economy-labeling
Best Practice : Fuel Economy Labelling

Regulatory framework
- Establish legislation and labelling specific regulation
- Introduce complementary fuel economy policies

Program design
- Make the program mandatory
- Design program to encompass widely used vehicles
- Conduct comprehensive market research and survey consumer expectations of fuel efficiency regularly
- Collect in-use fuel consumption performance data

Label design and information
- Present vehicle fuel efficiency and/or CO2 emissions in both absolute value and comparable grade rating
- Link label to fiscal expense or benefit where possible by presenting running cost or fiscal information
- Make information for alternative fuel vehicles comparable to conventional vehicles, through metrics such as gasoline equivalent fuel efficiency, CO2 emission, running cost, and financial information

Source: ICCT 2015
### Best Practice: Fuel Economy Labelling

<table>
<thead>
<tr>
<th>Consumer outreach</th>
<th>Compliance and enforcement</th>
<th>Performance assessment</th>
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<tr>
<td>• Establish a user-friendly VFEL website providing additional services beyond the fixed information on the label</td>
<td>• Establish mechanisms to ensure the credibility of the registered fuel efficiency value and empower agencies for enforcement</td>
<td>• Schedule periodic assessments to monitor and report on VFEL outcomes and improve the effectiveness of VFEL programs</td>
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<tr>
<td>• Require fuel efficiency information in promotional materials through other major media, especially online sources</td>
<td>• Design monitoring and reporting systems to encourage compliance of labeling requirement and specify actions for enforcement.</td>
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<tr>
<td>• Build two-way communication channels to collect and respond to questions and comments from consumers</td>
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Source: ICCT 2015
Vehicle Labeling - New Zealand

Fuel economy label generator

Fuel economy labels tell buyers how much it costs to run a vehicle. If you’re a registered motor vehicle trader, you are required to print labels to display on vehicles for sale and provide fuel economy information on websites offering vehicles for sale. Simply enter a vehicle’s details into our

Step one: Enter vehicle details

Only enter one option at a time. Use VIN or Plate number if the car was first registered in New Zealand more than two days ago (the database is updated with VIN data nightly) - otherwise try Chassis number.

- VIN
- Registration plate

Or, for other vehicles, use:
- Chassis number

Source: http://resources.fuelsaver.govt.nz/label-generator.html#970

- Simplified approach
- Strong consumer outreach component
- 66ktCO2 saved
- 56 million USD cumulative savings (2008-2013)
Vehicle Labeling in Viet Nam

• Seven-seater cars and smaller ones are required to carry energy rating labels
• Required on cars from January 1, 2018 and motorcycles from January 1, 2020
Labeling and taxation in Chile

- Adopted a mandatory fuel economy labelling scheme from February 2013 becoming the first Latin American country to adopt such a scheme
- In September 2014 adopted a taxation scheme that puts a tax on less efficient and polluting vehicles, based on CO$_2$ and NOx ratings
- In 2015 adopted a scheme to provide subsidies for cleaner and more efficient taxis based on the fuel economy labeling scheme, with the aim to replace the 60,000 taxi fleet over the next 8 years
Thailand Case Study (1/6)

- Population: 68.8 million (2016 estimate)
- GDP per capita (nominal): $7,588
- Total vehicle population (2016): 8.146 million

- What they did:
  - Active participation in GFEI trainings and meetings since 2012
  - Baseline development (2012)
  - Establishment of national multi-stakeholder process
  - Review of current policies

Sources:
Wikipedia; Googlemaps
http://englishnews.thaipbs.or.th/thailand-now-has-more-than-37-million-registered-cars/
Integrating fuel economy improvement policies and targets into national plans (2/6)

Fuel Efficiency Targets

Thailand Energy Efficiency Development Plan (2015 - 2036)

Energy Policy and Planning Office
MINISTRY OF ENERGY

Expected Energy Saving by Economic sector

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<tr>
<th>Economic sector</th>
<th>Total (ktoe)</th>
<th>(%)</th>
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<td>E11</td>
<td>5,156</td>
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<tr>
<td>E12</td>
<td>1,166</td>
<td>2%</td>
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<td>E13</td>
<td>4,149</td>
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<td>E14</td>
<td>9,524</td>
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<td>E15</td>
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<td>E16</td>
<td>500</td>
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<td>E17</td>
<td>9,524</td>
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<td>Total</td>
<td>51,700</td>
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Economic Sector
1. Industry
2. Commercial
3. Residential
4. Transportation

2014

A Target to reduce Energy Intensity by 30% in 2036, compared with that in 2010

Source: GIZ, 2018
Fuel economy labeling – Thai Eco-Sticker (3/6)

Eco Sticker

Source: Mitsubishi Motors Thailand
## Thailand Vehicle Excise Tax Structure (4/6)

### Categories of Vehicle

<table>
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<tr>
<th>Engine Capacity (Horse Power)</th>
<th>Tax Structure Before Jan’2016</th>
<th>Current Tax Structure</th>
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<td></td>
<td>E10</td>
<td>E20</td>
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<tr>
<td>Passenger Vehicles, ≤2,000 CC</td>
<td>30</td>
<td>25</td>
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<td>Passenger Vehicles, 2,001-2,500 CC</td>
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<td>30</td>
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<td>Passenger Vehicles, 2,501-3,000 CC</td>
<td>40</td>
<td>35</td>
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<td>Passenger Vehicles, &gt;3,000 CC (≥80 HP)</td>
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<td>50</td>
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<tr>
<td>PPV / DC /Space Cab/Pick Up, ≤3,250 CC</td>
<td>20/12</td>
<td>/3,18</td>
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<tr>
<td>PPV / DC /Space Cab/Pick Up, &gt;3,250 CC</td>
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<td>Eco Car (Benzine/Diesel) / E85, 1,300/1,400 CC</td>
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<td>Electric Vehicle /Fuel Cell/ Hybrid, ≤3,000 CC</td>
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<td>Electric Vehicle /Fuel Cell/ Hybrid, &gt;3,000 CC</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>NGV-OEM, ≤3,000 CC</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>NGV-OEM, &gt;3,000 CC</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks**
- *: Assign safety standard (ABS+ESC) for Passenger Vehicles and Vans less than 10 seats must obtain CO₂ ≤150 g/km. PPV must obtain CO₂ ≤100 g/km.
- **: HEV-PPV ≤75 g/km = 23%, HEV-DC ≤75 g/km = 10%.
- EV tax 2%.
- Hybrid tax + 2.

Source: GIZ, 2018
**Results from GIZ’s study (Phase I)**

**Weight Average FE of Passenger Light Duty Vehicles (PLDV) sales during 2013-2016**

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>New sale (Top 10 ranked vehicles)</th>
<th>Weight-averaged FC (l/kg/100km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O01 Eco car</td>
<td>187,429</td>
<td>118,519</td>
</tr>
<tr>
<td>O02 City car, subcompact: Sedan &amp; Hatchback</td>
<td>271,018</td>
<td>167,522</td>
</tr>
<tr>
<td>O03 Compact car C-segment: Sedan Hatchback Coupe Roadster</td>
<td>89,975</td>
<td>66,586</td>
</tr>
<tr>
<td>O04 D-segment full size sedan</td>
<td>34,363</td>
<td>19,343</td>
</tr>
<tr>
<td>O05 mini-MPV and B-SUV</td>
<td>42,046</td>
<td>41,046</td>
</tr>
<tr>
<td>O06 MPV and SUV</td>
<td>10,307</td>
<td>10,617</td>
</tr>
<tr>
<td>O07 PPV</td>
<td>58,942</td>
<td>48,646</td>
</tr>
<tr>
<td>O08 Single cab pickup</td>
<td>75,024</td>
<td>51,325</td>
</tr>
<tr>
<td>O09 Extended cab pickup</td>
<td>278,019</td>
<td>206,130</td>
</tr>
<tr>
<td>O10 Double cab (4 doors) pickup</td>
<td>164,650</td>
<td>114,385</td>
</tr>
<tr>
<td>Sub-total vehicle (% share of total vehicle registration)</td>
<td>1,211,773</td>
<td>844,119</td>
</tr>
<tr>
<td>DLT new registers</td>
<td>1,299,508</td>
<td>904,969</td>
</tr>
</tbody>
</table>

Source: GIZ, 2018

Ref: GIZ preliminary study based on data from Department of Land Transport
https://www.globalfueleconomy.org/media/418761/wp15-ldv-comparison.pdf
Impact of CO$_2$-based excise tax on engine size (6/6)

CO$_2$-based excise tax approved in Dec 2012 for implementation on 1 Jan 2016

- Fuel consumption [Liter/100km]
- Engine size [Liter]

Circle center is FE
Circle area is units of vehicles

- 50,000 units

Source: GIZ, 2018
Philippines Case (1/3)

- Population: 100.9 million (2015 estimate)
- GDP per capita (nominal): $3,541 (2018 estimate)
- Total vehicle population (2017): approx. 10 million

- What they did:
  - Active participation in GFEI trainings and meetings since 2014
  - Baseline development (2014)
  - Review of current policies
  - Inclusion of fuel economy policies in national strategies and plans
  - Revision of vehicle taxation scheme
  - Development of fuel economy label

Sources:
Wikipedia; Googlemaps
Vehicle Base Price | Tax Rate
---|---
Up to P600,000 | 4%
Over P600,000 to 1,000,000 | 10%
Over P1,000,000 to P4,000,000 | 20%
Over P4,000,000 | 50%

“(a) Automobile shall mean any four (4) or more wheeled motor vehicle regardless of seating capacity, which is propelled by gasoline, diesel, electricity or any other motive power: Provided, That for purposes of this Act, buses, trucks, cargo vans, jeepneys/jeepney substitutes, single cab chassis, and special-purpose vehicles shall not be considered as automobiles.

“Provided, That hybrid vehicles shall be subject to fifty percent (50%) of the applicable excise tax rates on automobiles under this Section: Provided, further, That purely electric vehicles and pick-ups shall be exempt from excise tax on automobiles.”
Estimated impact of vehicle price-based tax system (3/3)

- Vehicle excise tax reform results to new LDV fuel consumption of about 6.2 Lge/100km, therefore leading to an annual fuel economy improvement rate of about 3.2% between 2013 and 2020
- The fuel economy improvement results in significant reductions in fuel use and emissions within the LDV segment, especially over the longer 10-year time-frame until the year 2027
- Fuel use could be reduced by 7% in 2020 and by 17% in 2027 compared to the benchmark scenario
- By 2020 1.5 MtCO2 emissions of could be saved annually, growing to 6.2 MtCO2 by 2027
Electromobility

Source: Agora Verkehrswende
Electromobility: Not just about vehicles
Opportunity for Transformation
Prioritizing E-mobility Options
Areas of implementation

- rail/ tram
- private cars
- governmental/ company/ tourism fleets
- public transport
- two-wheelers
- three-wheelers
- x-sharing/ taxi/ ridehailing
- urban freight

Source: GIZ (nd)
## Policymakers’ Toolbox

<table>
<thead>
<tr>
<th>Tools</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal</td>
<td>Rules and directives designed to mandate, enable, incentivize, limit or otherwise direct subjects to act accordingly to policy goals</td>
</tr>
<tr>
<td>Financial</td>
<td>The policy instruments involve either the handing out or taking away of material resources (cash or kind), in order to incentivize or disincentivize behaviour by subjects.</td>
</tr>
<tr>
<td>Communication</td>
<td>Instruments that influence the value chain of e-mobility through to the communication of arguments and persuasion, including information and education</td>
</tr>
<tr>
<td>Organisation</td>
<td>Actions by government that provides the physical ability to act directly, using its own forces to achieve policy goals rather than others. This includes the allocation of means, capital, resources and the physical infrastructure needed to act</td>
</tr>
</tbody>
</table>

Source: Steen et al. (2015)
Case Norway: Regulations

- **1990**: Purchase tax exemption (up to 10,000€)
- **1990**: No import tax
- **1996**: Reduction on annual ownership tax
- **1997**: Urban toll exemption
- **1999**: Free municipal parking and reserved parking spots
- **2000**: 50% reduced company car tax
- **2005**: Access to bus lanes
- **2008**: Funding for public charging network (also fast charging)
- **2009**: Ferry toll exemption
- **2011**: Funding for charging stations at home
- **2013**: Weight tax deduction for EVs

Source: Dennis Knese
Building and Electrical Codes

- Policymakers can ensure preparedness for the integration of hardware through building code legislation.
- For example, California has required that new housing and parking lots have conduit and service panel capacity since 2015.
- Palo Alto (California) has mandated new homes to be prewired and moving towards charging and parking requirements for hotels, apartments, commercial buildings. It is estimated that the cost of wiring an EVSE in new homes are four times cheaper than existing structures.
- In Seattle, Washington, the 2008 edition of the city’s adopted version of the electrical code identified and added some notable changes specific to EVs, with the purpose of making it easier to install home and commercial EVSE.

Zoning Ordinances

• Zoning ordinances relating to charging stations and PEVs provide homeowners and businesses with details and direction on how to handle charging stations. The sample PEV zoning ordinance covers permitted locations, right of way restrictions, accessibility, lighting, safety, usage fees, signage, and maintenance, among other things.

• Incorporating language specific to PEVs in a jurisdiction’s Master Plan is an important step for any municipality.

Source: Clean Energy Coalition, Next Energy, OHM. (2013)
Summary

- Fuel economy policies work
- Implementing fuel economy can substantially reduce CO$_2$ emissions
- Variety of policy tools exist
- Importance of multi-stakeholder and inter-government consultation processes
- Strong vehicle taxation are effective in encouraging more efficient vehicles
- Fuel economy labelling a strong prerequisite for other policies
- Electromobility: systems thinking, not just about vehicles
- E-mobility to be situated within wider goals, but pose significant opportunities for transformation
Thank you

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