Gas vehicles, much like steam engines, will look cool only in museums!

*Elon Musk - August 2019*

5 weeks later →

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Daimler abandons internal combustion engine development to focus on EVs

In a rather surprising announcement, German automaker Daimler has revealed that it will be stopping its internal combustion engine development initiatives as part of its efforts to...
Electric Vehicles
History

• Among the earliest automobiles, and contrary to common belief, Electric Vehicles (EVs) actually predate the Internal Combustion Engine (ICE) vehicles

• First mass-produced EVs appeared in USA in early 1900s- at one point in history they out-sold the gasoline-powered vehicles

• Held many vehicle land speed and distance records in the early 1900s
Edison and a 1914 Detroit Electric model 47

Courtesy: National Museum of American History
But then happened..

• New highway networks;

• Oil discoveries in Texas, Oklahoma and California; and

• Henry Ford
Reintroduction

• EVs made a brief reintroduction towards the end of 1990s with manufacturers like GM, Ford, Chrysler, Honda and Toyota producing limited numbers of EVs in California

• GM’s EV1 particularly got very popular…but then was suddenly discontinued!

• A mystery which has even been subject of a movie ‘Who Killed the Electric Car?’
Modern EVs

• The renewed interest in EVs has been caused by;
  • Fear of peak oil
  • Climate change
  • Efficient batteries

• Today, almost all top automobile players are launching or have already launched electric versions of their vehicles

• More than 100 EV makers in China

• And then, of course, there is Tesla...
Why EVs?... Why not?

- On per km basis, EVs are up to 10x cheaper than conventional vehicles
- A typical EV has around 18 moving parts vs 2,000+ moving parts in CE vehicles
- Next to zero maintenance cost!
- Latest EV models promise anywhere between 500,000 to 1,000,000 mile life.....~4x more than those of gasoline vehicles

- De-carbonization of transport sector
- Cutting down of air and noise pollution
Timing of cost-parity of electric vehicles with fuel vehicles, based on TCO in the EU

<table>
<thead>
<tr>
<th>Segments</th>
<th>2018</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
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<tbody>
<tr>
<td>Long-haul truck</td>
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<td>Regional truck</td>
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<td>City buses</td>
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<tr>
<td>Passenger cars</td>
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</tbody>
</table>

Source: McKinsey Energy Insights
Global long-term passenger vehicle sales by drivetrain

Million vehicles

Source: BloombergNEF
Global EV and ICE share of long-term passenger vehicle sales

Share of annual sales

Source: BloombergNEF
Global long-term passenger vehicle fleet by drivetrain

Billion vehicles

Source: BloombergNEF
EV share of global vehicle fleet by segment

Source: BloombergNEF. Note: Commercial vehicle adoption figures include the main markets of China, Europe, and the U.S.
Global short-term passenger EV adoption by region

Global long-term passenger EV adoption by region

Source: BloombergNEF. Note: Europe includes EU + EEA + Switzerland.
National Electric Vehicle Policy 2019
NEVP 2019- Objectives

• Climate change & carbon emissions
  • 43% of the airborne emissions in Punjab are from transport sector- almost twice as much as developed countries

• Reduce oil import bill
  • Annual savings of Rs 100bn+ expected by year 5

• Use idle power generation capacity
  • Will actually help reduce the electricity tariffs!
<table>
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<th>Till 2025</th>
<th>Till 2030</th>
<th>Till 2040</th>
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<tr>
<td>Car</td>
<td>100,000</td>
<td>30% of New Sales</td>
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<tr>
<td>Van</td>
<td>500,000</td>
<td>50% of New Sales</td>
<td>90% of New Sales</td>
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<tr>
<td>Motorcycle</td>
<td>1,000</td>
<td>50% of New Sales</td>
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<tr>
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<td>Truck</td>
<td>1,000</td>
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</tr>
</tbody>
</table>
Fiscal Incentives- General

- All existing incentives under Auto Development Policy 2016 shall remain intact

- Only 1% GST (for the next 7 years)

- Exemption from registration fees and annual token taxes

- Reduced custom duty on imports

- Permission to import used EVs

- Subsidized financing rates for EV leasing
Special Measures

• The government shall purchase 1,000 all-electric buses and trucks and will ask commercial operators to operate them for a concessionary period.

• Metro buses and BRT routes in Lahore, Islamabad/Rawalpindi, Multan and Peshawar will be prioritized for electrification of buses.

• The Policy also covers charging infrastructure and allied EV industries (like LIBs etc.). Similar fiscal incentives will be provided to these industries.

• The charging stations will be rolled out along main highways, motorways and in city centers so as to minimize range anxiety associated with EVs.
EVs- Impact on National Grid
EVs- Aligning mobility with grid flexibility..

• EVs- while primarily a mobility solution...increasingly being viewed as a grid flexibility solution too!

• Cars typically spend about 95% of their lifetime parked....this idle time (combined with battery storage capacity) has an opportunity for grid flexibility

• Important to view EVs as ‘battery banks on wheels’

• Alignment, thus, a MUST
Grid boon or bane?

- Optimal EV integration will be a function of charging patterns/habits of EV owners and energy mix of the grid

- Energy mix changes- more of a medium/long term measure

- Charging patterns relatively easier to control
  - Time of use pricing- peak/offpeak tariffs
  - Direct control mechanisms
  - Dynamic pricing

Smart Charging

*Smart charging- the difference between grid flexibility and grid nightmare!*
Smart Charging

V1G = Unidirectional controlled charging
Vehicles or charging infrastructure adjust their rate of charging

V2G = Vehicle-to-grid
Smart grid controls vehicle charging and returns electricity to the grid

V2H/B = Vehicle-to-home/-building
Vehicles will act as supplement power suppliers to the home

Source: IRENA
Smart Charging- How does it help?

• *Shaves peak demand*

• *Fills load valleys* (remember Duck Curve?)

• *Grid load balancing* by adjusting charging levels

• *Manages grid congestion*

• *Helps customers better utilize their existing infrastructure*

• *Increases renewable power self-consumption* (both for customers and grid)
Other EV Challenges for Grid!

- Slow charging (mostly for home & office charging) suits the grid, Tariff, infrastructure and range

- But mobility needs are different and will require fast or ultra-fast charging...

- Imagine 50 EVs getting fast charged (each at 50kW-150kW) at Jinnah Super Market in peak hours!!

- DISASTER!
Managing impending disasters...

• Peak-time stress can be managed by;
  • Battery swapping
  • Charging stations with buffer storage
  • Night time charging for EV fleets

• Broader regulatory framework must be flexible to generate timely price signals and implement dynamic pricing regimes and CTBCM implementation is great hope!
Leveraging CPEC
Generous incentive package...

• One-time customs duties **exemption** on plant and machinery

• Income tax **exemption** for 5-10 years

• Gas, electricity and other utilities provided in the Zones

• Captive power generation allowed

• **Accessibility** to major highways, motorways, dry ports and airports
The Green Loop

Lower unit cost of electricity (capacity charge dilution)

Higher capacity utilization of generation infrastructure

Increased electricity consumption

Short-term

EVs

EVs

Short-term

EVs

EVs

Long-term

Storage infrastructure via LIBs

Cheap renewables to further drive down electricity costs

Improved viability of renewables in the generation mix
Thank you

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