Role of Digitisation and e-commerce in Indian Economic Growth

Ashok Jhunjunwala, IIT Madras (on sabbatical)
Principal Advisor, Minister of Power and NRE

ashok@tenet.res.in
Three engines of e-commerce growth

**E-payment**
- Mobile payment
- Net-banking
- Credit card

**Communications**
- Internet Viewing, experiencing and ordering on line
- Social media: recommendations / opinion

**Transport**
- Affordable packet delivery at homes / offices
- GPS, tracking, shared transport

*Smart-phones and 4G have accelerated it*
Business flourishes with Digitisation

• Access to markets across Geography
• Access to suppliers, components across geography
• Access to technology / knowledge
• Coordination of production across multiple Centres
• Coordination of wide-scale distribution
• Access to financial status and finances
But above all Enabling

**New Business Models**

Ola and Uber example: have totally changed transport and added huge efficiency
Let us examine another sector: *Electric Vehicles* and the role of Digitisation
Why is Electric Vehicle (EV) the future transport?

Better efficiency with less number of moving parts

<table>
<thead>
<tr>
<th>Area</th>
<th>Petrol / Diesel</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency</td>
<td>17 – 21%</td>
<td>90 – 95%</td>
</tr>
<tr>
<td>Moving parts (reliability)</td>
<td>2000+</td>
<td>20+</td>
</tr>
</tbody>
</table>

Falling battery costs

<table>
<thead>
<tr>
<th>Year</th>
<th>Li battery costs per kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>USD 600</td>
</tr>
<tr>
<td>2015</td>
<td>USD 450</td>
</tr>
<tr>
<td>2017</td>
<td>USD 250</td>
</tr>
<tr>
<td>2020</td>
<td>USD 150</td>
</tr>
<tr>
<td>2024</td>
<td>&lt; USD 100</td>
</tr>
</tbody>
</table>

• In five years, EV capital costs will be less than that of petrol vehicles
  – with acceptable range and operational costs at a fraction of that of petrol vehicles

• But if we wait, India will import most EV sub-systems and batteries instead of oil
So how do we enable Electric Vehicle today

• World-over EVs happen today with 30 to 40% subsidy

• India does not have enough money for subsidy
  – So how do we do it without subsidy?
    • must make economic sense

• At the same time scale early
  – And take leadership in the world at least in some segments
  – As far as possible, Make in India and develop the complete eco-system from end to end
Approach

- Focus on higher efficiency: Wh/km (equivalent to kms/litre of petrol)
  - Lower Wh/km brings down battery size, weight and cost
  - For e-autos in last six months: from 70 to 80 Wh/km to 45/50 Wh/km
  - E-buses: from 1600 Wh/km to 900 Wh/km

- Split battery into smaller size (one third) and swap
  - No waiting time to charge battery; no public infrastructure required

- Battery-life severely affected by Fast Charging at 45 deg C: one-third as compared to charging in two hours below 25 deg C
  - Possible with swapping
Approach (contd)

• Separate **vehicle business** (without battery) & **energy business** (battery)
  • Capital cost similar to that for petrol / diesel vehicle
  • Operation cost today same as petrol / diesel vehicle
    – WITH no SUBSIDY; but zero-rated GST for strictly three years

• Drive Volumes using public vehicles
  • Get companies to buy vehicles in bulk (100,000 plus) and lease
  • Get companies to buy batteries in bulk and set up energy business
  • Private vehicles to leverage the eco-system

  • No subsidy needed as with these 5 steps, capital cost of vehicle similar to that for petrol vehicles, and ₹/km operation costs same as petrol / diesel / CNG
  • Manufacture motors and drives, chargers, batteries, cells and battery-chemicals in India

August 2017
High Quality Three wheelers: e-rickshaw, e-auto

- Use **swapping**: 50 km range Li-Ion **Locked battery**
  - swap in 2 minutes at some 200 locations in a city
  - Quality electric vehicles at **similar price as petrol/CNG vehicles**
  - Charged Li-ion **hire price** per km less than that petrol/CNG vehicles
- **50** vehicle, battery & subsystem manufacturers, aggregators, energy business enable
  - Common and **modular Locked battery pack** specs driven with industry
  - Vehicles efficiency (35 Wh/km for e-rick, 45 Wh/km for e-auto), safety and easy battery-swapping

- **Launch in November 2017**
  - 100K order: can target 1 million 3-wheelers in 18 months

Everything other than battery cells made in India
For City-Buses

• Most city-buses travel less than 30 kms per trip
  – Some 8 to 10 trips per day: Ten minutes break between trips

• Batteries with 50 kms range: Swap batteries (using robots) at trip-terminal point
  – Operation costs per km is no more than for diesel vehicle

• High performance (low Wh/km) buses without battery
  – Capital Costs similar to that of today’s buses

• 30 bus, battery and subsystem manufacturers/ swappers define
  – Common Locked battery pack specs
  – Specs for vehicles: efficiency, safety, easy battery-swapping (with robotics)

• Could launch in January 2018: can target 10000 buses in 15 months
Get going at Speed

• Build Volumes
  – Prices depend much on volumes
  – Focus on **Make in India**
    • Everything other than battery cells are manufactured in India

• Will enable **personal vehicles** to take off
  – Two-wheelers can use the **same battery module** as used in 3-wheelers
  – Four-wheeler need more work

• Other **vehicles** in future
  – Long-distance buses, Tempos, Trucks, Agricultural Equipment and vehicles

---

**Cell to Pack Manufacturing**
- 2017 – some 15 companies

**Cell Manufacturing**: 2019 -20

**India has little Li, Mn, Co**
Battery Recycling to recover 95% of Li, Mn and Co

August 2017
Digitisation & Economic Growth
EV program will be a big-boost to India’s economy

• But how is it related to digitisation and e-commerce?

• Two fundamental tenets
  – EVs in India today WITHOUT SUBSIDY
  – Swapping as an enabler

• Energy Business supplies electrical energy to EVs with Locked Batteries (L-Batt) as containers
  – What is L-Batt?
L-Batt

• Can not be charged except through authorised Chargers
• Can not feed power except to authorised vehicle
  – Encrypted Key exchange between Charger / vehicle and L-batt
  – Relay turns on only after authentication (each L-batt has an unique ID)

• Important for Energy Business, as they charge by kWh used
  • Charge includes depreciation and interest cost of batteries besides costs of charging and swapping
  – Without Locking, a vehicle owner auto can charge – discharge a battery multiple times and not pay the Energy Business

• At swap-point
  – a mobile phone will read actual kWh used and transmit to CMS for e-payment
  – Program the new battery to be usable to specific vehicle and inform CMS
L-Batt designed

- To contain all data about usage: at what time
  - what speed and acceleration the vehicle had been driven?
  - how much energy of battery was used, L-batt State?

- Data read by authorised chargers and send to CMS where it analyses
  - The efficiency of the vehicle
  - The driver-characteristics (does she speed, how often she applies breaks, etc.)
  - The Battery characteristics: State of Charge, state of cells and unbalanced cells, cell temperature, state of health
  - Determine how to pair multiple modules

- Similarly during charging battery, charger sends all information to the CMS for analysis
  - How to extend life of each battery module
  - Enable second use of battery module (when its capacity deteriorates to below 80% of initial level)
Charging Buildings and Swapping-Outlets

• L-Batt charged in special air-conditioned buildings, which are guaranteed 24 x 7 power and have all safety precautions
  – Large number of swapping outlets in one-two km radius

• Software designed to track each module
  – What are the number of charged and discharged packs at each outlet?
  – How much is the rate of L-batt off-take at each outlet?
  – Coordinate vehicles (e-rickshaws) to transport charged L-batts to outlets and carry back discharged L-batt
  – All payments: from vehicle owners to Energy Business, from Energy business to transport operator and to each outlet
  – Charging uses a combination of kWh used as well as holding-time of a L-batt
To Sum Up

- It is the digitisation, communications, e-payment, that will enable EVs in India today without subsidy
  - Will create huge business opportunity for EV and battery manufacturers, manufactures of motors, controllers, EV sub-system manufacturers, battery chargers, energy companies, retail outlets, logistic players

- Was not possible yesterday

- A large number of similar business would get created by digitisation and communications