RETROFITTING FOR ELECTRIC VEHICLES
Status, Potentials and Challenges

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EV Retrofits
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Customer’s Needs
- Financial goals
- Sustainability goals
- Vehicle end-of-life

Society’s Needs
- Public health
- Climate change

Government’s Needs
- GDP growth
- Crude oil consumption
- ForEx conservation
- Carbon intensity of development

Industry’s Needs
- Leadership position
- Inevitability

Why Retrofit

Fuel Price / Capita Income

- In India Fuel price as a Pocket Pinching factor is highest.
- Hence, it is already a strong competitive development parameter

SOURCE: Fuel Price - Internal SIAM Data
“Rising fuel costs have forced us to make major design changes. Like the in-dash ATM, in case you run out of gas money.”
World fossil carbon dioxide emission 1970-2017

Million tonnes CO2/year

- Other countries
- China
- United States
- EU28
- India
- Russia
- Japan
- International shipping and aviation
• 1,200,000 – Premature deaths in India due to outdoor air pollution, each year

• 25% – Share of road transport in air pollution, including GHGs

• 14 of Top 20 Worst Polluted Cities of the World are in India

• Millions – Others suffering from severe to mild ill-health due to air pollution

• 5% – GDP impact of air pollution

• 85% – India’s crude oil imports as percentage of consumption

• 2x to 5x – Amount of emissions from older vehicles, compared to new vehicles
Hybrid Electric: In which the electric drivetrain is added to an existing vehicle and supplements the internal combustion engine to create a (P)HEV.
- Regulated by AIS-123 Parts 1 and 2
- This is usually a ‘torque-assist’ system

Full Electric: In which the electric drivetrain replaces the internal combustion drivetrain in an existing vehicle to create a BEV.
- Regulated by AIS-123 Part 3
How It Works

1. Saved battery energy drives motor.
2. No need for external charging infrastructure!

**During acceleration:**
Altigreen’s motor intelligently assists engine at just the right moments -
- Engine needs to generate less torque
- Lowers engine RPM → **saves fuel!**

**During braking:**
Altigreen’s motor becomes an electrical generator (regeneration) -
- Converts waste energy to electricity,
- **Saves energy in battery system.**

Typical Urban Drive Pattern –
Repeated Start-Stops → Low gear, high-rpm → High fuel consumption!
Retrofit Components

Real-Time Monitor
- Driver & Fleet aid
- USB, SD Card & OBD
- GPS/GPRS
- Mobile App

Battery Pack (48V – 450V)
- Li-ion, UCaps, or Lead Acid

EV Gearbox
- Single & 2 Speed

Integrated Motor/Generator
- High RPM, Torque
- Regeneration during braking
- Wide Band for Continuous Power

Robust Wire Harness
- Protected against high temp and environment
- Separation between signal and power lines

Drive Controller
- AC/DC & DC/DC Converters
- BMS with active balancing
- 48V & 12V SOC monitor
- Assist/Regen switching
**Key Components**

**Controller:**
- The ‘brain’ of the system.
- Ensures motoring and regeneration occur at precise moments.
- Manages battery charging / discharging

**Battery pack:**
- Saves energy during braking.
- Delivers energy to motor during acceleration.
- Ultra-caps / Lead Acid / Li-ion

**Motor-generator:**
- Replaces the existing alternator in the vehicle.
- Motor to assist engine
- Powers aux 12 V loads
- Charges battery during braking via regeneration.

**Global recognition**
- HyPixi™ awarded 19 global patents
- Patented in 60 countries including USA, Europe, Africa, SE Asia, Australia.
- Recognized as a unique retro-fitment solution globally.
Challenges of Retrofits

Technical
- Adequate power
- Marriage of 2 drives
- Regenerative braking
- Storage tech

Financial
- Cost of product
- Cost of fuel as proportion of total cost of operations

Regulatory / Policy
- Homologation – by model, variant and year
- State-level approvals
- Government support
Customer acceptance
- Certainty of benefit
- Peace of mind
- Cost
- Reversibility

Safety
- Vehicle balance / structure
- Fire
- Explosion
- Catastrophic failure
## Examples from Altigreen Retrofits

<table>
<thead>
<tr>
<th></th>
<th>Maruti Suzuki Swift Dzire</th>
<th>Toyota Etios</th>
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</thead>
<tbody>
<tr>
<td>OEM Mileage (km per litre)</td>
<td>17.4</td>
<td>10.5</td>
</tr>
<tr>
<td>Hybrid Distance Covered (km)</td>
<td>71,386</td>
<td>30,000</td>
</tr>
<tr>
<td>Hybrid Mileage (km per litre)</td>
<td>21.7</td>
<td>13.7</td>
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<tr>
<td>% Improvement in Mileage</td>
<td>25%</td>
<td>24%</td>
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<table>
<thead>
<tr>
<th></th>
<th>Tata ACE Facelift BSIV</th>
<th>Tata ACE BSIII</th>
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<tbody>
<tr>
<td>OEM Mileage (km per litre)</td>
<td>8.64</td>
<td>11.3</td>
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<tr>
<td>Hybrid Distance Covered (km)</td>
<td>6,334</td>
<td>11,112</td>
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<tr>
<td>Hybrid Mileage (km per litre)</td>
<td>10.49</td>
<td>13.8</td>
</tr>
<tr>
<td>% Improvement in Mileage</td>
<td>21%</td>
<td>22%</td>
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Possibilities: Enormous – a market size of millions of vehicles

Status: Embryonic – less than 500 retrofits so far

Future: To be determined
Thank You!