RETRO FIT

RETROFITTING HYBRID AND ELECTRIC VEHICLES:
An Alternate to importing newer vehicles

LIERA

THE UNIVERSITY OF LAHORE

IECE
INTEGRATED ENGINEERING CENTRE OF EXCELLENCE

SAHER
SUSTAINABLE AUTOMOTIVE HYBRID ELECTRIC RETROFITTING

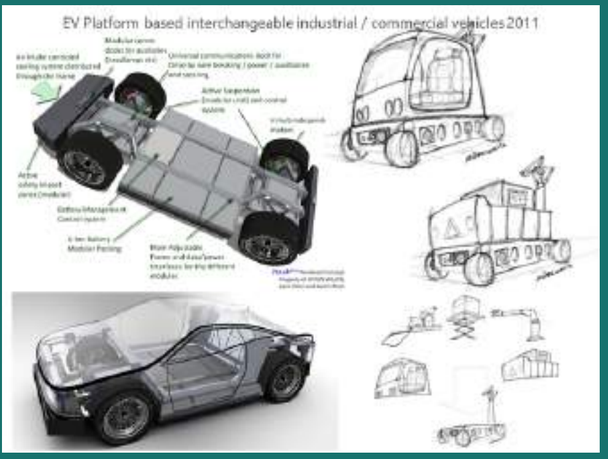
PAKEVO.COM
PAKISTAN EV OVERSIGHT COMMUNITY

1ST AI EV INTERNATIONAL EXPO 2023 PAKISTAN

WOMAN INITIATIVE
Women Opportunities: Mentorship Advocacy, & Nurture Initiative
In STEM & Health Sciences for Entrepreneurship Freelancing & Returnship

10 SECONDS INTRODUCTION AUTOMOTIVE PORTFOLIO

EV Platform based interchangeable industrial / commercial vehicles 2011



Vehicle Development: Aliera I at AEDESIGN LTD for Karakoram Motor company

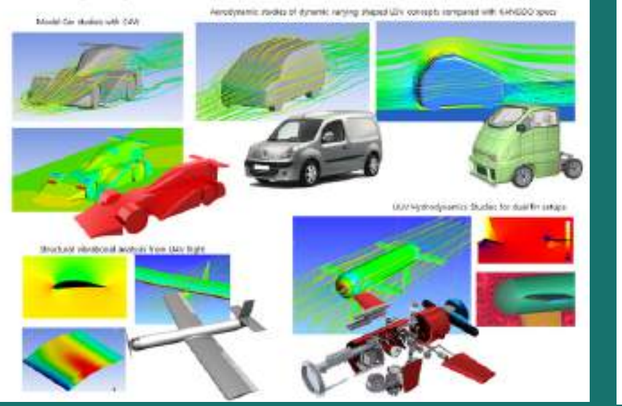
Vehicle prototyped in developed as a sub $4000.00 (without the engine) car based on the Atom Roadster structure asked by Client.

AI PREDICTIVE DRIVE: ELECTRIC AND HYBRID VEHICLE EMBEDDED ARCHITECTURE DEVELOPMENT

Multisensorial systems for drive cycles (vehicle drive behavior datalogging) & battery management system optimization, AI data analytics recommends engine-battery charging systems & battery health analytics for 2-3-4 wheel vehicles - AI based drive cycle prediction, crash safety systems, & battery health optimization (single cell prediction) for swappable battery systems

External and Vehicle Aerodynamics

- EXTERNAL (VEHICLE) AERO & HYDRO DYNAMICS



Electric scooters development 2015

Small personal scooter (equivalent to 50cc) road legal without requirement of motorcycle licence

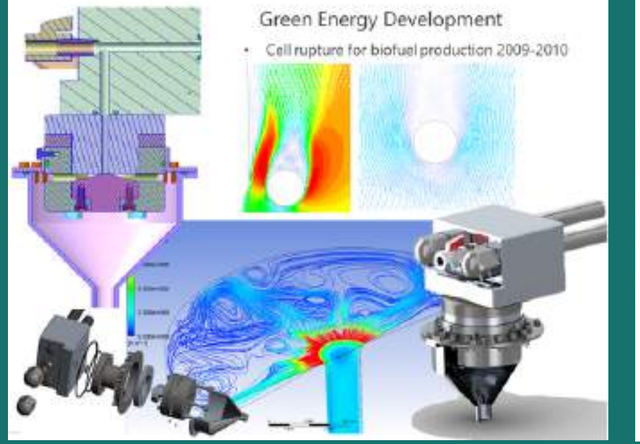
ADAM MOTOR COMPANY: REVO

- structural design for vehicle safety and ride and handling from 2004-2005
- Collaborative project with Adam Motor Company and Omar Abbas Engineering for Vehicle engineering.
- The vehicle was launched in 2006. 1L petrol engine market for Asia

Bottom pictures courtesy Adam Motor Company

Green Energy Development

- Cell rupture for biofuel production 2009-2010



Enterprise Ireland Project: ECOVolve – PRODUCT DEVELOPMENT 2012-2013

- Overall development cost of € 144,800.00 funded by Enterprise Ireland (Republic of Ireland), ECOMove and Dublin City University)
- Vehicle Design & Development: from concept till prototyping for a special out of drive cycle construction for a niche product placement (1 Tonne inside – outside industrial electric vehicle)
- Aydon Wilson was involved in the completed design of the vehicle including the mathematical modelling for kinematics, dynamics, stability analysis, structural analysis, hydraulic system design, sensorial and control system & Energy Management System and has royalty to the design
- The vehicle is being sold in Ireland under ECOVOLVE brand (www.eco-volve.com)

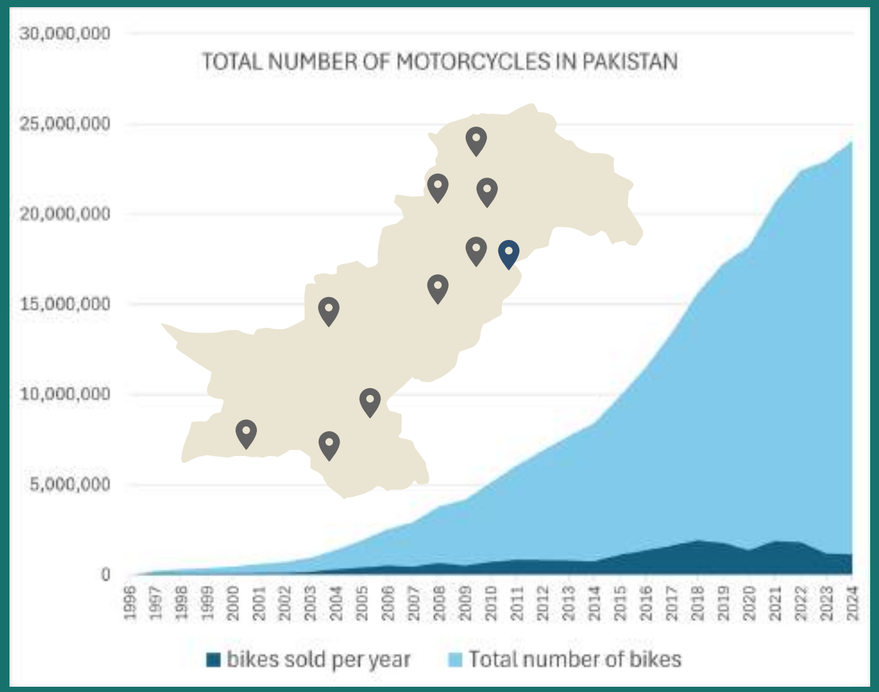
ALIERA LTD CONSULTANCIES (with Centurion Electronics Ltd UK)– 2014-2019

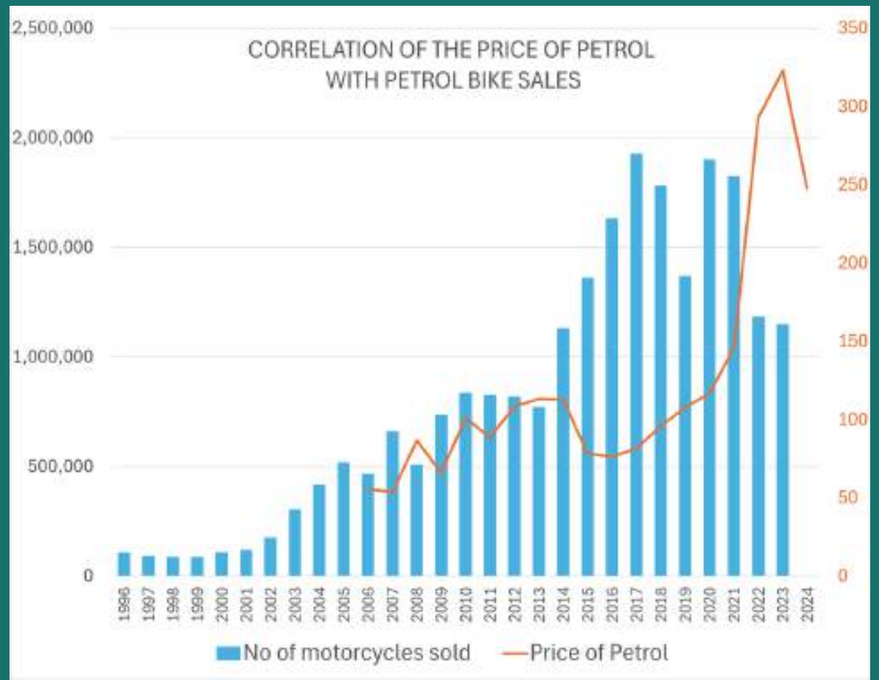
Volvo XC90 2010 product development with Centurion Electronics Ltd UK (images not owned / taken with permission)

Mercedes Next Gen RSE Electronics and controls (lower image owned Centurion / Aliera Ltd)

Bentley Mulliner product development (lower image owned by Aliera Ltd)

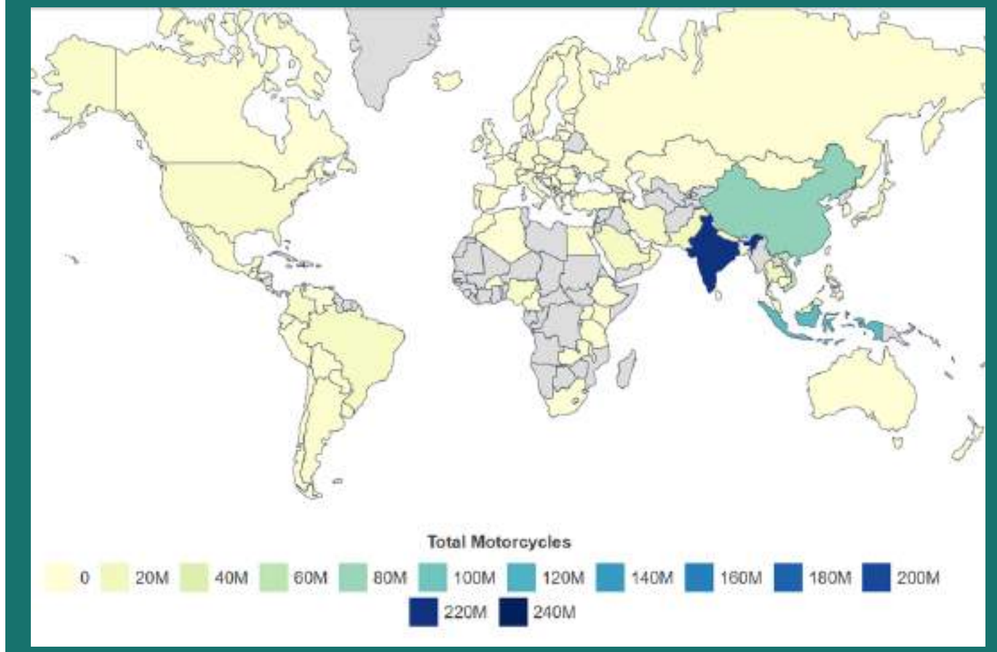
PAKISTAN





MARKET SIZE

GLOBAL



Global motorcycle sales in 2023: US$ 79.57 Billion p/yr

Growth to US$140 Billion by 2032 at a CAGR of 6.5%

Global Total sales: 715,348,307 motorcycles

Top 20 countries motorcycles on road

	country	Motorcycles
1	India	221,000,000
2	Indonesia	112,000,000
3	China	85,000,000
4	Vietnam	58,000,000
5	Pakistan	24,884,786
6	Thailand	21,588,420
7	Malaysia	14,891,580
8	Saudi Arabia	14,154,000
9	Taiwan	14,000,000
10	Brazil	12,900,000
11	Iran	11,650,000
12	Japan	10,350,000
13	Colombia	9,400,000
14	United States	8,575,569
15	Nigeria	8,000,000
16	Philippines	7,328,120
17	Oman	6,644,000
18	Argentina	6,000,000
19	Italy	5,210,761
20	Mexico	4,800,000

24 MILLION RETROFITTING

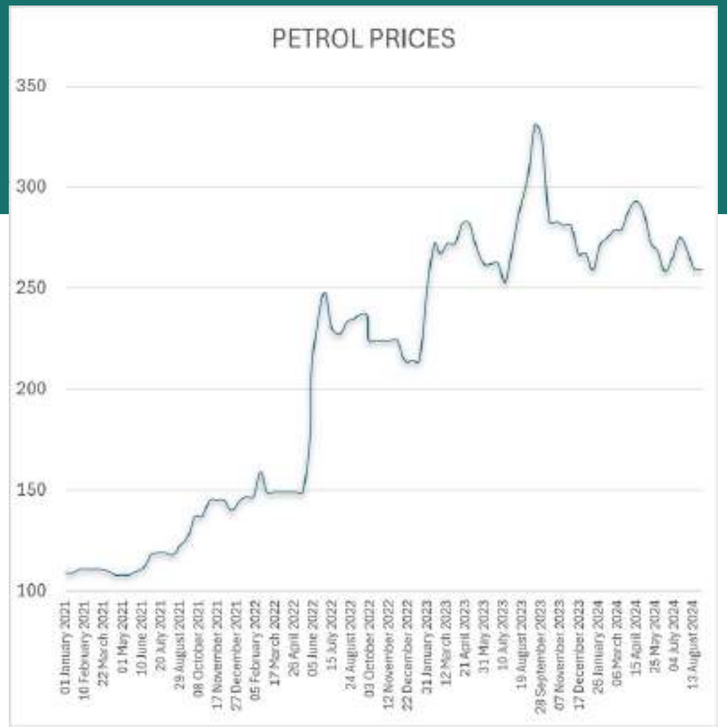
1.2 MILLION NEW BIKES P/YR

The retrofitting market covers the 24 Million motorcycles Pakistan government's Climate NDC aims to reduce emissions by 30 million tons in 2030 (50% of all motorcycles)

1.2 million new motorcycles p/yr (CAGR of 6%)

PROBLEM STATEMENT

PAKISTAN'S LONG SLOW ROAD TOWARDS TRANSPORT ELECTRIFICATION



01 Increasing Cost of Petrol & High fuel import bill

- Rise from Rs.120 to Rs.260 (peak Rs.330)
- The running cost of a regular motorcycle ride has risen by over 150%

02 Emissions, & its impact on climate and health

- One motorcycle (50km per day), emits 0.84 ton of CO2e/yr
- 20 million tons of CO2e per year in Pakistan which is 70% of all transport emissions

03 Slow EV development cycle: Expensive imported scooters, range anxiety, and lower power

- A handful new E-motorcycle developers in Pakistan
- 10K-20K EVs / year (demand is 1.1M)
- Imported Chinese Scooters that vary cost between Rs.220K-700K with the price fixed to the dollar. (Rs.170K for IC)
- These scooters mainly have fixed battery systems promoting range anxiety and importers do not have the facilities to service them.

04 Lack of Charging Infrastructure & slow adoption

Only a handful of charging stations currently operate in Pakistan. Battery swapping stations are in their Pilot testing infancy phase.

05 High electricity cost due to circular debt

A lot of Excess Capacity generated in the Grid is being wasted outside of the high demand months (May - Sep)

LIERA

SOLUTION - Quick & high rate of Electric Motorcycle Adoption

The Case for Retrofitting:

- **Electric vehicles are net zero emissions, not negative emissions**
- Need to phase out “retire” one petrol motorcycle for every one electric / hybrid motorcycle added to the system to reduce actual emissions
- With retrofitting 1 petrol motorcycle is replaced with 1 hybrid/electric motorcycle: Twice the number of EV % adaption per each conversion
- Does not require new registration – lesser new vehicles on the road
- Cheaper than buying new EVs - 30-75%

NEW EV TECHNOLOGY LAUNCH

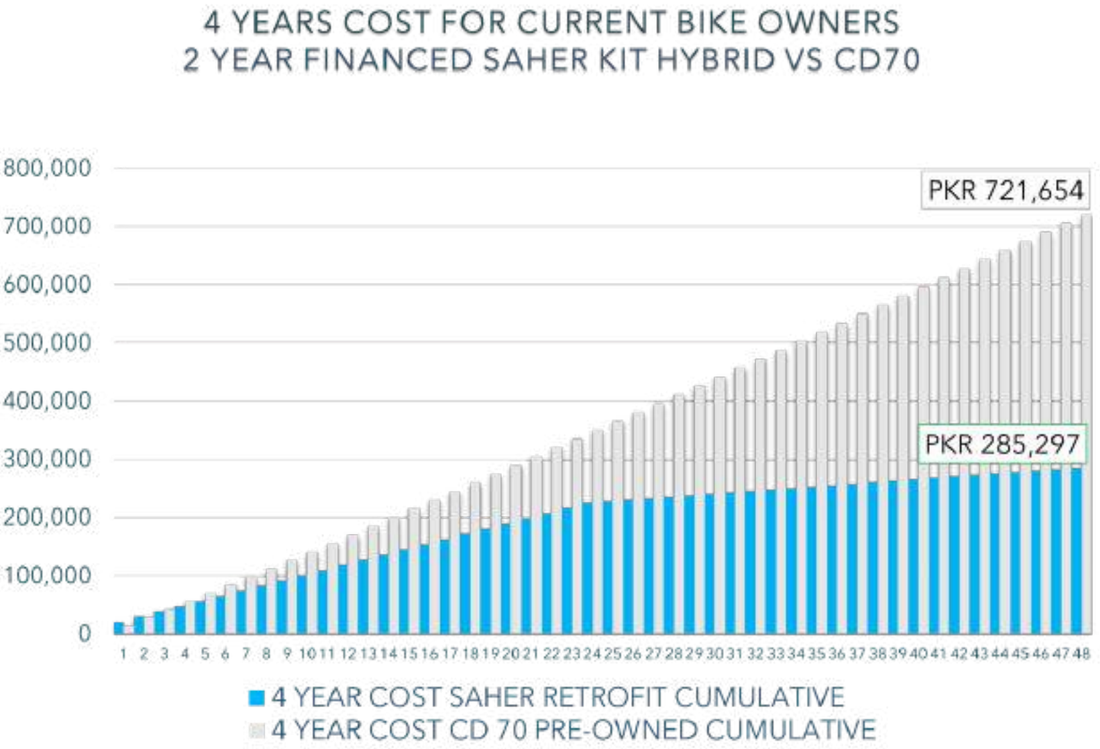
01 Retrofitting Electric Kit with Hybrid Range Extension (using the engine to charge the battery):

- **Indigenously Developed systems** and logistics program (specific for Pakistan and developing countries Allowing in hourse service of systems
- **Swappable battery kit** and battery management system BMS
- Retrofitted to current motorcycles within 30 minutes
- **Built in range extender** and switchable IC engine control reduces range anxiety / the initial hurdle of requiring a well-developed charging infrastructure.

02 AI & IOT based asset management system and dynamic networked vehicle connectivity:

- **Embedded smart connected supervisory controller:** On the fly integration & monitoring
- **Integrated data logger system:** drive cycle behaviours, battery health, charge discharge mapping, vehicle-to-Infrastructure network connectivity that allows for a dynamic charging network.
- **IOT Asset management system integrated:** Vehicle tracking, tamper proofing electronics and batteries, remote shutdown. Vehicle connection through phone apps

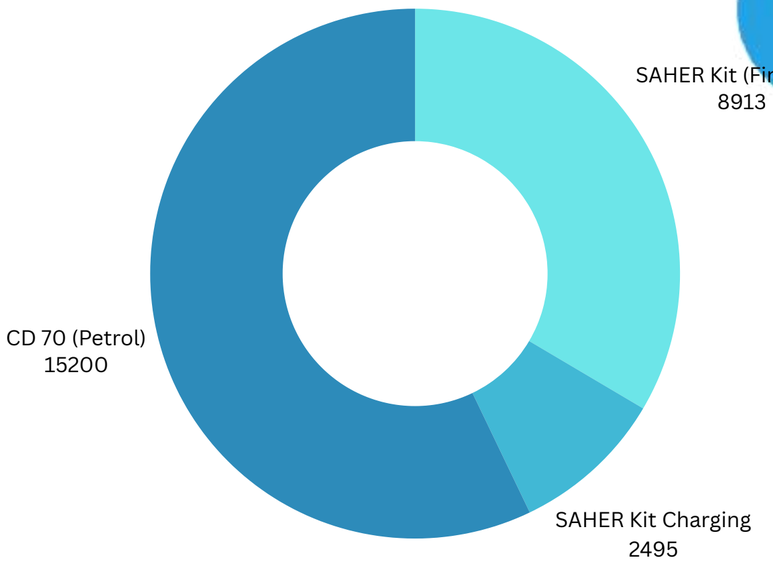
01 COST ADVANTAGE OVER PETROL MOTORCYCLES

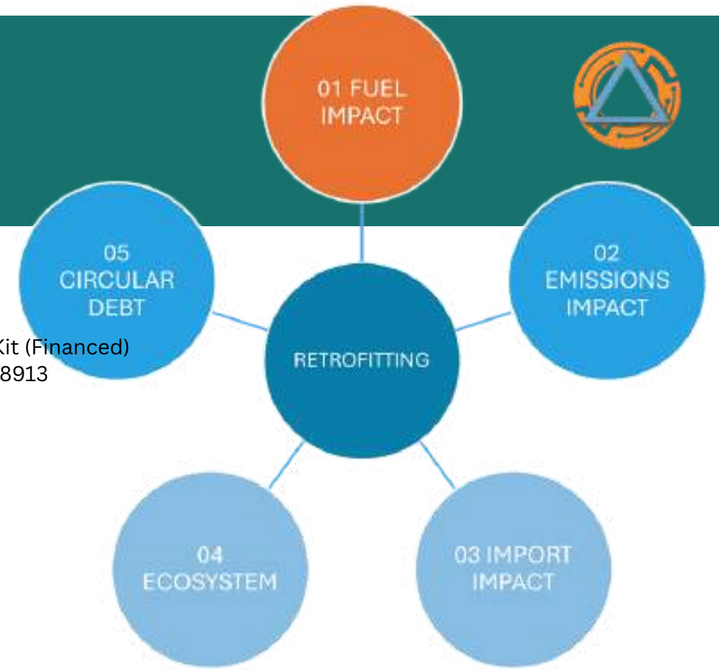


Retrofitting KIT vs pre-owned Honda CD70:

SAVING OF PKR 590,200

***Average Salary Rs30K, Petrol Bill: 15.2K per month**



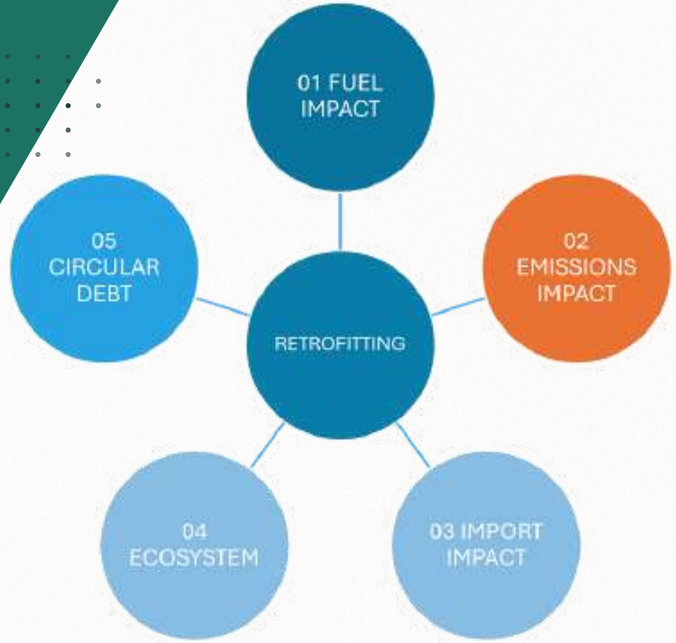


RUNNING COSTS

The retrofitting system is 1/2 to 1/5 cheaper per month than the equivalent IC engine Honda CD 70

FUEL IMPORTS SAVED:

At an Average of 50km/day, each motorcycle consumes 375L a year That is an import cost of $3.62Billion to Pakistan, and $8.31Billion to the Public (mostly marginalised community who run motorcycles in Pakistan*)



EMISSIONS

Pakistan's Nationally Determined Contributions and the Pakistan Energy Vehicle Policies (2019, 2025) target half the CO2 emissions reduction, and 30% of motorcycle sales to be electric or hybrid by 2030, 90% by 2050 and 100% on the road by 2060

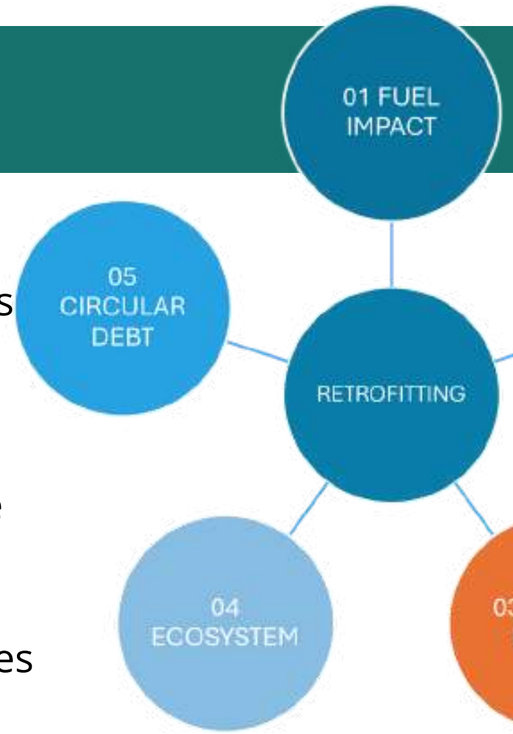
- One motorcycle (50km per day), emits 0.84 ton of CO2e/yr
- 1 retrofitted vehicle replaces 1 IC engine vehicle reducing the CO2e for each
- Saves 20 million tons of CO2e per year in Pakistan which is 70% of all transport emissions

THE PRODUCT FEATURES

QUICK DEPLOYMENT AND EXPANSION

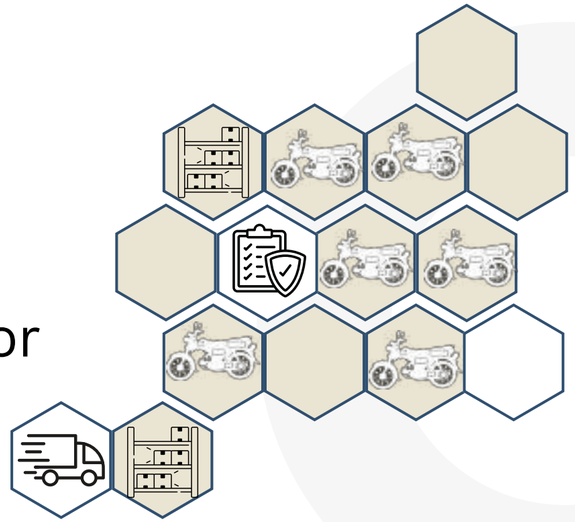
QUICK DEPLOYMENT

1. Quick startup for developing countries with shared technology development
2. A complete 30 minute per bike retrofitting
3. 2 team based cell structure allows the capacity to be increased cellularly exponentially
4. Retrofitting in container type structures and after market businesses with training.
5. An AI optimised production monitoring system for fault tolerance checks during processes

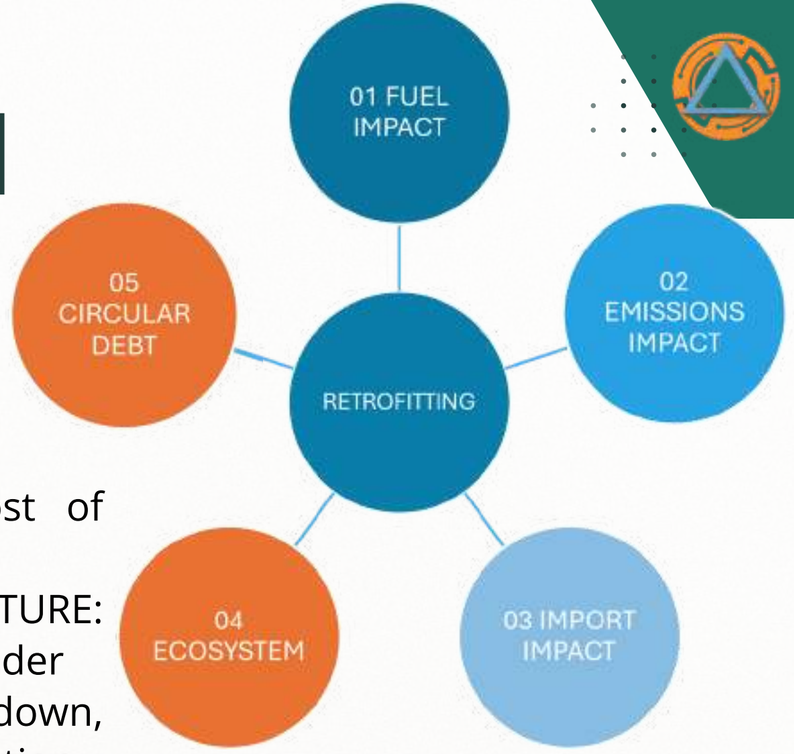


Retrofitting costs between Rs.75K-110K

Current Import and Developed market is Rs.450,000 (Rs.200,000 for scooters) - 80% still chinese components



ECOSYSTEM



Quicker adoption with minimal charing infrastructure

1. SOLAR CHARGING READY: Reducing the cost of running the motorcycle even further
2. INDEPENDENT OF CHARGING INFRASTRUCTURE: Able to take on long rides due to its range extender
3. ASSET MANAGEMENT: Remote tracking, shutdown, operations and tracking to the next charging station
4. DATA LOGGING: Data collected by the system in Pilot projects will be used to develop and deploy similar systems in other countries globally
5. Dynamic Charging and swapping stations from Analytics

Reduction of Circular Debt of Capacity Charges

1. Pakistan produces 6000 GWh per month of which 1000 GWh is 18% losses
2. The overcapacity production in Non peak months is estimated between 40-50% which is recovered as Capacity charges (for non use of the capacity)
3. The use of charging stations is an incentive for the government to use all the extra capacity during non peak seasons, and use Optimized Power distribution (another ALIERA project) to utalise Charing stations as MicroGrids for peak seasons.

SOME PILOT NUMBERS

Pilot of **10,000** Retrofitted systems costing **US$4.6 million** total with 3 years of battery life, 3 charging and swapping stations would:

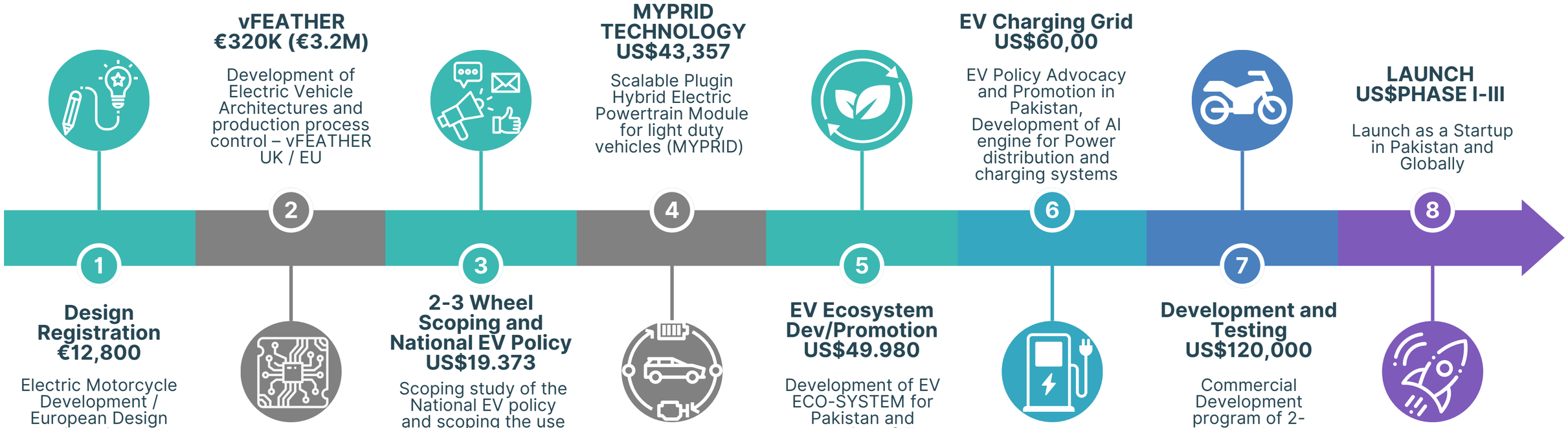
- Reduce CO2e by **42,620 Tonne**
- Save fuel Import by **13.68 million litre**, **US$5.5 million**
- Total cost of running Retrofitted Vehicles for consumers is 12 million Units (**275MWh / month**) or US$1.9 million (75% on Grid and 25% DRE) saving consumers around **US$10.5 million**.
- This is utilising surplus energy reducing electricity costs
- Total Savings on Import cost of new EVs (cheapest Scooter): **US$4.6 million**

Social:

- The total savings on Social Cost of Carbon emissions according to US EPA 2023, is **US$2.71 million**
- Trading Carbon market for 42K tonne CO2e

DEVELOPMENT TIMELINE

RESEARCH AND TECHNICAL DEVELOPMENT INVESTMENT TIMELINE FOR THE EV ECOSYSTEM



THANK YOU

LOOKING FORWARD TO HEARING FROM YOU

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