Electro hydraulic system development for City bus, Commercial vehicles, 24 meter flat deck bus, heavy equipment like Tipper, etc.

FULL ELECTRIC SYSTEMS

SUSTAINABLE SOLUTIONS FOR ELECTRIC CONVERSION

An innovative business model

BACKGROUND

The company was formed in the beginning of 2017, leveraging 12 years-experience in EATON Corporation, as an advanced electro-hydraulic system engineer working on major and most innovative global projects.

COMPANY VISION

To partner with OEM's, having a specific focus on the vehicle electrification, inorder to develop the most suitable technology for heavy duty vehicles by sharing our know-how and expertise, relying on a selected and trusted network of companies.

VALUE PROPOSITION

By a modular design approach combinned with the company agility, we offer system integration services as well as full machine design including cabin, chassis, erogomic study, homologation support granting quick time to market and competitive costs.

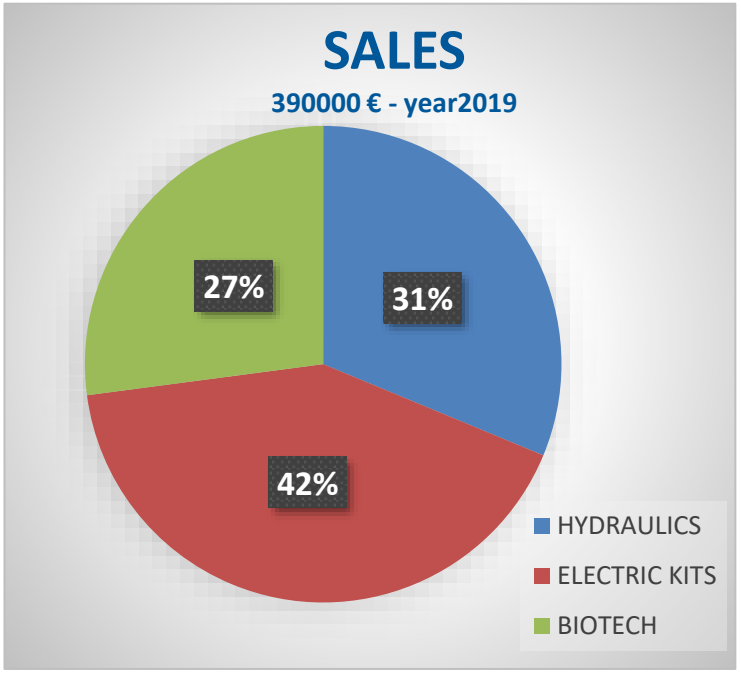
About us…

COMPANY STRATEGY PLANNING…

The company was formed in the beginning of 2017. After 3 year of operations, the company designed and developed architecture solution for the development of medium to high volume projects.

COMPANY STRUCTURE…

Based on long year of large corporate experience, we defined a new business model which focuses on key internal knowledge allowing us to be still a small company (5 people) with an highly strategic network of parnters which can allow us to deliver best and most advanced technology with a high level of support and customization with very competitive pricing and development times. The company can design and supply full systems completely customized to customers requirement.

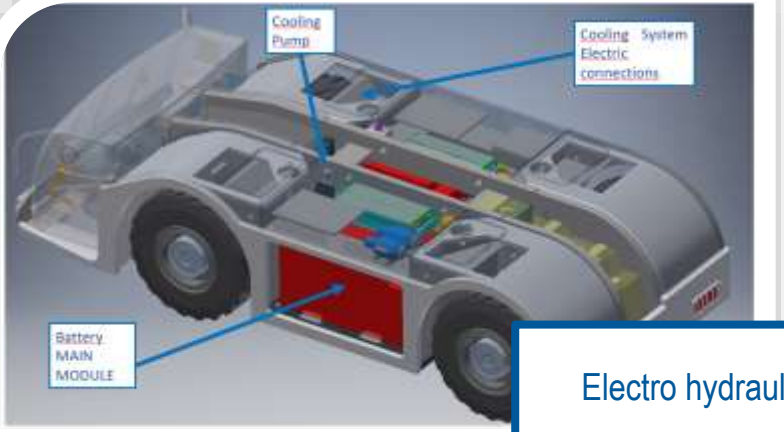


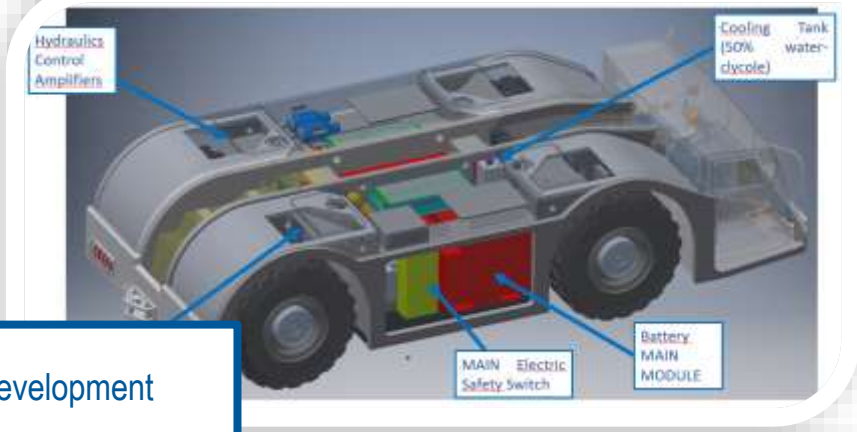
OUR SOLUTIONS…

Our system design is based on TCO (total cost of ownership) rational. This allows for a cost efficient production set-up and sustainable market penitration with very short break-even times. In the last 3 system developed, the proto-type and machine associated costsnwere always below a standard thermalm engine architecture cost.

The Company works in different engineering areas such as Biotech machines, this allows us to have practical knowledge of many different technologies. We believe this is a key competence asset, in order to support the customers in defining the next market solutions.

E-Tow Tractor 45 TON 850 kW @ 600 V: e-mobility





Electro hydraulic system development

LARGE SYSTEMS EXPERTISE

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Our Vision: industrial e-mobility

What we can do to support this vision? We designed our company to be able to provide:

- Modular and customized electric **powertrain design and supply** (partner with MOOG)
- **B2W** (battery to wheel) axle, gear and shift control design for optimal traction and efficiency
- Design and supply of advanced customized battery systems
- Design and supply of full automation and power electronics control system
- Design and Supply of **FULL ELECTRIC DRIVE (Safe) by WIRE** systems
- Remote diagnostics and telemetrics and data logging for **advanced FLEET MANAGEMENT**
- Full hydraulic system design and supply (both for DIESEL and ELECTRIC vehicles)

Our Vision: industrial e-mobility.

Most of the strategic analysts of industrial vehicle markets recognize that the time between y2020 and y2025 will be the turning point in terms of e-mobility development in the industrial markets.
The transformation from a diesel engine driven vehicle towards a FULL-Electric one will generate new market opportunities even for existing companies.

The key design aspects where the most significant benefit can be obtained are: duty cycle, vehicle chassis constrains, fuel consumption, pollution issues.

The analysis shows the best fit for an e-mobility vehicle transformation are **UNDERGROUND MINING VEHICLES** and **PUSH BACK TRACTORS** for aircraft towing services, CITY BUS, TIPPER, etc.

Our Vision: Urban Fleet e-mobility

The public people transportation fleets and the last mile delivery fleets represent a significant market in terms of volumes but also carries an important contribution factor related to the predictable path and the ability to leverage a relative large number of vehicle in a concentrated environment.

This allows for immediate cost-out solutions, advanced monitoring and service telematics, smart range extending solutions on demand and charge planning schedules.

In order to truly generate a TCO (total cost of ownership) oriented design, we, believe that there are the major points of focus on:

- Remanufactoring kits (for public fleets electric conversion at sustainable cost)
- Advanced Lithium+SyperCAP storage solution
- Range Extension (aluminium air pack)
- Advanced REGENERATION (bring actual ɳ=25% to ɳ=90%)
- LTO cells with extended life service

FULL ELECTRIC CITY-BUS

FOR STANDARD WEIGHT PLATFORMS 11 – 25 TON CLASS

25 TON [DIRECT DRIVE/ GEAR]

18 TON [DIRECT DRIVE/ GEAR]

11 TON [DIRECT DRIVE]

FULL ELECTRIC - TRANSPORTER

For standard weight Platform 3 – 7 Ton Class

Our targets for this class can be summarized here below:

- Bus voltage = Above 600 V
- Max Speed = 80 Kmh
- Max Slope = 25%
- Max Weight = 4500/6500 kg
- Optimized Energy Storage (for autonomy of 250 km/day)
- **Cost Effective RANGE EXTENDER (for additional range of +250 km/day)**

→ So the vehicle with or without range extender solution represents a highly modular propulsion platform suitable for much diverse operating cycles!

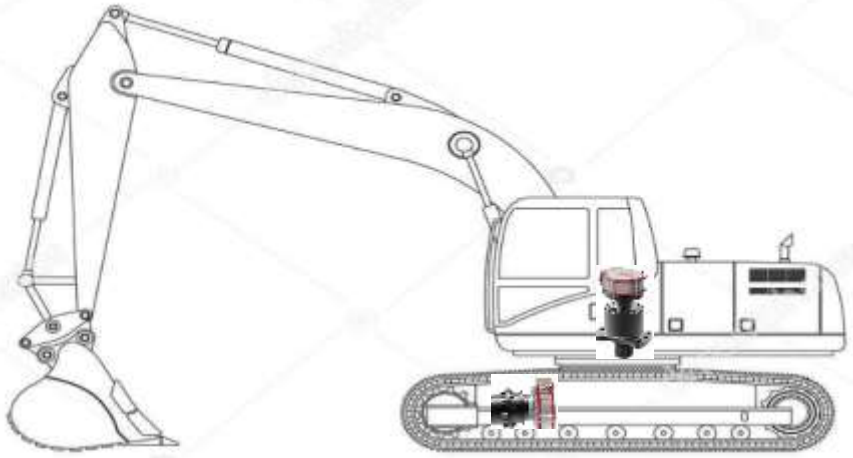
FULL ELECTRIC EXCAVATOR

FOR STANDARD WEIGHT PLATFORM 5-20 TON CLASS

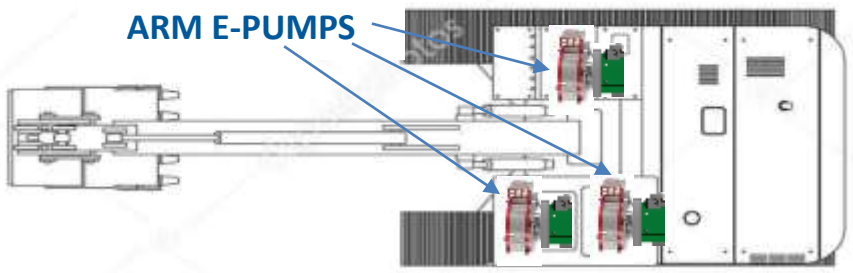
Focus points on this architecture are based on hydraulic power distribution concepts.
Today **Load-Sensing Flow-share** technology is at the core of these machines.
The ELECTRIC architecture opens up the great efficiency improvement related to **valve elimination**.

Not only the traction and rotation will be DIRECT DRIVE electric, but also the **hydraulic actuations will be controlled electrically** enabling a +40% of efficiency compared to actual technology (and much less noise).
The system will so be based on a set of load dedicated electro-pumps which will deliver and meter the power to all the hydraulic actuations. The system will be a **POWER ON DEMAND** type.

In many cases options for RANGE EXTENDERS chargers and plug in operation can be evaluated and cost analyzed if the machine can be operated in a compatible field area.



HYDRAULIC ARM E-PUMPS



ROTATION MOTOR

TRACTION MOTOR

PLATA 4.0 – Vehicle Control Platform

PLATA 4.0 is a highly customizable vehicle control platform based on Codesys IDE, that can be quickly adapted and configured for any industrial vehicle both ELECTRICAL DRIVE and DIESEL DRIVE.
It includes controls and diagnostics over prime mover, all hydraulics, electrical traction control and any other major machine service.

It provides GSM, 3G/4G data telematics from remote diagnostics and local WIFI access for easy FLEET MANAGEMENT.

This ready to use platform will allow to build quickly statistics of use and consumption which can be used to validate and certify a superior level of efficiency for the operating cycle.

Advanced LTO Battery Chemistry

25000 cycles @ 80% DoD / 9C peak discharge rate

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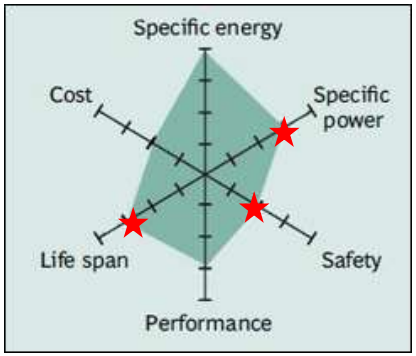
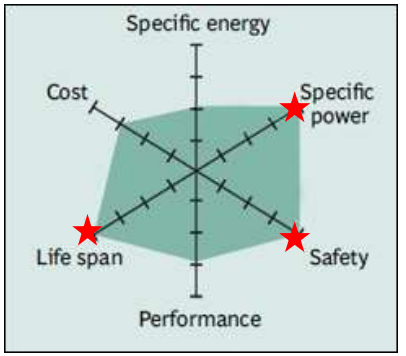
Lithium Nickel Cobalt Aluminum Oxide ($Li_4Ti_5O_{12}$) — LTO



Lithium Iron Phosphate ($LiFePO_4$) — LFP



Voltages	2,5V nominal; typical operating range 1,8–2,7V/cell	3.20, 3.30V nominal; typical operating range 2.5–3.65V/cell
Specific energy (capacity)	260-280Wh/kg; 300Wh/kg predictable	90–120Wh/kg
Charge (C-rate)	4C, charges to 2,70V (most cells), **ultra fast charge possible with some cells (when C rate > 5)**	2C typical, charges to 3.65V; 3h charge time typical
Discharge (C-rate)	4C typical, 8C max ; 3.00V cut-off; **h**	1C, 25C on some cells; 40A pulse (2s); 2.50V cut-off
Cycle life	**25000** (at 3C recharge average 80 % DoD)	2500/3000 and higher (at 3C average 80 % DoD, temperature sensitive)
Thermal runaway	150°C (302°F) typical, High charge promotes thermal runaway	270°C (518°F) Very safe battery even if fully charged
Cost	**~$450-500 per kWh**	**~$650/700 per kWh**

LEASING 12 years practical

LEASING 12 years practical

Our Hydro-electrical package Benefits

- Creation of first modular EV energy advanced storage kit that can be considered financially viable for Electric Vehicles, enabling full leasing coverage of batteries (10 years operation).
- +900% lithium cells lifespan (compared to stad LiFePo4 chemistry)
- +40% traction power peak (at same battery cost)
- +65% efficiency improvement on the BRAKE REGENERATION (up to 8C peaks)
- X3 FASTER CHARGE due higher manageable currents (3C recharge)
- Advanced BALANCING SYSTEM with advance monitoring capability
- Often cheaper package (due to downsizing of lithium cell impact)
- Modularity from 10 kWh up to 300 kWh
- LTO new type chemistry enabling super extended life (25000 cycles @ 80% DoD)
- Ability to design small power application (< 20 kW) and big application (>400 kW) with the actual component range
- We have expertise and technical knowledge to support ELECTRIC INTEGRATION also on various other insustrial platforms such as: CONSTRUCTION EQUIP., SWEEPERS, TRANSPORT, MINING VEHICLES, AERIAL PLATFORMS, LIFTING MACHINES,

Some of our key partners…

JV Requirements for Hydro-electric kit manufacturing in India.

- A financially sound partner, who would like to take advantage of the upcoming market.
- Investment of about 8 CR in phases, depending upon the business volume targeted. (phase 1 - 50 L, Phase 2 – 2 CR, phase 3 – 3 CR, Phase 4 – 3 CR). After second phase investment two vehicles can be retrofitted and tested. Once the trial vehicle is tested funds can be raised for the working capital, and/or additional investment. Testing and certification can take between 3 to 6 months, so the third phase investment will require after about an year of initial investment. Investment for phase 3 and 4 is mainly for land & building, setting up the manufacturing facility, technology transfer charges etc. Working capital required is not considered in the investment here.
- Willing to local manufacturing e – kit components to our design and quality standards.
- Building of about 2000 SQ. Feet to start with (about 5000 SQ. Feet for mid range manufacturing, capacity of about 500 e-kit per annum)
- Set up of a garage for retrofitting e-kit, about min. 5000 sq. feet. (Can be done at existing work shop initially).
- Skilled and unskilled manpower for retrofitting (One engineer, 4 technicians, two helping hands).
- Hand tools and Test equipment.
- Manufacturing capacity considered –

Year 1 – 100 kit, Year 2 – 300 Kit, Year 3 – 500 Kit. Depending on the requirement in the year 4 manufacturing capacity may be added.

FINANCIAL FEASIBILITY (estimated) at 500 e kit retrofitting –

Cost of the kit –	2,500,000 RS.
Hardware & consumable –	1,000,000 RS.
Labour for retrofitting -	50,000 RS.
Battery 100 KW -	3,600,000 RS.***
Profit -	500,000 RS.
Total -	7,650,000 Rs.

Estimated Profit at 500 units = 500 x 500000 = 250,000,000 RS. (25 CR)
Payback of investment after conversion of 160 units, or in the year 3 of operation.

Estimated working capital required – Year 1 – RS. 69,49,87,000/- (69.5 CR)
- Year 2 - RS. 208,49,61,090/- (208.5 CR)
- Year 3 – RS. 3,47,50,00,000/- (347.5 CR)

** Subsidy of about RS. 1,000,000 not considered.

Is it practically possible to achieve these volumes ?

It is very well possible to achieve these volumes as the no of private buses working for commutation of staff in major city like Chennai, Banglore, Pune, Mumbai, Delhi, Noida, Gurgaon, Hyderabad, etc is in few thousands.

Since the retrofitted bus will be require very less maintenance cost, its running cost is also very low, in retrofitting we are creating a value for old bus with additional life of over 10 years, bus will be pollution free, and the very important thing Cost benefit – the bus will be at a less than half the price compared to new one, every one will prefer to do the retrofitting, once the bus is running satisfactory on the road.

The quantity planned is very low, not even 1% of the bus volume we have in metros. On proving and getting approval from designated agency ARAI, the franchisee model can be worked out in different cities.

The whole consideration is based on private use/industrial use, there is also a big volume of school bus and local transport, state government transport system etc. which can add very high volumes.

In short the business will have a very high boom in near future, as government policies are promoting for e-mobility. The market will suddenly open in next few years ike it was opened up for CNG retrofitting on petrol rickshaw.

To summarize this is an excellent business opportunity, technically and financially viable, any one entering at this stage will have an advantage of leader once the market open up.