50+ YEARS
BY “ELECTRIC WAY”

Romanian Concerns on the Field of Electric Mobility

www.icpe.ro
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FOREWORD

We give up the bad habits with difficulty, we have got into the habit of being dependent on the automobile. It seems that any initiative in reducing the dependence on this technological “drug” is meant to fail.

The special programs of encouraging the alternative mobility through systems such as “car sharing”, a special lane for motor cars with more than one passenger, “one day a week without using the car” and many, many others were not put into practice, remaining just experiments that cannot be generalized.

We are obstinate, we want our own car!

But, according to the most estimations, a third of the gas emissions, responsible for the anthropogenic intensification of the natural phenomenon called greenhouse effect and, implicitly, for the phenomenon of the planet global warming, is due to the heat engine conventional vehicles and, among them, of course, the automobile is the leader.

It is more and more difficult to ignore the evidence proving the global warming of the Earth. The glaciers melt at ever higher speed, the planet temperature rises slowly, but, certainly, the ocean level increases and, in Europe, the temperatures of over 40°C have become an everyday phenomenon, the planet ozone protecting layer is affected and all these phenomena are the basis of some apocalyptic movie parables.

The illusion that the evident synergy of the phenomena is just a coincidence can be fatal to us. Today mankind needs a sustainable development and not one at any price.

We are afraid of the Kyoto Protocol, the protection measures of the nature are just local and do not have an impact at the planetary level, while the fleet of heat engine vehicles increases at a stunning speed, new kilometers of road replace the forests in Brazil and what will happen, when China and India, with their enormous populations, reach a level of development which will require the related mobility, can be imagined with difficulty.

It is, however, obvious that things cannot go on like this, that the heat engine motor car has to be replaced and the electric motor car seems to be the closest to the original taste “sweetener”.

Because of the importance the environment protection and the energy conservation start to gain in the present society, the purely electrical vehicles and the hybrid electrical vehicles have begun to develop in an accelerated rhythm, so that on the market there have already appeared commercially viable achievements, being especially designed for the urban traffic.

According to the forecasts, in the next 50 year, the world population will increase from 6 to 10 billion and the number of vehicles will increase from 700 million to 2.5 billion. The replacing of the heat engine by the electric machine is the premise for the development of a sustainable and ecological road transport. The main factor that stimulates the electric vehicles development is, at present stage, the ecological factor but step by step electro-mobility is opening a new fascinating market.

For the next years, one anticipates that both the electrical vehicles and the commercially available hybrid electrical vehicles will have different market segments.

The Authors
Always interested in the latest trends in scientific research, ICPE was a promoter in the field of propulsion system for electric and hybrid vehicles in Romania from the beginning.
Electric Bicycle (1973)

"Pegasus" type Romanian electric bicycle equipped with 350W/24V/3000 rpm DC motor
Elmo Scooter (1976) developed in partnership with IM Zarnesti. DC disc motor, 500W/24V/3000rpm
1974. Senior researcher Sigismund Sleiher and his DC disk rotor electric vehicles
The 70s. Electric Mobra in Icpe courtyard
The famous “MOBRA” electric moped awarded
After 1990s, Icpe started again the EV program and built a strong research team in order to carry on new projects, the team included universities like POLITEHNICA University from Bucuresti, University from Pitesti, private companies interested in this field like: CARANDA Batteries, Subansamble Auto Pitesti, REVA Romania, Electrotehnica and local and central authorities like Danube Reservation Authority, RATB and many others.

Based on its own skills, the group begun to redefine the importance of electric vehicles in Romania, and all its work started with the foundation of AVER – Association for promoting electric vehicles in Romania.

Several results of such projects are presented, as follows.
**Electric Tricycle**

- 1000W x 3 phase AC motor powered by 72V DC inverter
- Top speed: 20 km/h  
  - Maximum load: 1 person + 100 kg cargo
- Range: 2 hours continuous operation  
  - Power supply: 72 V DC
This first prototype of a light electric vehicle (LEV-1) designed to be a successful product, as a safe, affordable, environmental friendly effective mode of transportation. The Romanian LEV-1 is a four-wheeled platform, with a 25km/h top speed, equipped with a DC propulsion system, offering to the manufacturer the possibility of building several variants of electric light cars. The LEV-1 has high efficiency, low weight, high safety and reliability, appealing design and affordable price/performance ratio, that's why it may be one of the first solution for an electric car successfully manufactured in Romania.
Applications: fairs and exhibitions, commercial centers, entertainment parks, sport grounds/centers, health resorts, historical city center, airports

**Technical characteristics** of the propulsion system: D.C. permanent magnet motor with a nominal continuous power $P=5$ kW at 2000 rpm, supply voltage: 120 V, electronic converter, regenerative breaking.

**Performances**: Top speed: 30 km/h, load: 2 persons and max. 100 kg luggage, range: 45-50 km
Light electric vehicle - LEV2
light car chassis equipped with 120 V DC motor 3,5 kW / 2000 rpm 120V,
regenerative braking
Electric Car Sharing Application

This is an electric vehicle designed to be used in car-sharing system in Bucuresti. The images presents the vehicle during the demonstration meeting at the workshop "EV-2003", held in Pitesti, Romania. Car Sharing was a new concept for urban transport in Europe and Romania at that moment and Romania could have been one of the first countries that were going to integrate it.

The Propulsion System

- DC rare earth permanent magnet motor:
  10 kW continuous power @ 2000 rpm
- PWM-controlled IGBT transistors Electronic Drive
- Supply voltage:
  180V DC (15 batteries VRLA 12V/66Ah each)
Electric Small Bus

Technical characteristics:
- D.C. permanent magnet motor, 15 kW / 2000 rpm
- Supply voltage: 168 V DC (14 lead acid VRLA batteries, 12V/120 Ah each)
- Electronic converter
- Regenerative breaking

Performances:
- Top speed: 25-30 km/h
- Payload: 12 persons (1000 kg)
- Range: 60 km (2 hours at top speed / max. payload)
Bus propulsion system general structure
The ELMAS Project

Water cooled brushless motor for (Fiat) hybrid propulsion system - FP5 European research program, led by the Electrical Engineering Faculty from POLITEHNICA University-Bucuresti
ELMAS project partners

PermMotor Gmbh, Germany

Politecnico di Torino, Italy

The University of Sheffield Electrical Machines & Drives Research Group

SRDrives Ltd, Great Britain

VOLVO Gottenburg, Sweden

CRF, Italy

ika, Germany

INSTITUT FÜR KRAFTFAHRWESEN AACHEN

EMD The University of Sheffield Electrical Machines & Drives Research Group

Breisach, Germany

Politecnico di Torino, Italy
Starter-alternator 4kW/8000 rpm/310A developed by Icpe for ECOAIR company (USA)
**Electric Boat** with solar panels 2,4kW/ 2000rpm/24V brushless motor and servo-drive
Pan-cake brushless servomotor for a hybrid vehicle
The propulsion system consists of:
- permanent magnet synchronous servomotor (SP-EV-X-Y-MS)
- drive unit (SP-EV-X-Y-BAC), featuring:
  - speed control – using the signal supplied by the specific devices on the vehicle
  - electronic current limitation
  - recuperative braking

The propulsion system series manufactured by Icpe is suitable for light electric vehicles, such as: bicycles, scooters, tri-cycles, 4-wheeled light electric vehicle
Two-wheel vehicles have always been a practical transportation solution for individuals in urban agglomerations, where the average speed of travel for a vehicle with 4 wheels often fall under the walking speed due to the number of cars and transport infrastructure. When this mobility is combined with a special propulsion system the result is a clean vehicle that contribute substantially to solving two of the most distressing problems of the inhabitants of cities and local government: transportation and environmental protection.

Motorcycles and electric scooters enjoy growing popularity, due mainly to continued growth in oil prices. Battery technology made significant progress, making this mode of transport ever more interesting for potential users.

Many prototypes have been developed for different customers and partners all over the world.
Conventional thruster systems (hydraulic or electric) consist of a propeller driven by a motor via a shaft operate under ship’s hull. This design has hydrodynamic drawbacks. In this new technology (type: driven thruster) brushless permanent magnet motors are structurally integrated in a marine propeller. The stator of the motor is mounted in the duct while the rotor forms a ring around the propeller rim. Only the propeller blades are in the water and only electric cables pass through the hull.
New projects had been carried on, especially dealing with innovative solutions for propulsion systems.

Some examples are presented below, where we are the partner responsible for the propulsion system:

- **EcoBoat Project**, an EraNet project developed as a partnership between SCANNER (Italy), Pars Makina (Turkey) and **Icpe** (Romania)

- **ELECTROCAMPUS Project**, a national funded project, a partnership between “Politehnica” University from Bucuresti, Technosoft and **Icpe**

-- **Mobile photovoltaic platform**, on SIMOPEL project, funded by UEFISCDI is a national project coordinated by **Icpe**

-- **e-VW Beetle**, on SIMOPEL project, funded by UEFISCDI is a national project coordinated by **Icpe**
ELECTROCAMPUS Project

In the frame of this project, we carried out an innovative solution for the in wheel synchronous permanent rare earth magnets motor.
ELECTROCAMPUS Project

E-MOBILITY
ERA NET (MANUNET) ongoing project

Icpe will integrate their electric motor within the proposed system. The motor will be integrated not only by the mechanical point of view (in terms of casing, shafts, etc.) but also within the power management system. Should the management system be modified to allow the integration of the motor, this action will be performed by Icpe.
Photovoltaic Movable System

General Description:
*Power supply for remote consumers and electric vehicle charging stations*
Holiday dwellings, weather stations, irrigation (gardens, farms), apiculture, shepherd settlements, Light signals (streets, roads), Stand-alone power supply for reparations and service in isolated places, Portable military applications
Tourism: camping, mountain huts, cottages and dwellings far away from the grid.

*Technical data:*
PV array (1680 WPk on a foldable structure on a car trail)

- Nominal voltage: 12 VDC
- Inverter:
  - Maximum power: 3, 7, 20 kW
  - Output voltage: true sine 230VAC
- Storage battery (Pb-acid) 12 V/ 500 Ah
- Operating temperature: -15 - +45 °C
## Technical specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated operational voltage</td>
<td>230 Va.c.;</td>
</tr>
<tr>
<td>Rated insulation voltage</td>
<td>1500 Va.c.</td>
</tr>
<tr>
<td>Rated thermal current</td>
<td>6 A; 10 A; 13 A; 16 A; 20 A; 32 A;</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Socket outlet</td>
<td>IEC 62196-2</td>
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<tr>
<td>Network connection</td>
<td>10/100 Base –T Ethernet</td>
</tr>
<tr>
<td>Standby power consumption</td>
<td>10 VA</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-30°C to +40°C</td>
</tr>
<tr>
<td>Protection degree of contactor</td>
<td>IP 54</td>
</tr>
<tr>
<td>Overall dimensions (mm x mm x mm)</td>
<td>425 x 335 x 245</td>
</tr>
<tr>
<td>Net weight</td>
<td>8 kg</td>
</tr>
</tbody>
</table>
EV BMS (Electric vehicle battery management system)

BMS subset monitors LiFePO4 cells connected. Measures voltage and temperature of each item and current charge/discharge element (with shunt current reading) and also measures the heating contactors static charge/discharge of the battery. LiFeYPO4 ordered swinging elements ensure control of the central unit or autonomous.
E-VW Beetle

E-VW was created by SIMOPEL project (funded by UEFISCDI). Icpe demonstrates once again the interest on electric mobility. The project ("Modular electric propulsion technology made flexible for land vehicles and watercraft") in which Icpe aims to become one of the leading manufacturers of components and services that can be used in the field of electric mobility.

Icpe, as coordinator of this project, led, organized and supervised activities to achieve project objectives. Products resulting from this project are new, high performance, with the possibility of extending the main technical characteristics as well as alternative construction.

For more details on the project SIMOPEL [Link](www.icpe.ro/simopel)

Icpe can produce systems, components and can offer services based on the concept of electric mobility and some of them are:
- Equipping a ground vehicle or boat with electric propulsion
- Develop innovative and efficient propulsion systems for electric vehicles
- The development of specialized modules which can be used in the propulsion system
- Designing infrastructure or power supply using renewable energy
- Developing environmentally friendly transport modules for geographically defined areas, such as nature reserves, parks etc. (Each way which included electric vehicles, charging station and system management module)

The vehicle Volkswagen Beetle was presented at the International Conference organized by Icpe - EV 2015. The “kafer" (based on petroleum-derived fuel car) entered among modern vehicles, clean, green and vintage transportation exposed at the conference.
E-VW Beetle
AVER- Asociatia pentru Promovarea Vehiculelor Electroice in Romania - (Association for promoting electric vehicles in Romania)

Is a NGO promoting electric vehicles in Romania. It has been founded in 2005. This was another attempt of the EV consortium members to develop a research and co-operative network in the field of electrical vehicles.

The main targets and missions of AVER can be found visiting

www.aver.ro
The RO market for EVs is poor yet but “the times they are a-changing” and the interest of the main actors in the market is clearly increasing. Two years before a “National strategy on EV” had been settled down but unfortunately it was meanwhile forgotten. Anyway, it was a beginning and, for sure, other steps will be made.
AVER is working hard in this direction.
On the other hand, regarding the Romanian producers and their possible integration in The horizontal supply system, for a while, the only possible users of the Romanian OEM EV components remained the foreign companies which have discovered they may get good customized items at competitive price.

CONCLUSIONS

Although implementation of clean and efficient transport in Romania at present stage, is growing fast: 200% registered EVs growth on year 2015 than year 2014. The market consists of a few dozens zero emission vehicles.
Optimistic “scrap book” from the previous editions
EV-CONFERENCE: Mr. Aristide Caranda loves the electric vehicles
EV-CONFERENCE: Faztech company from USA presenting its revolutionary charging technology
EV-EXPOSHOW. Dacia standard car equipped with electric propulsion system
EV-EXPOSHOW TEST DRIVE. ACAROM - So delighted to drive this electric car
EV-EXPOSHOW. Metropolitan Palace
EV-EXPOSHEW. Mass media break
EV-EXPOSHOW. Tesla Motors Roadster Sport Convertible
EV-EXPOSHEET. Tesla Motors Model S, VW E-up!, VW E-Golf, Renault Twizy
They deserve a greener future!
Therefore, arm in arm with the nature or against it?

At this moment, one must emphasize the seriousness of those involved in the field of electrical vehicles. If, some years ago, the enthusiastic researcher, who was approaching this subject, was considered an open-eyed dreamer, passionate but never taken too seriously, today the number of those interested is much larger and the funds placed at their disposal lead to the attaining of the final objective: series manufacturing of some electric motor cars which should bring profit to the producers.

Throughout its existence, the human civilization has always found the resources for overcoming the major crises through which it passed. It seems that we are passing through such a crisis but nothing from the political activity of the great leaders of the world suggests this thing.

The scientists sent out various warning signals and persevere in convincing the politicians to apply adequate and urgent legislative measures.
The conference which takes place under the “EV” logo represents the most important scientific event in the field of electric mobility which takes place in Romania.

The first edition, EV 2001, was also the first conference in Romania in the field of electric mobility. Moreover, this event re-opened Icpe`s scientific research related to green transportation (initially started in 1970 – [http://www.icpe.ro/en/d/2/p/overview](http://www.icpe.ro/en/d/2/p/overview))

EV-2001 was the beginning of a long term partnership with a group of companies and organizations involved in the field of electric mobility.

Some examples below:
TRENDS IN EUROPEAN URBAN ELECTRIC TRACTION. ELECTRIC CAR
17th – 19th of October, 2001 ("STAR" Conference Hall – Pitesti)

www.evshow.ro
ARE WE READY FOR THE ELECTRIC CAR?
7th – 8th of October, 2004 (“STAR” Conference Hall – Pitesti)
50 Years by Electric Way
4th – 5th of October, 2012 (Conference Center of Patriarchal Palace – Bucuresti)
AVER – 10 YEARS
4-5 October, 2015 (Icpe Solar Park – Bucuresti)
EV2017 IS AN IEEE LISTED CONFERENCE

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https://youtu.be/DyrQ6Uh9DSI
https://youtu.be/epcNVawYFDg
https://youtu.be/wsWarE8v5VY
https://youtu.be/ouZy2mJkJJuM
In the media

http://www.nationaltv.ro/stiri/expozitie-de-masini-electrice-la-bucuresti
Contact

Icpe

Headquarters
313 Splaiul Unirii,
030138 – București,
ROMÂNIA

M: office@icpe.ro
T: +4021 589 3300
F: +4021 589 3434

www.icpe.ro