EUMOB

EUMOB 2017

Electric Urban Mobility

- Working with EV's and hybrid vehicles - safety standardization in EU or not
- A project concerned with teaching and working with electrical vehicles and hybrid cars

Erasmus+

EUMOB

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Introduction

Hybrid vehicles and electrical vehicles have been on their way over the last decades. Presently the pace of development seems to speed up and what was once a prototype hybrid car or an electrical vehicle is now produced in high numbers and can be seen on the streets all over the world. There are national and regional differences as to how fast the urban mobility technology changes the traffic systems and people's driving habits.
Electric Vehicles and hybrid vehicles have fought for public acceptance and have had a hard time in the competition against the good old combustion engine driven vehicles. However, things seem to be changing this decade. One reason for the change in the public eye is for example the Formular One racecars which today are the state of the art of hybrid vehicles and in this way play a role in the change of attitude to this new technology and the acceptance of hybrid electrical systems. Another example is the Tesla sports car, which has proven that it is possible to build a high-end sports car driven solely by electricity. However, there are many many other examples of different electrical and hybrid vehicles and initiatives that influence the change in urban mobility. It is for sure that E-mobility and the new types of electrical vehicles have started to penetrate the mobility markets all over the world.

There is another aspect of the changing urban mobility systems that deserves some attention and that is the safety- and working conditions of the professionals that in some way or another get into contact with electrical vehicles in their professional working life. These professionals are for example automotive mechanics, emergency and ambulance people, the police force or anyone who is in risk of being first on site in traffic accidents involving electrical vehicles.
As opposed to working with for example air-conditioning systems and refrigerators, where a safety certificate is needed in order to be allowed to work with this area of a vehicle, there is no legislation for working with these new electrical vehicles, not at national level or European level. The electrical systems of EV's and hybrid cars are very different from the electrical systems on an ordinary vehicle with a combustion engine, the voltage is so high that it is lethal if you get an electric shock. In addition, there are no production standards for manufacturers as to clearly mark an electrical or hybrid vehicle or to place crucial HV cables in a specific way in electrical vehicles. This is a problem and can cost human lives.

This brochure presents information about urban mobility systems of three different countries, Spain, Denmark and UK. The brochure presents two sets of comparison, one involving the general situation of the market for EV's and hybrid vehicles in the three countries and one involving the safety standards in different professional fields in the three countries. The comparisons are only indicatory and exemplary and offer a general view of the actual situation of three countries' urban mobility and also the work related aspects of having EV's and hybrid vehicles on the roads.

The clean mobility systems SPAIN

Type (Vehicle /Infrastructure)

Electric Cars

The population of Spain is
46, 449, 565 people.

There are 44 different models of electrical vehicles in Spain, 175 electric motorcycles and 177 electric bikes.

Charging points

Spain has 24691 (www.electromaps.com) charging points, in Madrid there are 237 public charging points , in Barcelona 413, in Valencia 108 and in Basque Country 138. Posts are delivered by different companies, Endesa, IBIL (www.ibil.es) OEMs (Renault, Nissan, Tesla…), besides the chargers delivered by public institutions, municipalities, hotels and restaurants.

The standard UNE-EN 61851 (conductive charging system for electric vehicles), defines the types and requirements for load models that will use electric vehicles in Spain. The proposed classification and characteristics are shown below:

1. Load mode in base outlet non-exclusive use. Using a standard outlet but not exclusively for electric vehicles VE connection to the AC mains with a maximum allowable intensity of up to 16 A.a way to load privately considered; although in some countries such as USA, it is prohibited.

2. Base standard outlet not use with protection included in the cable. Connection of electric vehicles to a base standard power outlet, via a special cable that has a control pilot conductor (between VE and pin) and a system of differential protection. maximum intensity allowable charging up to 32 A

3. Special power for use to recharge electric vehicles. charging station for the exclusive use of electric vehicles (SAVE dedicated, specific power system Electric Vehicles), it enables “intelligent” communication between the vehicle and the operator of the electricity system. maximum intensity allowable charging up to 32 A (although it may be extended to 64 A)

4. Connection mode current (d.c.). The electric vehicle is connected to the low voltage network through a dedicated SAVE within the docking station’s C.A / d.c. conversion takes control functions and protection they are on the side of the fixed installation. This model is designed for fast charging with currents up to 400 A

BEST PRACTICES

Procurement for public ‘electromobility’ in Barcelona.
While Barcelona’s network is already one of the cleanest in Europe thanks to its hybrid and Compressed Natural Gas (CNG) buses and the retrofitting of its diesel vehicles with particulate filters, the public transport operator Transports Metropolitans de Barcelona (TMB) has decided to integrate fully-electric buses into its fleet. This started with the purchase of a BYD K9 bus and two IRIZAR buses. A tender for two additional electric buses was subsequently published in January 2014. These two extra buses (along with the IRIZAR buses) are part of the EU ZeEUS project which aims to introduce electric buses into the fleets of European municipalities

Number of users

Electrical Vehicles in Spain:

In January 2015 the number of electrical vehicles sold in Spain were 82. In January 2016 the number of electrical vehicles sold in Spain were 242.
Increase was about 195,12%.

In 2016 there will be at least nine new models of electrical vehicle s on the market.

The majority of users
are professionals working either in industry or in state institutions/municipalities.

Hybrid Vehicles in Spain:

In January 2015 the number of hybrid vehicles sold in Spain were 1471. In January 2016 the number of hybrid vehicles sold in Spain were 2127.

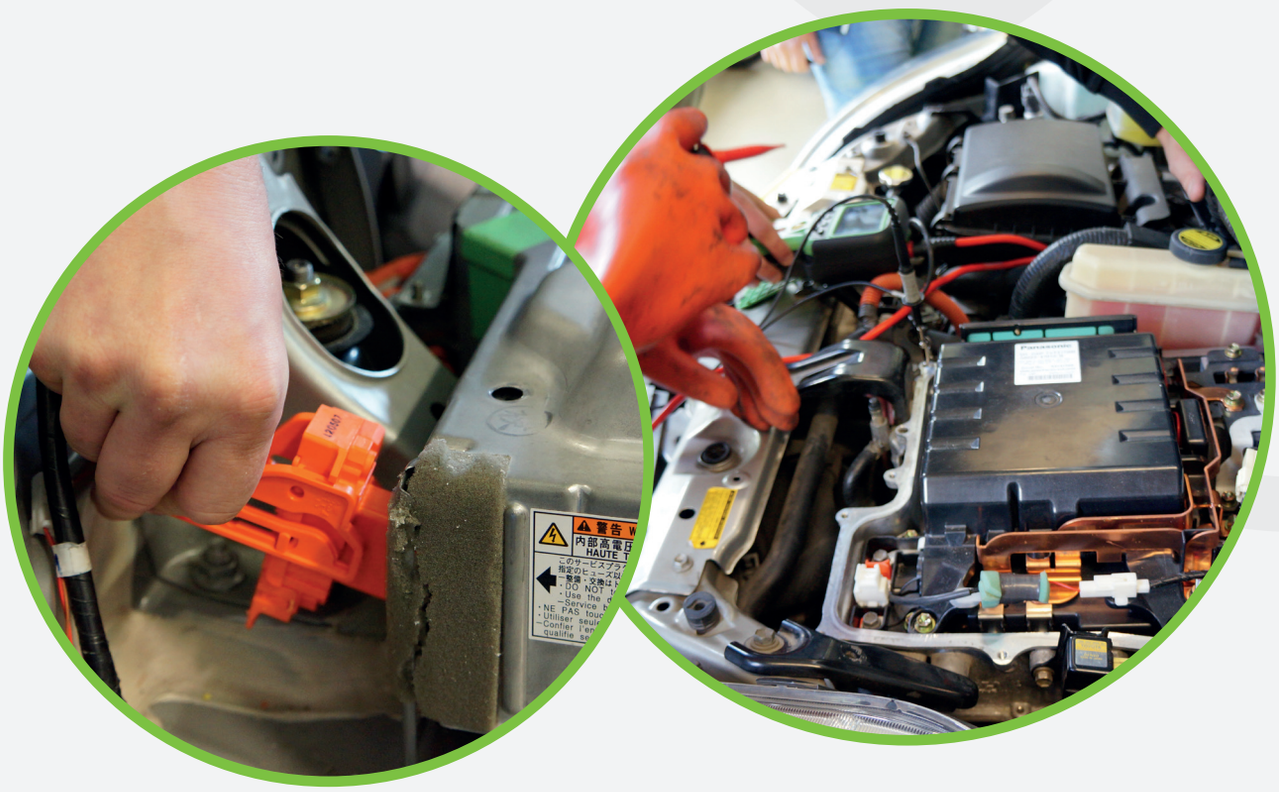
Increase was about 44,60%.

Best practices.

Post Group announces the acquisition of 25 vans and 100 electric motorcycles last generation.

The environmental commitment under Correos is remarkable with new vehicles want to keep the challenge of reducing CO2 emissions. Currently, the percentage reduction of contamination of the pool falls by 33%

The models were selected according to the criteria of need that the company, in this case prevail autonomy, loading, technical performance and profitability. For vans, the model selected was the Renault Kangoo ZE, with a range of 170 kilometers, they will be distributed by the cities of Madrid, Barcelona, Valencia and Sevilla.
For motorcycles, it has joined one model Scutum. The autonomy of the electric motorcycle is 70 kilometers and would be operational by the end of the first quarter of 2016. The cost of the 100 motorcycles amounted to 375,000 euros. In addition to the 363,527 euros that cost the electric vans, the total cost of the acquisition is 738,000 euros.



Environmental impact /Energy consumption

Energy consumption

1. The average consumption of current electric vehicles is 14 kWh / 100km.

2. The average emissions of Spanish electrical generation mix is KgCO2 0.234 / kWh.

3.The consumption of a diesel vehicle (approx. 100 hp) is 5 L / 100km.

4. The emissions per liter of diesel consumed is 2.67 kgCO2 / L

According to these values of CO2 emissions generated by an electric vehicle and a motor vehicle diesel per 100 kilometers, it would be close to 3.3 KgCO2 KgCO2 and 13.3, respectively. The balance is clearly positive for the electric vehicle.

Environmental impact

Spain is one of the countries with the worst air quality in the Europea22 Union. The Spanish Environment Ministry amounted to 16,000 premature deaths caused by pollution in Spain in 2010, a number seven times greater than those killed in traffic accidents (1,710 in 2010).
As it indicated in some studies, reducing these compounds could make a significant improvement in areas such as environmental or related to public health:
Reducing the levels of PM 2.5 to 20 pμ / m3 in Barcelona, Madrid, Bilbao, Seville and Valencia, 11,375 deaths would be avoided.
In Barcelona, if the current level of PM10 50 pμ / m3 to 40pμ / m3 were reduced, 1,200 deaths a year, 390 admissions for respiratory diseases, cardiovascular diseases 2010 revenues and 1,900 people get sick less than bronchitis is avoided.

Government incentives /Policies

Spanish policies to promote sustainable mobility focuses on the following objectives:

1. Shaping a more efficient transport to improve the competitiveness of the productive system.

2. Improve social integration of citizens, providing access to all citizens.

3. Increase the quality of life of citizens.

4. Not compromise the health of citizens.

5. Provide more security on the go.

Spanish incentives for purchasing an electric/hibryd vehicle are:

M1 (cars), N1 (commercial), M2 (coaches to 5.000kg), M3 (over 5,000 kg coaches), N2 (trucks up to 12,000 kg), and L5e L3e (motorcycle more than 45 km / h), L6e and L7e (light and heavy quadricycles).
The amount of the grant categories M1, N1, L6e, L7e, and L3e L5e be 25% of its retail price before taxes and to a maximum of:

Max	Range	(a)
2000€	15 km	< a <40km
4000€	40 km	< a <90km
6000€	90 km	< a

Basque Country

The Basque Energy Board (EVE) has launched a series of measures to encourage the purchase of efficient vehicles, consisting of a non-repayable grant of 10% of the vehicle cost, excluding taxes, up to 2,000 euros.

Garages companies for fleets of electric vehicles:

Investment concept	Maximun eligible cost	Economic aid
Full installation of a charging point with power less than 40 kW	4.000€	Up to 30% of the eligible cost with a maximum of 1.200€
Full installation of a charging point with power more than 40 kW	50.000€	Up to 30% of the eligible cost with a maximum of 15.000€
Centralized control and management system of charging	50.000€	Up to 30% of the eligible cost with a maximum of 15.000€

Independent points of recharge and networks of charging stations for public use:

Investment concept	Maximun eligible cost	Economic aid
Full installation of a covered charging point with power less than 40 kW	4.000€	Up to 40% of the eligible cost with a maximum of 1.600€
Full installation of a public road charging point power more than 40 kW	6.500€	Up to 40% of the eligible cost with a maximum of 2.600€
Battery replacement station	60.000€	Up to 40% of the eligible cost with a maximum of 24.000€
Centralized control and management system of charging	50.000€	Up to 40% of the eligible cost with a maximum of 20.000€
communication campaign (only for recharging networks)	6.000€	6.000€

Cost per person

PURCHASE

Well, now, using fairly new technologies, trying to use, whenever possible, the latest in battery to have longer life, faster recharging or more energy density, and especially because still made very few electric motors for cars, traction batteries for cars, car chargers ... etc., the manufacturing cost of an electric car is greater than that of a conventional car.

As for taxes on the purchase, electric cars also pay the same tax than any other car in Spain is 21%, and then pay a 0% tax, due to its very low emissions. Stating that many cars with internal combustion engine also pay a 0%: those whose CO_2 emissions are less than 120g / km (many SUVs and compact usually accomplish this)

INSURANCE

In general we can say is that the cost of insurance for an electric car is very similar to that of an equivalent conventional car of similar price. They are taking some instances where you get to see the price of an electric car insurance is between 5 and 15% cheaper, but not always.

Price municipal road tax

As electric cars of interest to the cities because they are zero local emissions, try to encourage them a little reducing what you have to pay tax through a bonus share (ie, a discount). There are several cities that do, for example, in Madrid the bonus is 75%.

Cost of energy consumed.

Although electricity in Spain is one of the most expensive in the European Union, it remains very account to kilometers with an electric car as gasoline or diesel are not anything cheap. With that car make gasoline can cost 100 km theoretically and approval according to the order of about 6.65 euros (1.33 liter gasoline euros).

With the electric car “type”, do 100 km can cost around 2.15 euros, all taxes included, but if you have the rate of time-based discrimination supervalle, recharging at night the cost is slightly less than half, 1 euro, with all taxes included (with current prices of electricity in Spain, just over 12 cents per kWh at the normal rate, slightly less than 6 cents per kWh in the supervalle rate, plus taxes corresponding).

Type (Vehicle /Infrastructure)

Electric Cars
The population of Denmark is
5, 668, 743 people.

There are 28 different models of electrical vehicles in Denmark plus variants.

Denmark has 988 charging points, in Copenhagen there are 245 charging points alone. Posts are delivered by three different companies, EON, Clever og Cleancharge, besides the chargers delivered by public institutions, municipalities, hotels and restaurants.
The chargers are of different types:
CHAdeMO
Combo 2
IEC Type 1
IEC Type 2
Super charger

Type (Vehicle /Infrastructure) Public Transport - Hybrid Busses

Electrical busses and hybrid busses are still in an experimental phase in the cities of Denmark. However, some municipalities have tested and invested in hybrid busses.

2015, the Odense hybrid/diesel project.
Odense city has invested in 18 parallel-hybrid diesel busses to run the public transport of the city together with the existing diesel busses. Twelve of the busses are delivered by Volvo and six from Scania.
The technology of the Odense hybrid/diesel busses is a parallel system where the electrical engine and the diesel engine can work both on a parallel basis and independently. The electrical engine is for starting the bus and acceleration up to 20 km. per hour and it can function as engine and alternator. At higher speeds the diesel engine takes over and runs the bus.
When the busses brake, the friction accumulates energy to be used for starting the bus again.

The electrical engine has a very low noise level and in this way the public will experience very silent busses and people living nearby bus stops will notice the lower noise level of the public transport.

Number of users

Electrical Vehicles in Denmark: 7842 December 2015.
In 2015 the number of electrical vehicles in Denmark doubled.
In 2016 there will be at least nine new models of electrical vehicle s on the market.
In 2015 4523 new registrations of electric vehicles in Denmark.

The majority of users
are professionals working either in industry or in state institutions/municipalities.

Example from Odense City:
Between 60,000 and 70,000 people use the busses in Odense and suburbs a month.

Example from Ålborg and Copenhagen:
2013 – Both cities testes 6 hybrid diesel busses of the make Volvo 7700 Hybrid.

Other public traffic companies use other strategies than hybrid and electric vehicle and work with the improvement of the bus drivers' driving skills and other energy systems such as for example biofuel systems.

Environmental impact /Energy consumption

Over the last five years many municipalities in Denmark have analyzed their vehicle fleet for different specific purposes in the public service sector. For example Fredericia Municipality, a midsized city in Denmark, would potentially be able to save 25 per cent by simply buying electric vehicles when replacing old vehichles. At the same time the city would improve it CO" budget with a reduction of 20%.
Research has shown that:

•Electric vehicles can easily cover the transport job for public service vehicles of the municipalities
•Central leasing and buying contracts with suppliers can save money
•Electric vehicles are competitive in price (excluding charging infrastructure) *and are cheaper in energy usage due to the use of less fuel/energy, less tax, less maintenance and insurance discounts*
•Electrical vehicle give a reduction in the CO2 budget of ½-1½ ton per year per car
•Employees are happier, because they are part of a green movement
•Companies benefit by advertising progress and a green policy

A total cost of ownership, TCO Calculator, is available, so that companies and public institutions can calculate the cost of an electric powered fleet service

http://87.54.37.86/TcoBeregner/(S(555b04xonwpqgm1ey12lcdz4))/default.aspx

2015, the Odense City hybrid –diesel bus project:

Tests show that the parallel-hybrid busses use approximately 20 per cent less diesel fuel when driving in the city centre og the emission of the busses is 20 per cent lower and the other diesel busses running in Odense.

Government incentives /Policies

Copenhagen: a city with a vision. Copenhagen is to be carbon neutral by 2025.

Arriva, the city of Copenhagen and 400 electric vehicle BMWs.

Since September 2015 citizens in Copenhagen and visitors can use their travel card for public transport to book one of 400 EV BMWs to travel through the city. The system is called "Drive now".
People can locate and reserve a car nearby, wherever they are by using the Drive-Now App. You can park the car and end the booking at any time within the business area. The Drive-Now does not have any stationary return locations. No commitments. No electricity costs. Just drive. Insurance, car tax, parking – all included

Local Municipalities initiate different strategies and work with government-initiated projects.

Odense City Municipality have decided on a 2020 green strategy for the public transport of Odense and it is the intention that Odense will invest in even more parallel-hybrid and full electrical busses over the next decade

Cost per person

Nissan Leaf available from 33.000 - 38.000 euro in Denmark
160 km of motoring in a Nissan Leaf costs around
5,50 Euros

Electric cars
Prices are almost similar to conventional cars at the moment, due to the Danish tax system.

In Copenhagen a single fares cross the city centre average around 3 Euros per person

The clean mobility systems UK

Type (Vehicle /Infrastructure)

Electric Cars

38 different models available in the UK (plus variants)

9,388 Charging points in the community plus home charging capability

There are three main EV charger types: 'slow' charging units (up to 3kW) which are best suited for 6-8 hours over-night; 'fast' chargers (7-22kW) which can fully recharge some models in 3-4 hours; and 'rapid' charging units (43-50kW) which are able to provide an 80% charge in around 30 minutes. Rapid chargers also come in two charge point types – AC and DC – depending on whether they use alternating current or direct current.

Monthly figures published by the Society of Motor Manufacturers and Traders (SMMT) show that electric car sales in the UK have raised dramatically during the past 12 months. While only around 500 electric cars were registered per month at the start of 2014, this has now risen to an average of around 2,400 per month in 2015. As a percentage of new car registrations, electric cars now represent just over 1% of the total new car market in the UK.

Sources:

www.nextgreencar.com

www.herefordshire.gov.uk/media/755749/home_charge_faqs_v2_250614.pdf

Public Transport– Buses

The definition of a LCEB is as follows:

"A Low Carbon Bus produces at least 30% fewer Greenhouse Gas Emissions than the average Euro 3 equivalent diesel bus of the same total passenger capacity. The Greenhouse Gas (GHG) emissions will be expressed in grams of carbon dioxide equivalent measured over a standard test, and will cover "Well-to-Wheel" (WTW) performance, thereby taking into account both the production of the fuel and its consumption on board".

Source:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/205956/certification.pdf

Public transport such as buses can be powered by a wide range of fuel types, such as:

- **Compressed Natural Gas**
- **Bio-methane / biogas**
- **Hydrogen fuel cells**

The above represent a selection that is available.

In the UK especially in major city's such as London, the majority are powered via a Diesel – Electric HybridMotor

WTW CO2eq emissions savings can reach around 30% compared to traditional diesel buses, as can tailpipe Emissions, However this varies according to what extent the electric motor is used. It is strongly dependent on the duty cycle, the topography of the route, congestion and driver efficiency.
This is now a reasonably mature technology, with similar reliability to a standard Diesel bus.

Draw backs - Diesel is a fossil fuel.

Number of users

48,000 cars registered in the UK (JAN 2016)

2900 Vans registered in the UK (JAN 2016)

38 different models available (plus variants)

In the year ending March 2015:

There were an estimated 5.16 billion bus passenger journeys in Great Britain, around two-thirds of all public transport journeys, of these 4.65 billion journeys were in England, of which more than half were in London.

Bus passenger journeys in England decreased by 0.6% compared with the previous financial year

There were around 9.8 million older and disabled concessionary bus passes in England, with an average of 102 bus journeys per pass per year.

Bus mileage in England decreased by 0.6% when compared with the previous year. This was largely due to 10% reduction in mileage on local authority supported services outside London.

Source:
https://www.gov.uk/government/collections/bus-statistics

Environmental impact /Energy consumption

Electric cars produce zero emissions at source. However, the electricity needed for charging is produced in largely coal fired power stations in the UK which emit high CO2 or Nuclear powered stations which have issues around hazardous nuclear waste. If more was done to capture wind, wave or solar energy this could be a clean solution to our electricity production.

Mileage is limited to 100 miles a day.

A report at a UN Habitat III meeting ahead of Ban Ki-Moon's climate summit.
Presentedfindings from a study by researchers from the University of California, Davis, and the Institute for Transportation and Development Policy (ITDP).
It calculated that emissions from urban transportation could be cut by more than half by 2050 and economies save in excess of US $100 trillion.
It also added that it would reduce annual premature deaths by 1.4 million.

The report also states that, without changes in policies and investments, rapid urbanisation will result in emissions from urban transportation almost doubling from 2010 levels by 2050. Road will become gridlocked and infrastructure will not cope with the demand.

Source:
http://www.bbc.co.uk/news/science-environment-29207644

Government incentives /Policies

Department of Transport offering the Plug-in grant 25% of the cost of an electric car; and zero road tax.

More than 49,500 claims have been made through the Plug-in Car and Van Grant schemes (as of February 2016).

During the last election MPs were also heard making pledges to install recharging points in local communities as part of their electioneering.

The UK Governments Green Bus fund helps bus companies and local authorities in England to buy new low carbon buses. Its main purpose is to support and hasten the introduction of hundreds of low carbon buses across England.

Various fee reduction charges are available depending on individual circumstances such as age, job or disability.

In London single fares average £1.50 per person, aimed at encouraging the use of public transport.

Various European Laws governing emission levels from Diesel engines such as EURO V and EURO VI

London has operated one of its entire routes on eight hydrogen fuel cell buses since 2011 and a refuelling station has been built in the City. Despite the fact that hydrogen buses are expensive, TfL decided to purchase the vehicles, thus gearing hydrogen buses towards commercialisation and
making them more affordable for future purchasers. The three main objectives of TfL's project were to reduce CO2 emissions, to improve air quality and to reduce noise pollution as the hydrogen buses are quieter than their diesel powered predecessors.

Source:
http://www.clean-fleets.eu/fileadmin/files/Clean_Buses_-_Experiences_with_Fuel_and_Technology_Options_2.1.pdf

Cost per person

Nissan Leaf available from £15,790 - £24,490

100 miles of motoring in a Nissan Leaf costs around £2 if the car is charged with off-peakelectricity

Electric cars are more expensive to buy than conventional cars, and at the moment there is no second hand market.

Mileage and maintenance costs tend to be lower than conventional vehicles.

According to Next Green Car, for an annual mileage of around 10,000 miles, switching from a conventional vehicle to an electric could save £800 in fuel costs alone.

Fares vary depending on individual circumstances such as age, job or disability.

In London single fares average £1.50 per person, aimed at encouraging the use of public transport.

Costs of acquisition of a Diesel – Electric Hybrid can be 50% more when compared to traditional diesel buses.

Spain: Existing safety rules and legislation for hybrid and electrical

National legislation

Today, in Spain there is no individual qualification for an operator of a workshop on handling and repair of hybrid and electric vehicles.

Despite not having a policy of prevention of electrical risks adapted specifically to electric vehicles, manufacturers are governed by the regulations in force to meet the specifications required by the Law on Prevention of Occupational Risks.

• Law 31/1995 on Prevention of Occupational Risks transposition of the Framework Directive 83/391 is collected. Article 20 of this law states that all employers are obliged to analyze the possible emergencies that may arise in your company and to adopt, among other measures, which, in first aid, reveal that analysis and have the means that marks prevention regulations for first aid assistance in case of accident.

• Minimum standards for the protection of the health and safety of workers from electrical risk provisions are contained in Royal Decree 614/2001, of June 8 (BOE, June 21, 2001).

Other applicable regulations are:

- **Royal Decree 486/1997, of April 14, laying down minimum safety and health are established in the work-place.**
- **Royal Decree 486/1997, of 14 April, on signalling safety and health at work.**
- **Royal Decree 773/1997, of May 30, on personal protective equipment.**
- **Royal Decree 1215/1997, of July 18, on work equipment**

And finally:

The UN / ECE Regulation No 100 UONU approval of electric vehicles recognized as dangerous vehicles those with voltages between:
60V-1500V DC
30V-1000V AC

Police /Rescue services

panish Police: No guide available specifically for police working in traffic. In Basque Country police staff is beginning to work according to the guidelines from the Sueskola Foundation.

Spanish ambulance service:

To be found out

Spanish Fire Brigade:

Work according to the guidelines from the SUESKOLA.
It is a Training Center Fire Prevention and Fire, which uses an innovative technology with real fire, making it a pioneer in Basque Country and the rest of the state.
www.sueskola.net

Roadside assistance:
The two main entities roadside assistance, offers no special training to technicians roadside assistance.

RAC: http://www.race.es

RACC: www.racc.es

Unique initiative is that DGT (National Traffic Agency) sent to owners of electric vehicles a distinctive identifying them as non-polluting.

Independent garages

Independent garages

Staff, mechanics and body-car technicians , from the independent garages in Spain are not prepared to work with safety protocols about hybrid and electrical vehicles.
Main of these vehicles (98%) are sent to authorized dealers.

Only a few Technical Colleges, including San Viator Centre, deliver a basic course for professional in the automotive sector as well as a safety course for working with hybrid- and electrical
vehicles inside adult continuous education.

There are no set standards or rules for the different chains of independent garages.

EuroTaller: *to be found out*

Bosch Car Service: *to be found out*

Authorized dealers

Each manufacturer of hybrid-electric vehicles provides an own guidelines for the authorized dealers across Spain.

This guidelines usually include:

1. Protocols to plug and unplug High voltage systems.
2. Safety rules and Individual Protection Equipment.
3. Levels of training for staff according to his function in the authorized dealer.

All staff from authorized dealers can also attend the safety course under branch.

Best practice.

BMW: Two levels of qualification for workshop technicians. Staff has a qualification level to interpret signs and restricted areas, Level 2 allows work on high voltage systems, both disconnection and repair work.to be found out

Nissan: *to be found out*

Renault:
Three skill levels:
1 Anyone dealer.
2. Car technicians and body-car .
3. Specific technicians for disconnection and battery replacement.
To be found out more description

Mercedes: *to be found out*

Schools /Educational staff

There are no guidelines or rules for teachers from automotive departments at technical colleges and other school systems.

The Department of Education does not detailed in nothing specific curriculum on safety standards in electric or hybrid vehicle.

Only it refers to the Law on Prevention of Occupational Risks mentioned in the first column of this document

However, it would be normal procedure that teachers attend to courses on new electric and hybrid vehicles in service training programs funded by the education department. These let them to update protocols and index car for new models.

Vocational education:

In Basque Country all automotive students and apprentices will get a short safety course " Safety on hybrid- and electrical vehicles" designed by San Viator Center in collaboration with TKNIKA http://www.tknika.eus as part of their education as a mechanic or body car repair.

Denmark: Existing safety rules and legislation for hybrid and electrical

National legislation

In Denmark there is no national legislation concerning safety rules for working with hybrid- and electrical vehicles.

Dansk Teknologisk Institut (DTI).
(The Danish Technological Institute) is a self-owned and not-for-profit institution.
They develop, apply and disseminate research- and technologically-based knowledge for the Danish and International business sectors.

January 2016 DTI published a guideline for working with and handling hybrid- and electrical vehicles.
The guideline commissioned by Industriens Branchemiljøråd (environmental council for industry), the guideline is available at the link below

Sikkerhedsstyrelsen (SIK)
They Danish Safety Technology Authority has no guidelines or legislation for professionals working with hybrid- and electrical vehicles.
They have published a few guidelines for owners of hybrid- and electrical vehicles regarding charging and cables.

March 2014
Håndværksrådet
(Branch organization for small and medium sized companies) published the results of a survey about hybrid- and electrical vehicles in automotive workshops. The survey shows that the majority of the independent workshops feel that they have the relevant safety competences amongst their staff and that they can easily adjust to new type of vehicles by following the manufacturers' guidelines
http://www.hvr.dk

Best practice:

The best national guidelines for working with hybrid- and electrical vehicles are provided by Danish Emergency Management Agency.
http://www.brs.dk

Police /Rescue services

Danish Police:
No guide available specifically for police working in traffic. Police staff must like the Danish Fire Brigade work according to the guidelines from the Emergency Management Agency in Denmark.

Danish ambulance service:
Not within the area of their working field. They must wait for police, fire brigade and roadside assistance.

Danish Fire Brigade:
Work according to the guidelines from the Emergency Management Agency in Denmark.

All staff from Danish state institutions working with the automotive sector or public traffic can also attend the safety course under the AMU-system. (see description below)

Roadside assistance:
Dansk Autohjælp: Staff can attend the safety course under the AMU-system (see description below)

Independent garages

Staff, mainly mechanics, from the independent garages in Denmark are regular course participants in the courses under the AMU-programme for adult continuous education. Technical Colleges deliver a variety of technical courses for professionals in the automotive sector as well as a safety course for working with hybrid- and electrical vehicles (see description below).

There are no set standards or rules for the different chains of independent garages.

Autopartner: Garages can send staff to attend a safety course on a voluntary basis

AutoMester: to be found out

Authorized dealers

The branch organization for authorized dealers, Industriens Branchemiljøråd, has commissioned a guide.
See link below

In addition, the car import centres in Denmark provide guidelines from the manufacturers for the dealers across Denmark.

All staff from authorized dealers can also attend the safety course under the AMU-system. (see description below)

Best practice

Nissan: Nissan Import DK provides the dealerships with the required education for professionalswho work with hybrid and electrical Nissans

Renault: Renault Import DK provides the dealerships with the required education for professionalswho work with hybrid and electrical Renaults

BMW: BMW Import DK provides the dealerships with the required education for professionalswho work with hybrid and electrical BMWs

Schools /Educational staff

There are no guidelines or rules for teachers from automotive departments at technical colleges and other school systems. However, it would be normal procedure that teachers attend for example the safety course “safety on hybrid- and electrical vehicles” under the AMU-programme before working with the subject of hybrid- and electrical vehicles and battery technology in their teacher job.

Vocational education:
All automotive students and apprentices will get a safety course “ Safety on hybrid- and electrical vehicles” as part of a module about hybrid and electrical vehicles in their education as a mechanic (EQF level 4).

Safety course available for all professionals in the automotive sector, private and public:

“Safety on hybrid- and electrical vehicles”, a course for professionals under the programme for continuous qualification training provided by technical colleges like SDE College or AMU-schools (AMU- Labour Market Courses under Ministry of Education and the Ministry of Labour Market). This course was described and available in 2010.

England: Existing safety rules and legislation for hybrid and electrical

National legislation

No specific national legislation is in place for working on Hybrid or Electric vehicles.

The UK Health and Safety Executive recommends that all those working on or with such systems undertake training.

Employers may be prosecuted by HSE or individuals if they are found guilty of not providing suitable care for workers under the Health and Safety at Work Act 1974. Often referred to as HASAW or HSW, this Act of Parliament is the main piece of UK health and safety legislation. It places a duty on all employers “to ensure, so far as is reasonably practicable, the health, safety and welfare at work” of all their employees.

Police /Rescue services

In the UK, Emergency services are seeking their own training by region.

Many fire crews and police officers have sourced training with a local college or training provider with no real national focus or drive from Government.

Independent garages

No legislation or common safety rules in place. The Institute of the Motor Industry (IMI) recommends training and are talking with UK Government to pass Law that you must be qualified to work with High Voltage vehicles. However this looks unlikely to come into force in the near future.

Authorized dealers

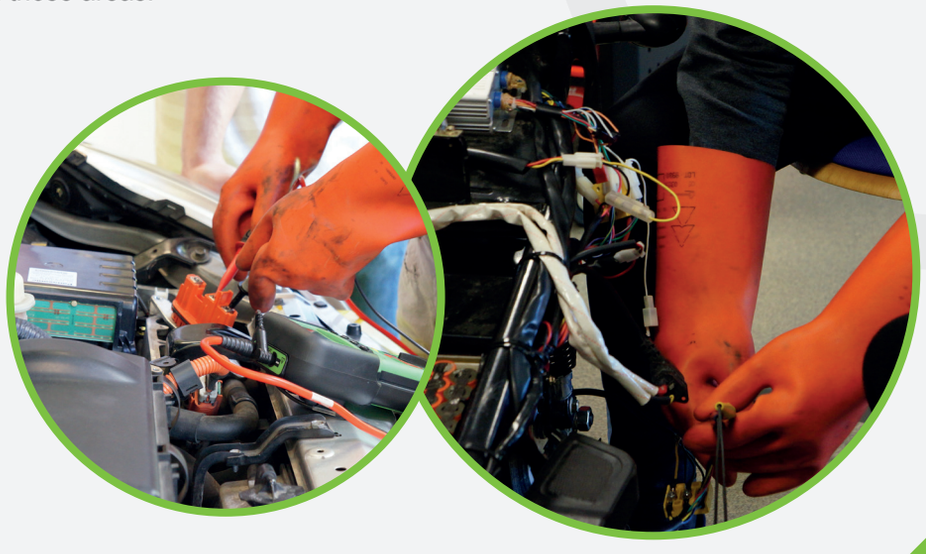
All authorised dealerships in the UK with an EV Range are providing model specific training to the technician network as new models are released on the UK market.

Dealerships are not permitted to allow unskilled or untrained technicians to work on such systems without having passed the course.

Schools /Educational staff

UK College staff delivering Automotive are required to complete 15 – 30 hrs Continues professional development per year. Hybrid and Electric vehicle training can be part of that training.

Hybrid and EV topics are not yet part of the curriculum being taught to our students at College so many staff members are not focusing on the need for CPD in those areas.



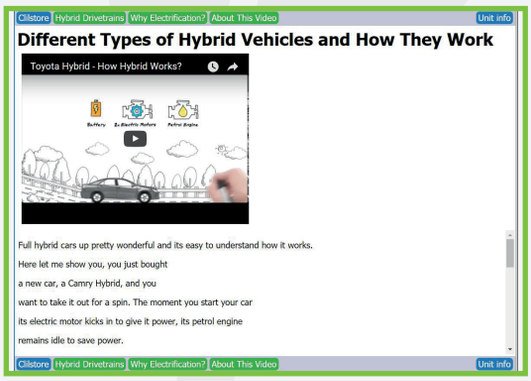
E-learning materials

The EUMOB project promises to deliver an online training programme about urban mobility in general and safety and maintenance procedures on hybrid and electrical vehicles. The online training programme consists of seven units where students can get specific information through educational videos, text and an easy-to- use translation software called Wordlink. The units are free to use for every one and are accessible through the EUMOB website. The units also include small self-tests where students can test themselves on the specific area of knowledge. The headlines of each unit are as follows

Basic concepts

In this unit students can learn about the background for the ongoing research in and development of new types of energy sources for vehicles. The students can get information about global warming and the reasons for global warming.

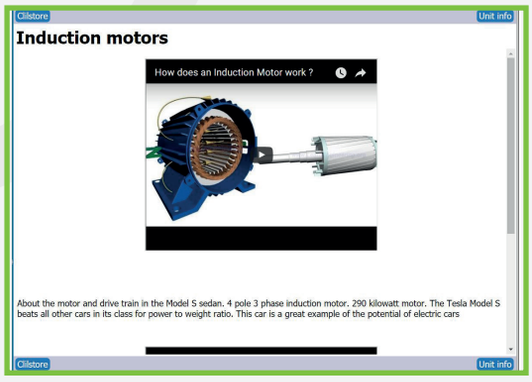
1



Different hybrid vehicles

In this unit students can learn about different types of hybrid vehicles and electrical vehicles in general terms. Videos and articles explain about different vehicle types. Students can see exploded views of vehicles and get technical information about the basic principles of electrical vehicles and hybrid cars.

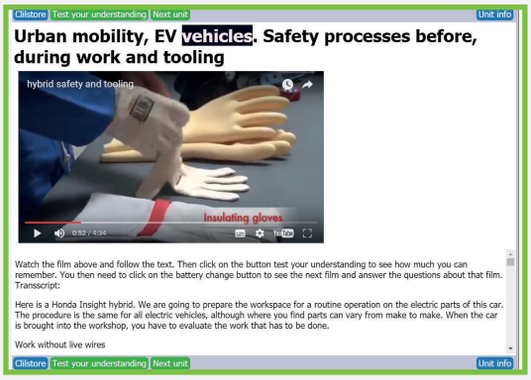
2



Systems and components

This unit supplies the students with technical data and technical explanations about electric motors, drive trains, battery packs and energy use. Videos, diagrams and articles explain specific elements and specific parts of electrical vehicles.

3



Safety

4

In this unit the students learn about the safety issues related to working with hybrid and electrical vehicles.
The unit describes the safety hazards of working with electrical vehicles as mechanic and the unit also gives information about how to work step by step in order to work maintain an electrical vehicle in a safe way. Videos and small tests will give students the basic knowledge concerning safety and maintenance.

Future developments

5

In this unit students learn about some of the develoments of the future such as driverless vehicles, light

weight materials, connected vehicles and infra structure and services of the future etc. etc.

The Dynacar

6

This is not a unit like the others. This unit merely explains the purpose of the Dynacar. The Dynacar is a simulation tool developed for the EUMOB project. It is a simulation tool that VET teachers can use with their automotive students. Students can simulate the experience of driving an electrical vehicle and can adjust many different parametres such as mileage, speed, weight etc. etc. in order to test the output and efficiency of the batteries for example.

Electrical vehicles today – three examples

7

This final unit gives the students three examples of existing hybrid or electrical vehichles. The three examples provide the students with the possibility of comparing three car makes and their electrical cars. All three examples are of cars that are available on the market today. The three car makes are BMW, Tesla and Mitsubishi

E-learning materials

1. *Basic concepts*
2. *Different hybrid vehicles*
3. *Systems and components*
4. *Safety*
5. *Future developments in urban technology*
6. *Dynacar – a test tool for students*
7. *Electrical vehicles today – three examples*

In the EUMOB project automotive students from Spain, the UK and Denmark have tested the online units two times in the project period. In both test rounds the students have worked through the online units as preparation before an international mobility where they would travel to a partner country and participate in an onsite course. This means that the online units function as the first part of a full course in the subject area of safety and maintenance on hybrid and electrical vehicles for automotive students. The learning outcomes of the completed course are all level 4 according to the European Qualification Framework.

The online units can be used for training students in different ways. They can be used as supplementary teaching materials for the topic of hybrid and electrical vehicles for automotive students in their national VET-education, they can be used as study materials for lessons in technical English, in specific content and language integrated learning (CLIL) and they can be used as preparation for an international mobility where students work with all the online units before going abroad and participating in an onsite module “Safety and maintenance in hybrid and electrical vehicles. The learning outcomes for the international safety course for automotive students are thus as follows:

- The student can carry out work processes on or nearby no-voltage/high voltage electrical systems on hybrid or electrical cars
- The student can use, inspect and maintain safety tools and health and safety equipment correctly when working on hybrid or electrical vehicles (following safety standard EN60900)
- The student will acquire a basic knowledge about how to deal with first aid in relation to injuries caused by work on hybrid and electrical vehicles.
- The student will know the hybrid and electrical system components and operation and will know how to carry out basic maintenance and fault finding
- The student will know the construction and function of battery modules, charging technologies, e.g. regeneration, plug-in, and battery monitoring
- The student will know the basic principles about electrical engines, hybrid systems, e.g. converter and inverter systems.

Recommendations for common Safety Rules for Working on Electric Vehicle (HEV) and Hybrid Electric Vehicles (PHEV).

Technicians need to be aware of the additional hazards that exist when working with these vehicles. E&HVs introduce additional hazards into the workplace to those normally associated with the repair and maintenance of vehicles.

Voltages present in E&HVs can be up to 650 Volts direct current (dc). Accidental contact with parts that are live can be fatal.

There are substantial differences in the designs of E&HVs from different manufacturers. Having information specific to the manufacturer and the vehicle being worked on is important in identifying what actions are necessary to work safely.

Risks of working with E&HVs

- *fatal electric shock.*
- *the storage of electrical energy with the potential to cause explosion or fire.*
- *components that may retain a dangerous voltage even when a vehicle is switched off.*
- *electric motors or the vehicle itself that may move unexpectedly due to magnetic forces within the motors.*
- *manual handling risks associated with battery replacement.*
- *the potential for the release of explosive gases and harmful liquids if batteries are damaged or incorrectly modified.*
- *the potential for the electrical systems on the vehicle to affect medical devices such as pacemakers.*
- *Remote operation keys that only need to be close to the vehicle for the vehicle to be powered up should be kept away from vehicles. This is to prevent the vehicle from accidentally moving.*
- *People who move these vehicles around the workplace should be aware that others may not hear it approaching them. Similarly, people who work around E&HVs should be aware that they may move without warning.*

Always locate the vehicle within an area that can be secured and barrier off such that people who could be put at risk are not able to approach the vehicle. Warning signs should be used to make people aware of the dangers.

Pressure washing has the potential to damage high voltage electrical components and cables. High voltage cables are usually coloured orange.

Refer to guidance from manufacturers before valeting in any under body areas including the engine bay.

Vehicles should be visually checked for signs of damage to high voltage electrical components or cabling (usually coloured orange). Consider whether the integrity of the battery is likely to have been compromised. Shorting or loss of coolant may present ignition sources in the event of fuel spillage. If the vehicle is damaged or faulty, and if safe to do so, isolate the high voltage battery system using the isolation device on the vehicle.

Refer to manufacturer's instructions for guidance.

During any recovery onto a recovery vehicle, the remote operation key should be removed to a suitable distance and the standard 12/24v battery disconnected to prevent the vehicle from being activated/started.

Remote operation keys should always be kept away from the vehicle to prevent any accidental operation of electrical systems and accidental movement of the vehicle. Keys should be locked away with access controlled by the person working on the vehicle. If the key is required during the work the person working on the vehicle should check that the vehicle is in a safe condition before the key is retrieved.

Have access to reliable sources of information for specific vehicle types.

Avoid towing E&HV vehicles unless it can be determined that it is safe to do so. Dangerous voltages can be generated by movement of the drive wheels.

Unless a specific task requires the vehicle to be energised always isolate or disconnect the high voltage battery in accordance with manufacturer's instructions.

Determine the locations of high voltage cables before carrying out tasks such as panel replacement, cutting or welding. Take appropriate precautions to prevent them from being damaged.

High voltage systems should be isolated (that is the power disconnected and secured such that it cannot be inadvertently switched back on) and proven dead by testing before any work is undertaken. Always isolate and lock off the source of electricity and in accordance with manufacturer's instructions. You must always test and prove that any high voltage cable or electrical component is dead prior to carrying out any work on it.

Even when isolated, vehicle batteries and other components may still contain large amounts of energy and retain a high voltage. Only suitable tools and test equipment should be used. These may include electrically insulated tools and test equipment.

Some electronic components may store dangerous amounts of electricity even when the vehicle is off and the battery isolated. Refer to manufacturers data on how to discharge stored energy.

There may be circumstances (after collision damage) where it has not been possible to fully isolate the high voltage electrical systems and to discharge the stored energy in the system. Refer to the manufacturer's instructions about what controls measures should be implemented before attempting to carry out further remedial work.

Battery packs are susceptible to high temperatures. The vehicle will typically be labelled advising of its maximum temperature and this should be considered when carrying operations such as painting where booth temperatures may exceed this limit. Measures should be implemented to alleviate any potential risks, such as removing the batteries or by providing insulation to limit any temperature increase in the batteries.

Working on live electrical equipment should only be considered when there is no other way for work to be undertaken. Even then it should only be considered if it is both reasonable and safe to do so. You should consider the risks for working on this live equipment and implement suitable precautions including, as a final measure, the use of personal protective equipment (PPE). Refer to manufacturer's instructions for precautions when working live, including their PPE requirements.

Always locate the vehicle within an area that can be secured and barrier off such that people who could be put at risk are not able to approach the vehicle. Warning signs should be used to make people aware of the dangers.

(HSE.GOV.UK, 2016)

Safety Rules for use when interacting with HEV High Voltage (HV) systems

- **It is a recommendation that all technicians and/or emergency service professionals are trained in safe working of Hybrid and Electric vehicles (manufacturer or recognised institution / Awarding Body certificated).**
- **All HEV's to be clearly identified with warning signs and cordoned off whilst work is being undertaken on the HV system.**
- **Keys are removed and stored in lockable container away from the vehicle. Only the technician working on the HEV is to have access to the lockable container.**
- **Specific manufacturer data to be referred before disconnecting and connecting the HV systems.**
- **Manufacturer data should be referenced before working on any system on a HV Vehicle.**
- **Insulated tools, gloves and floor mats rated for work on voltages in excess of 650 volts should be used.**
- **Technicians and/or emergency service professionals should not work with HV systems if they have electrical health devices fitted. (Pacemaker).**
- **Vehicles that have been involved in a collision may have HV components exposed – precautions against fire and electric shock should be taken (fire extinguisher).**

Information about the project EUMOB

1
Programme

Erasmus+

2
Key Action

Cooperation for innovation and the exchange of good practices

3
Action

Strategic Partnerships

4
Field

Strategic Partnerships for vocational education and training VET

Participants

VET Centre

Strategic Partner

Centro San Viator	Bridgwater College	SDE	TECNALIA
EUS	UK	Syddansk Erhvervsskole DK	

Project Total Duration - 36 months

CREATE AN OPEN-SOURCE E- LEARNING PLATFORM TO LEARN ABOUT URBAN MOBILITY TECHNOLOGY.

PROMOTE STUDENTS/ STAFF MOBILITY.

CREATE AWARENESS IN THE YOUNGER GENERATION AND SOCIETY ABOUT THE IMPORTANCE OF NEW EFFICIENT AND CLEAN MOBILITY SYSTEMS IN URBAN ENVIRONMENTS.

GIVE COMPREHENSIVE TRAINING TO YOUNG PEOPLE, IN THE AREA OF ELECTRIC URBAN MOBILITY, NOT ONLY FOCUSING ON NEW HYBRID AND ELECTRIC ENGINES, BUT ALSO ON THEIR IMPACT ON MOBILITY AND SOCIETY

CREATE A LIST OF SUGGESTIONS OF CREATING WORKING SAFETY RULES FOR THE INDUSTRY

Intellectual outputs

- Open educational re sources.
- Research on the impo tance of “Clean Mobility Systems”.
- Recommendations of common safety rules.

Multiplier events

- Local conferences
- Workshops
- A final international conference.

Learning activities

- Short-term joint staff training events
- Long-term teaching or training assignments

01

STUDENTS

- Provide a more attractive education and training programs based on ICT methodologies and open educational resources (OER).
- Good practices and awareness on electric urban mobility, aligned with the European project and the EU values.
- Increase understanding and responsiveness to social and environmental problems.
- Opportunity of learning and training in another EU country.

02

TEACHERS

- Access to knowledge that so far was out of our range.
- Good practices and increase awareness on electric urban mobility, aligned with the European project and the EU values.
- Increase their understanding and responsiveness to social and environment problems.
- Increase opportunities for professional development.

03

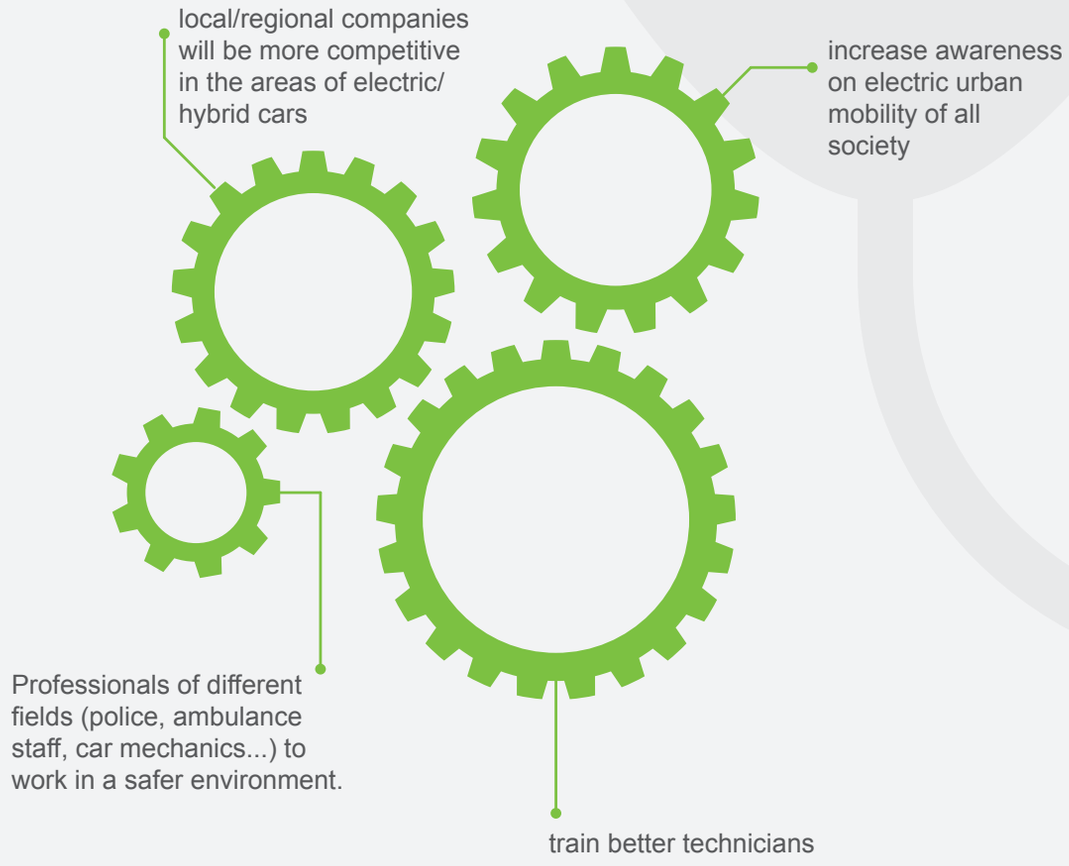
ORGANISATIONS

- Improve internationalization strategies and reinforce cooperation with partners from other countries.
- Increase synergies and links between the different systems of education, training and youth at national level.
- Better prepared proffessionals that will enhance ORGANISATIONS the education provided.

04

POLICY MAKERS

- Increase awareness on electric urban mobility, aligned with the European project and the EU values.
- Increase awareness on the necessity of safety and intervention protocols and hybrid electric car.



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