INVESTIGA R&D&I 2018/2019

SPECIFIC WORK GUIDE ON "IS ELECTRIC MOBILITY THE KEY TO THE ZERO EMISSIONS MODEL?"

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Introduction

The spectacular decrease in the cost of generating electric energy from renewable energies achieved in the last two decades has led to planning the future energy system in certain countries with very ambitious objectives in terms of the reduction of greenhouse emissions.

For example, in the European Union the goals agree upon in the European Council in the year 2014, within the climate and energy framework for the year2030, were:

- A reduction of at least 40% of the greenhouse-effect gas emissions. (in relation to the existing levels in 1990).
- A quota of at least 27% in renewable energies.
- An improvement of at least 27% in energy efficiency.

But additionally a road map until 2050 has been defined in which objectives are proposed to reduce the greenhouse-effect gas emissions by 60% and 80% by the years 2040 and 2050, respectively.

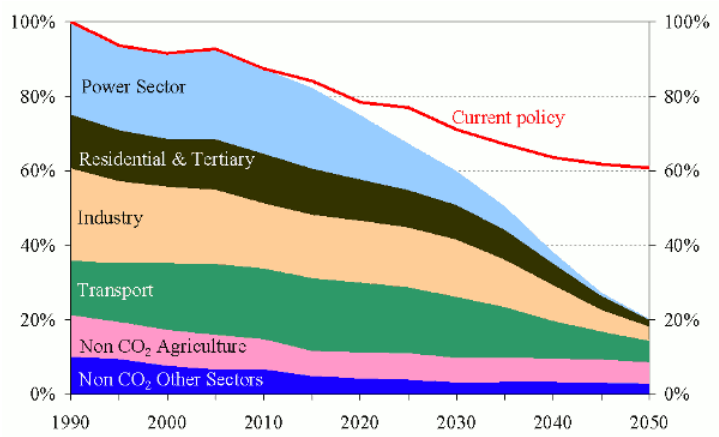


Figure 1: Possible path to 80% reduction of the greenhouse-effect gas emissions in the European Union (Emissions 1990 = 100%) (Source: EC)

It's clear that in order to reach that goal, the European Union will have to advance sustainedly towards a society with low carbon emissions, in which clean technologies play a fundamental role, but the variability of said sources makes it mandatory that, in order to manage that great quantity of clean energies, it is necessary to develop solutions for energy storage and/or for management of energy demand.

Nowadays, the electric sector represents the greatest potential for reduction given the growing competitiveness of renewable energies, but in order to be able to achieve nearly the complete elimination of greenhouse-effect gas emissions by 2050, we will have to evolve towards a more flexible two-way electric system, with a capacity to manage the energy. In short,we will have to move towards the so-called smart grids, which are still in the development phase in most countries today.

In the transport sector and in heat production, electricity can partially substitute fossil fuelswhich are still predominant nowadays. The progressive electrification of the energy normally supplied by fossil fuels is going to facilitate the integration of renewable energiesif these demands are included as another component of the energy system.

One example is thedeployment of the electric or hybrid vehiclewhich can be chargedfrom the electric grid. The battery recharging of these vehicles is normally one-way. The energy always goes from the electric grid towards the battery, but it could also be two-way, which opens the chance to use the battery of electric vehicles as a system of distributed energy storagewhich can facilitate greater integration of renewable energy helping to achieve the proposed goalsto reduce greenhouse-effect gas emissions.For that purpose, a certain adaptation of current electric vehicles is needed, as well as two-way chargers and the application ofa new communications protocol genericallly calledV2X (Vehicle-to-Everything), which includes the V2G protocol (Vehicle-to-Grid), which is the one at hand in this guide.

The strategy of Vehicle-to-Grid (V2G) describes a system in which electric vehicles connectable to the grid, as are Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs) or Fuel Cell Electric Vehicles (FCEVs), can communicate with the control of the smart grid to offer services responding to demand, returning electricity to the grid or regulating their charging rate.

Electric System of the Future:Smart Grids.

In order to develop this strategy, smart grids have to be deployed. A smart grid is one that can efficiently integrate the behavior and actions of every user connected to it, in such a way that a sustainable, efficient energy system is assured, with low losses and high levels of quality and supply security.

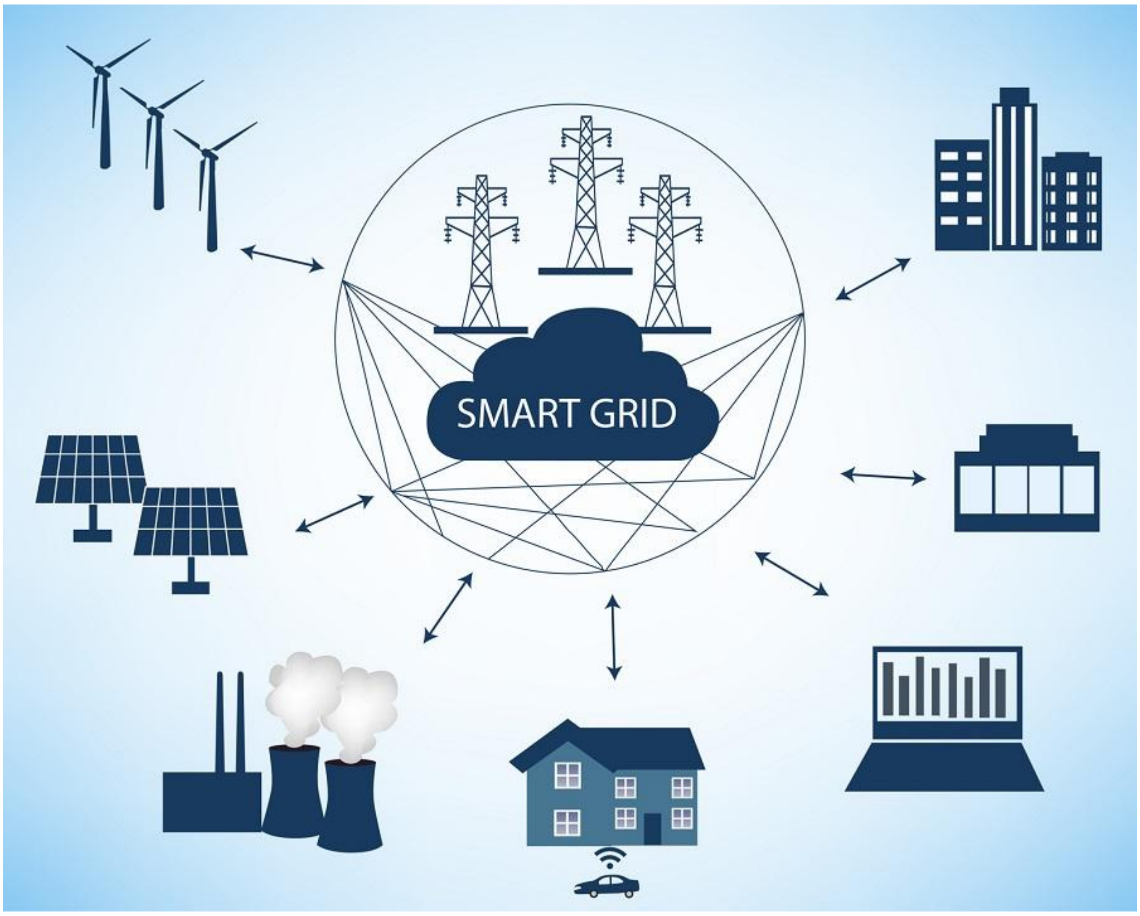


Figure 2: Basic scheme of a smart grid

Before the challenge of maintaining the supply security in a decarbonized electric system, smart grid initiatives are being promoted with the aim of anticipating solutions in the field of new technologies in storage, the dynamic capacities of the grid, monitoring of the grid elements, self-consumption, electric vehicles and the new options for consumers which are currently shaping the electric grid of the future.

As opposed to traditional grids, a smart grid incorporates the digital technology necessary for smooth communication in both directions to take place between the installation and the user. That is to say, it's smart. Making use of the Internet, a smart grid uses IT and domotic tools, as well as state-of-the-art technology and the most innovative equipment, to provide a firm response to volatile electricity demand.

And the thing is that you have to remember that electricity has a peculiar nature: it has to be consumed simultaneously at the time it is generated. An electric plant generates energy, but it can't store it until it is needed.

This is why energy which isn't used is usually lost, and at a time like this, when we are looking for maximum energy efficiency, solutions have to be sought. And smart grids are just that, since they are the emblem of transition towards a future version of our electric power grids.

One of the new components which can be useful to the smart grid is the electric vehicle, especially if it is connected with a two-way charger so the energy can go from the electric grid to the vehicle battery and viceversa when the grid needs it. These smart grids have to establish a communication protocol calledV2G (Vehicle-to-Grid)to be able to control the energy flow optimally.

The energy stored in the vehicle batteries can be used to provide the grid with support at certain moments, to reduce demand at moments of high consumption in residential or office buildings or also tooccasionally power isolated systems, such as dwellings or houses isolated from the electric grid.

As the penetration of renewable energies in the grid increases and its own inertia is reduced, it's necessary to compensate it with the inclusion of virtual inertia systems and electric vehiclesoffer great potential in this sense as distributed storage systems with little unit capacity but with great capacity as a whole.

Electric Vehicle.

Highway transportation is one of the sectors most dependent on fossil fuels and the most complicated one whenfinding a sustainable alternative which reduces the dependence on costly imported energy sources as well as greenhouse-effect gas emissions.

So far, the only large-scale option to reduce dependence on fossil fuels in transportation has been the incorporation of biofuels, either through production of bioalcohol or biodiesel, though lately biomethane is also being developed, a biogas similar to natural gas with the advantage that it is renewableand comes from valorization through anaerobic digestion of organic waste coming from agricultural activitiessuch as the by-products of fruit, vegetables, meat or fish; from livestock excrement(manure, slurry), sewage sludge; or from gas generated in the gasification of biomass.

But electric transportation is currently considered to be the most promising possibilityto transform the current system into another one which is environmentally sustainable. In certain special situations as for example in the case of mobility in the cities, it’s the only solution to solve the additional problem incurred by pollution in the big cities which has become alarming lately. Electric vehicles don’t generate any kinds of emissions during their use, and moreover the levels of noise pollution are considerably reduced.

The electric vehicle (called BEV for the abbreviation of Battery Electric Vehicle) is a vehicle powered by an electric engine powered by batteries which are recharged through a power socket connected to the electric grid. Its range is limited by the capacity of its battery. Current technology allows a range of between 130 km and 600 km. The battery recharge is carried out exclusively from the electric grid, although they have systems which recover the energy from braking the vehicle itself.

Most conventional electric vehicles are charged with alternating current, so they have an alternating current to continuous AC/DC converter, to charge the battery, but to be able to be two-way, they have to be able to convertdirect current into alternating current, so the current converter will have to be two-way and moreover for V2G strategies, there must be connectivity which they normally don’t have.

The Battery

The battery is the decisive component in electric vehicles. In the battery, the reversible chemical reaction takes place in which an electric current is produced that is able to power an electric engine. Reversely, on applying an electric current to the battery, the ions and electrons return to their original situation.

For mobile applications, the battery must be efficient, light and competitive in costs. The batteries used nowadays in electric vehicles are mainly lithium-ion. There are many varieties out on the market and they are the ones which are experiencing the greatest development for their application in the automobile industry. One of the most important features together with its useful life and the number of charging/discharging cycles is theenergy density, which can reach high values of between 90and 100 Wh/Kg for lithium-ion batteries with a $LiFePO_4$ (lithium-iron-phosphate) cathodeand withstands some 2000 charging/discharging cycles, of between 100 and 250 Wh/Kg for lithium-ion batteries with a $LiCoO_2$ (cobalt oxide and lithium) cathode, which withstand up to 1200 charging/discharging cycles and lastly,lithium polymer (LiPO) batteries with an energy density of up to 300 Wh/Kg and they withstand up to 1000 charging/discharging cycles.

The development of these types of batteries has given electric vehicles practically unstoppable momentum, but the great expected increase in the demand for batteriesand the shortage and difficulty to mine some of their components such as cobalt has forced manufacturersof lithium-ion batteries to seek newcompositions for the cathodes with strong reductions in this component (up to 59%), such as the so-called NCM (nickel-cobalt-manganese) or NCA (nickel-cobalt-aluminum) batteries.

Nowadays all lithium-ion batteries have liquid electrolyte but by the year 2025, lithium-ion batteries with crystal electrolyte, also known as solid-state batteries, are expected to reach the market. They promiseto be revolutionary, multiplying electric cars' range, leading it to reach 750 kilometers per charge.

One drawback of the V2G strategy is that the batteries have a finite number of charging cycles, as well as a useful life; therefore, using vehicles as a storage system for the electric grid could affect the battery's longevity. The studies with batteries which complete charge-discharge cycles two or more times per day have shown great decreases in their capacity and a reduction of their useful life. However, the battery's capacity is a complex function depending on factors such as the battery'schemistry, charging and discharging speed, temperature, charge state andage. Most studies with slower discharge rates show only a small percentage of additionaldegradation, while another study has suggested that greater longevity is possible in comparison with the vehicles which weren't used for energy storage on the grid.Therefore, there is a need in this area for clear research and development focused on identifying what has to be modified in order to achieve reliable batteries with this new strategy.

Finally, we comment that sometimes the modulation of the charge of a fleet of electric vehicles by an aggregator to offer services to the grid but without real electric flow from the vehicles to the grid is called one-way V2G, unlike two-way V2G, which is what we are analyzing in this guide.

Recharging Systems

Most recharging systems are one-way. There are several possibilities to recharge an electric vehicle:

Conductive Recharging (by means of connector cables), which is the most usual and developed one, and which is carried out by connecting the vehicle to apower outlet by means of a cable, whether it be in a domestic socket or through a charge point.

The type of conventional charging is the so-called slow charge, which usually takes some six to eight hoursand uses the intensity and voltage at the same level which the home itself has. This single-phase solution is the most suitable one to recharge the vehicle during the night in a garage at the home.

There is moreover a semi-fast charging system which uses three-phase systems of up to 50 kW of power with higher levels of tension and voltage which aren't possible in domestic systems without installing suitable power and control equipment. Normally these chargers are used in shopping centers, restaurants and hotels. With this charging system, the process can take between two and four hours.

There is a third recharging mode that is the fast recharge,which is about 15 minutes in length and by which up to 65% of the battery's total charge can be completed.These chargers can reach wattage of up to 200 kW. Finally, there are currently ultra-fast chargers of up to 350 kW which charge the battery in a process of between 5 and 10 minutes.

The fast and ultra-fast charge uses greater electric intensity, delivering the energy in direct current. From the driver's viewpoint, this solution is the most similar to current fueling systems at a service station.

For this type of fast or ultra-fast charge, it is necessary to go to one of the specific recharge points normally installed along the highways. Nowadays, the deployment of so-called electric stations has begun in Spain, in which there are chargers with different charging systems (semi-fast, fast and ultra-fast) so that customers choose the charge mode depending ontheir needs and possibilities.

Inductive Recharging or Wireless Recharging by Magnetic Induction is one of the most promising markets for fueling electric vehicles given its advantages over other systems which require a cable connection. Through the use of induction technology, the user only has to place his or her vehicle, equipped with a receiving element in the underbody, over a charging platform which is on the ground. When the system detects that it has the car over it, they establish a wireless connection with one another and the transfer of energy and the charging process begin. It ends whenthe recharge has been completed, when it is interrupted manually or when the vehicle moves away from the charge point. For example, this system would enable the recharge of a vehicle when it stops at a traffic light or simply going over plates which are embedded in the asphalt.

A critical issue is the type of connector used for the charging process. Due to the fact that there is still no standardization in connectors, there are different models and makes, with differentconfigurations and technical specifications.

The different types of connectors are:

Schuko Connector: is compatible with European power outlets andmeets the standard CEE 7/4 Type F. It has a ground connection, two pins andsupports a current of up to 16A, so it is only compatible with slow recharges. It is common in certain electric motorcycles and bicycles, and even in some electric cars such as the Renault Twizy.

SAE J1772 Connector (Type 1):is a Japanese standard (adopted by Americans and accepted in the EU), for recharging in alternating current. It has a total of 5 pins; two of themfor current, another two complementary ones and the last one is for grounding. This type of connector has two levels; one of them up to 16 A, which would be for a slow recharge. The other level is up to 80 A, which corresponds to a fast recharge. Apt for the models Opel Ampera, Nissan Leaf, Nissan ENV200, Mitsubishi Outlander, Mitsubishi iMiev, Peugeot iON, Citröen C-Zero, Renault Kangoo ZE (type 1), Ford Focus Electric, Toyota Prius Plug in, and the KIA SOUL EV.

MENNEKES Connector (Type 2):is a German connector. Although it isn't specifically for electric vehicles, its use in them is very usual. This connector has 7 pins, 4 of which are for current (three-phase), another for grounding and two for communications. In this type we have the option of two currents, on the one hand single-phase (up to 16Ain a slow recharge),and on the other three-phase (up to 63A/ 43,8kW- semi-fast recharge). Apt for models like the BMW i3, i8, BYD E6, Renault Zoe, Tesla Model S, Volvo V60 plug-in hybrid, VW Golf plug-in hybrid, VW E-up, Audi A3 E-tron, Mercedes S500 plug-in, Porsche Panamera, and the Renault Kangoo ZE.

Combined Charging System (CCS) Connector: is a proposal created by Germans and Americans as a standard solution. It consists of 5 pins distributed for current, ground connection and communication with the grid. This type of connector accepts both recharges; that's to say, slow and fast. Manufacturers such as Audi, BMW, Daimler, Porsche and Volkswagen now incorporate this type of connector.

Scame Connector (Type 3):has 5 or 7 pins, depending on if the current is single-phase or three-phase, including in both grounding and communication with the grid. It accepts up to 32 A, and it is for semi-fast recharging.

CHAdeMO Connector:is the standard for Japanese manufacturers. It is intended for fast recharge in direct current. To that end, it has 10 pins, ground connection and communication. This connector is for ultra-fast recharges, since it accepts up to 200 A. It is the one that has the greatest diameter of all connectors. It is equipped for cars like the Nissan Leaf, Nissan ENV200, Mitsubishi Outlander, Mitsubishi iMiev, Peugeot iON, Citröen C-Zero, and the KIA SOUL EV.

Figure 3. CHAdeMO and SAE J1772 (Type 1) Connectors in a Nissan Leaf

Of these 6 different connectors, the most usual one is the Schuko connector, the SAE J1772 and the MENNEKES.

The European Union is promoting the standardization of connector standards so that drivers can fuel their electric vehicles anywhere without surprises.

The Electric Vehicle as a Distributed Energy Storage System.

We all understand the electric vehicle as an automobile capable of storing in its battery electric energy taken from the grid, with the purpose of turning it into kinetic energy. When the energy stored in the battery is used up, it has to be charged again by means of a charger connected to the electric grid.

This is the present, but there are already different projects underway to make it possible for the energy stored in electric cars and connectable hybrids to be able to be "returned" to the outside, whether it be to power our home, other buildings or even the grid itself.

It has already been commented previously that these technologies as a whole are known as V2G. One of the global objectives of V2X is to correct the imbalance between the production of electric energy (relatively constant and practically impossible to store) and the consumption by users (variable according to the time of day, the time of the year, geographical location, etc.). Thus, the basic solution consists of taking advantage of the storage capacity of electric vehicles in order to turn them into "mobile suppliers" of energy; energy with which, to give an example, we could power our home during the most costly time band of our electric rate, taking advantage of the off-peak times to recharge the vehicle.

As an example of use on a larger scale, the corporate buildings of a specific company could do the same thing with its fleet of electric cars, taking the remaining charge from the batteries to use it as a power source at the times of greatest consumption. Once the "peak" time of demand has passed, it will turn out less costlyto recharge the vehicles so that employees can return to their homes. And thus, once back home, this cycle beneficial to all parts (even for the electric companies, which wouldn't waste the electricity generated at the times of less consumption) would continue.

The maximum load leveling can enable electricity distribution companies to have new ways to provide regulation services (maintaining stable voltage and frequency) and to provide a spinning reserve (to meet sudden demands for energy).

Another added advantage is that electric vehicles can serve as emergency batteries or UPSs (uninterruptible power supplies) in the case of a natural disaster or grid crash. The typical “blackout” would no longer be a problem, since just as the battery of a laptop computer saves us from losing our work, the connected car will avoid that we’re in the dark at home.

Lastly, it has already been commented that electric vehicles could help manage renewable energy sources such as eolic or solar energy, for example, storing the excess energy produced during periods of high eolic or solar resources, returning it to the grid during times of high energy demand, effectively stabilizing the intermittency of eolic or solar energy. Some see this V2G technology application as the chance for renewable energies to enter the market as a manageable conventional source.

Since demand can be measured locally by means of a simple measurement of frequency, dynamic load leveling can be provided as needed. “Carbitrage” is a fusion of the words car and arbitrage and is sometimes used to refer to the minimum price of electricity which a vehicle would discharge its battery for.

Of course, we need our electric or rechargeable hybrid vehicle to have a two-way electric power inverter or converter which enables charging or discharging the battery at will, as well as a two-way smart charge point.

In this sense experiences are starting to be developed with smart buildings where the potential of electric vehicles to act as a means of energy storage is being explored.

One example of a vehicle with a V2Gcharger has been carried out at the offices of the company ENGIE in Zaandam, Holland,where they have photovoltaic solar energy on the roof of the building.When the building generates more solar energy than it needs, this excess energy is stored in the electric automobile battery. This energy can be discharged again to the grid when appropriate. Therefore, the automobile battery acts as an energy storage system, but also as an emergency power source.

The demonstration project has been carried out jointly with the Japanese companies Hitachi Europe Ltd., developer of the V2X charger and Mitsubishi Motors, developer of the electric vehicle with a capacity for energy charging and discharging.

There are more examples, most of which are experimental and mostly integrated in specific buildings or campuses with a capacity to generate renewable energies like the experience at the University of Delaware in the United States developed by the company AC Propulsion, the European project EDISON (Electric Vehicles in a Distributed and IntegratedMarketusingSustainableEnergy and Open Networks) developed on the Danish island of Bornholm which aims to go from 20% eolic penetration to 50% by using electric vehicles.

Several electric companies are collaborating with manufactures of electric vehicles and chargers to develop experimental projects whichhelp make out the possibilities of this new opportunity such as Pacific Gas and Electric Company (PG&E) with Toyota or XcellEnergy with Ford in the United Statesand also in Europe, as for example the project "GridforVehicles" (Analysis of theimpact and possibilities of a massintroduction of electric and plug-in hybridvehiclesontheelectricitynetworks in Europe) which included the participation of electric companies like ENDESA, EDP, VATENFALL and ELECTRICITE DE FRANCE in which the impact was simulated of the integration of multiple two-way vehicles in the distribution electric grid with different charge control strategies. Certain drawbacks were identified such as additional costs and the disturbance of the quality of the grid, concluding that the advantages of electric vehicles with a capacity for two-way charging were not significant. Possibly the low penetration of renewable energies at the time of the study decisively influenced this conclusion. The current strategy of evolving towards smart cities and communities is going tolead to the massive integration of renewable energies in them, so the synergy between renewable energy and electric vehicles V2G is clearly promising.

V2X Communication Protocol

The communication of the Vehicles-to-Everything (V2X) is based on the transfer of information from a vehicle to anyentity which might affect the vehicle, and vice versa. It is a vehicular communication system which incorporates other types of more specific communication such as V2I (Vehicle-to-Infrastructure), V2N (Vehicle-to-Network), V2V (Vehicle-to-Vehicle), V2P (Vehicle-to-Pedestrian), V2D (Vehicle-to-Device) and V2G (Vehicle-to-Grid).

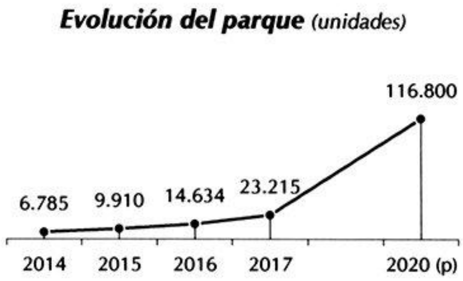
The main motivations for V2X are road safety, traffic efficiency and in our case, thesaving and optimum management of energy. There are two types of V2X communication technology depending on the underlying technology used: the one based on WLAN and the one based on cellular.

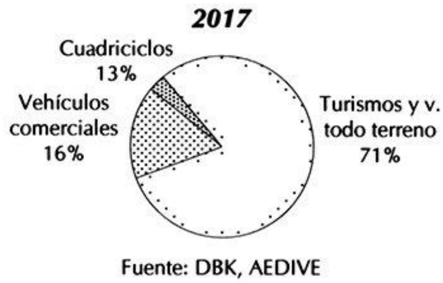
But is an energy system with zero emissions possible?

Nowadays there are regions in certain developed countries which are already considering the production of 100% of the electric energy consumed from renewable resources, but reaching an energy system with zero emissions is a greater challenge although technicallyit could have more capacities such as energy or nuclear origin or energy coming from fossil fuels but applying novel techniques in sequestration, storage and the use of CO_2 emissions.

To reach an energy system with zero emissions, you moreover have to develop clean energy generation systems, develop reliable, competitive energy storage systems, reduce energy demand by means of the application of energy efficiency techniques and manage energy demand as far as possible.

Most vehicles are parked 95% of the time.In Spain alone, there are expected to be over 115,000 electric vehicles in the streets in 2020.With an average capacity of 40 kWh per vehicle, the total storage capacity would be 4.76 GWh.





Questions and debate matters.

In this section, I propose to you a series of questions and mattersso that you begin to explore in search of some discoverywhich allows you to objectively decide on your response.

1) In order to reach the decarbonization of society, it is necessary to produce a lot of renewable energy such as eolic energy and photovoltaic solar energy, but they are variable sources. Energy storage can help decisively. What measures do you consider would have to be applied in order to promote the use of energy storage systems?
2) Nowadays the only solution of massive energy storage applied in Spain is by means of hydraulic pumping. There is over 4750 MW of power from the so-called reversible hydroelectric storage. Compare this solution centralized in some 20 power stations with the distributed solution with batteries of the 115,000 electric vehicles in 2020 which we expect with a discharge capacity of 40 kW. You realize that in total, we would have practically the same available power as that of all existing centralized storage in Spain. Try to reflect upon the energy available in both cases.

3) Lithium-ion batteries have an estimated number of charge/discharge cycles. Seek information about the charge/discharge cycles of the batteries which are out on the market and try to estimate the useful life with an electric vehicle with one charge/discharge cycle per day and analyze the reduction in useful life with a greater number of charge/discharge cycles in the case where it is used to support the grid (V2G).
4) A very important parameter to manage the battery of an electric vehicle is the charge state of the battery. How do you believe said charge state can be estimated?
5) The people in charge of the electric system on the Danish island of Bornholm estimate that currently 20% of the energy which is consumed on said island comes from the wind, exactly the same as in continental Spain at present. These responsible parties believe that applying the V2G system, the eolicharnessing could reach up to 50%. How do you think that increase in harnessed eolic energy could come about safely?Do you believe that the same level of eolic integration could be achieved in continental Spain applying V2G?And on the different islands in Spain?
6) The V2G concept seems very novel, but it is from the late past century. It was proposed by professor WillettKempton at the University of Delaware in 1997 in an article entitled "Electric Vehicles as a New Power Source for Electric Utilities".

   In this article, he proposes as an incentive for the owner of the electric vehicle, the electric utilities company could offer a subsidy for the purchase of vehicles, lower electricity rates or the purchase and maintenance of the batteries of future vehicles. For the electric utilities company that takes advantage of the electric vehicle's power, the greater energy storage capacitywould provide it with benefits of the system such as the increase in reliability with lower costs, and it would moreoverfacilitate the large-scale integration of intermittent renewable energy resources.What is your opinion about this?

7) Do you think that in order to develop V2G technology, besides having interactive technologies in terms of power and communications,policies in favor and market strategies are needed?How could the market be stimulated, in your opinion?
8) For the V2G strategy to work correctly, the service suppliers (aggregators) will be required to organize blocks of a specific minimum power size (MW) depending on the use for regulation or reserve or peak power.What do you think would be the right power and how many vehicles would have to be associated?
9) These service suppliers must also be able to communicate with vehicles in order to obtain the location of the vehicle, the charge state of the battery, the owner's preferences and to send signals in order to transmit? charge? or? dispatch? How do you think said communication should be organized?
10) Finally, do you think it will be possible to supply all the energy consumedin the country with renewable energies supported by distributed storage systemswhich, just like generation technologies based on renewable sources, progressively increase their scale of power and stored energy at competitive costs?

Bibliography.

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- Introductory Guide to the Subject 'Distributed Generation' (2017-2018 Edition).
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- AEDIVE Business Association for the Development and Promotion of Electric Vehicles. http://aedive.es/
- AUVE Association of Electric Vehicle Userswww.auve.org
- Electric Mobilityhttps://movilidadelectrica.com/
- IDAE Vehicles and Alternative Technologies: http://coches.idae.es/portal/CombustiblesAlternativos/CombustiblesAlternativos.aspx
- Websites of electric companies and other agents of the electric sector(most of the large electric companies, as well as the system operator, have developed activitiesfor the promotion of electric vehicles and recharging systems. In particular, you can find informationon the websites of ENDESA and RED ELECTRICA DE ESPAÑA).
- Websites of automobile manufacturers (without aiming to be exclusive, at least the following manufacturers have developed models of electric vehicles both with batteries and with fuel cells: RENAULT, NISSAN, BMW, PSA PEUGEOT CITROEN, TOYOTA, HONDA,TESLA, etc.).
- Deloitte Report: *"A Model of Decarbonized Transportation for Spain in 2050"*. https://perspectivas.deloitte.com/descarbonizacion-transporte
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Information about Techniques, Methods and Basic Material Resources on the Internet

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