Charging stations for electric cars and the ways of charging

http://projektstepahead.sk/

STEP AHEAD: The support of Professional development of VET teachers and trainers in following of New trends in Automotive Industry

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Charging stations for electric cars and the ways of charging

EVOKÁCIA

Cieľ aktivity: Navodenie problematiky nabíjania akumulátorov elektromobilu.

KROK 1.

Stručný popis aktivity: Žiaci sú uvedení do problematiky nabíjania akumulátorov z pohľadu vodiča hybridu/elektromobilu.

https://www.youtube.com/watch?v=aXSGz5uO4Ys

Inštrukcie pre študentov: Watch the video. What does it say about vehicle charging? What did you find interesting in the video?

KROK 2.

Stručný popis aktivity: Elektromobily na pohon využívajú elektrickú energiu uloženú v akumulátoroch. Dojazd elektromobilu závisí od kapacity akumulátorov. Dĺžka nabíjania akumulátorov závisí od výkonu nabíjačky (veľkosti nabíjacieho prúdu). Pre majiteľa elektromobilu je dôležité sledovať aktuálny dojazd elektromobilu a mať prehľad o sieti dobíjacích staníc.

Formou brainstormingu diskutujte o:

- spôsoboch nabíjania (rýchlo nabíjačky, nabíjanie zo zásuvky)

Učiteľ zapisuje kľúčové poznámky z diskusie na tabuľu. V prípade nedostatku času použite brainstorming a zadajte len jednu otázku - „čo vám zíde na um, keď počujete nabíjanie elektromobilov..“ s cieľom zistiť, čo už žiaci o danej problematike vedia a zároveň o tému vzbudiť záujem.

Inštrukcie pre študentov: What comes to your mind when you hear about „electric cars charging“? What do you know about the ways of charging?

Together we write notes down on the blackboard/flipchart.

Pomôcky: Počítač s pripojením na internet, dátový projektor, tabuľa/flipchart na zapisovanie poznámok

Čas: 25 min.

Poznámky: Hodina je rozvrhnutá na 2 x 45 minút.

Zdroje: https://www.youtube.com/watch?v=aXSGz5uO4Ys

https://www.youtube.com/watch?v=Turt1YaZncI

https://www.youtube.com/watch?v=iazBFYmz_kE

fotografia na titulnej strane: https://pixabay.com

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UVEDOMENIE

Cieľ aktivity: Pochopenie rozdielov medzi jednotlivými spôsobmi nabíjania.

KROK 1.

Stručný popis aktivity: Metóda V-CH-D (Príloha č.1), žiaci pracujú individuálne.

Žiaci na tému: „Nabíjacie stanice elektromobilov“ napíšu, čo o téme vedia, do stĺpca V.

Učiteľ vytvorí tabuľku V - CH – D na tabuli a zaznačí do nej prezentované odpovede do stĺpca V.

Inštrukcie pre študentov: You are going to work with a chart with 3 columns (Annex 1). Your task now is to fill in the first column („I KNOW“) and write down everything you already know about the EV charging. Read loud what you wrote.

Together we´ll make notes and fill in the chart on a blackboard.

KROK 2.

Stručný popis aktivity: Žiaci na tému: Nabíjacie stanice elektromobilov spoločne diskutujú o tom, čo chcú vedieť.

Učiteľ na tabuli zaznačí prezentované odpovede do stĺpca CH a žiaci si vyplnia stĺpec CH v tabuľke.

Inštrukcie pre študentov: Now please shortly discuss and tell us what would you like to know about EV charging. Fill in the second column of the chart „I WANT TO KNOW“.

KROK 3.

Stručný popis aktivity: Učiteľ rozdá žiakom materiál z prílohy č. 2 - Nabíjacie stanice elektromobilov.

Žiaci si pozorne individuálne preštudujú materiál a do stĺpca D napíšu to, čo sa dozvedeli.

Alternatíva:

Text z prílohy môžete rozložiť na samostatné časti a nechať žiakov pracovať v 6. skupinách (príp. dvojice, trojice), pričom každá pracuje s inou časťou textu. Skupiny si navzájom prezentujú získané informácie formou poznámok zapísaných na flipové papiere.

Inštrukcie pre študentov: You are going to work in 6 groups. In each group you´ll receive a part of a text. Your task is to read it carefully, make notes from your key findings and present them to the rest of the class.

Please read carefully text about EV charging. After reading, try to fill in the third column of the chart „I´VE GOT TO KNOW“ based on what you´ve read.

KROK 4.

Stručný popis aktivity: Upevnenie vedomostí cvičeniami na portáli.

Inštrukcie pre študentov: Work online on the interactive screens related to EV charging at

http://projektstepahead.sk/

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Pomôcky: Zošity, perá

Príloha č. 1 – V-CH-D tabuľka (žiaci si ju buď prekreslia do zošitov alebo im učiteľ rozdá vytlačenú prílohu)

Príloha č. 2 - Nabíjacie stanice elektromobilov – textový materiál nakopírovaný pre individuálnu ALEBO skupinovú prácu študentov

Prístup na internet a portál pre každého žiaka

Čas: 40 min.

Zdroje:

Denton Tom: Electric and hybrid vehicles, New York, 2016

Klíma Dalibor: Elektromobilita v plienkach, Auto magazín, marec 2015

http://www.greenway.sk/

http://teslaclub.sk/forum/

http://elektromobily.sk/nabijanie-elektromobilov

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REFLEXIA

Cieľ aktivity: Porovnať výhody a nevýhody rôznych spôsobov nabíjania elektromobilov.

KROK 1.

Stručný popis aktivity: Žiaci sa rozdelia na skupiny po štyroch a v skupinách diskutujú na tému: Ako by som predstavil záujemcovi o kúpu elektromobilu možnosti nabíjania a vysvetlil mu výhody a nevýhody rôznych spôsobov nabíjania. Každá skupina pracuje s iným typom nabíjania. Argumenty a výhody/nevýhody si žiaci zapisujú do zošita.

Inštrukcie pre študentov: Create the groups with 4 students in each. In each group, please also choose one concrete way of EV charging. Discuss it and prepare your arguments to present concrete way of charging to someone interested in EV purchase, including pluses and minuses. You have 5 minutes to prepare your presentation.

KROK 2.

Stručný popis aktivity: Jeden žiak za skupinu odprezentuje argumenty, zapísané výhody i nevýhody konkrétneho spôsobu nabíjania pripravené svojou skupinou.

Inštrukcie pre študentov: Now present your arguments, including pluses and minuses, to the class.

Pomôcky: Zošit, poznámky v zošite z metódy V - CH- D, pero

Čas: 25 min.

Charging stations for electric cars and the ways of charging

Príloha 1

VIEM / I KNOW	CHCEM VEDIEŤ / I WANT TO KNOW	DOZVEDEL SOM SA / I´VE LEARNED

Charging stations for electric cars and the ways of charging

Príloha 2

GROUP 1

An **electric vehicle charging station**, also called **EV charging station, electric recharging point, charging point, charge point and EVSE** (electric vehicle supply equipment), is an element in an infrastructure that supplies electric energy for the recharging of electric vehicles, such as plug-in electric vehicles, including electric cars, neighbourhood electric vehicles and plug-in hybrids.

As plug-in hybrid electric vehicles and battery electric vehicle ownership is expanding, there is a growing need for widely distributed publicly accessible charging stations, some of which support faster charging at higher voltages and currents than are available from residential EVSEs. Many charging stations are on-street facilities provided by electric utility companies or located at retail shopping centres and operated by many private companies. These charging stations provide one or a range of heavy duty or special connectors that conform to the variety of electric charging connector standards.

Charging stations fall into four basic contexts:

1. **Residential charging stations:** An EV owner plugs in when he or she returns home, and the car recharges overnight. A home charging station usually has no user authentication, no metering, and may require wiring a dedicated circuit. Some portable chargers can also be wall mounted as charging stations.
2. **Charging while parked** (including public charging stations) – a commercial venture for a fee or free, offered in partnership with the owners of the parking lot. This charging may be slow or high speed and encourages EV owners to recharge their cars while they take advantage of nearby facilities. It can include parking stations, parking at malls, small centres, and train stations (or for a business's own employees).
3. **Fast charging at public charging stations >40 kW**, delivering over 60 miles (100 km) of range in 10–30 minutes. These chargers may be at rest stops to allow for longer distance trips. They may also be used regularly by commuters in metropolitan areas, and for charging while parked for shorter or longer periods. Common examples are CHAdeMO, SAE Combined Charging System, and Tesla Superchargers.
4. **Battery swaps or charges in under 15 minutes**. A specified target for CARB credits for a zero-emission vehicle is adding 200 miles to its range in under 15 minutes. In 2014, this was not possible for charging electric

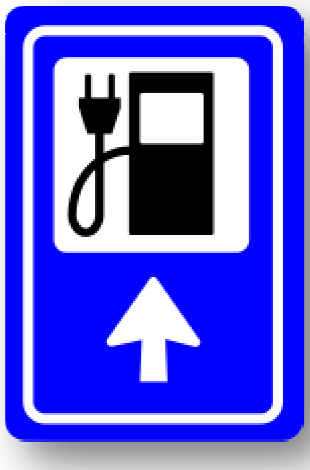
vehicles, but it is achievable with EV battery swaps and Hydrogen Fuel Cell vehicles. It intends to match the re-fuel expectations of regular drivers.

Battery capacity and the capability of handling faster charging are both increasing, and methods of charging have needed to change and improve. New options have also been introduced (on a small scale, including mobile charging stations and charging via inductive charging mats).

GROUP 2

International status

U.S. traffic sign used for EV charging station



Public-domain European charge station sign

As of December 2012, around 50,000 non-residential charging points were deployed in the U.S., Europe, Japan and China. As of August 2014, there are 3,869 CHAdeMO quick chargers deployed around the world, with 1,978 in Japan, 1,181 in Europe and 686 in the United States, 24 in other countries. As of December 2013, Estonia is the first and only country that had completed the deployment of an EV charging network with nationwide coverage, with 165 fast chargers available along highways at a maximum distance of between 40 to 60 km (25 to 37 mi), and a higher density in urban areas.

As of March 2013, 5,678 public charging stations existed across the United States, with 16,256 public charging points. As of November 2012, about 15,000 charging stations had been installed in Europe.

As of March 2013, Norway, which has the highest electric ownership per capita, had 4,029 charging points and 127 quick charging stations. As part of its commitment to environmental sustainability, the Dutch government initiated a plan to establish over 200 fast (DC) charging stations across the country by 2015. The rollout will be undertaken by Switzerland-based power and automation company ABB and Dutch start-up Fastened, and will aim to provide at least one station every 50 kilometres (31 miles) for the Netherlands' 16 million residents. In addition to that, the E-laad foundation installed about 3000 public (slow) charge points since 2009.

As of December 2012, Japan had 1,381 public quick-charge stations, the largest deployment of fast chargers in the world, but only around 300 slow chargers. As of December 2012, China had around 800 public slow charging points, and no fast charging stations. As of December 2012, the country with the highest ratio of quick chargers to electric vehicles (EVSE/EV) was Japan, with a ratio of 0.030, and the Netherlands had the largest ratio of slow EVSE/EV, with more than 0.50, while the U.S had a slow EVSE/EV ratio of 0.20.

As of September 2013, the largest public charging networks in Australia exist in the capital cities of Perth and Melbourne, with around 30 stations (7 kW AC) established in both cities – smaller networks exist in other capital cities.

In April 2017, YPF, the state-owned oil company of Argentina, reported that it will install 220 fast-load stations for electric vehicles in 110 of its service stations in national territory.

GROUP 3

Standards

In SAE terminology, 240 volt AC charging is known as Level 2 charging, and 500 volt DC high-current charging is known as DC Fast Charge. Owners can install a level 2 charging station at home, while businesses and local government provide level 2 and DC Fast Charge public charging stations that supply electricity for a fee or free.

The International Electrotechnical Commission modes definition (IEC 62196):

- *Mode 1* – slow charging from a regular electrical socket (single- or three-phase)
- *Mode 2* – slow charging from a regular socket but with some EV specific protection arrangement (e.g., the Park & Charge or the PARVE systems)
- *Mode 3* – slow or fast charging using a specific EV multi-pin socket with control and protection functions (e.g., SAE J1772 and IEC 62196)
- *Mode 4* – fast charging using some special charger technology such as CHAdeMO

There are three connection cases:

- *Case A* is any charger connected to the mains (the mains supply cable is usually attached to the charger) usually associated with modes 1 or 2.
- *Case B* is an on-board vehicle charger with a mains supply cable which can be detached from both the supply and the vehicle – usually mode 3.
- *Case C* is a dedicated charging station with DC supply to the vehicle. The mains supply cable may be permanently attached to the charge-station such as in mode 4.

There are four plug types:

- *Type 1* – single-phase vehicle coupler – reflecting the SAE J1772/2009 automotive plug specifications
- *Type 2* – single- and three-phase vehicle coupler – reflecting the VDE-AR-E 2623-2-2 plug specifications
- *Type 3* – single- and three-phase vehicle coupler equipped with safety shutters – reflecting the EV Plug Alliance proposal
- *Type 4* – fast charge coupler – for special systems such as CHAdeMO

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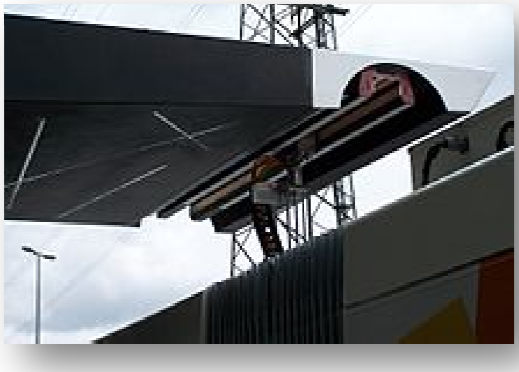
A charging station in Monza, Italy



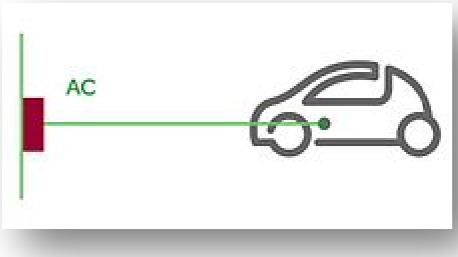
A battery electric bus charging station in Geneva, Switzerland

GROUP 4

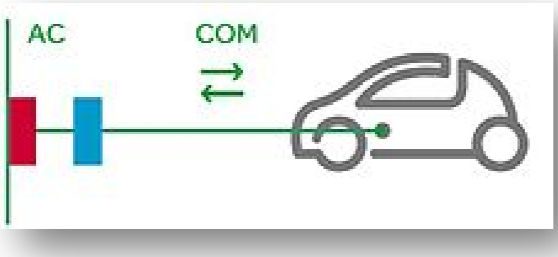
Residential charging

Mode 1: Household socket and extension cord

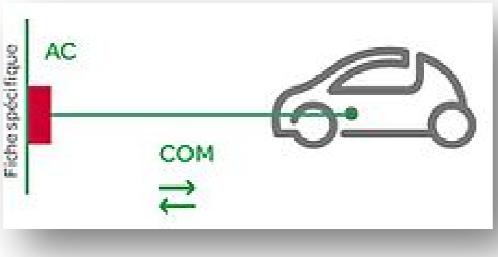
Mode 1: Fixed, non-dedicated socket



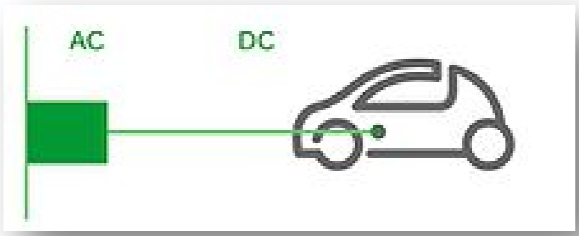
Mode 2: Non-dedicated socket with cable-incorporated protection device



Mode 3: Fixed, dedicated circuit-socket



Mode 4: DC Connection



The vehicle is connected to the power grid through standard socket-outlets present in residences, which depending on the country are usually rated at around 10 A. To use mode 1, the electrical installation must comply with the safety regulations and must have an earthing system, a circuit breaker to protect against overload and an earth leakage protection. The sockets have blanking devices to prevent accidental contacts.

The first limitation is the available power, to avoid risks of:

- Heating of the socket and cables following intensive use for several hours at or near the maximum power (which varies from 8 to 16 A depending on the country).
- Fire or electric injury risks if the electrical installation is obsolete or if certain protective devices are absent.

The second limitation is related to the installation's power management.

- As the charging socket shares a feeder from the switchboard with other sockets (no dedicated circuit) if the sum of consumptions exceeds the protection limit (in general 16 A), the circuit-breaker will trip, stopping the charging.

All these factors impose a limit on the power in mode 1, for safety and service quality reasons. This limit is currently being defined, and the value of 10 A appears to be the best compromise.

Mode 2: Domestic socket and cable with a protection device

The vehicle is connected to the main power grid via household socket-outlets. Charging is done via a single-phase or three-phase network and installation of an earthing cable. A protection device is built into the cable. This solution is more expensive than Mode 1 due to the specificity of the cable.

Mode 3: Specific socket on a dedicated circuit

The vehicle is connected directly to the electrical network via specific socket and plug and a dedicated circuit. A control and protection function is also installed permanently in the installation. This is the only charging mode that meets the applicable standards regulating electrical installations. It also allows loadshedding so that electrical household appliances can be operated during vehicle charging or on the contrary optimise the electric vehicle charging time.

Mode 4: Direct current (DC) connection for fast recharging

The electric vehicle is connected to the main power grid through an external charger. Control and protection functions and the vehicle charging cable are installed permanently in the installation.

GROUP 5

Infrastructure

Prototype modified Renault Laguna E.V. cars charging at Project Better Place charging stations in Ramat Hasharon, Israel, north of Tel Aviv

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Public charging stations in a parking lot near Los Angeles International Airport. Shown are two old/obsolete (6 kW level-2) EVSE units (left: inductive Magne-charge gen2 SPI, right: conductive EVII ICS-200 AVCON).

REVAi/G-Wiz i charging from an on-street station in London

SemaConnect Electric vehicle charging stations for commercial use

Charging stations for electric vehicles may not need much new infrastructure in developed countries, less than delivering a new alternative fuel over a new network. The stations can leverage the existing ubiquitous electrical grid and home recharging is an option.

GROUP 6

Charging time

BYD e6 taxi in Shenzhen, China. Recharging in 15 Minutes to 80 Percent

Solaris Urbino 12 electric, battery electric bus, inductive charging station

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The battery capacity of a fully charged electric vehicle from electric vehicle automakers (such as Nissan) is about 20 kWh, providing it with an electrical autonomy of about 100 miles. Tesla Motors initially released their Model S with battery capacities of 40 kWh, 60 kWh and 85 kWh with the latter having an estimated range of approximately 480 km; as of May 2017 they have three models, 70 kWh, 90 kWh and 100 kWh. Plug in hybrid vehicles have capacity of roughly 3 to 5 kWh, for an electrical autonomy of 20 to 40 kilometres, but the gasoline engine ensures the full autonomy of a conventional vehicle.

As the electric-only autonomy is still limited, the vehicle has to be charged every two or three days on average. In practice, drivers plug in their vehicles each night, thus starting each day with a full charge.

For normal charging (up to 7.4 kW), car manufacturers have built a battery charger into the car. A charging cable is used to connect it to the electrical network to supply 230 volt AC current. For quicker charging (22 kW, even 43 kW and more), manufacturers have chosen two solutions:

- Use the vehicle's built-in charger, designed to charge from 3 to 43 kW at 230 V single-phase or 400 V three-phase.
- Use an external charger, which converts AC current into DC current and charges the vehicle at 50 kW (e.g. Nissan Leaf) or more (e.g. 120-135 kW Tesla Model S).

Charging time for 100 km of BEV range	Power supply	Power	Voltage	Max. current
6–8 hours	Single phase	3.3 kW	230 V AC	16 A
3–4 hours	Single phase	7.4 kW	230 V AC	32 A
2–3 hours	Three phase	11 kW	400 V AC	16 A
1–2 hours	Three phase	22 kW	400 V AC	32 A
20–30 minutes	Three phase	43 kW	400 V AC	63 A
20–30 minutes	Direct current	50 kW	400–500 V DC	100–125 A
10 minutes	Direct current	120 kW	300–500 V DC	300–350 A

The user finds charging an electric vehicle as simple as connecting a normal electrical appliance; however to ensure that this operation takes place in complete safety, the charging system must perform several safety functions and dialogue with the vehicle during connection and charging.

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DC charging stations (rapid)

Tesla Model S charging at a Tesla Motors Supercharger network (rapid-charging) station in Gilroy, California.

These companies (among AC slow-charging stations) design and manufacture DC Fast charging stations (less than 30 minutes). These systems may offer a restricted charge, stopping at a charge level of 80%, or may change the charging rate to a lower level after a charge level of 80% is reached.

- Andromeda Power (Stations with CHAdeMO and SAE Combined Charging System CCS) power input from Solar Panel (S2V) and from another vehicle (V2V).
- EVTRONIC (Stations with CHAdeMO, and SAE Combined Charging System CCS) .
- Bosch Automotive Service Solutions Inc. (Stations with SAE Combined Charging System CCS).
- Eaton (Stations with CHAdeMO and SAE Combined Charging System CCS) (US and Canada) up to 1 MW.
- EFACEC (Stations with CHAdeMO and CCS (E.U. or U.S.)
- ABB (Stations with CHAdeMO and CCS)
- AeroVironment
- Fuji Electric and
- Schneider Electric
- Signet Systems
- Delta Electronics (Stations with CHAdeMO)
- Valent Power
- E-Station (Australia)

Source: https://en.wikipedia.org/wiki/Charging_station

POZNÁMKY