A C A D E M I A R O M Â N Ă
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Electricity-powered charging stations with renewable energy

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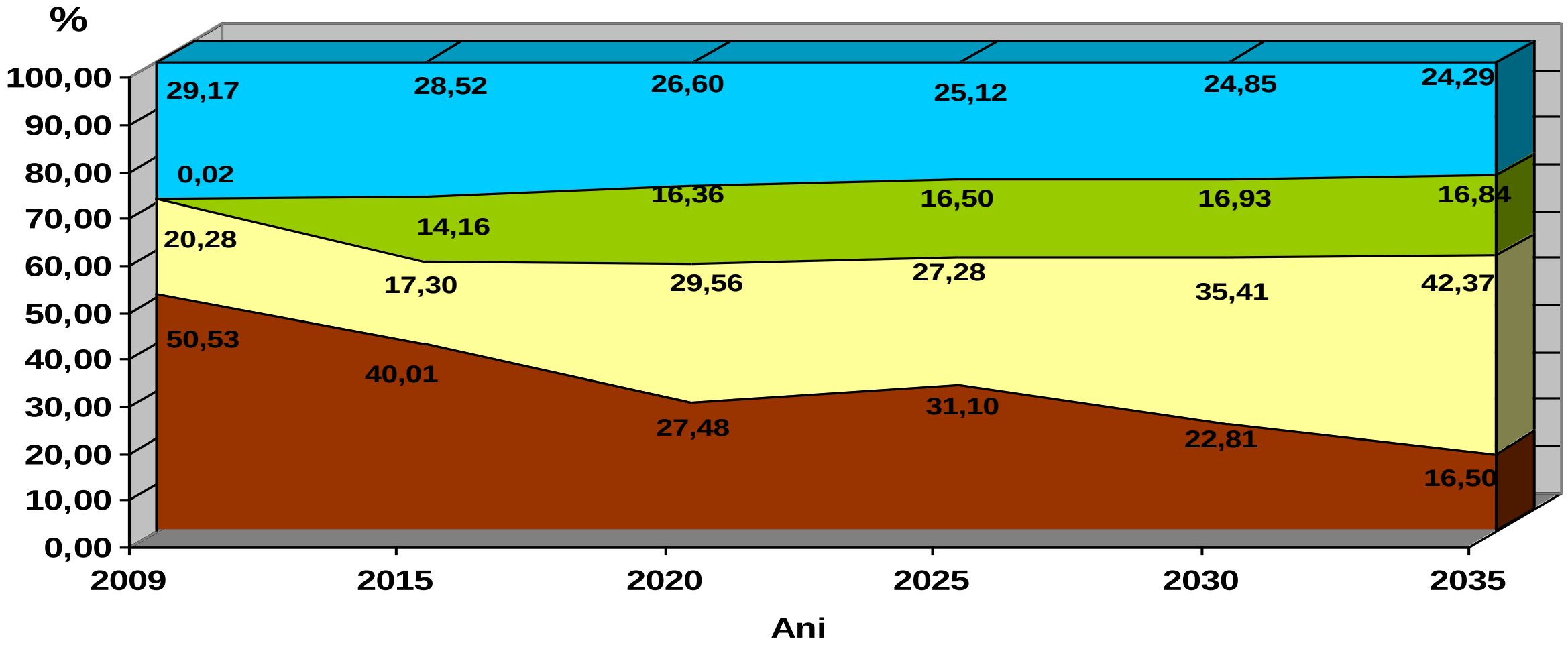
Renewable Energy Sources and Energy Efficiency Centre

2022 January 19

Romanian Energy Resources *quota*!

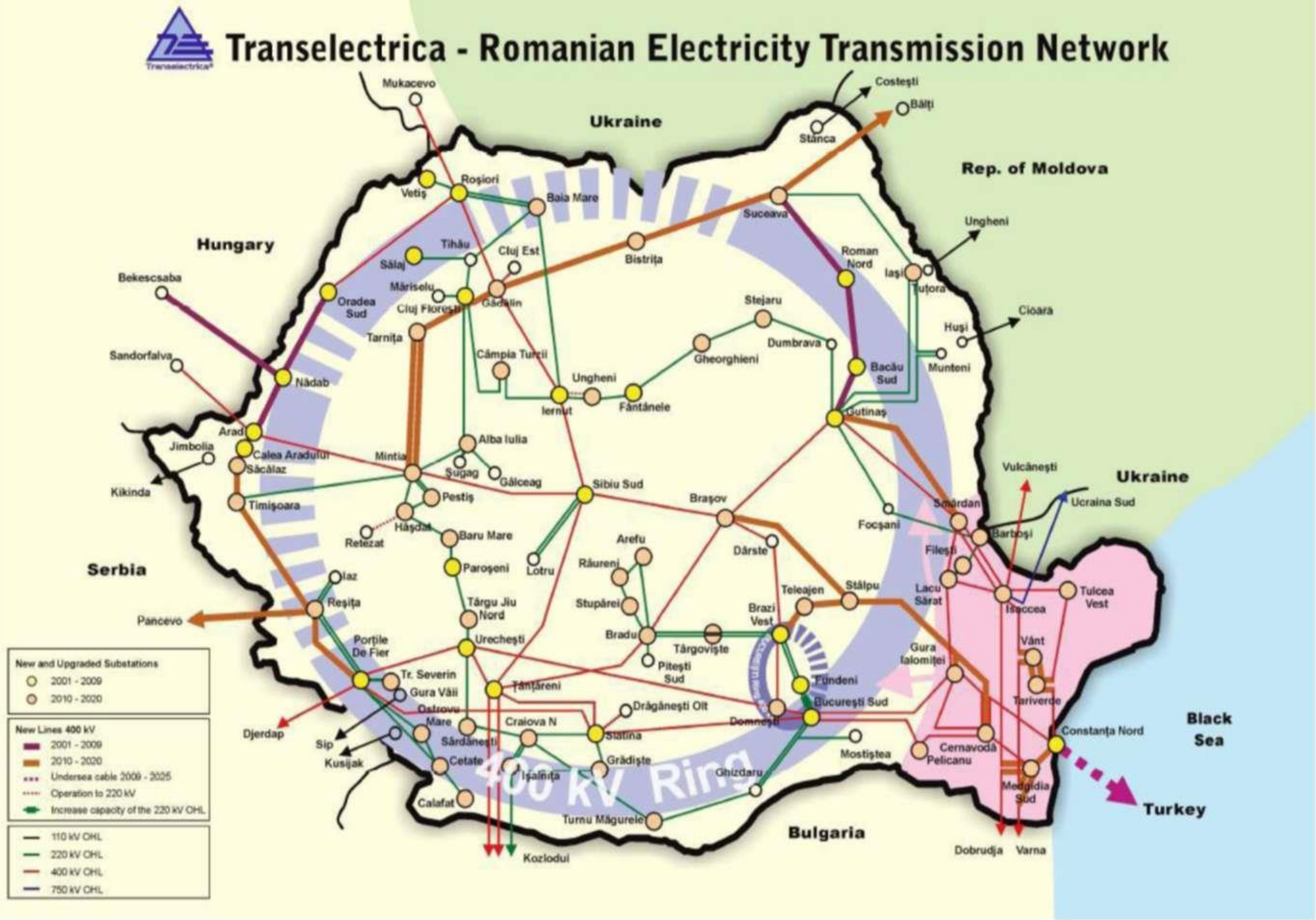


100% ROMANIA

Transition to 100% wind, water, and solar (WWS) for all purposes
(electricity, transportation, heating/cooling, industry)

2050
PROJECTED ENERGY MIX

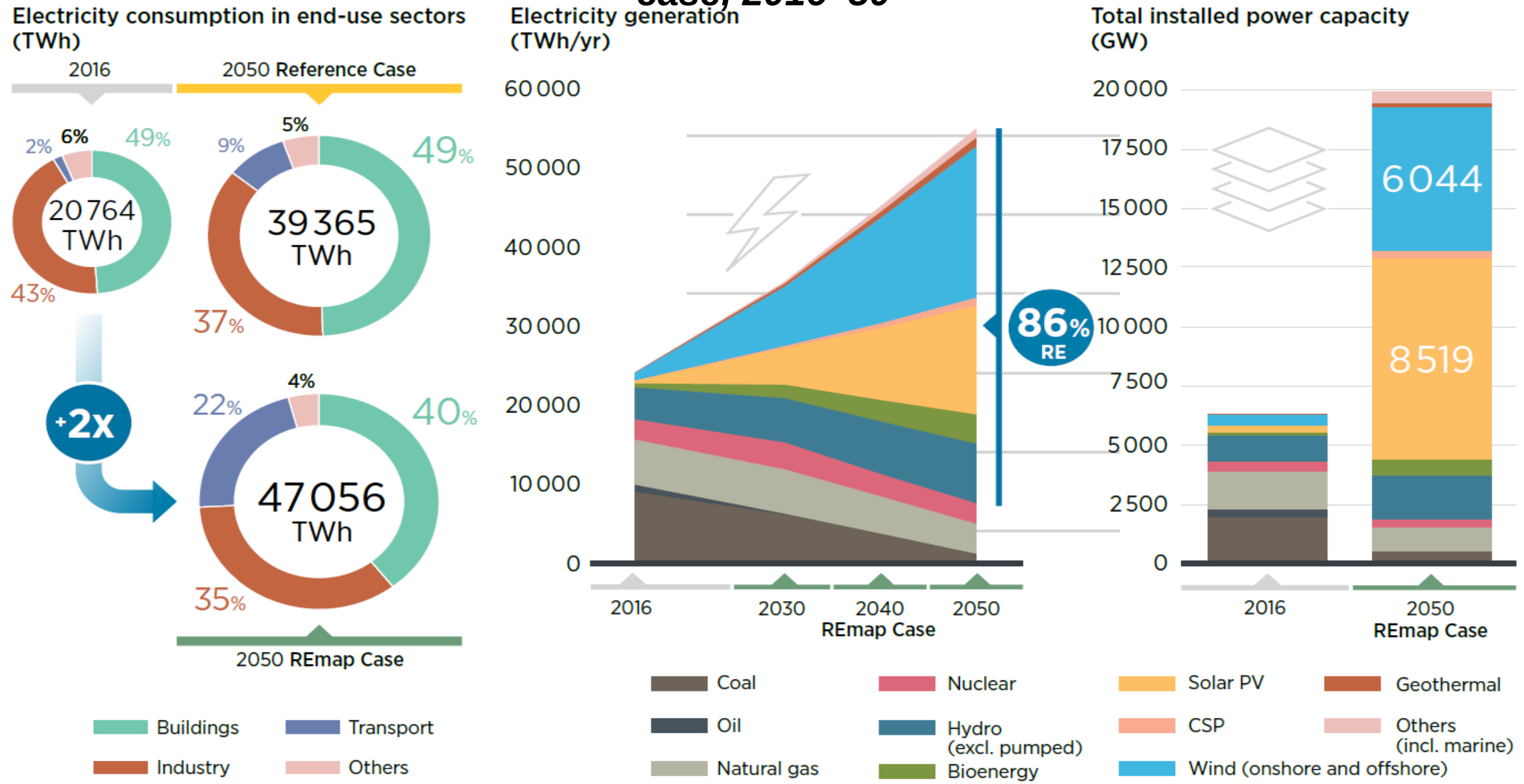
- Residential rooftop solar **1.6%**
- Solar plant **36%**
- CSP plants **0%**
- Onshore wind **24.4%**
- Offshore wind **22%**
- Commercial/govt rooftop solar **5.4%**
- Wave energy **0.3%**
- Geothermal **0.3%**
- Hydroelectric **10.1%**
- Tidal turbine **0%**


Transelectrica - Romanian Electricity Transmission Network
Ukraine
Rep. of Moldova
Hungary
Serbia
Bulgaria
Ukraine
Black Sea
Turkey
400 kV Ring
Mukacevo
Costeşti
Bălţi
Stânca
Roşiori
Vetiş
Baia Mare
Suceava
Ungheni
Tihău
Sălaj
Cluj Est
Bistriţa
Roman Nord
Iaşi
Ţuţora
Bekescsaba
Oradea Sud
Mărişelu
Cluj Floreşti
Gădălin
Stejaru
Cioara
Huşi
Tarniţa
Dumbrava
Munteni
Sandorfalva
Câmpia Turzii
Gheorghieni
Ungheni
Bacău Sud
Nădab
Iernut
Fântânele
Gutinaş
Arad
Jimbolia
Calea Aradului
Săcălaz
Alba Iulia
Mintia
Şugag
Gâlceag
Sibiu Sud
Vulcăneşti
Kikinda
Peştiş
Braşov
Ucraina Sud
Timişoara
Smârdan
Focşani
Barboşi
Haşdat
Baru Mare
Retezat
Arefu
Dârste
Fileşti
Lotru
Paroşeni
Răureni
Lacu Sărat
Tulcea Vest
Iaz
Teleajen
Stâlpu
Isaccea
Reşiţa
Stupărei
Târgu Jiu Nord
Brazi Vest
Pancevo
Porţile De Fier
Urecheşti
Bradu
Târgovişte
Vânt
Gura Ialomiţei
Piteşti Sud
Tr. Severin
Ţânţăreni
Fundeni
Gura Văii
Bucureşti Sud
Tariverde
Drăgăneşti Olt
Ostrovu Mare
Domneşti
Djerdap
Craiova N
Constanţa Nord
Sip
Sărdăneşti
Slatina
Mostiştea
Kusijak
Cetate
Grădişte
Cernavodă
Pelicanu
Işalniţa
Ghizdaru
Medgidia Sud
Calafat
Turnu Măgurele
Kozlodui
Dobrudja
Varna
New and Upgraded Substations
2001 - 2009
2010 - 2020
New Lines 400 kV
2001 - 2009
2010 - 2020
Undersea cable 2009 - 2025
Operation to 220 kV
Increase capacity of the 220 kV OHL
110 kV OHL
220 kV OHL
400 kV OHL
750 kV OHL

Overall share of energy from renewable sources *(% of gross final energy consumption, 2019)*

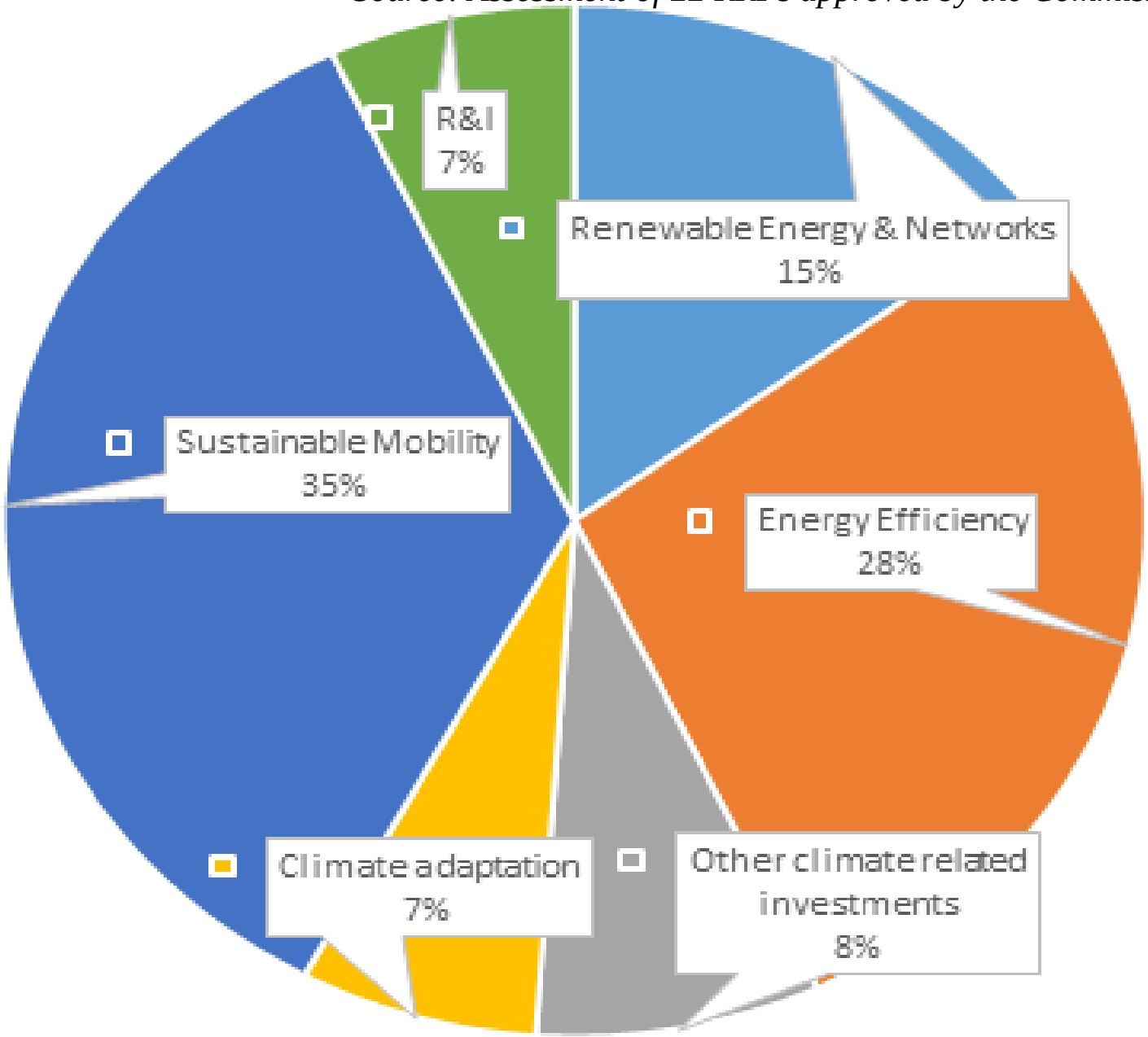
Source: Eurostat

Electricity generation mix & power generation installed capacity by fuel, *REmap case, 2016–50*

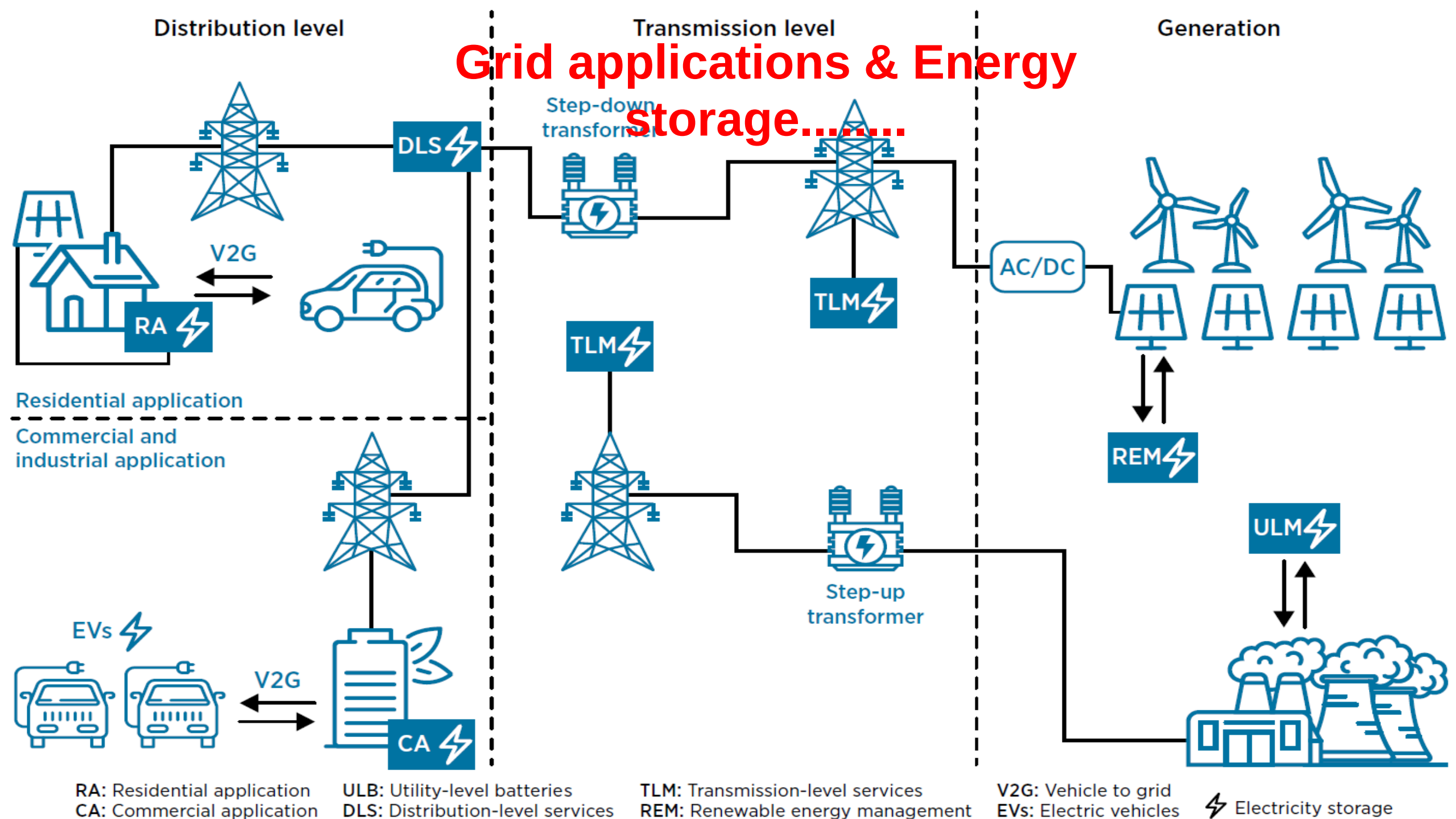


Distribution of climate-related investments in Member States Recovery and Resilience Plans (MS' RRPs)

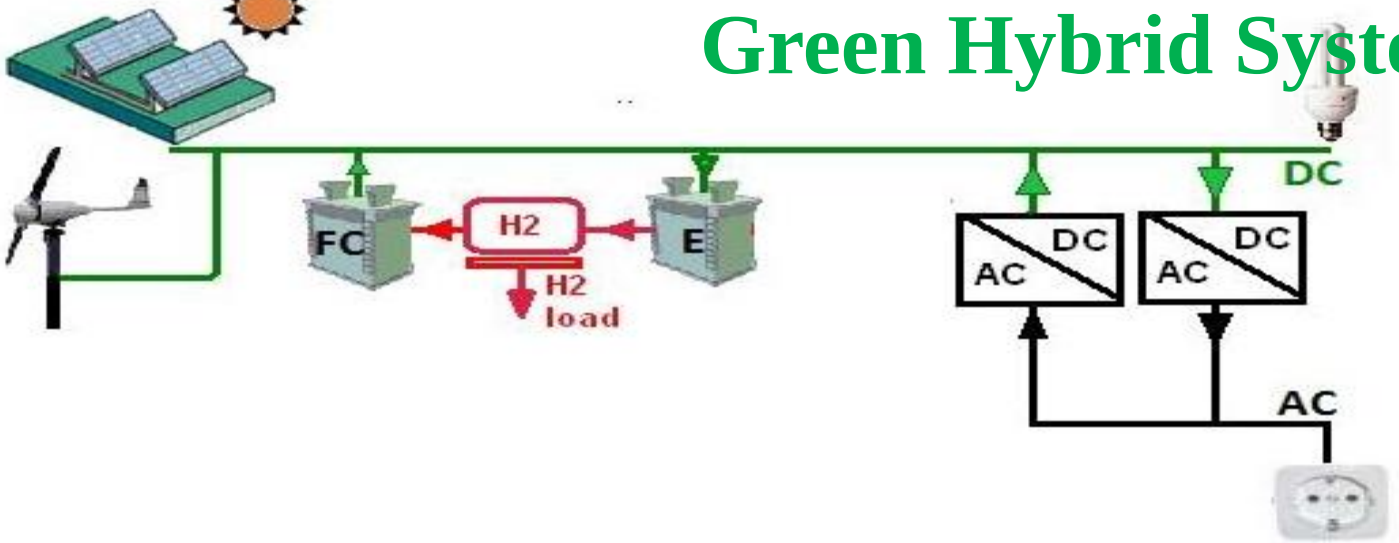
Source: Assessment of 22 RRPs approved by the Commission (by 5 October 2021

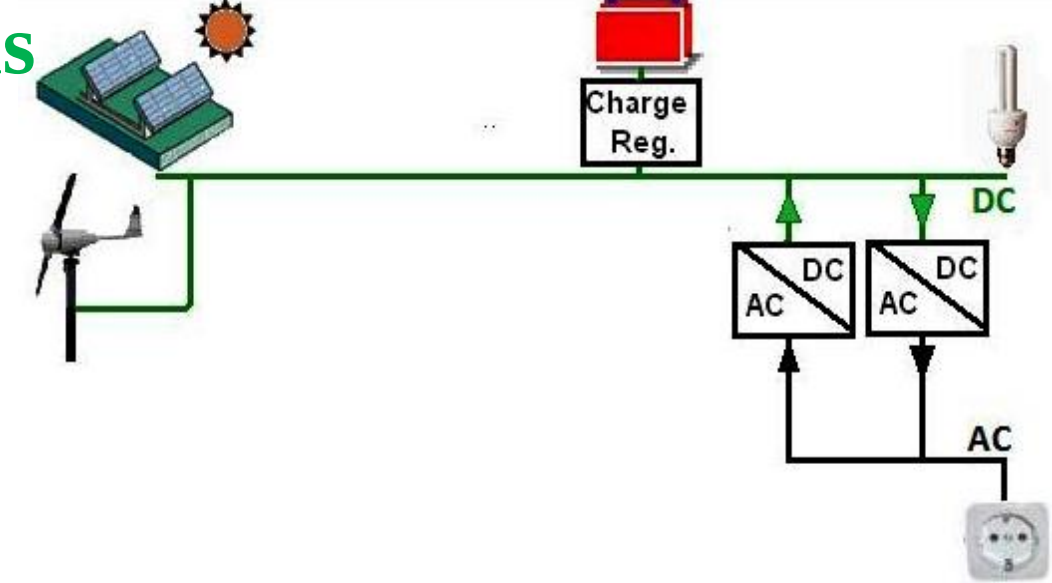


Grid applications & Energy storage.....



Green Hybrid Systems





S_1: photovoltaic panels, wind turbine, inverter and hydrogen production, storage and conversion technology - electrolyzer, hydrogen tank, fuel cell; the system makes use of solar & wind energies as

(1) *renewable green sources* (for power supply of the electricity-powered charging stations *during the peak load period and weather fluctuation conditions*,

(2) fuel cell works and employes hydrogen conversion into electricity - *secondary source of energy*); the hydrogen is produced on-site by the electrolyzer by harnessing the RES (*solar & wind*).

S_2: the hybrid system has the following equipments:

(1) photovoltaic panels & a wind turbine for harnessing solar and wind resources,

(2) lithium-ion batteries for renewable energy storage and

(3) inverter for DC/AC conversion.

The EU's Directive on Alternative Fuel Infrastructure (DAFI) set clear objectives for all 28 member states in 2014.

Future reductions of CO_2 emissions from passenger cars will be strongly dependent on increased sales of alternatively-powered vehicles, including electric, hybrid, fuel-cell & natural gas-powered vehicles.

The market for 'electrified' passenger cars *can be split in 2 categories*:

1. **Electrically-chargeable vehicles (ECVs)** include full battery electric vehicles and plug-in hybrids, both of which require appropriate recharging infrastructure:

- **Battery electric vehicles (BEVs)** *are fully powered by an electric motor, using electricity stored in an on-board battery that is charged by plugging into the electricity grid*;

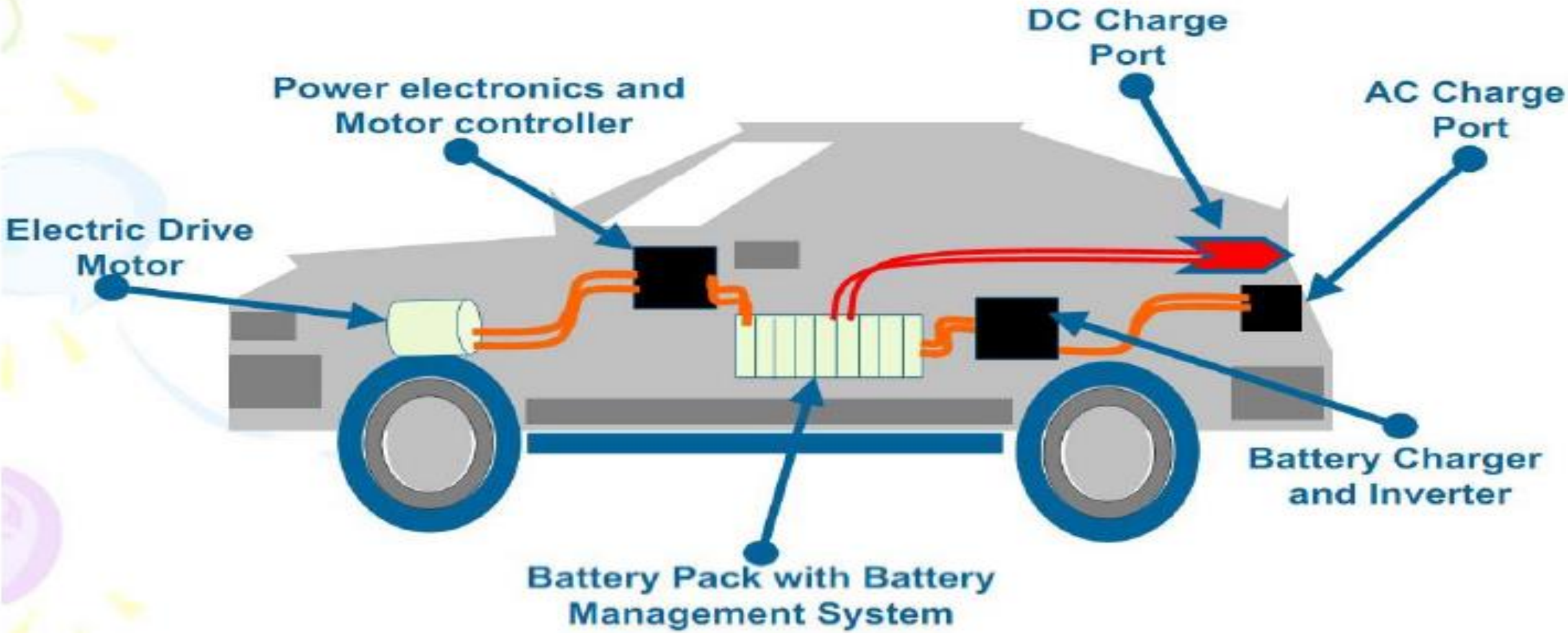
- Plug-in hybrids (PHEVs) *have an internal combustion engine (running on petrol or diesel) and a battery-powered electric motor (the combustion engine supports the electric motor when required, and th battery is recharged by connecting to the grid as well as by the on-board engine);*

The market for ‘electrified’ passenger cars (2)

2. Hybrid electric vehicles (HEVs) are powered by an internal combustion engine (*running on petrol or diesel*),

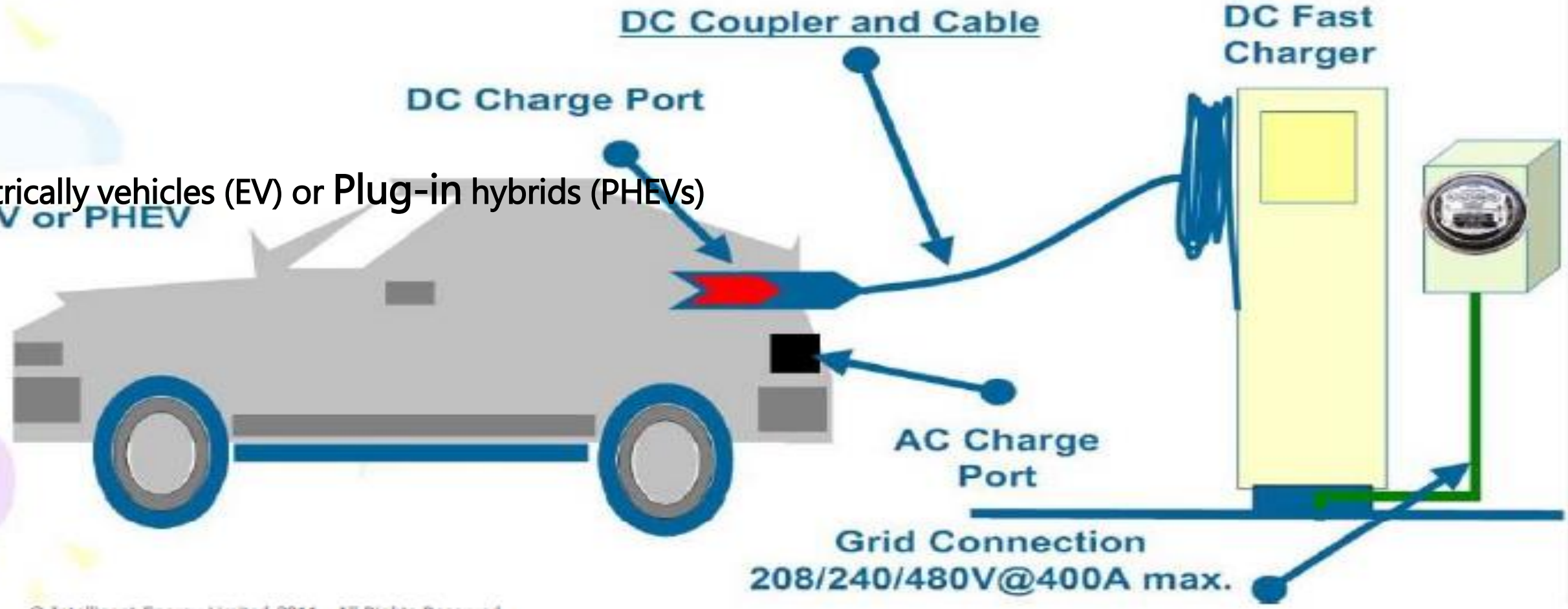
but also have a battery-powered electric motor that serves to complement the conventional engine *(their electricity is generated internally from regenerative braking and the internal combustion engine, so they do not need recharging infrastructure; the hybridisation level ranges from mild to full).*

The Basic Electric Vehicle Drive and Energy Storage and Charging System



The Basic Electric Vehicle Grid Interconnection

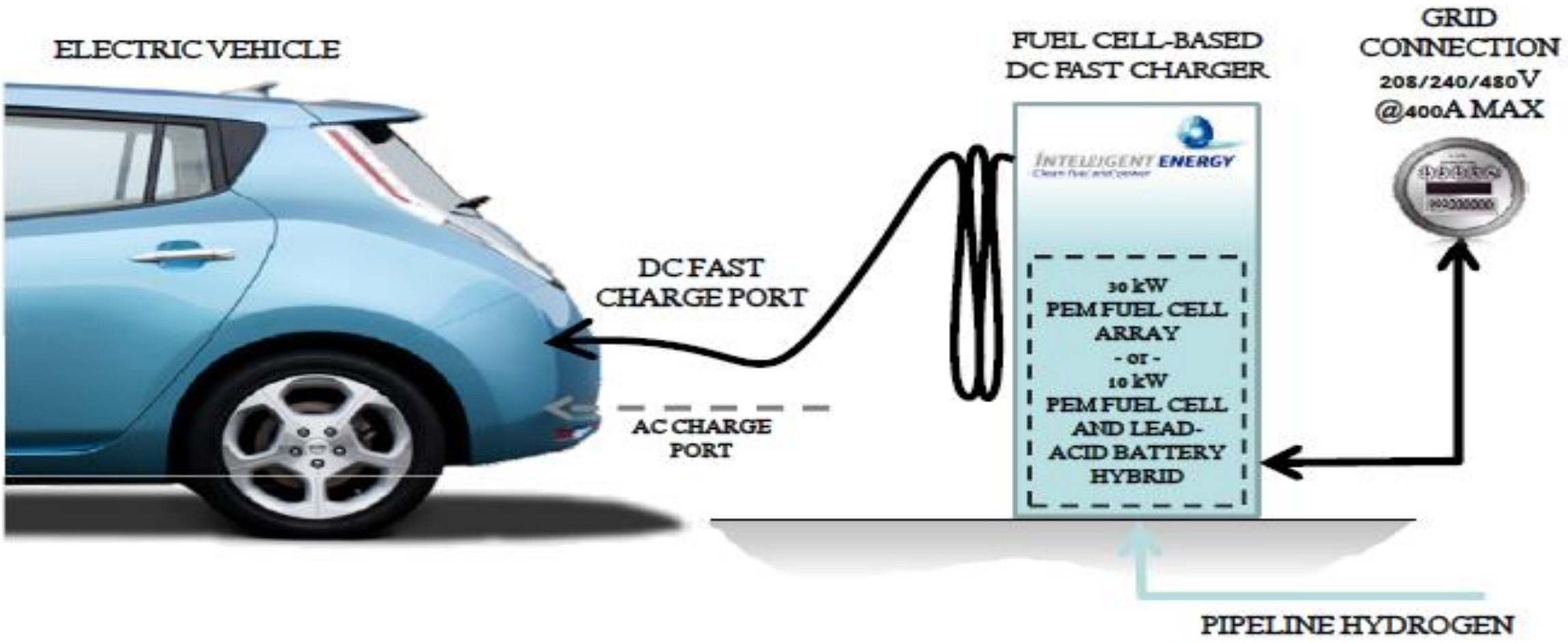
SAE J1772™ DC Off-Board Charging

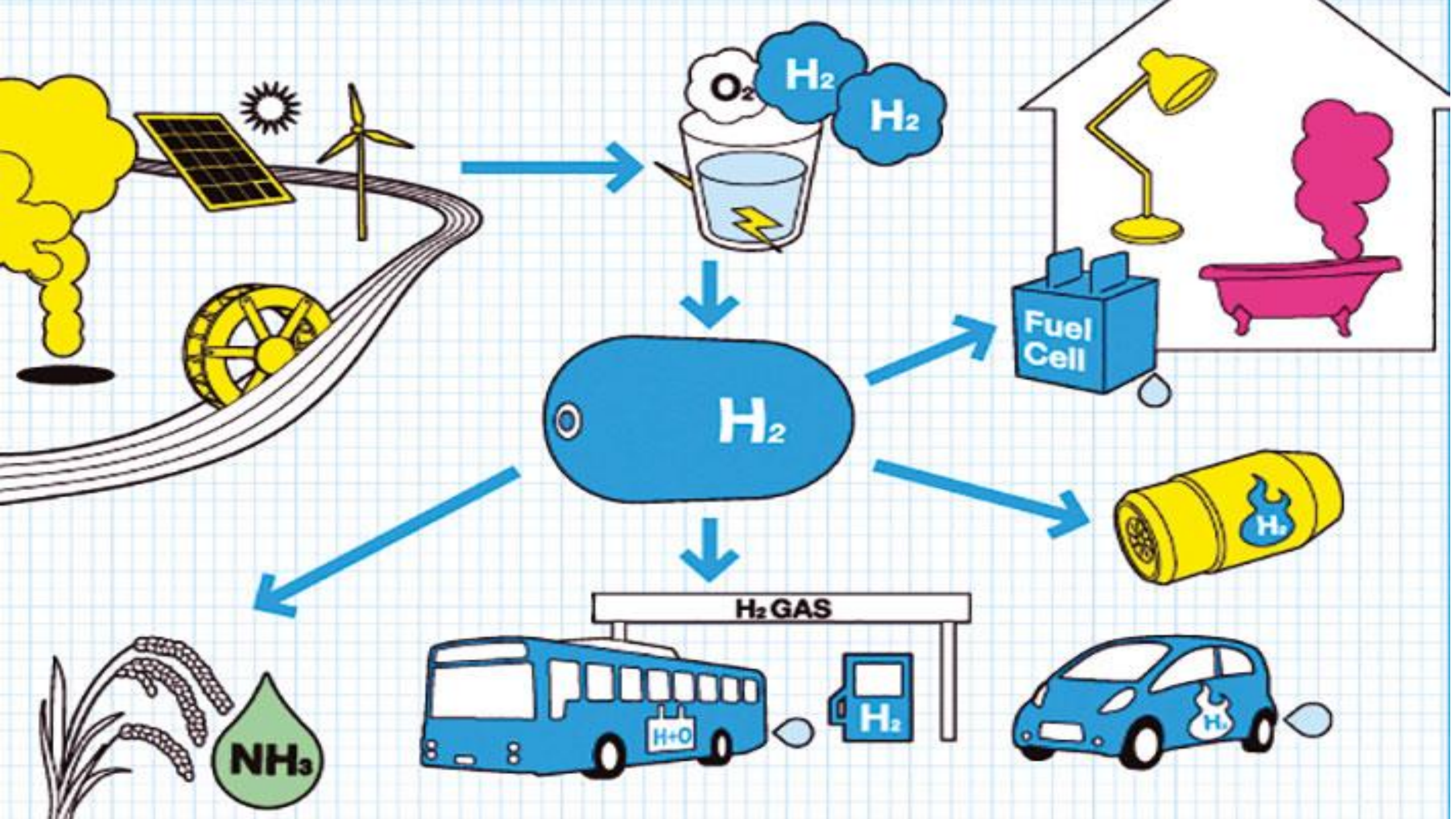


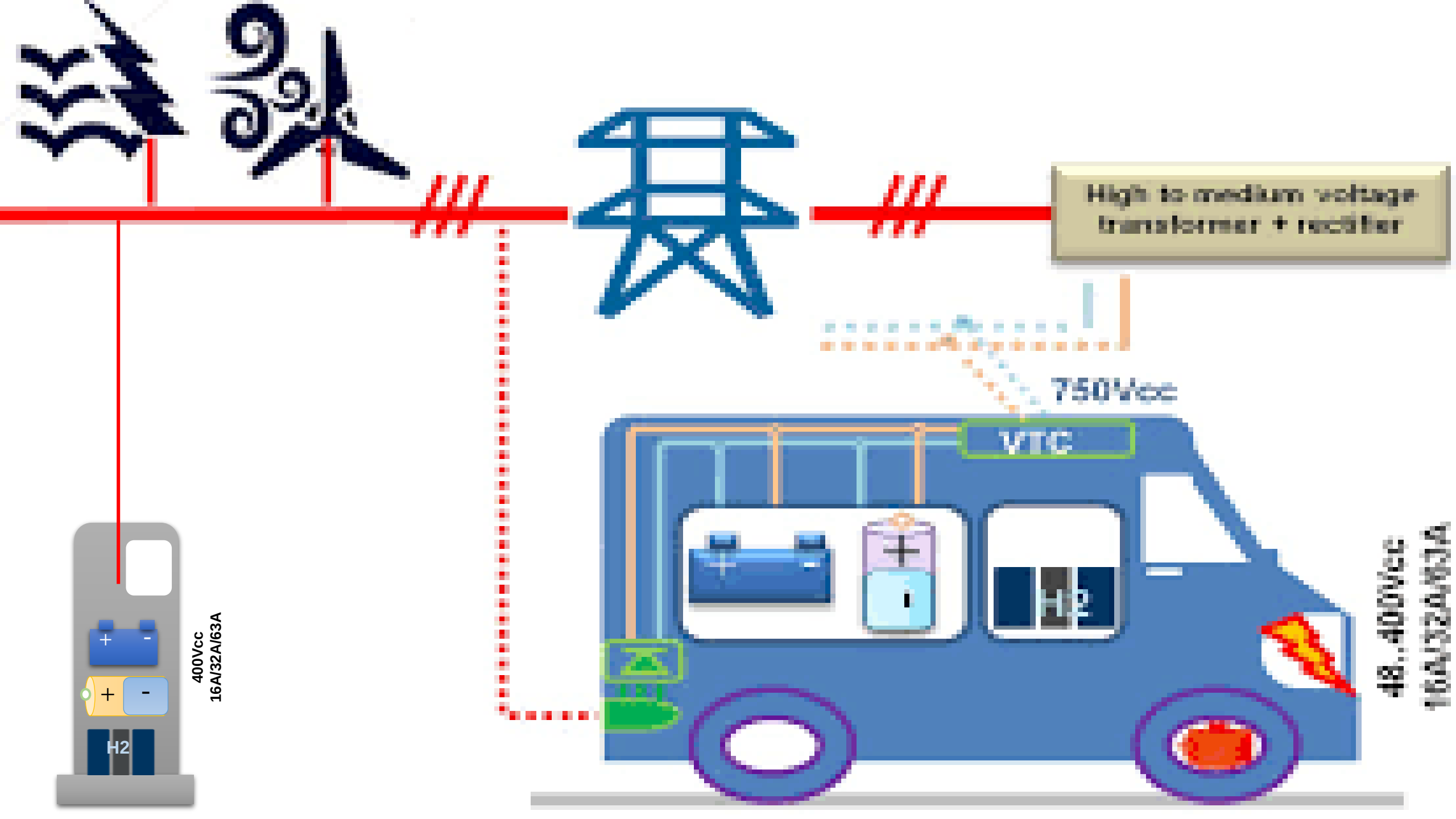
Electrically vehicles (EV) or Plug-in hybrids (PHEVs)

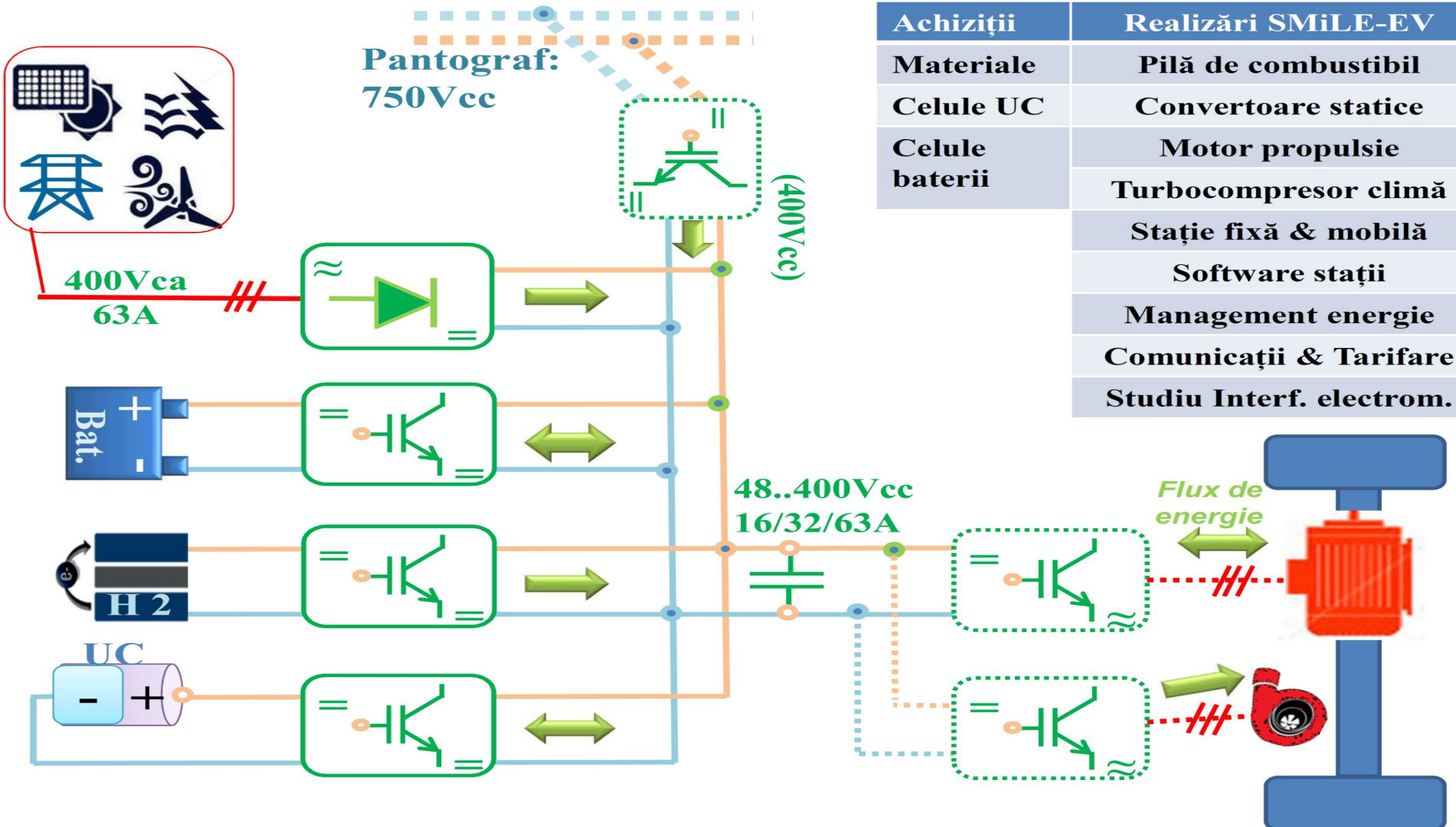
Fuel-cell vehicles (FCEVs) are propelled by an electric motor, and their electricity is generated within the vehicle by a *fuel-cell that uses compressed hydrogen & oxygen from the air*.

For the time being, fuel-cell cars are still quite rare in Europe.




O2
H2
H2
Fuel Cell
H2
H2 GAS
H2
H2O
NH3


High to medium voltage transformer + rectifier
750Vcc
VTC
H2
400Vcc
16A/32A/63A
48..400Vcc
16A/32A/63A
+
-
H2



Achiziții	Realizări SMiLE-EV
Materiale	Pilă de combustibil
Celule UC	Convertoare statice
Celule baterii	Motor propulsie
	Turbocompresor climă
	Stație fixă & mobilă
	Software stații
	Management energie
	Comunicații & Tarifare
	Studiu Interf. electrom.

EMERGENCY ROADSIDE RAPID DC RECHARGING

ELECTRIC VEHICLE, STRANDED WITH A FULLY DISCHARGED BATTERY

TRUCK EQUIPPED WITH 30 kW PEM FUEL CELL AND COMPRESSED HYDROGEN SUPPLY