

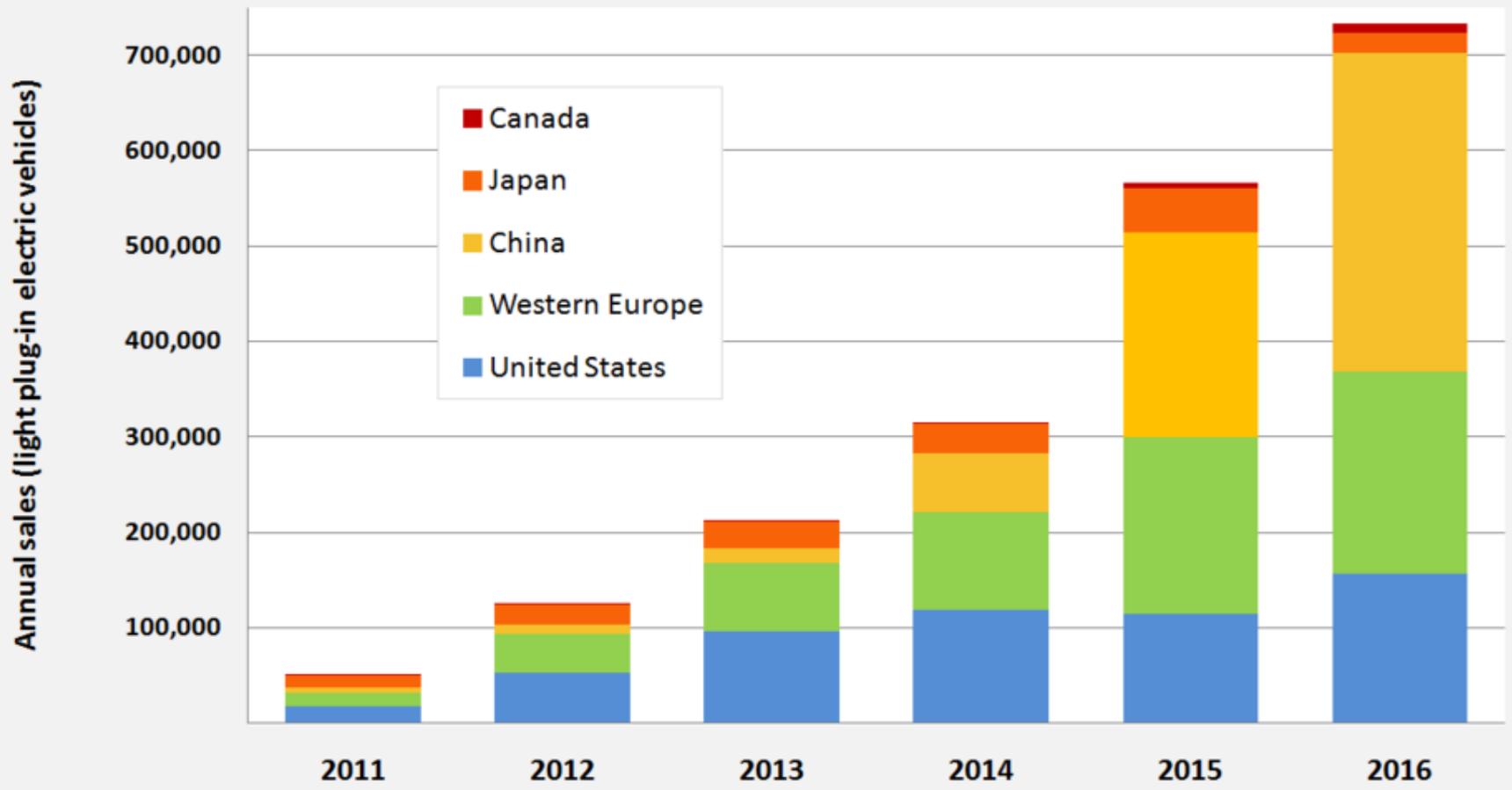
New energy security paradigm - electric vehicles (and regional hints)

Dr. Petar Stanojevic



FACTS ABOUT ELECTRIC VEHICLES SALE IN THE WORLD

Global annual sales of light-duty plug-in electric vehicles in top selling markets (2011 - 2016)

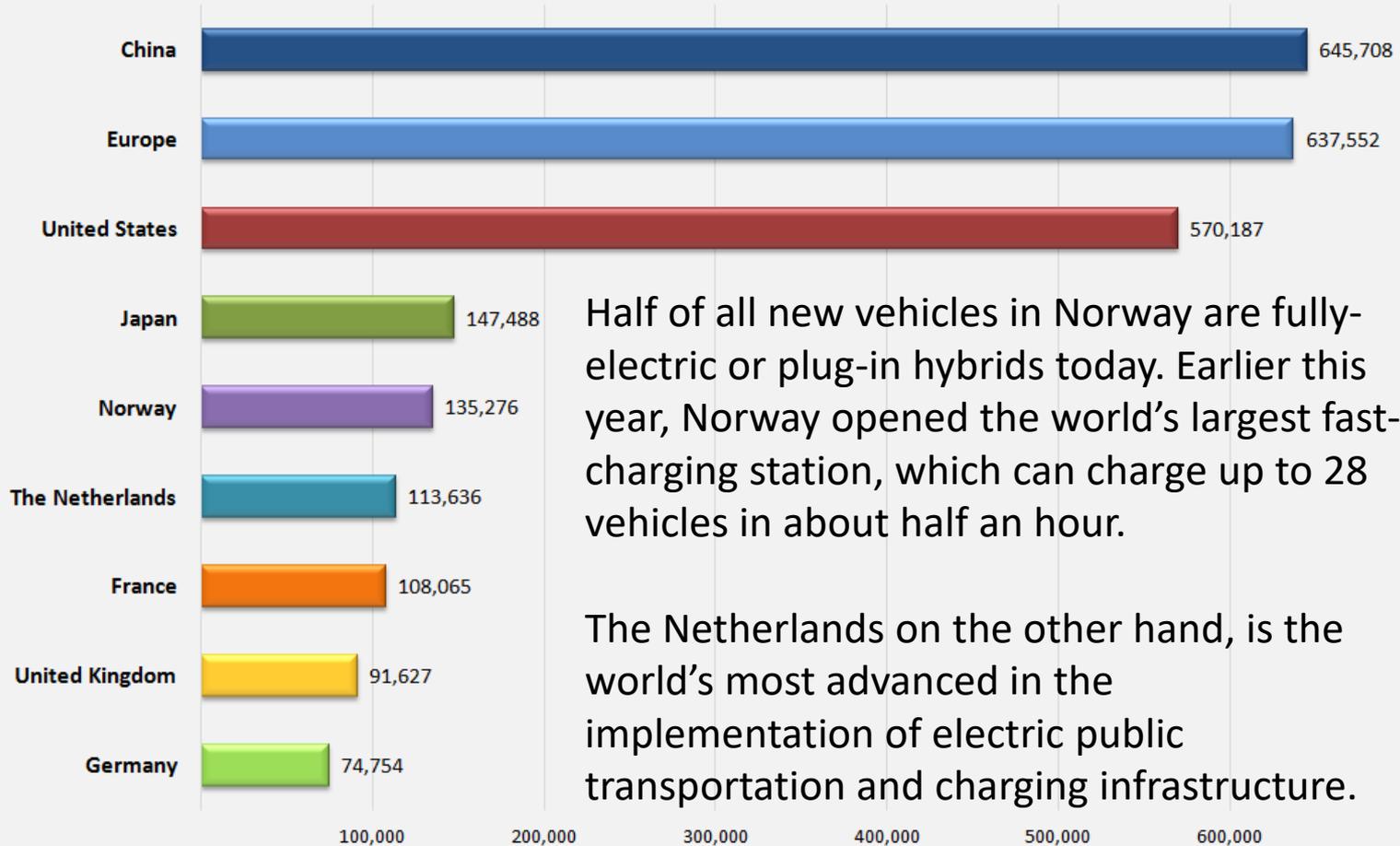


Note: In 2010, fewer than 700 EVs were sold across the EU. In comparison in the US, as evidenced by the 400,000 people who have paid \$1000 to be on the waiting list for Tesla's \$35,000 Model 3 car.

IT IS STILL LESS THAN 1% OF CARS SALE IN THE WORLD

<https://www.theguardian.com/environment/2017/feb/07/power-to-the-ev-norway-spearheads-europes-electric-vehicle-surge>

**Top-selling light-duty plug-in electric vehicle global markets
(cumulative sales through December 2016 by country/region)**



Half of all new vehicles in Norway are fully-electric or plug-in hybrids today. Earlier this year, Norway opened the world's largest fast-charging station, which can charge up to 28 vehicles in about half an hour.

The Netherlands on the other hand, is the world's most advanced in the implementation of electric public transportation and charging infrastructure.

EU Perception



- The European Commission has published a **European strategy for low-emission mobility** (EC, 2016). The longer-term objectives of the new strategy are to decrease oil import dependency, increase innovation and competitiveness and faster opportunities for growth and jobs.
- The **Alternative Fuels Infrastructure Directive** (EU, 2014) requires Member States to set targets for recharging points accessible to the public, to be built by 2020, to ensure that electric vehicles can circulate at least in urban and suburban areas. Targets should ideally include a minimum of one recharging point per 10 electric vehicles.
- In the 2011 **White Paper on Transport**, the European Commission set a target of halving the use of conventionally fueled cars in urban transport by 2030 and phasing them out in cities by 2050.
- The Netherlands is planning to phase out all internal combustion engine vehicles by 2035. The Netherlands has the highest ratio between public charging points and electric vehicles. 47% of Dutch drivers often or always charge at work.
- The transport sector's GHG emission reduction targets are, for example, designed to contribute to the **EU's overall goal to reduce GHG emissions by 80–95 % by 2050**.

Incentives are widely in place....

	Purchase grant <i>one time</i>	Ownership tax <i>annual</i>	Company car tax <i>annual</i>
	€4,000 grant	No tax at all	120% deductible
	< €10,000 grant	50% or 100% discount	No tax at all
	£4,500 grant	No tax at all	9% instead of 17%
	€4,000 grant	No tax at all	< €8,000 discount
	No VAT on purchase	NOK 455 instead of NOK 2.820	50% discount
	No purchase tax	No tax at all	4% instead of 22%

2017
electric car **incentives**
in western europe

EVBOX

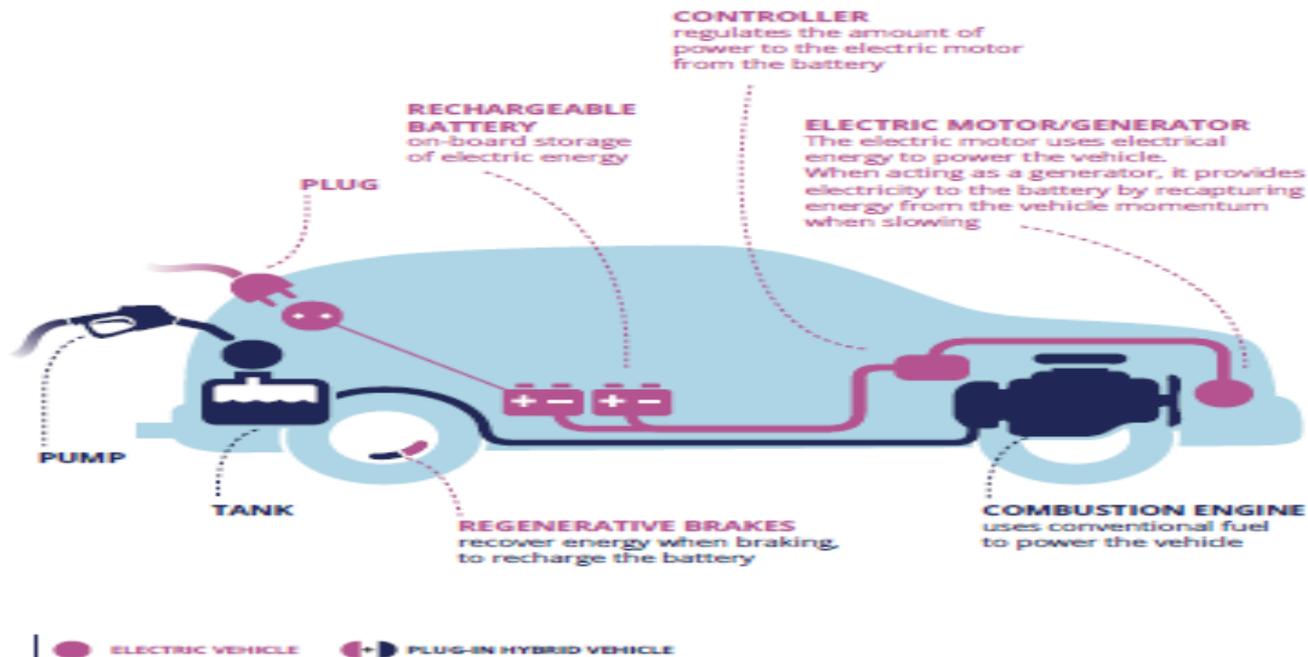
2017 Incentives for fully-electric vehicles.
Check out more details at
blog.ev-box.com/electric-car-incentives

Electrical Vehicles technology features

Electric motors have several advantages over conventional combustion engines:

- this includes their higher efficiency (an electric vehicle converts around 80 % of the energy it uses to usable power, compared with around 20 % for a conventional vehicle),
- high durability,
- lower maintenance costs and
- quieter noise levels at low speeds.

NOTE: With regard to the wider transport sector, electric vehicles are a ready technology only at the light-weight end. The aviation, shipping and haulage industries had to make big efficiency gains in the short term. Because zero-emissions solutions in those areas remained in development.



ENVIRONMENTALISTS POINT OF VIEW

<http://www.climatechangenews.com/2016/09/15/climate-targets-mean-an-end-to-oil-fuelled-cars-by-2035/>

- If the world is to stand any chance of staying within the 1.5C warming limit set by world leaders in Paris last year, electric vehicles must replace traditional combustion engines entirely by 2035.
- To reach the secondary goal of the Paris agreement – keeping warming below 2C – electric vehicles will still need to be hugely mobilized. By 2050 half of all cars would need to be “zero-emissions”.
- The electric vehicles come with their own challenges, most importantly, the increased demand for electricity.
- The emissions gains won by electric vehicles will be undermined unless the electricity sector is decarbonized.
- If no clean energy sources than alternatives are to reduce the average CO2 emitted from power facilities or to capture carbon.
- Use of electric vehicles can decrease congestion, and noise in urban centers as well as pollution.

BANK's PREDICTIONS

From "the guardian"
13/07/2017.



- “All new cars sold in Europe will be electric within less than two decades, driven by government support, falling battery costs and economies of scale, a **Dutch ING bank** has predicted”.
- The forecast of the UK’s National Grid said it expects 90% of new cars in Britain to be electric by 2050.
- France’s committed to ban combustion car sales by 2040.
- The ING bank said that it believed pure electric cars would “become the rational choice for motorists in Europe” sometime between 2017 and 2024, as their car showroom prices fall, their ranges increase and charging infrastructure becomes more widespread.
- By 2024, the report’s authors forecast that in Germany the cost of ownership for an electric car – including buying and fueling it – would be the same as a conventional petrol or diesel model.

PETROLEUM INDUSTRY AND IEA STANDPOINT

- Shell, Saudi ARAMCO and the International Energy Agency (IEA) dismissed the idea that electric vehicles will hurt oil demand.
- Global development is estimated to be 3% next year which will push up the consumption.
- The IEA raised its forecast for global oil demand in 2017 to 98m barrels a day, with growth revised up 0.1mb/d on its projection last month, to 1.4mb/d.
- IEA that greenhouse gas emissions from transportation will “increase by 120% from 2000. to 2050. as a result of a projected three-fold increase” in the number of cars worldwide.
- Existing known oil & gas deposits are more than enough to satisfy the future consumption and price will not fly up high.
- At the same time Shell and other petroleum companies hurriedly install chargers on existing petrol stations.



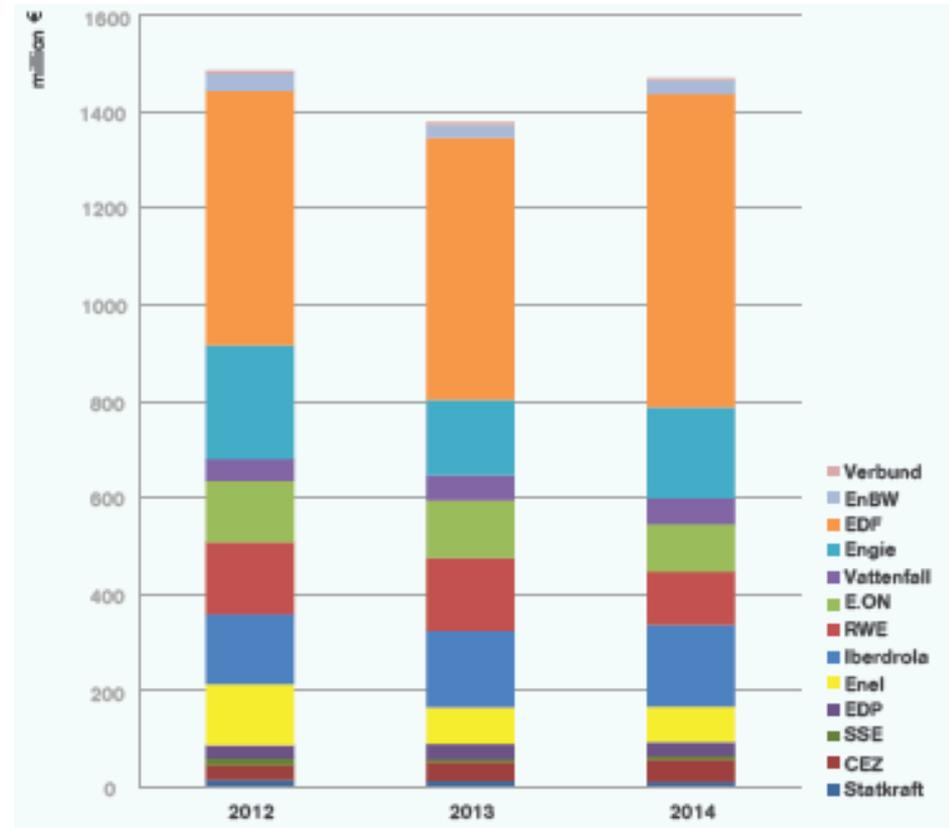
Car Producers point of view



- Almost every car manufacturer has now included electric vehicles in its range, with each producer launching at least one new plug-in hybrid electric model each year.
- More than 30 models are currently available in Europe. But that is a small number compared with the number of available conventional car models.
- Accounting for sales during the first nine months of 2014, the Tesla Model S outsold the Audi A8, BMW 7 Series and Jaguar XJ, ranking second in the European luxury vehicle segment after the Mercedes-Benz S-Class.
- Small petrol & diesel cars are still significantly cheaper and are small fuel consumers (cost of ownership are low) and are one of the development directions.
- Despite the huge investments in the battery's development progress is not as fast as expected and some producers (like Toyota) are working in parallel on more efficient engines development.
- Development of “intelligent car” is also a trend in the car industry.
- Cost of ownership (including fuel cost) will be the main market driver in the future as it was in the past.
- Battery is still expensive and charging infrastructure still need significant development.
- Developing countries are still hungry for cars of any type.
- Car-makers in Europe say that emissions standards are a regulatory burden that place them at a competitive disadvantage.
- Critics argue the industry is highly profitable and will need to invest heavily in electric vehicles to remain in business. “European car companies will suffer the same catastrophic collapse Nokia experienced for failing to embrace new technologies”.

Energy sector reaction

- We see a little reluctance or slight support from the energy sector. The electricity sector is interested but for different purposes. The utilities are more interested in electric vehicles as an energy peak solution than anything else.”
- With renewable energy not always generating power when it is needed, using it to charge electric vehicles overnight would help to even out the distribution of power that they generate.
- There are also fears that governments could attempt to recoup some of the lost revenue from fuel duties as people turn to electric vehicles, by charging a higher rate for electricity used to power electric cars. This could threaten the economic viability of going electric and offers governments a poison pill that would threaten the sector.



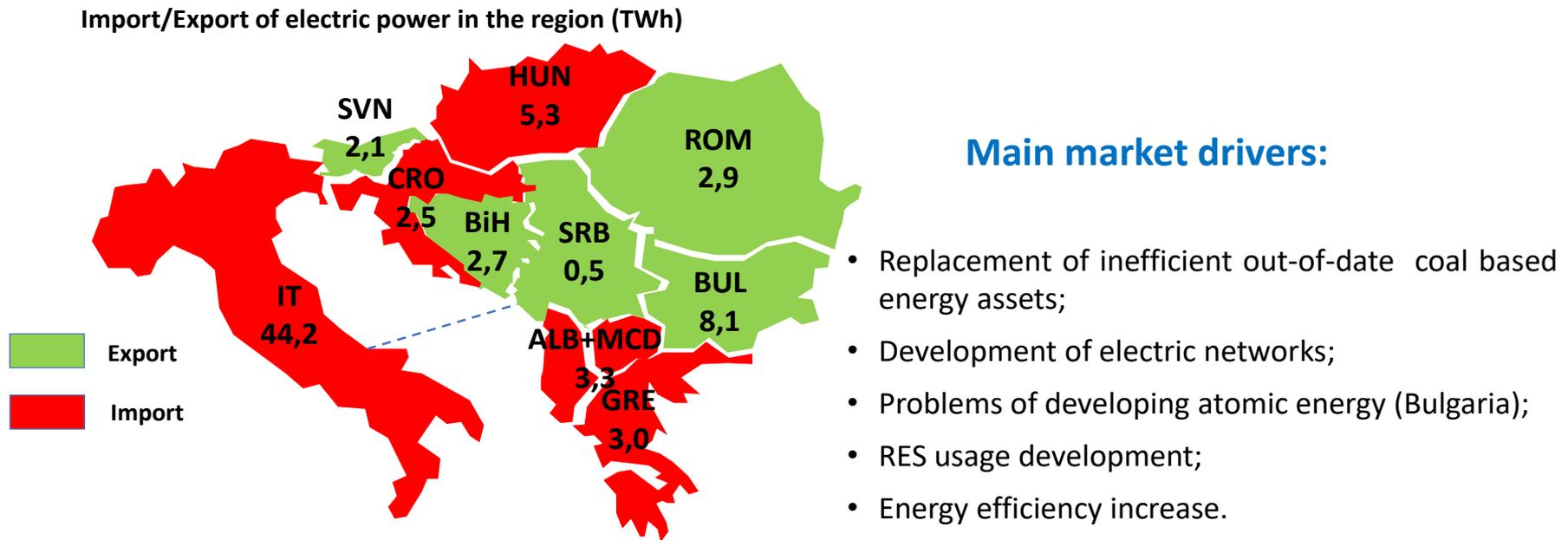
It has been estimated that accelerated innovation in power supply technologies and business models for energy efficiency will be worth €70 billion to the EU economy by 2030.

New load on the electricity generation and infrastructure

- **Recent findings from the EEA show that, if a hypothetical 80 % of cars in 2050 were electric, an additional 150 GW** of additional electricity generation capacity would be needed across the EU (assuming no reduction of demand from other sectors) (EEA, 2016a).
- Contemporary EU total capacity is about 980 GW so **required increase should be cca. 15% driven** only by the EVs.
- Distribution grid and interconnections have to grow accordingly.
- Several European studies have concluded that, in most scenarios, it is possible to ensure everyday mobility using only common electric vehicles charging overnight at home. Such guidance is necessarily simplified. It focuses on everyday mobility in urban areas and disregards long-distance trips.

Republic of Serbia and Region Perspective

Electricity – Serbia put priority on production capacities



The region, including Italy, is in deficit (the deficit was 40 TWh (15-75TWh up to 2020), which is the equivalent to 9 GWh of power). Main importers are: Italy, Hungary, Greece, Croatia. Main exporters are: Bulgaria, Romania, Bosnia & Herzegovina. Situation is worse if to add Turkey.

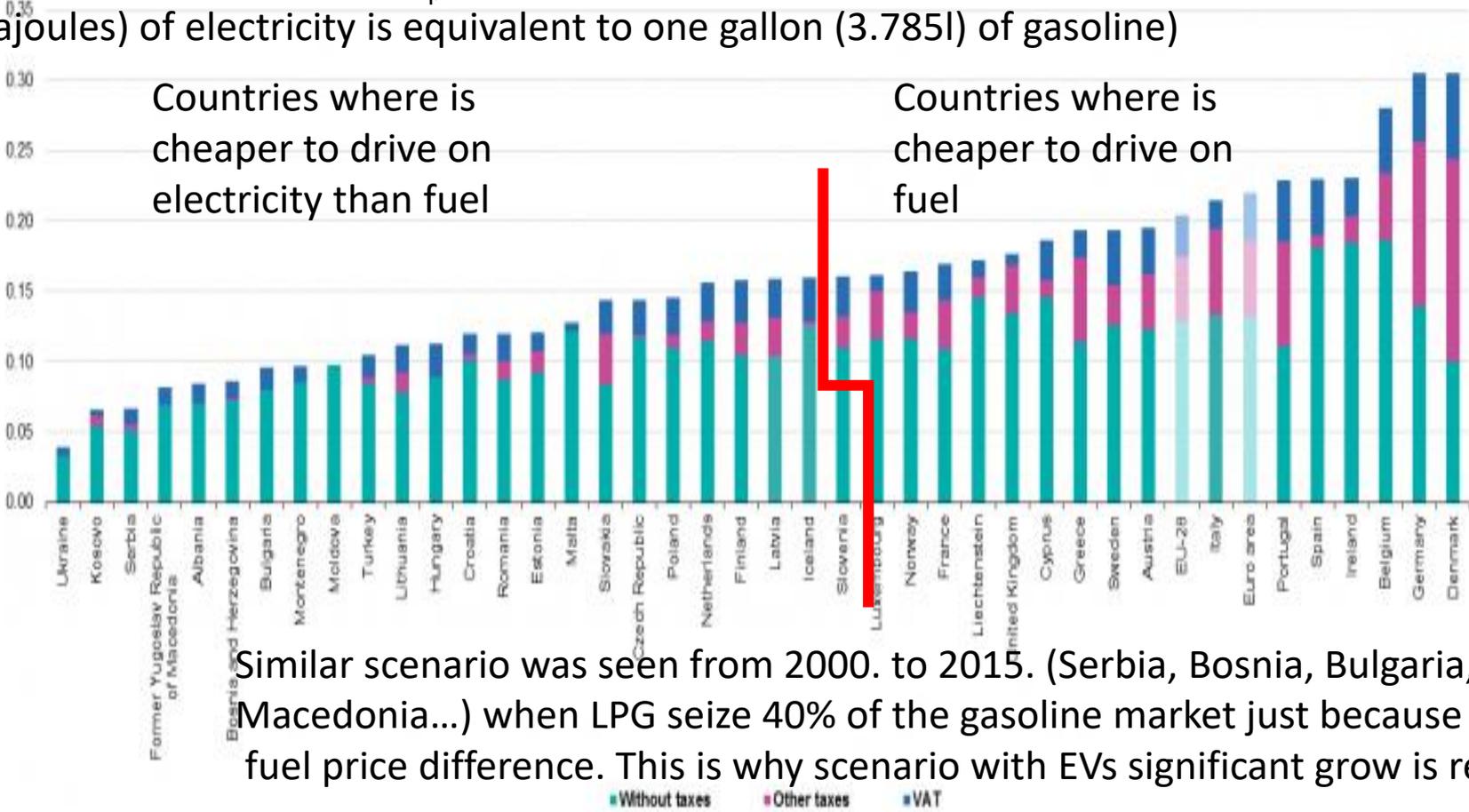
The project of installing underwater power cable is in the progress for many years, which will enable electric power export from the region to Italy and vice versa.

By 2020, due to inefficiency, exploitation due dates and noncompliance with EU environmental demands, numerous providers (power plants) will be shut down in the region.

Current state of play with EVs in Serbia and the Region

- Almost no incentives except some in Hungary and Italy.
- Incentives in Serbia and Croatia withdrawn.
- Almost no government concern about possible future issues.
- No, or partial regulatory frame.
- Very few charging stations per country (5-15). Estimate is that Serbia requires 1000 chargers by 2020.
- Couple of dozens EVs operate.
- Generally high energy intensity (1.6-1.8 times higher than in EU) and low energy efficiency.
- Serbia has (for e.g.) to scrap up to 1070MW generation due to age and non compliance.
- Slow generation capacities development in both fossil or renewable area.
- Serbia posses proven lithium deposits that can satisfy 10-20% of global demand. This is the basic raw material for any kind of the batteries: new lithium-iron-oxide battery, traditional lithium-cobalt-oxide or wide used lithium ion ones.

The EPA (US Environmental Protection Agency) official range for the 2017 Model S 100D, which is equipped with a 100 kWh battery pack, is 335 miles (540 km). The EPA rated the 2017 90D Model S's energy consumption at 200.9 watt-hours per kilometer (32.33 kWh/100 mi or 20.09 kWh/100 km) for a combined fuel economy of 104 miles per **gallon gasoline equivalent** (2.26 L/100 km or 125 mpg_{-imp}). NOTE: EPA's formula, in which 33.7 kilowatt-hours (121 megajoules) of electricity is equivalent to one gallon (3.785l) of gasoline)



Similar scenario was seen from 2000. to 2015. (Serbia, Bosnia, Bulgaria, Macedonia...) when LPG seize 40% of the gasoline market just because of fuel price difference. This is why scenario with EVs significant grow is realistic.

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

NOTE: Calculation based exclusively on energy prices

What is to be expected in near future?



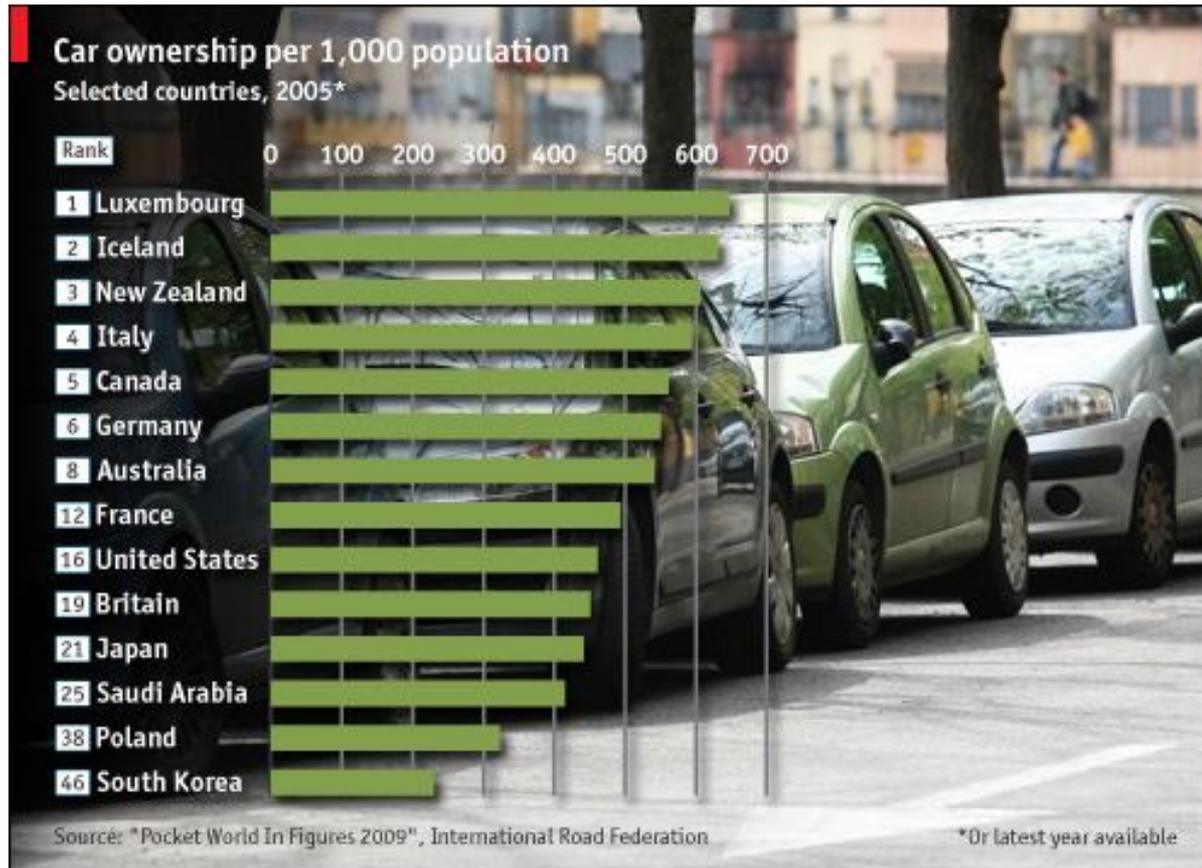
Inflow of:

1. Cheap second-hand petrol & diesel cars
2. Second-hand EVs
3. New luxurious EVs

to the less developed European and other countries.

Average car age in Serbia is 13-14 years. More than 500,000 are older than 20 years.

What is the potential of the car numbers increase and subsequent load on energy system?



ROUGH
CALCULATION
(Serbia) up to 2040.:

- 1.5 mil. replaced fuel cars
- 0,5 million new fuel cars
- 1 million EVs

Serbia has 258 cars per 1,000 inhabitants. Similar are the regional figures. EU average is 460-500. If socio-economic development would not be interrupted vehicle numbers should be doubled in no more than 20 years in case of 3% steady growth of GDP...

Hints

- **Electrical vehicles (EV) seems to be the future of transportation in Europe, USA, China..... This generates new challenges in energy security field....**
- **Recent findings from the EEA show that, if a hypothetical 80 % of cars in 2050 were electric, an additional 150 GW** of additional electricity generation capacity would be needed across the EU (EEA, 2016a).
- Contemporary EU total capacity is about 980 GW so **required increase should be cca. 15% driven** only by the EV.
- Serbia and South-Eastern Europe have significant gap in production and transmission capacities, especially in renewables. For e.g. Serbia has to build 40-50% of additional capacities.
- General scarce of energy in the region combined with increased consumption growth and slow development of production capacities and grid infrastructure can lead only to electricity price hike. This hike can be dangerous for overall economic growth and have social impact as well.
- To achieve goals in introduction of the renewable energy sources further digitalization and decentralization of electricity production and distribution system has to be achieved (smart grids).
- Lack of security of energy production and transmission infrastructure, including cyber security can just worsen the situation.