

Čista vozila i inovativne tehnologije u planiranju održivog prometa

Elektrifikacija cestovnog transporta



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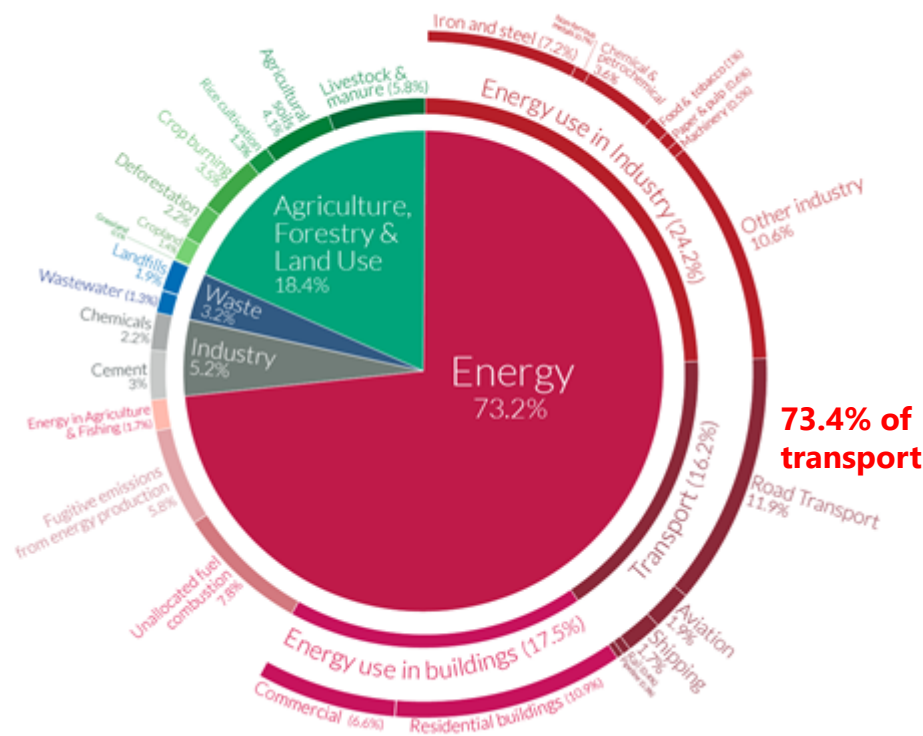
Tehnički fakultet, Sveučilište u Rijeci
<https://www.linkedin.com/in/vedrankirincic/>



Greenhouse gas emissions

Global

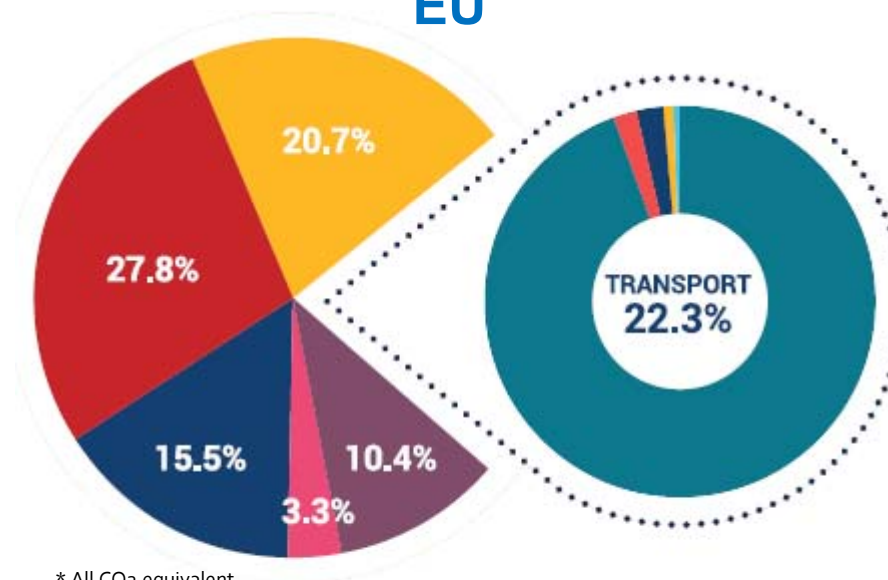
Global greenhouse gas emissions by sector
This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.



73.4% of transport

OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).
Licensed under CC-BY by the author Hannah Ritchie (2020).

EU



* All CO₂ equivalent

- ENERGY SECTOR
- INDUSTRY**
- TRANSPORT
- AGRICULTURE
- WASTE SECTOR
- OTHERS, INCL BUILDINGS

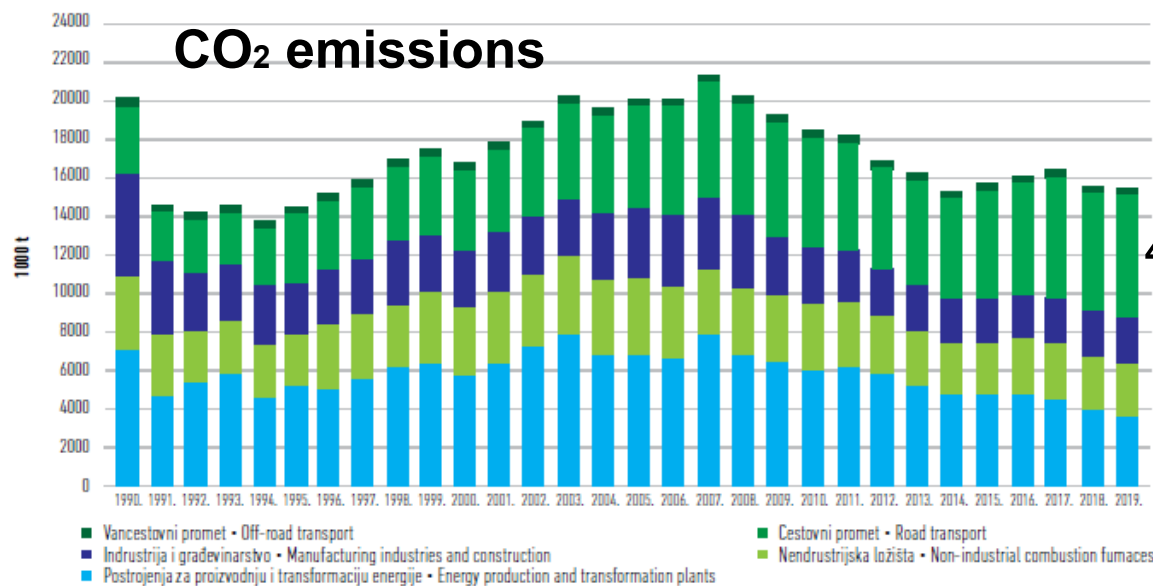
- ROAD TRANSPORTATION = 21.1% **94.6% of transport**
 - Passenger cars = 12.8% **60.6% of road transport**
 - Vans = 2.5%
 - Heavy-duty trucks and buses = 5.6%
 - Motorcycles = 0.3%
 - Other road transportation = 0.0%
- AVIATION = 0.4%
- WATER NAVIGATION = 0.5%
- RAILWAYS = 0.2%
- OTHER TRANSPORTATION = 0.1%

Source:

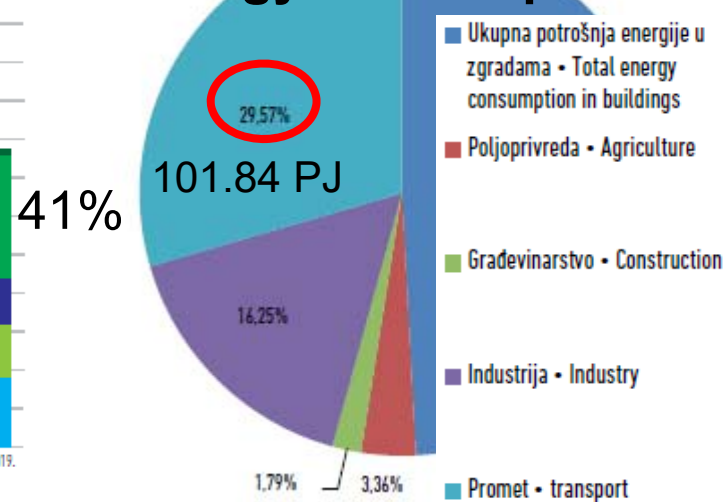
<https://ourworldindata.org/ghg-emissions-by-sector#licence>

https://www.acea.be/uploads/publications/ACEA_10-point_plan_European_Green_Deal.pdf

Croatia



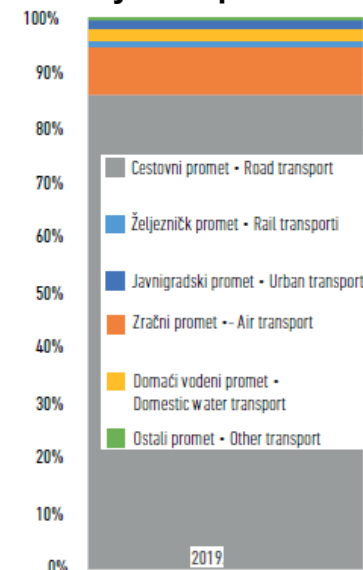
Energy consumption



Izvori: EKONERG, EIHP • Source: EKONERG, EIHP

VOLUME OF ROAD TRAFFIC (NATIONAL VEHICLES), BY TYPE OF VEHICLE, Vehicle-kilometres, million	2014.	2015.	2016.	2017.	2018.
Total	22.480	24.136	26.047	26.974	28.237
M1: Passenger cars	18.262	19.444	20.809	21.473	22.322
M2/M3: Buses and coaches	276	304	328	335	351
N1: Goods vehicles up to 3.5t MPW	2.058	2.311	2.623	2.803	3.138
N2: Goods vehicles between 3.5t and 12t MPW	336	334	341	338	334
N3: Goods vehicles over 12t MPW	1.162	1.345	1.545	1.626	1.670
L1/L2/L6: Mopeds	148	148	142	130	126
L3/L4/L5/L7: Motorcycles	173	184	201	217	241
T5: Tractor on wheels	65	66	60	51	54

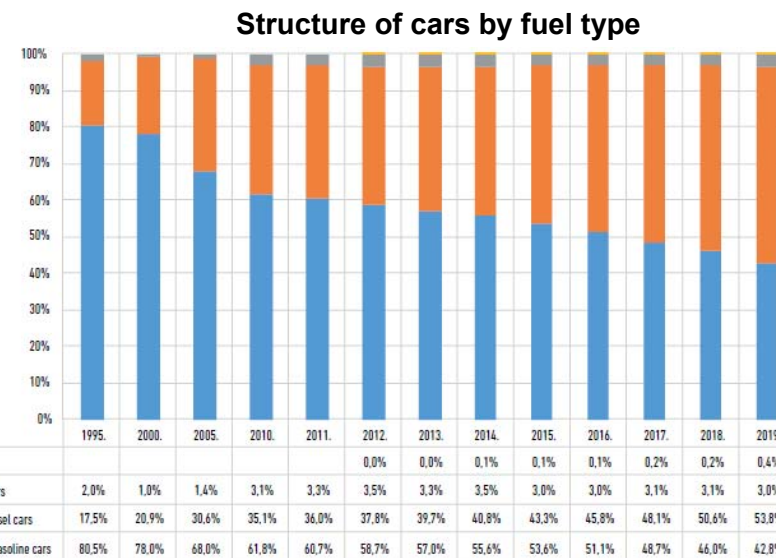
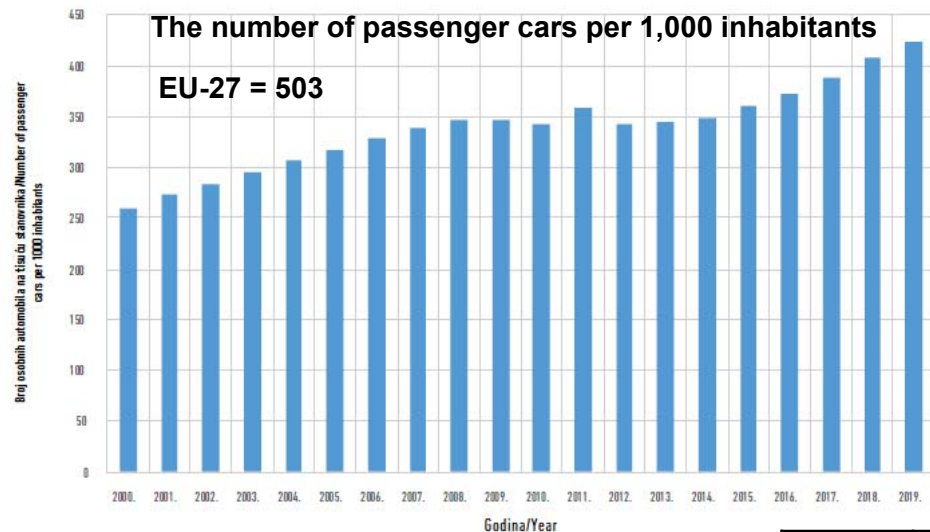
Fuel consumption by transport mode



Source: EIHP Energy in Croatia – Annual energy report 2019

Croatian Bureau of Statistics, https://www.dzs.hr/Hrv_Eng/Pokazatelji/Transport%20i%20komunikacije/Transport%20-%202002%20cestovna%20infrastruktura,%20obujam%20cestovnog%20prometa.xlsx

Croatia



Source: EIHP Energy in Croatia – Annual energy report 2019

Izvor: MUP, DZS, SB, EIHP • Source: MUP, DZS, SB, EIHP

M1 km (k)	2014	2015	2016	2017	2018	2019
CVH	12.75	12.51	12.70	12.81	12.68	12.54

CO2 emissions from energy subsectors	2014.	2015.	2016.	2017.	2018.	2019.*	2019./18.	2014.-19.
	tisuće tona / thousand metric tons						%	
Postrojenja za proizvodnju i transformaciju energije • Energy production and transformation plants	4 744	4 719	4 847	4 465	3 908	3 656	-6,4	-5,1
Neindustrijska ložišta • Non-industrial combustion furnaces	2 531	2 720	2 790	2 821	2 747	2 568	-6,5	0,3
Industrija i građevinarstvo • Manufacturing industries and construction	2 324	2 223	2 229	2 430	2 411	2 571	6,6	2,0
Cestovni promet • Road transport	5 346	5 671	5 885	6 343	6 113	6 274	2,6	3,3
Vancestovni promet • Off-road transport	234	217	221	227	228	233	2,2	-0,1
Ukupno • Total	15 179	15 549	15 972	16 286	15 406	15 301	-0,7	0,2

Final energy consumption by means of transport	2014.	2015.	2016.	2017.	2018.	2019.	2019./18.	2014.-19.
	PJ						%	
Željeznički promet • Rail Transport	1,43	1,30	1,34	1,34	1,26	1,26	0,0	-2,5
Cestovni promet • Road Transport	74,17	78,37	80,26	86,37	84,29	87,93	4,3	3,5
Zračni promet • Air Transport	5,56	5,40	5,71	6,75	8,29	8,94	7,8	10,0
Pomorski i riječni promet • Sea and River Transport	1,93	1,84	1,87	1,98	2,10	2,18	3,8	2,4
Javni gradski promet • Public City Transport	1,35	1,35	1,41	1,46	1,45	1,42	-1,7	1,1
Ostali promet • Non Specified	0,09	0,11	0,12	0,14	0,16	0,11	-27,3	4,7
UKUPNO PROMET • TOTAL TRANSPORT	84,53	88,37	90,71	98,04	97,54	101,84	4,4	3,8

Decarbonising the Road Transport

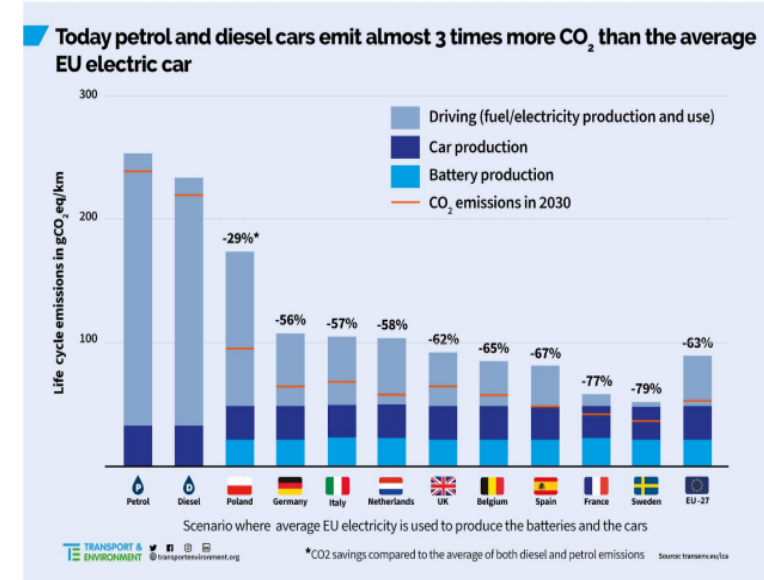
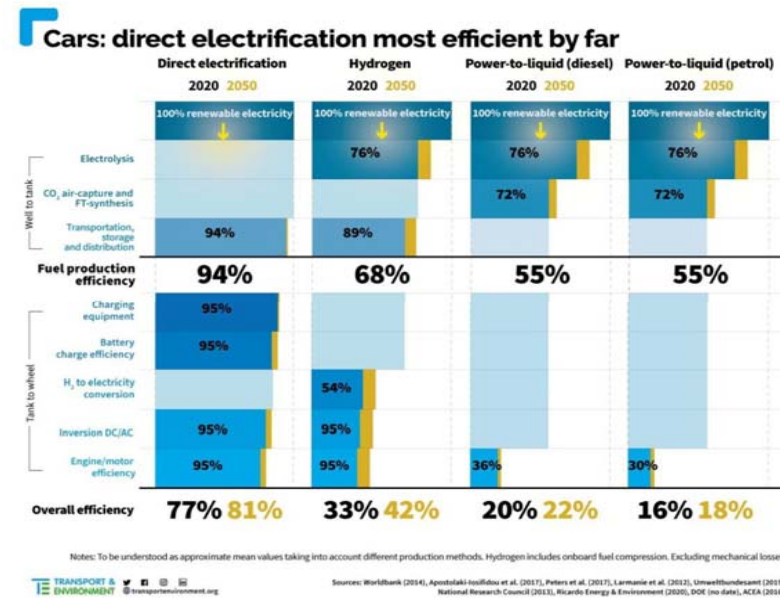


Figure 4: Lifetime CO₂ emission savings from electric cars in key EU countries

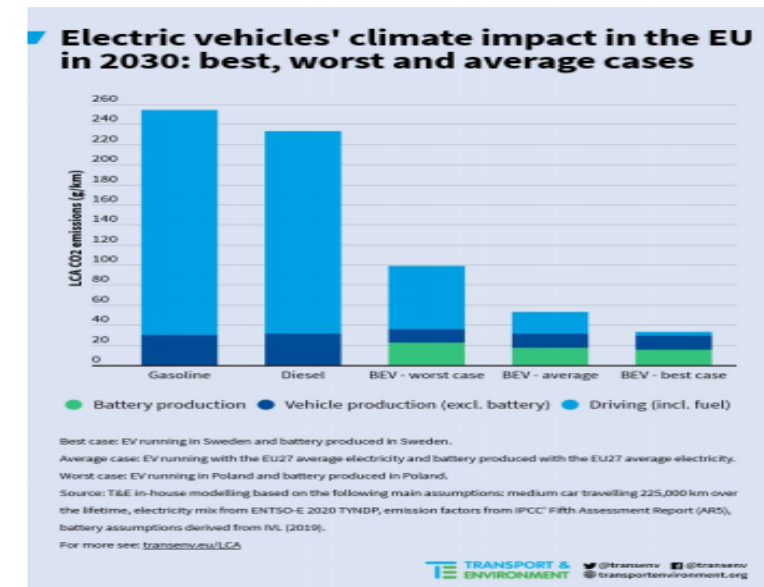
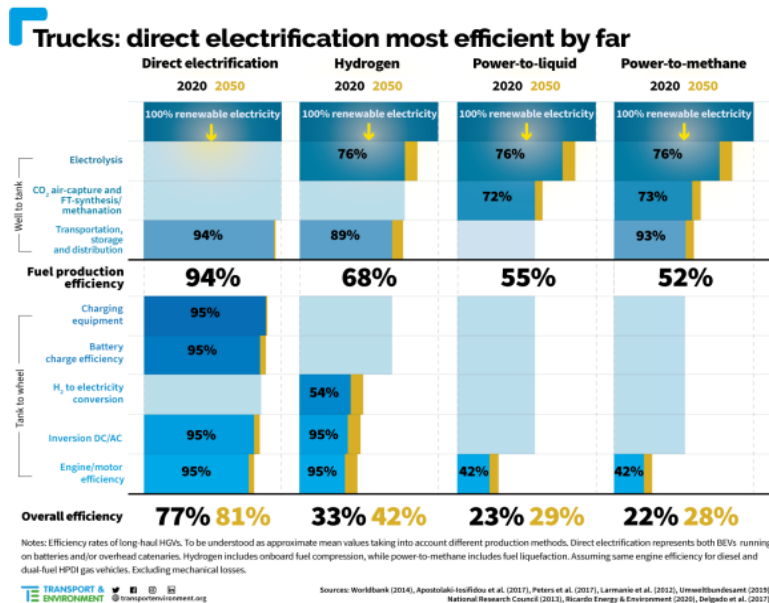
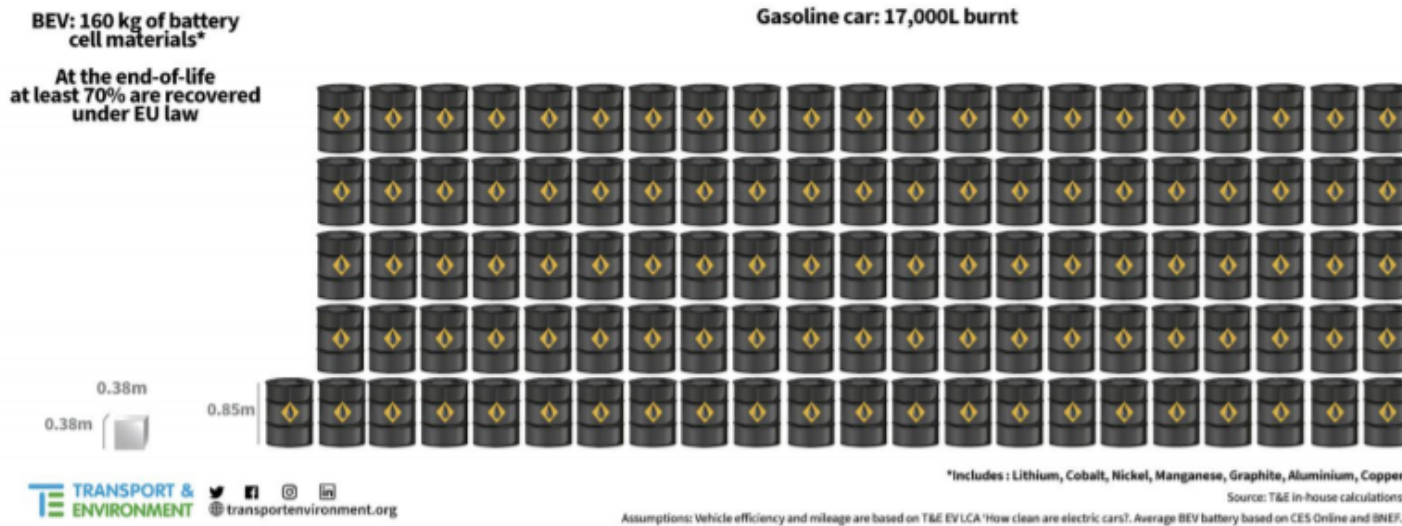


Figure 7: Lifetime CO₂ emissions of an electric car in 2030

Source: Transport & Environment 2020_12_Briefing_feasibility_study_renewables_decarbonisation.pdf

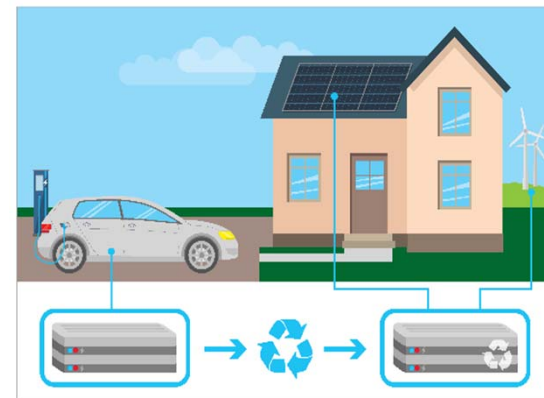
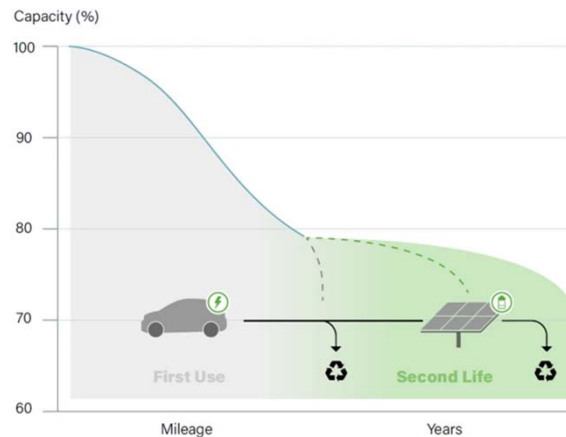
https://www.transportenvironment.org/sites/te/files/publications/2020_12_Briefing_feasibility_study_renewables_decarbonisation.pdf

Lifetime raw material consumption: EV battery vs petrol car



Source: Transport & Environment, From dirty oil to clean batteries - Batteries vs. oil: as systematic comparison of material requirements, 2021
https://www.transportenvironment.org/sites/te/files/publications/2021_02_Battery_raw_materials_report_final.pdf

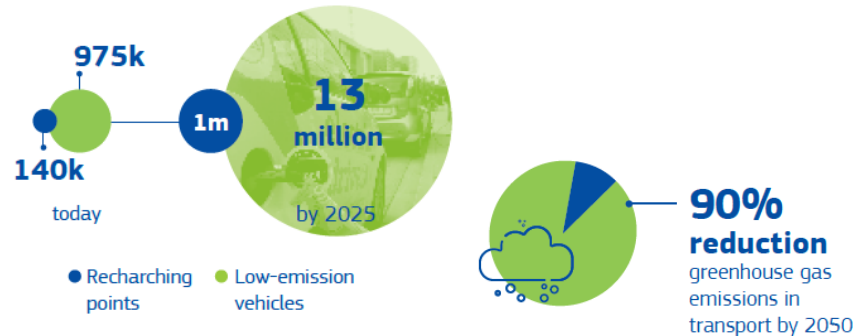
Batteries second life



Source: <https://link.springer.com/article/10.1007/s12398-020-00273-x>
<https://ec.europa.eu/jrc/en/science-update/li-ion-batteries-second-life-energy-storage>

Decarbonising the Road Transport

Alternatively fuelled cars and public recharging points in the EU



Charging points for EVs per country, plus percentage of EU total (2019)

Austria	4,443	2.2%	Italy	9,370	4.7%
Belgium	6,551	3.3%	Latvia	306	0.2%
Bulgaria	135	0.1%	Lithuania	202	0.1%
Croatia	629	0.3%	Luxembourg	913	0.5%
Cyprus	38	0.0%	Malta	102	0.1%
Czech Republic	808	0.4%	Netherlands	50,824	25.4%
Denmark	2,817	1.4%	Poland	884	0.4%
Estonia	391	0.2%	Portugal	1,791	0.9%
Finland	2,145	1.1%	Romania	344	0.2%
France	30,367	15.2%	Slovakia	649	0.3%
Germany	40,517	20.3%	Slovenia	628	0.3%
Greece	61	0.0%	Spain	5,769	2.9%
Hungary	735	0.4%	Sweden	8,792	4.4%
Ireland	1,076	0.5%	United Kingdom	28,538	14.3%
			EU total	199,825	

Source: EAF0

Normal and fast charging points, by country (2019)

	Normal (<22kW)	Fast (> 22kW)		Normal (<22kW)	Fast (> 22kW)
Austria	3,742	701	Italy	8,312	1,058
Belgium	6,070	481	Latvia	83	223
Bulgaria	70	65	Lithuania	79	123
Croatia	479	150	Luxembourg	900	13
Cyprus	38	0	Malta	102	0
Czech Republic	410	398	Netherlands	49,520	1,304
Denmark	2,244	573	Poland	509	375
Estonia	202	189	Portugal	1,471	320
Finland	1,786	359	Romania	211	133
France	27,661	2,706	Slovakia	350	299
Germany	34,203	6,314	Slovenia	452	176
Greece	40	21	Spain	4,500	1,269
Hungary	592	143	Sweden	4,036	4,756
Ireland	818	258	United Kingdom	22,359	6,179

Source: EAF0

EV market share / charging points per 100 km of road*, by country (2019)

	ECV share	Charging points per 100 km		ECV share	Charging points per 100 km
Austria	3.5%	3.4	Italy	0.9%	3.7
Belgium	3.2%	4.2	Latvia	0.5%	0.4
Bulgaria	0.6%	0.7	Lithuania	0.4%	0.3
Croatia	n/a	2.3	Luxembourg	n/a	31.6
Cyprus	n/a	0.4	Malta	n/a	3.6
Czech Republic	0.5%	0.6	Netherlands	15.0%	36.4
Denmark	4.2%	3.8	Poland	0.5%	0.2
Estonia	0.3%	0.7	Portugal	5.7%	12.5
Finland	6.9%	2.8	Romania	0.9%	0.4
France	2.8%	2.8	Slovakia	0.4%	1.1
Germany	3.0%	17.6	Slovenia	0.9%	1.6
Greece	0.4%	0.1	Spain	1.4%	0.9
Hungary	1.9%	0.3	Sweden	11.3%	4.1
Ireland	4.1%	1.1	United Kingdom	3.1%	6.8

Source: EAF0, Eurostat, ERF

* Includes motorways, main and national roads, secondary and regional roads

Rollout of charging points for ECVs – Trend over time in the EU (2019)

	EU total	2014	2015	2016	2017	2018	2019	% 14/19
ECV charging points		34,448	59,200	89,214	126,449	142,803	199,825	+480%

Source: EAF0 ACEA, MAKING THE TRANSITION TO ZERO-EMISSION MOBILITY 2020 PROGRESS REPORT
https://www.acea.be/uploads/publications/ACEA_progress_report_2020.pdf

HIGHEST EV purchase incentives

1. Romania (up to €11,500)
2. Croatia (up to €9,200)
3. Germany (up to €9,000)

Croatia



Capital:
Zagreb

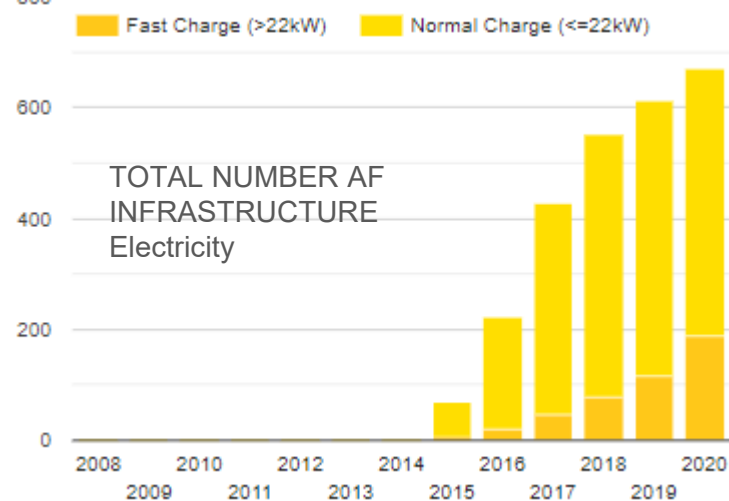
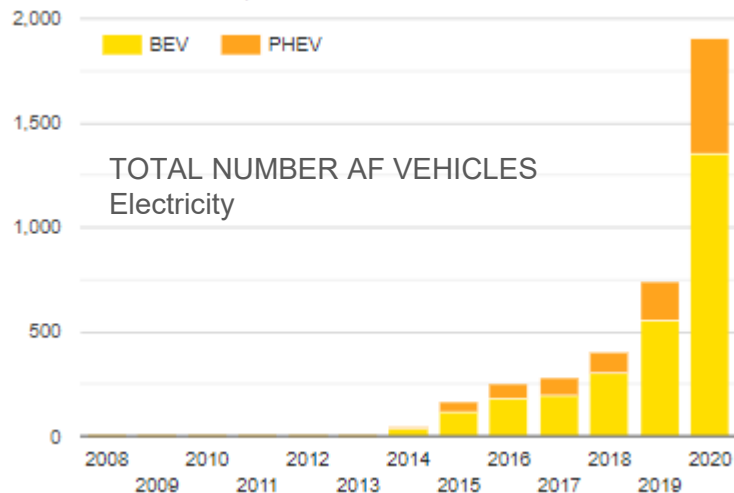
Population:
4,076,246

Total land area (km2):
56,594 km2

Passenger cars:
1,665,391

Highway (km):
1,310 km

GDP per capita
14,936.10 USD



Norway



Capital:
Oslo

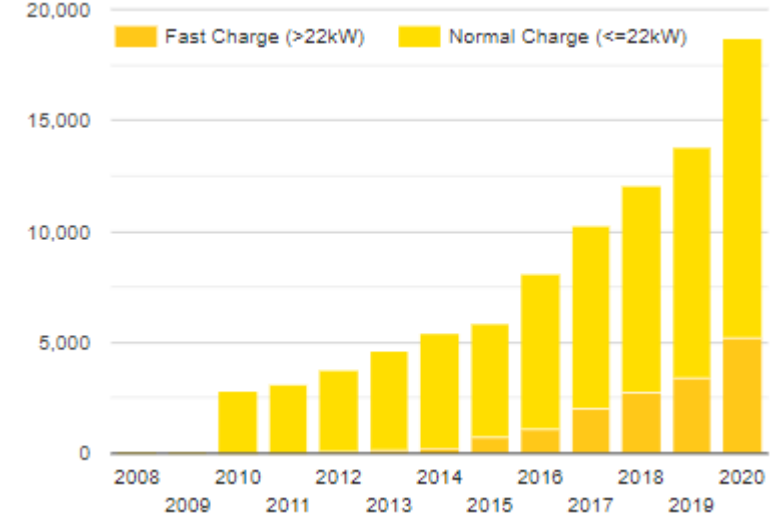
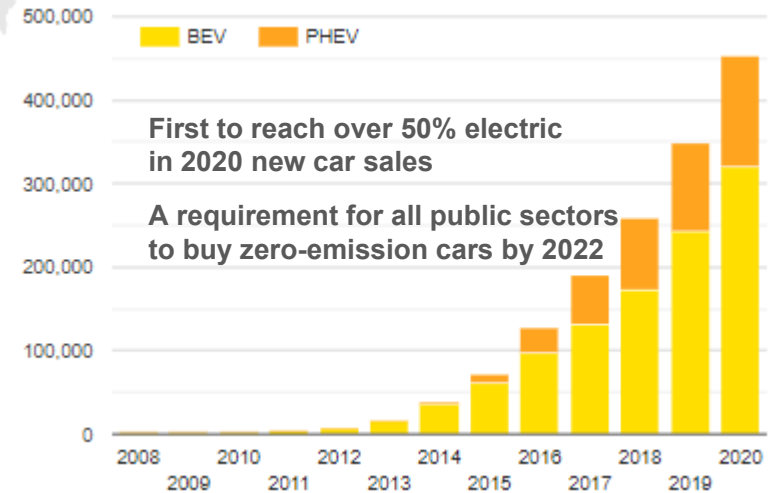
Population:
5,328,212

Total land area (km2):
323,802 km2

Passenger cars:
2,700,000

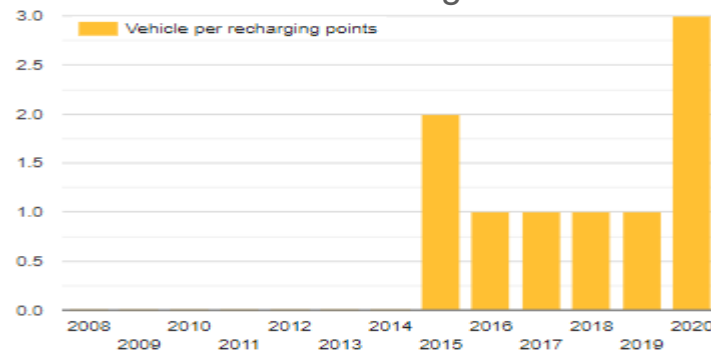
Highway (km):
523 km

GDP per capita
75,419.63 USD

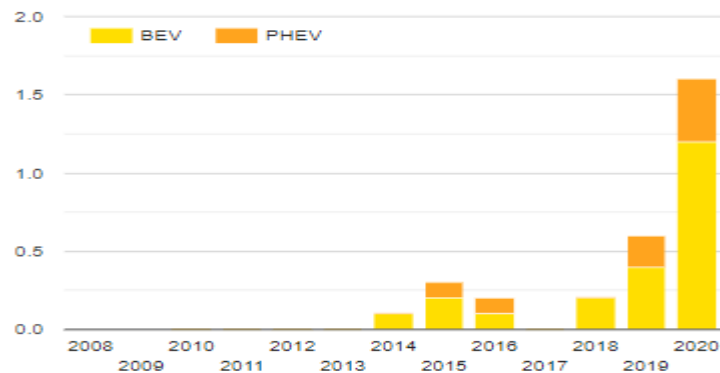


Croatia

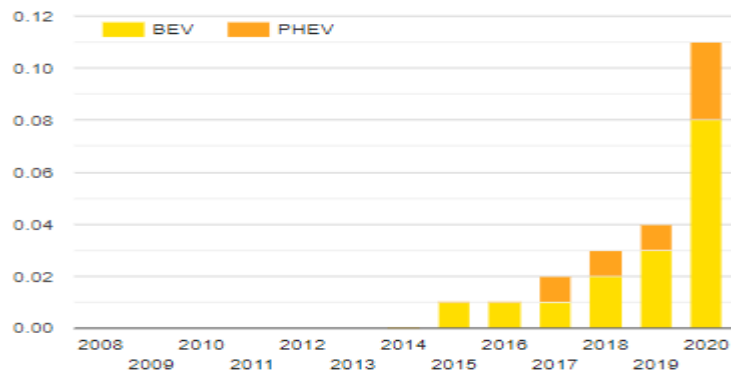
Plugin Electric Vehicles per public charging point



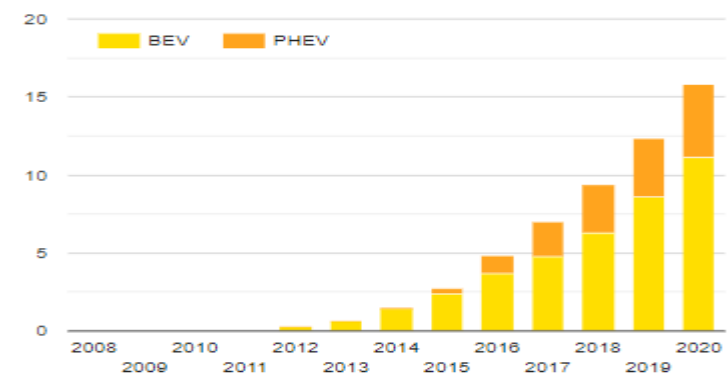
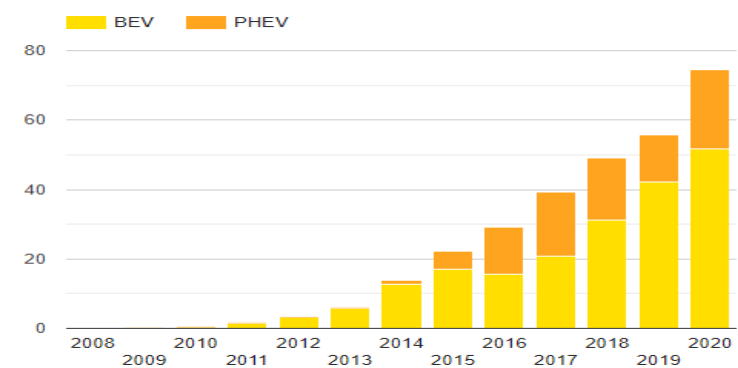
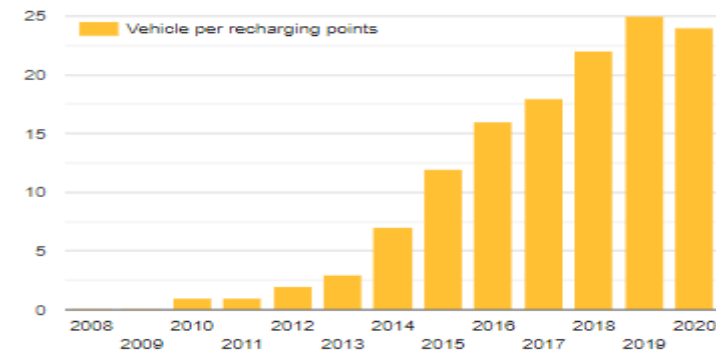
Market share new registrations M1



Fleet percentage of total fleet M1



Norway



Norway

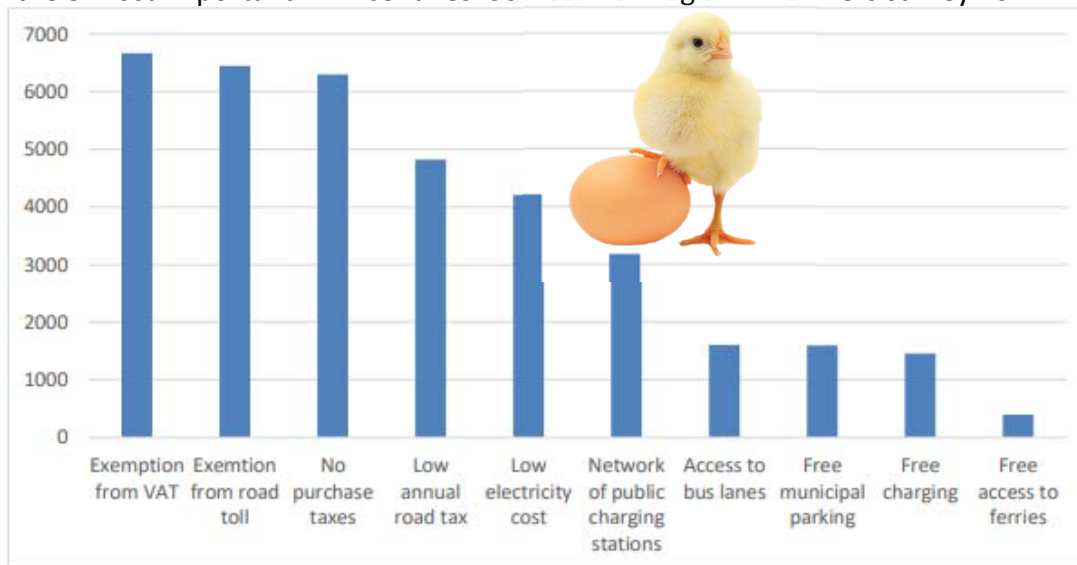
The Norwegian EV incentives:

- No purchase/import taxes (1990-)
- Exemption from 25% VAT on purchase (2001-)
- No annual road tax (1996-)
- No charges on toll roads or ferries (1997- 2017).
- Maximum 50% of the total amount on ferry fares for electric vehicles (2018-)
- Maximum 50% of the total amount on toll roads (2019)
- Free municipal parking (1999- 2017)
- Parking fee for EVs was introduced locally with an upper limit of a maximum 50% of the full price (2018-)
- Access to bus lanes (2005-).
- New rules allow local authorities to limit the access to only include EVs that carry one or more passengers (2016)
- 50 % reduced company car tax (2000-2018).
- Company car tax reduction reduced to 40% (2018-)
- Exemption from 25% VAT on leasing (2015)
- Fiscal compensation for the scrapping of fossil vans when converting to a zero-emission van (2018)
- Allowing holders of driver licence class B to drive electric vans class C1 (light lorries) up to 4250 kg (2019)

How often do you charge? Source: Norwegian EV owner survey 2017

	Detached housing	Apartment buildings
At home, daily or weekly	97 %	64 %
At home, monthly or never	3 %	36 %
At work, daily or weekly	36 %	38 %
At work, monthly or never	64 %	62 %
At public charging stations, daily or weekly	11 %	28 %
At public charging stations, monthly or never	89 %	72 %
At fast charging stations, daily or weekly	12 %	18 %
At fast charging stations, monthly or never	88 %	82 %

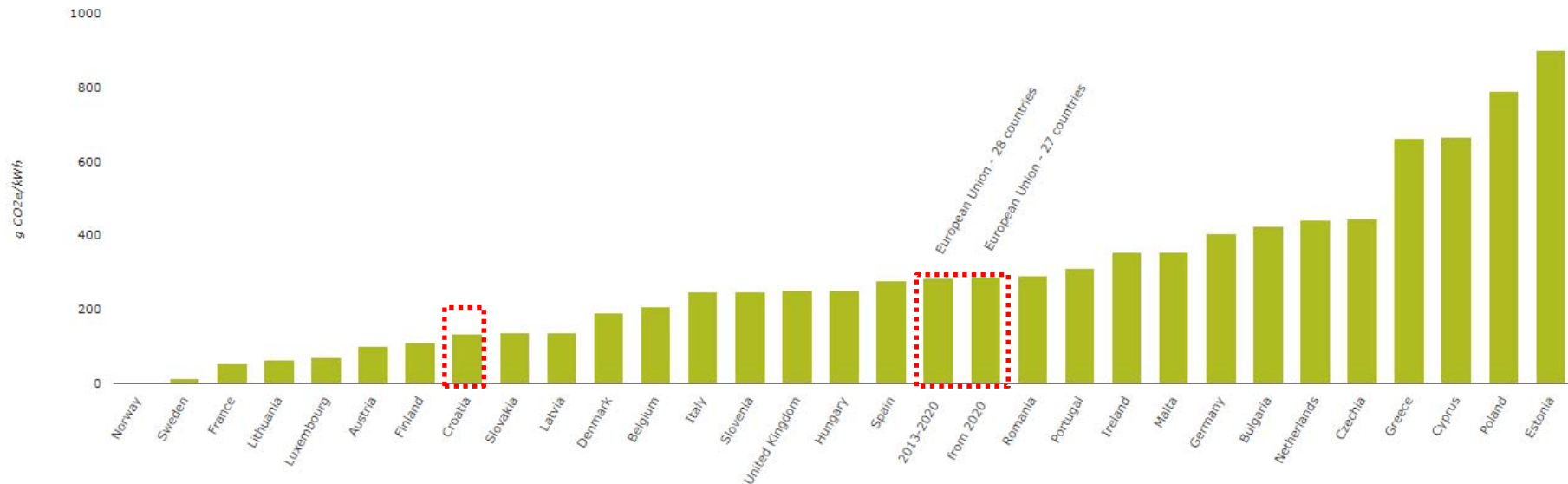
Most important EV incentives according to Norwegian EV owners. Question: Select the 3 most important EV incentives. Source: Norwegian EV owners survey 2017



Source: Norwegian EV policy

<https://elbil.no/wp-content/uploads/2016/08/EVS30-Charging-infrastructure-experiences-in-Norway-paper.pdf>

Greenhouse gas emission intensity of electricity generation



	2014.	2015.	2016.	2017.	2018.	2019.*	Prosjeak/Average 2014.-2019.
kg/ kWh							
Specifični faktor emisije CO ₂ po ukupno potrošenoj el. energiji u Hrvatskoj Specific CO ₂ emission factor per total electricity consumption in Croatia	0,151	0,148	0,163	0,131	0,106	0,121	0,137
Specifični faktor emisije CO ₂ po ukupno proizvedenoj el. energiji u Hrvatskoj Specific CO ₂ emission factor per total electricity production in Croatia	0,195	0,236	0,233	0,207	0,148	0,179	0,200

Izvori: EIHP • Source: EIHP

Source: EIHP Energy in Croatia – Annual energy report 2019

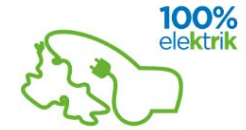
EEA **Greenhouse gas emission intensity of electricity generation**

https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-6#tab-googlechartid_googlechartid_chart_111_filters=%7B%22rowFilters%22%3A%7B%7D%3B%22columnFilters%22%3A%7B%22pre_config_date%22%3A%5B2018%5D%7D%3B%22sortFilter%22%3A%5B%22index_2018%22%5D%7D

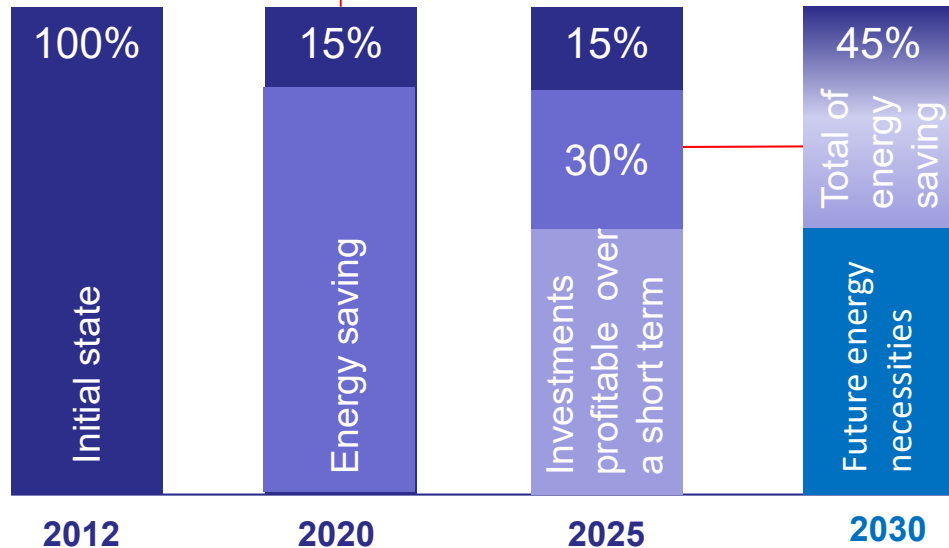
11

The island of Krk – 2030 strategic aims

Steps towards zero GHG emissions



112 GWh/A



Energy saving by rising the public awareness – 15%

Economically profitable investments in energy efficiency – 30%

Total of energy saving - 45%

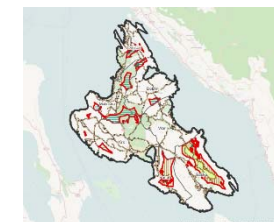
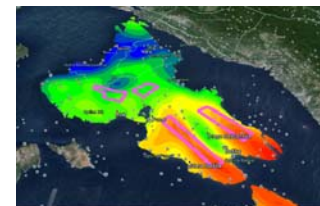
Necessities covered by renewable sources (wind, sun, bio-mass)

62 GWh/A



Source: “Interdisciplinary strategy of zero emissions for integrated development of the island of Krk”, igr AG, Ponikve Eko Otok Krk, Croatia, 2012.

Wind



Solar

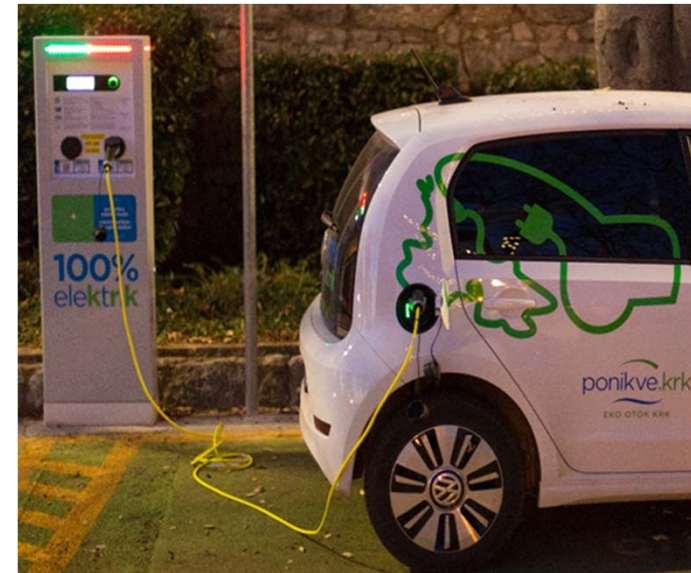
eMobility

ELECTRIC CHARGING STATIONS

- ✓ 12 charging stations (7 municipalities)
127.300 Euro, EPEEP fund: 64.200 Euro (40%)
2 x 22 kW
IEC 62196 Type2 Mode 3

ELECTRIC VEHICLES

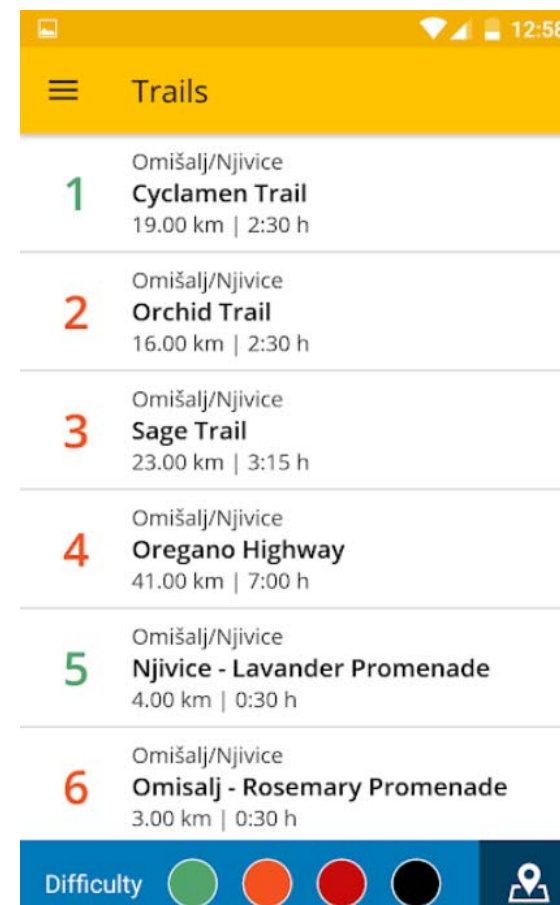
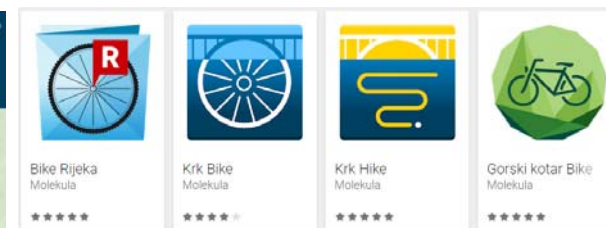
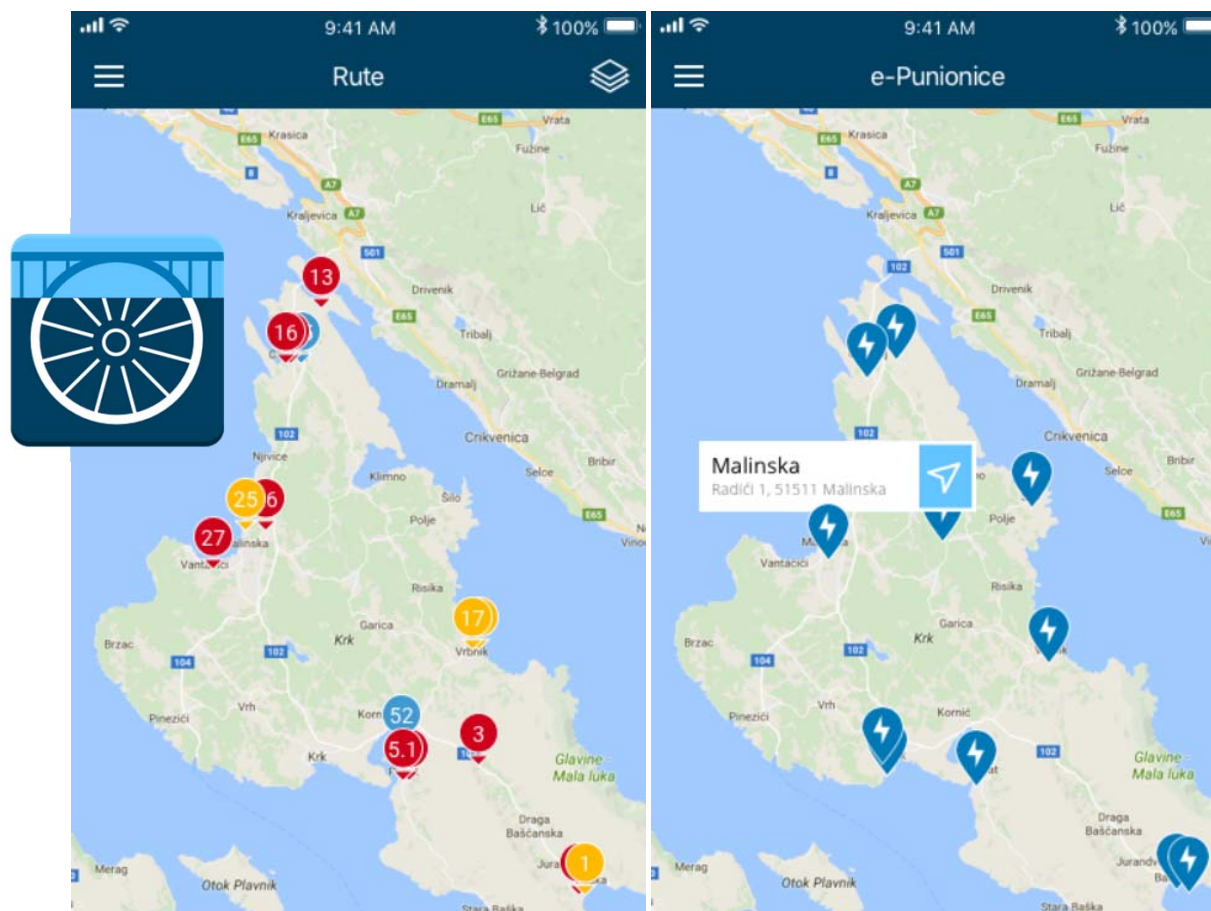
- ✓ 10 electric vehicles 207.452 Euro,
EPEEP 88.346 Euro (30%)



Charging stations on the island of Krk – no range anxiety!



Source: Main electrotechnical project for charging stations at the island of Krk, E.G.S.-ELEKTROGRADITELJSTVO d.o.o., 2016.



Source: "Sustainable Urban Mobility Plan (SUMP) for the island of Krk - Interdisciplinary study of electromobility at the island of Krk and the mobile phone application"; Faculty of Engineering, Sensum and Molekula for Ponikve eko otok Krk Ltd, Croatia, 2017.

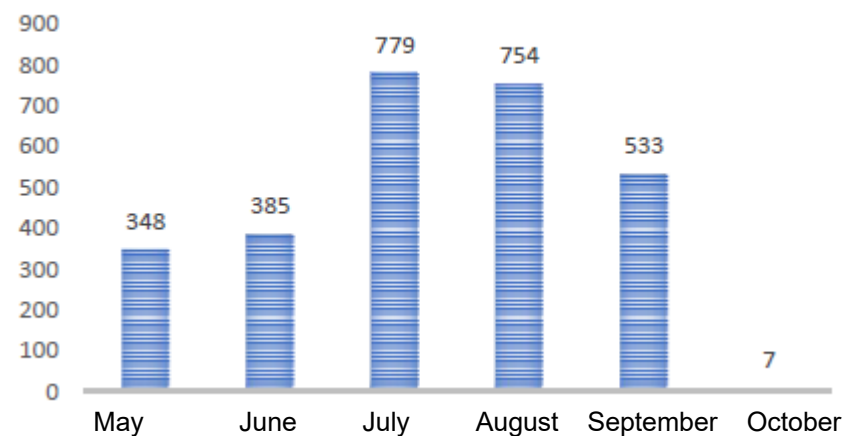
Available @ Google Play, App Store, <https://www.krkoutdoor.com/>

Bike sharing system on the island of Krk

- 8 charging locations
- 10 zones with 10 sockets each
- Ministry of tourism
- 107.803 Euro
- Domestic provider – vehicles, charging equipment, software



Number of sessions in 2020



Source: Ponikve Eko Otok Krk

E-mobility support and strategic documents



SUMP – Sustainable Urban Mobility Plan

INTERDISCIPLINARY STUDY OF
ELECTROMOBILITY AT THE ISLAND OF KRK
AND THE MOBILE PHONE APPLICATION



SHARING SYSTEM STUDY AND MARKETING STUDY FOR ELECTRIC VEHICLES ON THE ISLAND OF KRK



January 2017

SHARING SYSTEM ON THE ISLAND OF KRK MANAGEMENT PLAN



LOCAL ELECTROMOBILITY ANALYSIS
County of Primorje and Gorski Kotar



December 2019



"Small-Scale Infrastructure Network" ACTION PLAN
County of Primorje and Gorski Kotar



December 2019.



EnerNETMob

Action Plan of "Sustainable Electro-
Mobility Plan"

September 2019



EnerNETMob

Local Framework Analysis on Electro-
Mobility and Energy Supply State of Art

August 2019

Mobility & Transport Arena

www.woom.zone #GreenArena 4. besplatni webinar

**10.12.2020.
1:00 PM - 3:00 PM CET**

"ODRŽIVI PROMET I EMOBILNOST KAO NOVI KONCEPT U ENERGETICI I PROMETU"

Moderator:
Doc. dr. sc. Vedran Kirinčić, Tehnički fakultet Rijeka

Panelisti:
Željko Purgar, poslovno savjetovanje, Željko Purgar s.p.
Domagoj Puzak, Tim za e-Mobility HEP Grupe
Tin Koren, voditelj marketinga, Strujni krug udruga vozača EV
Igor Ban, E-Mobility Manager, TSG Croatia, Piraex d.o.o.

Vedran Kirinčić
Željko Purgar
Domagoj Puzak
Tin Koren
Igor Ban

www.woom.zone #Mobility&Transport Arena 2. besplatni webinar

**07. 04. 2021.
2:00 PM - 3:00 PM CET**

enasolAuto - investicijska prilika u energetskom sektoru Hrvatske

Panelisti:
Predrag Šeatović - direktor enasolAuto Startupa
Milan Horvat - FIMA, financijski savjetnik Enasola

Moderator:
Doc. dr. sc. Vedran Kirinčić, Tehnički fakultet, Sveučilište u Rijeci

Predrag Šeatović
Milan Horvat
Vedran Kirinčić

www.woom.zone #Mobility&Transport Arena 1. besplatni webinar

**17.02.2021.
2:00 PM - 3:30 PM CET**

"Zašto nam je potrebna rEvolucija u mobilnosti i transportu"

Moderator:
Doc. dr. sc. Vedran Kirinčić - Tehnički fakultet Rijeka

Panelisti:
Dr. sc. Duško Radulović - SENSUM
Dr. sc. Ivan Güttler - Državni hidrometeorološki zavod
Dr. sc. Bruno Židov - Energetski institut Hrvoje Požar
Nevena Đukić - Energetski portal

Vedran Kirinčić
Duško Radulović
Ivan Güttler
Bruno Židov
Nevena Đukić

Medijski partneri: **STRUJNI KRUG** **ENERGETSKI PORTAL** **Alumni TFR**

www.woom.zone #Mobility&Transport Arena 3. besplatni webinar

**12.04.2021.
2:00 PM - 3:30 PM CET**

"Jedinice lokalne i područne (regionalne) samouprave kao pokretači tranzicije u mobilnosti i transportu"

Panelisti:
Gordana Lalić - Grad Poreč-Parenzo, CEO gradskog poduzeća Parentium d.o.o.
Martin Bučan - viši savjetnik, Splitsko-dalmatinska županija
Ivan Ivanković, dipl. ing. el. - pomoćnik pročelnika za energiju i klimu, Grad Zagreb, Gradski ured za gospodarstvo, energetiku i zaštitu okoliša
Doc. dr. sc. Vedran Kirinčić - Tehnički fakultet Rijeka - moderator webinara

Gordana Lalić
Martin Bučan
Ivan Ivanković
Vedran Kirinčić

Medijski partneri: **STRUJNI KRUG** **ecoportal.me** **Alumni TFR** **ENERGETSKI PORTAL** **HRVATSKA ENERGETSKA TRANZICIJA** **sdeswes**

www.woom.zone #Mobility&Transport Arena 4. besplatni webinar

**26.05.2021.
2:00 PM - 3:30 PM CET**

"FLOTE ELEKTRIČNIH VOZILA - USPAVANI DIVOVI ELEKTROMOBILNOSTI"

Sponzor:
ADRIA P.A.

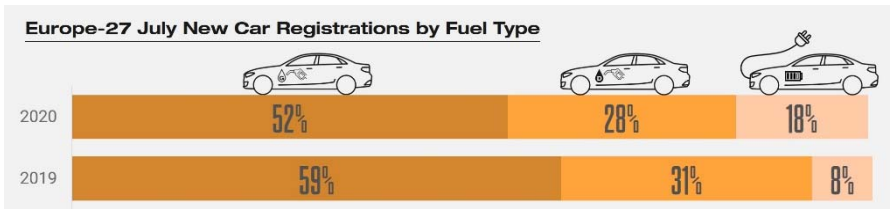
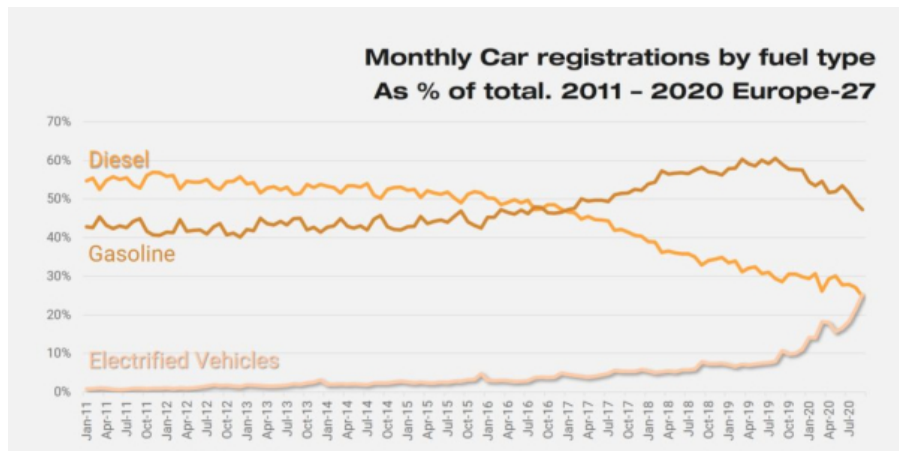
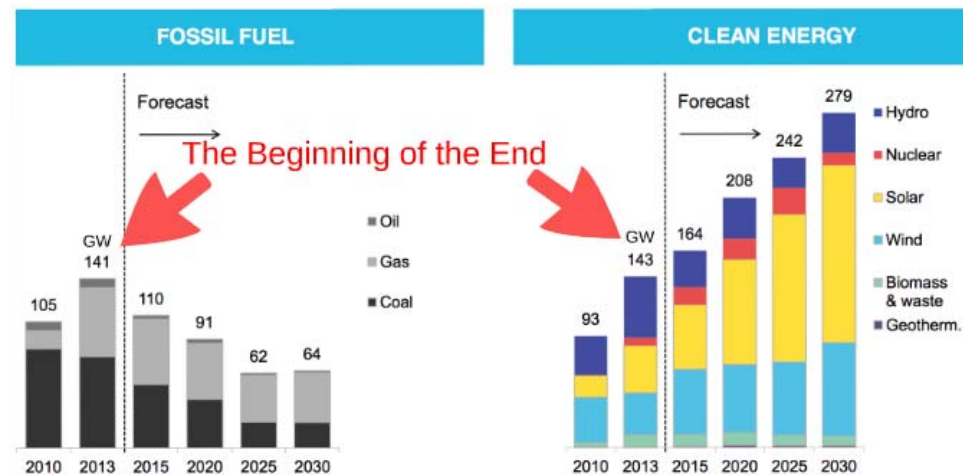
Panelisti:
Zvonimir Stopić - Corporate Fleet and Technical Means Coordinator, Atlantic Grupa
Paolo Brusich - savjetnik za ključne kupce i koordinator Rabljenih vozila, Adria P.A.
Dean Pilipović - Key Account Manager, General Logistics Systems Croatia d.o.o.
Doc. dr. sc. Vedran Kirinčić - Tehnički fakultet Rijeka - moderator webinara

Zvonimir Stopić
Paolo Brusich
Dean Pilipović
Vedran Kirinčić

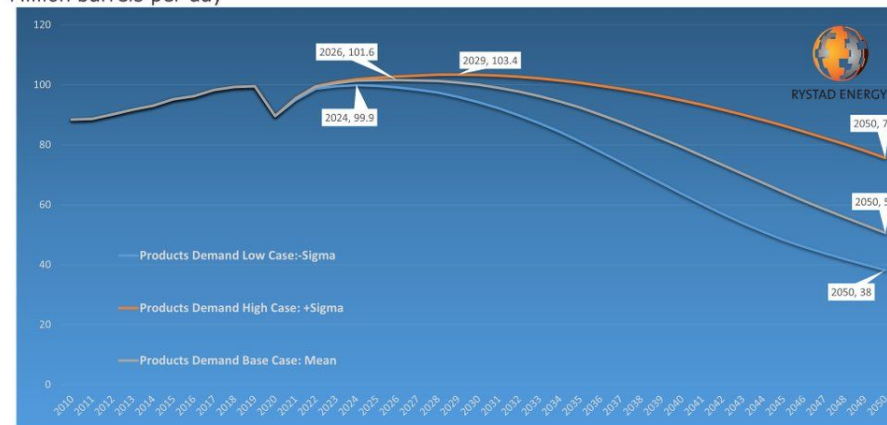
Medijski partneri:

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End?! Just a beginning!!



Rystad Energy's long-term global oil demand scenarios (base, low and high case)
Million barrels per day



Source: Rystad Energy OilMarketCube, research and analysis

Čista vozila i inovativne tehnologije u planiranju održivog prometa

Elektrifikacija cestovnog transporta



Doc. dr. sc. Vedran Kirinčić

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Tehnički fakultet, Sveučilište u Rijeci
<https://www.linkedin.com/in/vedrankirincic/>

