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Your Source of Context in South East Europe

**An overview of energy sector trends in Croatia and beyond  
Zagreb, 30 October, 2020**



**CRODIASPORA**



# **A QUICK LOOK AT SOME GLOBAL ENERGY SECTOR TRENDS**

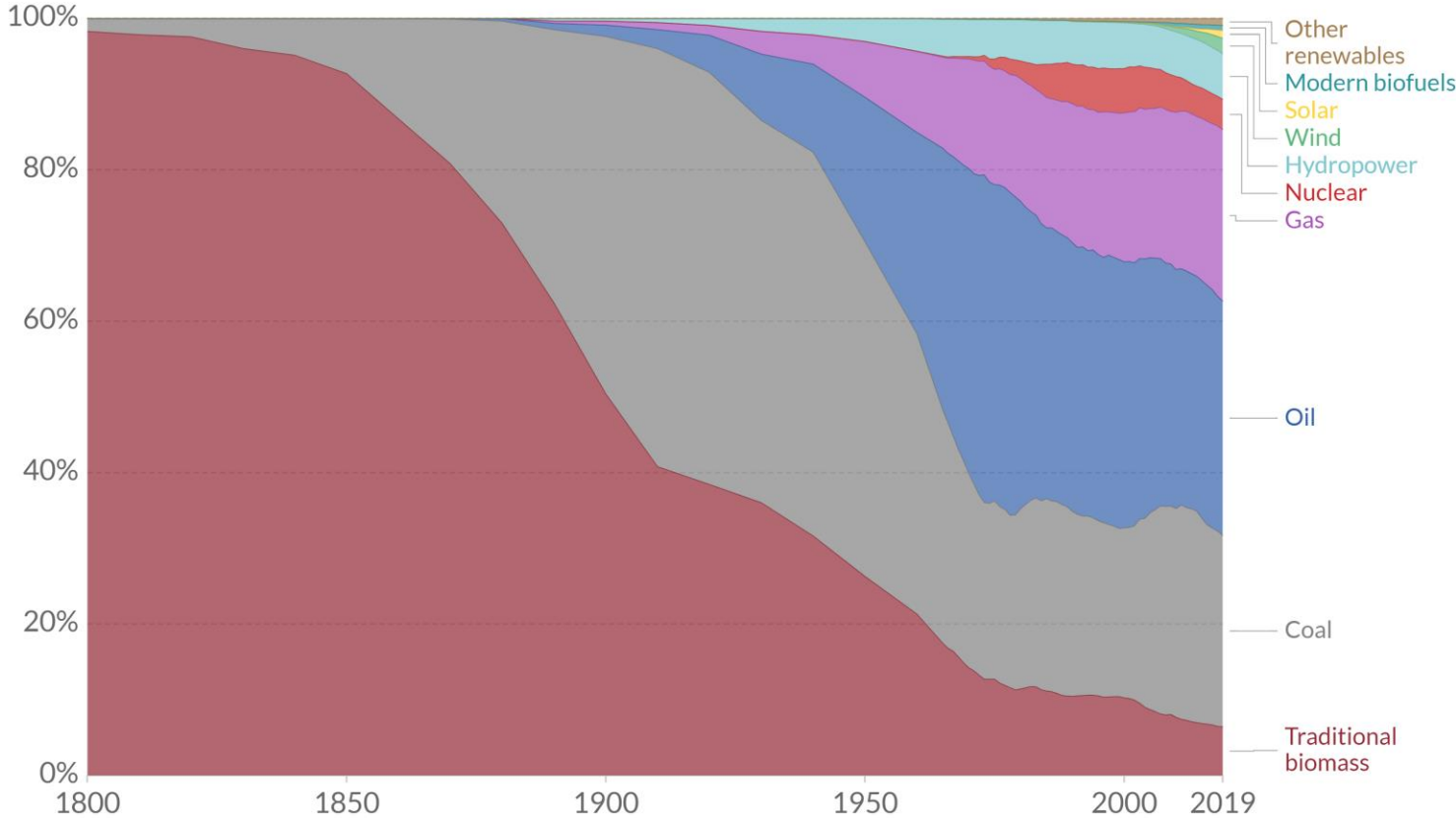


# Fossil fuels dominate the global energy mix

## Global primary energy consumption by source

Our World  
in Data

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.



Source: Vaclav Smil (2017) & BP Statistical Review of World Energy

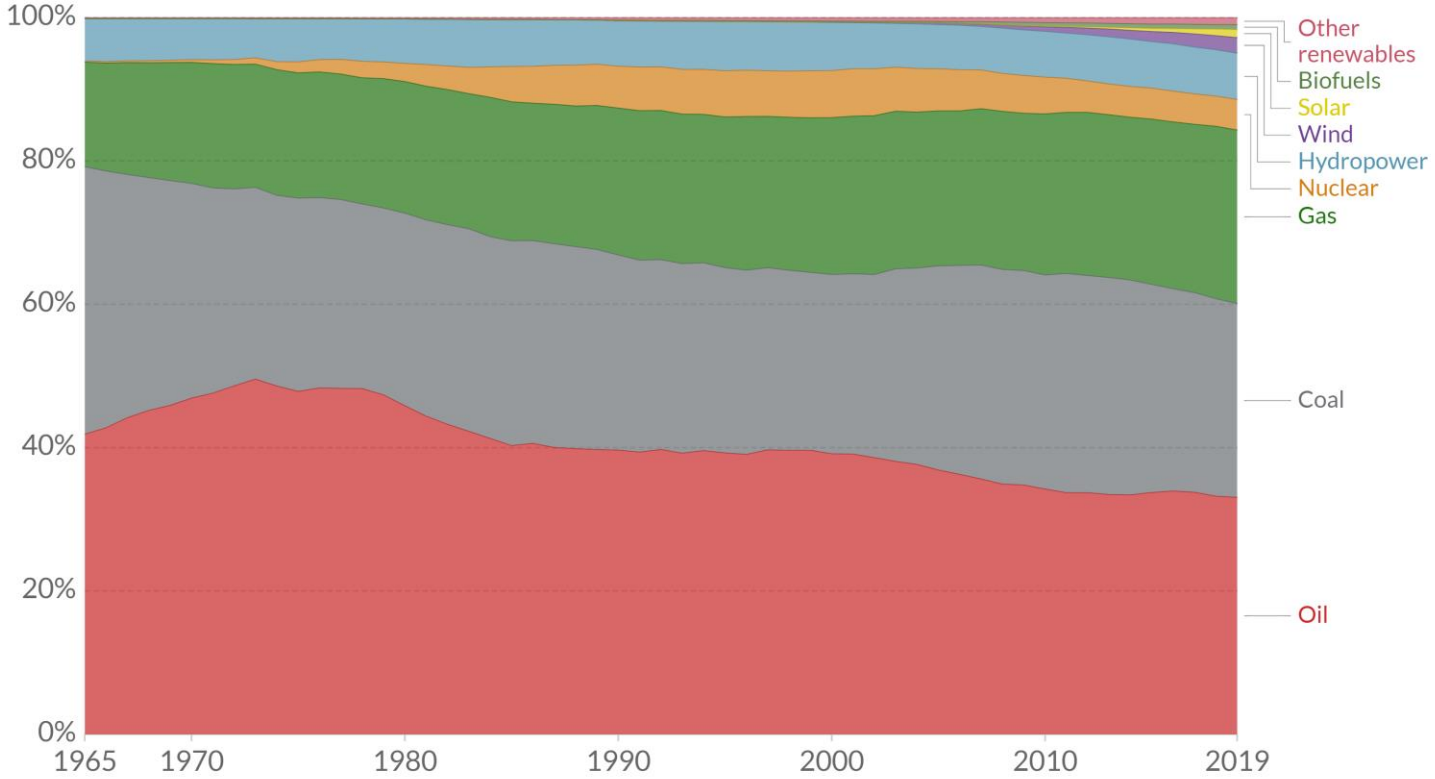
OurWorldInData.org/energy • CC BY



# And have continued to do so in the past 50 years

## Energy consumption by source, World

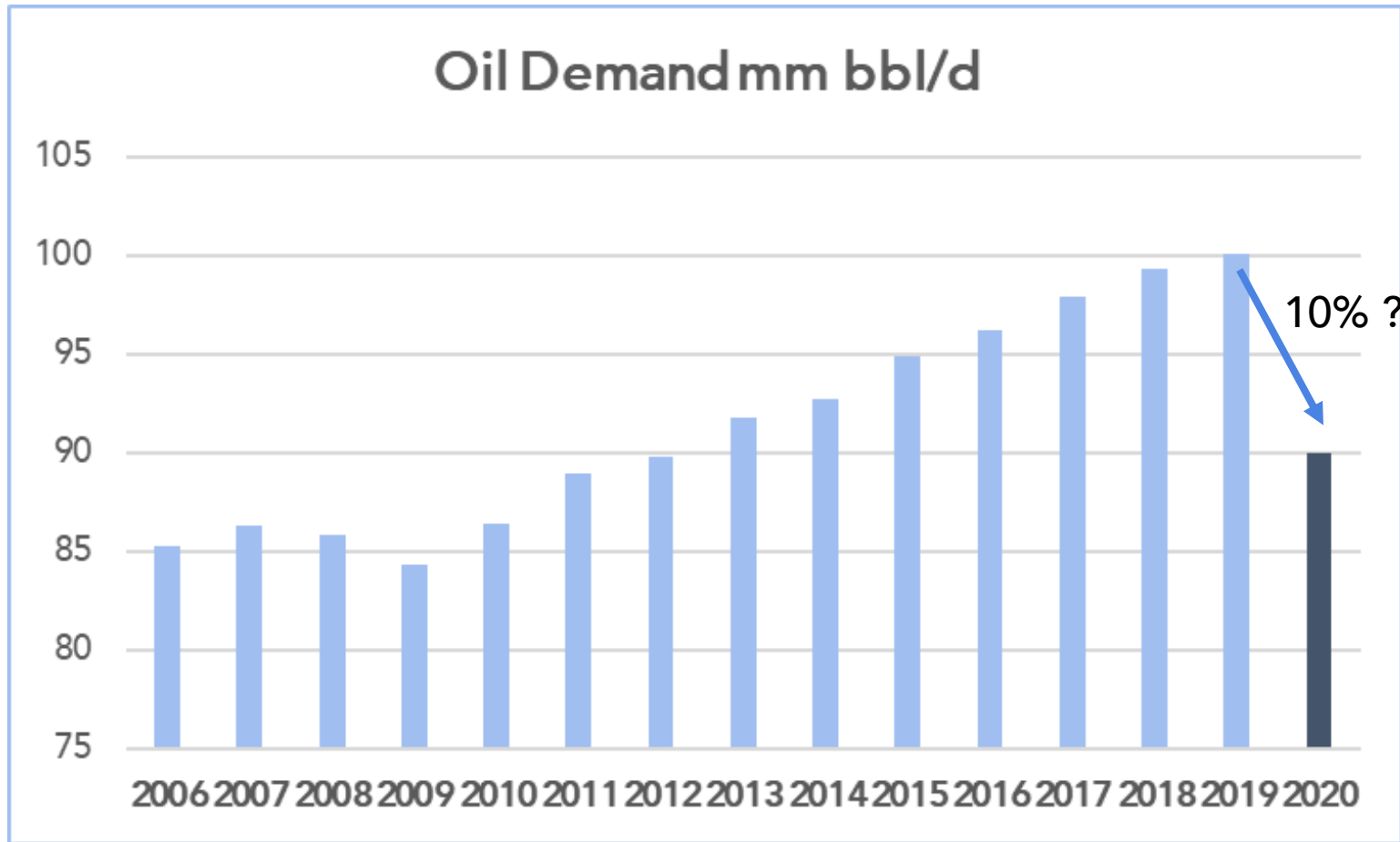
Primary energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor (the 'substitution' method) has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.



Source: BP Statistical Review of World Energy  
Note: 'Other renewables' includes geothermal, biomass and waste energy.  
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# Global Oil demand



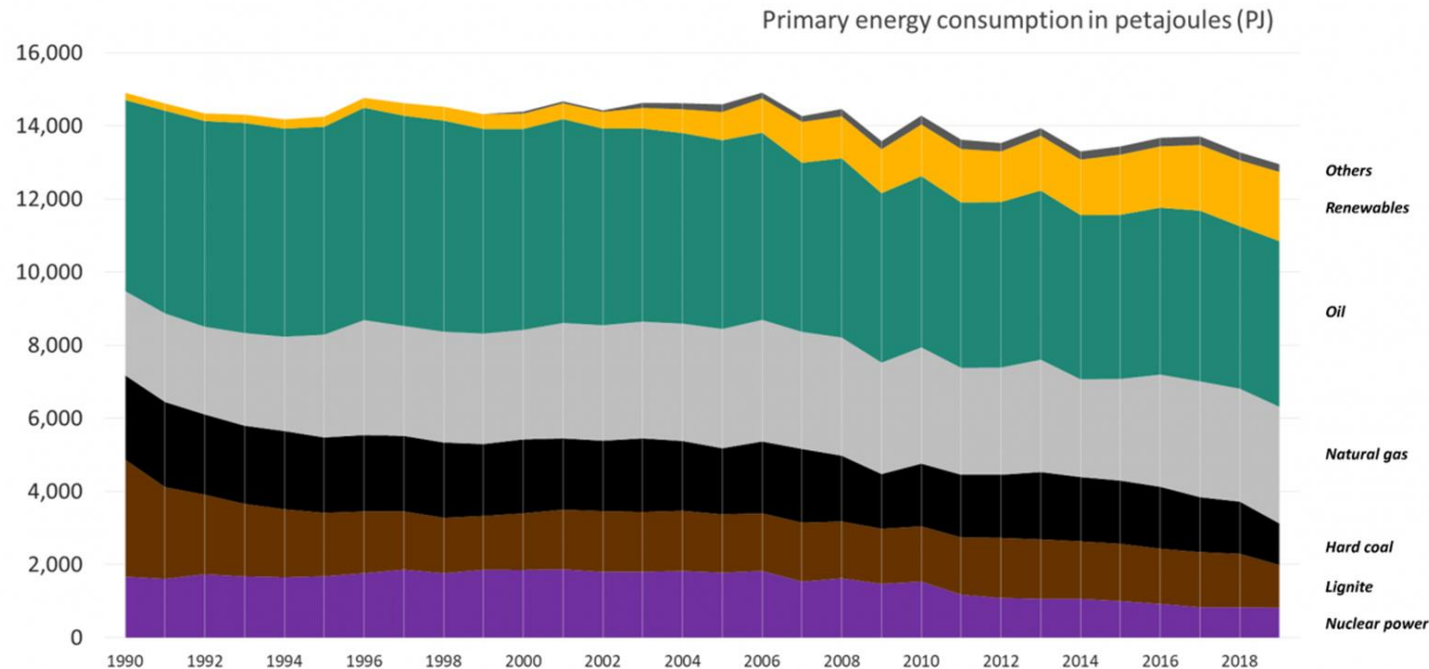
Source: Statista, IEA, IMELUM



# Not easy to move away from fossil fuels – the example of Germany

German energy sources' share in primary energy consumption 1990 - 2019.

Data: AG Energiebilanzen 2020



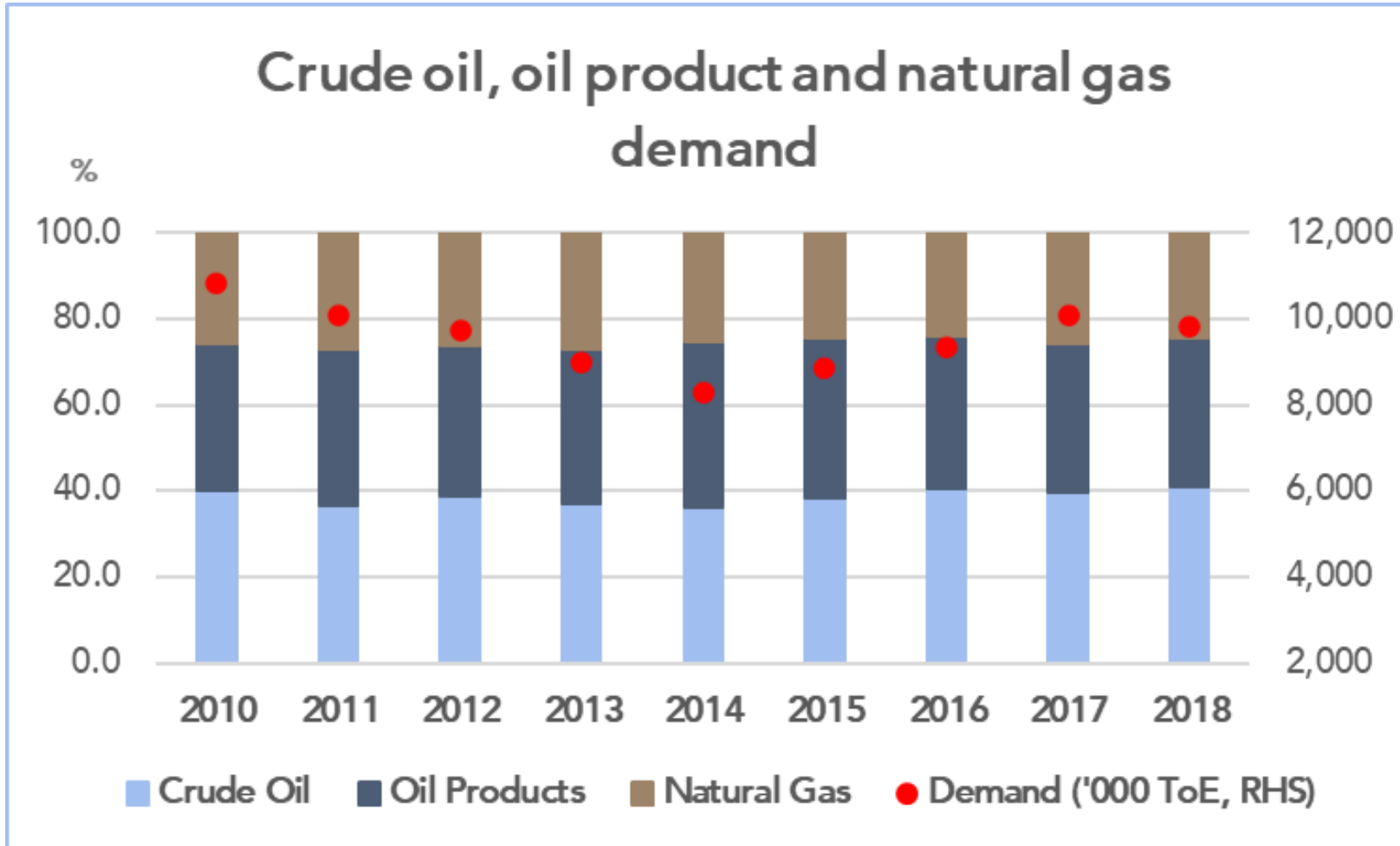
CC BY SA 4.0



# **A QUICK LOOK AT ENERGY SECTOR TRENDS IN CROATIA**



# Crude oil, oil product and natural gas demand

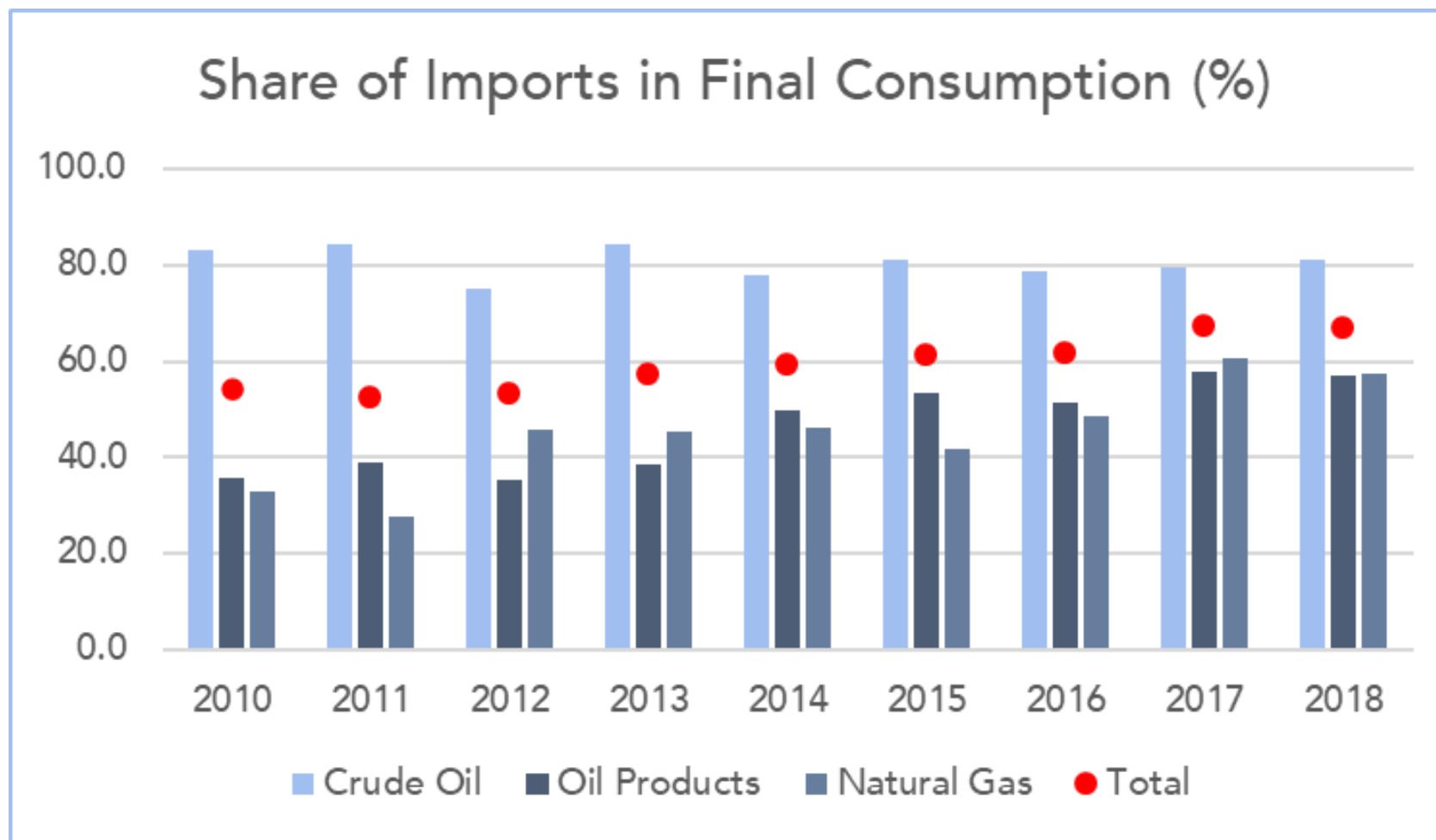


Source: DZS, IMELUM





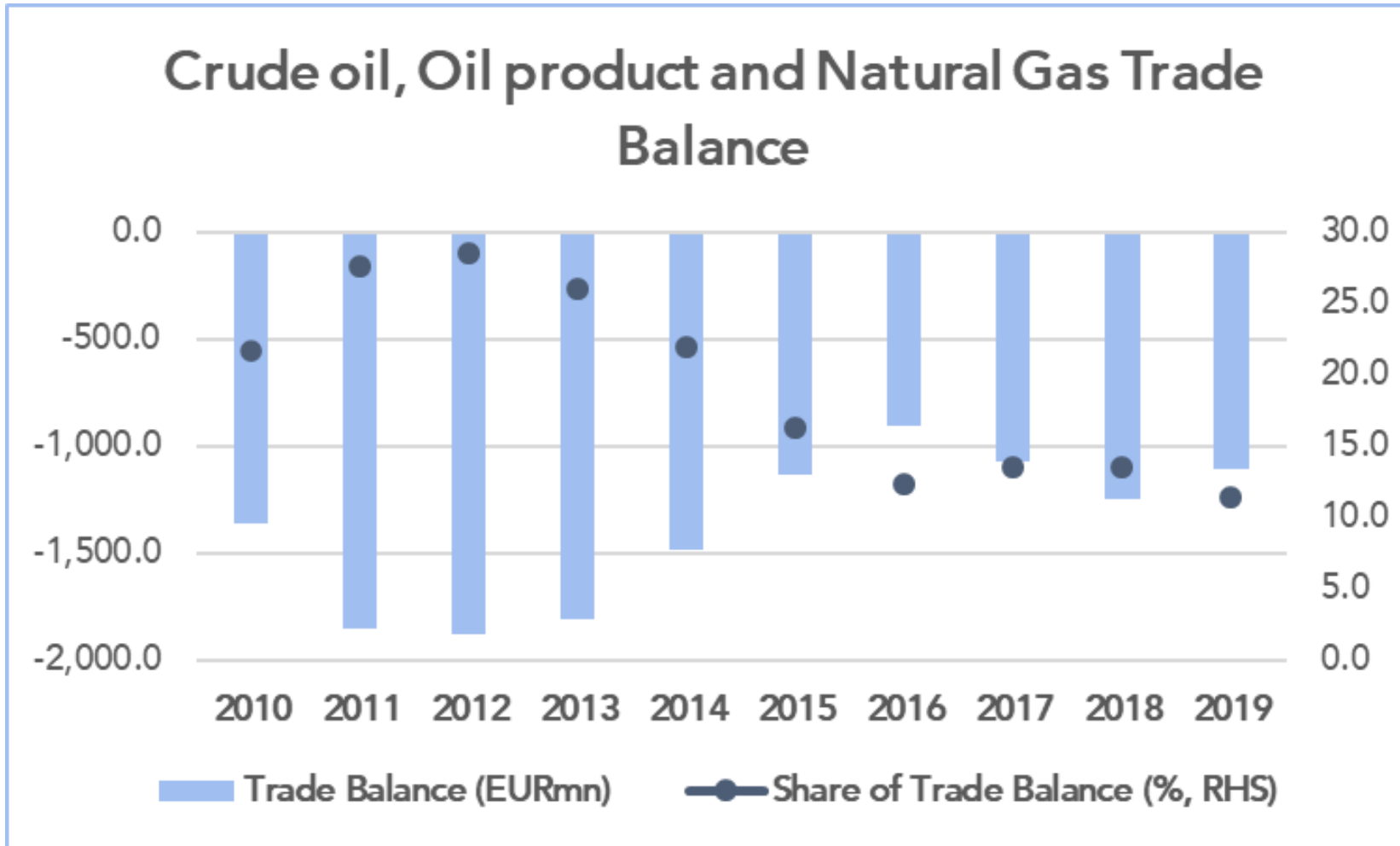
# Structure of imports of energy



Source: DZS, IMELUM



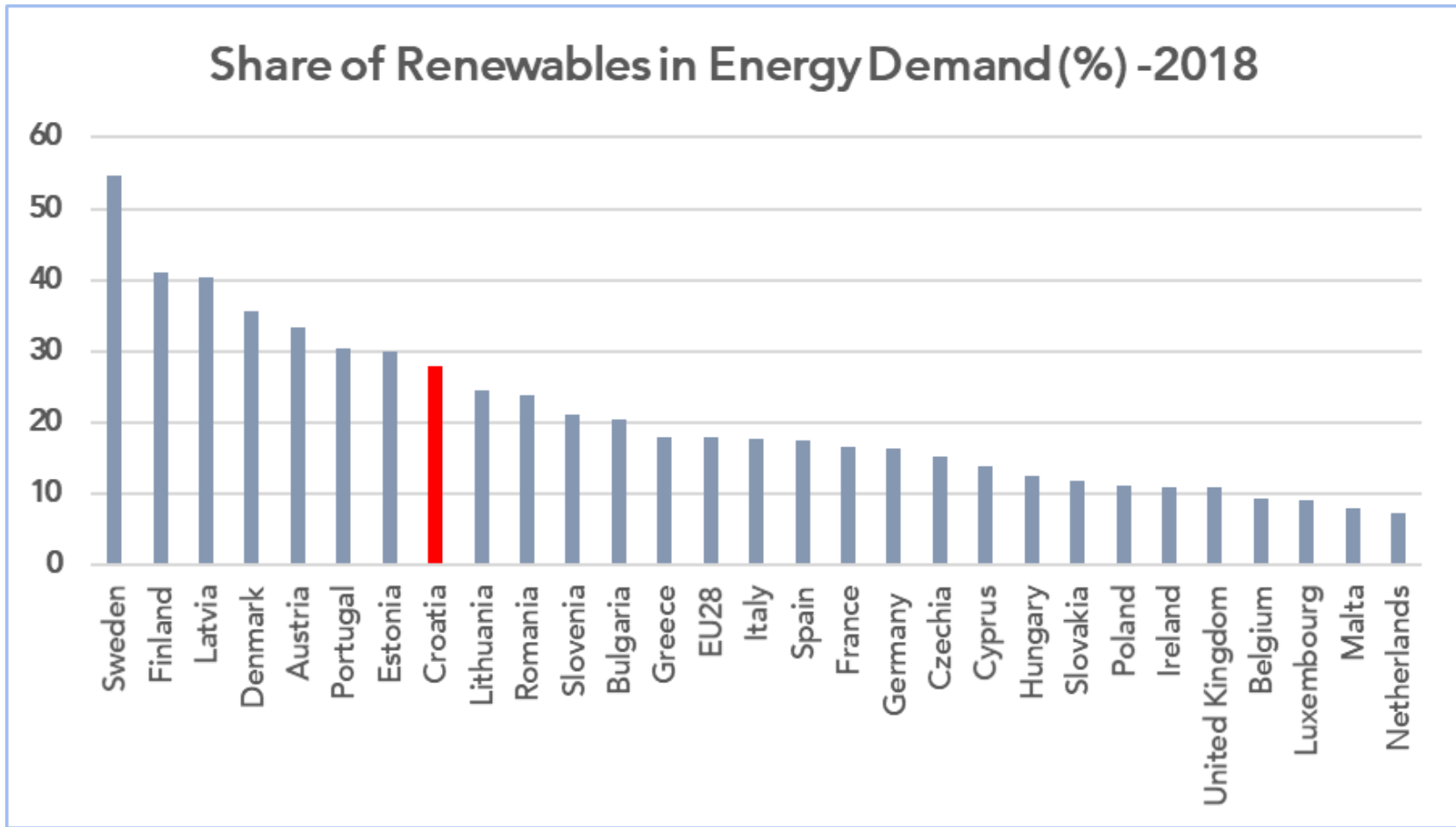
# Energy imports and share of trade deficit



Source: DZS, HNB, IMELUM



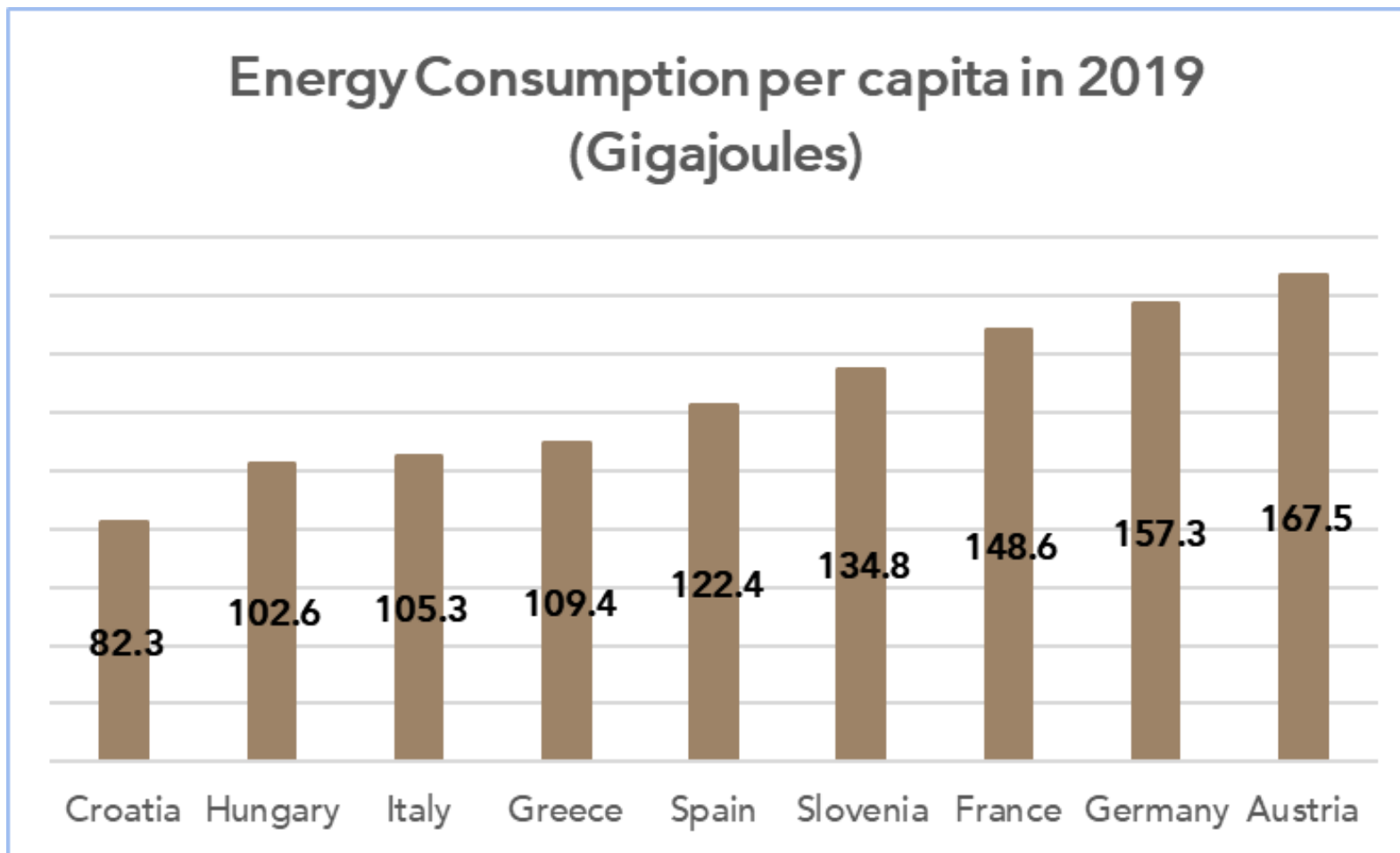
# Croatia and renewables – access to hydropower



Source: Eurostat



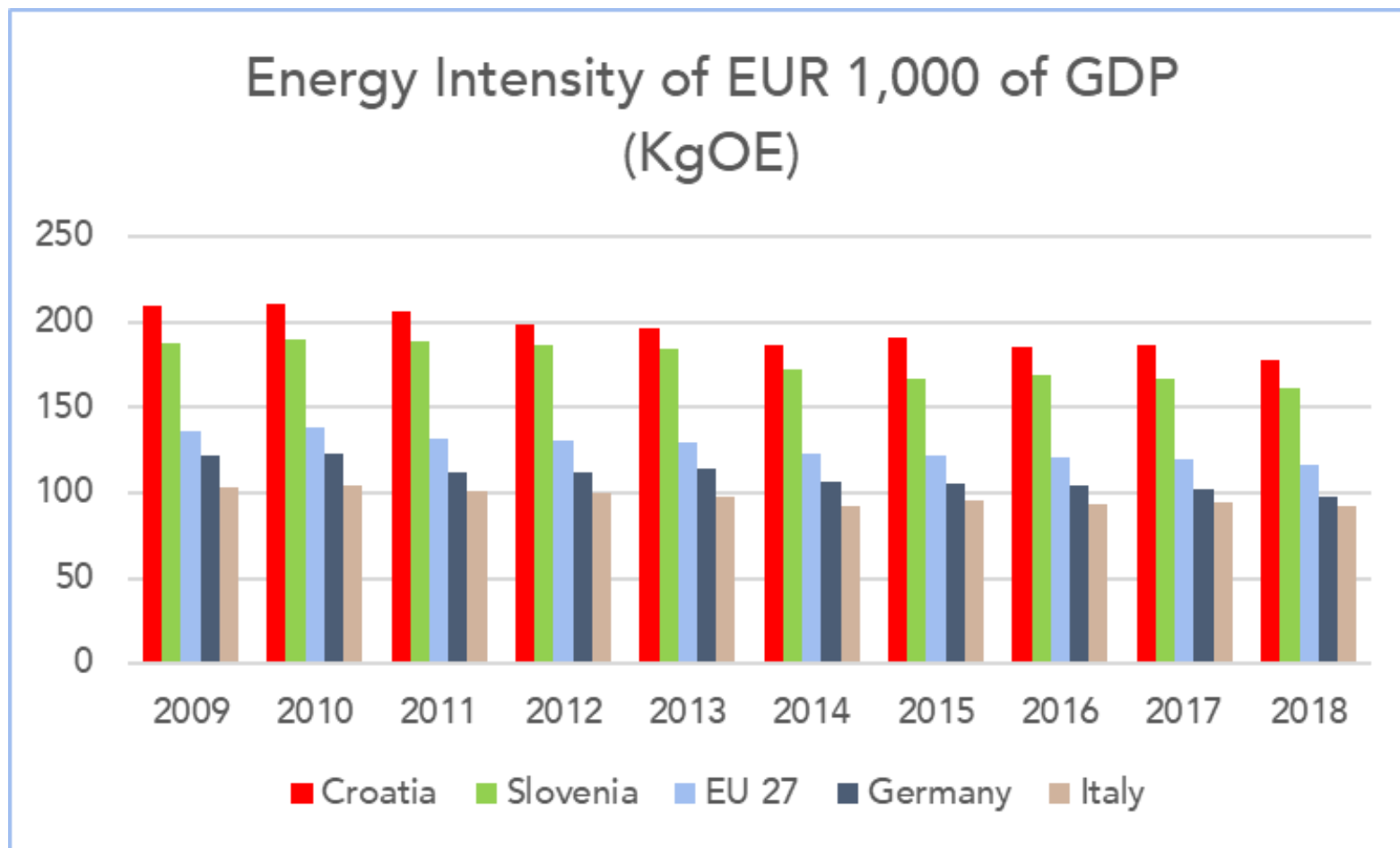
# Croatia consumes relatively little energy per capita...



Source: BP Statistical Review of World Energy, 2020



# ...and does so relatively inefficiently



Source: Eurostat



# Issues to consider

- Energy transitions take time and the process of reducing fossil fuels in the energy mix is no different because:
  - fossil fuels are **reliable** and very **efficient, stable** sources of power;
  - trillions of dollars have been invested in energy infrastructure since the 20<sup>th</sup> century to supply oil, natural gas and similar sources of energy
    - consider the cost of: geological surveys, oil rigs, refineries, pipelines, storage facilities, fuel depots, retail sales networks, specialised equipment etc.
- Croatia is not overly endowed with energy sources
  - Natural gas reserves are dwindling, after 130 years of oil extraction, easily recoverable resources are low
- There is value in exploring and supporting the use of new technologies because they:
  - unlock resources in a financially viable manner
  - enable (increase the likelihood) of positive spillover effects of economic development – keep the country in the technological loop as new energy technologies are developed
  - Support the activity in less developed regions of Croatia



# Disclaimer

Prepared by: **Goran Šaravanja**  
Contact: [goran.saravanja@imelum.com](mailto:goran.saravanja@imelum.com)

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# Croatia: Energy Opportunities

October 30<sup>th</sup>, 2020

**GEORGE KOVACIC**

info@croscorp.com





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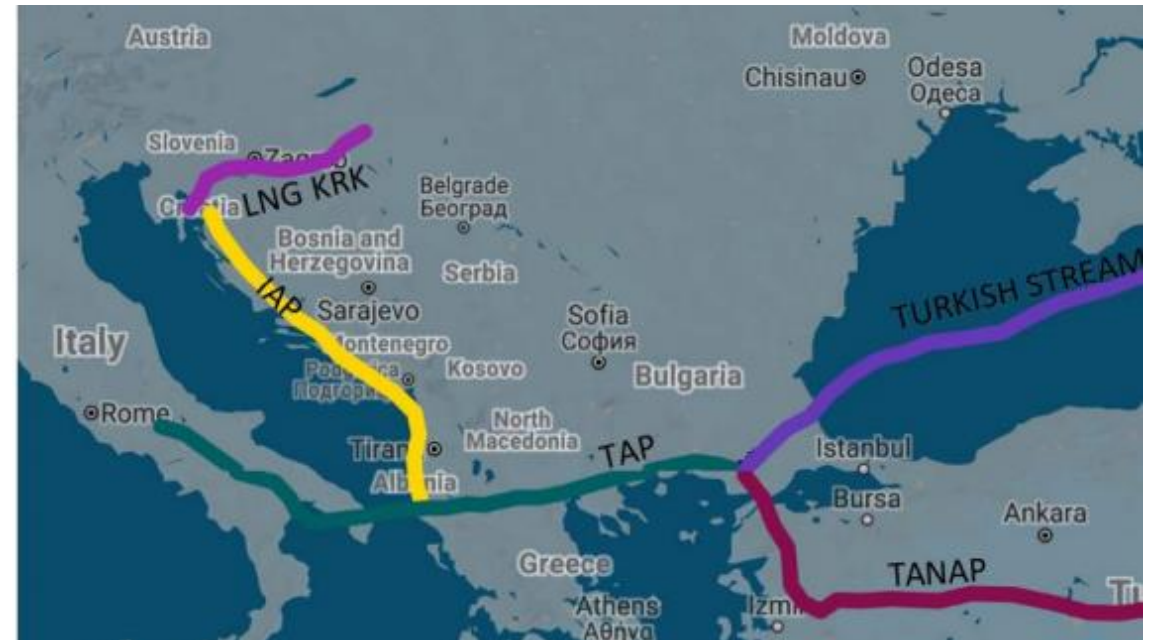


# Croatia – Energy Potential

- Solar
- Wind
- Hydro
- Geothermal
- LNG and corresponding transportation
- Onshore and offshore exploration and production of oil and gas
- Carbon capture and storage, flooding and EOR
- Hydrogen – in situ from decommissioned and/or marginal fields

# Croatia – Energy Opportunities

- Multi-tiered Europe
- Domestic and regional infrastructure under development
- Natural resources have not been developed



Map from: Status of Projects for Diversification of Natural Gas Supply in BiH dated July 2, 2019

# Objective - address energy poverty and climate concerns

- Develop natural resources and energy infrastructure



- Lower cost energy & increase competition
- Decreased import dependency
- Energy security
- Revenue and jobs
- Decrease dependence on wood and coal
- Stimulate carbon capture and storage

# Nord Stream 2 – German competitive advantage

## Nord Stream 2 Details: under construction

- Annual capacity of 55 billion m<sup>3</sup> (1.9 tcf)
  - Capacity - 22 times Krk LNG



Photo from: Bloomberg article, "Nord Stream 2 Urgency Diminishes" – October 13, 2020

## Why Germany wants Nord Stream 2:

- Reliable, efficient and stable supply of energy
- Lower cost – subsidy to industry and residents
- First inline – Energy Security
- Help Germany move away from nuclear and coal – decarbonization by moving to gas.

# Offshore oil production – German competitive advantage

## Mittelplate details: producing oil

- Produce oil offshore in a National Park
- Seven km from the shore, in shallow water
- Produced 146 million barrels of oil

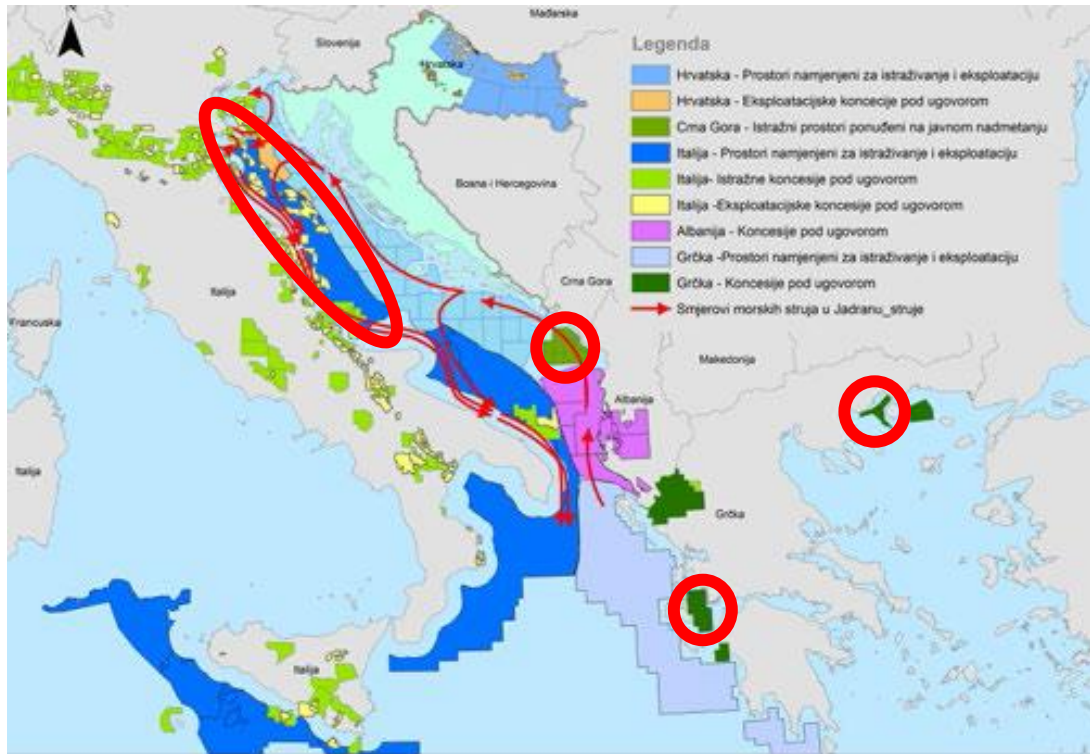


Photo from: Wikipedia Mittelplate post

## Why Germany produces their national resources:

- Reliable, efficient and stable supply of energy
- Lower cost – subsidy to industry and residents
- High paying technical jobs
- Tax Revenue
- Strong domestic oil and gas industry
- Oil and gas service industry plus export of their products and services
- Stimulation of other industries – hot houses, fertilizer, petrochemical and others

# Neighbors pursuing their best interests



Map from: <http://www.azu.hr/hr-hr/%C5%A0to-trebamo-znati>

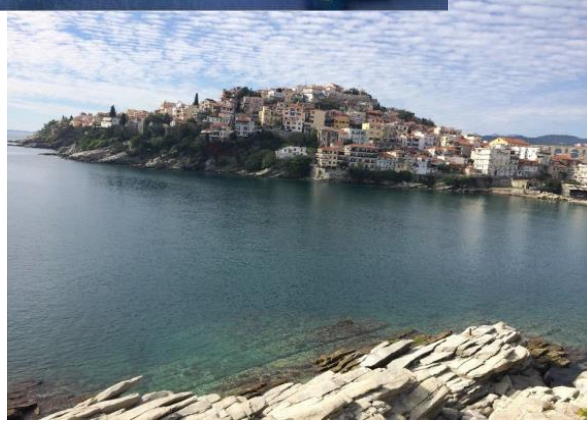
- Italy – offshore production of oil and gas
- Montenegro – upcoming offshore exploration
- Greece – offshore production of oil and ongoing exploration



# Greek example – Kavala Bay

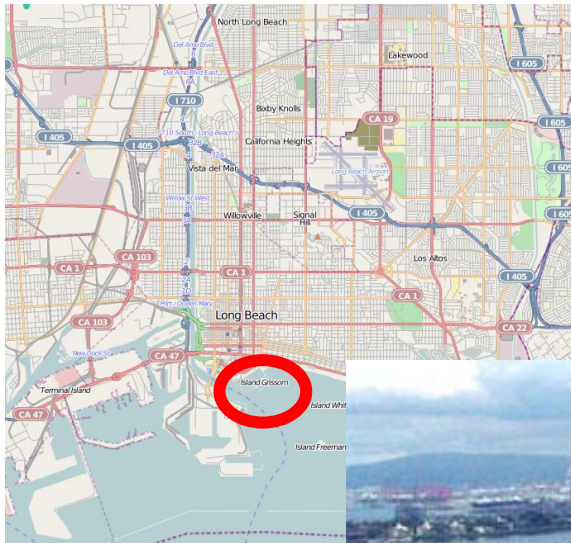


- Oil production in the Aegean Sea
- Co-existence of oil production, tourism and fishing
- Oil production stimulates tourism and fishing





# US example – Santa Barbara, Long Beach



**Island Grissom, THUMS Islands, one of the four oil production islands off Long Beach, California**

- The Santa Barbara and Los Angeles regions produce over 100,000 barrels of offshore oil per day.
- Tourism, fishing and offshore oil production successfully co-exist and stimulate each other



Photo from: [https://en.wikipedia.org/wiki/THUMS\\_Islands](https://en.wikipedia.org/wiki/THUMS_Islands)

# How should Croatia move forward?

- Hydro
- Geothermal
  - Minimal carbon emissions
- LNG and corresponding transportation
- Onshore and Offshore exploration and production of oil and gas
  - Vermilion gas plant in Vukovar county - 2022
- Carbon capture and storage/carbon flooding
  - Reduce carbon footprint
  - Carbon neutral or negative
- Other EOR
- Hydrogen – in situ from decommissioned and/or marginal fields
  - Zero carbon emissions

# Geothermal Example & Opportunities

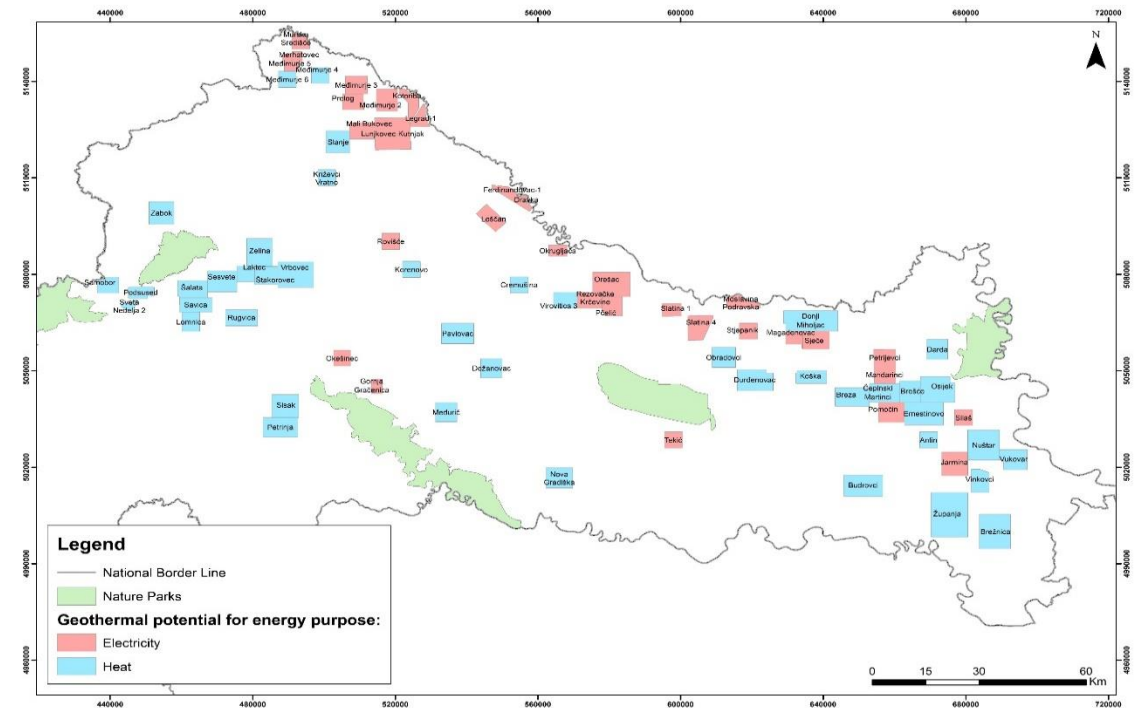
## Velika Ciglena – 10 MW installed capacity

- Produces 24/7/365
- Does not require backup capacity
- More expensive than fossil fuels



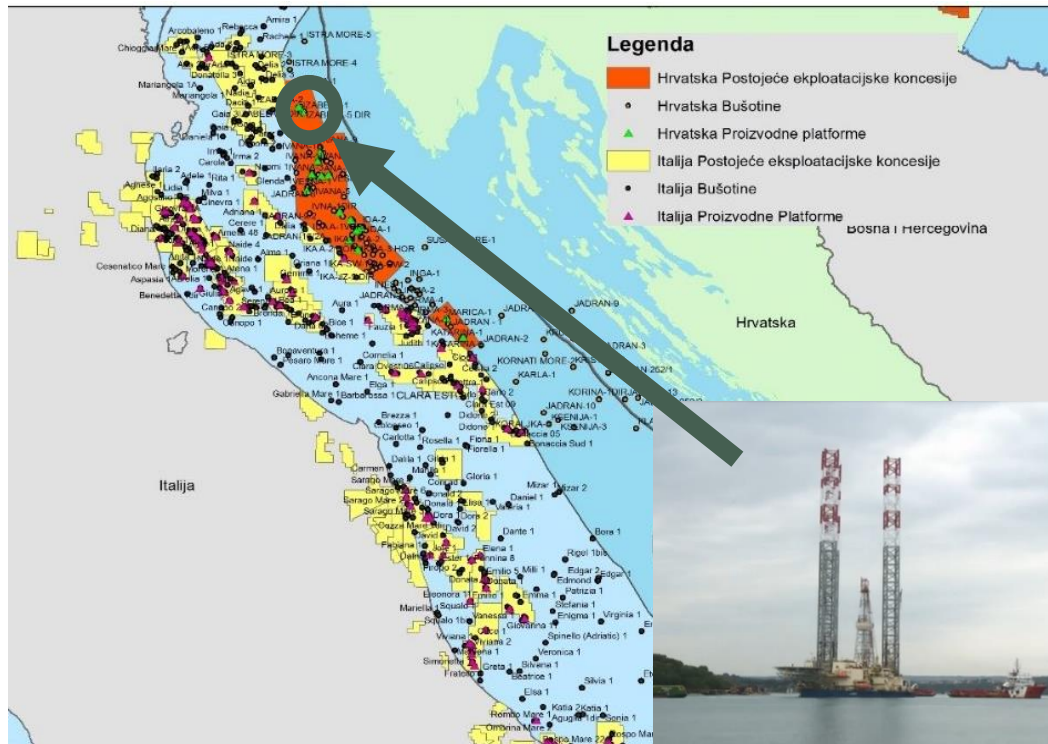
Photo from: CHA presentation Geothermal potential of the Republic of Croatia

## Geothermal Potential – Estimated 800 MW



Map from: CHA presentation Geothermal potential of the Republic of Croatia

# Offshore Examples & Opportunities



Map from: <http://www.azu.hr/portals/0/Dokumenti/azu-brosura-2015.pdf>

Screenshot from: <https://m.youtube.com/watch?feature=youtu.be&v=IPbXf4KiAvU>

- Croatia has been producing Adriatic natural gas since 1999
  - Drilling Irena-2
- Italy has produced Adriatic oil and gas for decades
- Existing hydrostatic pressures prevent spills

# Core natural oil and gas seeps – environmental protection

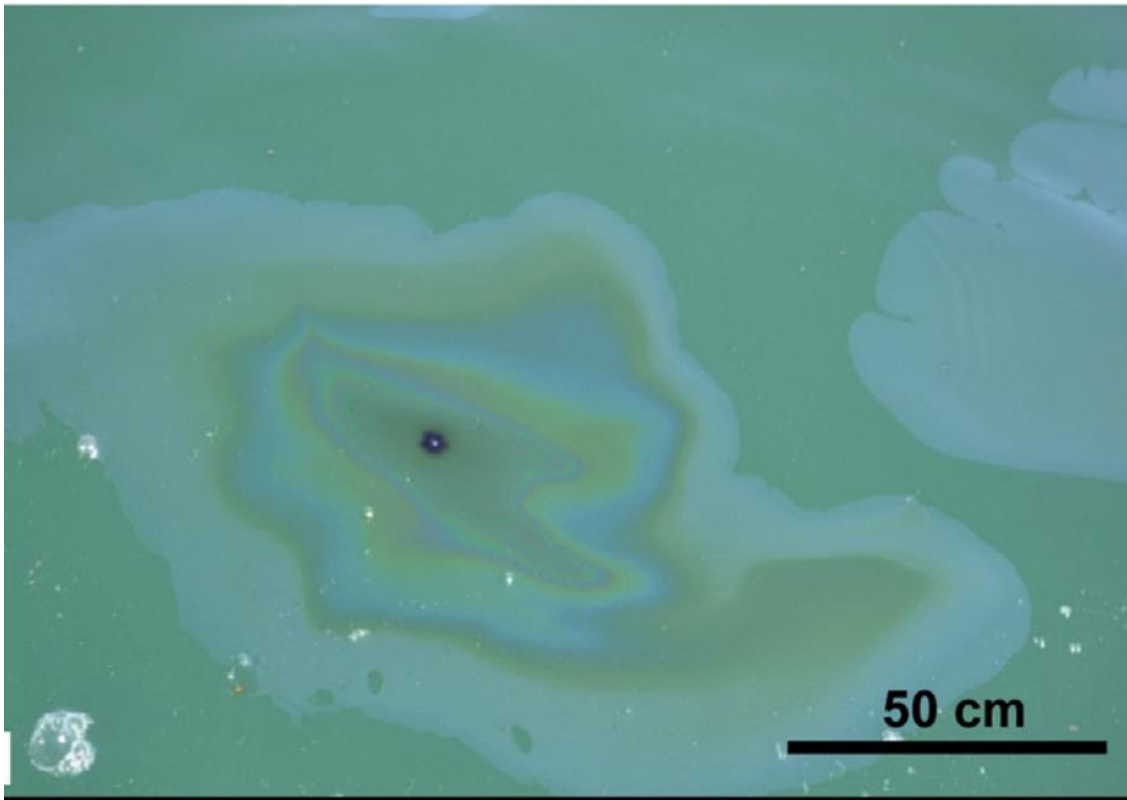
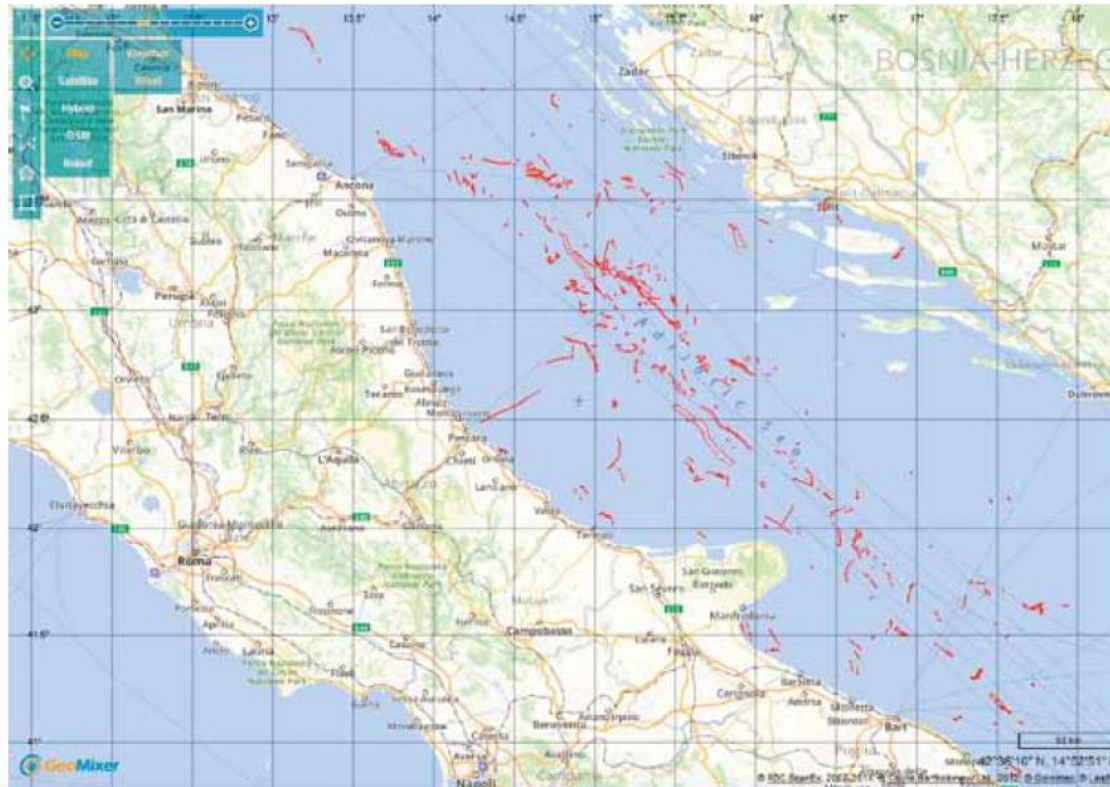


Photo from: [ftp://ftp.ingv.it/pub/paola.vannoli/Pubblicazioni/Pubblicazioni\\_JCR\\_altre/Etiopo\\_etal%202014\\_MPG.pdf](ftp://ftp.ingv.it/pub/paola.vannoli/Pubblicazioni/Pubblicazioni_JCR_altre/Etiopo_etal%202014_MPG.pdf)

- Natural oil and gas seeps occur throughout the Adriatic
- Result is surface oil slicks and gas bubble plumes
- Natural oil seeps have been identified by radar reflectance and optical satellites in the Croatian Adriatic



# Stop illegal oil dumps – environmental protection



- According to a European Commission study, illegal oil dumps regularly occur in the Adriatic
- Tankers that import oil present the greatest risk to offshore Croatia

Map from: [hrcak.srce.hr/file/224030](http://hrcak.srce.hr/file/224030)

Radar images of the Adriatic oil slicks. Slicks correlate with main shipping routes

# Excellent offshore potential plus CCS potential

- 203 offshore leads identified
- Interest exists to explore and produce

Lead Type	Number of leads	Indicative lead values				Indicative lead values				Relative Size	Potential Play Type Reserves - Oil (mmbo)				Potential Play Type Reserves - Gas (bcf)			
		Oil (mmbo)				Gas (bcf)					P90	P50	Mean	P10	P90	P50	Mean	P10
		P90	P50	Mean	P10	P90	P50	Mean	P10									
Cretaceous Fan	1	8	66	190	524					Only	8	66	190	524	0	0	0	0
Cretaceous Kastified Lmst	1	8	43	86	223					Only	8	43	86	223	0	0	0	0
Cretaceous Platform Margin	9	12	44	68	159	109	494	891	2240	Largest	36	132	204	477	327	1482	2673	6720
(Cretaceous cored) Tertiary Anticline	8	11	40	60	138					Average	11	40	60	138	0	0	0	0
Eocene Debris Flow	1	5	24	43	107	18	87	167	426	Only	5	24	43	107	18	87	167	426
Eocene - Miocene Anomaly	1	68	382	814	2156					Only	68	382	814	2156	0	0	0	0
Eocene Reef	1	5	30	72	193					Only	5	30	72	193	0	0	0	0
Jurassic Fault Blocks	19					148	774	1563	4056	Average	0	0	0	0	148	774	1563	4056
Jurassic Platform Margin	1					109	494	891	2240	only	0	0	0	0	109	494	891	2240
Mesozoic Anticline	35	58	319	673	1764					Largest	464	2552	5383	14112	0	0	0	0
Messinian Channel	12					8	51	126	337	Average	0	0	0	0	80	510	1260	3370
Oligo - Miocene slump	1	2	12	24	63	5	30	70	186	Only	2	12	24	63	5	30	70	186
Oligo - Miocene Anomaly	5					10	87	287	783	Largest	0	0	0	0	25	217.5	717.5	1958
Permo Triassic	20					5	28	61	159	Average	0	0	0	0	100	560	1220	3180
Plio Quaternary Anomaly	90					70	604	1924	5246	Largest	0	0	0	0	210	1812	5772	15738

Chart from: <http://www.spectrumgeo.com>

Indicative potential lead recoverable (un-risked) resource estimates and total potential by play type

To facilitate opportunities and potential:

**George Kovacic**

**+1 604 420 2262**

**info@croscorp.com**

**linkedin.com/in/georgekovacic**

**THANK YOU**

