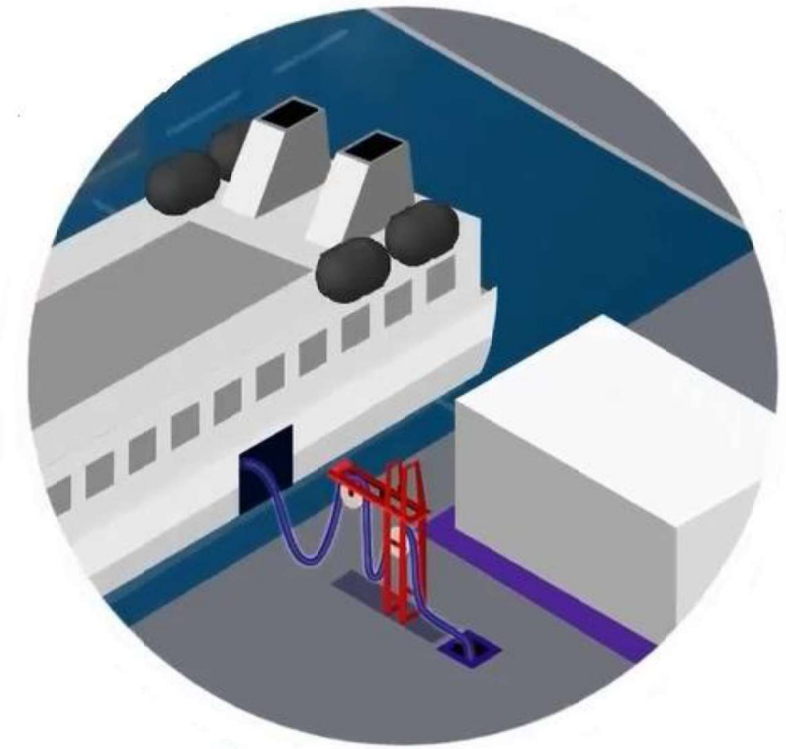
elemed

electrification
in the **e**astern
mediterranean

Green ports & renewable energy sources



Dr. Takvor Soukissian
Research Director HCMR

Electrification of Eastern Mediterranean Corridor: elemed & Koper case

Koper, January 29, 2018

hcmr
ΕΛΚΕΘΕ

Co-financed by the European Union
Connecting Europe Facility

OVERVIEW

- RES technologies & potential for the Mediterranean
- Obstacles and perspectives in the Mediterranean
- RES in ports
- Benefits of RES in cold ironing
- RES potential in Slovenia & Koper port
- Conclusions

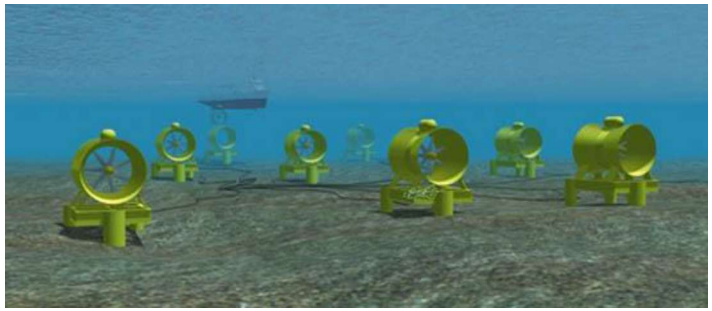
elemed

hcmr
ΕΛΚΕΘΕ

RENEWABLE ENERGY TECHNOLOGIES

Onshore/offshore wind

Tidal/current energy



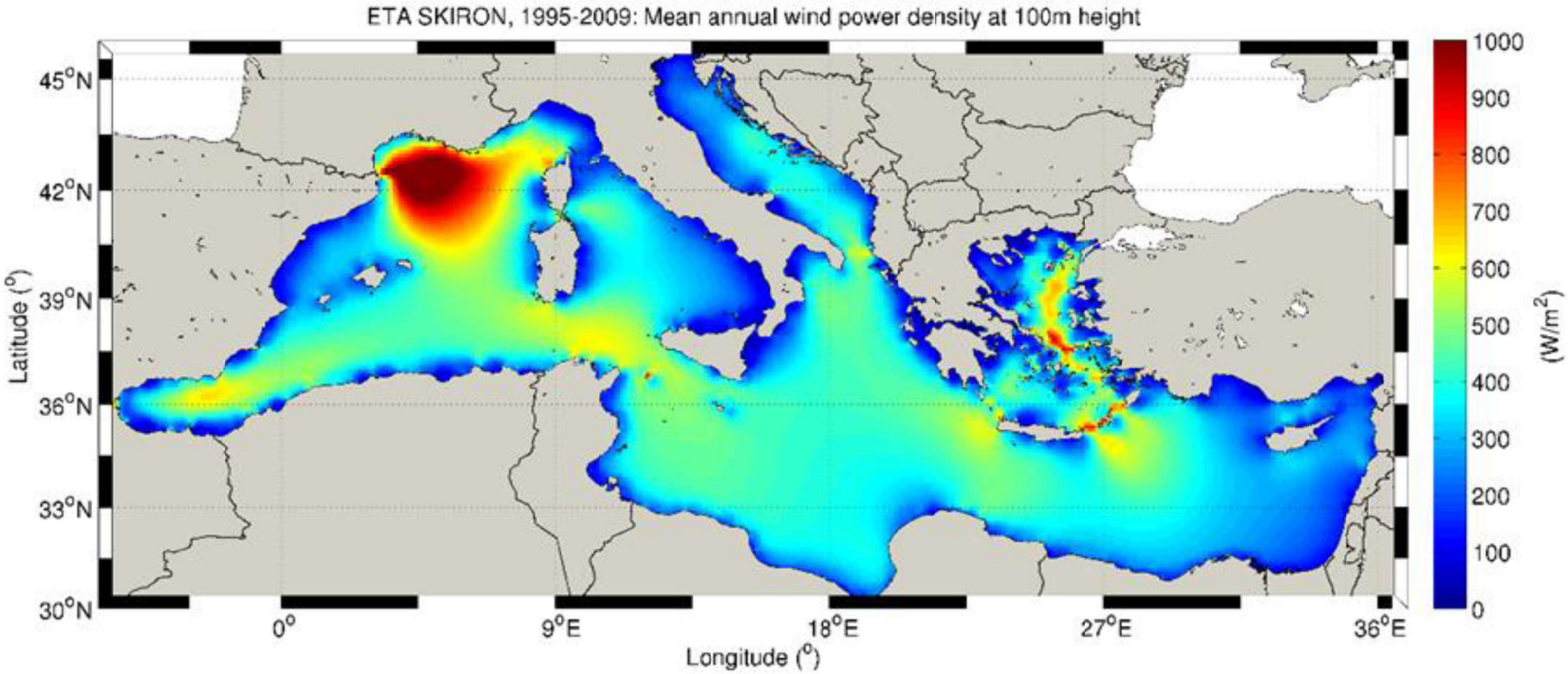
Energy Islands?

Wave energy

Solar

elemed

hcmr
ΕΛΚΕΘΕ

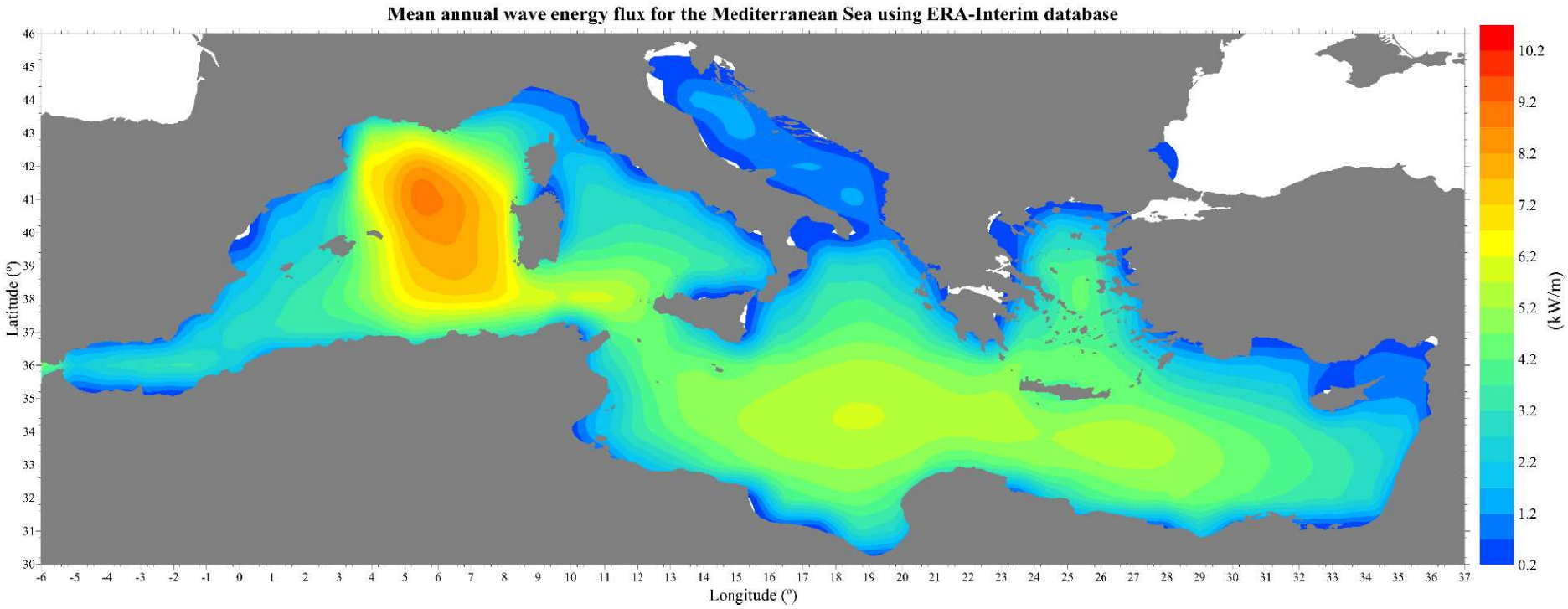


Mean annual offshore wind power density for the Mediterranean Sea

Source: CoCoNET project, WP5: Offshore Wind Farms in the Mediterranean and Black Seas. Restricted Report

elemed

hcmr
ΕΛΚΕΘΕ

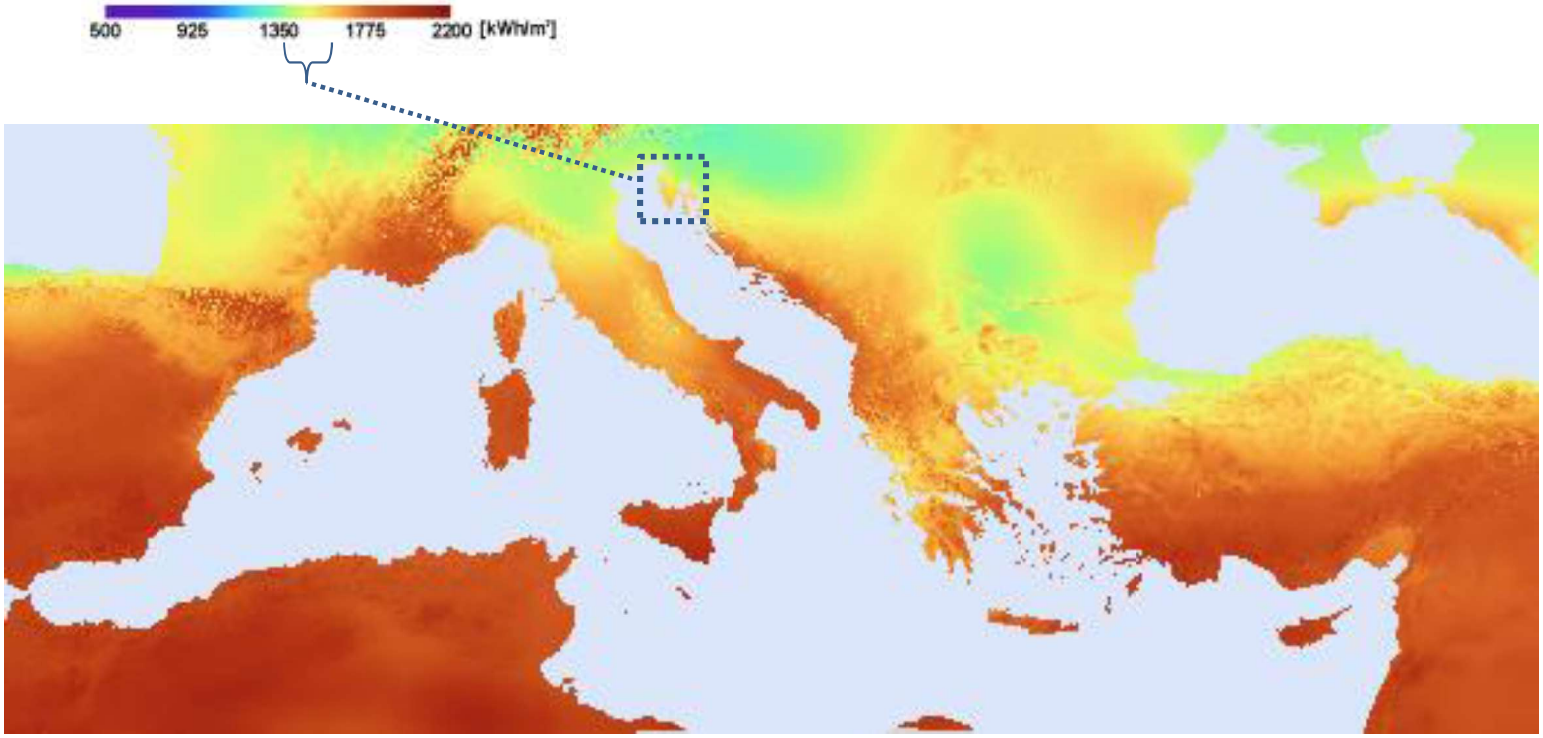


Mean annual wane energy flux for the Mediterranean Sea

Source: Soukissian et al., 2017 (in press)

elemed

hcmr
ΕΛΚΕΘΕ



Solar radiation in the Mediterranean Sea (1981 – 1990)

Source: PVGIS-CMSAF, European Commission

elemed

hcmr
ΕΛΚΕΘΕ

OBSTACLES & PERSPECTIVES OF BE IN THE MED SEA

- Available resource NOT AMPLE, but certainly EXPLOITABLE in industrial terms
- Technical restrictions – lack of infrastructure
- Multiple & different uses of marine space
- Legislative gaps & (usually) complex licensing procedures
- Difficult financing – …still risky business
- Need for smart adaptation of existing technologies and INNOVATION
- New employment positions
- Boost of local/regional and national economies
- Energy safety & independence
- Clean Environment & harmonization with EU targets
- Co-utilization of marine space – Ideal for Mediterranean countries
- Blue Tourism… Why not?
- Important EU financing as regards Blue Growth & Blue Energy

elemed

hcmr
ΕΛΚΕΘΕ

EUROPEAN PORTS USING RES

- Port of Antwerp (Belgium)
- Port of Amsterdam (Netherlands)
- Port of Rotterdam (Netherlands)
- Port of Genoa (Italy)
- Port of Hamburg (Germany)

Port of Goteborg
The only case where RES are used to support cold ironing

elemed

hcmr
ΕΛΚΕΘΕ

BENEFITS OF INTRODUCING RES IN COLD IRONING

Environmental

- Reduction of ship emissions
- Improvement of air quality
- Higher climate performance
- Increase of RES share in the energy mix
- Increase abundance of species in case of offshore wind farms
- Sustainable mobility
- . . .

Socio-economic

- Job creation & work opportunities
- Improvement of public health & quality of life
- Decrease of health costs
- "Green port"
- Enhancement of tourism & trade
- Cost saving for port authorities & ship owners
- Energy independence
- . . .

elemed

hcmr
ΕΛΚΕΘΕ

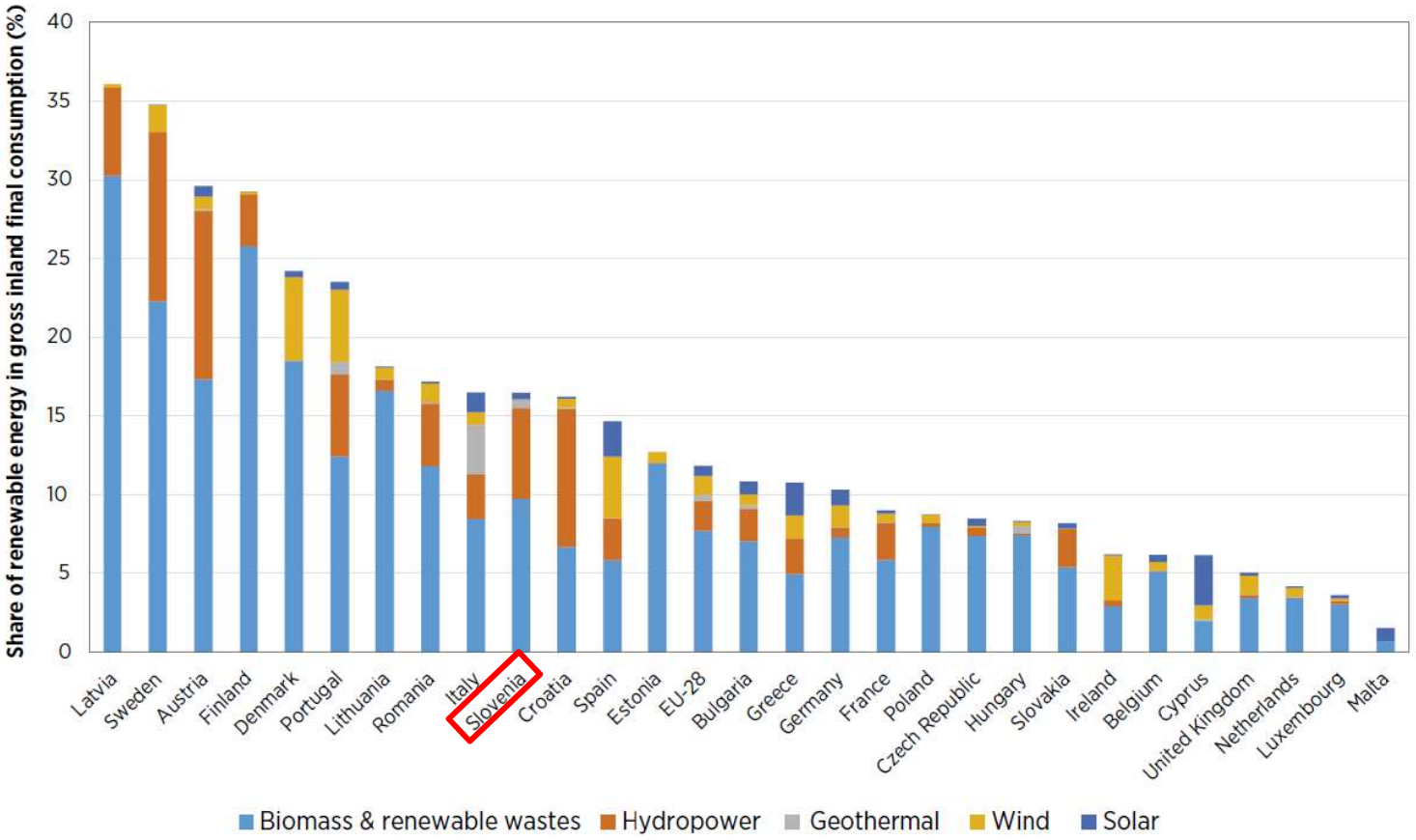
RES FACTS & PROJECTIONS FOR SLOVENIA

- Overall share of energy from RES: 2013-22.4%, 2014-21.5% & 2015-22.0%
- Total Primary Energy Supply from RES (2011): 11,028 GWh (13.1%)
- Electricity generation from RES (2011): 3,876 GWh (24.4%)
- Electrical capacity from RES (2011): 1,188 MW (36.4%)
- Onshore wind power capacity (2016): 5 MW
- Solar energy capacity (2016): 257 MW
- Electricity prices for reference industrial customers (2015): 0.0714 EUR/kWh (taxes excluded)
- 2020 RES target: 39% of electricity demand met by electricity generated (Directive 2009/28/EC)
- 2030 RES-E share target: 54.6% (based on the low energy demand scenario and 30% RES share on EU scale)

elemed

hcmr
ΕΛΚΕΘΕ

Share of RES in EU countries

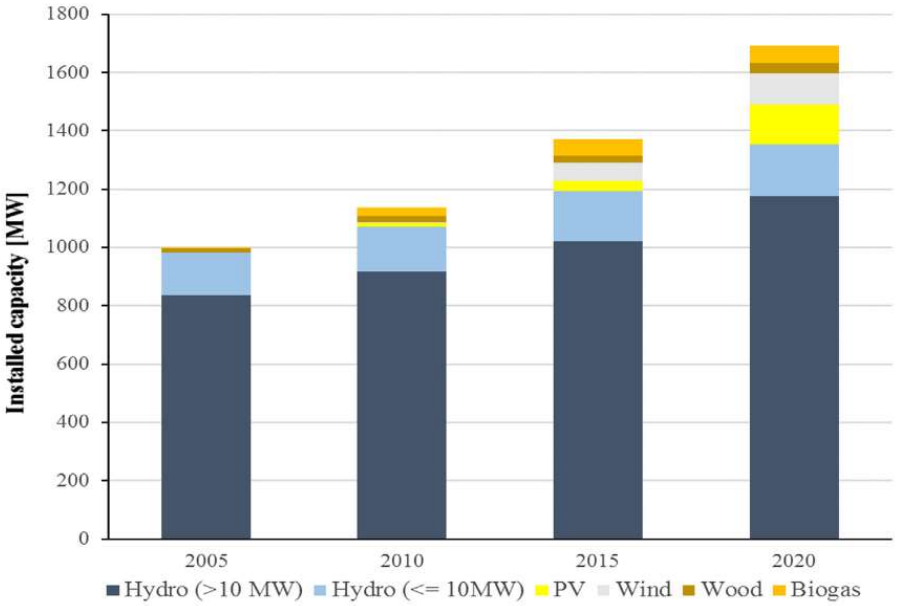


Source: Renewable energy prospects: Germany, IRENA – Report 2015

elemed

hcmr
ΕΛΚΕΘΕ

Expected contribution in installed capacity of each individual RES till 2020



Feed-in tariffs and premiums for the electricity from PV (top) and wind (bottom) in 2012 and 2013, respectively

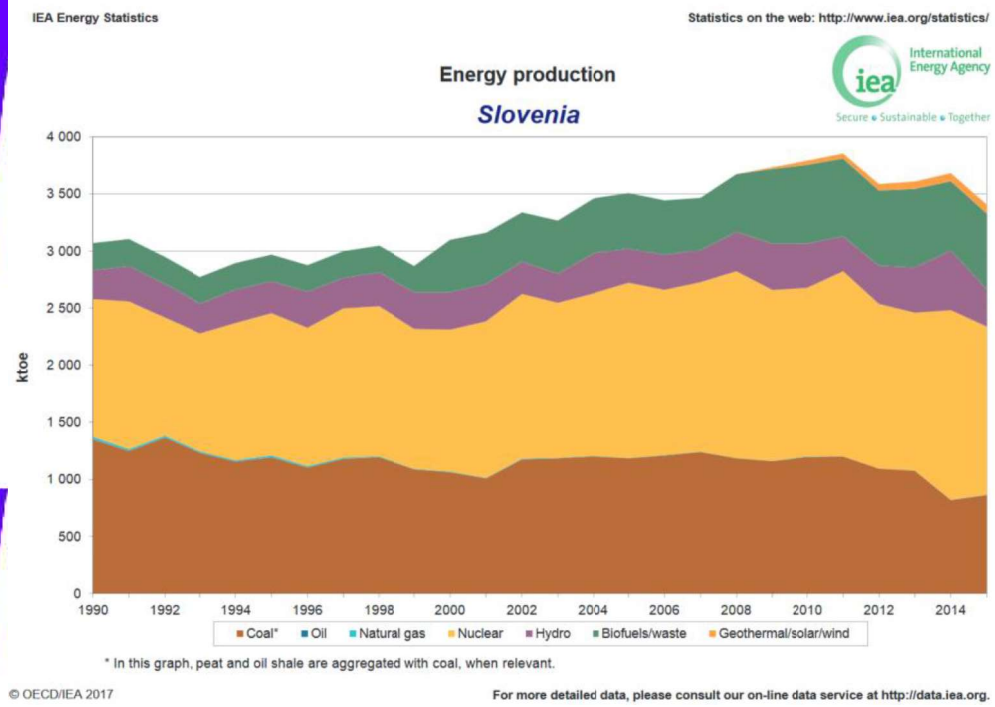
	Year 2012[b]					
	Feed-in tariff (EUR/MWh)		Premium (EUR/MWh)		Feed-in tariff (EUR/MWh)	Premium (EUR/MWh)
	Jan–Jun	Jul–Nov	Jan–Jun	Jul–Nov	December[c]	
PV – on buildings[a]						
Up to 50 kW	290.82	197.55	246.24	152.97	150.00	105.42
From 50 kW to 1 MW	266.01	180.70	221.43	136.12	137.19	92.61
From 1 MW to10 MW	220.75	149.95	174.65	103.85	113.85	67.75
10 MW–125 MW	–	–	145.84	82.82	–	50.68
Other PV						
Up to 50 kW	273.29	185.64	228.71	141.06	140.95	96.37
From 50 kW to 1 MW	251.80	171.04	207.22	126.46	129.86	85.28
From 1 MW to10 MW	202.99	137.89	156.89	91.79	104.68	58.58
10 MW–125 MW	–	–	137.79	77.35	–	46.53

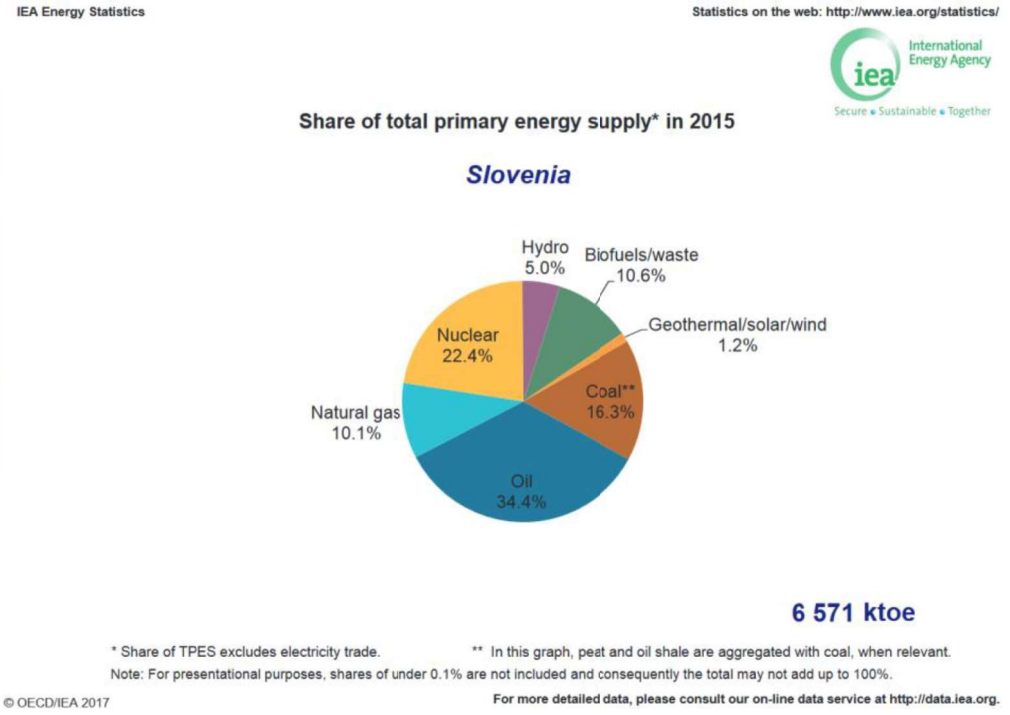
[a] The bonus was ended in 2011. Integrated solar PV power plants with building permits issued until 30.9.2011 that are connected to the grid until 31.12.2011 are still eligible for the bonus.
[b] Due to a change in legislation the reference costs for 2012 plants were updated twice: first half (from 1 January to 30 June) and second half (from1 July to 31 November). Therefore there are two support levels – one (higher) for plants built in the first half and another for plants in the second half of 2012 (only to November 2012).
[c] Due to a change in legislation in November 2012, the reference costs of PV plants are now updated monthly. The reference costs of PV power plants are reduced by 2% per month.

	Feed-in tariff (EUR/MWh)	Premium (EUR/MWh)
Up to 50 kW	95.38	54.85
From 50 kW to 1 MW		
From 1 MW to10 MW		
10 MW–125 MW	–	43.17

Source: F. Al-Mansour et al., (2014). Energy 77: 73-81

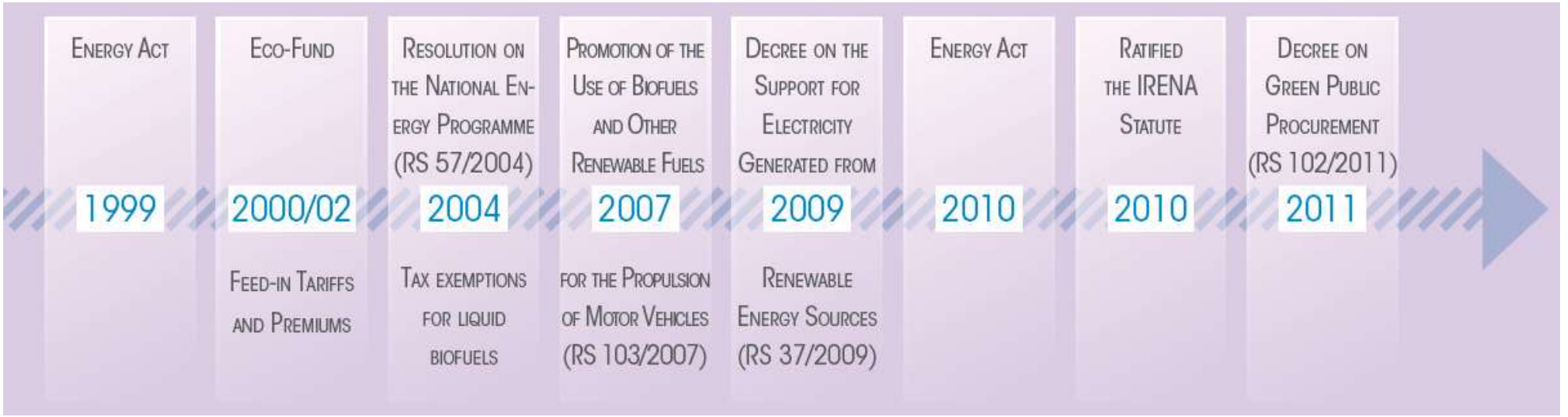
ENERGY PRODUCTION & SHARE OF TOTAL PRIMARY ENERGY SUPPLY (2015)





Source: International Energy Agency
https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=Slovenia

SLOVENIA: POLICIES TO PROMOTE RENEWABLE ENERGY SINCE THE RIO CONFERENCE (1992)



Source: Renewable energy country profiles: European Union, IRENA, Report 2013

elemed

hcmr
ΕΛΚΕΘΕ

Mean monthly offshore wind power density (in W/m^2) at 10 m height above sea level for the ports of Piraeus, Kyllini, Limassol & Koper

	Ports			
Months of the year	Piraeus	Kyllini	Limassol	Koper
January	39.14	69.38	159.78	43.14
February	44.80	68.62	187.75	32.43
March	34.76	54.73	176.06	30.97
April	22.84	24.38	153.94	20.87
May	24.91	16.88	116.33	14.33
June	24.97	13.65	118.49	13.94
July	25.44	13.05	121.80	13.70
August	24.33	11.03	126.55	13.96
September	21.11	18.41	107.96	19.11
October	23.85	30.44	60.31	26.43
November	33.79	54.87	105.89	43.54
December	50.52	78.88	146.61	56.07

elemed

hcmr
ΕΛΚΕΘΕ

Solar irradiance (in kWh/m²/day) for the ports of Piraeus, Kyllini, Limassol & Koper (optimized for best performance in annual basis)				
	Ports			
Months of the year	Piraeus	Kyllini	Limassol	Koper
January	2.86	2.85	3.86	2.09
February	3.28	3.26	4.52	2.98
March	4.07	4.21	5.59	3.78
April	4.80	4.83	6.02	3.98
May	5.17	4.98	6.43	4.30
June	5.68	5.50	6.78	4.38
July	5.73	5.62	6.74	4.61
August	5.69	5.51	6.75	4.47
September	5.14	5.01	6.59	3.66
October	3.93	4.09	5.77	2.66
November	2.72	2.84	4.41	1.98
December	2.33	2.40	3.62	1.63

elemed

hcmr
ΕΛΚΕΘΕ

CONCLUSIONS

- RES have direct & indirect impacts in terms of the environment, society & economy
- Mainly technological & legislative obstacles should be overcome for the development of BE
- RES in ports gain ground offering numerous benefits
- RES in cold ironing is a new and very promising concept towards sustainability (not only in monetary terms)
- Slovenia & Koper port have potentials for exploiting mainly offshore wind

elemed

hcmr
ΕΛΚΕΘΕ

elemed

our future
charged

Thank you

Dr. Takvor Soukissian

Research Director HCMR

tsouki@hcmr.gr

hcmr
ΕΛΚΕΘΕ

Co-financed by the European Union
Connecting Europe Facility