"Global Energy Trends and Regional Challenges"

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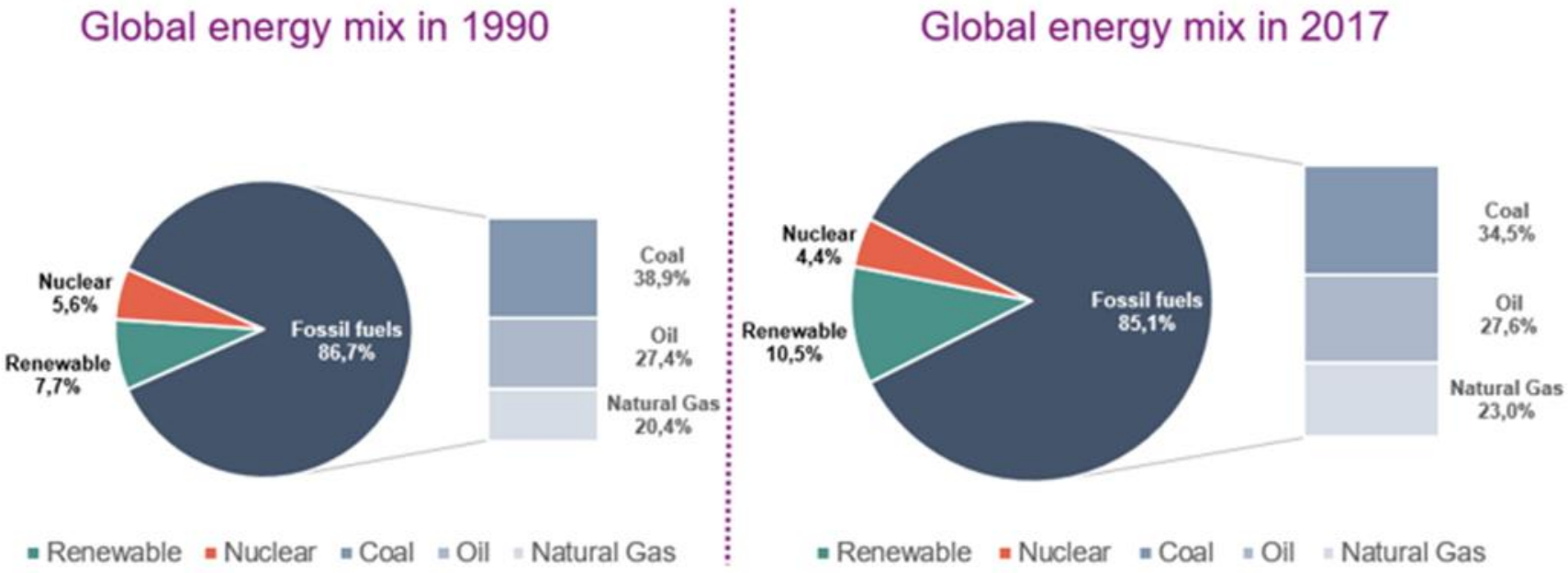
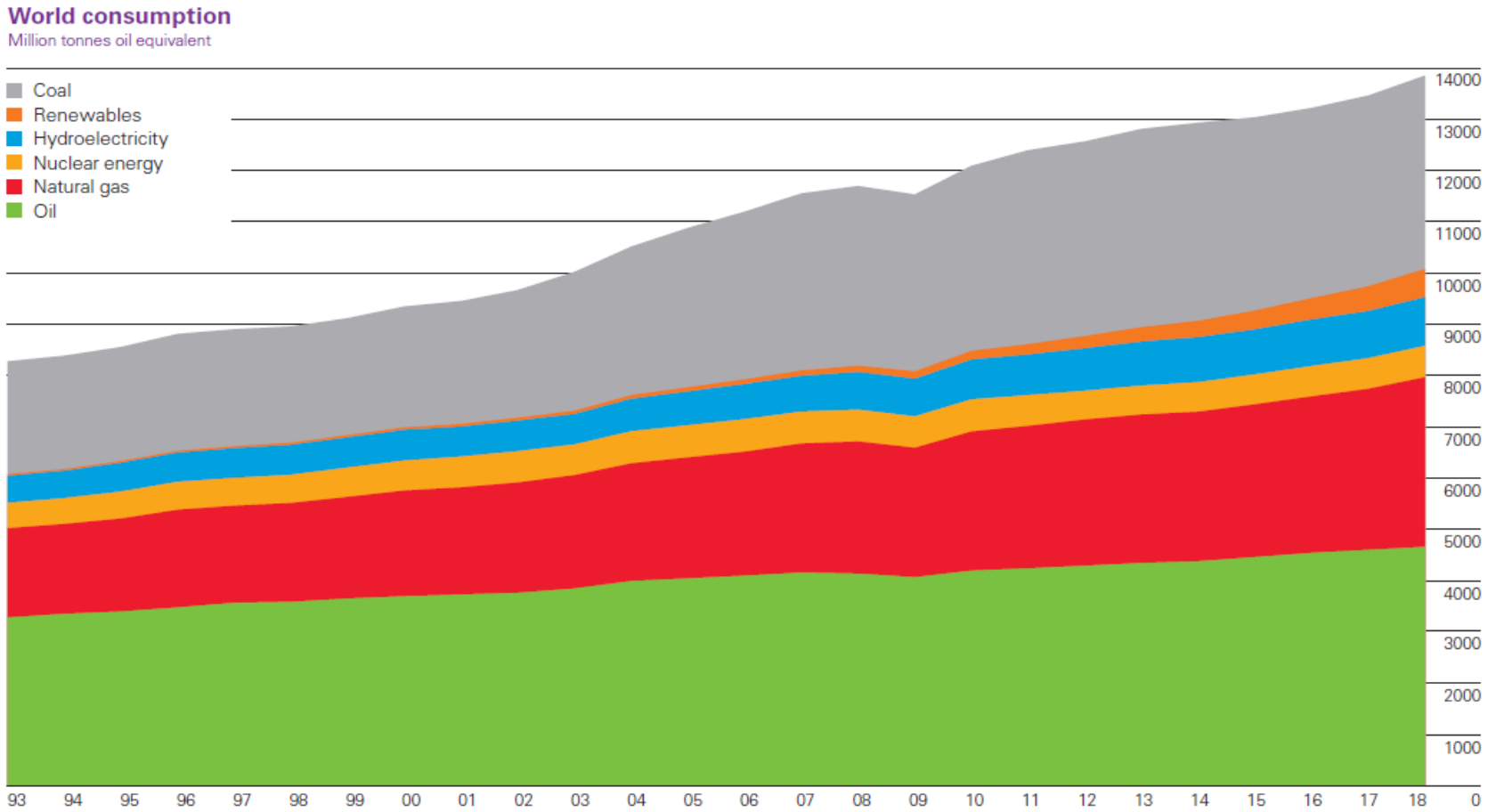
INSTITUTE OF ENERGY
FOR SOUTH EAST EUROPE

The Evolution of the Global Energy Mix (1990 and 2017)



Sources: Edmond de Rothschild Financial Group, IEA

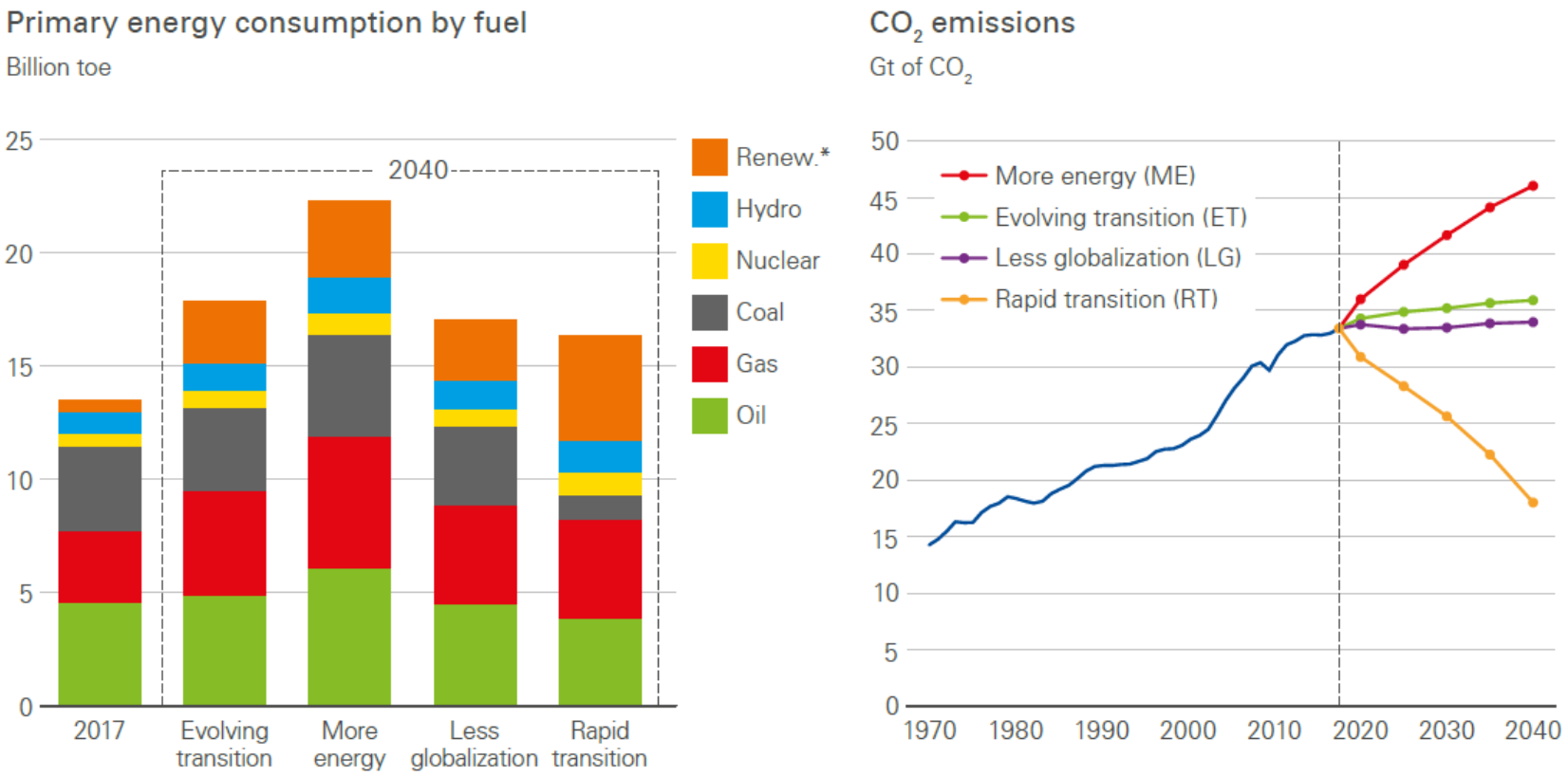
Global Energy Consumption (1993-2018)



Global energy consumption increased by 2.9% in 2018. Growth was the strongest since 2010 and almost double the 10-year average. The demand for all fuels increased but growth was particularly strong in the case of gas (168 mtoe, accounting for 43% of the global increase) and renewables (71 mtoe, 18% of the global increase). In the OECD, energy demand increased by 82 mtoe on the back of strong gas demand growth (70 mtoe). In the non-OECD, energy demand growth (308 mtoe) was more evenly distributed with gas (98 mtoe), coal (85 mtoe) and oil (47 mtoe) accounting for most of the growth.

Source: BP Statistical Review of World Energy 2019

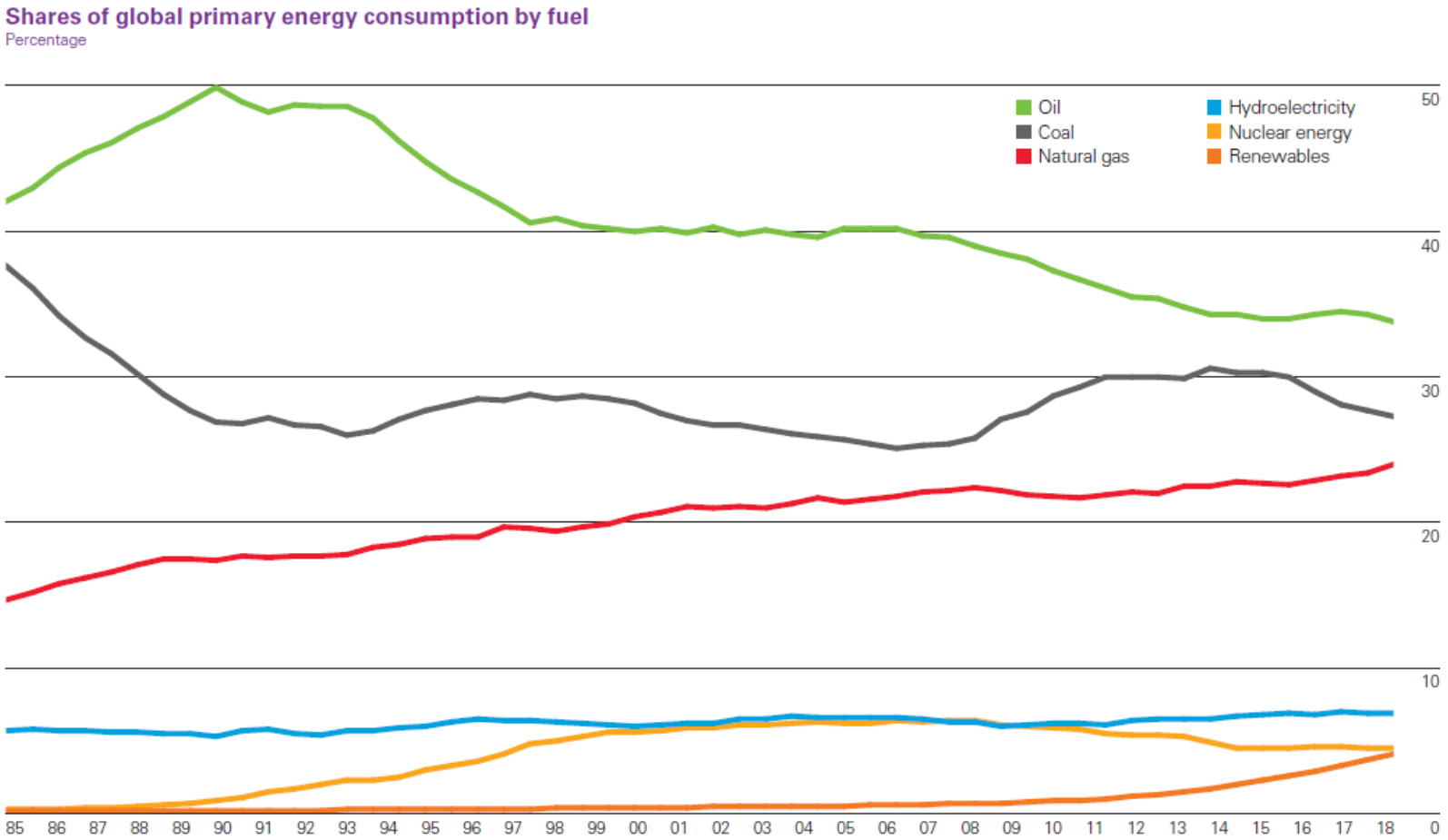
Primary Energy Consumption by Fuel and CO_2 Emissions



*Renewables includes wind, solar, geothermal, biomass, and biofuels. For full list of data definitions see p138

Source: BP Energy Outlook 2019

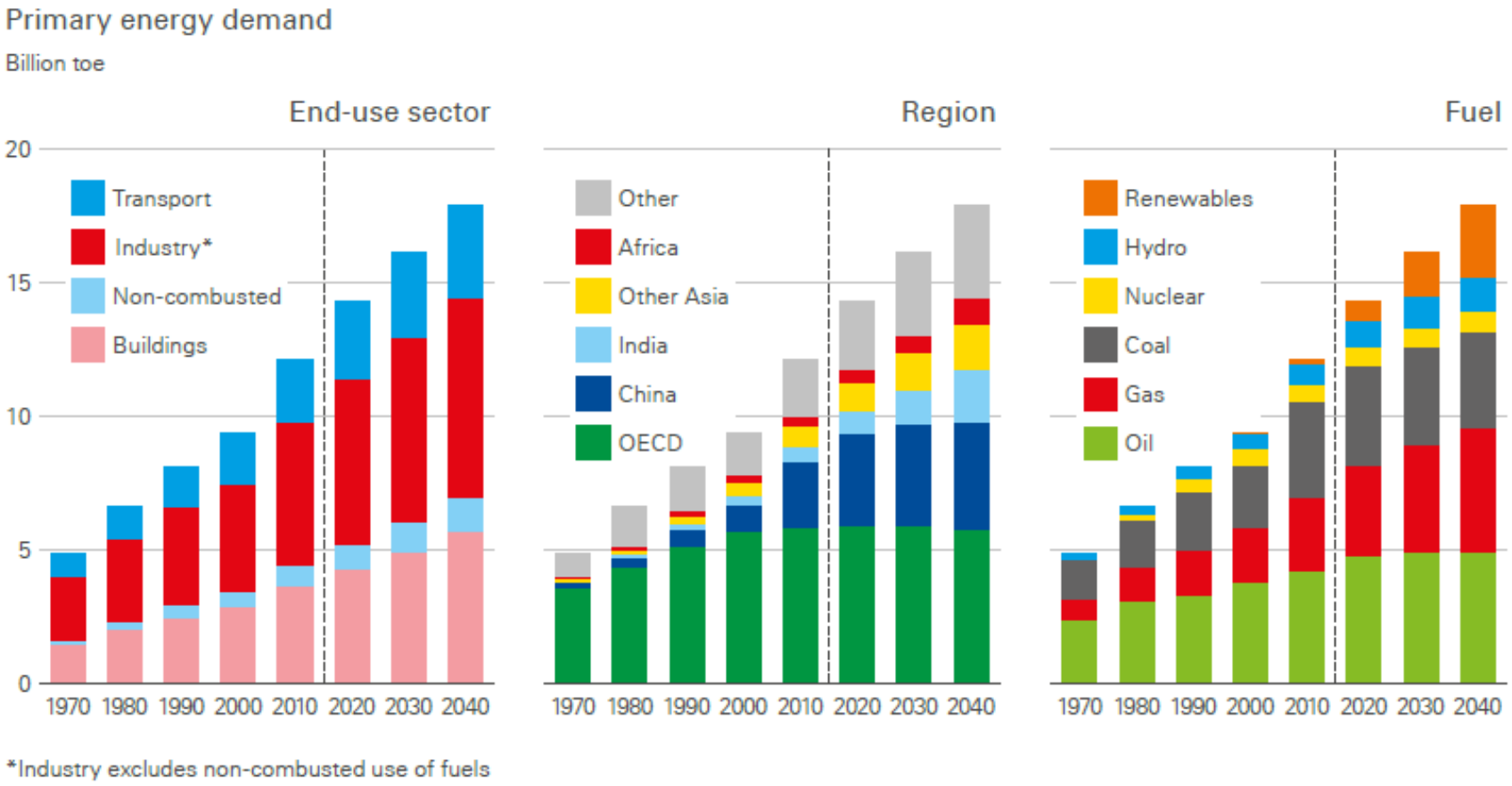
Shares (%) of Global Primary Energy Consumption by Fuel



Oil remains the most used fuel in the energy mix. Coal is the second largest fuel but lost share in 2018 to account for 27%, its lowest level in 15 years. The share of natural gas increased to 24% such that the gap between coal and gas has narrowed to three percentage points. The contribution of hydro and nuclear remained relatively flat in 2018 at 7% and 4%, respectively. Strong growth pushed up renewables share to 4%, just behind nuclear.

Source: BP Statistical Review of World Energy 2019

Primary Energy Demand (1970-2040)



Source: BP Energy Outlook 2019

World Primary Energy Demand by Fuel and Scenario (Mtoe)

			New Policies		Current Policies		Sustainable Development	
	2000	2017	2025	2040	2025	2040	2025	2040
Coal	2 308	3 750	3 768	3 809	3 998	4 769	3 045	1 597
Oil	3 665	4 435	4 754	4 894	4 902	5 570	4 334	3 156
Gas	2 071	3 107	3 539	4 436	3 616	4 804	3 454	3 433
Nuclear	675	688	805	971	803	951	861	1 293
Renewables	662	1 334	1 855	3 014	1 798	2 642	2 056	4 159
Hydro	225	353	415	531	413	514	431	601
Modern bioenergy	377	727	924	1 260	906	1 181	976	1 427
Other	60	254	516	1 223	479	948	648	2 132
Solid biomass	646	658	666	591	666	591	396	77
Total	**10 027**	**13 972**	**15 388**	**17 715**	**15 782**	**19 328**	**14 146**	**13 715**
Fossil fuel share	*80%*	*81%*	*78%*	*74%*	*79%*	*78%*	*77%*	*60%*
CO_2 emissions (Gt)	**23.1**	**32.6**	**33.9**	**35.9**	**35.5**	**42.5**	**29.5**	**17.6**

Notes: Mtoe = million tonnes of oil equivalent; Gt = gigatonnes. Solid biomass includes its traditional use in three-stone fires and in improved cookstoves.

Source: IEA World Energy Outlook 2018

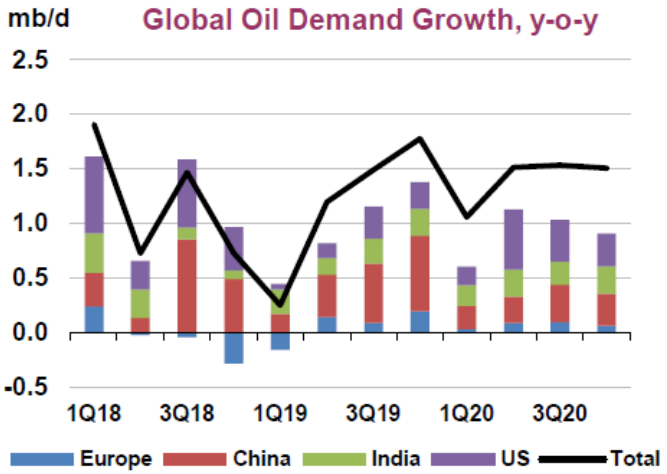
Global Oil Demand (2018-2020)

Global Oil Demand (2018-2020)

(million barrels per day)*

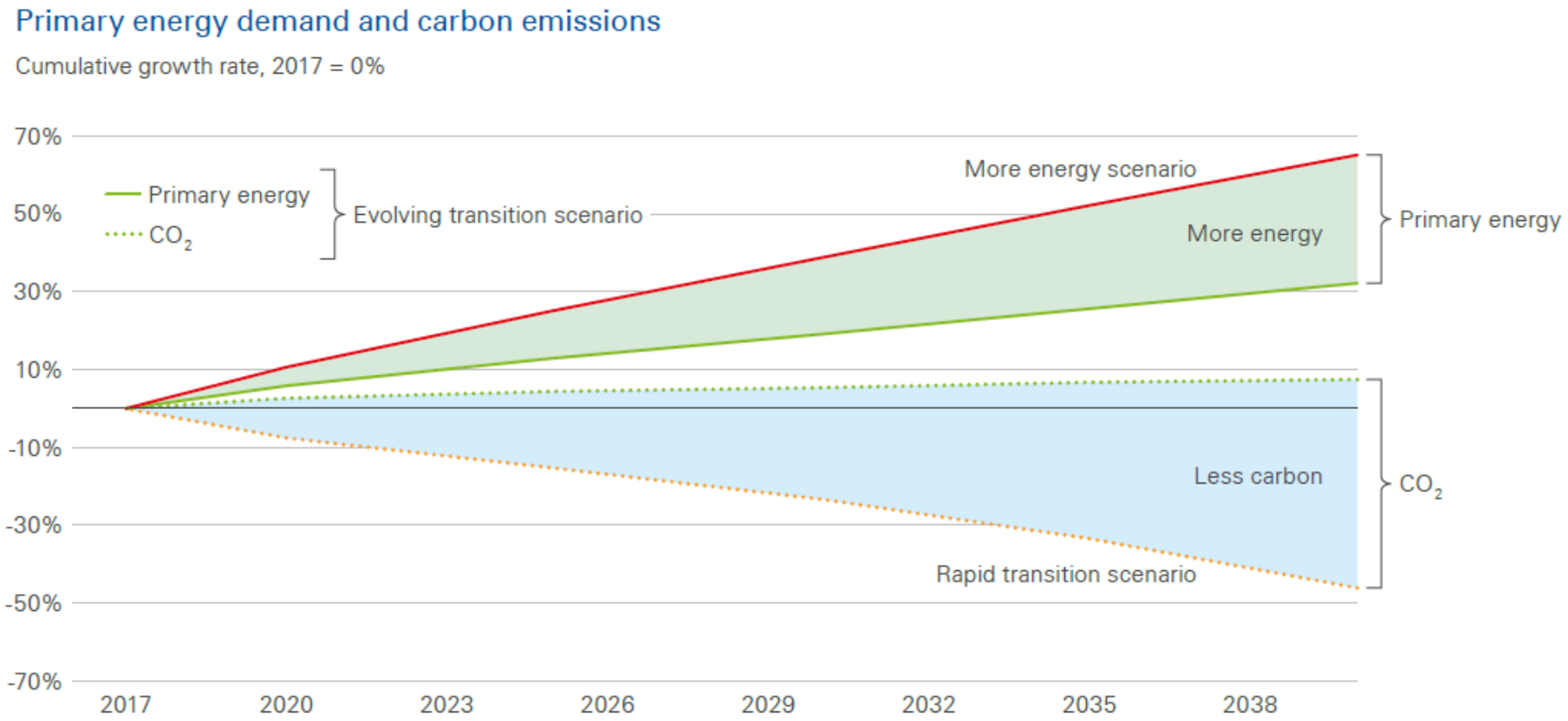
	1Q18	2Q18	3Q18	4Q18	2018	1Q19	2Q19	3Q19	4Q19	2019	1Q20	2Q20	3Q20	4Q20	2020
Africa	4.3	4.3	4.2	4.3	4.3	4.4	4.4	4.2	4.4	4.4	4.5	4.4	4.3	4.4	4.4
Americas	31.6	31.7	32.3	32.1	31.9	31.4	31.9	32.6	32.3	32.1	31.6	32.5	33.1	32.7	32.5
Asia/Pacific	35.0	34.7	34.3	35.1	34.8	35.4	35.2	35.2	36.1	35.4	36.0	35.9	35.9	37.0	36.2
Europe	14.8	15.0	15.5	14.9	15.1	14.7	15.2	15.6	15.1	15.2	14.7	15.3	15.7	15.2	15.2
FSU	4.5	4.6	4.9	4.8	4.7	4.7	4.8	5.0	5.0	4.9	4.8	4.8	5.1	5.0	4.9
Middle East	8.2	8.5	8.8	8.2	8.4	8.2	8.6	8.9	8.3	8.5	8.2	8.6	8.9	8.3	8.5
World	**98.5**	**98.8**	**99.9**	**99.4**	**99.2**	**98.7**	**100.0**	**101.4**	**101.2**	**100.3**	**99.8**	**101.6**	**102.9**	**102.7**	**101.7**
Annual Chg (%)	2.0	0.7	1.5	0.7	1.2	0.3	1.2	1.5	1.8	1.2	1.1	1.5	1.5	1.5	1.4
Annual Chg (mb/d)	1.9	0.7	1.5	0.7	1.2	0.2	1.2	1.5	1.8	1.2	1.1	1.5	1.5	1.5	1.4
Changes from last OMR (mb/d)	0.0	0.0	0.0	0.0	0.0	-0.4	-0.3	0.2	0.1	-0.1					

* Including biofuels



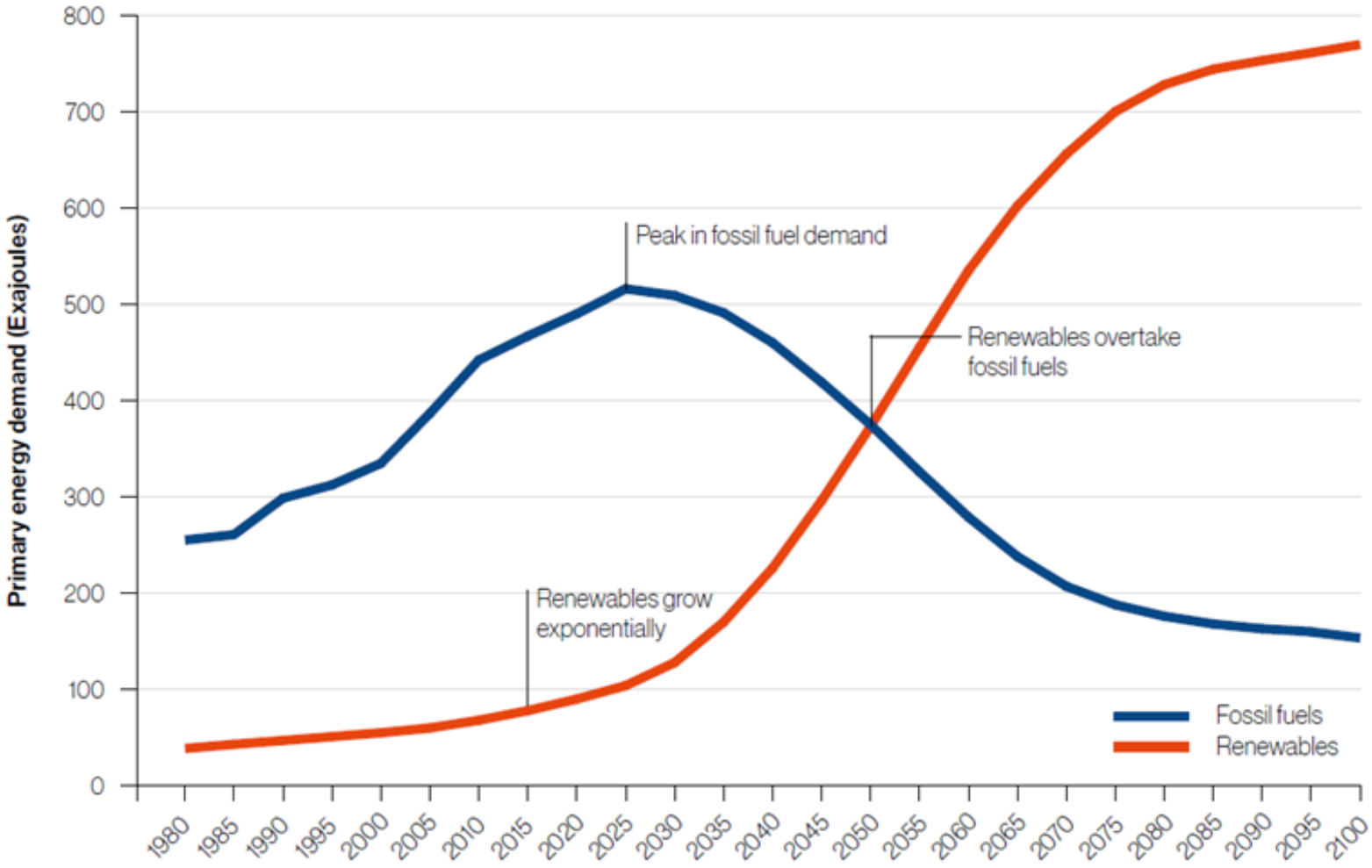
Source: IEA Oil Market Report, June 14, 2019

Primary Energy Demand and Carbon Emissions



Source: BP Energy Outlook 2019

The Global Energy Transition Framework



Source: Shell Sky Scenario

What Kind of Energy Transition?

- **The real challenge we face in the energy transition process is not our ability to switch to cleaner fuels but that of time**.
- We are now moving **from an energy system of scarcity to one of potential abundance** for almost every country around the world. This is because almost every country will have some degree of energy independence in the new energy system we are moving to since almost every country will be able to harness renewable energy. **This shift is a fundamental change for the world and it's going to have a profound impact on the global economy.**
- **Concerns have been expressed by several environmental organisations that action on addressing climate change lags behind** because, despite the pledges made by countries, planned policies still fall short of reaching the Paris Agreement's goals.
- This state of play is confirmed by the World Economic Forum's Fostering Effective Energy Transition 2019 report. **What stands out in 2019 is that the year-on-year increase of the global average score was the lowest of the last five years**. Moreover, considering the score evolution over the period 2014-2019, the dimension of "environmental sustainability" shows almost no enhancement. **In short, the pace of energy transition is globally much too slow.**
- Recently, we have witnessed an **unprecedented wave of attacks by certain funds on both sides of the Atlantic against the senior management of large oil corporations** including ExxonMobil, BP and Shell in an effort to force upon them radical change of policies, just short of demanding their total capitulation and abandonment of their core business; which is the production and trade of oil and gas. However, such confrontational approach is clearly short sighted.
- Rather than try to engage in a constructive dialogue with big oil, their critics and pro Climate Change activists are forgetting that **these global companies hold the keys to Energy Transition**. The mere size of their operation, the sophistication of their technological infrastructure and their extensive expertise in managing oil and gas are key elements of the know how that needs to be developed in the Energy Transition phase that we have now embarked.

The Future of Oil Companies and Stranded Assets

Investors and markets are at risk from $2.2 trillion of stranded fossil fuel assets

Carbon Tracker Initiative

Follow us @carbonbubble #strandedassets

Coal is the most carbon intensive fossil fuel. No new coal mines will be needed and nearly **$220bln** of projects are at risk.

Oil demand will peak around 2020 and more than **$1.4 trillion** of projects are at risk.

Growth in **gas** will disappoint industry expectations, especially in expensive LNG. Planned spending of more than **$520bln** is at risk.

Which are the companies with most financial exposure?

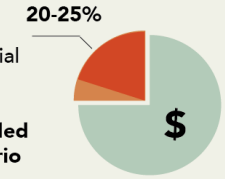
We identified the **20 companies** with most capex in the danger zone.

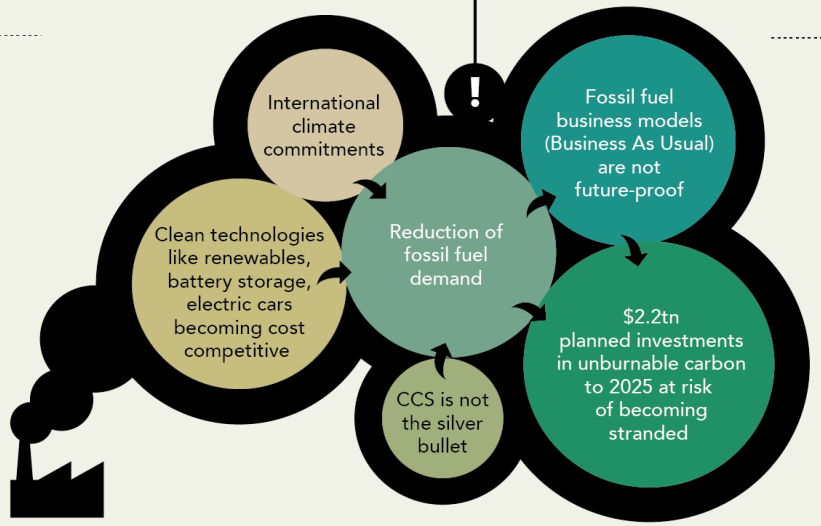
Top 3:

Shell
Exxon
Pemex

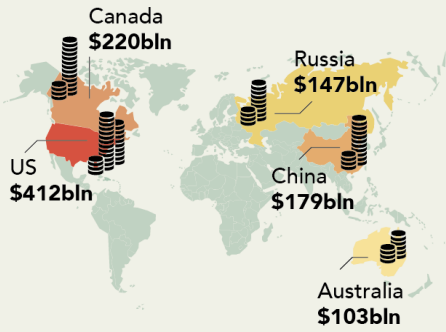
should each avoid potential investment of over **$70bln**

Oil and gas majors' potential investment on projects that **won't be needed in a 2°C scenario**





Which are the countries with most financial exposure?



Do the 2°C stress-test

Institutional Investors
Derisk portfolio by identifying companies aligned with a 2°C demand scenario or engaging with those that are not

Companies
Provide information on the decisions taken to align corporate strategy with a 2°C demand scenario

Governments
Stress test national resources, infrastructure and energy plans against a 2°C demand scenario

Analysts & Advisors
Provide sensitivity analysis of which stocks are more resilient to a 2°C demand scenario

Source: "The $2 trillion stranded assets danger zone: How fossil fuel firms risk destroying investor returns", Carbon Tracker 2015

The report can be downloaded at http://www.carbontracker.org/report/stranded-assets-danger-zone/

The SE Europe Area Defined

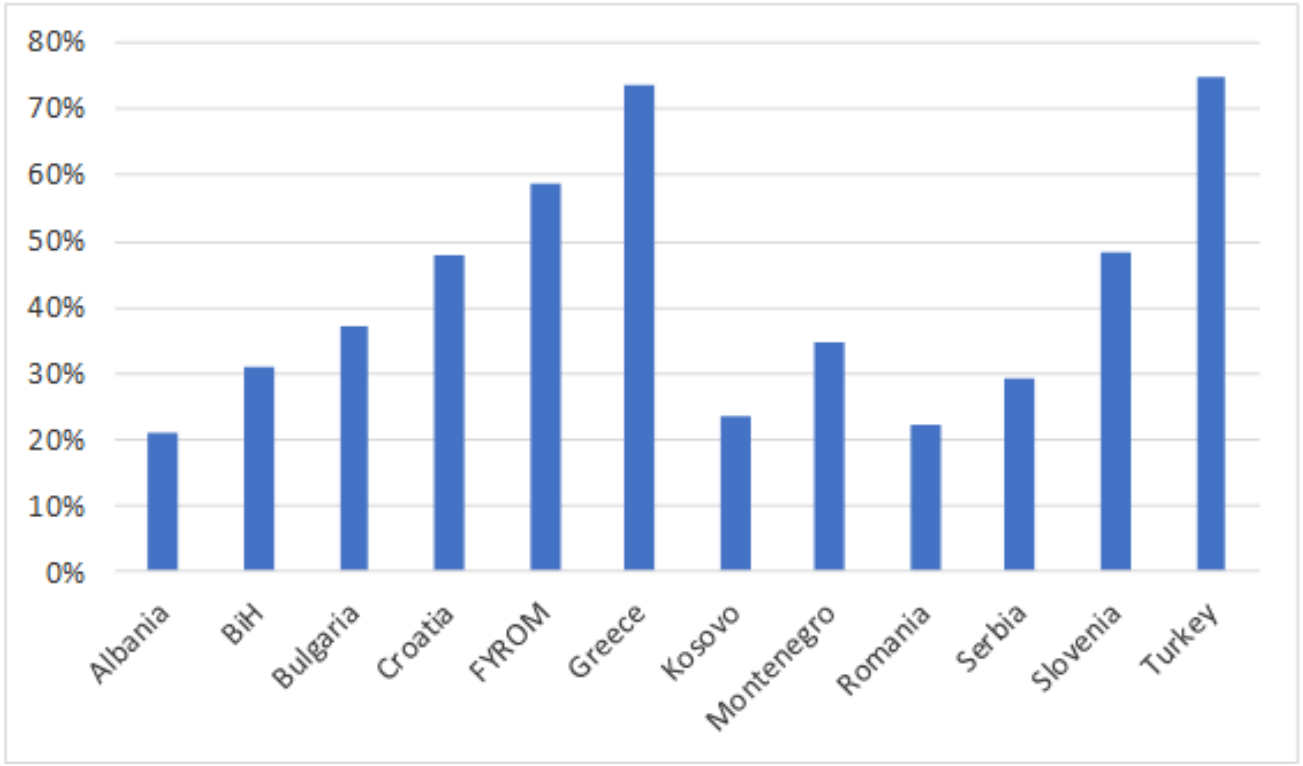
Source: IENE

Key Regional Energy Issues

- Marked divergence between EU and SEE energy strategies
- SEE is more energy security vulnerable than the rest of Europe
- Energy supply diversification in SE Europe is less important than security of energy transportation and transmission (oil, gas and electricity)
- SEE's high hydrocarbon dependence
- Electricity's newcomer gas alters supply balance
- Lack of adequate electricity and gas interconnections
- Coal is and will continue for sometime to be relevant
- SEE's path towards decarbonisation is difficult and uncertain
- Nuclear remains a viable option for SEE power generation
- RES growth impeded due to policy failures, financial and regulatory framework and electricity grid constraints
- Energy poverty is emerging as a regional concern mainly related to deteriorating social conditions

Key Regional Energy Issues – Energy Import Dependency

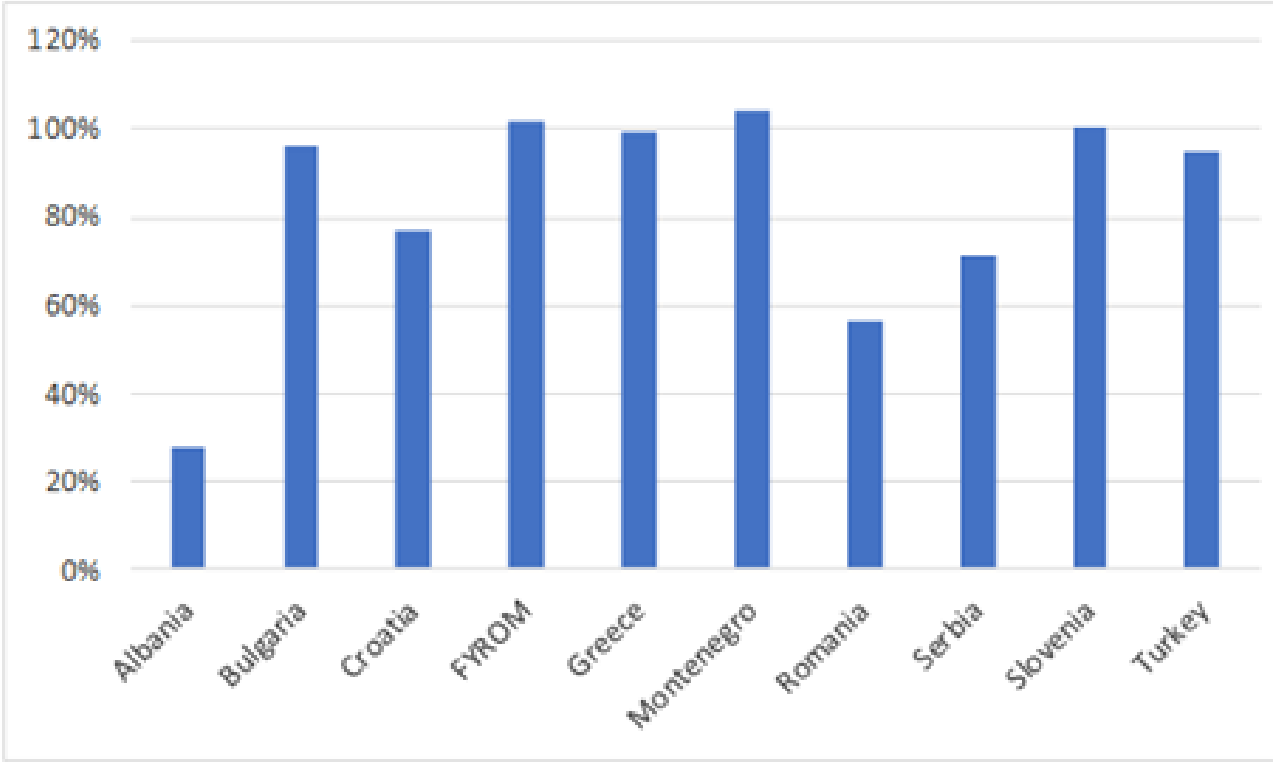
Energy Import Dependency (%) in SE Europe (2016)



Sources: Eurostat, IENE

Key Regional Energy Issues – Oil Import Dependency

Oil Import Dependency (%) in SE Europe (2016)

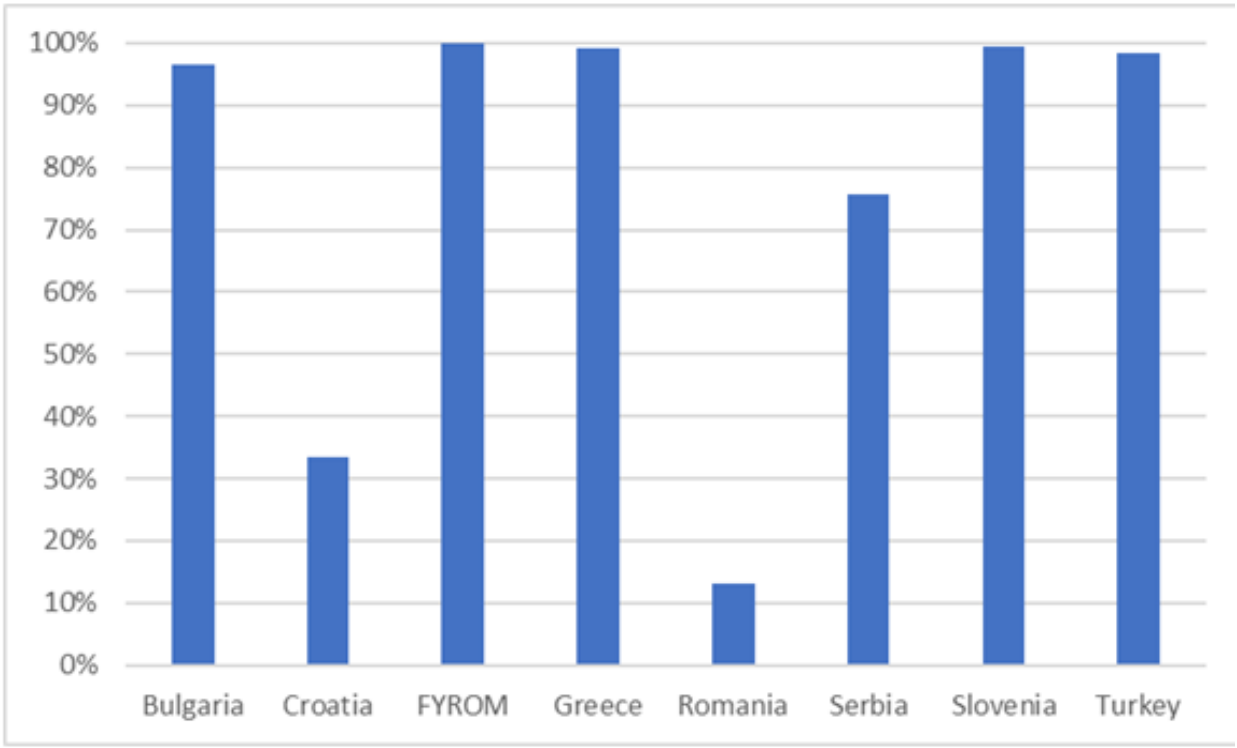


Note: A dependency rate in excess of 100% relates to the build-up of stocks. Eurostat provides no data for Bosnia and Herzegovina and Kosovo.

Sources: Eurostat, IENE

Key Regional Energy Issues – Gas Import Dependency

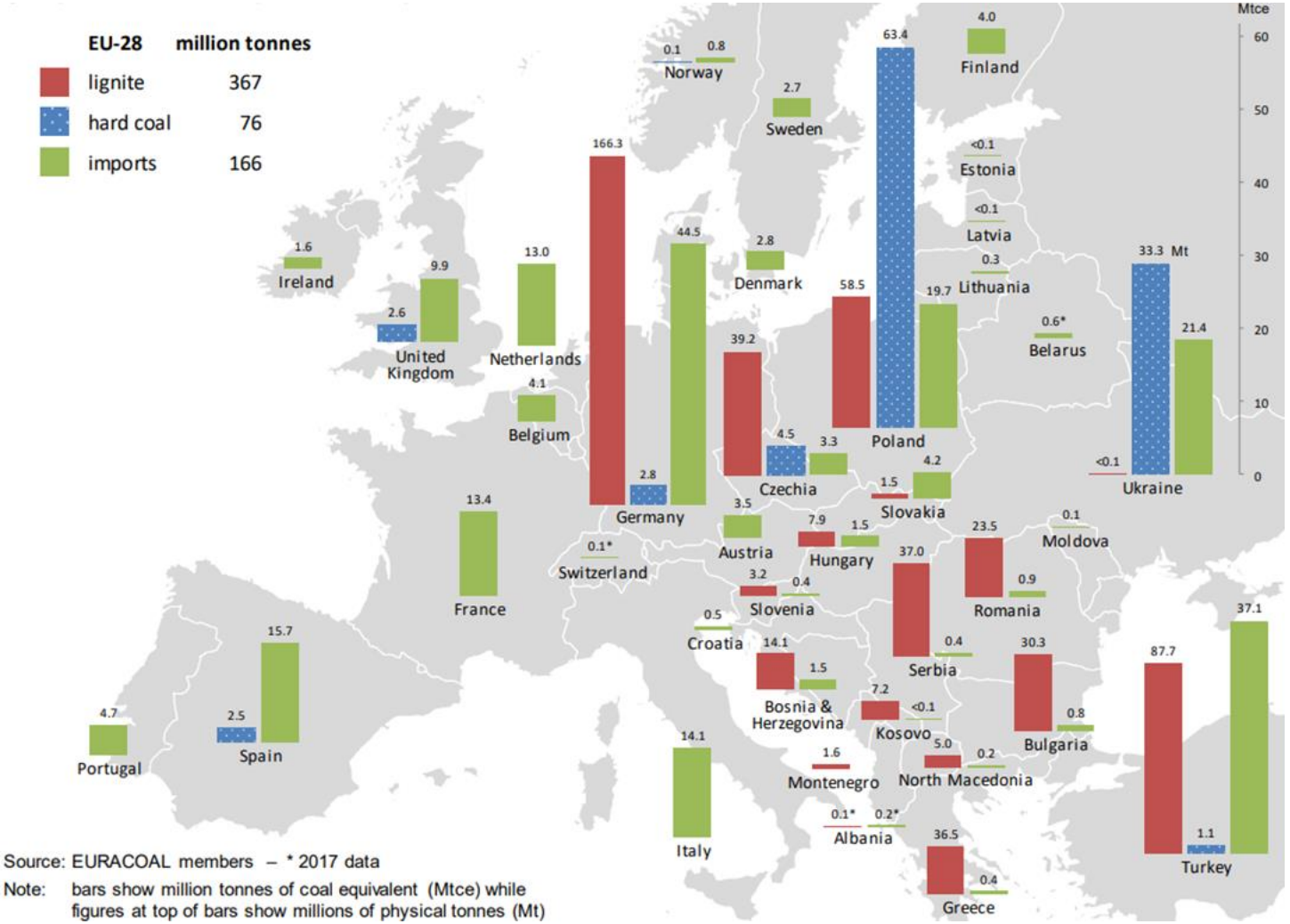
Gas Import Dependency (%) in SE Europe (2016)



Note: Albania, Cyprus, Montenegro and Kosovo do not import natural gas.

Sources: Eurostat, IENE

Production and Imports of Lignite and Hard Coal in Europe (2017)

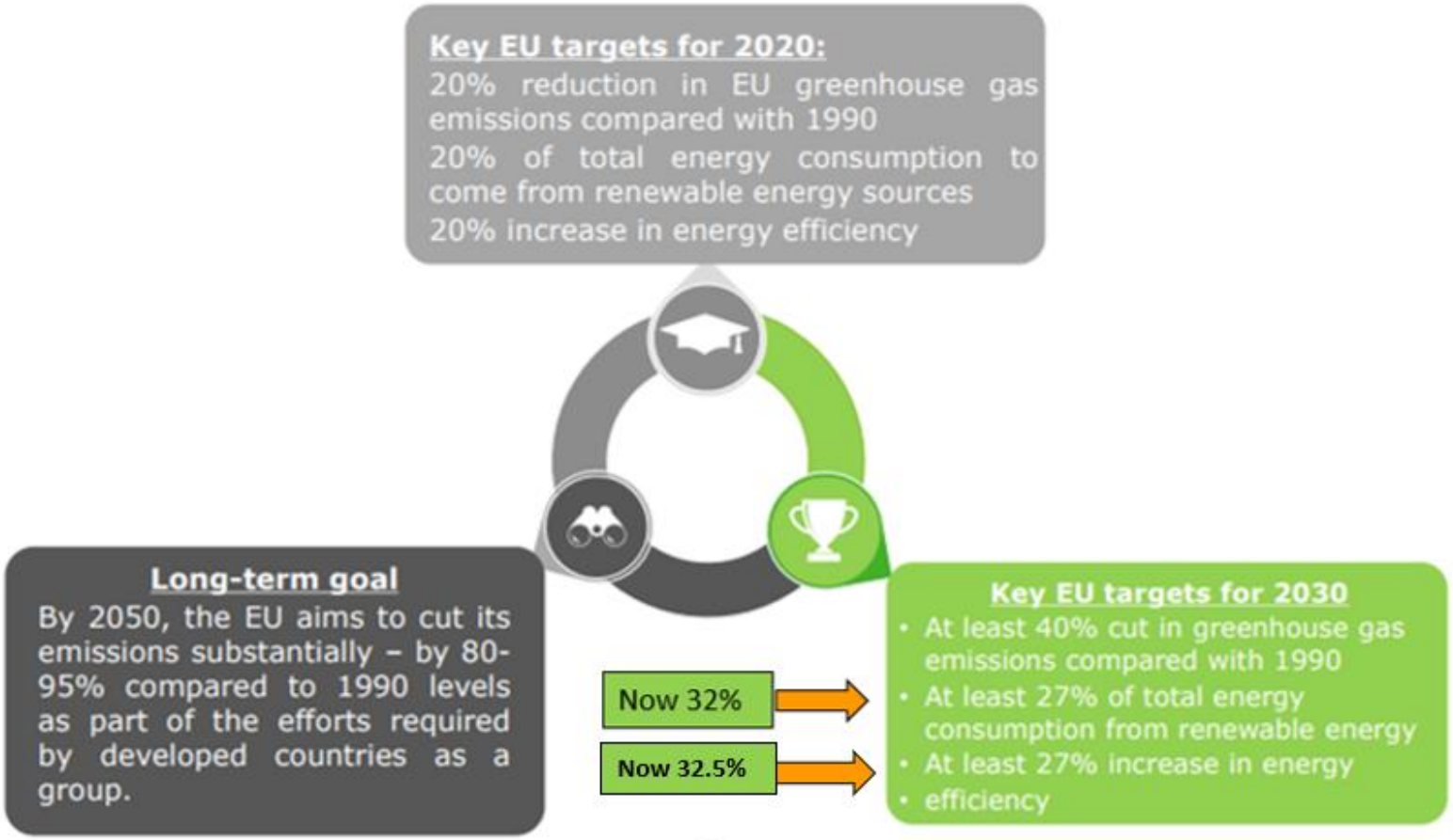


Source: EURACOAL

Price of CO_2 European Emission Allowances (€ per tonne)

Source: Business Insider

EU Energy Policy Framework (2020, 2030 and 2050)



Source: European Commission

EU Energy Policy Framework: How Does This Stand for SE Europe?

- It seems that an **inverted pyramid arrangement** has been developed in SE Europe, compared to pursued official Energy Union policies and stated targets as economic development at all costs remains number one priority for most countries.

- The energy policy priorities in broad terms for SEE would appear as follows:
  - Further large scale development of **coal and lignite resources** without any real recourse CCS/CSU provisions and plans
  - Further development of **electricity and gas interconnections in order to maximise cross border trade**
  - Promotion of **oil and gas exploration activities (onshore and offshore)** aiming towards maximizing production in the mid- and long-term
  - Further development of **renewables** in all application areas (i.e. solar, wind, biomass, hydro and geothermal) without necessarily aiming to adhere to specific targets (set by the EU)
  - Promotion of **energy efficiency**, focusing primarily on the building sector, incentivized by EU and green fund financing facilities
  - **Diversification** of supply routes and suppliers in order to secure future gas supplies
  - Reduction of CO_2 emission levels (least of priorities)

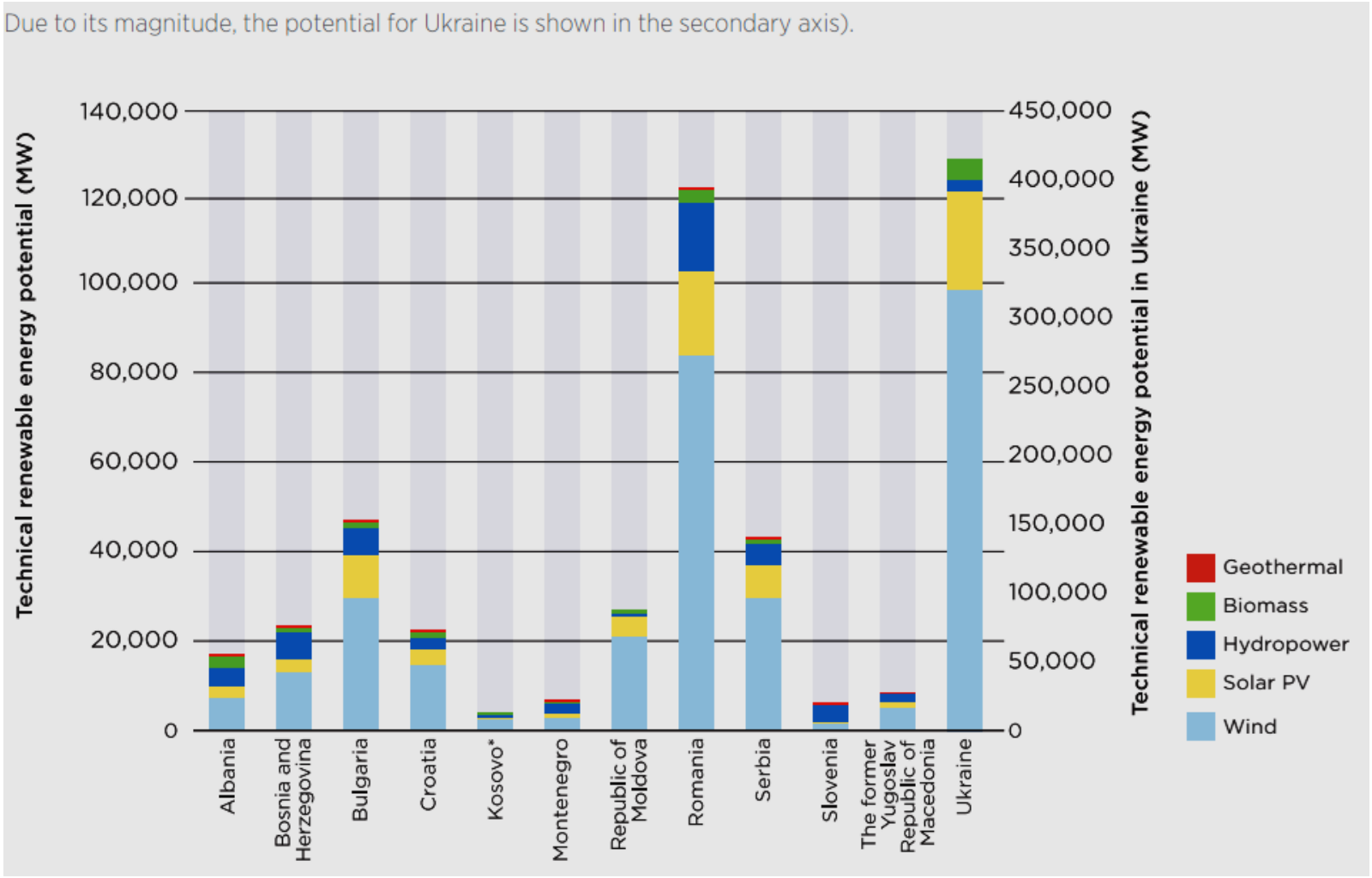
Under Construction and Planned Coal Plants in SEE Countries (MW)*, as of January 2019

Country	Announced New Plants	Pre-permit	Permitted	Announced + Pre-permit + Permitted	Under Construction	Shelved	Operating	Cancelled (2010-2018)
Turkey	12,8	17,311	6,555	36,666	800	24,554	18,826	41,031
Bosnia & Herzegovina	2,38	0	1,7	4,08	0	0	2,073	1,02
Serbia	1	0	350	1,35	0	0	4,405	1,82
Romania	0	600	0	600	0	0	5,305	5,105
Kosovo	0	450	0	450	0	0	1,29	330
Greece	0	450	0	450	660	0	4,375	800
North Macedonia	300	129	0	429	0	0	800	300
Montenegro	0	0	0	0	0	0	225	1,41
Bulgaria	0	0	0	0	0	0	4,889	2,66
Slovenia	0	0	0	0	0	0	1,069	0
Croatia	0	0	0	0	0	0	210	1,3
Albania	0	0	0	0	0	0	0	800

***Note:** Includes units 30 MW and larger

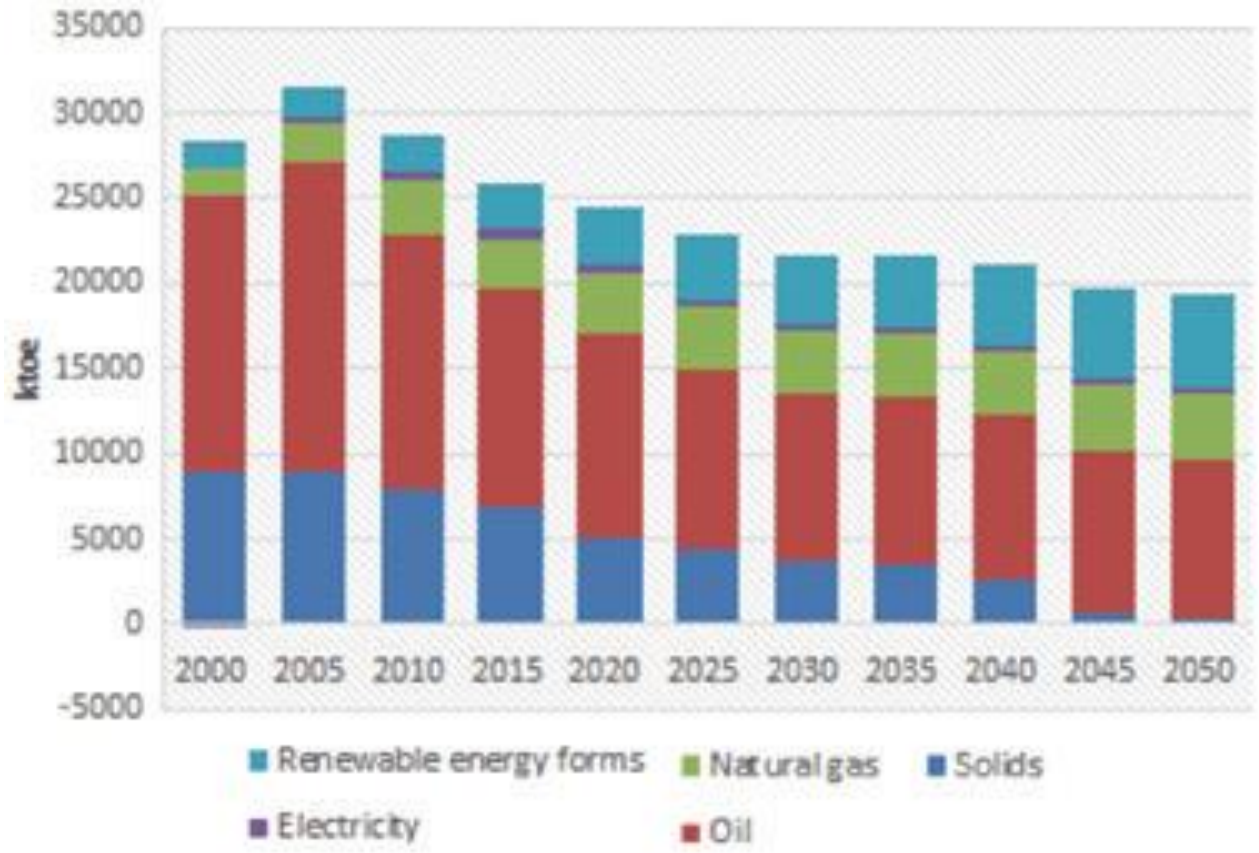
Sources: EndCoal, IENE

Technical RES Potential in SE Europe



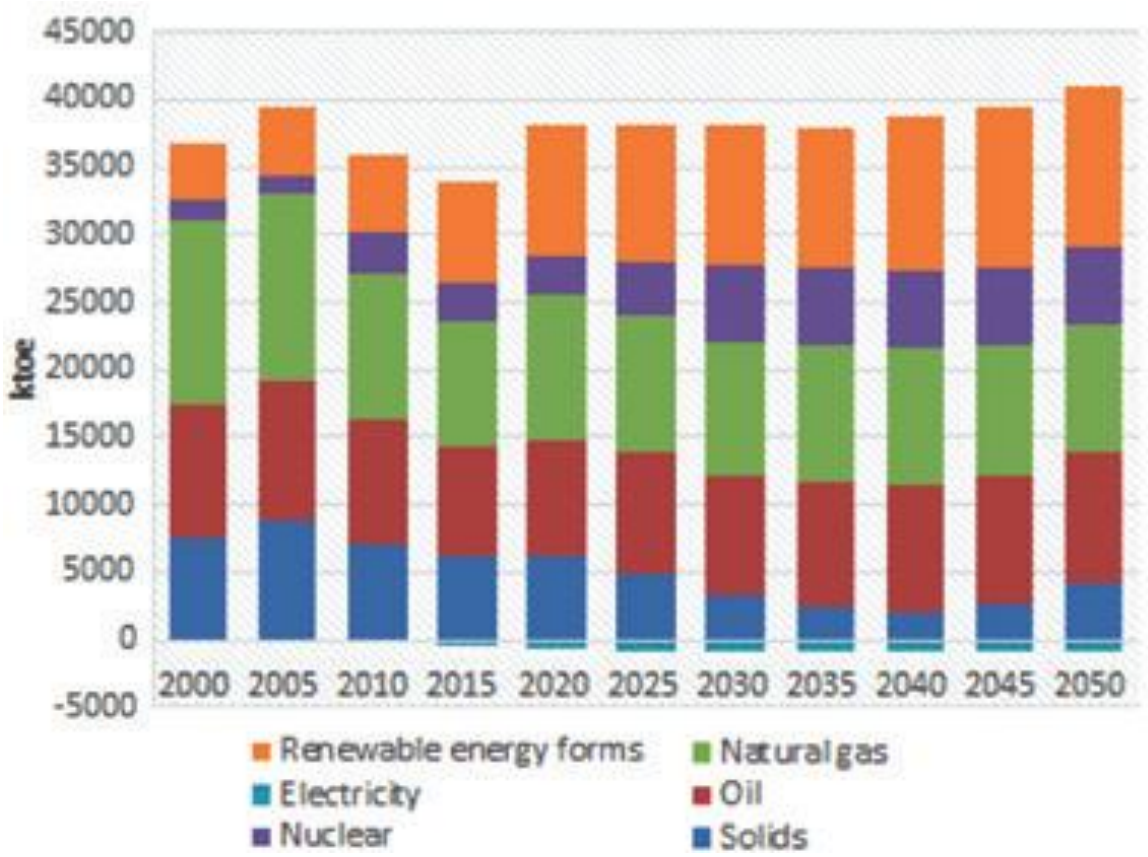
Source: IRENA

Gross Inland Consumption in Greece (2000-2050)



Source: IENE "SE Europe Energy Outlook 2016/2017", Athens, Greece

Gross Inland Consumption in Romania (2000-2050)



Source: IENE "SE Europe Energy Outlook 2016/2017", Athens, Greece

Energy Security in SE Europe (I)

- **Energy security is a complex issue** and as such cannot be considered in isolation.
  - SE Europe because of its geography, its proximity to high risk conflict zones (i.e. Syria, Iraq, Ukraine), a growing and uncontrolled refugee flow from the Middle East and North Africa and the location of some of its countries (i.e. Turkey, Greece, Romania) at vital energy supply entry points, faces **higher energy security threats** than the rest of Europe.
- There is a need to strengthen available mechanisms
  - The **strengthening of Emergency and Solidarity Mechanisms** and the **maintenance of adequate oil, coal and gas stocks**, constitute a short- to medium-term relief solution.
  - The achievement of a **balanced energy mix** provides the best long-term option in enhancing energy security both at country and regional level.
- Security of **supply/demand** and **differentiation of supply sources**
  - In the case of gas, it is becoming more important and pressing compared to other fuel sources, such as electricity, oil, coal and possibly uranium.
  - Gas is a primary area of concern largely because of its rather inflexible transmission method, mainly by means of pipelines.

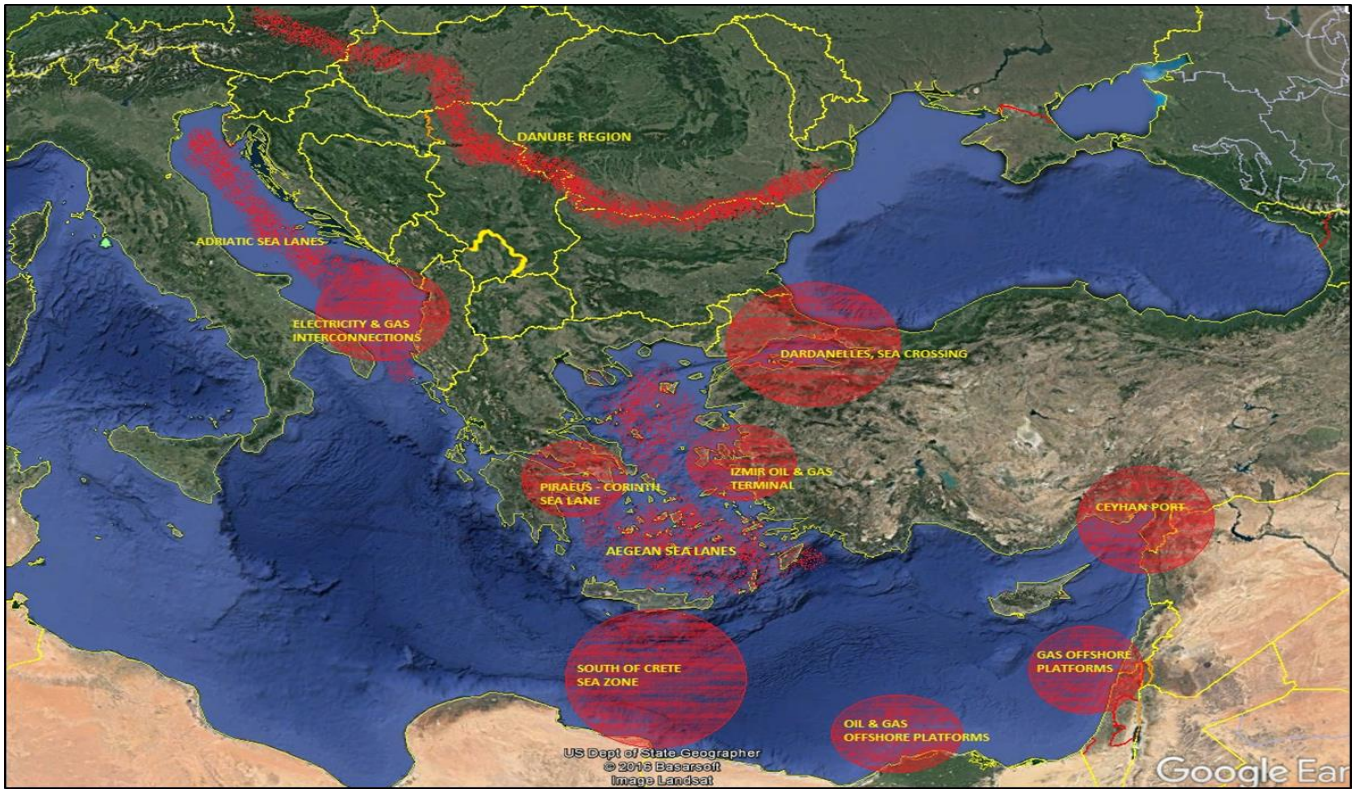
Energy Security in SE Europe (II)

- Security of **transportation**, shipment of **oil and gas**
  - Gas deliveries were twice disrupted (i.e. 2006 and 2009) with the shipment of Russian gas, through Ukraine, to Europe but also from Turkey and Greece (i.e. 2011 and 2016).

- **Smooth supply of electricity** and urgent need to connect various island groups to the mainland grid
  - Mitigation of possible power supply failures and shortfalls and minimization of environmental impact through the retirement of fuel oil or diesel-powered electricity generators on several islands.

Energy Security in SE Europe (III)

- **Effective protection of energy infrastructure**
  - Mitigation of terrorist threats and advanced level of safety against of physical hazards (e.g. hurricanes, floods, earthquakes) and cyber threats.
- The various vulnerable key energy infrastructure locations in SE Europe constitute **potential energy security hot spots** and as such should be properly identified (***see following Map***), while also crisis management plans must be prepared in order to meet any emergencies (e.g. physical hazards, large scale industrial accidents or terrorist actions).



RES and their Role in SEE Energy Security

- The development of renewables is an effective way to enhance energy security in electricity generation, heat/cool supply, and transport.

- Renewables reduce risks associated with dependency on imported fossil fuels and their scarcity. Being largely domestically produced, they can help to shelter countries from energy supply shortages and price shocks, as well as to reduce their energy trade deficit.

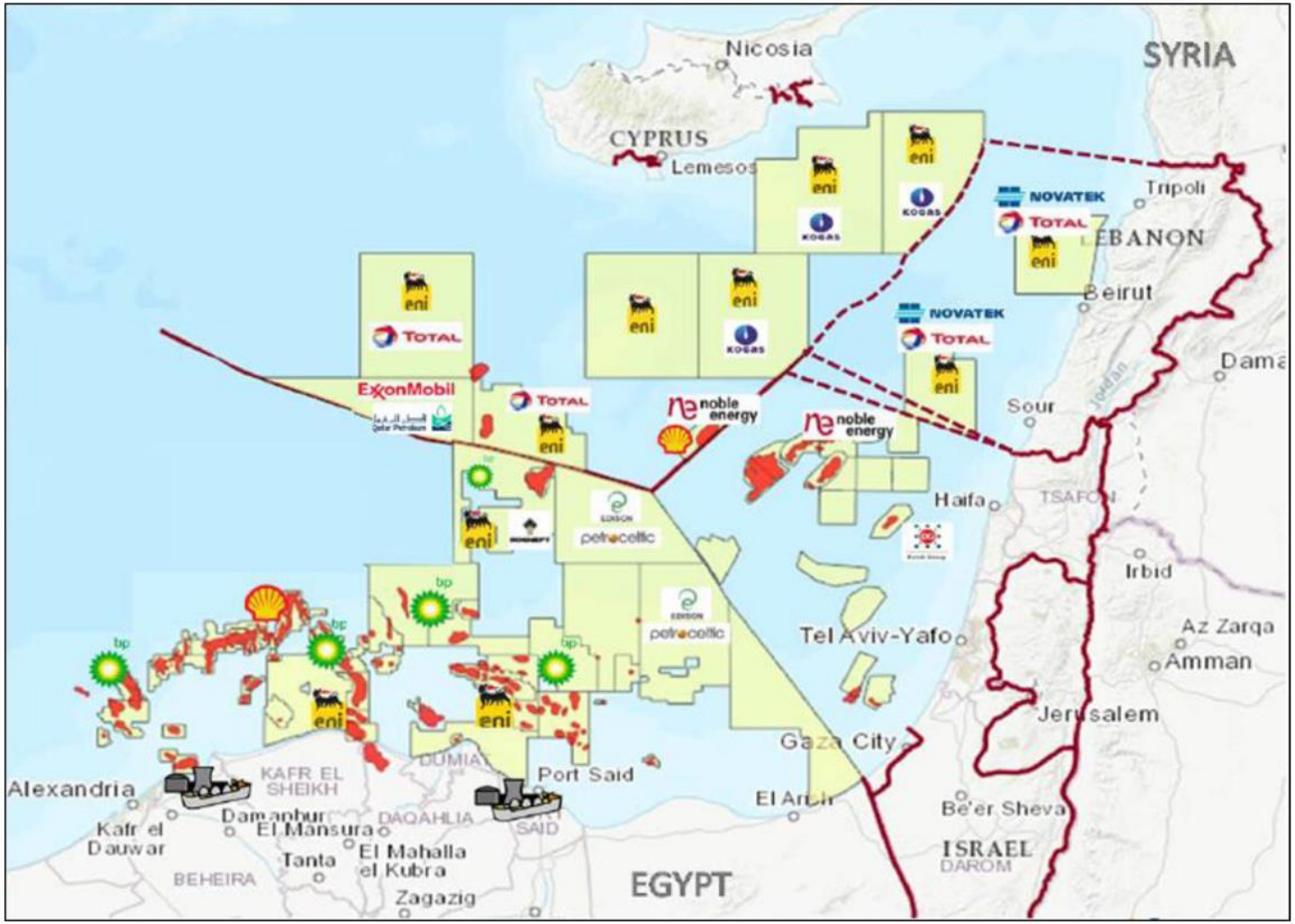
- They reduce geopolitical security risks by contributing to fuel mix diversification; their risks are completely different from those fossil fuel supply risks.

- In transport, biofuels represent a key source of diversification from petroleum products. As current biofuels' environmental impact and CO_2 savings benefits are doubtful if the impact of indirect land use change (ILUC) is taken into account, greater efforts are required to develop second generation biofuel technologies.

Oil and Gas Exploration in the East Mediterranean

- Substantial gas deposits have been discovered in the region over the last 10 or so years.
- Egypt, Israel and Cyprus have become the focus of attention by major oil and gas groups.
- Today, total gas deposits amount to about 3.0 tcf, substantially higher than the total amounts discovered in the Caspian Sea.
- Turkey, which has been left out of the gas bonanza, is keen to secure promising hydrocarbon concession areas.
- Hence, Turkey is actively disputing the sea boundaries of the Republic of Cyprus and Greece in its pursuit for gas resources and imposition of its sovereignty.
- Cyprus and Greece are not willing to accept Turkey's arbitrary sea border delineation which inevitably leads to conflict.
- All countries of the region support that solutions must be sought through the provisions of the International Law of the Sea (which Turkey does not recognize).

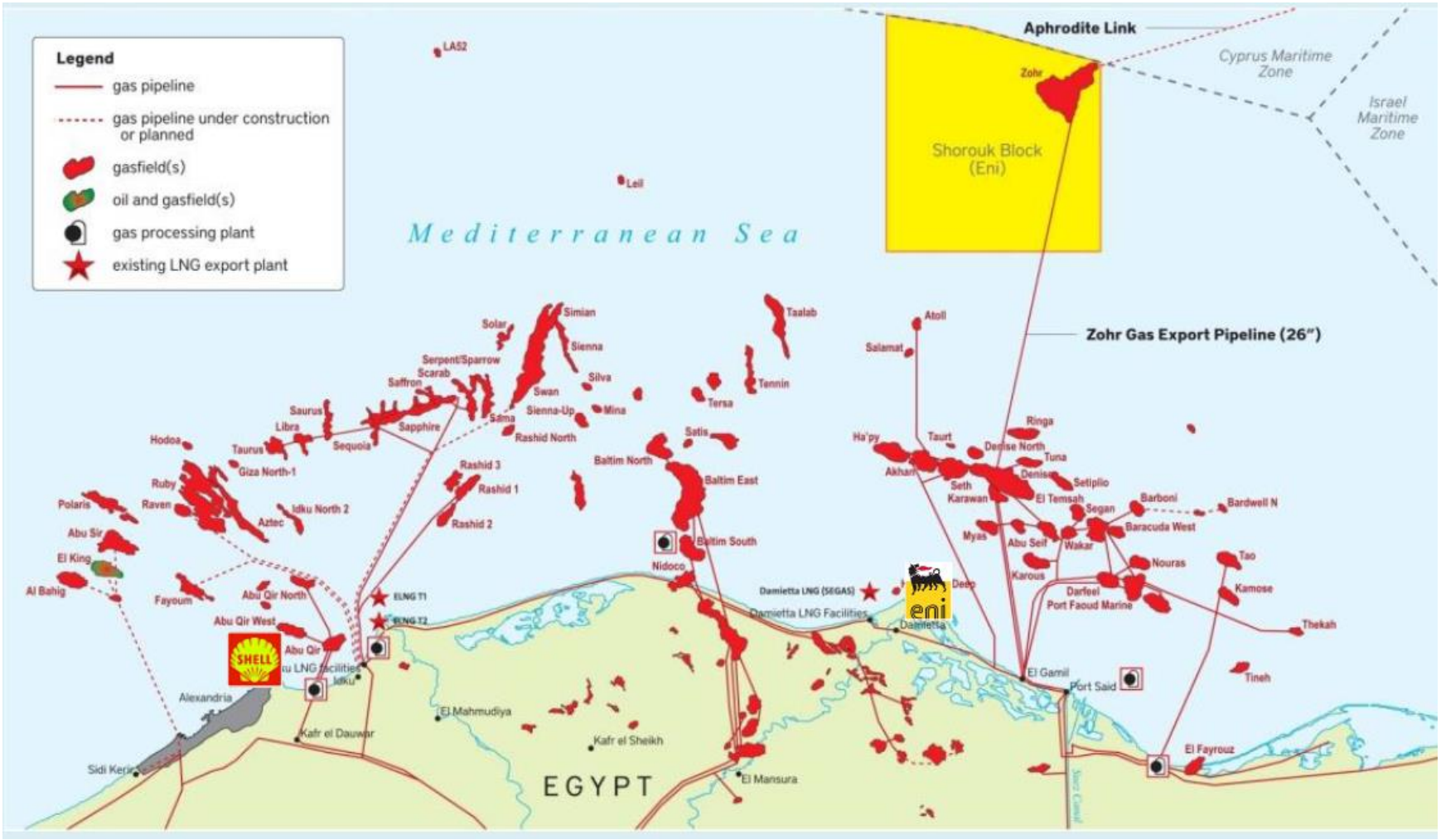
The East Mediterranean Exploration Blocks



Source: Charles Ellinas

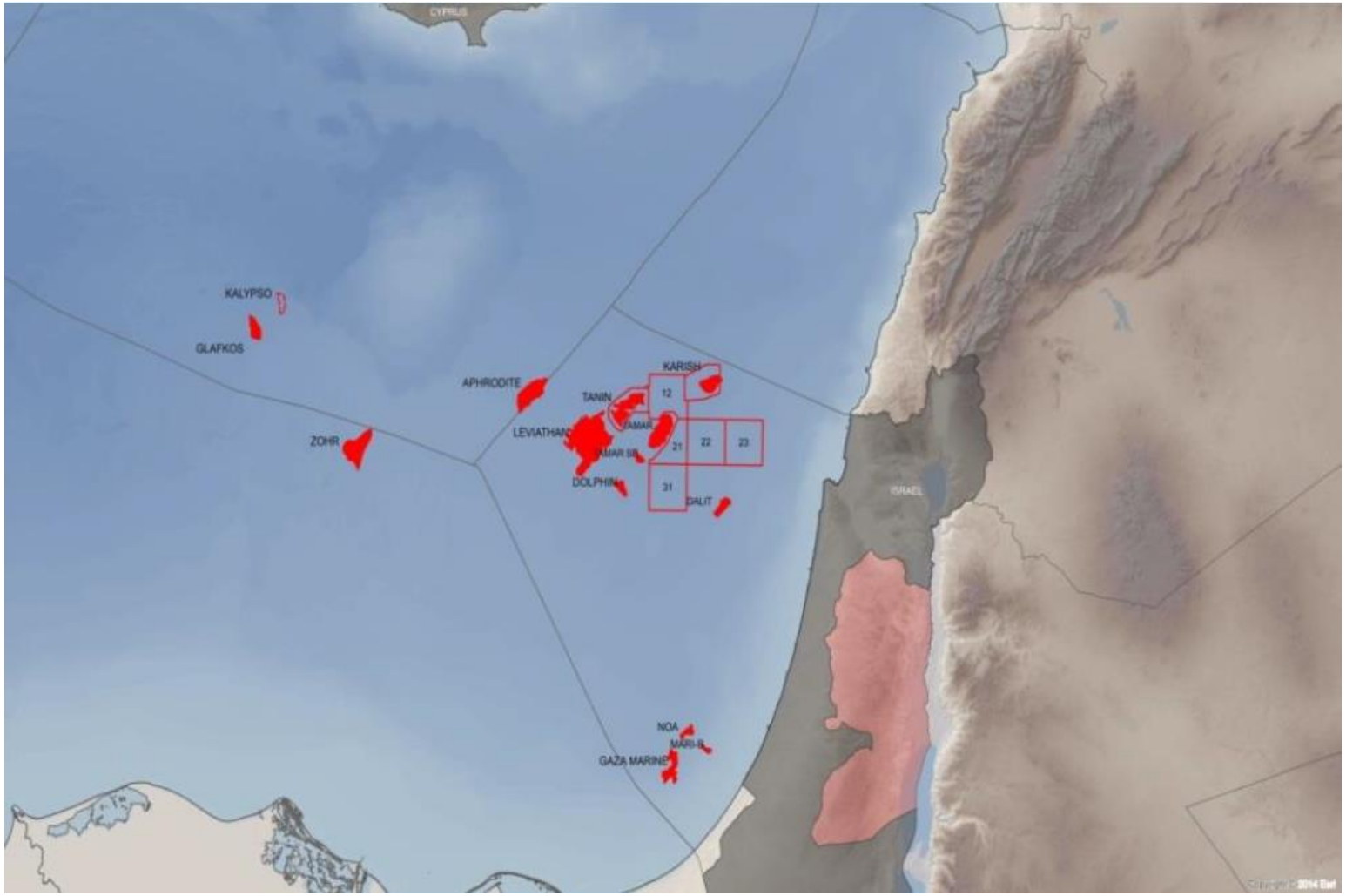
Gas Discoveries in the East Mediterranean

Gas Discoveries in Egypt



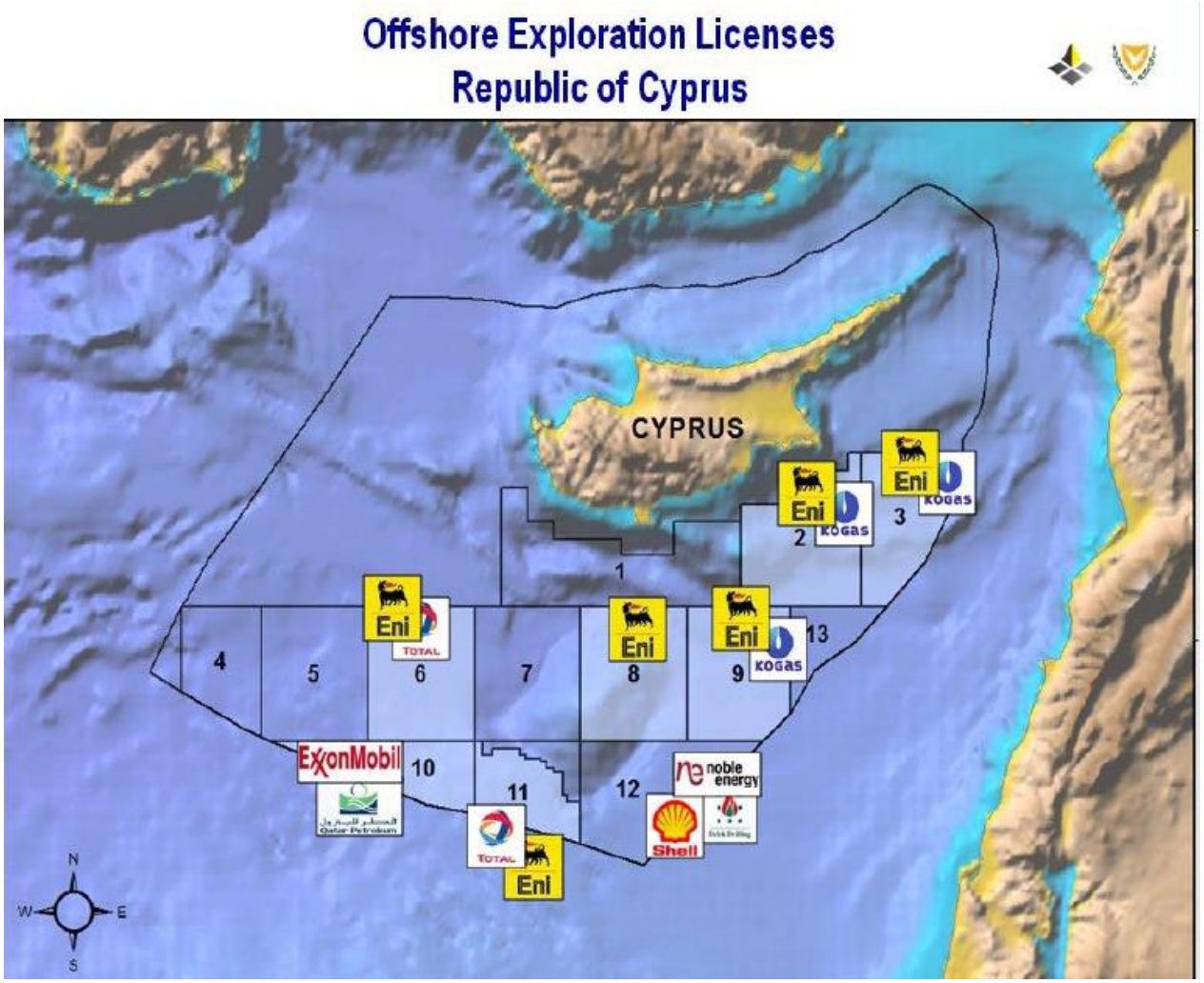
Source: Egypt's Energy Ministry

Gas Discoveries in Cyprus and Israel



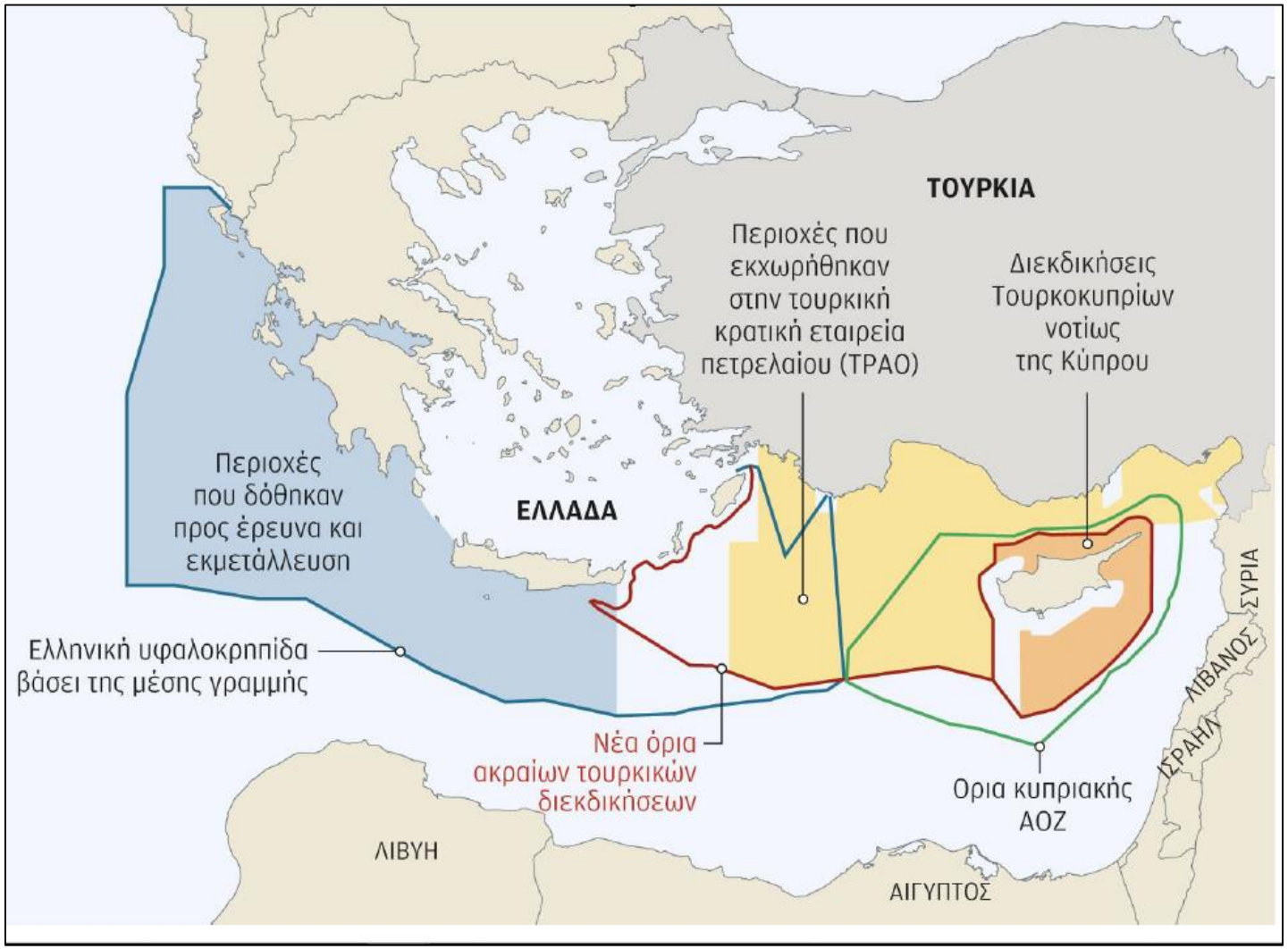
Source: Reuters

Hydrocarbons Exploration Activities in Cyprus



Source: Cyprus's Energy Ministry

Overlapping Claims on the East Mediterranean

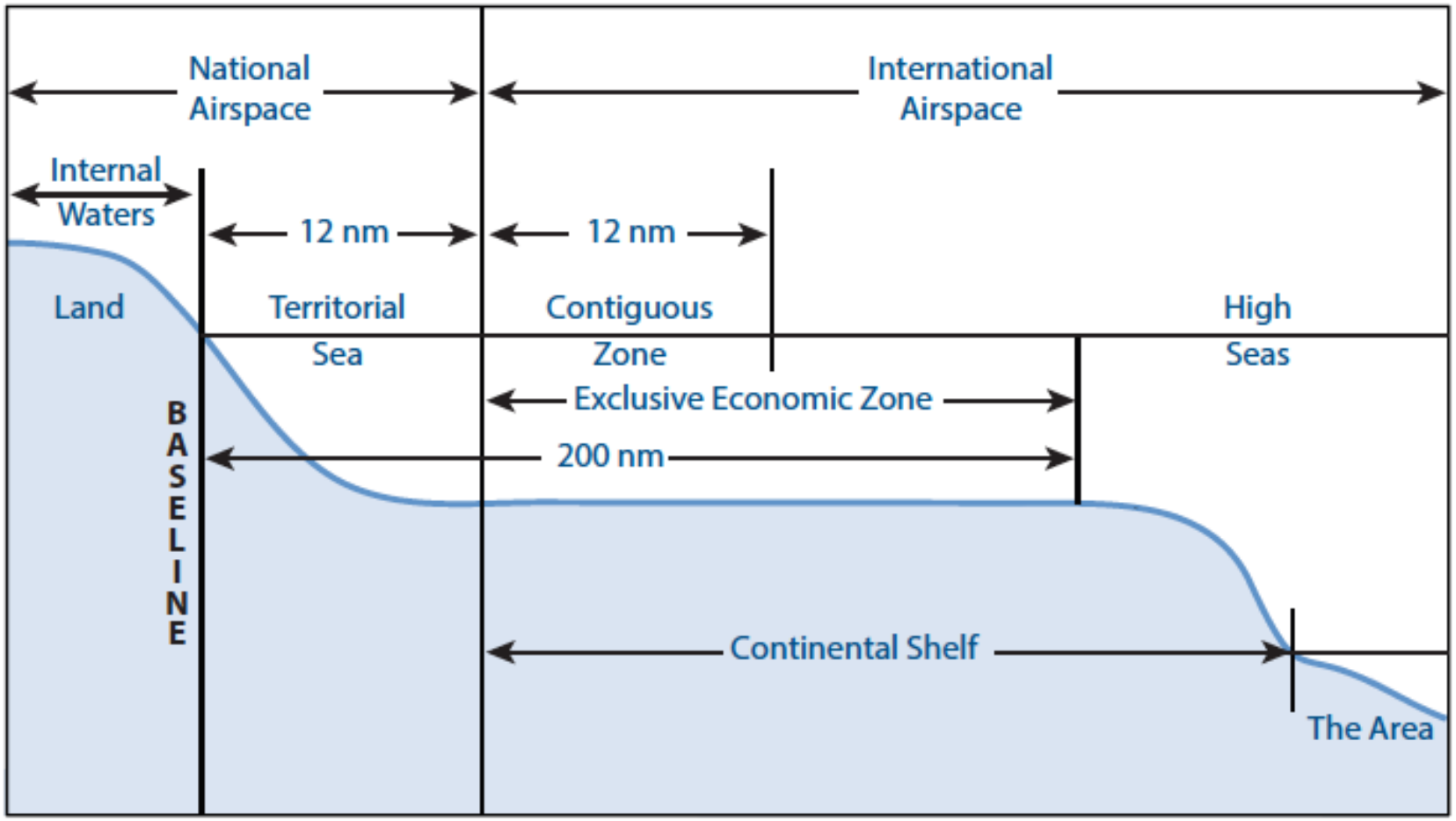


Source: Syrigos, A. (2019)

Turkish Claims on the Greek Continental Shelf (1973-74, 2011)

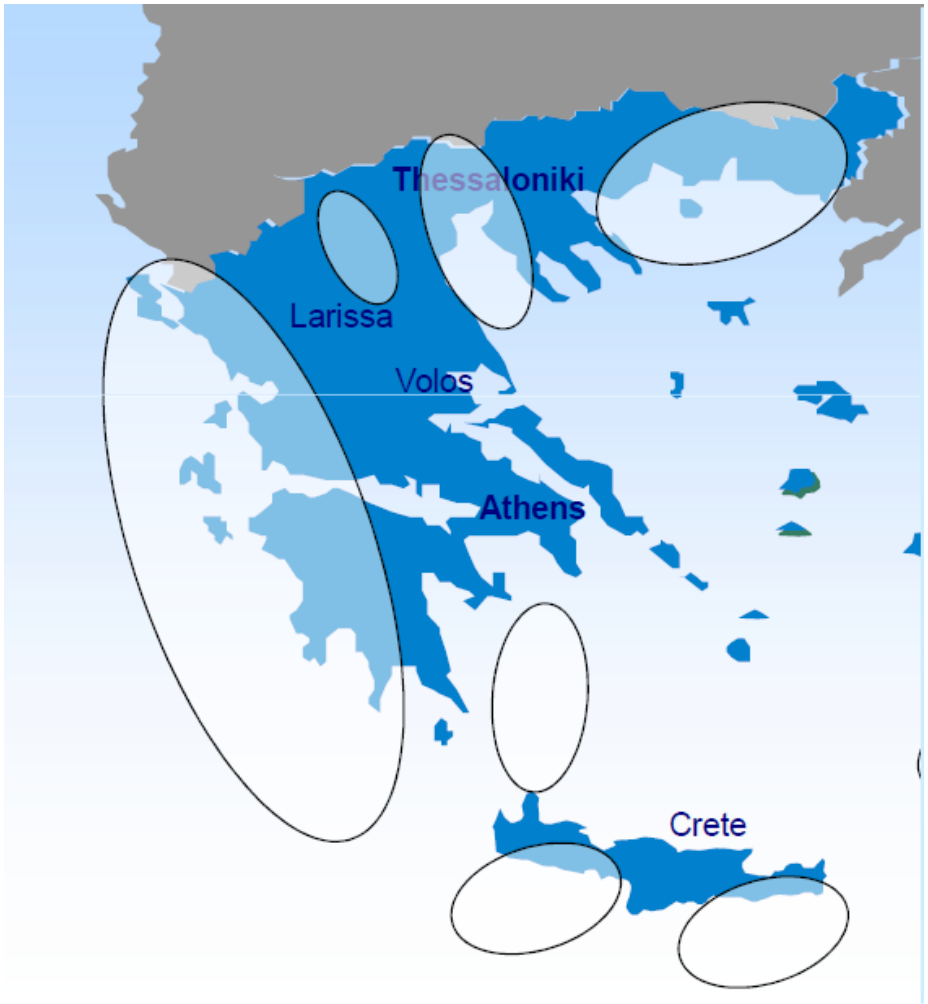
Source: Syrigos, A. (2019)

Maritime Zones Based on Law of the Sea



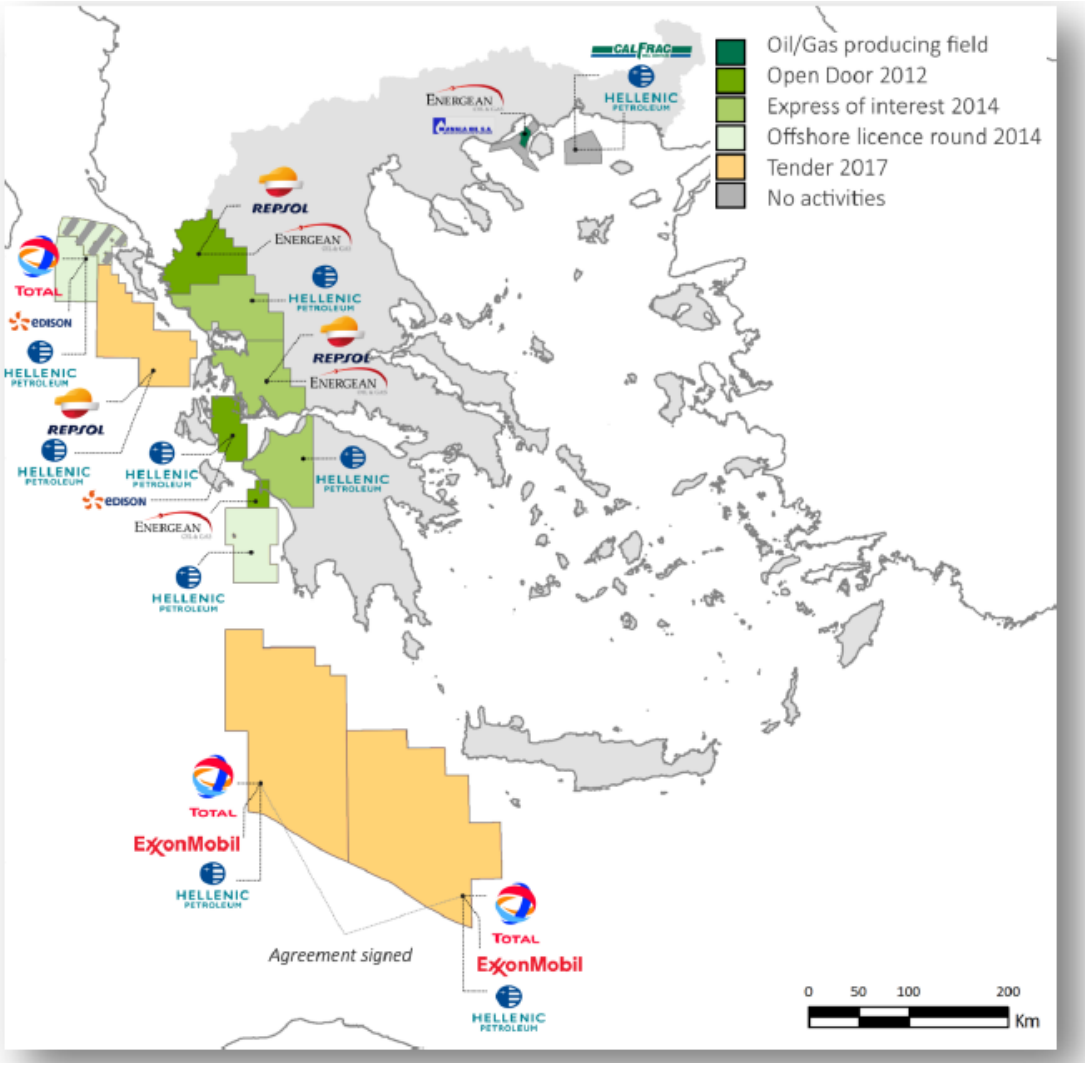
Source: United Nations Convention on the Law of the Sea

Unexplored Areas and Geological Targets in Greece



Source: HELPE

Current Status on Greece's Hydrocarbon Activities



Source: HHRM (June 2019)

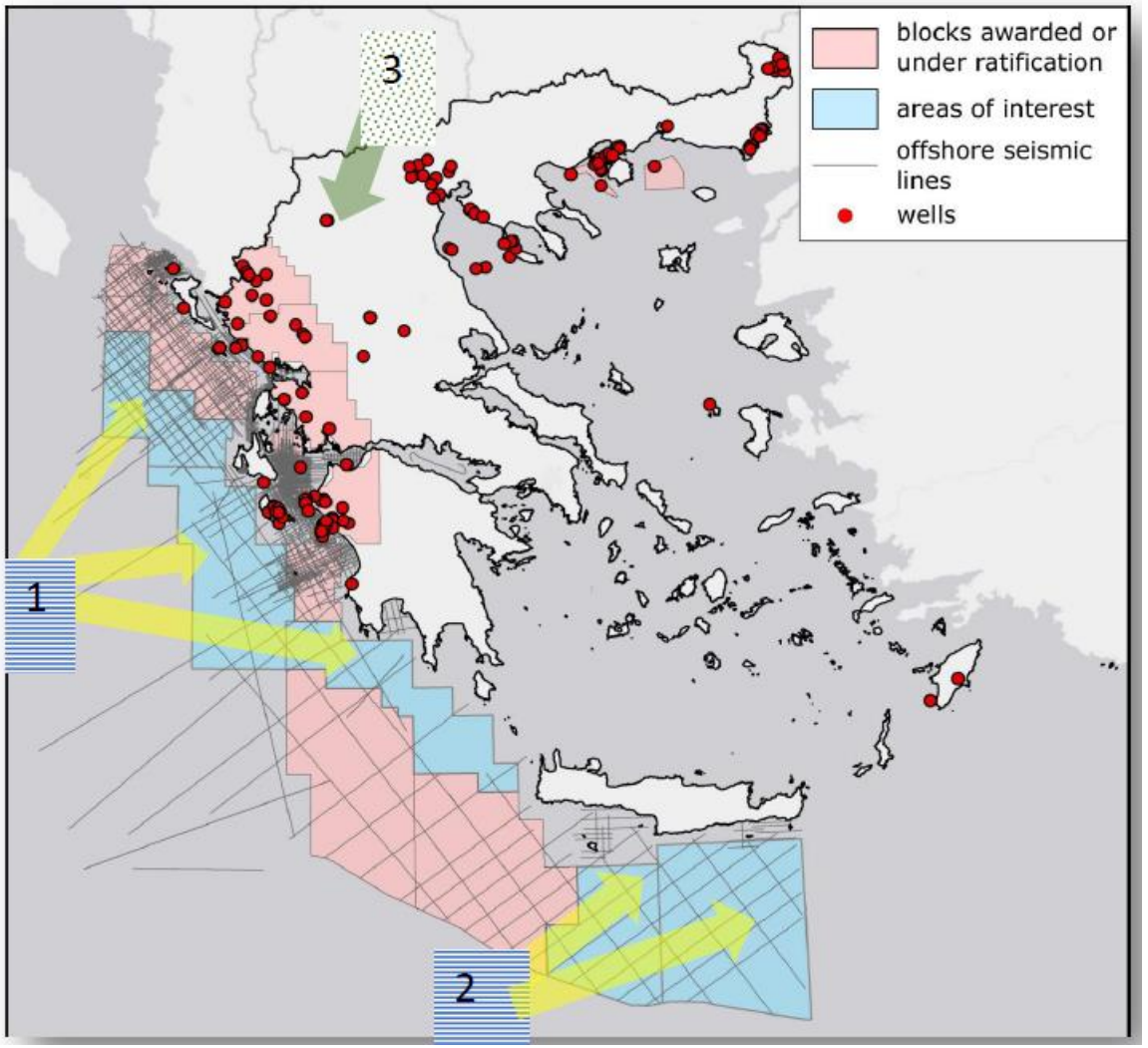
New Areas of Interest in Greece

1. Offshore (Western Greece)
- Central Ionian Sea (N & S part)
- South of Peloponnesus

2. Offshore
- South of Crete (central & eastern part)

3. Onshore (Central Greece)
- Mesohellenic Basin

– Under technical evaluation



Source: HHRM (June 2019)

Hydrocarbon Resources in Greece (Contingent, Proven and Prospective Resources, in million barrels)

Field	Date*(a)	Company	Estimated reserves or resources (in million barrels)	Category
East Thassos I	1971	Oceanic-Colorado	350.0	Contingent resources (Heavy oil)
East Thassos II	1971	Oceanic-Colorado	80.0	Prospective resources
Babouras	1971 /72	Oceanic-Colorado	150.0	Prospective resources
Stavros	1971 /72	Oceanic-Colorado	122.0	Prospective resources
Nike I	1971 /72	Oceanic-Colorado	60.0	Prospective resources
Nike II	1971 /72	Oceanic-Colorado	63.0	Prospective resources
South Kavala (natural gas)	1972	Oceanic-Colorado	(950.0 million m^3 gas)	Depleted Gas field
Amodes (heavy oil)	1972	Oceanic-Colorado	45.0	Contingent resources
Athos	1972	Oceanic-Colorado	45.0	Contingent resources
Prinos[b]	2018	Energean	17.8 21.6	Proven recoverable (P2) Contingent (2C)
West Katakolo	1982 2018	DEP/EKY Energean	(4.0) 10.0	Contingent resources Proven reserves (P2)
Alikes Zakinthou	1984 /85	DEP/EKY	35.0[c]	Contingent
Epanomi (natural gas)	1987	DEP/EKY	3.0	Contingent resources
Prinos- North Prinos	2015 2018	Energean Energean	3.3 2.4	Proven recoverable (P2) Contingent (2C)
Patraikos Gulf	1998/99 2016/2017	Enterprise Oil – Triton ΕΛΠΕ	100.0	Prospective
Prinos-Epsilon	2015	Energean	19.0	Proven recoverable (P2)
Total proven recoverable reserves			51.0	Proven recoverable (P2)
Total contingent reserves			502.0	Contingent (2C)
Total prospective reserves			575.0	Prospective
Total reserves and resources (proven, contingent and prospective)			1,128	

*(a) Date of discovery or latest evaluation, (b) Some 116 million barrels of oil had been recovered by the end of 2014. Estimated original reserves in place: 290, (c) Asphalt contingent resource base has been found but considered to be non-explorable duet to environmental

Source: IENE

INSTITUTE OF ENERGY
FOR SOUTH-EAST EUROPE

Thank you for your attention

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