UNIVERSITA'DEGLI STUDI DI NAPOLI "PARTHENOPE"
DIPARTIMENTO DI INGEGNERIA

CORSO DI LAUREA MAGISTRALE IN INGEGNERIA GESTIONALE

Introduzione allo studio e alla gestione dei sistemi energetici

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Fonti di energia non rinnovabili

Si definiscono energie "**non rinnovabili**”:

- quelle caratterizzate da **lunghi periodi di formazione** di molto superiori a quelli di consumo attuale (in particolare fonti fossili quali **petrolio**, **carbone**, **gas naturale**);
- quelle presenti in **riserve non inesauribili** sulla scala dei tempi umani (in particolare l'isotopo 235 dell'**uranio**, l'elemento attualmente più utilizzato per produrre energia nucleare), e quindi **limitate nel futuro**.

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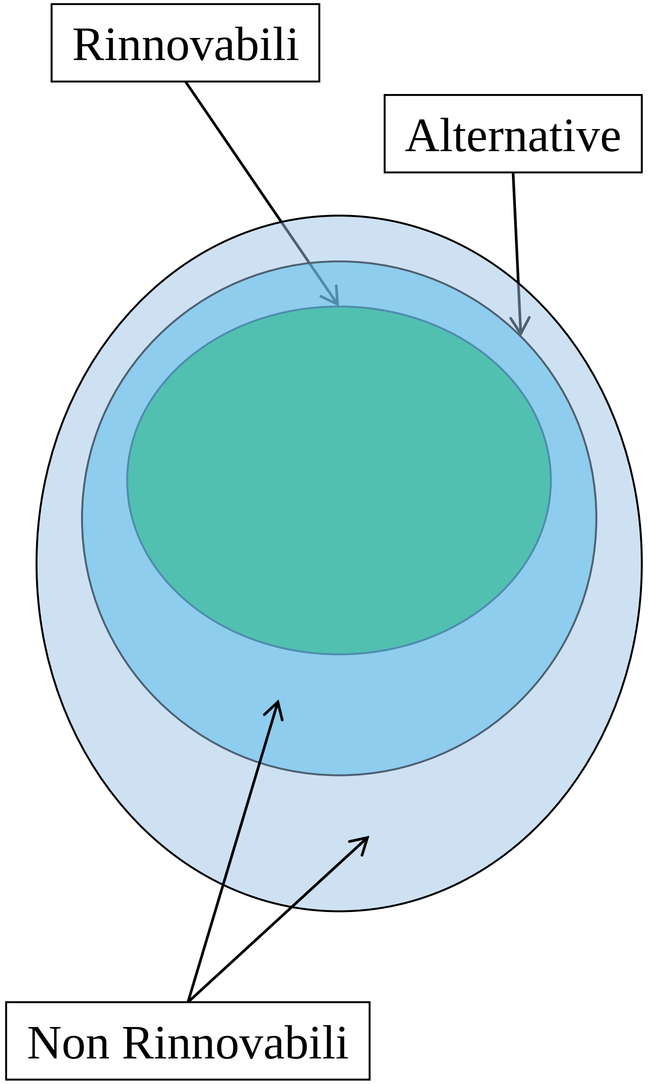
Fonti di Energia alternative

Per fonte di **energia alternativa** si intende un modo di ottenere energia elettrica che **non richieda l'utilizzo dei combustibili fossili**.

- Le fonti di energia alternativa comprendono quindi una classe più ampia rispetto alle energie rinnovabili.
- Una differenza sostanziale ad esempio è la presenza fra le fonti alternative dell'energia nucleare, che è una fonte non rinnovabile.



Rinnovabili

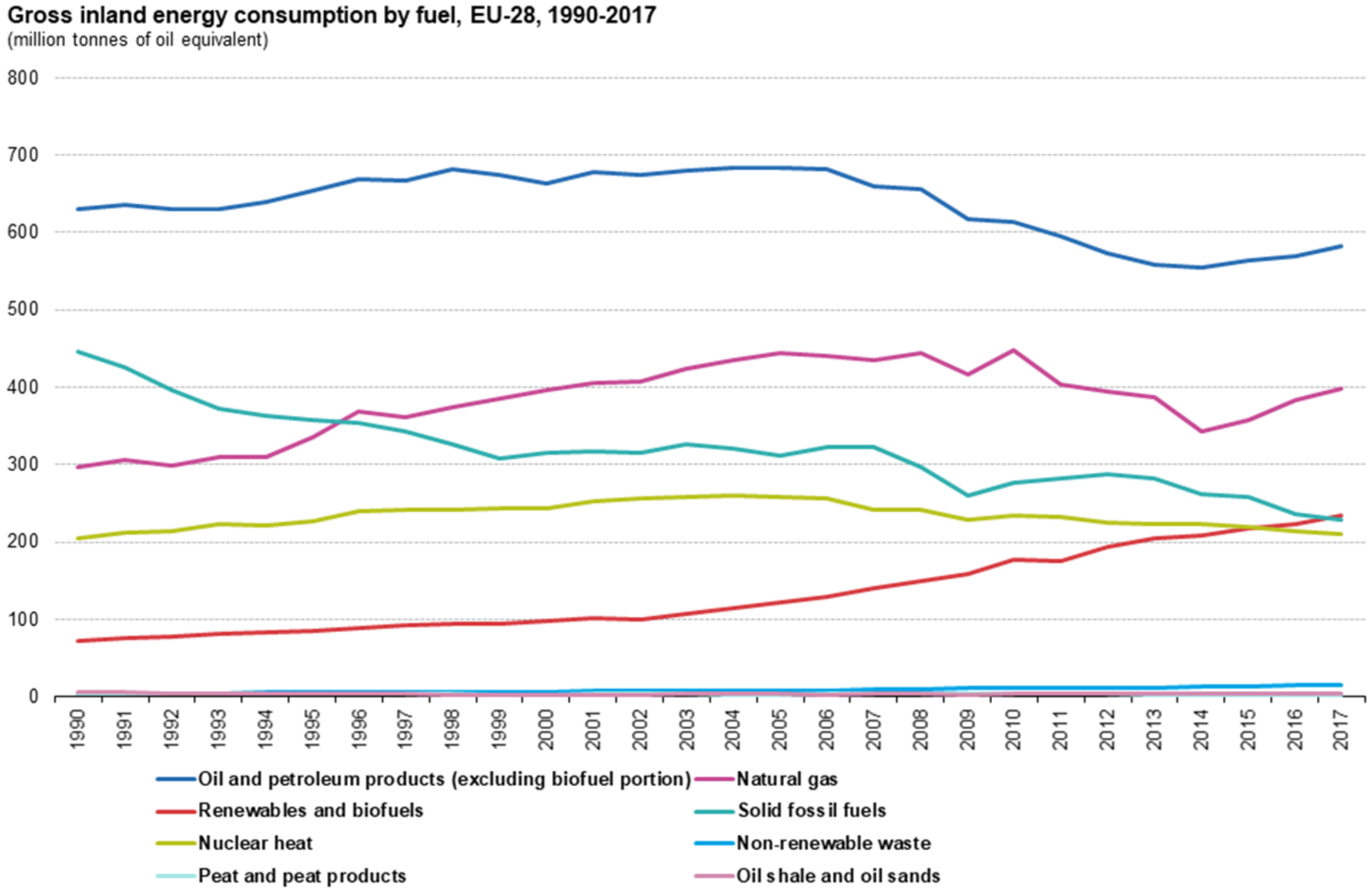
Alternative

Non Rinnovabili

Fonti di Energia rinnovabili

- Si definiscono **energie rinnovabili** quelle forme di energia generate da fonti che per loro caratteristica intrinseca **si rigenerano** o **non sono "esauribili" nella scala dei tempi "umani“**.
- L'utilizzo delle energie rinnovabili quindi **non pregiudica le risorse naturali per le generazioni future**.
- Sono dunque generalmente considerate "fonti di energia rinnovabile" l'energia **solare, eolica, idrica, del mare, geotermica**.

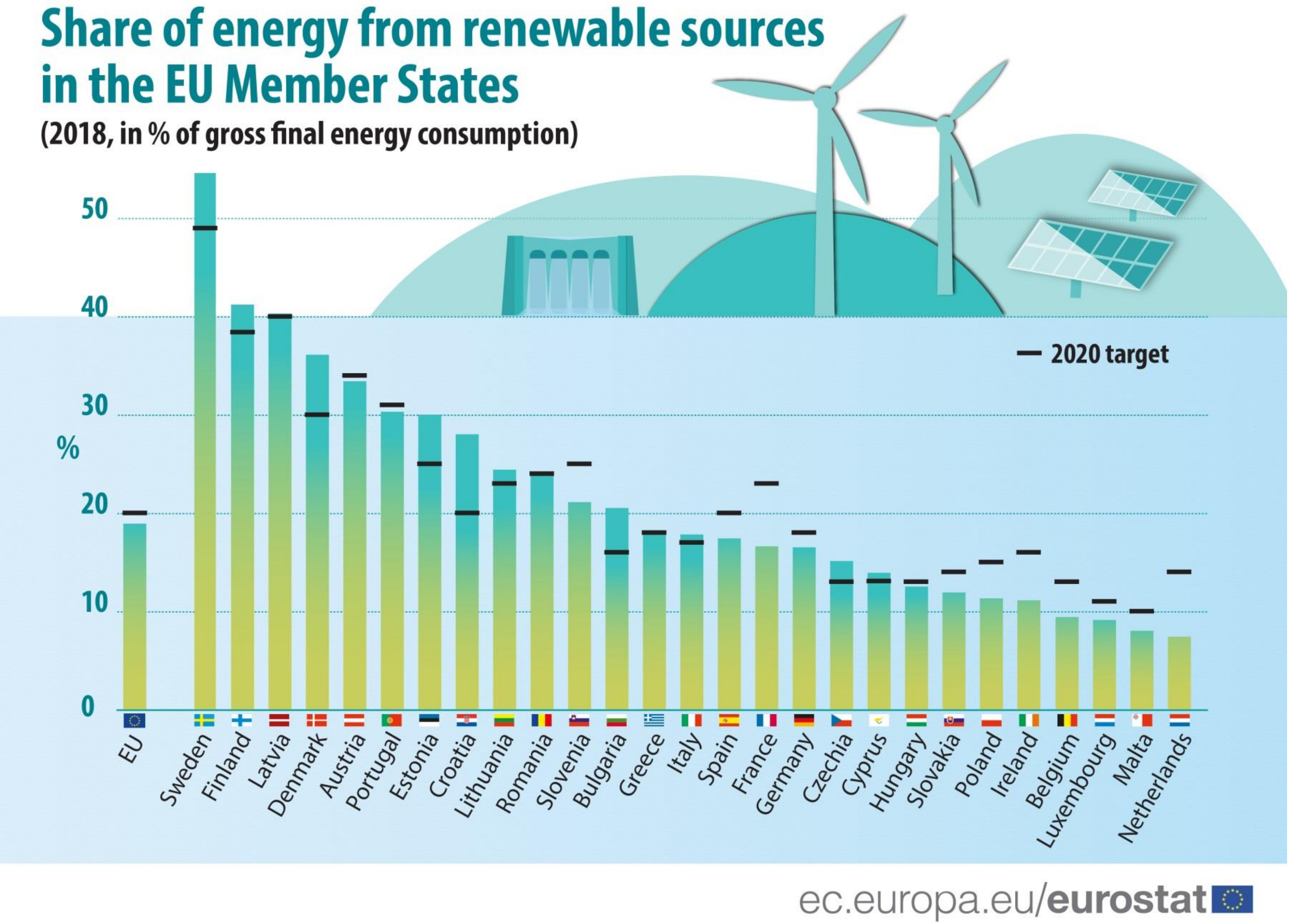
Consumi di energia per fonte


Gross inland energy consumption by fuel, EU-28, 1990-2017

(million tonnes of oil equivalent)

Source: Eurostat - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy

Produzione da rinnovabili in UE



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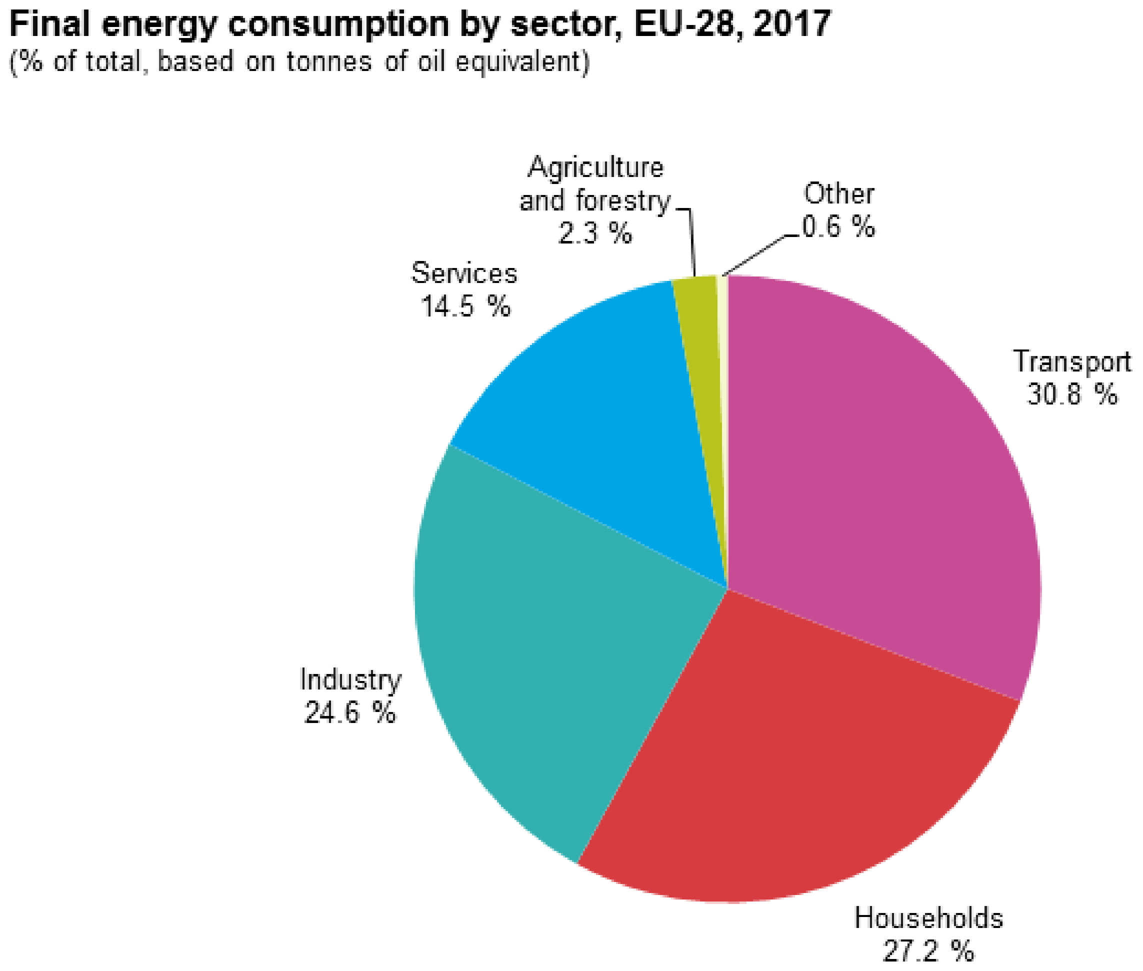
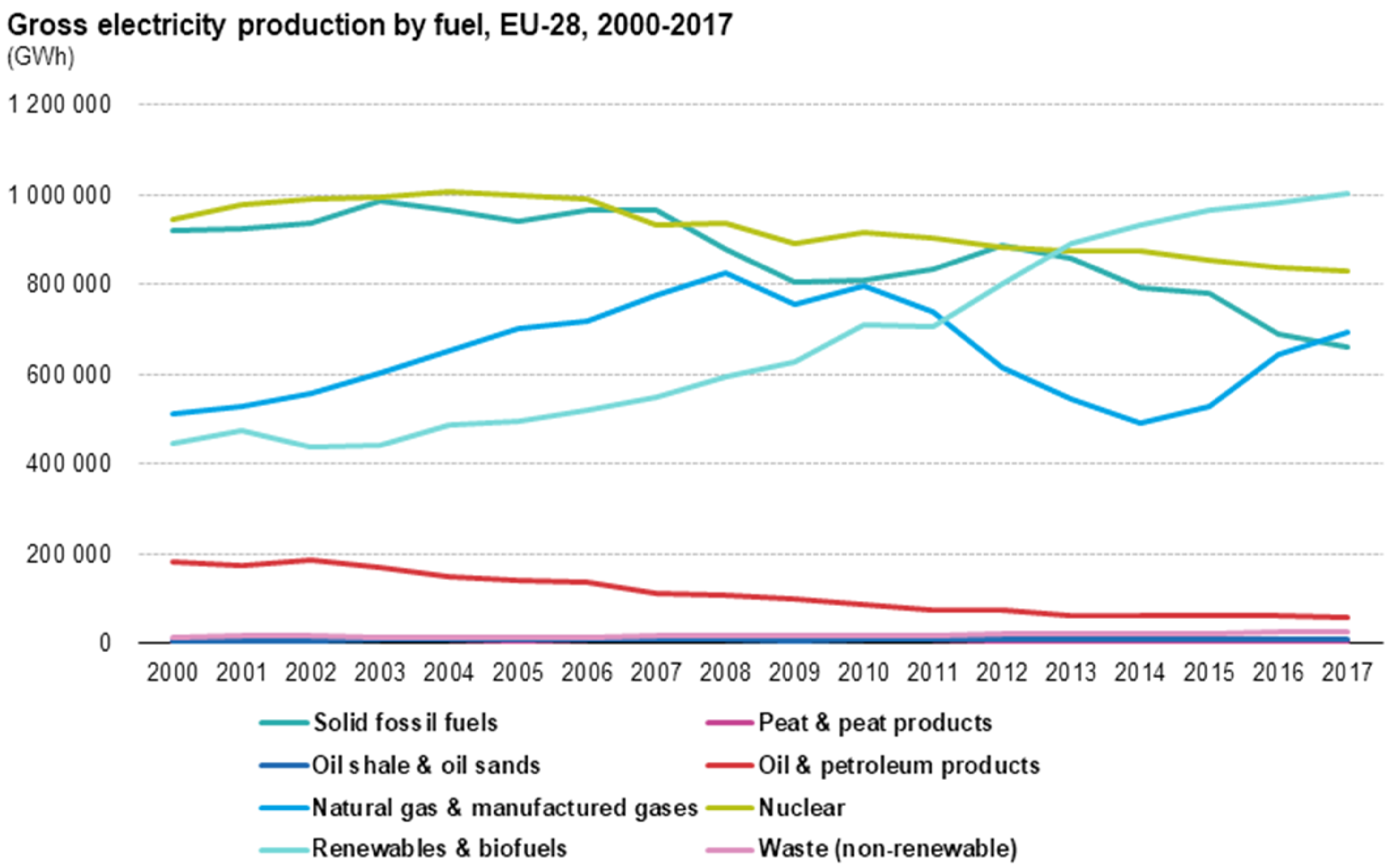
Consumi finali di energia per settore



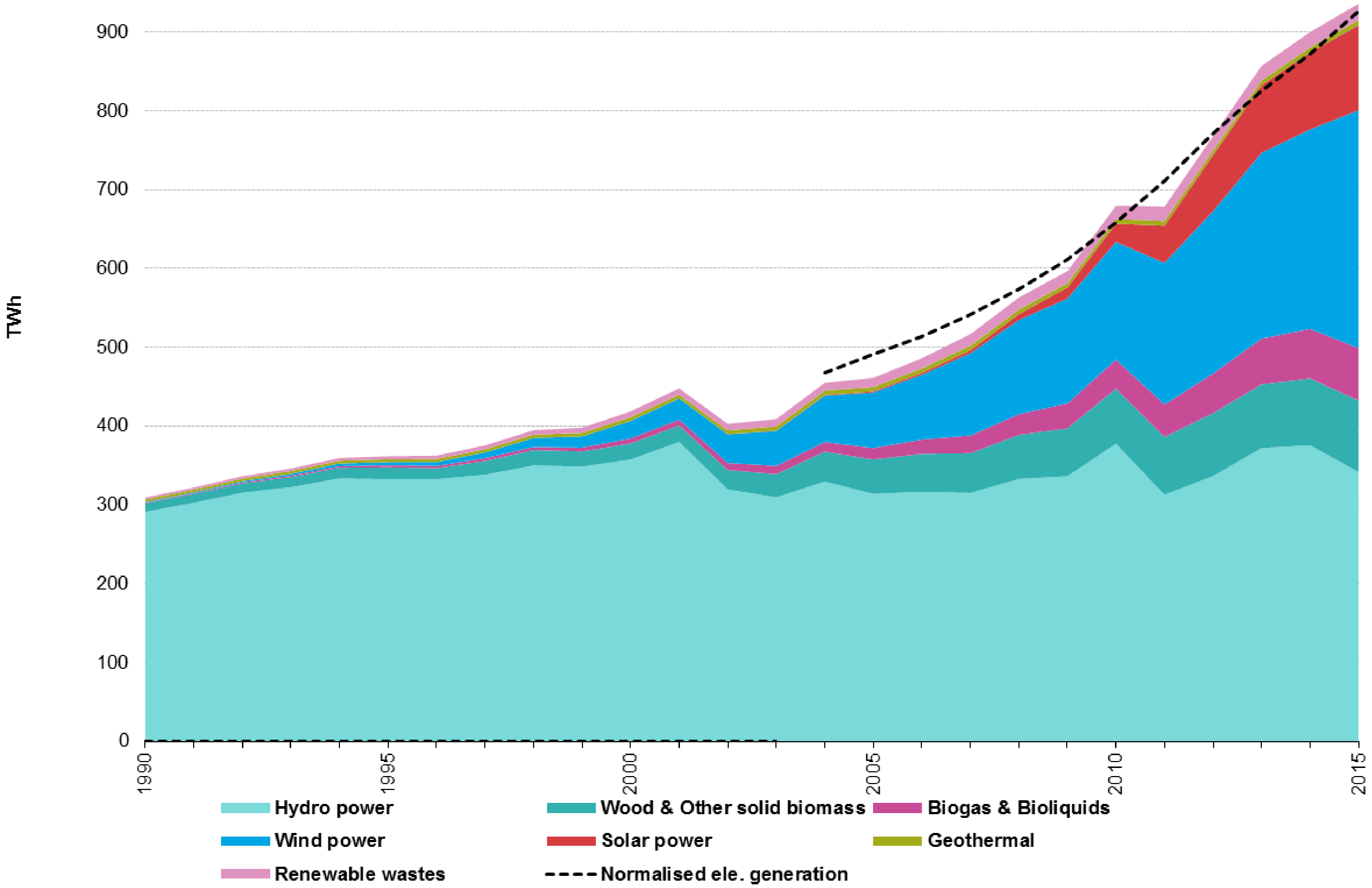
Source: Eurostat - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy

Produzione di energia elettrica per fonte



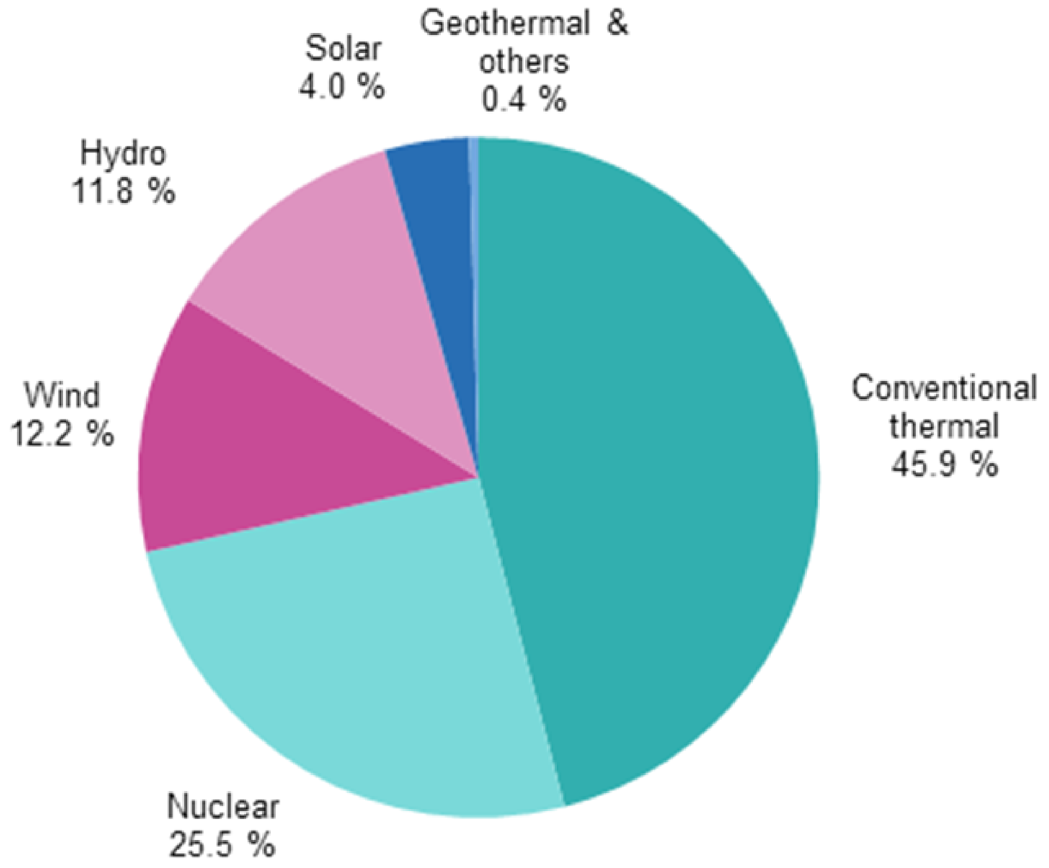
Source: Eurostat - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy

Energia elettrica da fonte rinnovabile



Produzione di energia per fonte EU-28

Electricity production by source, EU-28, 2018
(%)



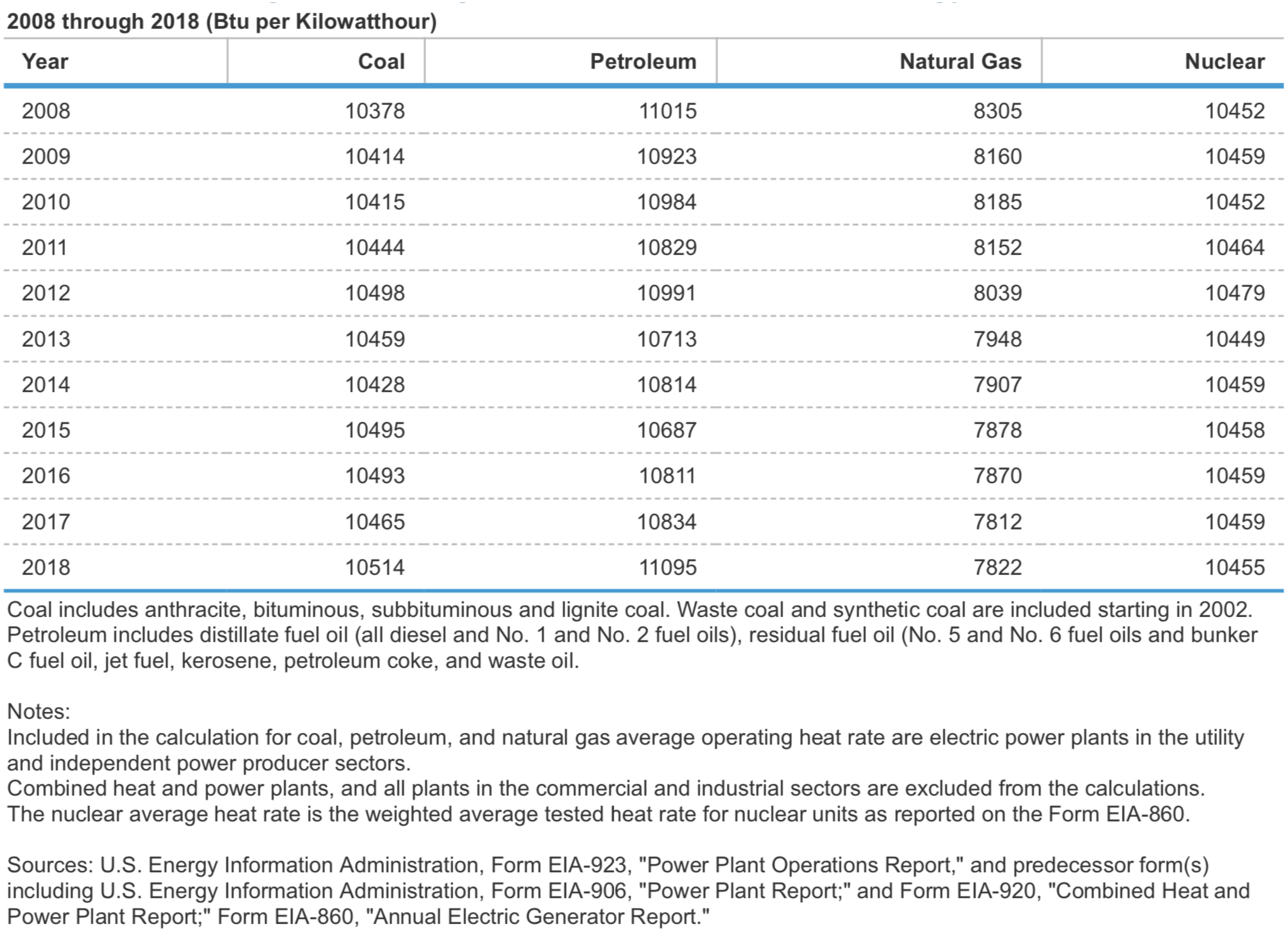
Source: Eurostat - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy

Existing Capacity by EnergySource, 2018 (Megawatts)

Energy Source	Facility Type	Number of Generators	Generator Nameplate Capacity	Net Summer Capacity	Net Winter Capacity
Coal	Utility Scale	738	264,072.5	242,785.6	244,283.9
Petroleum	Utility Scale	3,647	37,028.5	32,218.2	35,305.5
Natural Gas	Utility Scale	5,952	537,292.1	470,236.9	505,754.0
Other Gases	Utility Scale	97	2,894.4	2,543.9	2,585.0
Nuclear	Utility Scale	98	104,270.2	99,432.9	101,689.8
Hydroelectric Conventional	Utility Scale	4,041	79,911.6	79,871.8	79,264.3
Wind	Utility Scale	1,316	94,970.5	94,417.7	94,522.1
Solar Photovoltaic	Utility Scale	3,369	30,464.1	30,120.5	29,620.2
Solar Thermal	Utility Scale	19	1,774.6	1,757.9	1,581.8
Wood and Wood-Derived Fuels	Utility Scale	346	9,849.3	8,694.6	8,805.9
Geothermal	Utility Scale	170	3,806.0	2,444.3	2,776.6
Other Biomass	Utility Scale	1,959	5,713.7	5,038.6	5,103.1
Hydroelectric Pumped Storage	Utility Scale	153	21,871.3	22,830.2	22,689.6
Other Energy Sources	Utility Scale	213	2,569.1	2,346.7	2,383.9
Total	Utility Scale	22,118	1,196,487.9	1,094,739.8	1,136,365.7
Small Scale Photovoltaic	Small Scale	--	--	19,547.1	--
Estimated Total Photovoltaic	Utility and Small Scale	--	--	49,667.6	--
Estimated Total Solar	Utility and Small Scale	--	--	51,425.5	--

Source: U.S. Energy Information Administration

Average Operating Heat Rate for Selected Energy Sources.



2008 through 2018 (Btu per Kilowatthour)

Year	Coal	Petroleum	Natural Gas	Nuclear
2008	10378	11015	8305	10452
2009	10414	10923	8160	10459
2010	10415	10984	8185	10452
2011	10444	10829	8152	10464
2012	10498	10991	8039	10479
2013	10459	10713	7948	10449
2014	10428	10814	7907	10459
2015	10495	10687	7878	10458
2016	10493	10811	7870	10459
2017	10465	10834	7812	10459
2018	10514	11095	7822	10455

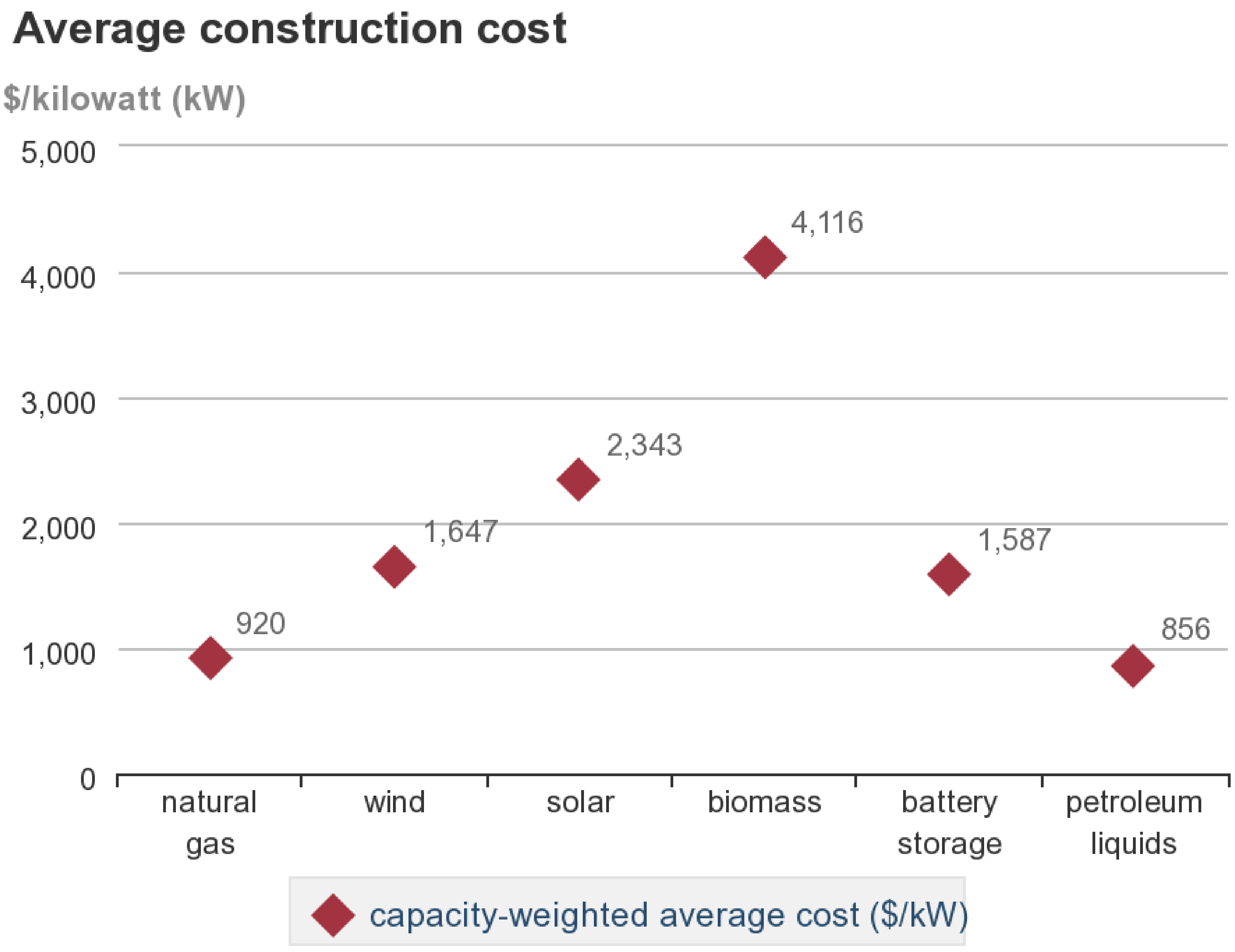
Coal includes anthracite, bituminous, subbituminous and lignite coal. Waste coal and synthetic coal are included starting in 2002.
Petroleum includes distillate fuel oil (all diesel and No. 1 and No. 2 fuel oils), residual fuel oil (No. 5 and No. 6 fuel oils and bunker C fuel oil, jet fuel, kerosene, petroleum coke, and waste oil.

Notes:
Included in the calculation for coal, petroleum, and natural gas average operating heat rate are electric power plants in the utility and independent power producer sectors.
Combined heat and power plants, and all plants in the commercial and industrial sectors are excluded from the calculations.
The nuclear average heat rate is the weighted average tested heat rate for nuclear units as reported on the Form EIA-860.

Sources: U.S. Energy Information Administration, Form EIA-923, "Power Plant Operations Report," and predecessor form(s) including U.S. Energy Information Administration, Form EIA-906, "Power Plant Report;" and Form EIA-920, "Combined Heat and Power Plant Report;" Form EIA-860, "Annual Electric Generator Report."

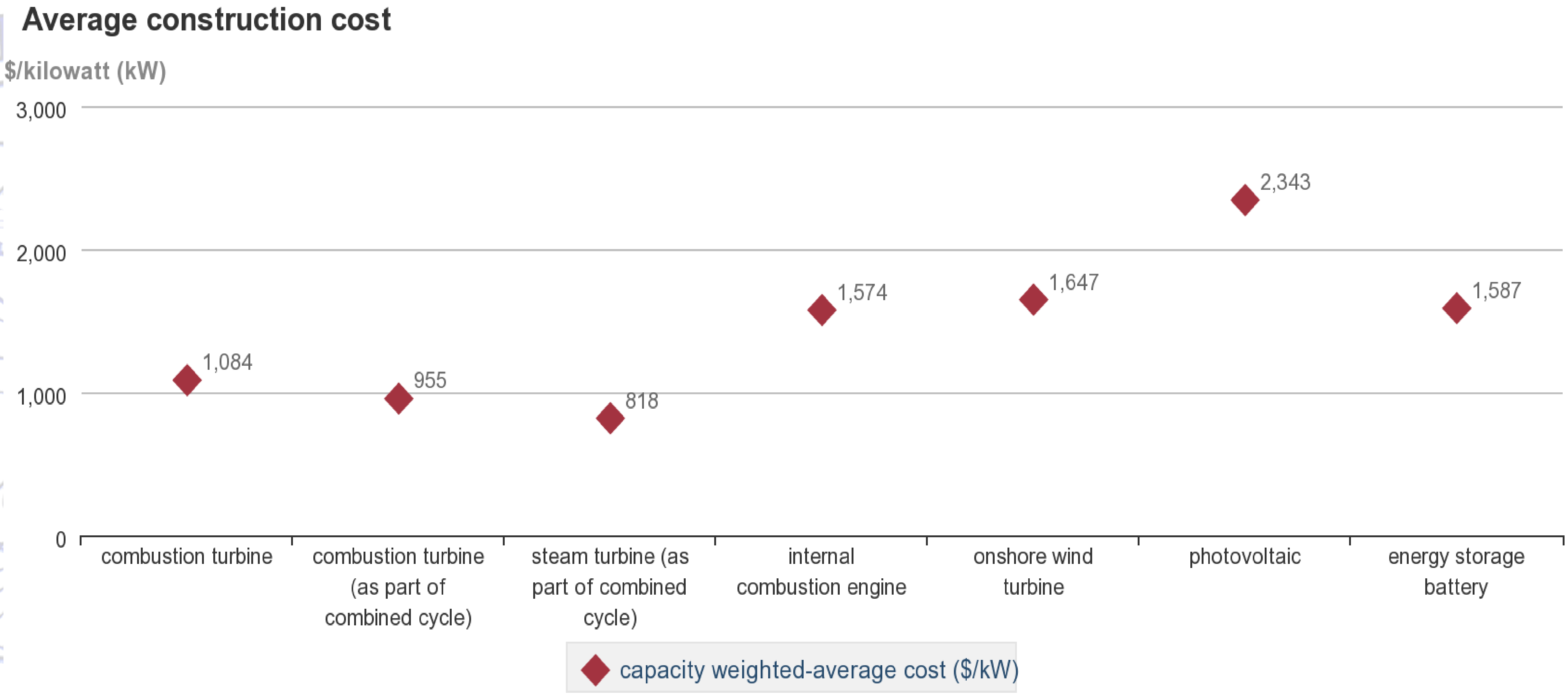
Source: U.S. Energy Information Administration

Costi di impianto per fonte



Source: U.S. Energy Information Administration,
Form EIA-860, *2017 Annual Electric Generator Report*

Costi di impianto per sistema energetico

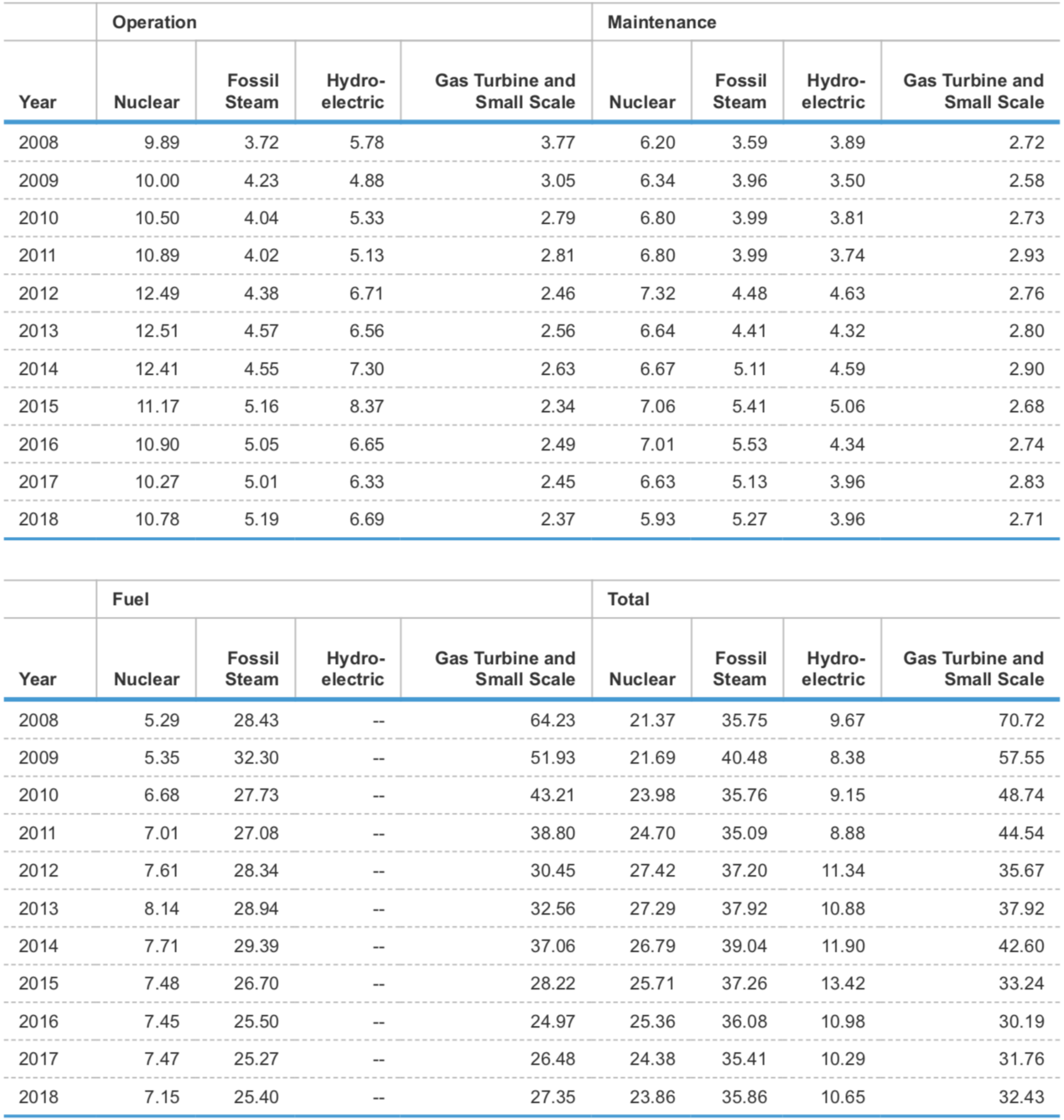


Source: U.S. Energy Information Administration, Form EIA-860, *2017 Annual Electric Generator Report*

Average Power Plant Operating Expenses

for Major U.S. Investor-Owned Electric Utilities, 2008 through 2018 (Mills per Kilowatthour)

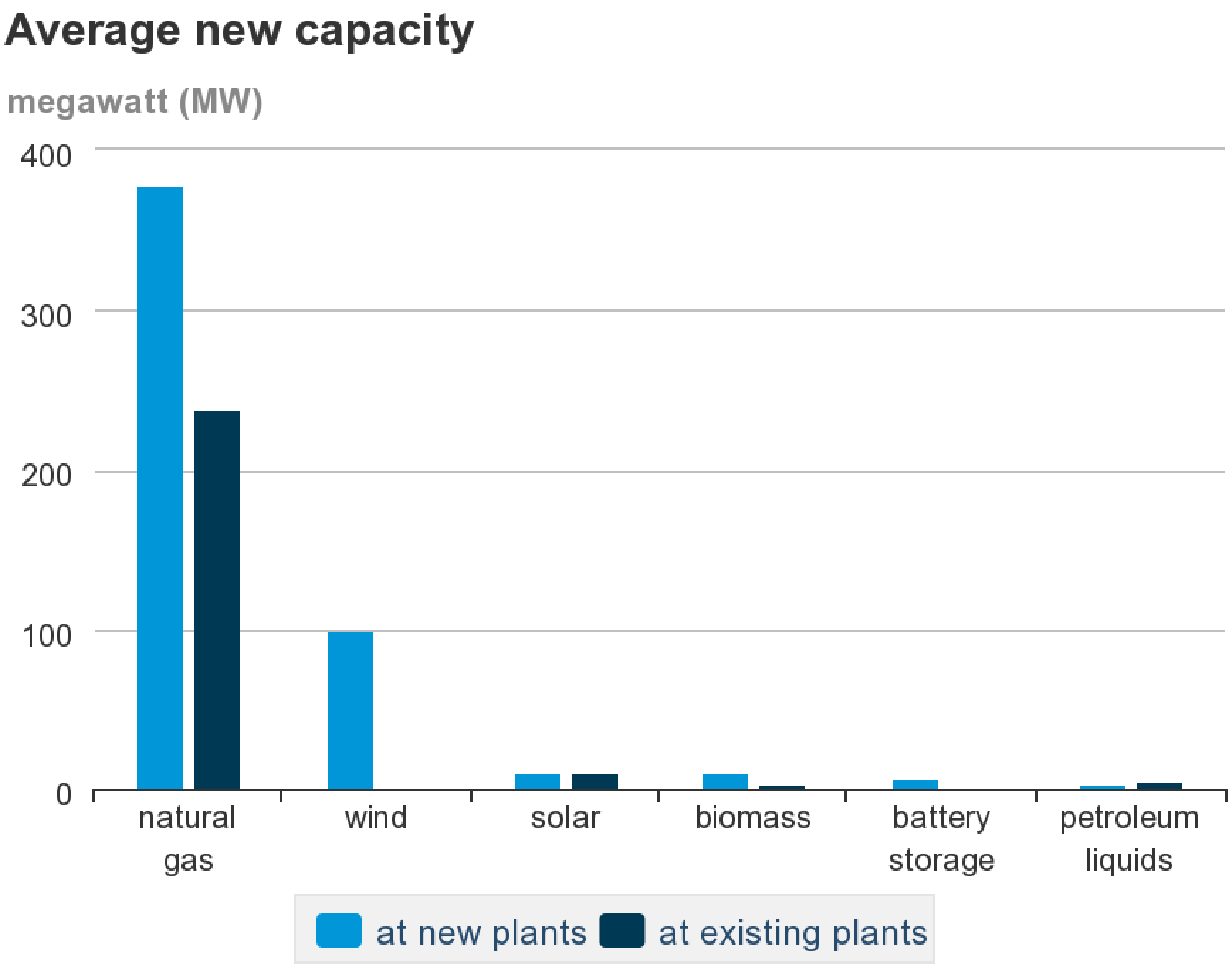
Source: U.S. Energy Information Administration



	Operation				Maintenance			
Year	Nuclear	Fossil Steam	Hydro-electric	Gas Turbine and Small Scale	Nuclear	Fossil Steam	Hydro-electric	Gas Turbine and Small Scale
2008	9.89	3.72	5.78	3.77	6.20	3.59	3.89	2.72
2009	10.00	4.23	4.88	3.05	6.34	3.96	3.50	2.58
2010	10.50	4.04	5.33	2.79	6.80	3.99	3.81	2.73
2011	10.89	4.02	5.13	2.81	6.80	3.99	3.74	2.93
2012	12.49	4.38	6.71	2.46	7.32	4.48	4.63	2.76
2013	12.51	4.57	6.56	2.56	6.64	4.41	4.32	2.80
2014	12.41	4.55	7.30	2.63	6.67	5.11	4.59	2.90
2015	11.17	5.16	8.37	2.34	7.06	5.41	5.06	2.68
2016	10.90	5.05	6.65	2.49	7.01	5.53	4.34	2.74
2017	10.27	5.01	6.33	2.45	6.63	5.13	3.96	2.83
2018	10.78	5.19	6.69	2.37	5.93	5.27	3.96	2.71

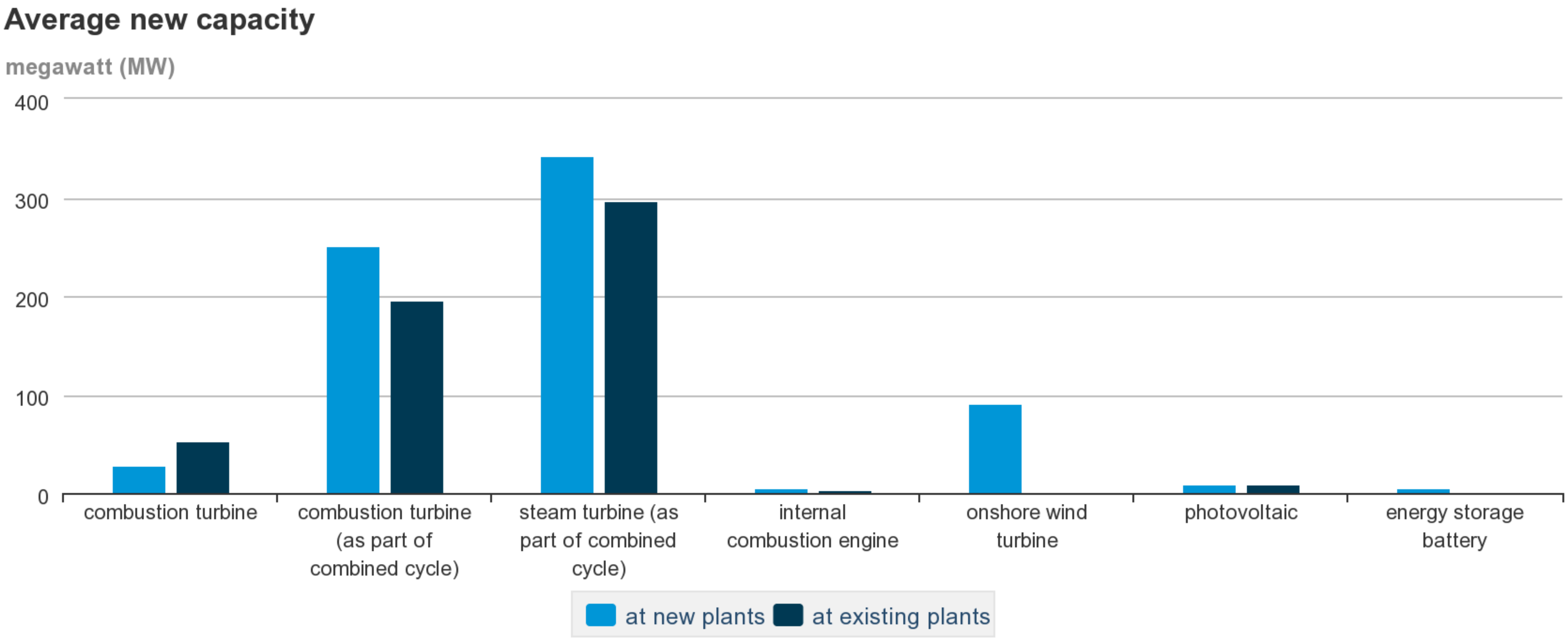
	Fuel				Total			
Year	Nuclear	Fossil Steam	Hydro-electric	Gas Turbine and Small Scale	Nuclear	Fossil Steam	Hydro-electric	Gas Turbine and Small Scale
2008	5.29	28.43	--	64.23	21.37	35.75	9.67	70.72
2009	5.35	32.30	--	51.93	21.69	40.48	8.38	57.55
2010	6.68	27.73	--	43.21	23.98	35.76	9.15	48.74
2011	7.01	27.08	--	38.80	24.70	35.09	8.88	44.54
2012	7.61	28.34	--	30.45	27.42	37.20	11.34	35.67
2013	8.14	28.94	--	32.56	27.29	37.92	10.88	37.92
2014	7.71	29.39	--	37.06	26.79	39.04	11.90	42.60
2015	7.48	26.70	--	28.22	25.71	37.26	13.42	33.24
2016	7.45	25.50	--	24.97	25.36	36.08	10.98	30.19
2017	7.47	25.27	--	26.48	24.38	35.41	10.29	31.76
2018	7.15	25.40	--	27.35	23.86	35.86	10.65	32.43

Potenza media sistemi energetici per fonte



Source: U.S. Energy Information Administration,
Form EIA-860, *2017 Annual Electric Generator Report*

Potenza media disponibile per sistema energetico



Source: U.S. Energy Information Administration,
Form EIA-860, *2017 Annual Electric Generator Report*

Approfondimenti

- Look at

  https://www.ge.com/power/resources/knowledge-base/what-is-a-gas-turbine

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