Tecnologie e sfruttamento delle fonti energetiche rinnovabili

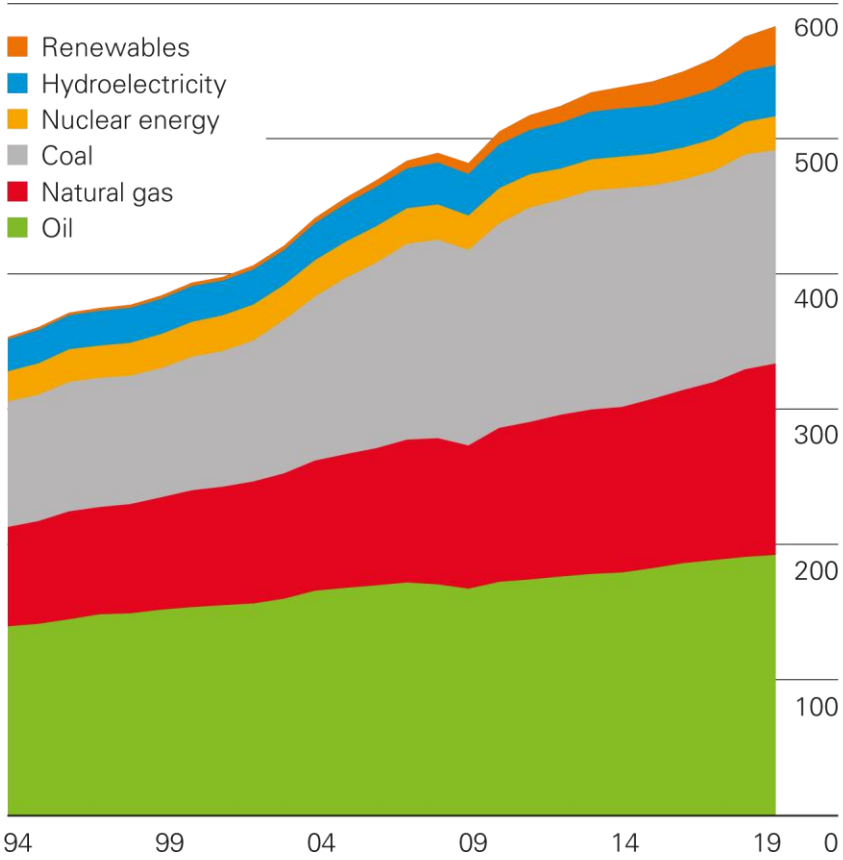
Davide Del Col

Università degli Studi di Padova
Dipartimento di Ingegneria Industriale

Fabbisogno mondiale

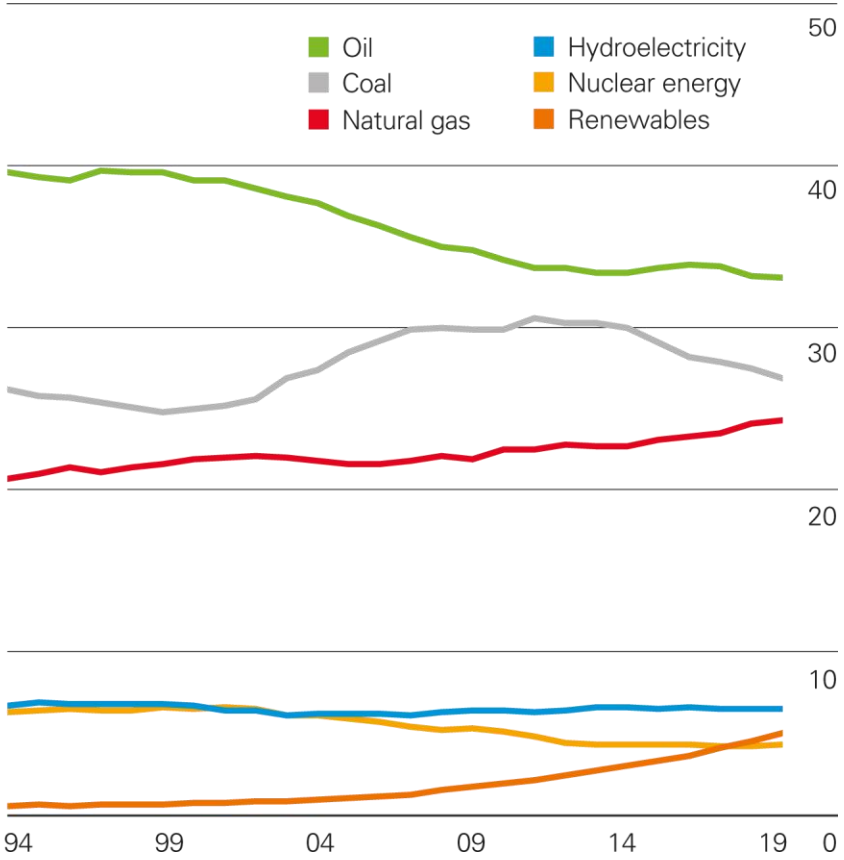
World consumption

Exajoules



Shares of global primary energy

Percentage



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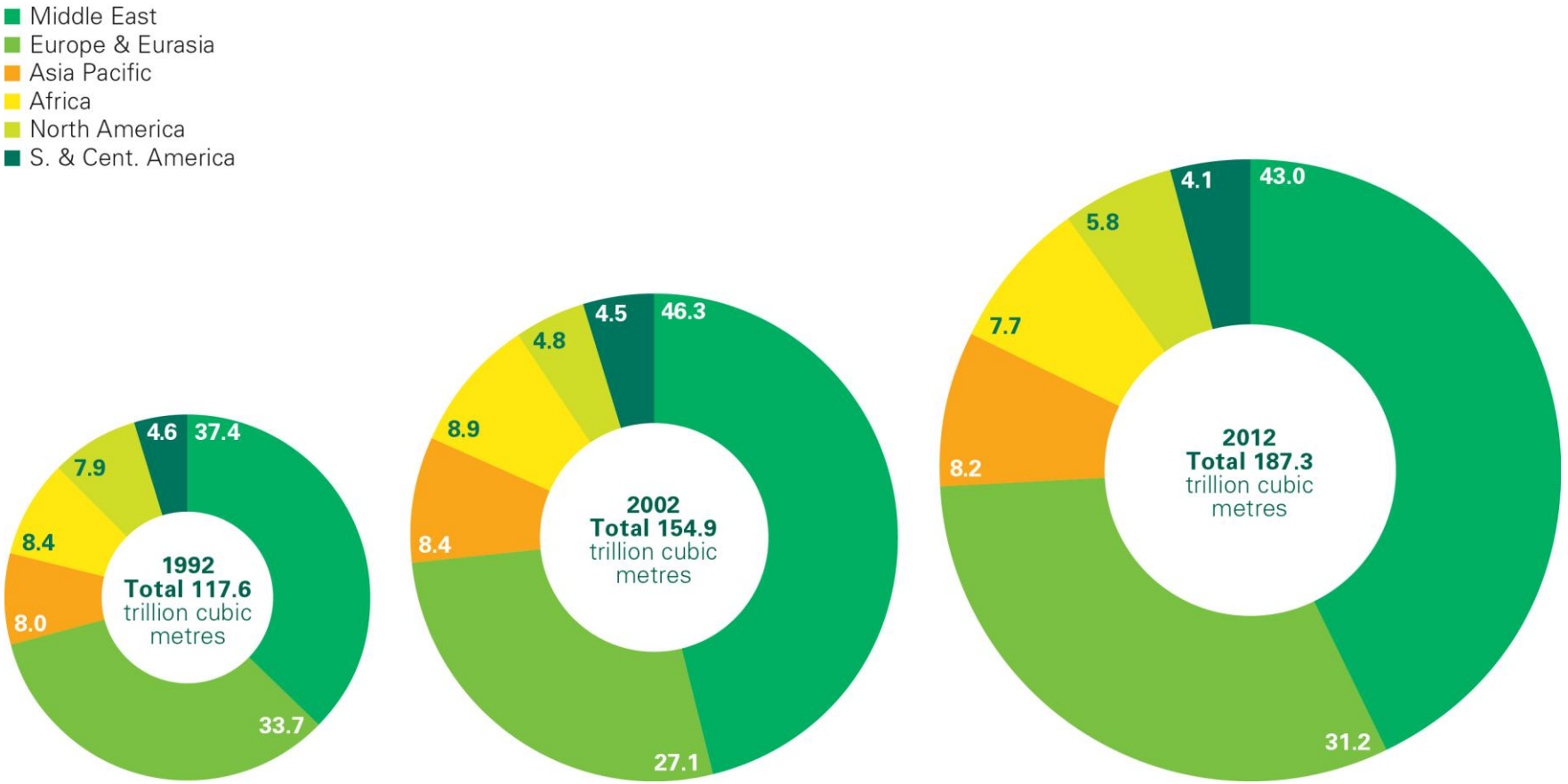
Riserve di petrolio

BP Statistical Review of World Energy 2013

Riserve di gas naturale



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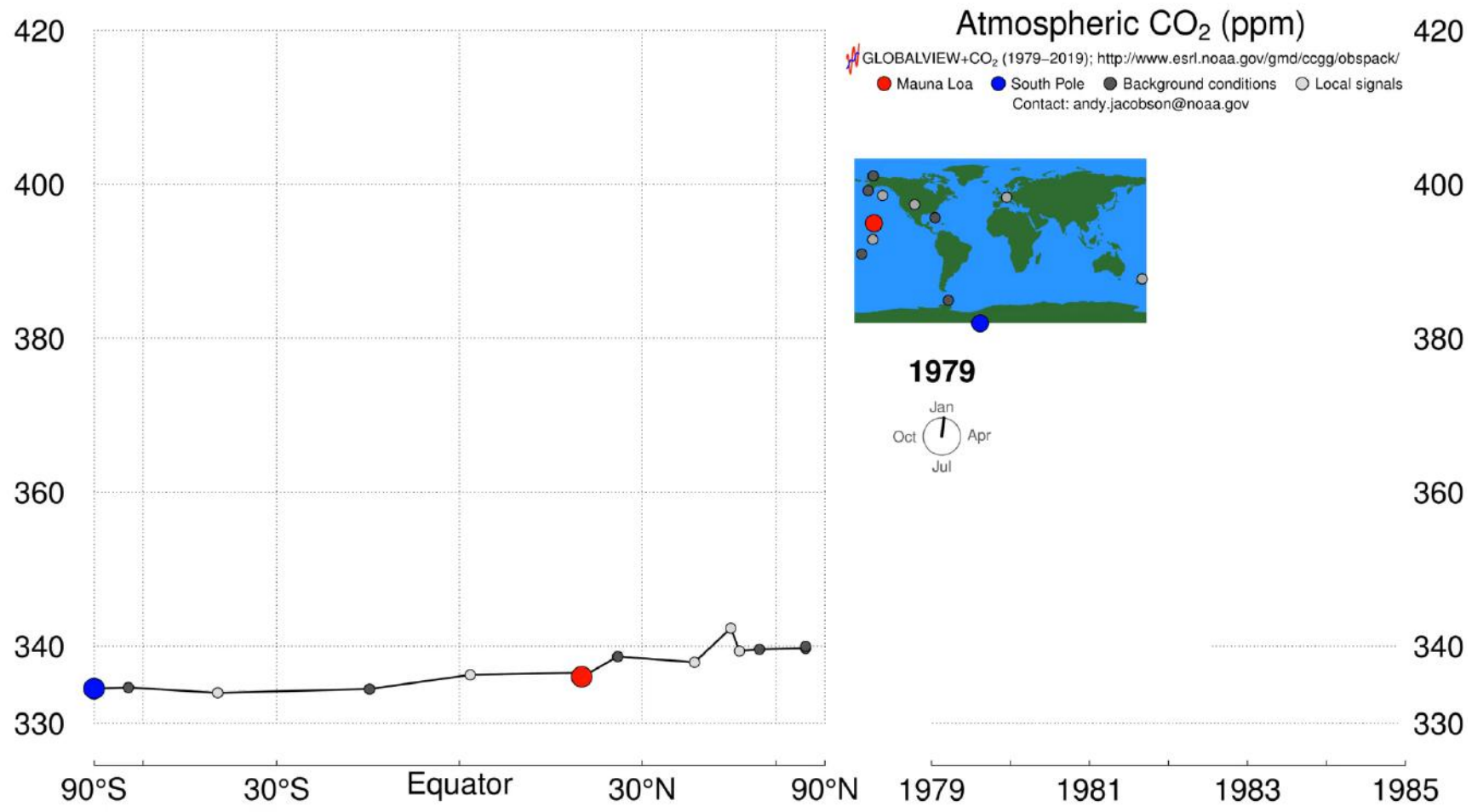
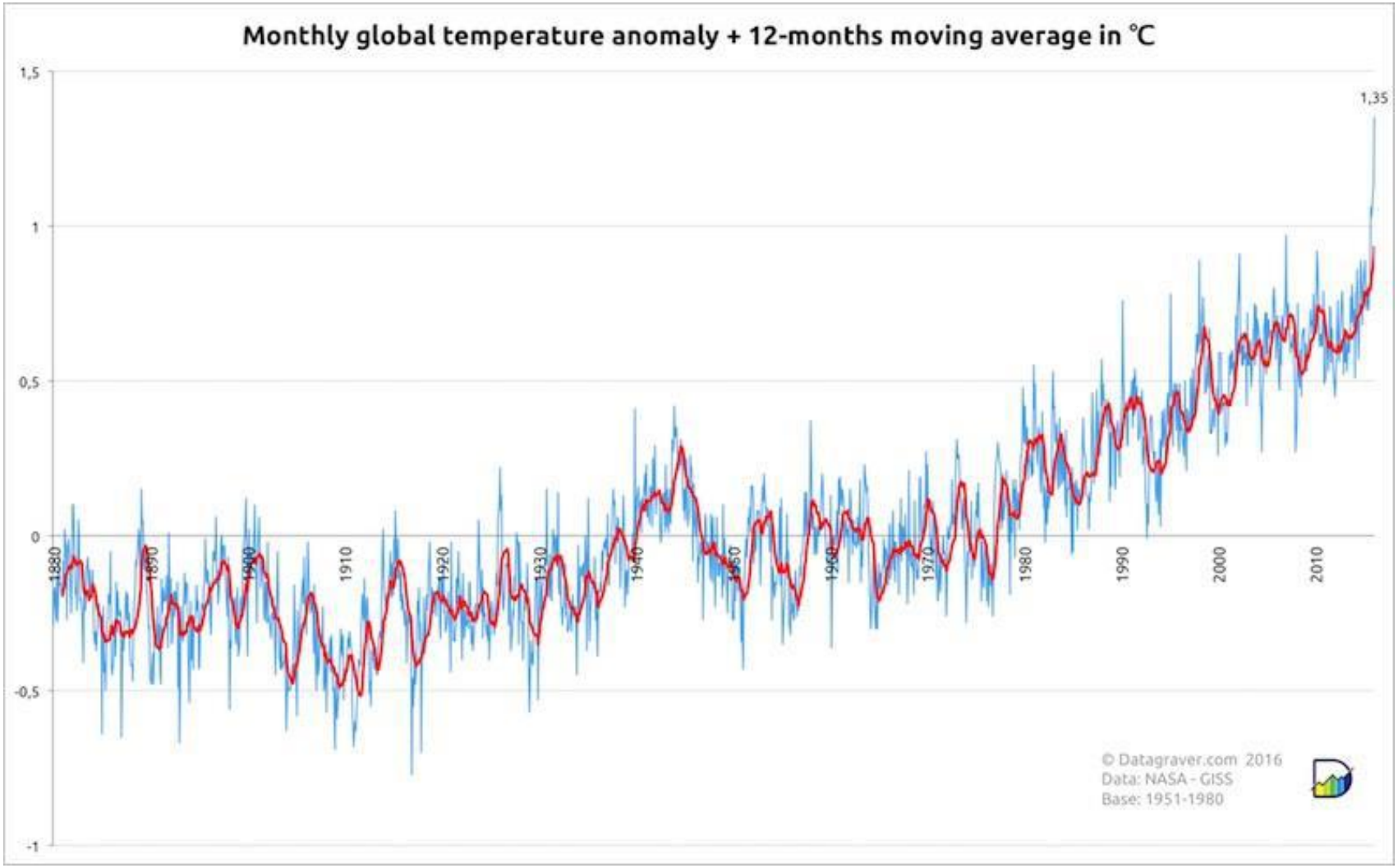
Anidride carbonica nell'atmosfera

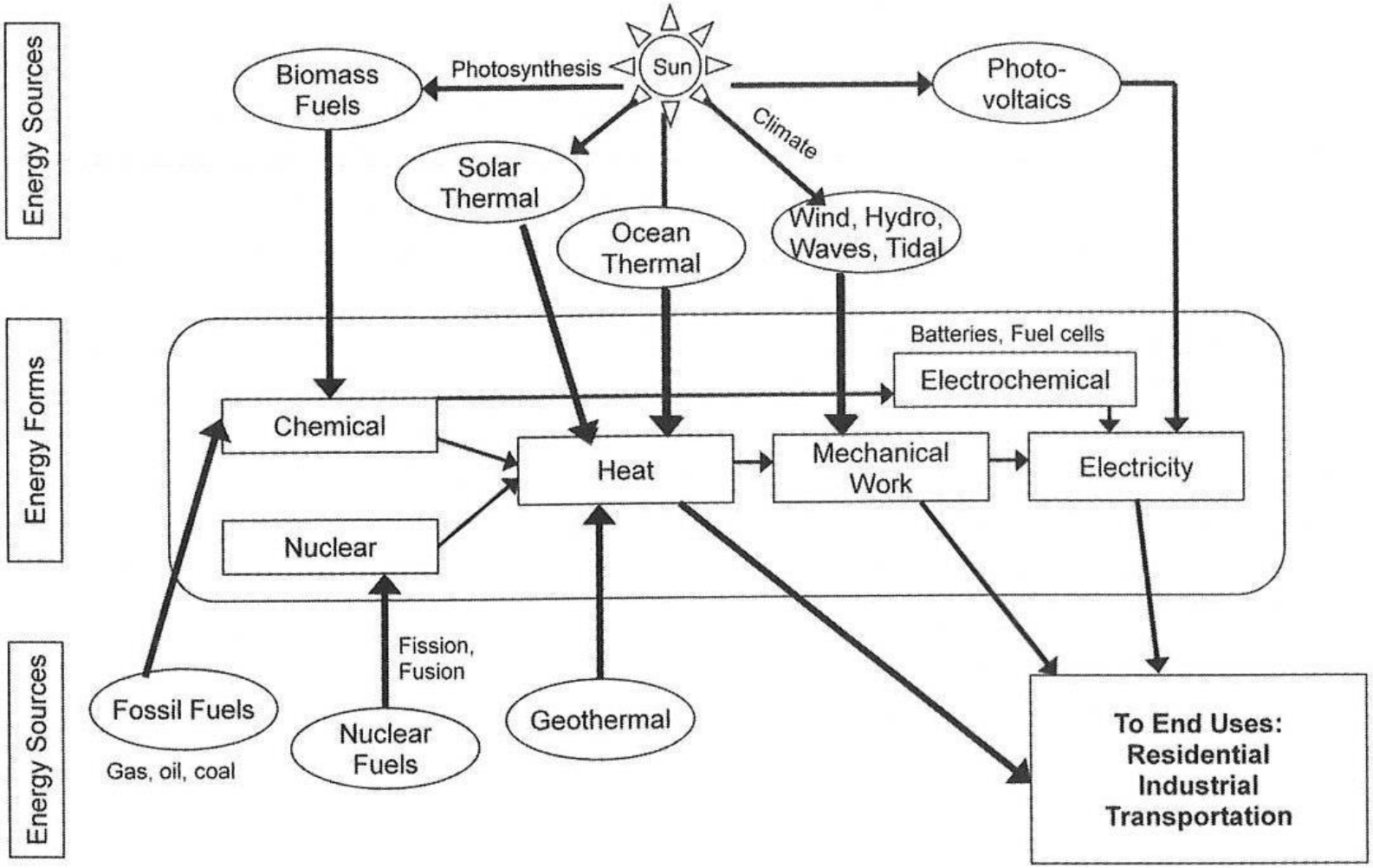


Courtesy: Earth System Research Laboratory, NOAA

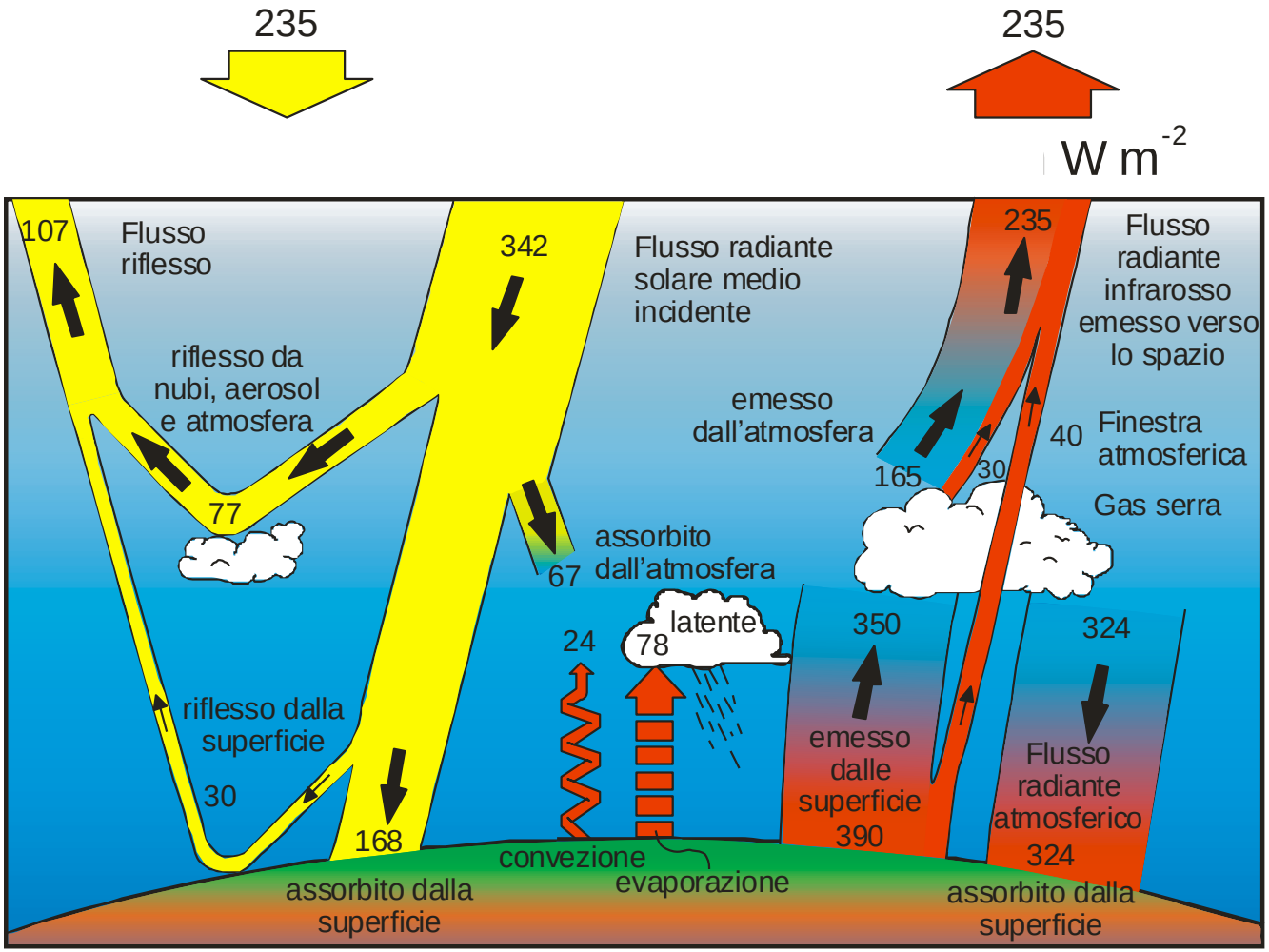
Variazione di temperatura sulla superficie terrestre



Fonti energetiche e processi di conversione



Bilancio di energia

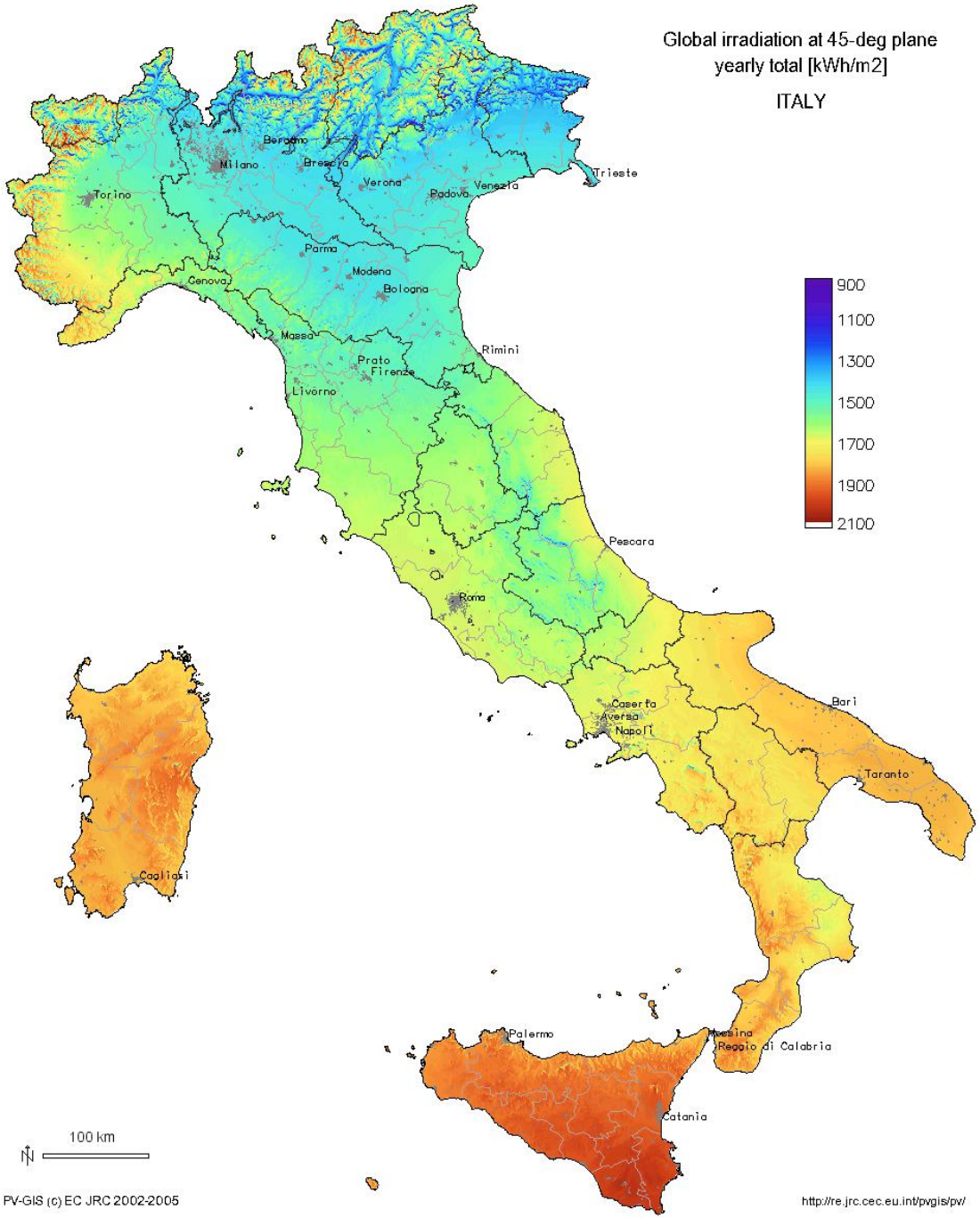


Risorse disponibili

World energy consumption per year (2011) : 12000 Mtoe/yr = 1,6 x 10^{10} kW = 16 x 10^{12} W = 16 TW

Resource	Energy Type	Total Flux, TW (quads/yr)	Net Stored Energy, TW-yr (quads)[b]
Solar	Land flux	27,000	0
	Ocean flux	53,000	0
	Total flux	80,000 (2.7×10^6)	0
Wind	Kinetic energy (land)	100 (3,000)	0
Waves	Kinetic energy (ocean), gravity	200 (6,000)	0
Biomass	Photosynthesis	30 (900)	750 (22,400)
Hydro	Latent evaporative heat	40,000 (1.2×10^6)	80,000 (2.4×10^6)
Tides	Gravitational forces between the moon and earth	>3 (90)	3 (90)
Geothermal			
Hydrothermal, geopressured, and magma	Convection	~2.5 (75)	1.710^5 (5.1×10^6)
Hot dry rock	Conduction	≥30 (900)	$3.3\ 10^6$ (1×10^8)
All fossil fuels	Chemical reaction enthalpies or heats[c]	10 (300)	≥360,000 (1.1×10^7)

[a] Estimates based on information provided by Armstead and Tester (1987), Grubb (1990), and Armstead (1983); US figures based in part on USGS estimates (e.g., see Muffler and Guffanti (1978), Sass (1993)).
[b] 1 quad = 3.35×10^{-2} TW-yr = 10^{15} Btu.
[c] Does not include any energy stored from the solar greenhouse effect, e.g., in atmospheric CO_2, H_2O, or CH_4.

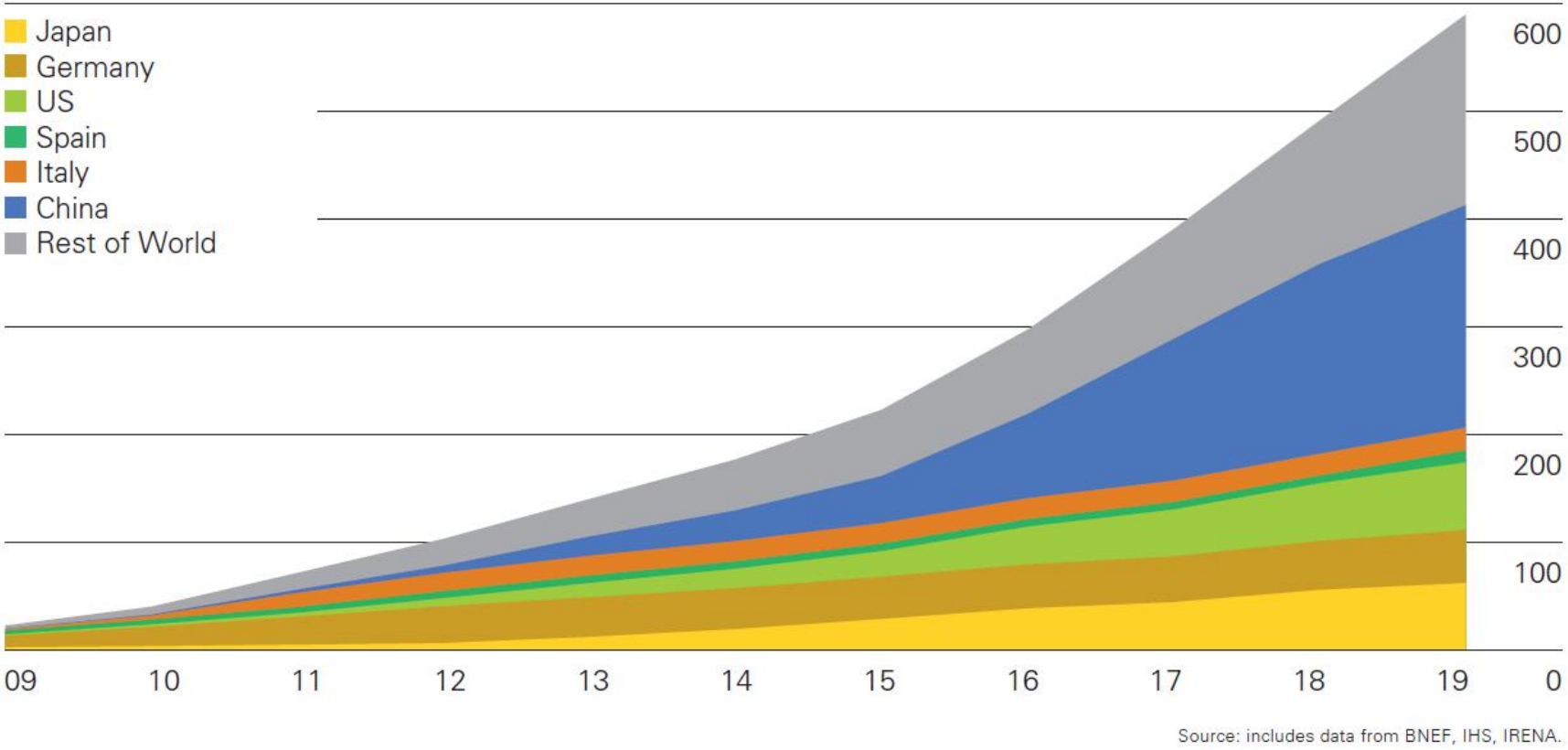

Global irradiation at 45-deg plane
yearly total [kWh/m2]
ITALY
900
1100
1300
1500
1700
1900
2100
Bergamo
Milano
Brescia
Verona
Padova
Venezia
Trieste
Torino
Parma
Modena
Genova
Bologna
Massa
Prato
Firenze
Rimini
Livorno
Pescara
Roma
Caserta
Aversa
Napoli
Bari
Taranto
Cagliari
Palermo
Messina
Reggio di Calabria
Catania
100 km
PV-GIS (c) EC JRC 2002-2005
http://re.jrc.cec.eu.int/pvgis/pv/

Fonte:
PV-GIS

Potenza FV

Solar PV generation capacity

Gigawatts, cumulative installed capacity



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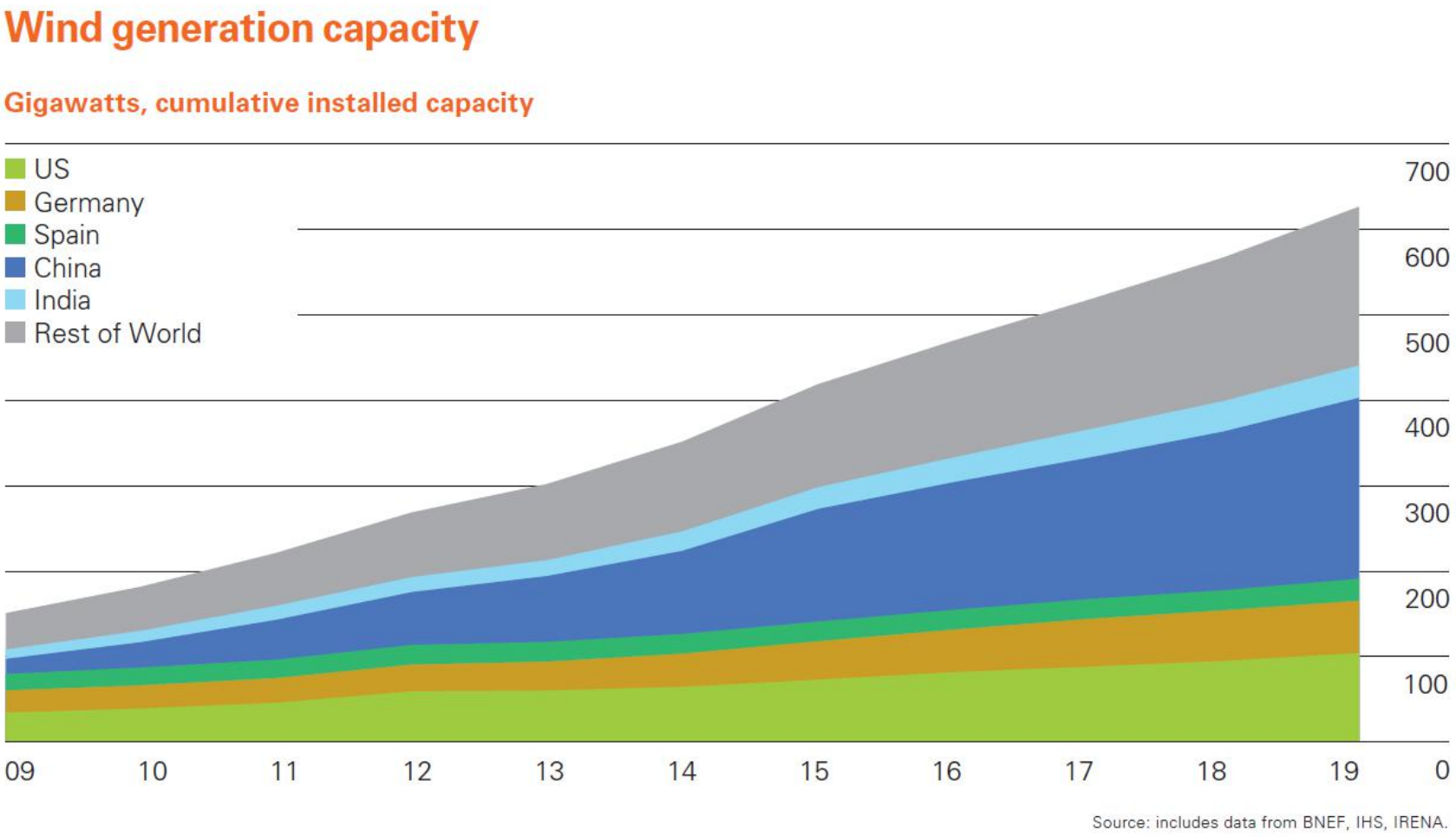
Potenza eolico



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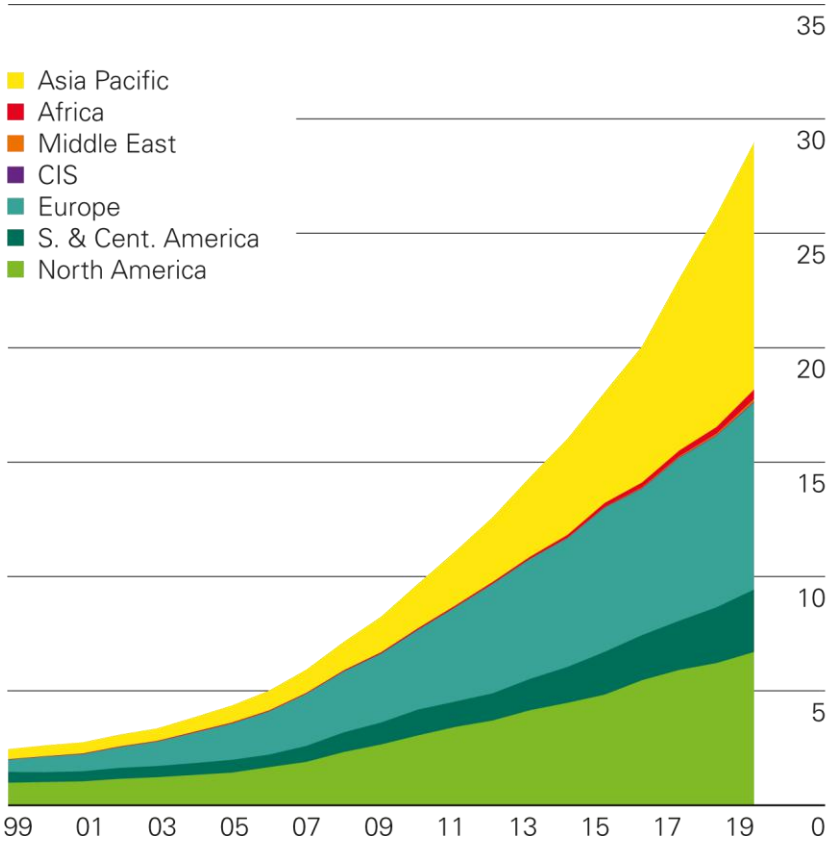
Consumi da fonti rinnovabili

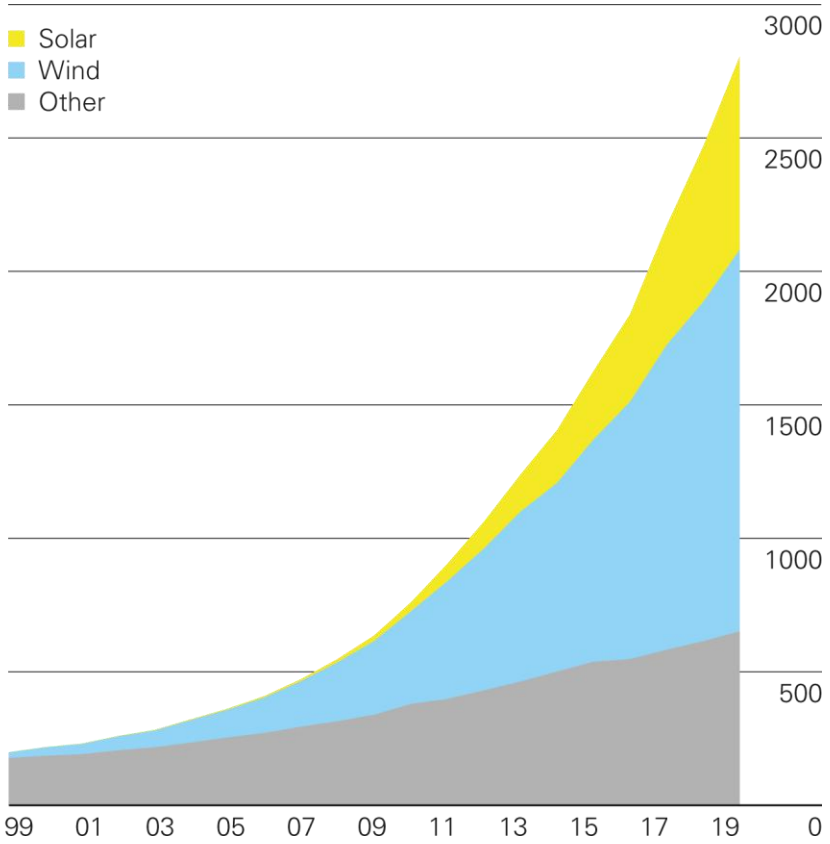
Renewables consumption by region

Million tonnes oil equivalent



Renewables generation by source

Terawatt-hours



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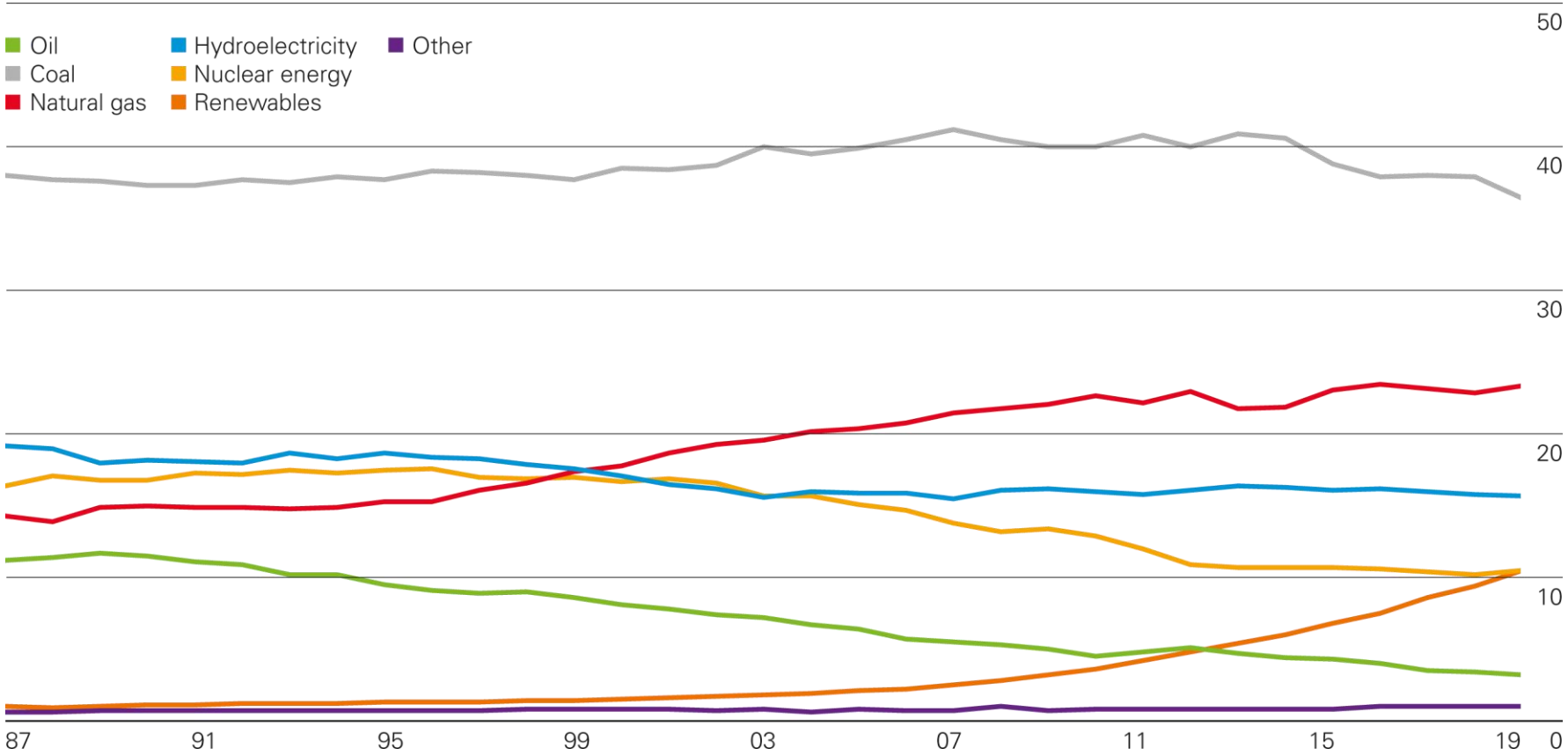
Frazione di energia elettrica prodotta dalle diverse fonti (%)



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FV in Europa

122.3 TWh

Photovoltaic electricity generated in the EU in 2018

7 606.5 MW

Photovoltaic capacity connected in the EU during the year 2018

Capacity installed in 2018 by the main non-EU photovoltaic markets

Countries	Newly added capacity in 2018 (GW)
China	44.4
USA	10.6
India	10.8
Japan	6.5
Turkey	1.6
Australia	3.8
Mexico	2.7

Sources : AIE PVPS, NEA

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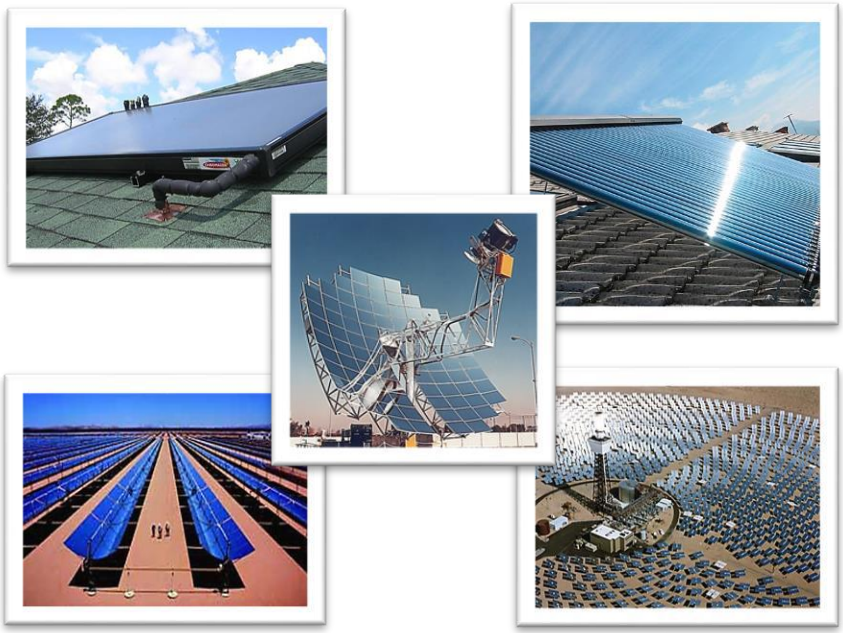
19th EurObserv'ER Report

Utilizzo dell'energia solare

Impianti solari termici



- Sanitary hot water
- Heating of buildings
- Heat generation for industrial applications
- Indirect production of electricity
- Solar cooling
- Desalination

Collettori solari termici

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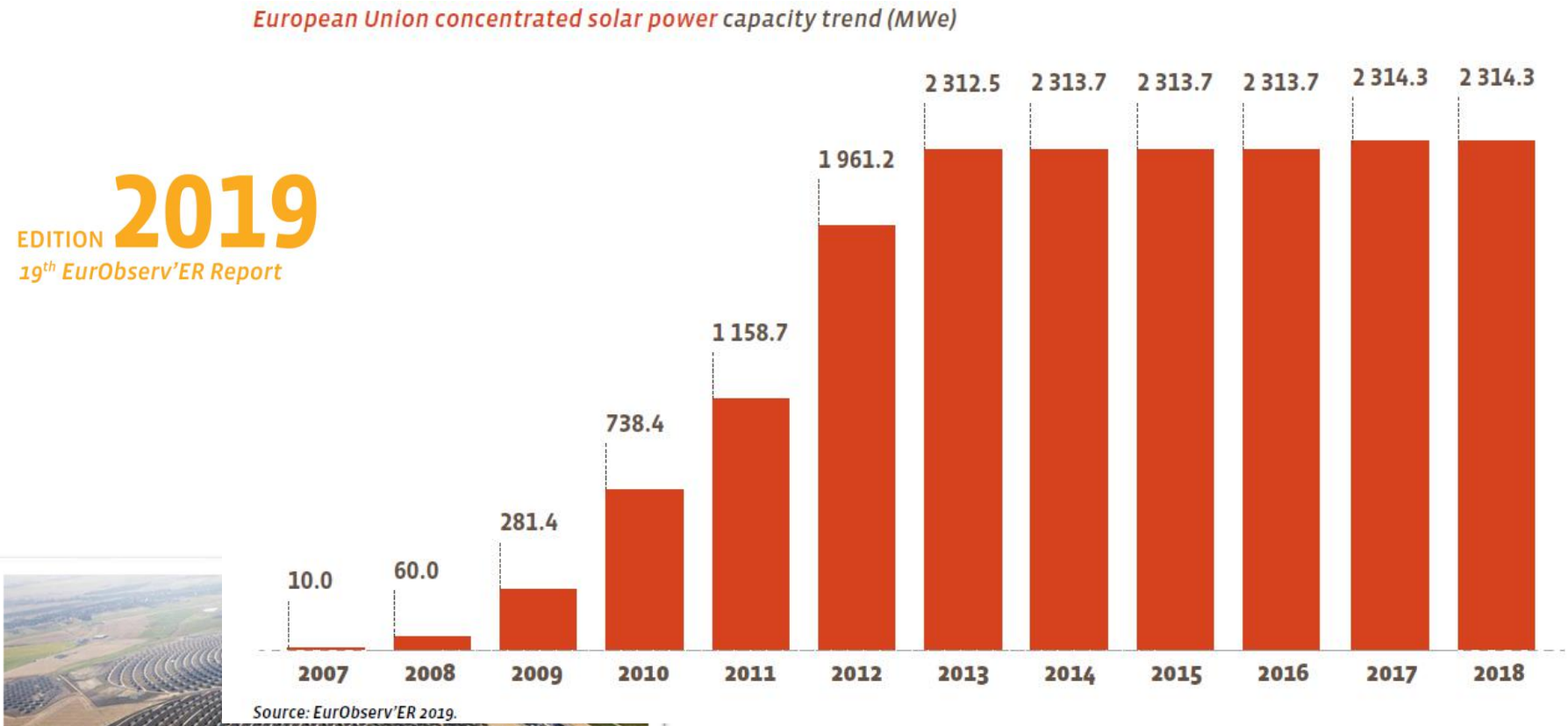
53.5 millions m²

The cumulated surfaces of solar thermal in operation in the European Union in 2018

Evolution of annually installed surfaces in the European Union since 1994 (in m²)

*Member states included at the date of their accession. * Estimations.* **Source: EurObserv'ER 2019.**

CSP – Concentrated Solar Power

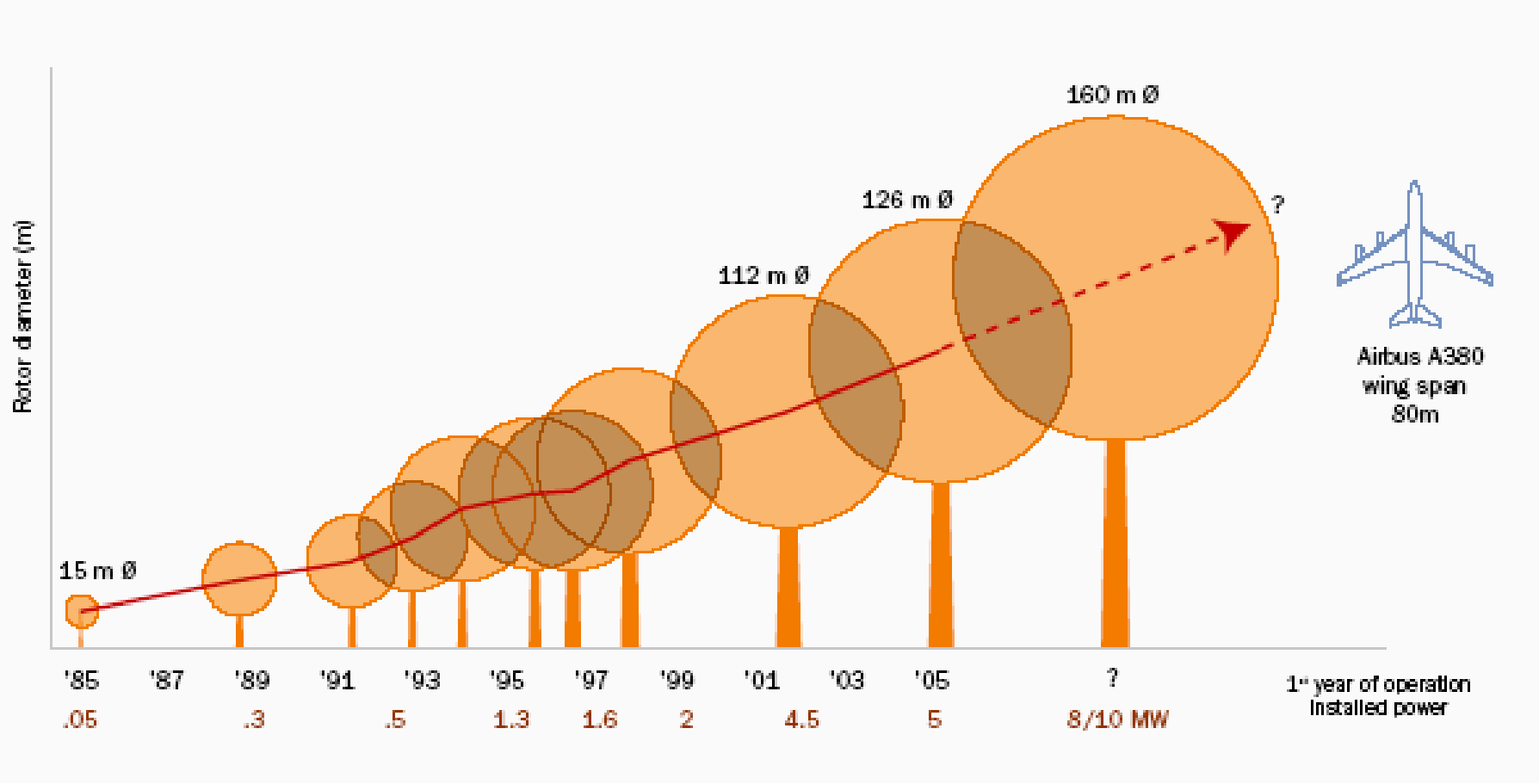


Centrali *PS20* e *PS10*
Solucar Platform in Sanlucar la Mayor, Spagna

Energia dal vento

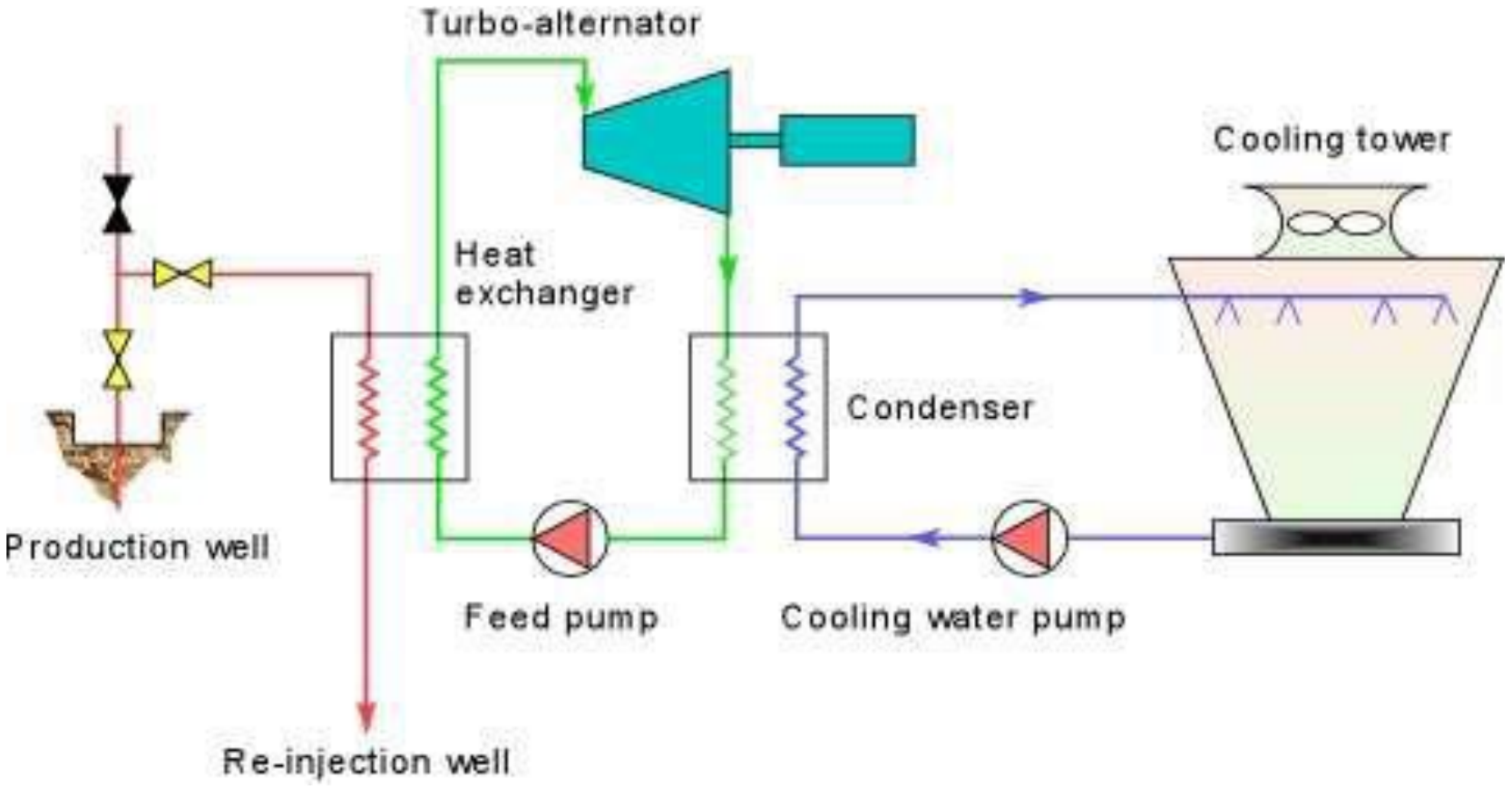
Energia dal vento

Dimensions of HAWT (horizontal axis wind turbines)



Energia geotermica

Electricity production



Energia geotermica

Capacity installed and net capacity usable of geothermal electricity plants in the EU in 2017 and 2018 (in MWe)*

	2017		2018	
	Installed capacity	Net capacity	Installed capacity	Net capacity
Italy	915.5	767.2	915.5	767.2
Germany	38.0	32.0	38.0	36.0
Portugal	34.3	29.1	34.3	29.1
Croatia	0.0	0.0	17.5	10.0
France	17.1	15.9	17.1	15.9
Hungary	3.4	3.0	3.4	3.0
Austria	0.9	0.9	0.9	0.9
Romania	0.05	0.05	0.05	0.05
Total EU 28	1 009.2	848.2	1 026.7	862.2

** Net maximum electrical capacity.* ***Source: EurObserv'ER (Installed capacity), Eurostat (Net capacity)***

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Gross electricity generation from geothermal energy in the European Union countries in 2017 and 2018 (in GWh)

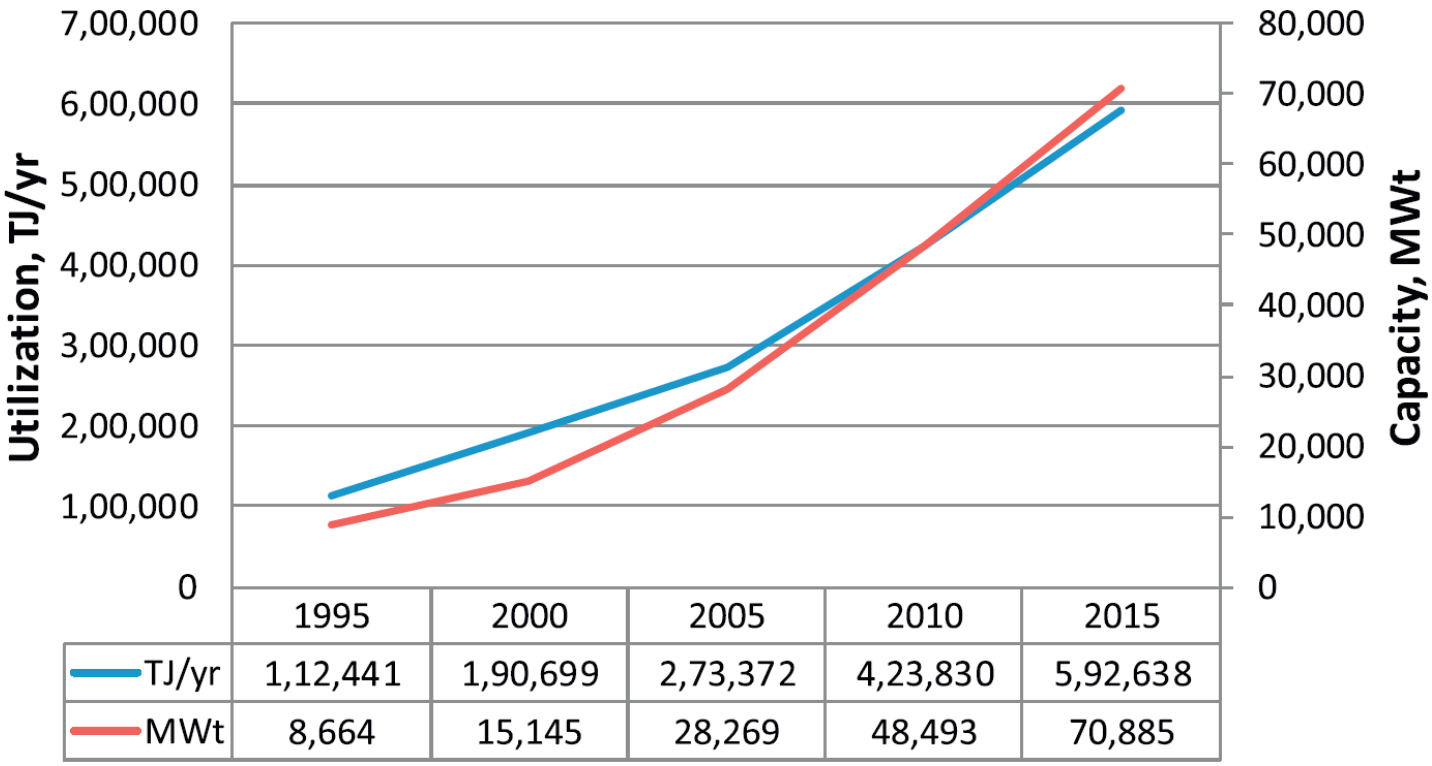
	2017	2018
Italy	6201.2	6105.4
Portugal	216.7	230.4
Germany	163.0	178.0
France	133.1	129.7
Hungary	1.0	12.0
Croatia	0.0	2.0
Austria	0.1	0.2
Romania	0.0	0.0
Total EU 28	6715.0	6657.7

Source: Eurostat

Energia geotermica

APPLICAZIONI NON ELETTRICHE

J.W. Lund, T.L. Boyd / Geothermics 60 (2016) 66–93



	1995	2000	2005	2010	2015
TJ/yr	1,12,441	1,90,699	2,73,372	4,23,830	5,92,638
MWt	8,664	15,145	28,269	48,493	70,885

Fig. 1. The installed direct-use geothermal capacity and annual utilization from 1995 to 2015.

Energia geotermica

Thermal applications

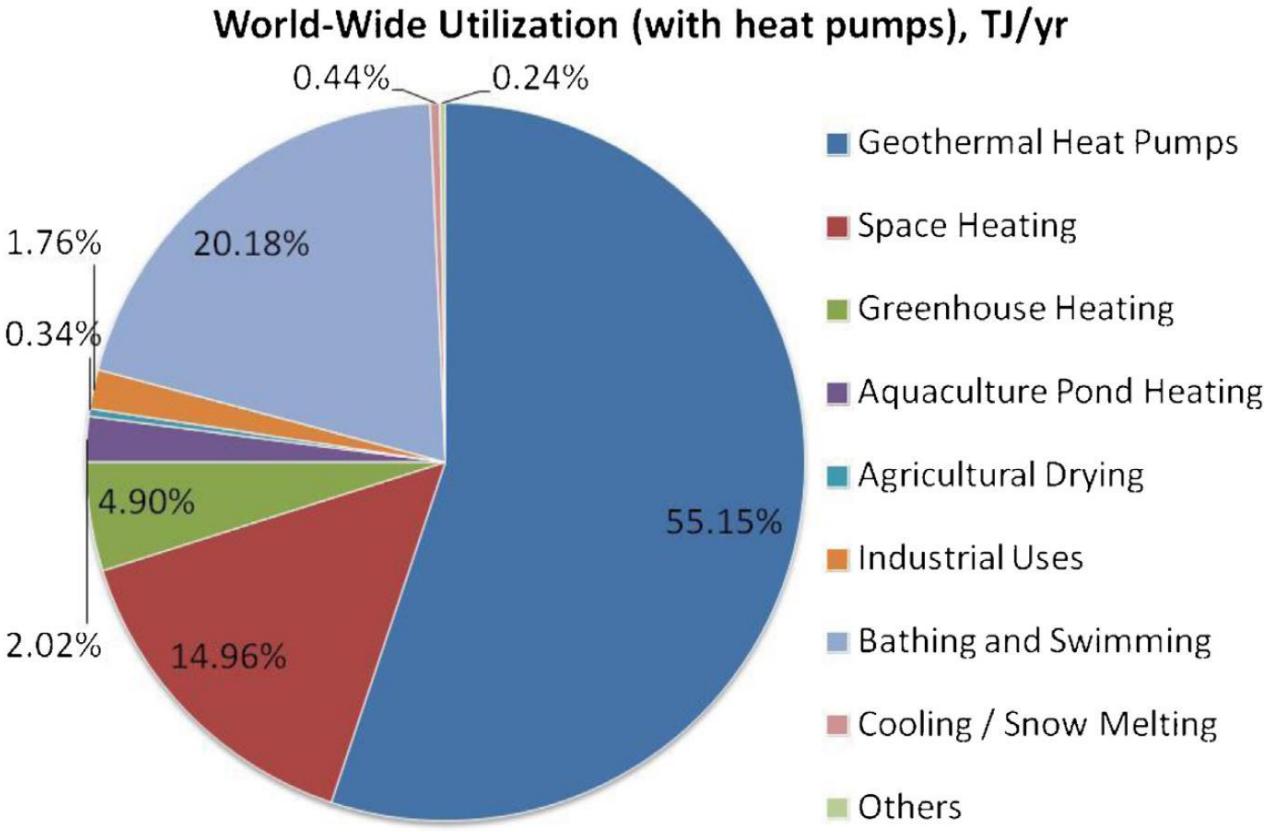
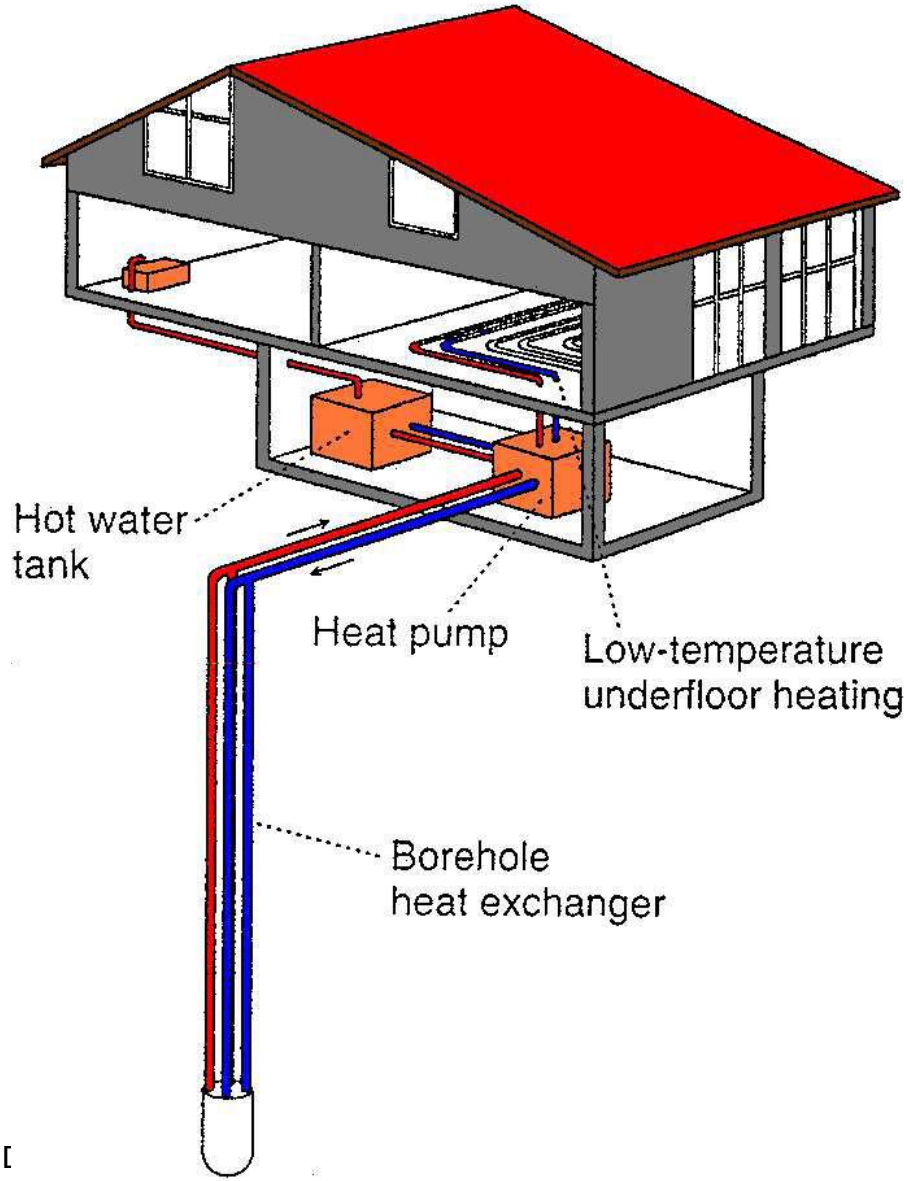


Fig. 4. Geotherml direct applications worldwide in 2015, distributed by percentage of total energy used (TJ/year).

Pompe di calore accoppiate a terreno



Ground Source Heat Pump

Stato e prospettive

IRENA
International Renewable Energy Agency

A fine 2018, la potenza elettrica installata da fonte rinnovabile
era di 2352 GW, con l'Asia a coprire il 61% della nuova potenza installata

Le più grandi economie del mondo producono una quota sempre maggiore di elettricità da fonti rinnovabili (e.g. la Germania il 40%, UK il 33%).

Nei trasporti, enormi progressi sono stati fatti nel campo della mobilità elettrica.

Nonostante ciò, l'uso delle fonti rinnovabili negli edifici e nell'industria rimane basso.

Secondo il report IRENA, bisogna che le emissioni di CO_2 dovute agli usi energetici si riducano del 70% rispetto ai livelli odierni entro il 2050.

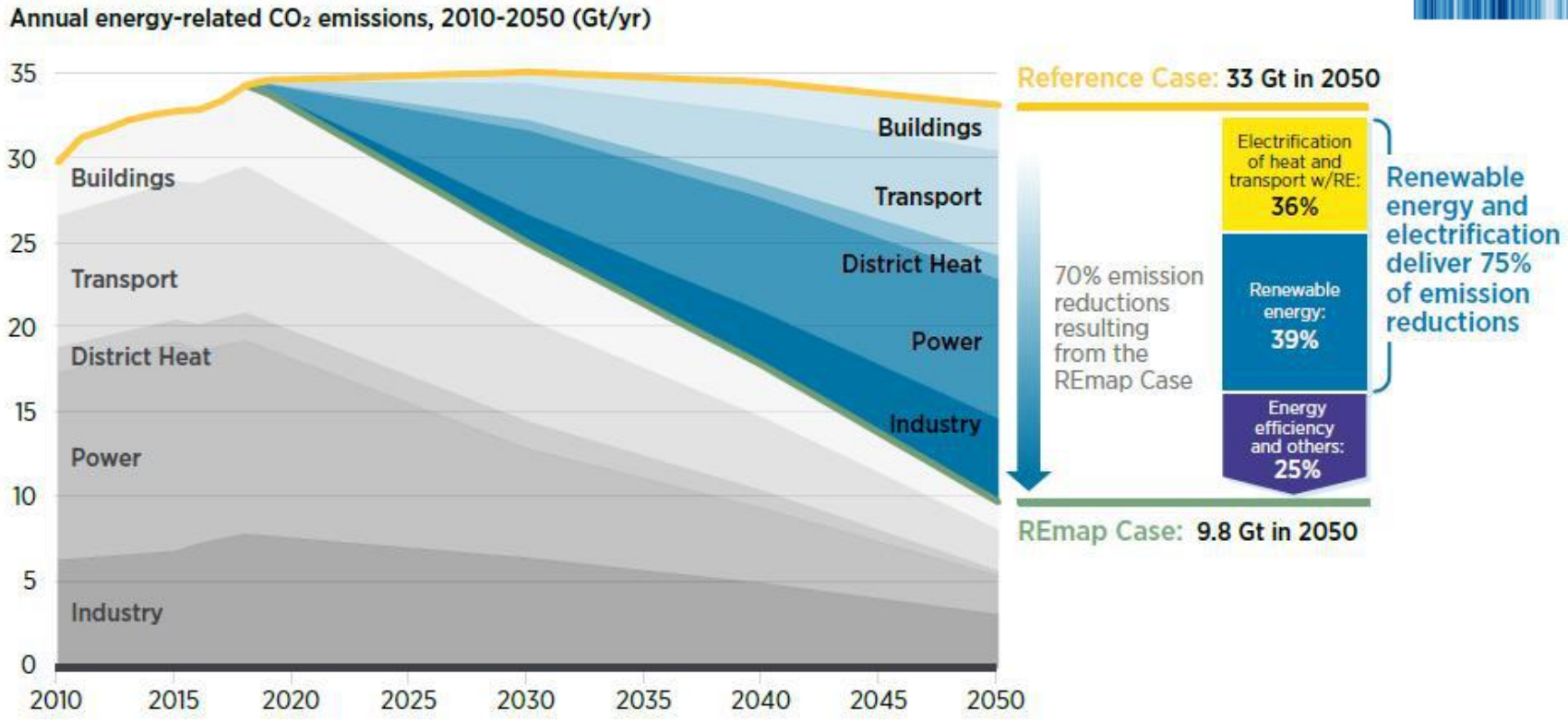
Roadmap (IRENA)

IRENA

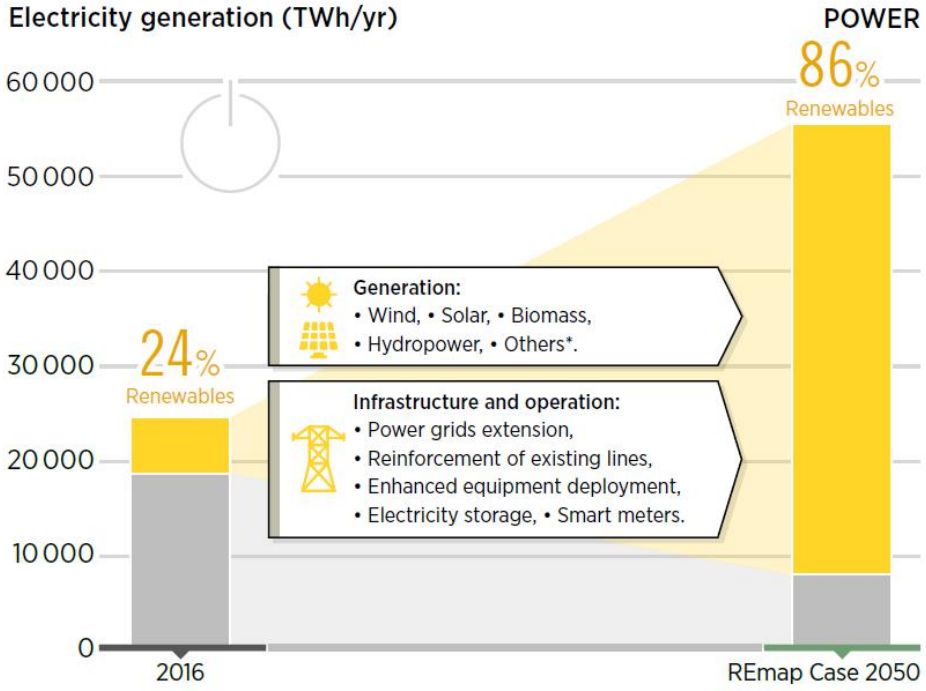
GLOBAL ENERGY TRANSFORMATION
A ROADMAP TO 2050
2019 EDITION

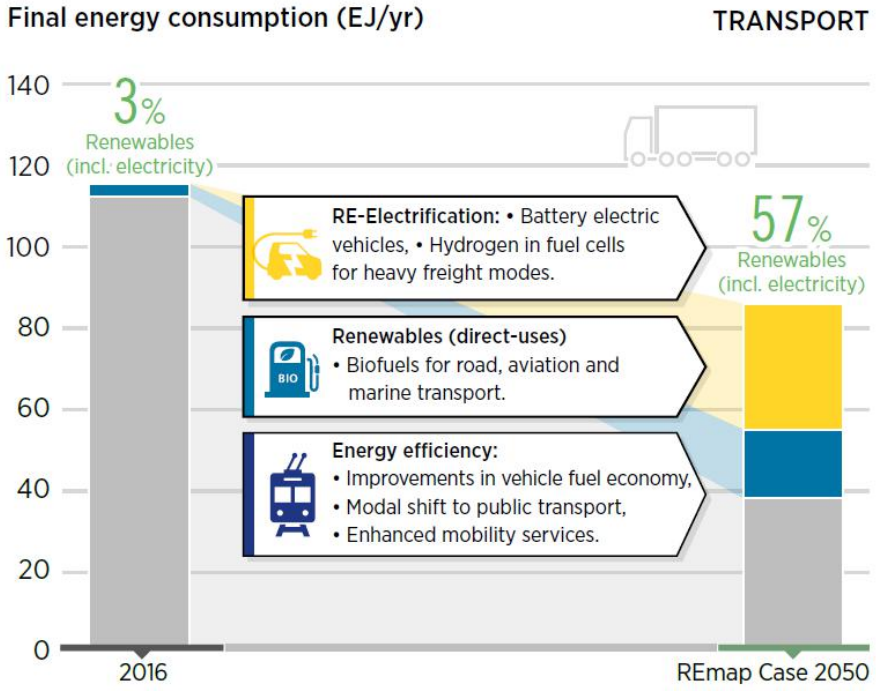
Figure 4. Renewables and energy efficiency, boosted by substantial electrification, can provide over 90% of the necessary reductions in energy-related carbon emissions

Annual energy-related CO_2 emissions in the Reference Case and reductions in the REmap Case, with the contribution by sector, 2010-2050 (Gt/yr)



Roadmap (IRENA)





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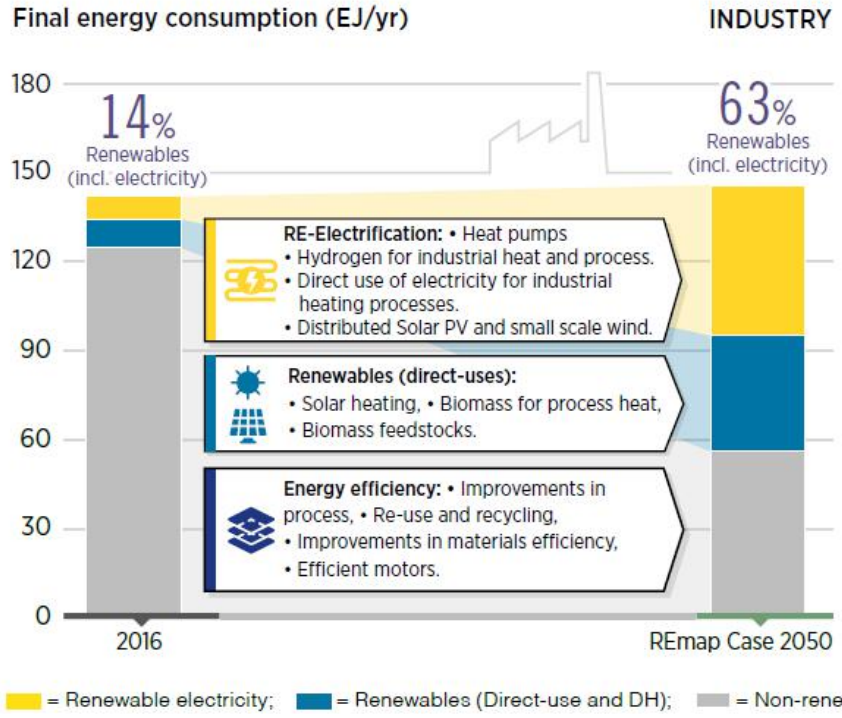

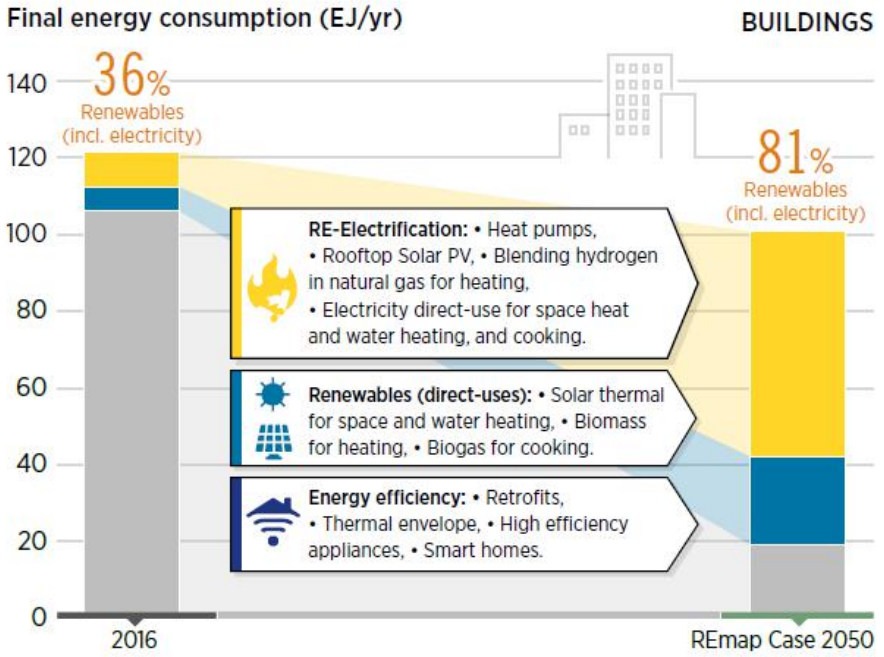

Grazie per la vostra attenzione

davide.delcol@unipd.it
Università degli Studi di Padova
Dipartimento di Ingegneria Industriale