

RETI ELETTRICHE E TRANSIZIONE ENERGETICA

Alessandro Massi Pavan

Martedì 30 giugno 2020



UNIVERSITÀ
DEGLI STUDI DI TRIESTE



Summer School on Energy
Giacomo Ciamician

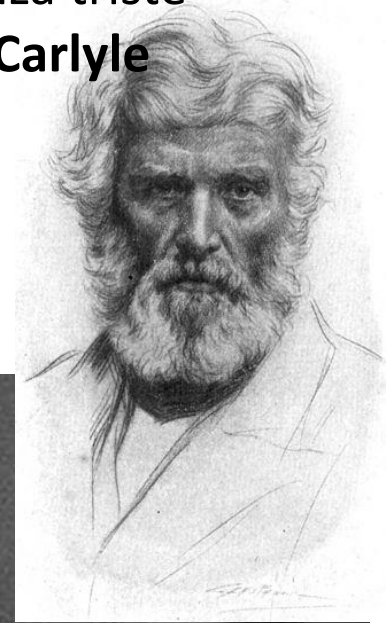
awareenergy

www.awareenergy.eu



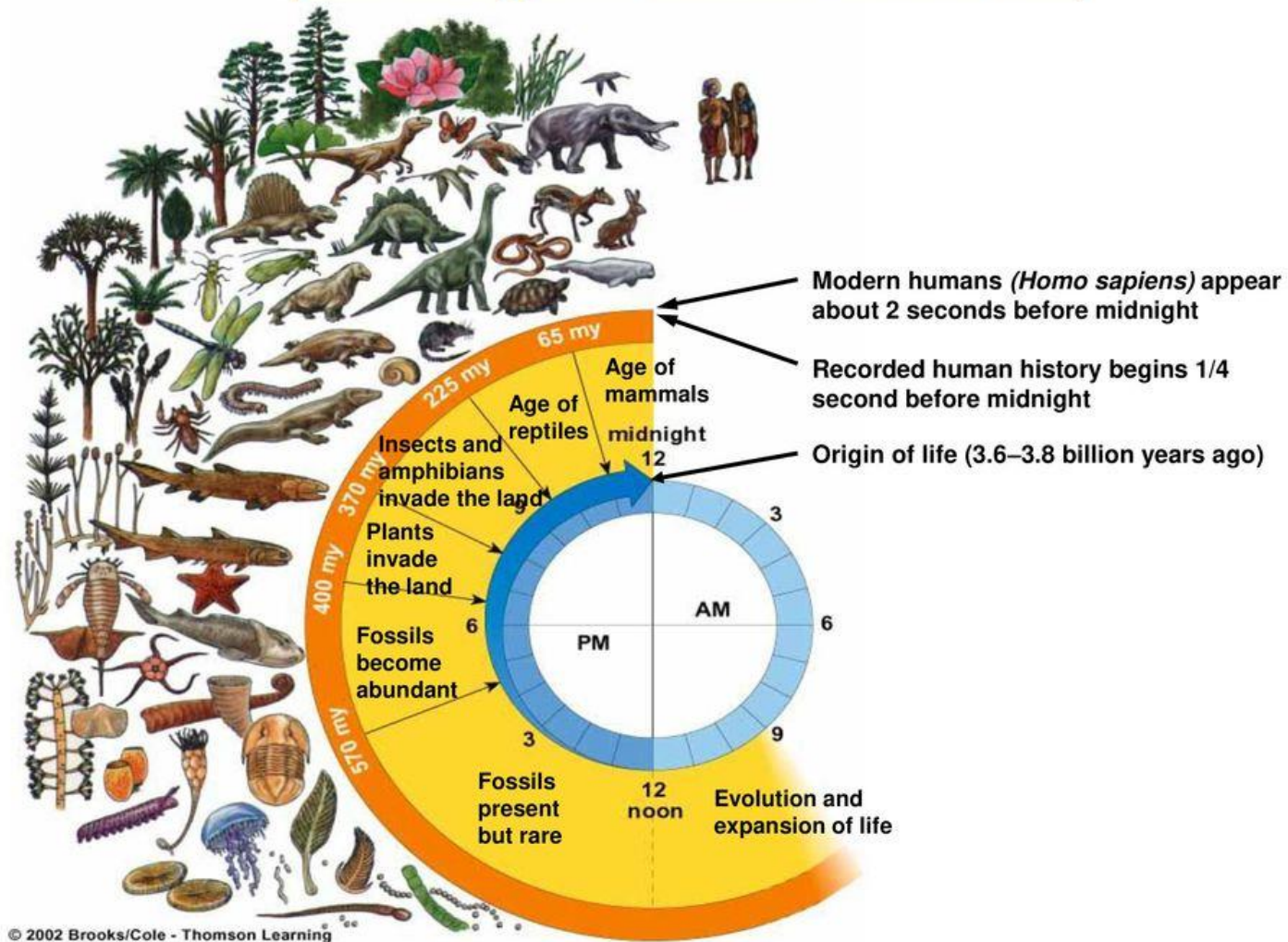
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TRIESTE

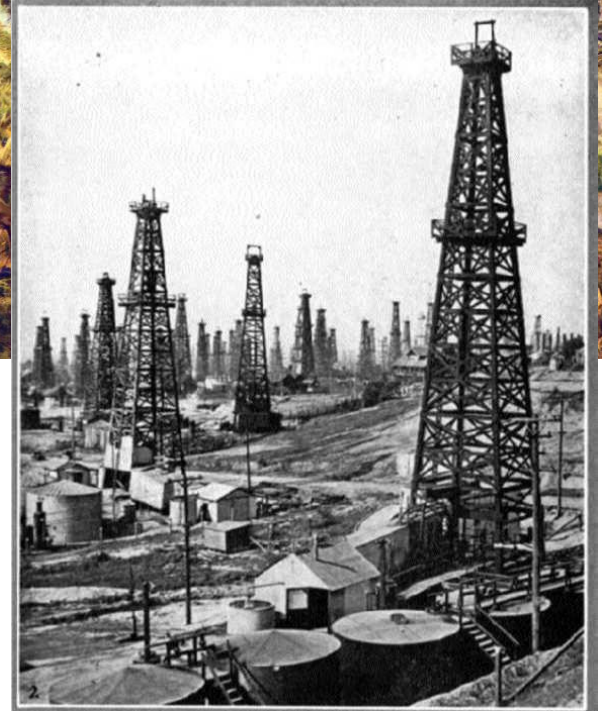
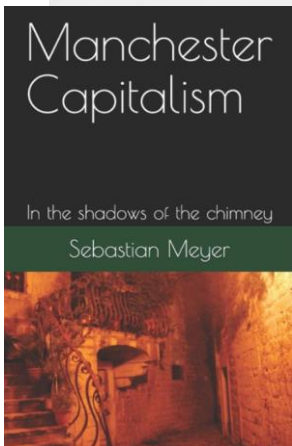
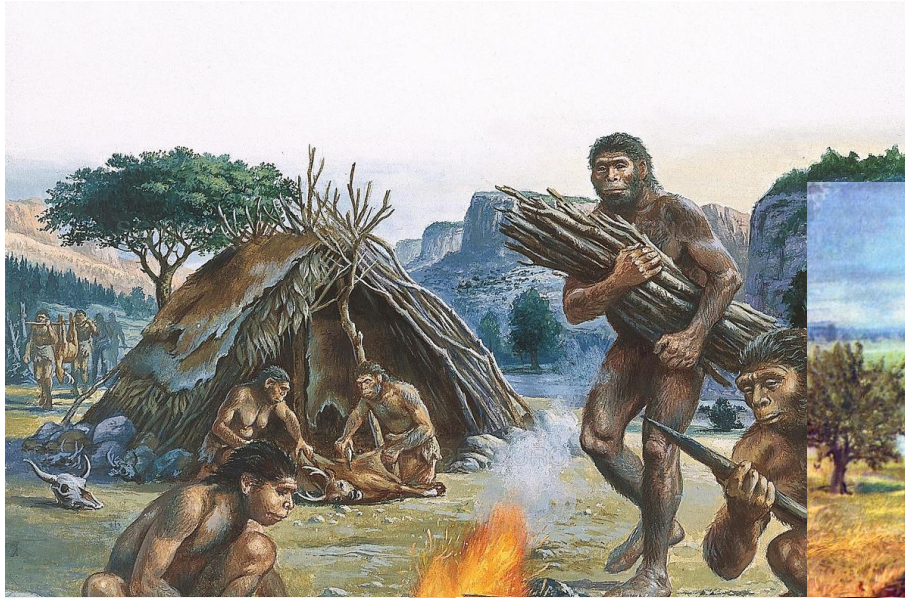
Economia, la scienza triste secondo **Thomas Carlyle**



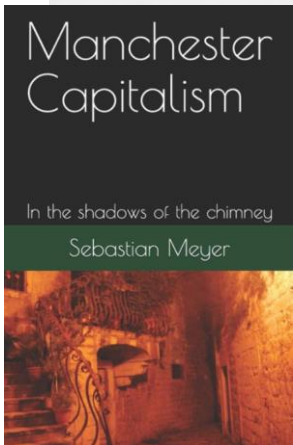
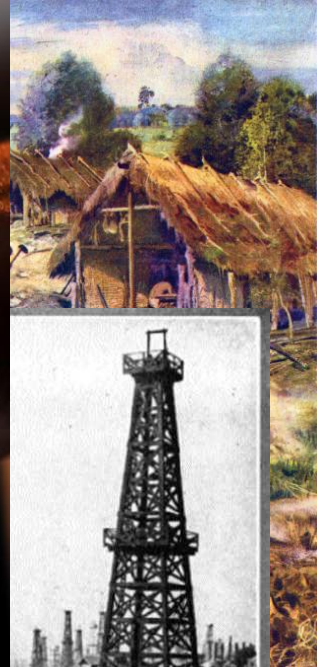
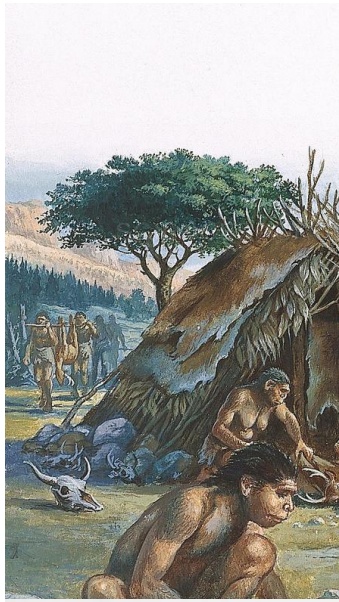
**Nicholas Georgescu Roegen, la
bioeconomia e la legge dell'entropia**

Biological Evolution





History of Steam Engine



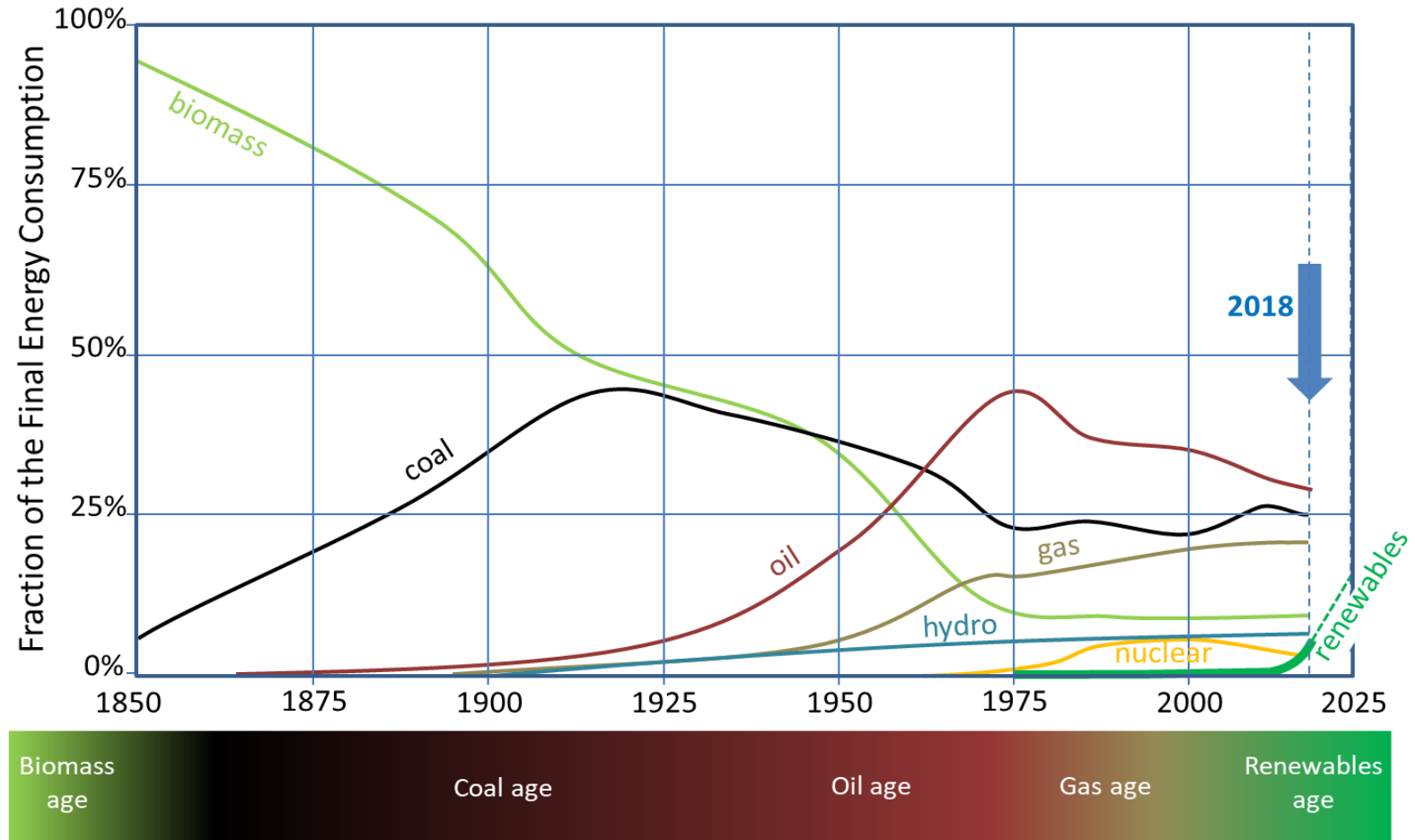
History of Steam Engine



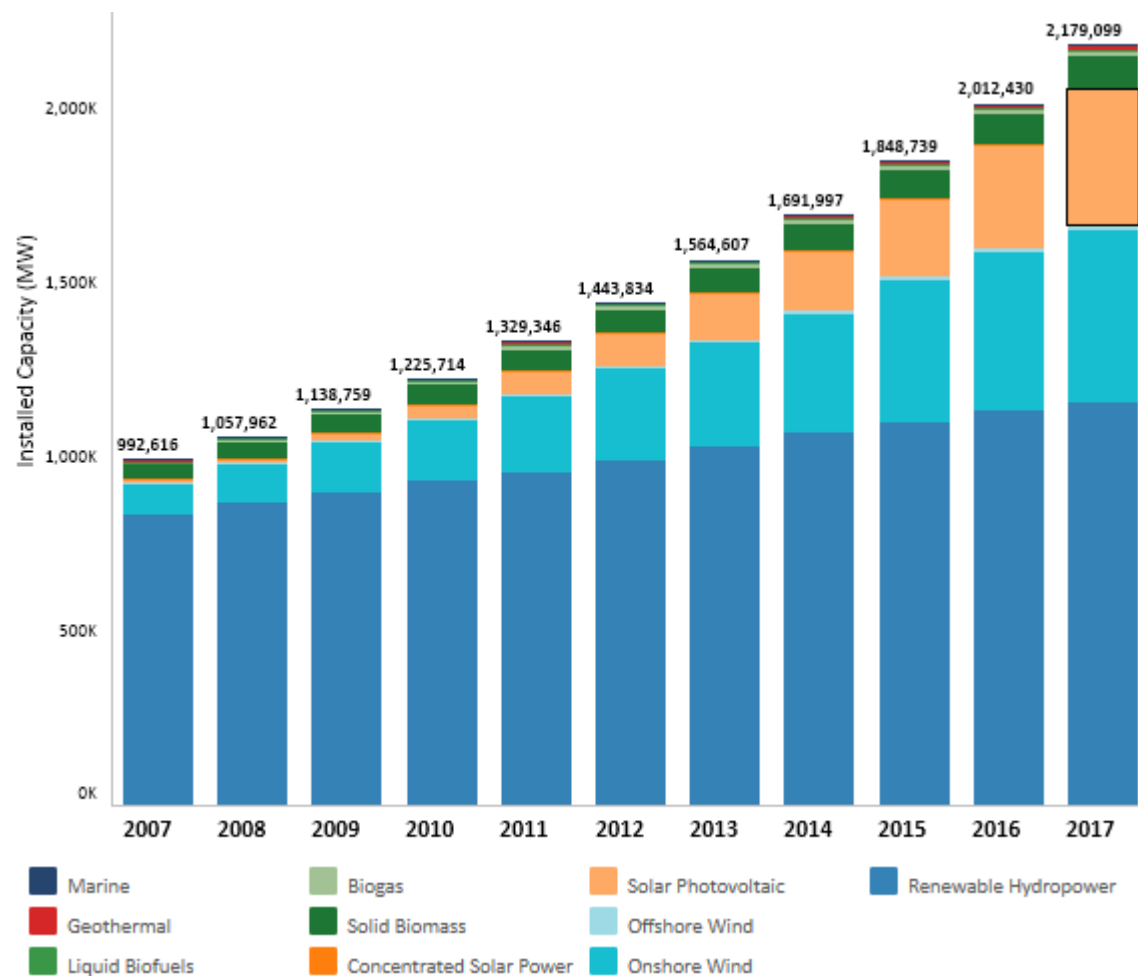


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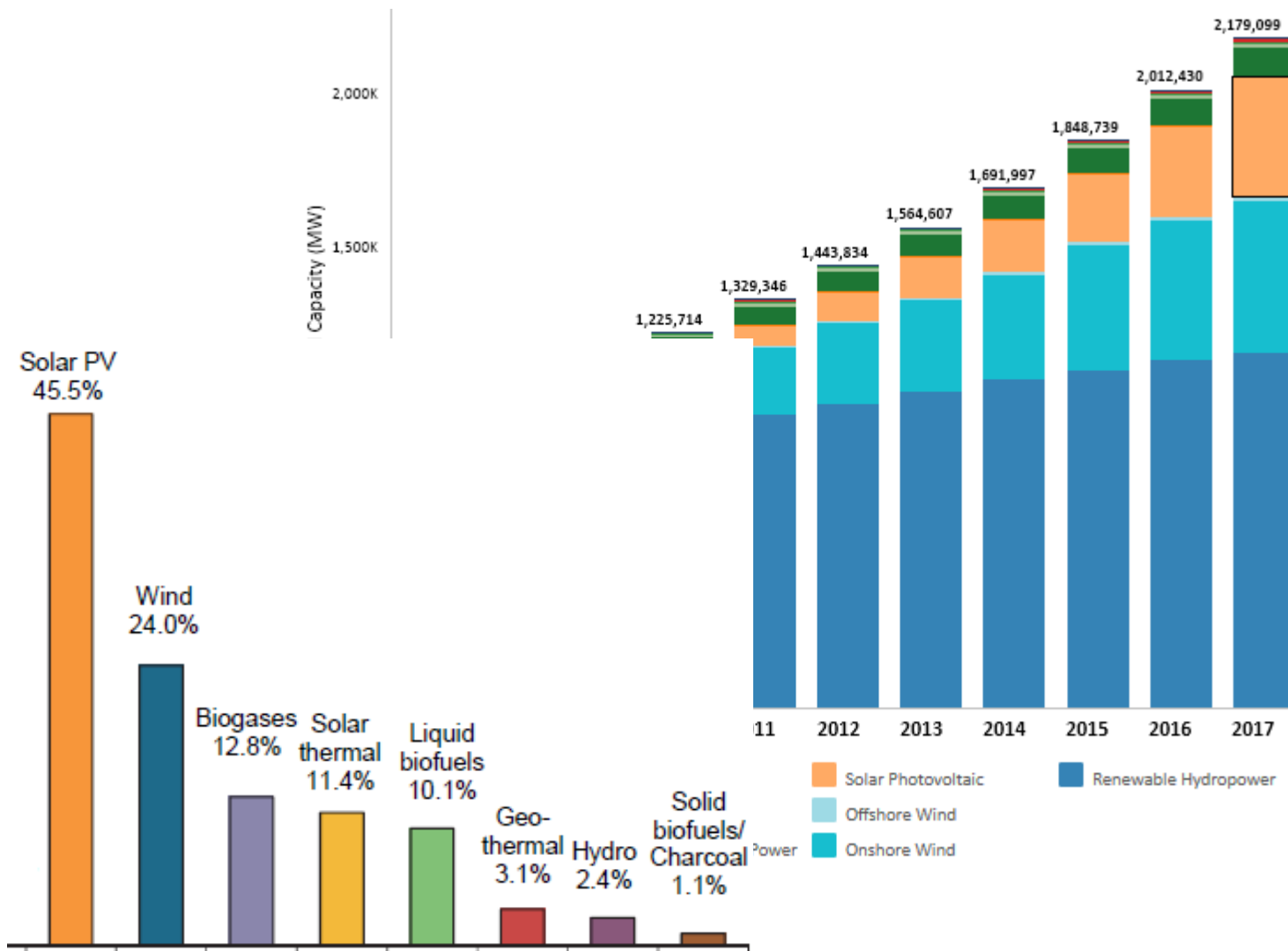
TRANSIZIONI ENERGETICHE



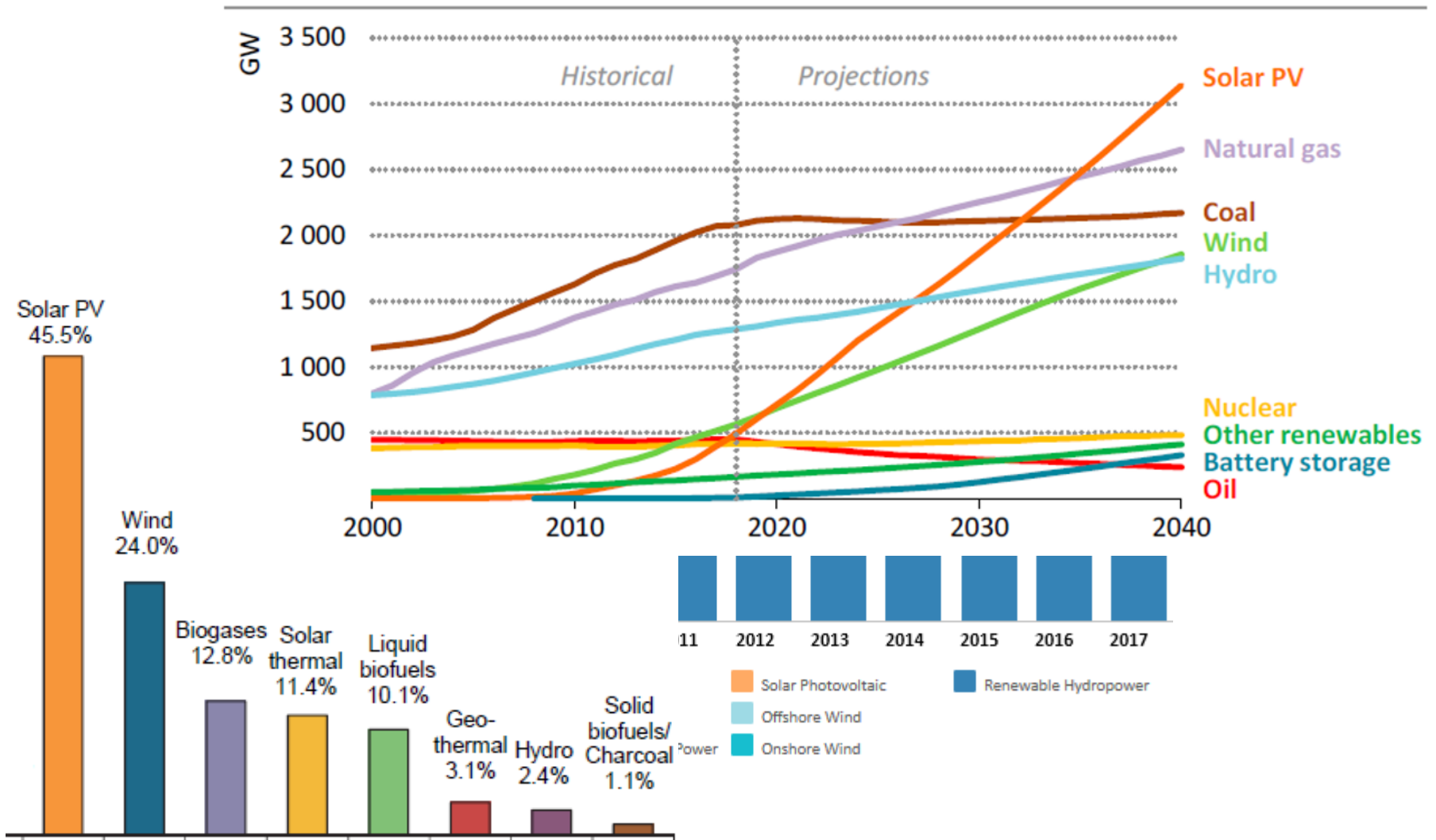
IL BOOM DELLE RINNOVABILI



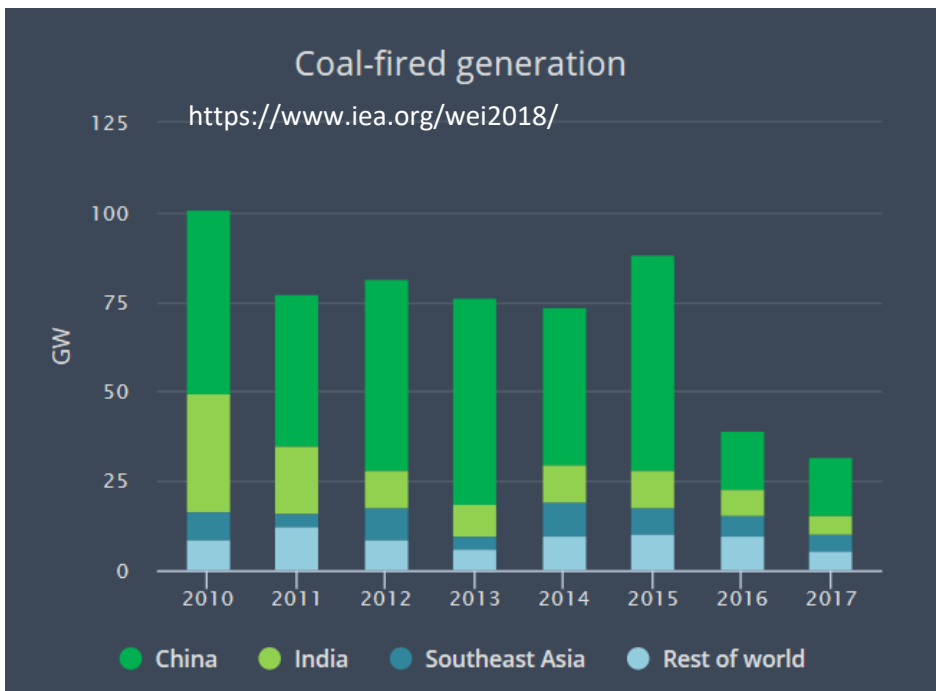
IL BOOM DELLE RINNOVABILI



IL BOOM DELLE RINNOVABILI

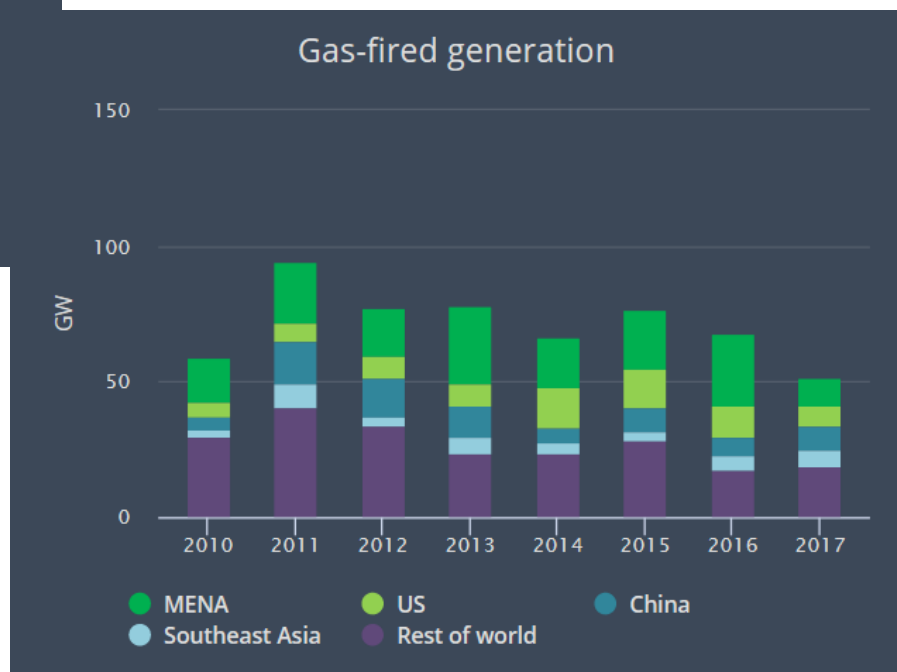


E LE TRADIZIONALI?



RES $\approx$ 2,2TW

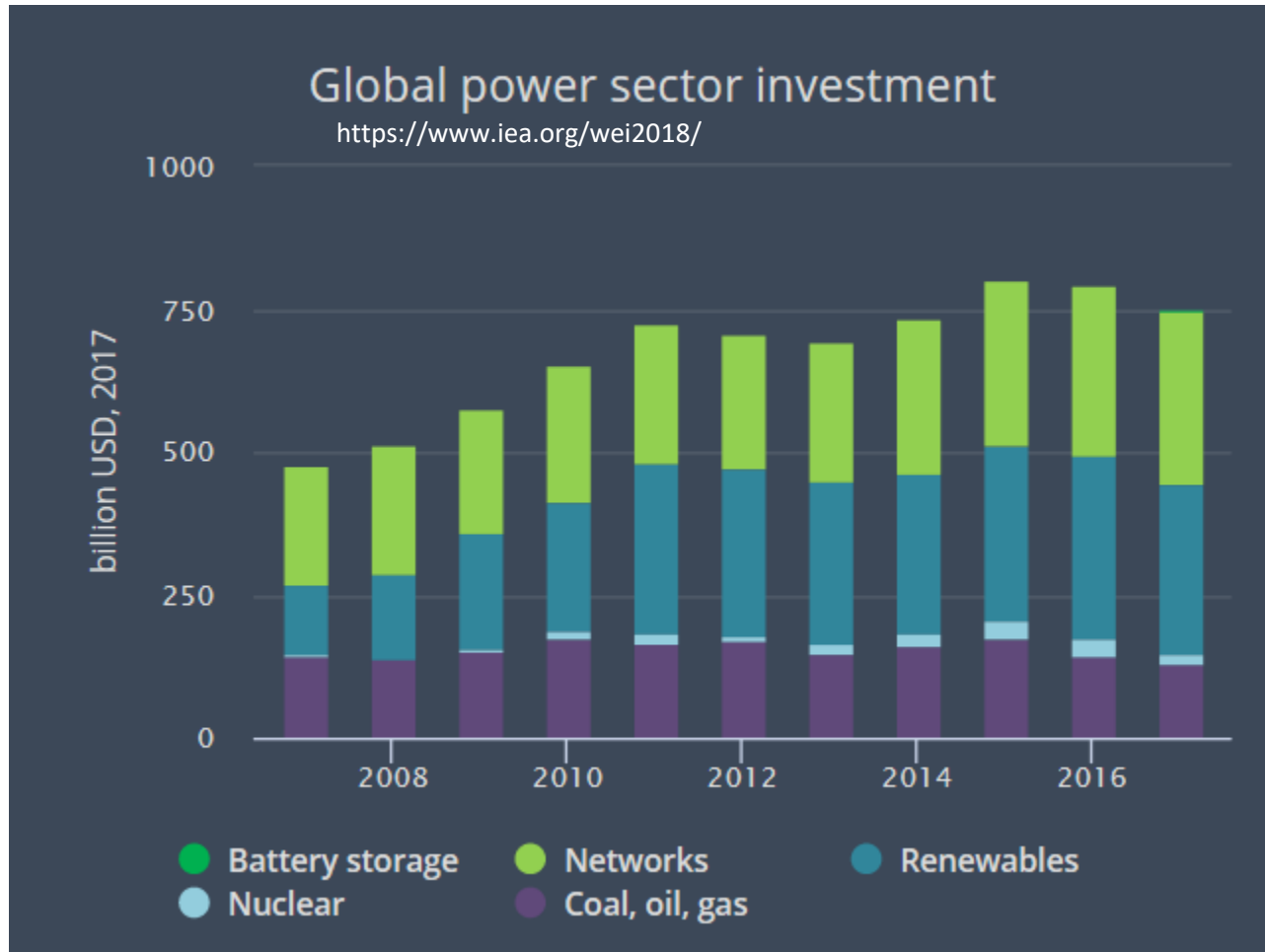
NUCLEARE $\approx$ 0,5TW



GAS $\approx$ 1,5TW

CARBONE $\approx$ 1,9TW

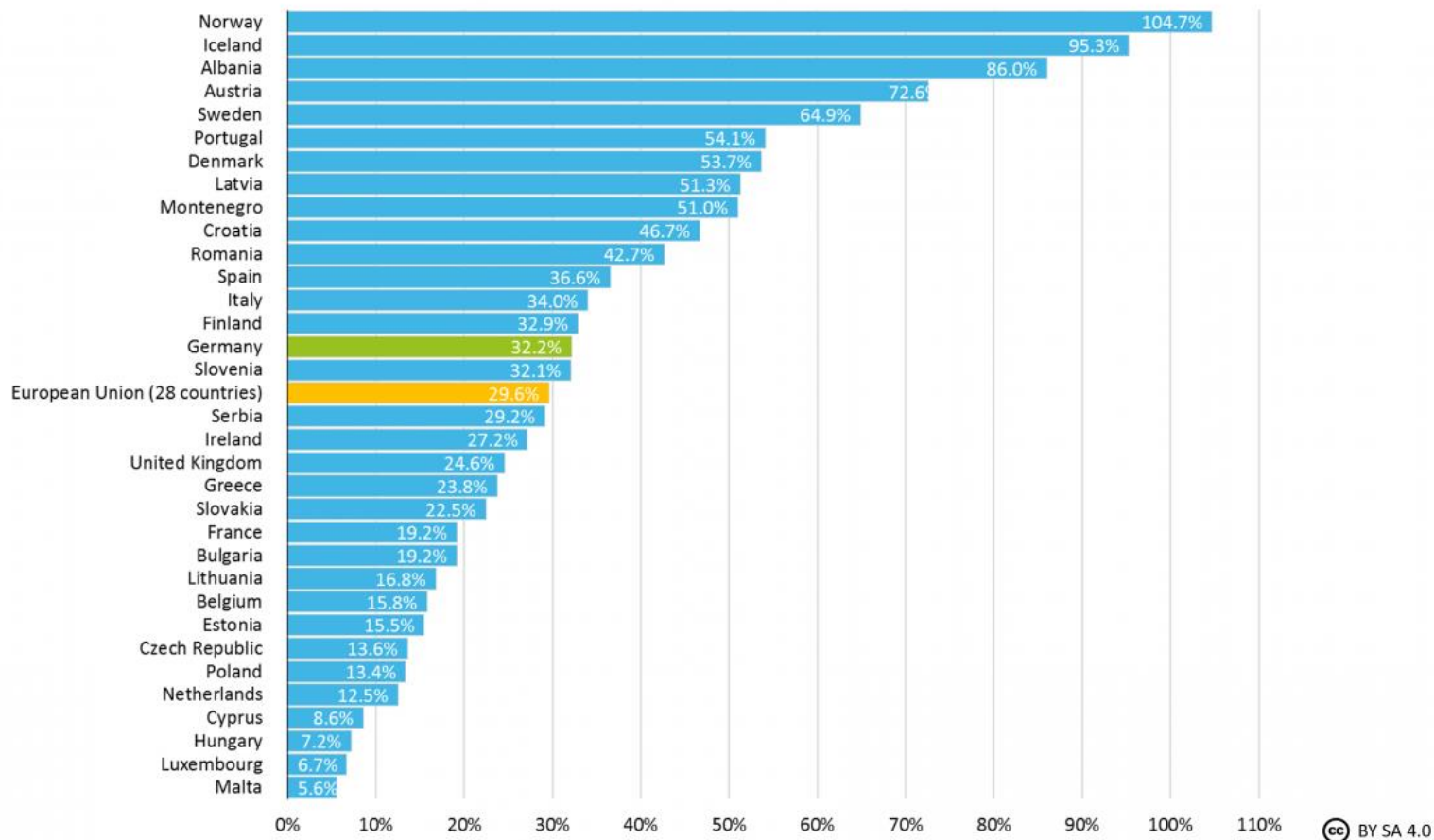
INVESTIMENTI SETTORE ENERGETICO



ENERGIA ELETTRICA IN EUROPA

Share of electricity from renewable sources in gross electricity consumption in European countries in 2016.

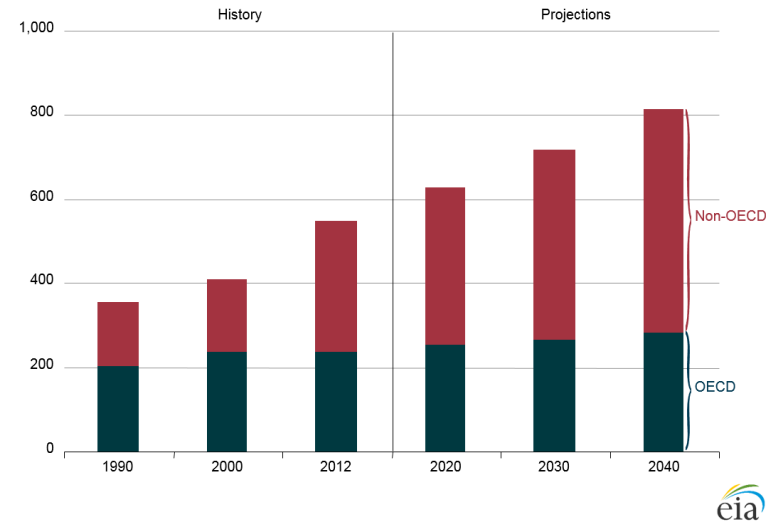
Data: Eurostat 2018.



LE RISORSE ENERGETICHE SONO LIMITATE



Figure 1-1. World energy consumption, 1990-2040
quadrillion Btu



Estimates of world crude oil and NGLs resources

billion barrels

Average Oil Demand (2013-2035): 100

	OPEC	Non-OPEC	Total world
Cumulative production to 2010 (a)	446	695	1,142
Proved reserves (b)			1,467
Reserves to be added ultimately (c)	617	620	1,237

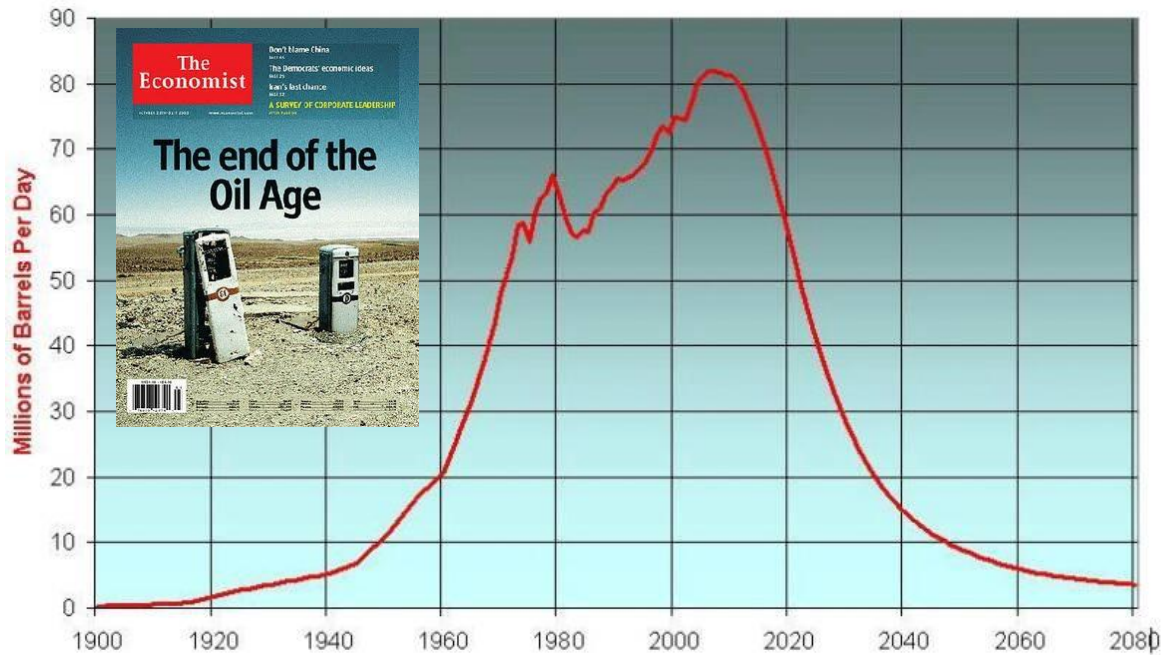
YEARS TO GO ARE $2,704/100 = 27!!!$

World Oil Outlook – OPEC 2012

Total reserves: 2,704

TUTTO E' LIMITATO

World Oil Production 1900-2080

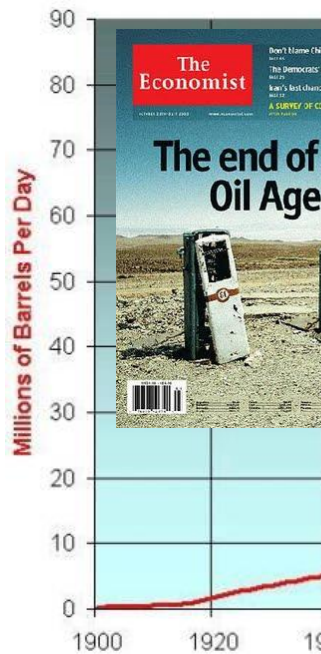


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w Oil, Food, Water: Is Everything Past Its Peak?



Thousands of Chinese people gather at Asia's biggest floating-swimming pool to cool off from the summer heat in Suining, southwest China's Sichuan province on July 20, 2010. The temperature had reached 40 degrees celcius. Photograph by STR/AFP/Getty Images

By Eric Roston | Feb 6, 2012 6:11 PM GMT

f t in g+1 47 COMMENTS

QUEUE

An unprecedented crisis faced America. Oil production was going to peak in just three to five years, resulting in foreign oil addiction and economic calamity. The scientist responsible for slapping the nation into consciousness implored industry and government to act: "The smug

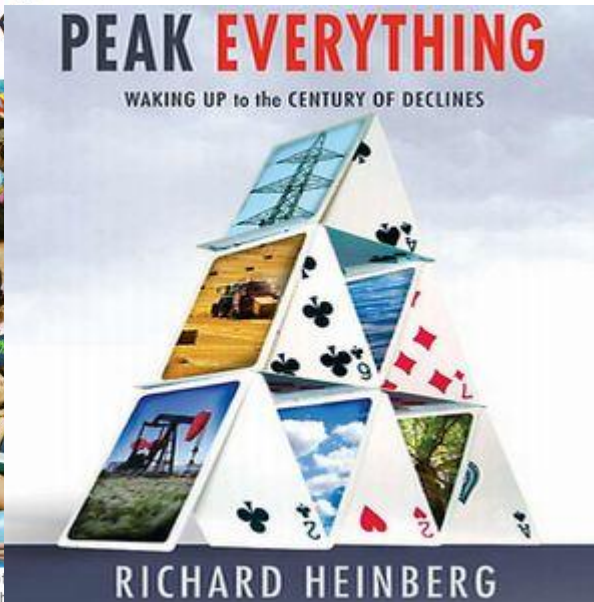
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Oil, Food, Water: Is Everything Past Its Peak



Thousands of people are seen in a crowded swimming pool in southwest China, as temperatures rise. STR/AFP/Getty Images



Heat in Suining, China. Photograph by [unclear]

By Eric Roston | Feb 6, 2012 6:11 PM GMT

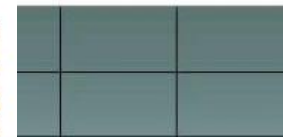


47 COMMENTS

QUEUE



An unprecedented crisis faced America. Oil production was going to peak in just three to five years, resulting in foreign oil addiction and economic calamity. The scientist responsible for slapping the nation into consciousness implored industry and government to act: "The smug



HEALTH POLITICS + ECONOMICS SCIENCE + TECHNOLOGY NATURAL WORLD

COMMENT HOW TO MAKE A DIFFERENCE ARCHIVE 1970-2011 VIDEO SUBS

books

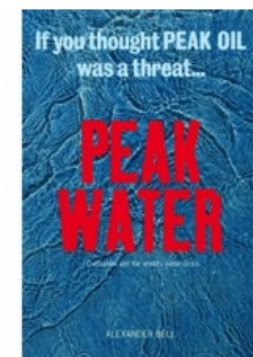
SEARCH

Oil: civilisation and the water crisis

+1 0 Like 8

Peak Water offers a light into our changing relationship with water

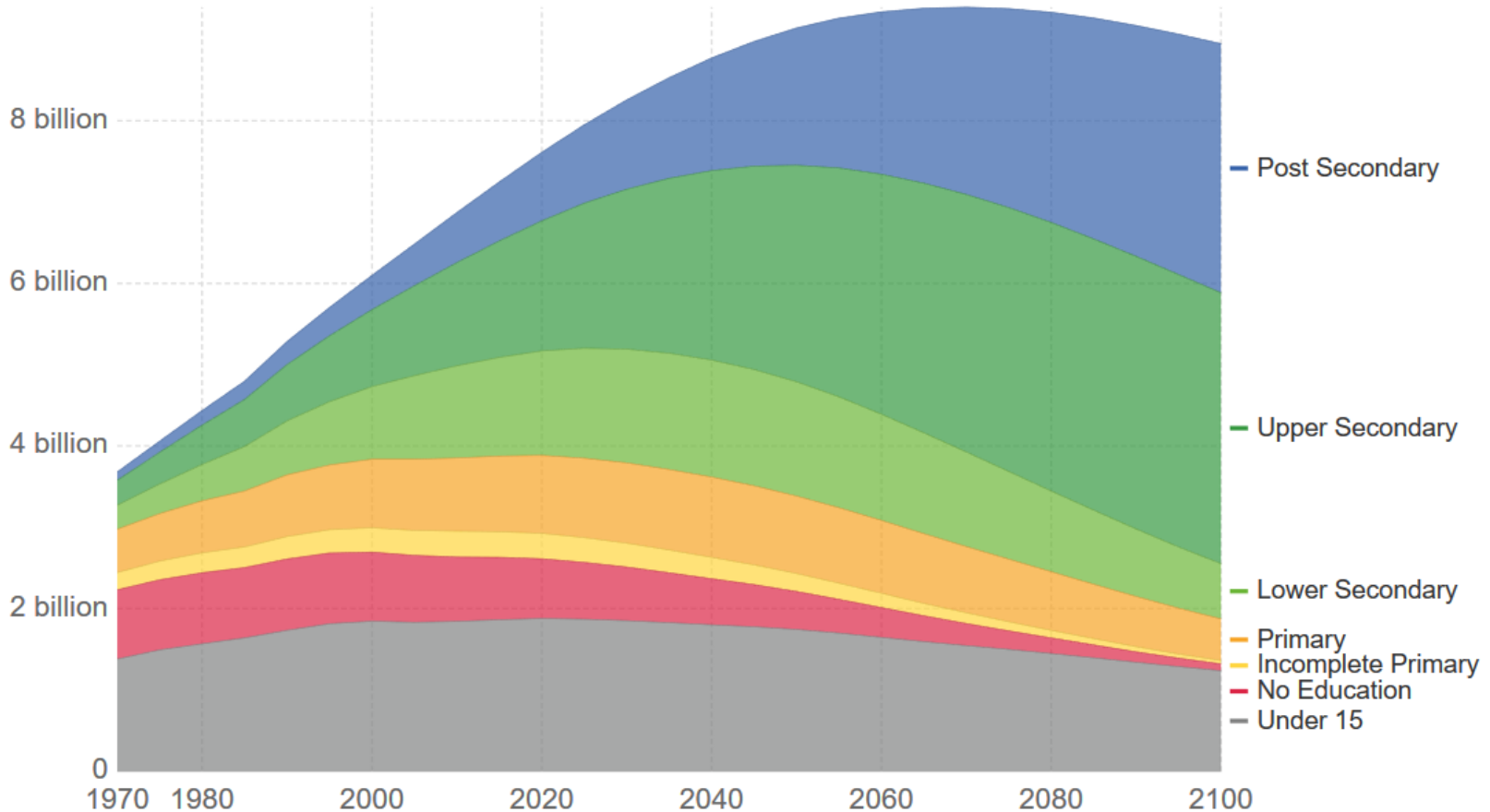
Civilization on water and drained the subject of Alexander Bell's



TUTTO E' LIMITATO

Projected world population by level of education

This visualization shows the Medium projection by the International Institute for Applied Systems Analysis (IIASA). The researchers who created this projection describe it as their "middle of the road scenario that can also be seen as the most likely path".



Source: Global Projection, Medium SSP2 - IIASA (2016)

OurWorldInData.org/world-population-growth/ • CC BY-SA



AMBIENTE

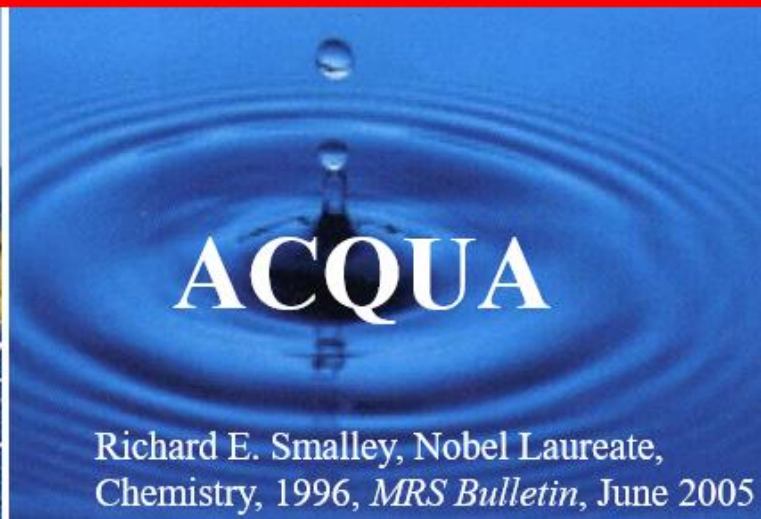


CIBO

4 Emergenze a livello Mondiale



ENERGIA



ACQUA

Richard E. Smalley, Nobel Laureate,
Chemistry, 1996, *MRS Bulletin*, June 2005

QUALITA' DELLA VITA



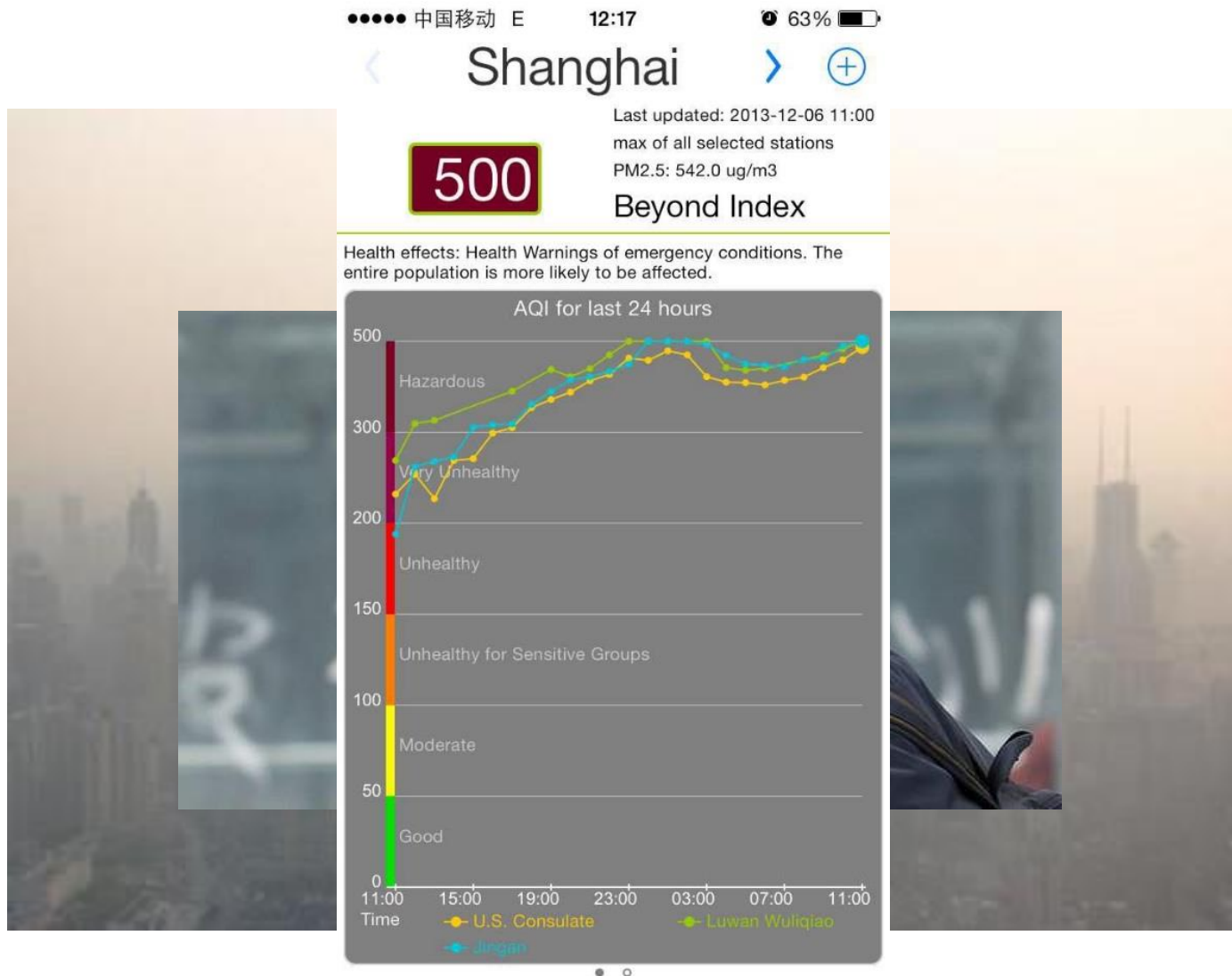
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QUALITA' DELLA VITA



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QUALITA' DELLA VITA



RISCHI PER LA SICUREZZA

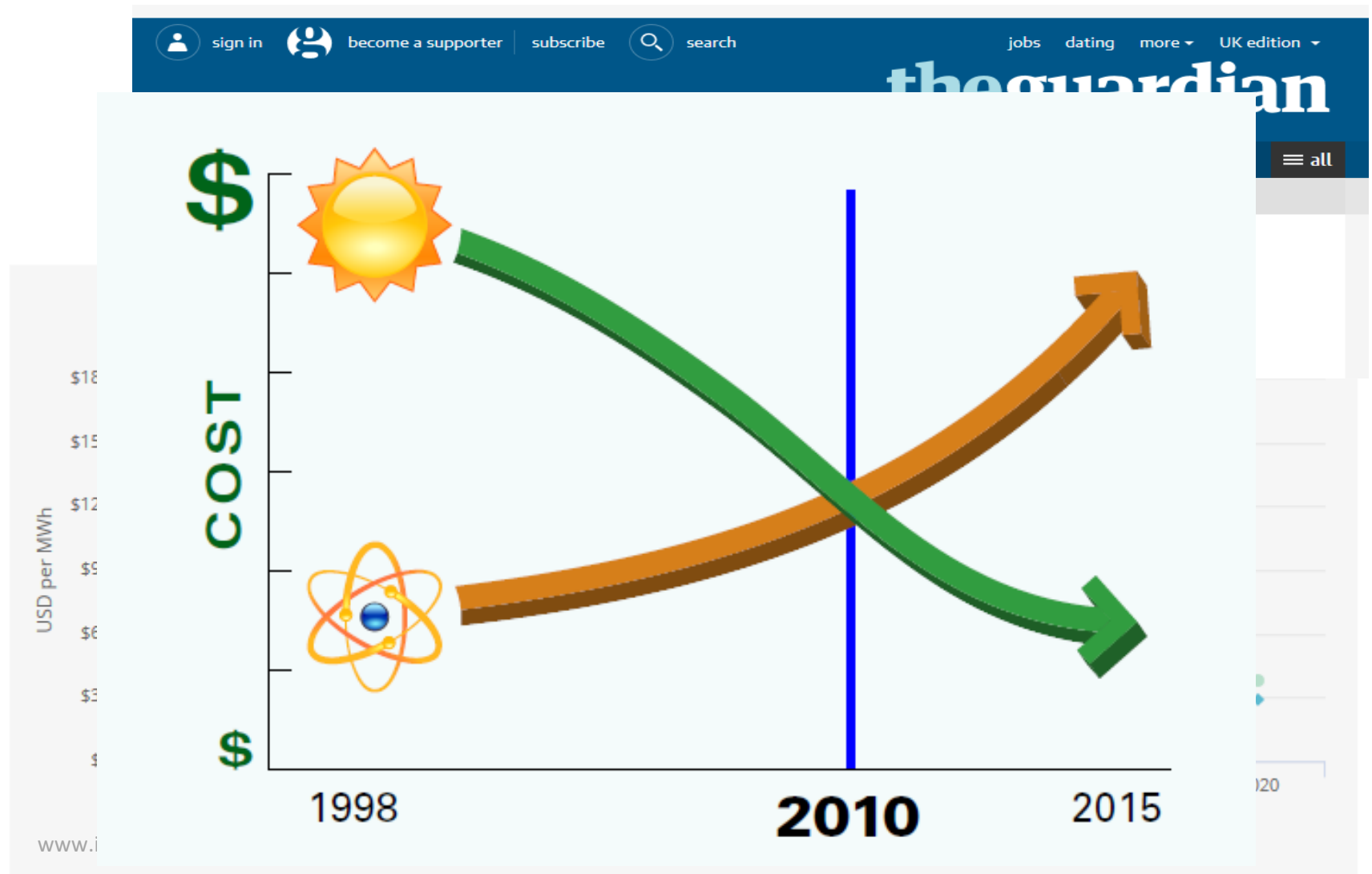
Attacco con droni al petrolio saudita: fermata metà della produzione

di Sissi Bellomo



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CONVENIENZA ECONOMICA



TEMPI DI INSTALLAZIONE

Technology	Number of years
 Solar PV	0.5
 Wind onshore	0.8
 Bioenergy	1.7
 Wind offshore	1.7
 Geothermal	1.9
 Solar thermal	2
 Marine	2.2
 Small hydro	2.3

<https://www.oecd-neo.org/ndd/pubs/2015/7195-nn-build-2015.pdf>
IRENA – Global Landscape of renewable energy finance 2018

Nucleare 6 – 12,5!!!

RISCALDAMENTO GLOBALE

Climate change
is real.
It's happening
right now



The Telegraph

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News

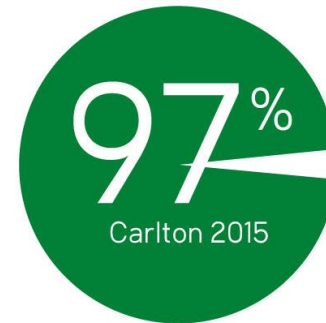
Italian composer Ludovico Einaudi solemn gig in the Arctic



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RISCALDAMENTO GLOBALE

Studies into scientific agreement on human-caused global warming

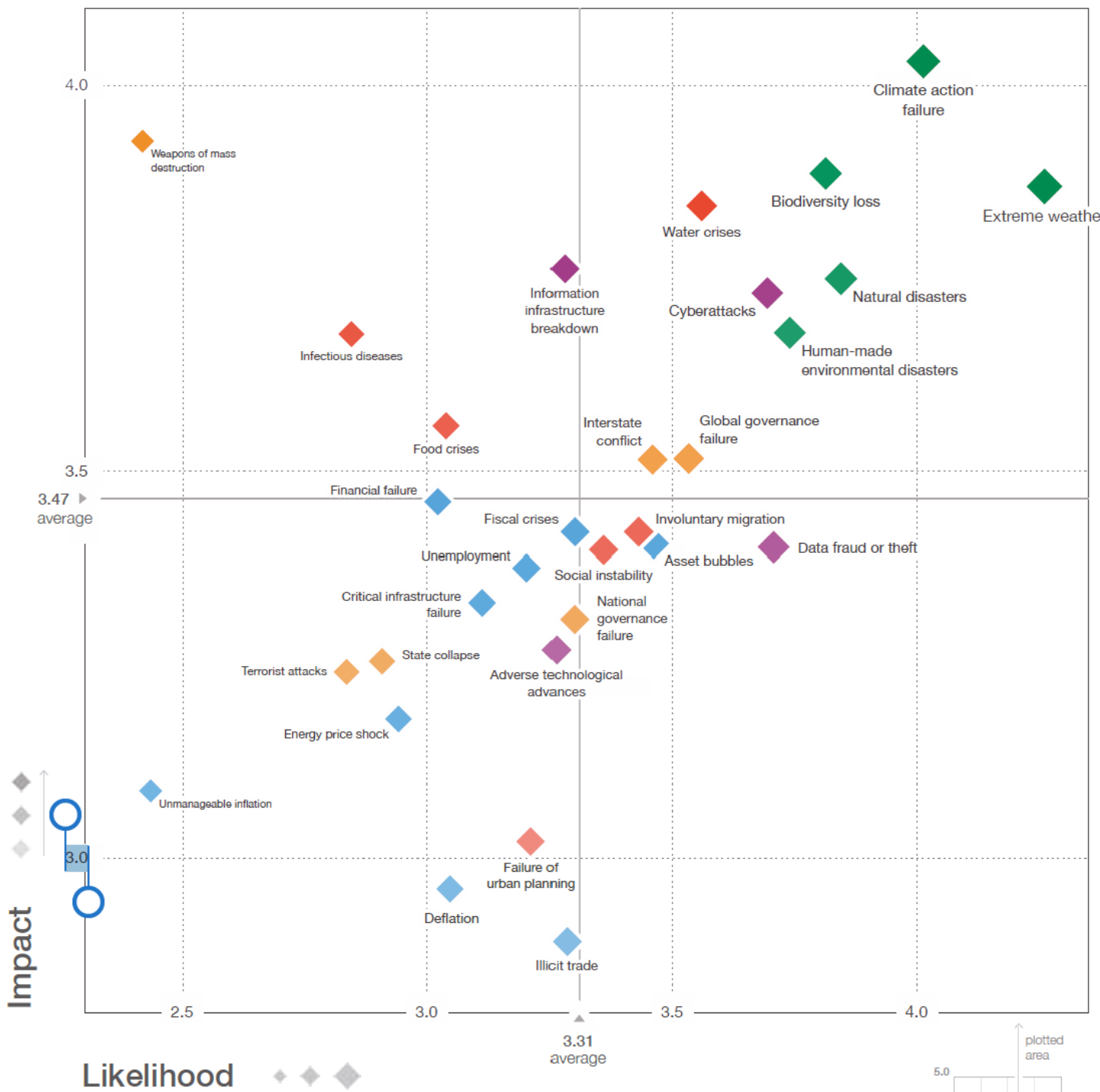


Top 10 risks in terms of Likelihood

- 1 Extreme weather
- 2 Climate action failure
- 3 Natural disasters
- 4 Biodiversity loss
- 5 Human-made environmental disasters
- 6 Data fraud or theft
- 7 Cyberattacks
- 8 Water crises
- 9 Global governance failure
- 10 Asset bubbles

Top 10 risks in terms of Impact

- 1 Climate action failure
- 2 Weapons of mass destruction
- 3 Biodiversity loss
- 4 Extreme weather
- 5 Water crises
- 6 Information infrastructure breakdown
- 7 Natural disasters
- 8 Cyberattacks
- 9 Human-made environmental disasters
- 10 Infectious diseases



GLOBAL RISKS

Top 5 Global Risks in Terms of Likelihood

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1st	Infrastructure breakdown	Blow up in asset prices	Asset price collapse	Asset price collapse	Storms and cyclones	Income disparity	Income disparity	Income disparity	Interstate conflict	Involuntary migration	Extreme weather	Extreme weather	Extreme weather	Extreme weather
2nd	Chronic diseases	Middle East instability	China economic slowdown	China economic slowdown	Flooding	Fiscal imbalances	Fiscal imbalances	Extreme weather	Extreme weather	Extreme weather	Involuntary migration	Natural disasters	Climate action failure	Climate action failure
3rd	Oil price shock	Failed and failing states	Chronic diseases	Chronic disease	Corruption	Greenhouse gas emissions	Greenhouse gas emissions	Unemployment	Failure of national governance	Climate action failure	Natural disasters	Cyberattacks	Natural disasters	Natural disasters
4th	China hard landing	Oil price shock	Global governance gaps	Fiscal crises	Biodiversity loss	Cyberattacks	Water crises	Climate action failure	State collapse or crisis	Interstate conflict	Terrorist attacks	Data fraud or theft	Data fraud or theft	Biodiversity loss
5th	Blow up in asset prices	Chronic diseases	Deglobalization (emerging)	Global governance gaps	Climate change	Water crises	Population ageing	Cyberattacks	Unemployment	Natural catastrophes	Data fraud or theft	Climate action failure	Cyberattacks	Human-made environmental disasters

Top 5 Global Risks in Terms of Impact

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1st	Blow up in asset prices	Blow up in asset prices	Asset price collapse	Asset price collapse	Fiscal crises	Financial failure	Financial failure	Fiscal crises	Water crises	Climate action failure	Weapons of mass destruction	Weapons of mass destruction	Weapons of mass destruction	Climate action failure
2nd	Deglobalization	Deglobalization (developed)	Deglobalization (developed)	Deglobalization (developed)	Climate change	Water crises	Water crises	Climate action failure	Infectious diseases	Weapons of mass destruction	Extreme weather	Extreme weather	Climate action failure	Weapons of mass destruction
3rd	Interstate and civil wars	China hard landing	Oil and gas price spike	Oil price spikes	Geopolitical conflict	Food crises	Fiscal imbalances	Water crises	Weapons of mass destruction	Water crises	Water crises	Natural disasters	Extreme weather	Biodiversity loss
4th	Pandemics	Oil price shock	Chronic diseases	Chronic disease	Asset price collapse	Fiscal imbalances	Weapons of mass destruction	Unemployment	Interstate conflict	Involuntary migration	Natural disasters	Climate action failure	Water crises	Extreme weather
5th	Oil price shock	Pandemics	Fiscal crises	Fiscal crises	Energy price volatility	Energy price volatility	Climate action failure	Infrastructure breakdown	Climate action failure	Energy price shock	Climate action failure	Water crises	Natural disasters	Water crises

■ Economic
 ■ Environmental
 ■ Geopolitical
 ■ Societal
 ■ Technological

Planet has only until 2030 to stem catastrophic climate change, experts warn



**West Nile.
Dengue Fever.
Zika.
What's the
climate
connection?**



Climate C
makes
me
si

Climate Change & Allergies



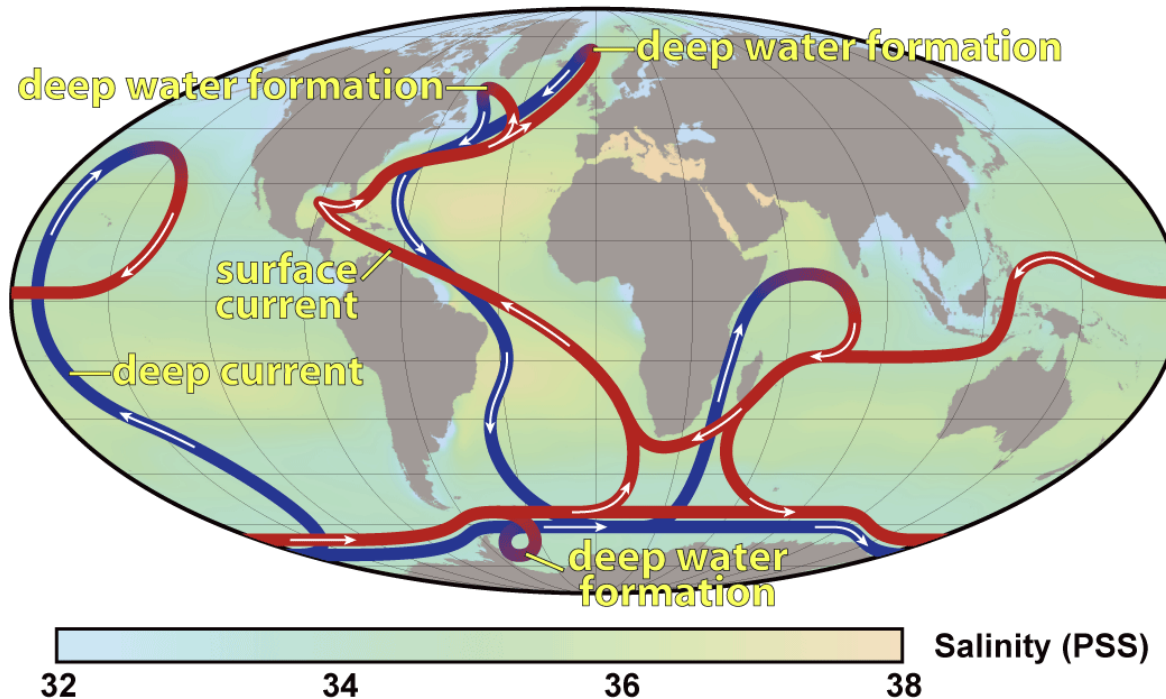
Pollen moving
to new areas



Longer & more
severe season

CLIMATE CO CENTRAL

Thermohaline Circulation



SUSSIDI ENERGETICI

Study: U.S. Fossil Fuel Subsidies Exceed Pentagon Spending

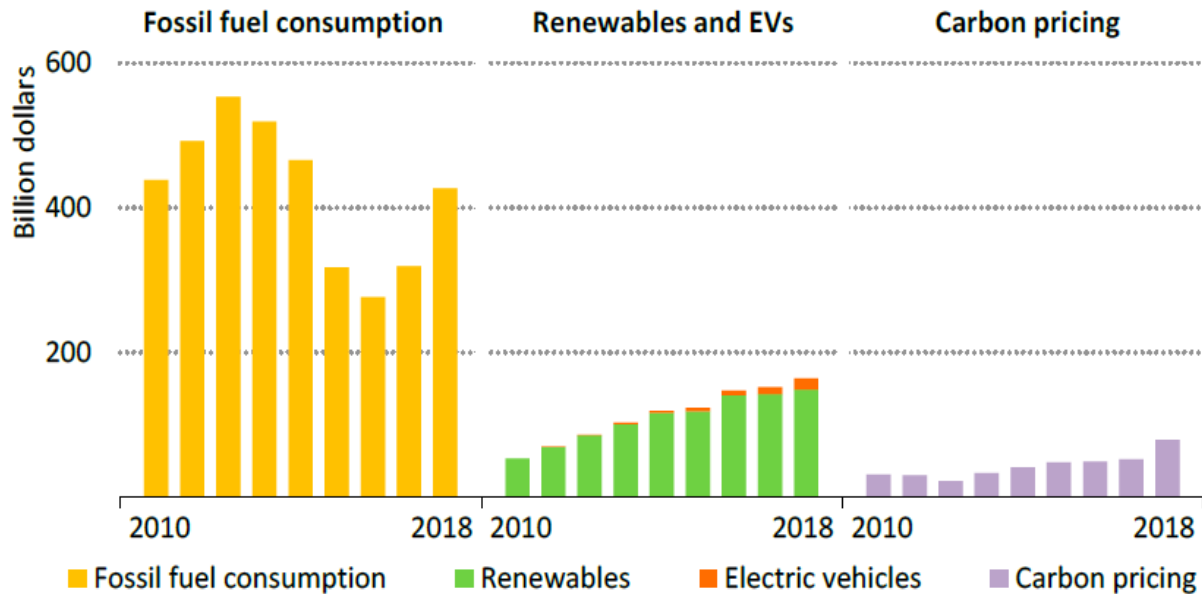
These subsidies are largely invisible to the public, and don't appear in national budgets. But according to the IMF, the world spent \$4.7 trillion — or 6.3 percent of global GDP — in 2015 to subsidize fossil fuel use, a figure it estimated rose to \$5.2 trillion in 2017. The world would be richer and healthier if the full costs of fossil fuels were paid, according to a new report from the International Monetary Fund



The dome of the U.S. Capitol is seen behind the smoke stacks of the Capitol Power Plant, the only coal-burning power plant in Washington, D.C.

SUSSIDI ENERGETICI

Figure 1.20 ▶ Estimated value of subsidies to fossil fuel consumption, renewables and electric vehicles, and carbon pricing, 2010-2018



The combined value of support measures in favour of energy transitions in 2018 was much less than that of fossil fuel consumption subsidies

ubsidies Exceed

in national budgets. But according to the the in 2015 to subsidize fossil fuel use, a figure it and healthier if the full costs of fossil fuels ury Fund



The dome of the U.S. Capitol is seen behind the smoke stacks of the Capitol Power Plant, the only coal-burning power plant in Washington, D.C.

14 gennaio 2020



Ue, approvato il Green Deal: in arrivo mille miliardi di investimenti per l'economia verde

la Repubblica



Il vicepresidente della Commissione europea Valdis Dombrovskis

Il piano di investimenti per i prossimi dieci anni. L'Unione europea prevede di dedicare un quarto del proprio bilancio alla lotta ai cambiamenti climatici.

Netherlands climate change: Court orders bigger cuts in emissions

20 December 2019



Climate change



The highest court in the Netherlands has upheld a ruling requiring the government to slash greenhouse gas emissions by at least 25% of 1990 levels by the end of next year.

European Investment Bank drops fossil fuel funding

14 November 2019

BBC



Climate change



The European Union is to stop funding oil, gas and coal projects at the end of 2021, cutting €2bn (£1.7bn) of yearly investments.

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QUALCOSA STA CAMBIANDO



Despite widespread expectations of another increase, global energy-related carbon dioxide emissions stopped growing in 2019, according to IEA data released today.

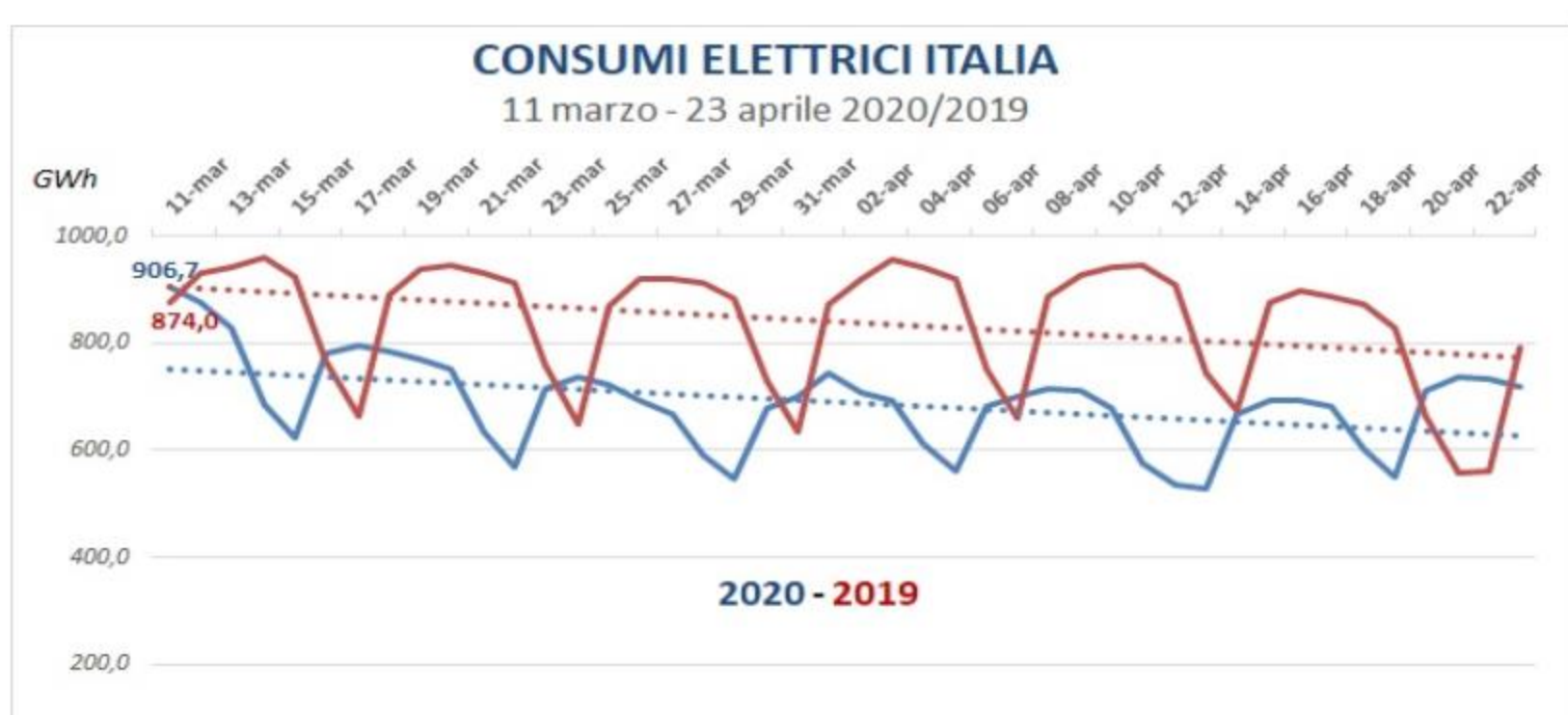
After two years of growth, global emissions were unchanged at 33 gigatonnes in 2019 even as the world economy expanded by 2.9%. This was primarily due to declining emissions from electricity generation in advanced economies, thanks to the expanding role of renewable sources (mainly wind and solar), fuel switching from coal to natural gas, and higher nuclear power generation. Other factors included milder weather in several countries, and slower economic growth in some emerging markets.

ENERGIA ELETTRICA IN ITALIA

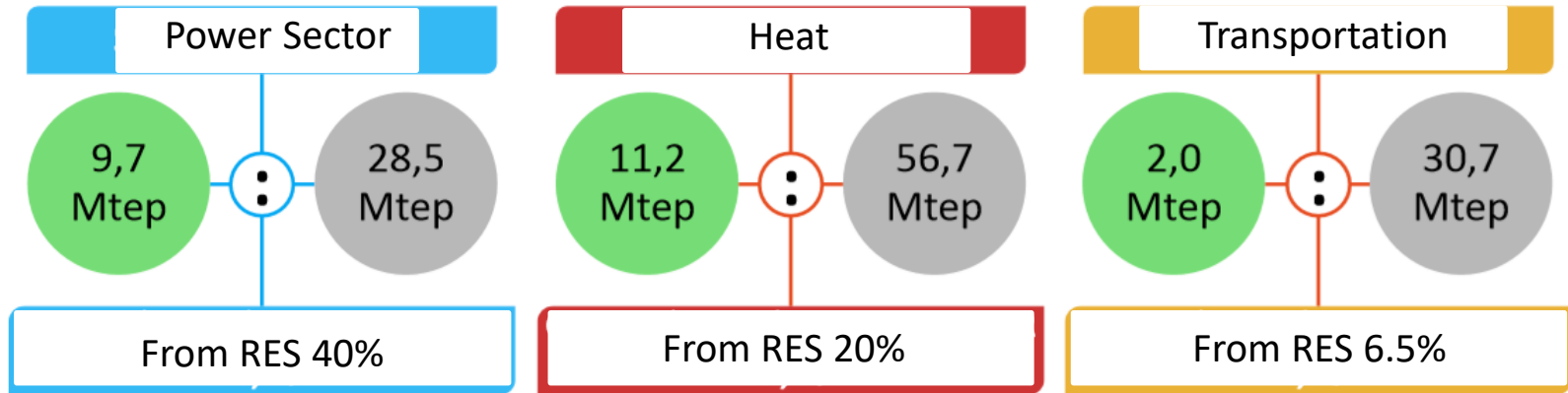
	2018	2005
Termoelettrico	59%	81%
Idroelettrico	18%	15%
Fotovoltaico	8%	0%
Eolico	6%	1%
Biomasse	6%	2%
Geotermico	2%	2%

Le rinnovabili hanno coperto il 20% della produzione di energia elettrica nel 2005 e il 40% nel 2018!!!

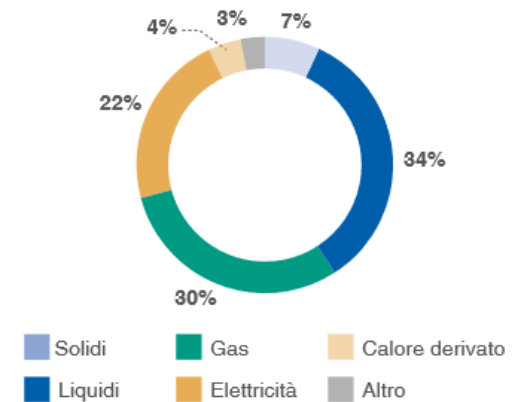
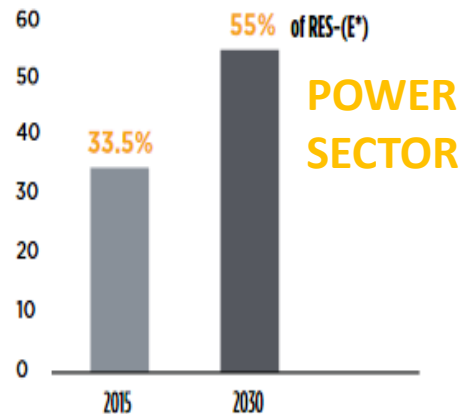
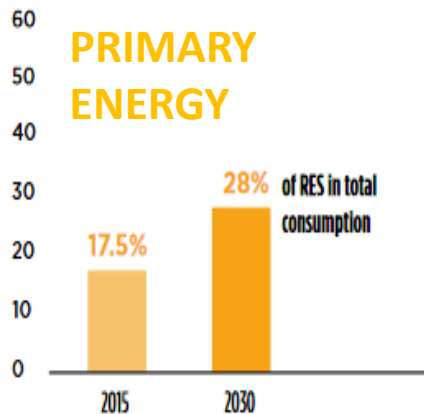
La domanda elettrica nel “lockdown” scende del 18%. Le rinnovabili salgono al 42%



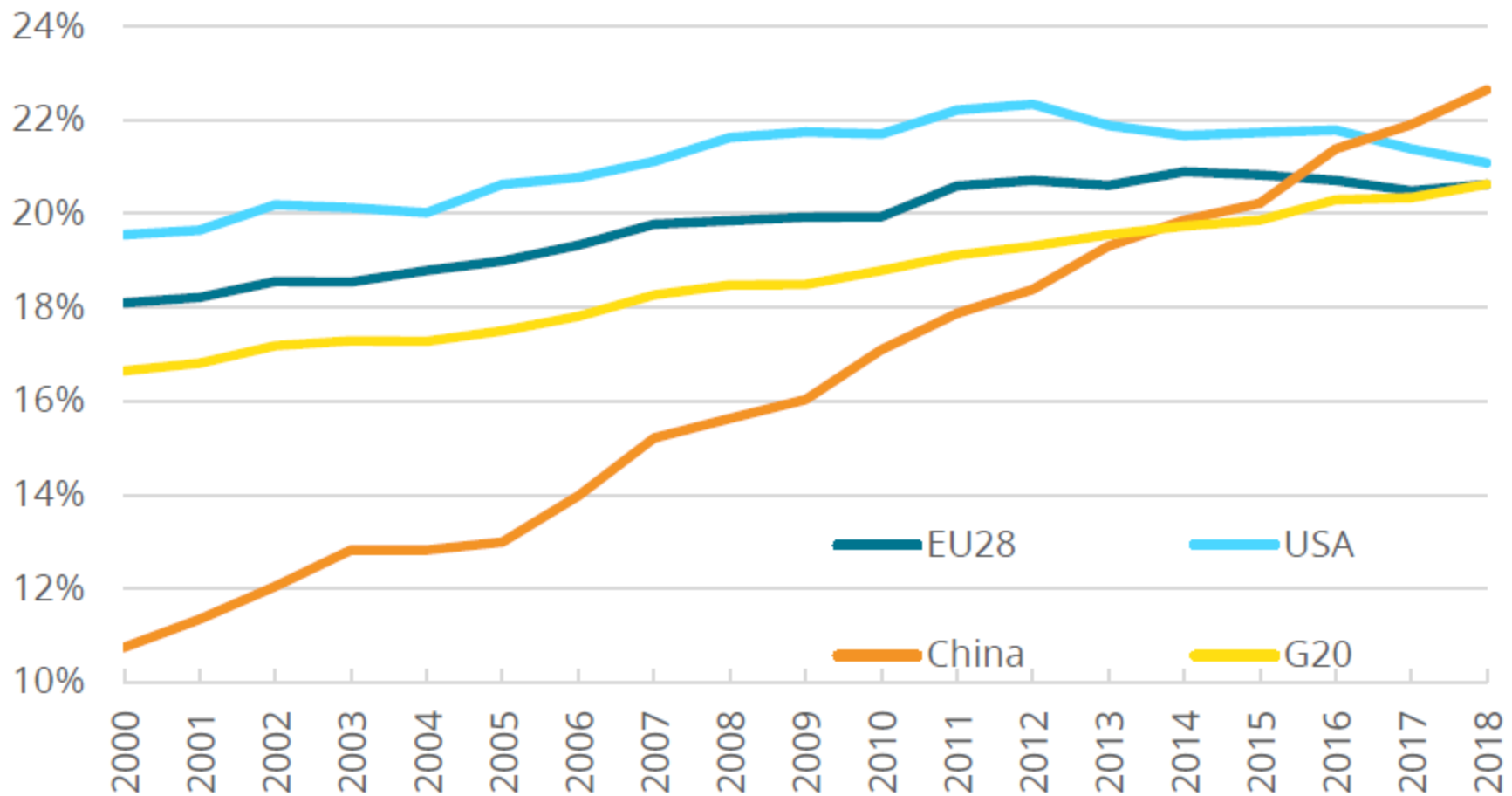
ENERGIA PRIMARIA



ITALY'S NATIONAL ENERGY STRATEGY 2017

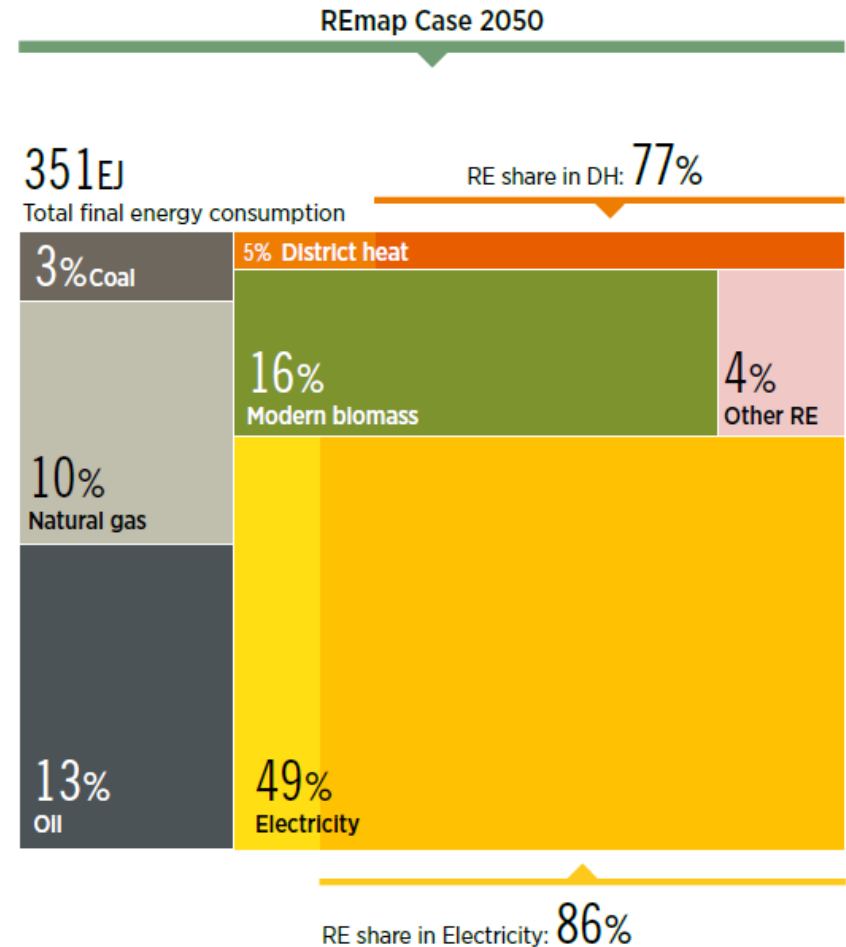
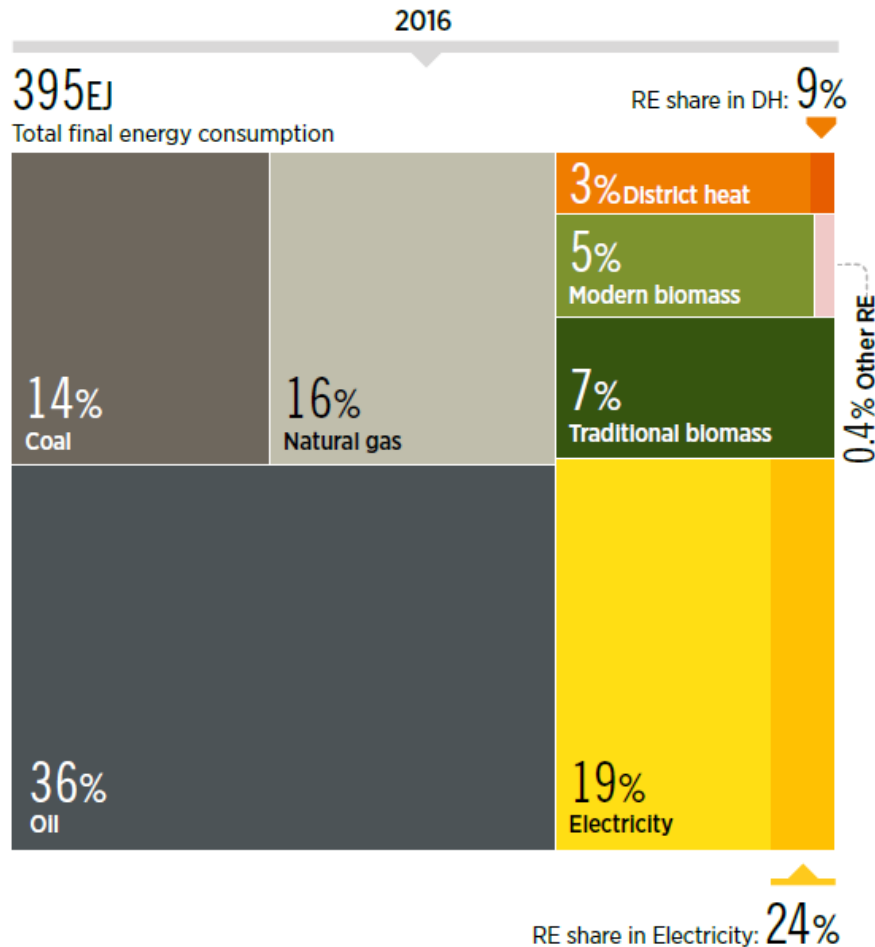


ENERGIA ELETTRICA GLOBALE



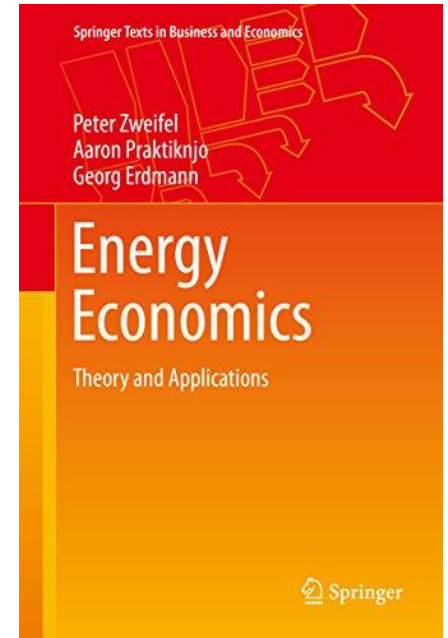
SEMPRE PIU' ENERGIA ELETTRICA

Total final energy consumption breakdown by energy carrier (%)



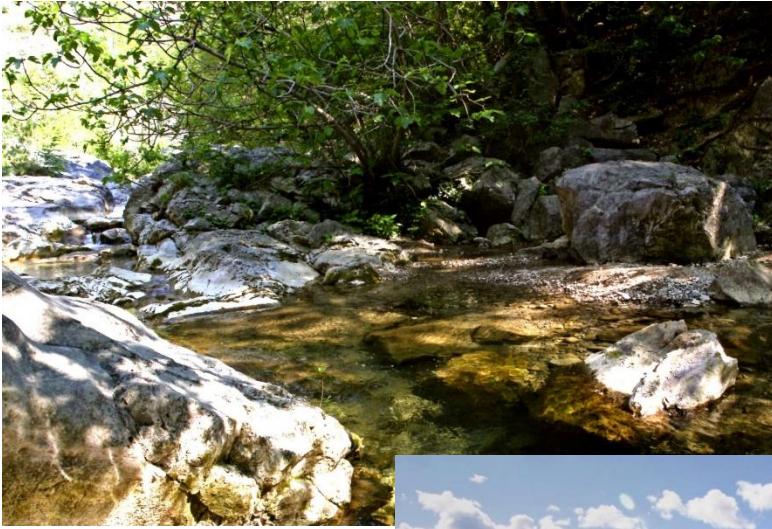
PERCHE' ENERGIA ELETTRICA?

- Fonte a maggiore exergia
- Priva di massa
- Impatto nullo in fase di utilizzo
- Pratica da usare
- Trasportabile su lunghe distanze

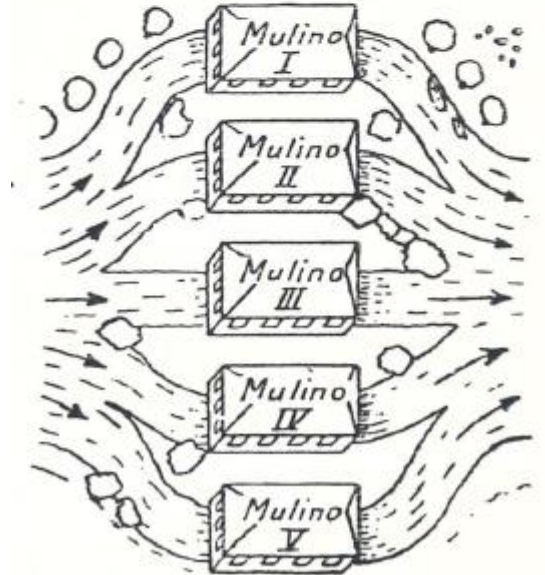
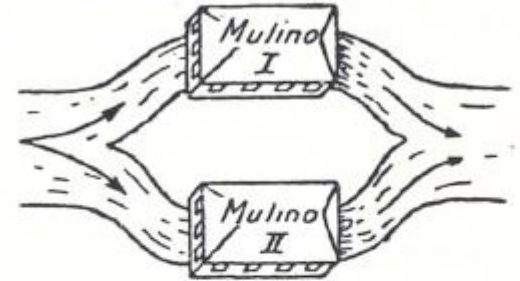


LA TRANSIZIONE VERSO IL 50% DI ENERGIA
ELETTRICA PASSA ATTRAVERSO UN PROFONDO
CAMBIAMENTO DELLA RETE ELETTRICA

LA CORRENTE ELETTRICA

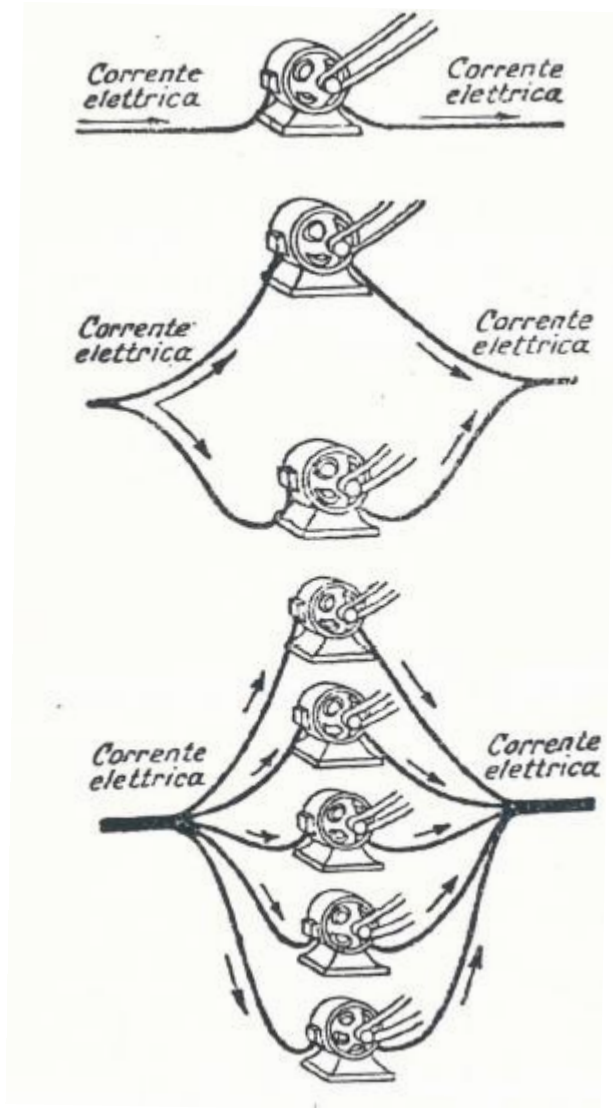


PORTATA – QUANTITA' D'ACQUA



La portata dei corsi dei fiumi si misura in litri o metri cubi nell'unità di tempo

INTENSITA' DELLA CORRENTE



La corrente elettrica è
analoga alla portata d'acqua
e si misura in ampere

INTENSITA' DELLA CORRENTE

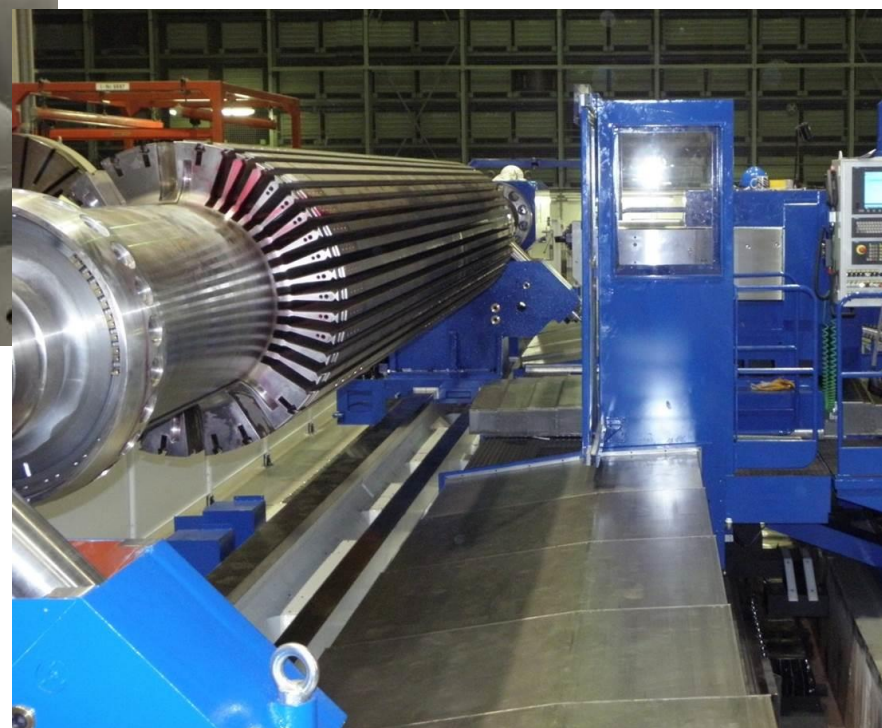
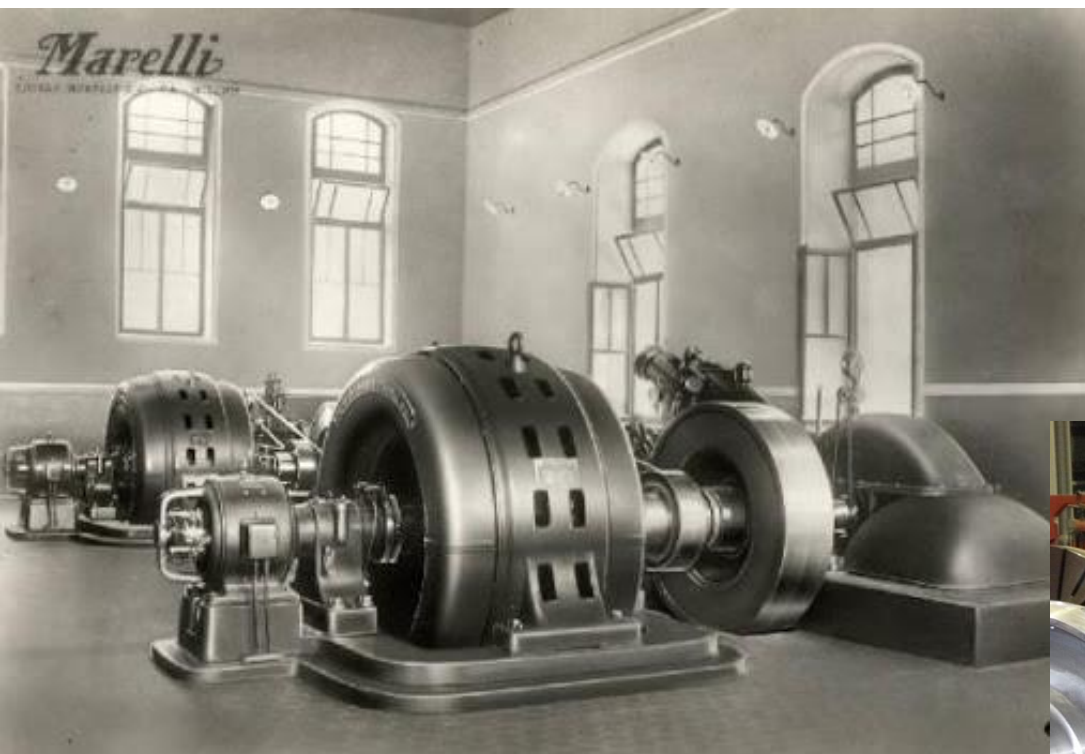


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SORGENTI DI CORRENTE ELETTRICA

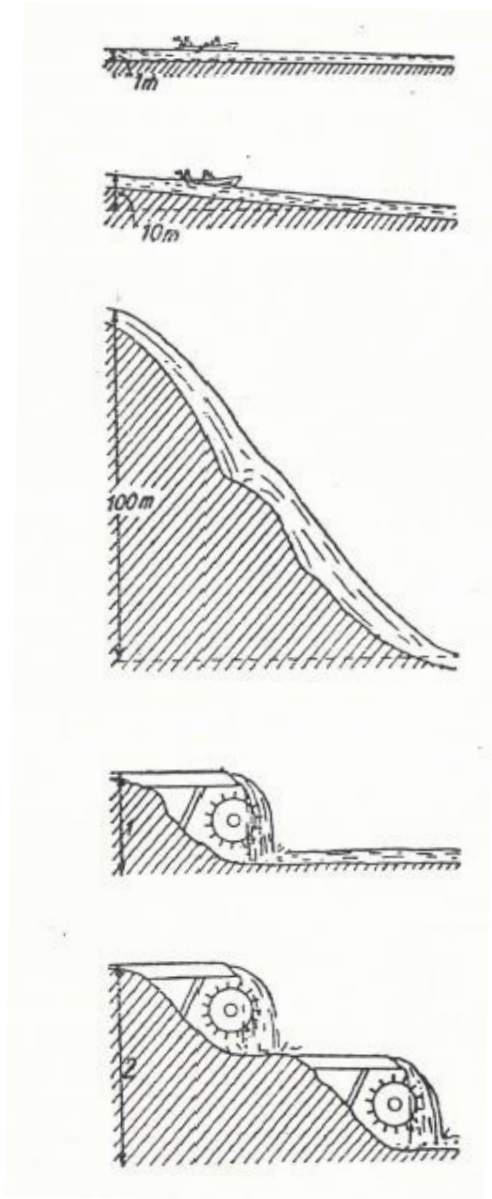


GENERATORI



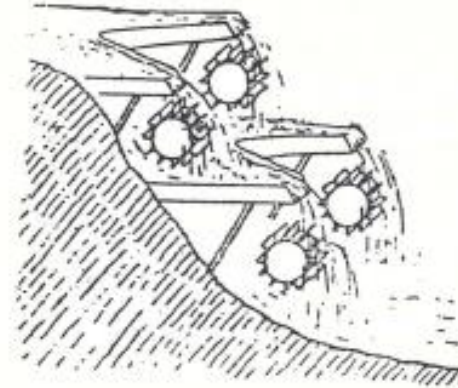
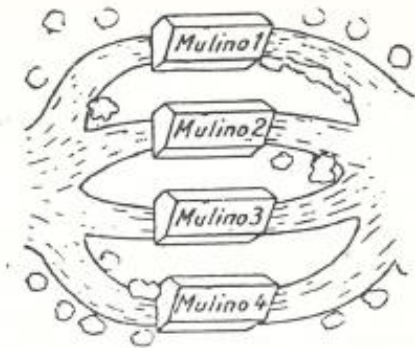
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LA TENSIONE ELETTRICA

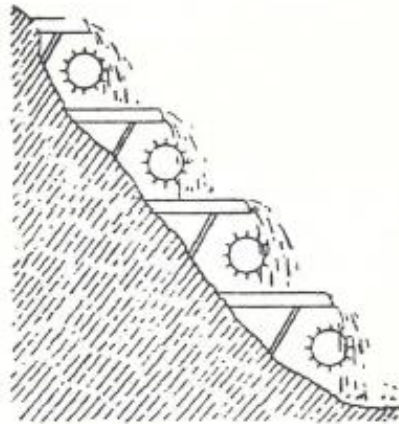


La tensione elettrica è
analoga alla pressione
idraulica e si misura in volt

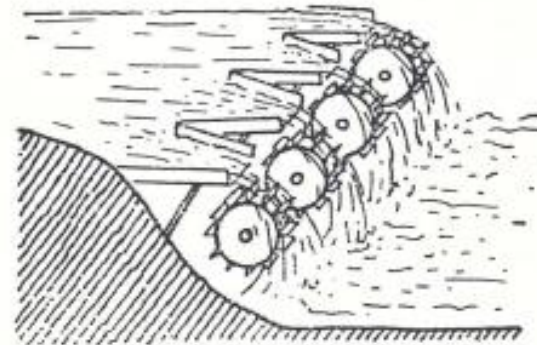
POTENZA



$$2 \times 2 = 4$$

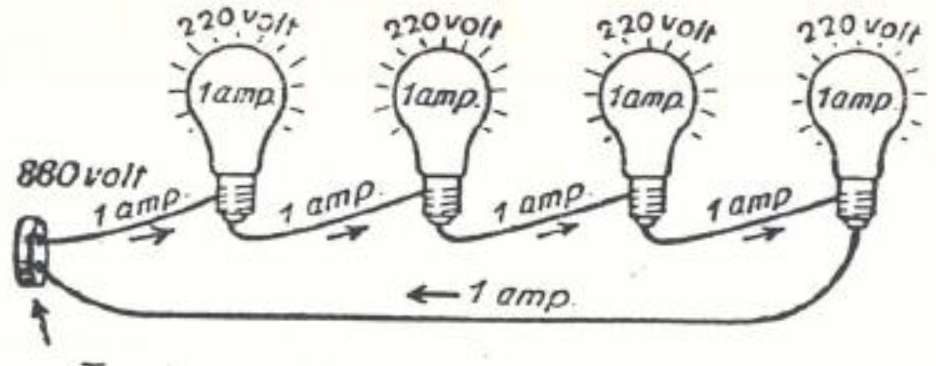
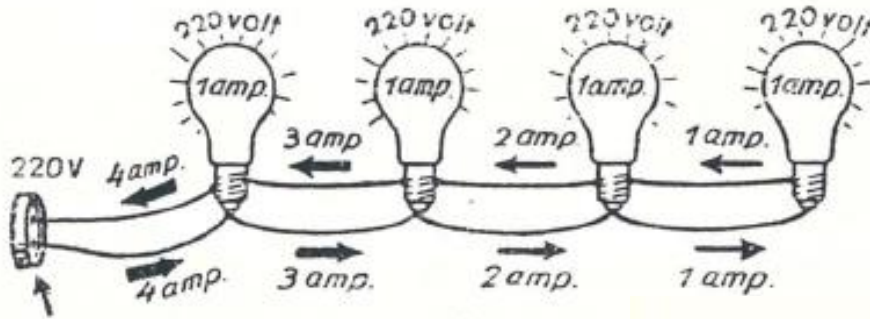


$$1 \times 4 = 4$$



$$4 \times 1 = 4$$

E LA POTENZA ELETTRICA?



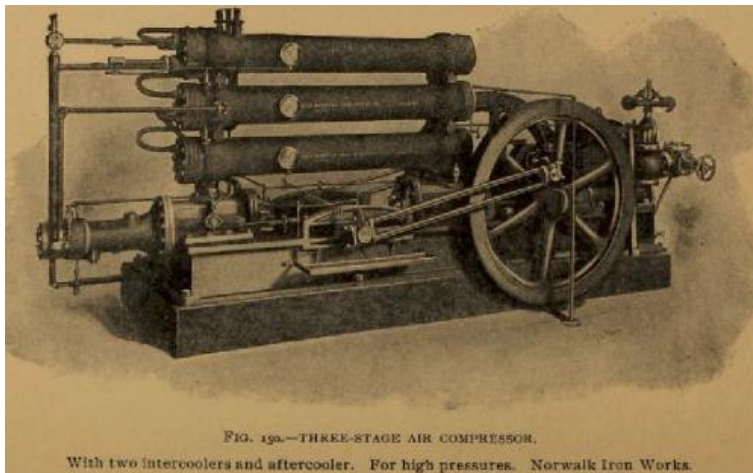
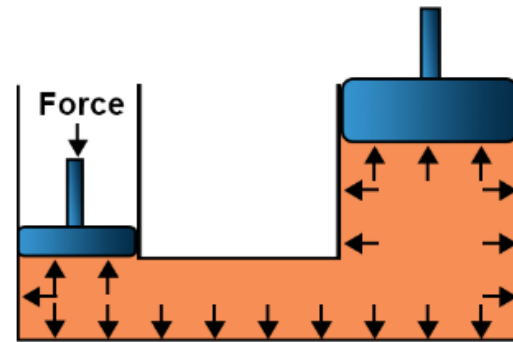
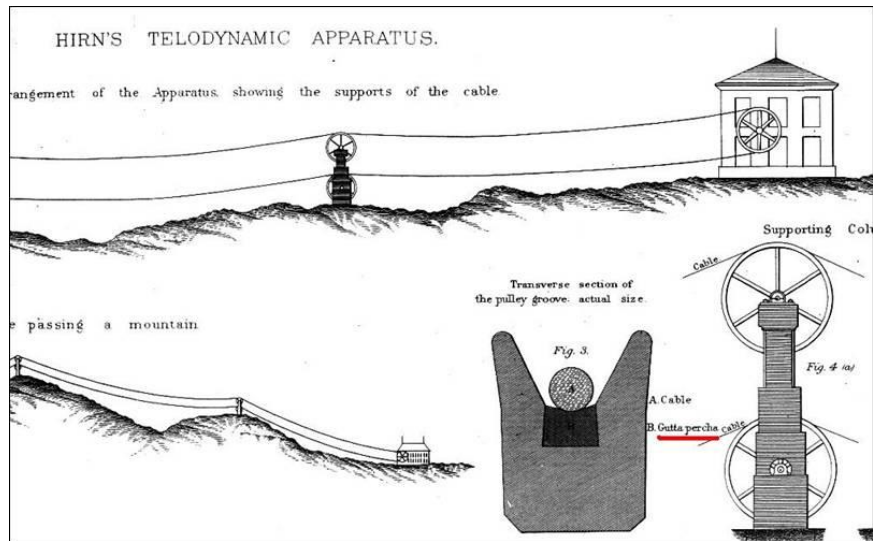
La potenza elettrica equivale al prodotto tra la tensione e la corrente e si misura in watt

ENERGIA ELETTRICA



L'energia elettrica è data dal prodotto tra la
potenza e il tempo e si misura in wattora

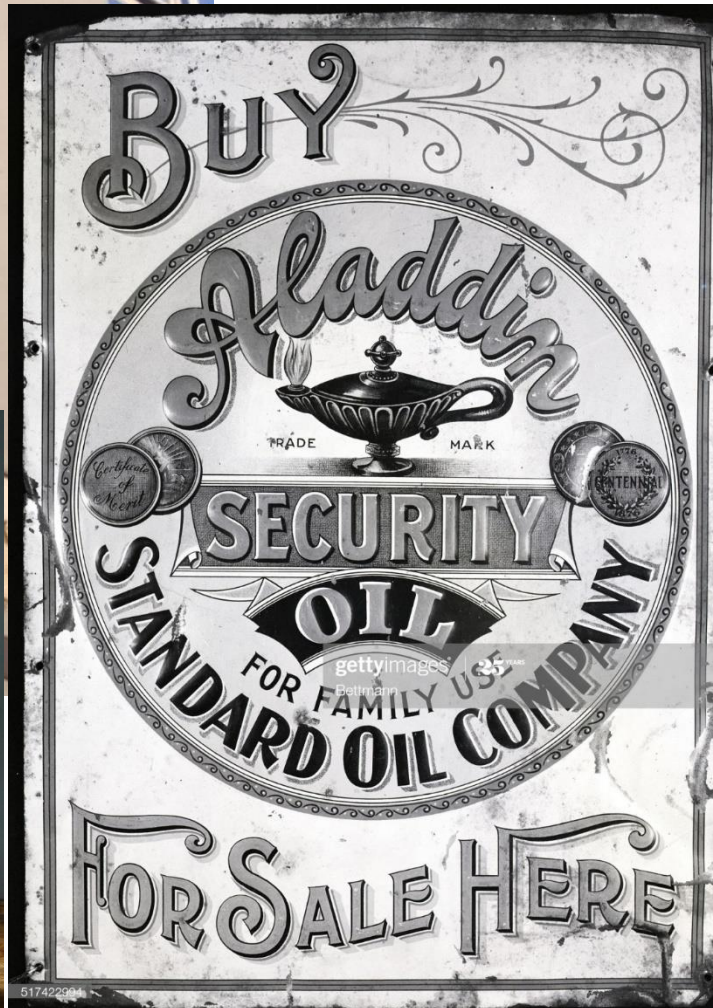
UN PO' DI STORIA



L'ILLUMINAZIONE



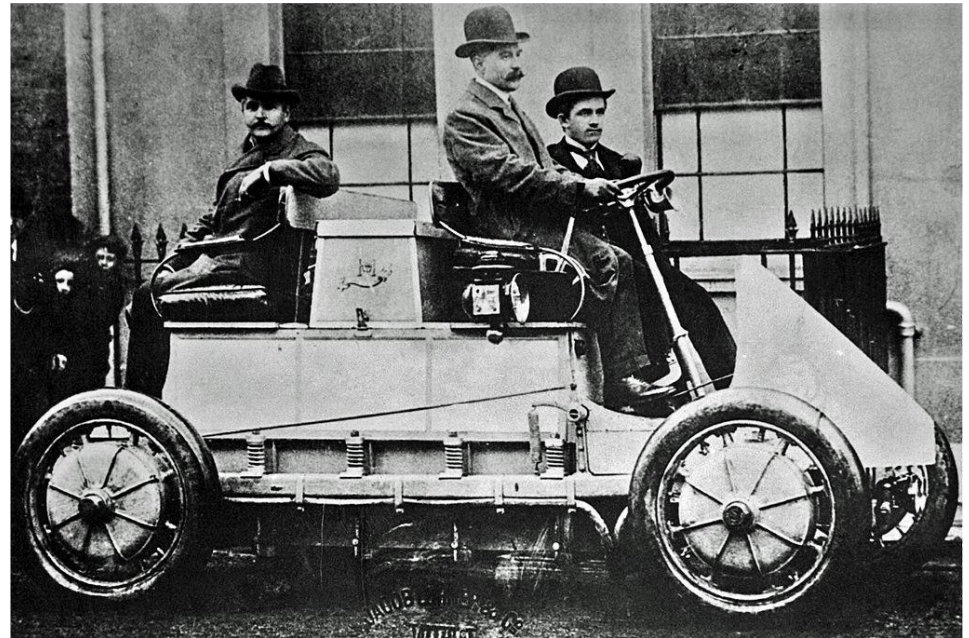
L'ILLUMINAZIONE ... 1807



L'ILLUMINAZIONE ELETTRICA FINE DELL'OTTOCENTO



I TRASPORTI: PRIMI DEL NOVECENTO



LE PRIME AUTOMOBILI: ELETTRICHE!



Baker Electric Vehicles
The Aristocrats of Motordom



The Electric Sensation of 1909
The Baker Electric Runabout has unusual speed and a mileage capacity of one hundred miles. It is swift, noiseless, and easy of control in congested streets.

The Ideal Car for Professional and Business Men
Our catalogue describing our latest models of Baker Electric Runabouts, Victorias, Coupés, Roadsters, Broughams, Landaulets, etc., mailed on request.

THE BAKER MOTOR VEHICLE COMPANY, 33 W. 80TH ST., CLEVELAND, OHIO.
Agencies in the principal cities.

LE PRIME RETI ELETTRICHE



Corrente continua



Diversi livelli di tensione



Diverse linee elettriche

(illuminazione, trasporti, motori, ...)

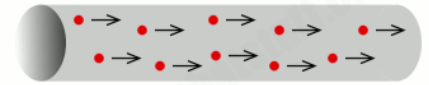


Generatori vicini ai carichi:

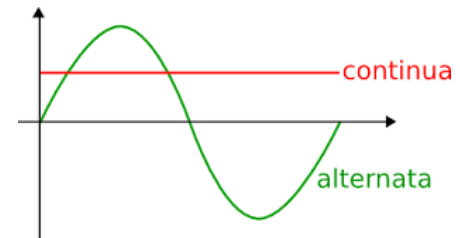
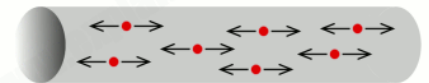
le prime esperienze di
generazione distribuita!

Direct current (DC)

www.explainthatstuff.com



Alternating current (AC)



VERSO UN SISTEMA CENTRALIZZATO



👉 1879

👉 Nuova «commodity»

👉 Due generatori

👉 10 \$ per lampada dal
tramonto a mezzanotte

ILLUMINAZIONE A MILANO: 1883



VERSO LA CORRENTE ALTERNATA



Diversi livelli di tensione

$$P = V \times I \qquad \textit{Perdite} \propto I^2$$

È necessario aumentare la tensione in
quanto le perdite sono proporzionali al
quadrato della distanza!

THE CURRENT WAR

THE TALE OF AN EARLY TECH RIVALRY

DC

DIRECT CURRENT

The flow of electricity is in one direction only. The system operates at the same voltage level throughout and is not as efficient for high-voltage, long distance transmission.

Direct current runs through:



Battery-Powered Devices Fuel and Solar Cells Light Emitting Diodes

"[TESLA'S] IDEAS ARE SPLENDID, BUT THEY ARE UTTERLY IMPRACTICAL."

- THOMAS EDISON



FALLING OUT

Edison promised Tesla a generous reward if he could smooth out his direct current system. The young engineer took on the assignment and ended up saving Edison more than \$100,000 (millions of dollars by today's standards). When Tesla asked for his rightful compensation, Edison declined to pay him. Tesla resigned shortly after, and the elder inventor spent the rest of his life campaigning to discredit his counterpart.



EDISON FRIES AN ELEPHANT

In order to prove the dangers of Tesla's alternating current, Thomas Edison staged a highly publicized electrocution of the three-ton elephant known as "Topsy." She died instantly after being shocked with a 6,600-volt AC charge.

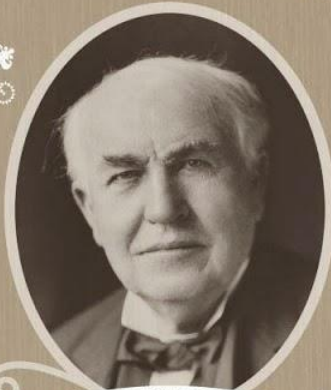
LATE BLOOMER

Thomas Edison, the youngest in his family, didn't learn to talk until he was almost 4 years old.

"Genius is one percent inspiration and ninety nine percent perspiration"

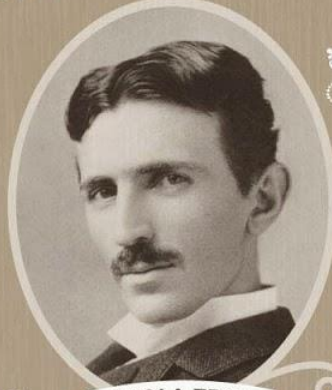
- Thomas Edison

Incandescent light making technology
DC motors and eli



THOMAS EDISON

VS.



NIKOLA TESLA

You would have never found two geniuses so spiteful of each other beyond turn-of-the-century inventors Nikola Tesla and Thomas Edison. They worked together—and hated each other. Let's compare their life, achievements, and embittered battles.



AC

ALTERNATING CURRENT

Electric charge periodically reverses direction and is transmitted to customers by a transformer that could handle much higher voltages.

Alternating current runs through:



Car Motors Radio Signals Appliances

"IF EDISON HAD A NEEDLE TO FIND IN A HAYSTACK, HE WOULD PROCEED AT ONCE... UNTIL HE FOUND THE OBJECT OF HIS SEARCH. I WAS A SORRY WITNESS OF SUCH DOINGS, KNOWING THAT A LITTLE THEORY AND CALCULATION WOULD HAVE SAVED HIM 90 PERCENT OF HIS LABOR."

- NIKOLA TESLA



WAR OF CURRENTS OFFICIALLY SETTLED

In 2007, Con Edison ended 125 years of direct current electricity service that began when Thomas Edison opened his power station in 1882. It changed to only provide alternating current.

The Polytechnic Institute at Gratz

ineering

his mind in detail before fully constructing it

rent)

er circuit; radio transmitter;
light; AC motors and electric
power generation system

NOBEL PRIZE CONTROVERSY



In 1915, both Edison and Tesla were to receive Nobel Prizes for their strides in physics, but ultimately, neither won. It is rumored to have been caused by their animosity towards each other and refusal to share the coveted award.

A COLLABORATION BETWEEN GOOD AND COLUMN FIVE

SOURCES: CHENEY, MARGARET. "TESLA: MAN OUT OF TIME" | UTH, ROBERT. "TESLA: MASTER OF LIGHT"

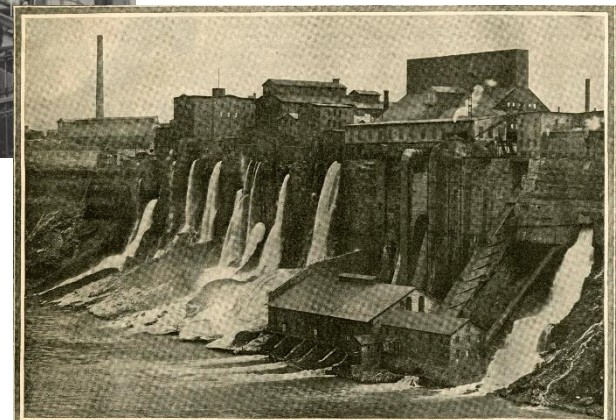
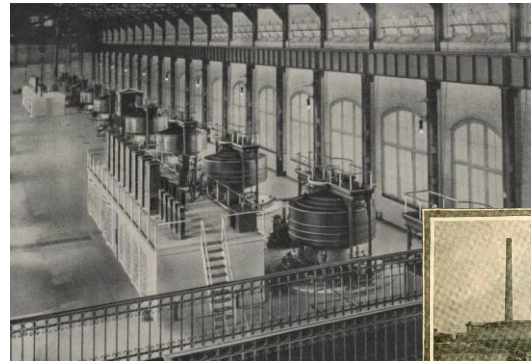
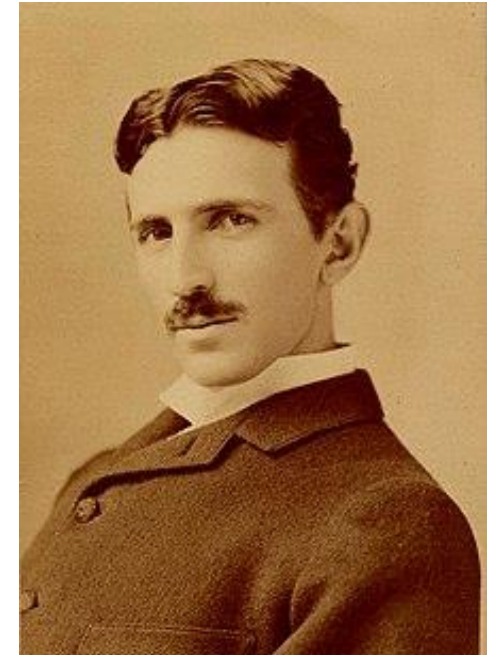
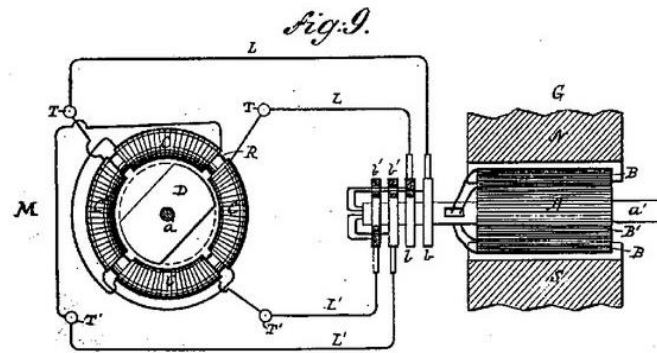
Trieste 30/06/2020
Alessandro Massi Pavan

LA CORRENTE ALTERNATA



No. 381,968.

Patented May 1, 1888.



Trieste 30/06/2020
Alessandro Massi Pavan

SISTEMA ELETTRICO CENTRALIZZATO

Flusso di potenza unidirezionale

Trasmettitore di energia elettrica

Distributori di energia elettrica

20/400 kV

400/150 kV

150/20 kV

20/0.4 kV

Trasformatore
Elevatore

Stazione
AAT/AT

Cabina
Primaria

Cabina
Secondaria

G

Generazione

Trasmissione

Distribuzione
AT

Distribuzione
MT

Distribuzione
BT

Produttori
di energia
elettrica

Utilizzazione AT

Utilizzazione MT

Utilizzazione BT

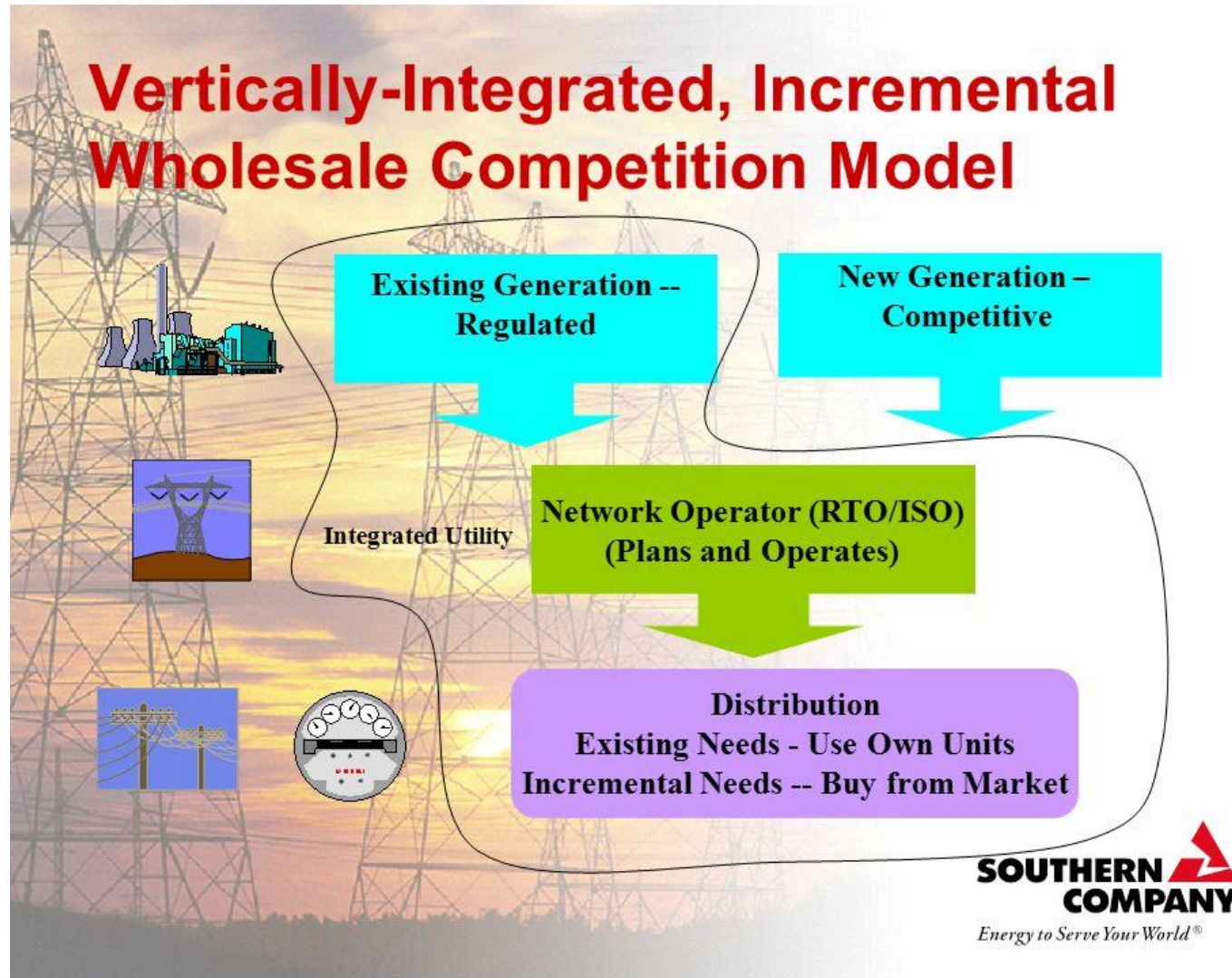
GLI UTENTI
SONO PASSIVI

Utenti Commerciali/Industriali

Utenti
Domestici

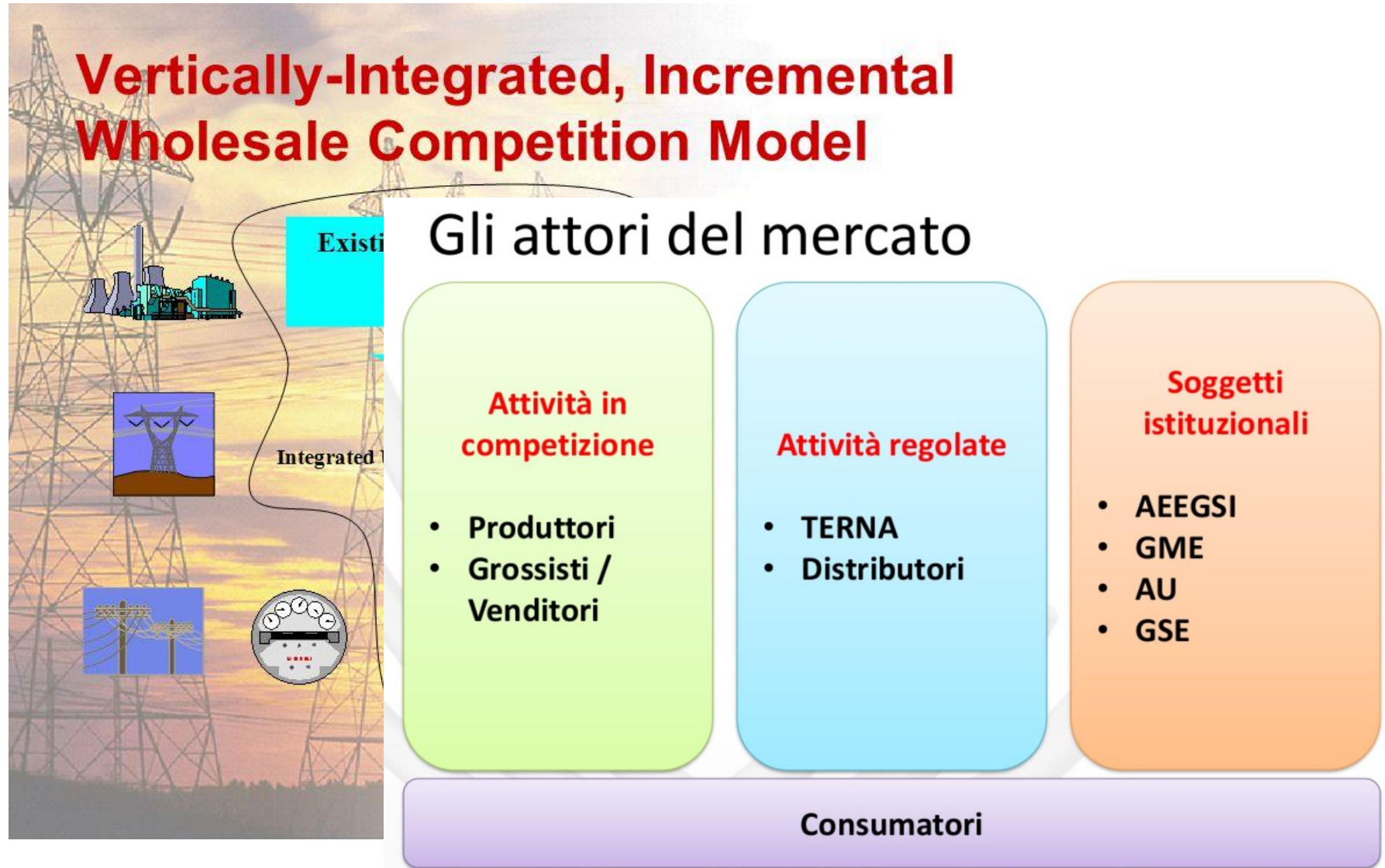
PLURALITA' DI SOGGETTI

Vertically-Integrated, Incremental Wholesale Competition Model



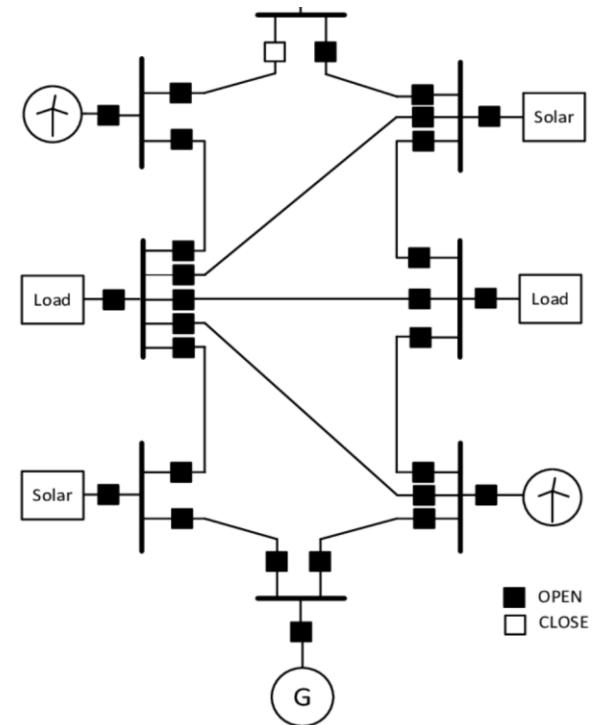
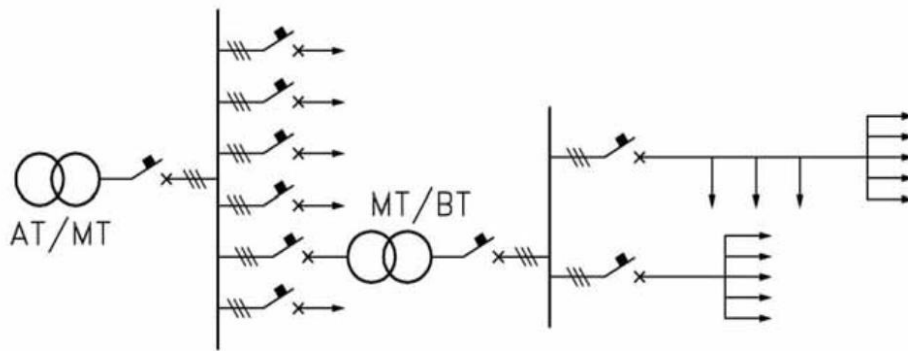
PLURALITA' DI SOGGETTI

Vertically-Integrated, Incremental Wholesale Competition Model



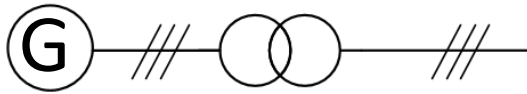
DIVERSE TIPOLOGIE DI RETI

- Tensione nominale: potenza e distanza (BT, MT, AT, AAT)
- Funzionamento
- Corrente: AC, DC
- Topologia: radiali, magliate



SISTEMA ELETTRICO - GENERAZIONE

20/400 kV



Generazione



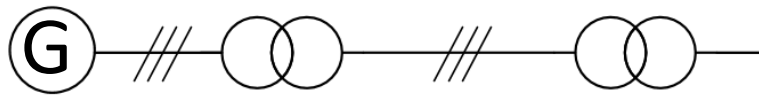
SISTEMA ELETTRICO - TRASMISSIONE

20/400 kV

Trasformatore
Elevatore

400/150 kV

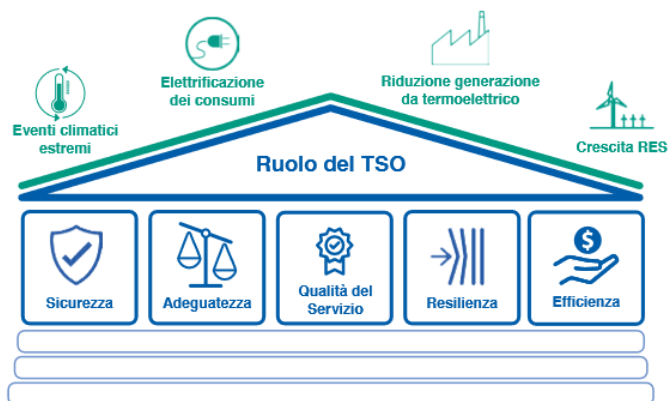
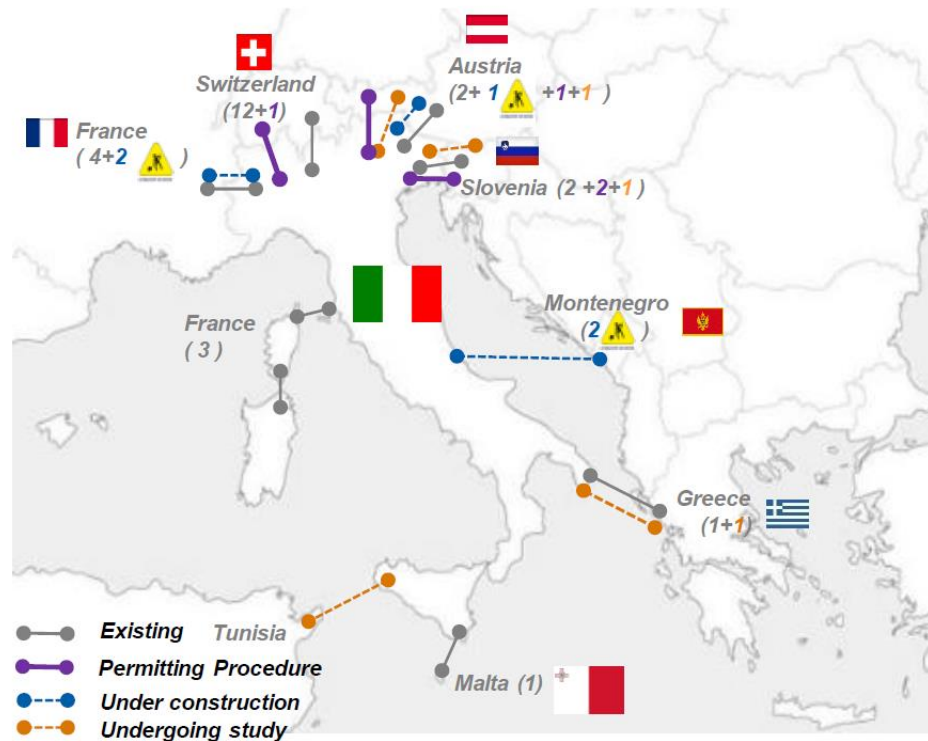
Stazione
AAT/AT



Trasmissione



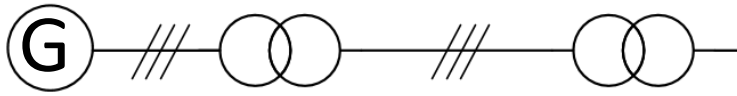
LA RETE DI TRASMISSIONE - Terna



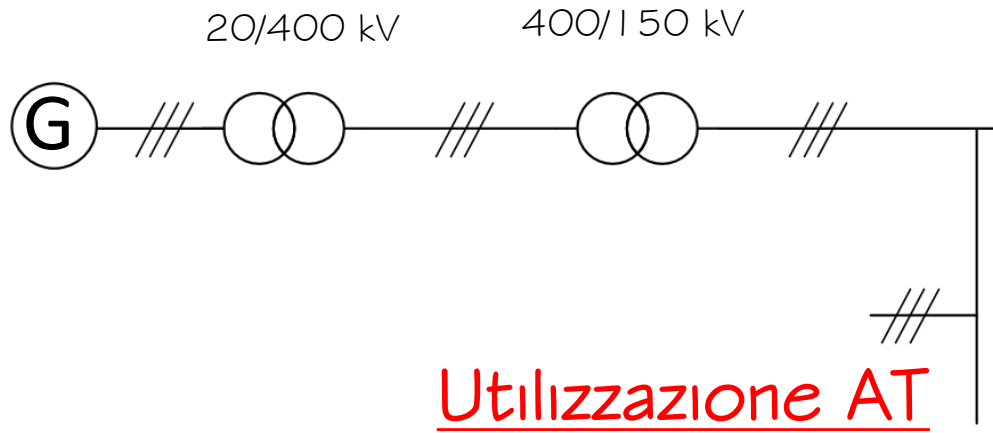
SISTEMA ELETTRICO – STAZIONI AAT/AT

400/150 kV

Stazione
AAT/AT



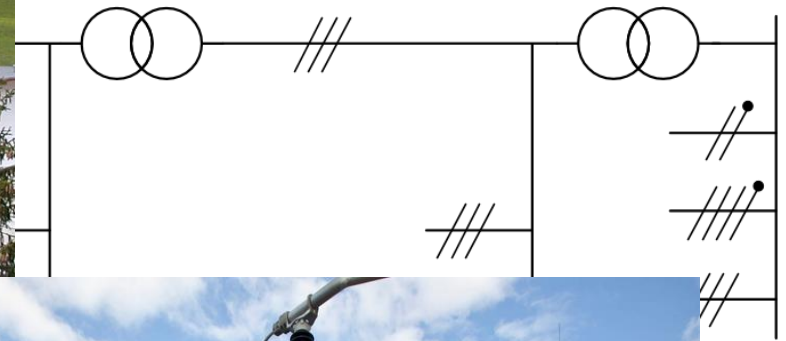
SISTEMA ELETTRICO – UTENTI AT



SISTEMA ELETTRICO – CABINE PRIMARIE

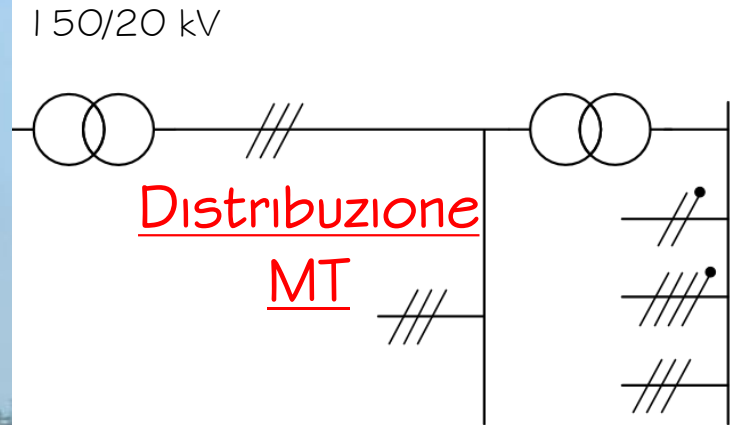
150/20 kV

Cabina
Primaria



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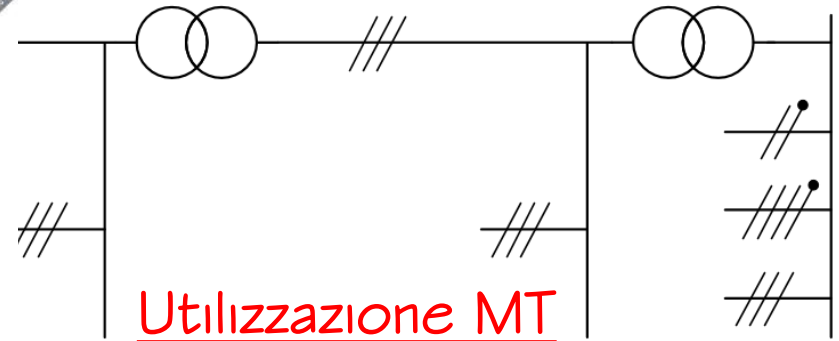
SISTEMA ELETTRICO – DISTRIBUZIONE MT



SISTEMA ELETTRICO – UTENTI MT



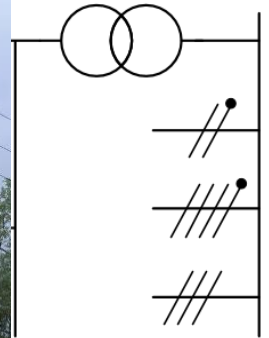
150/20 kV



SISTEMA ELETTRICO – CABINE SECONDARIE



20/0.4 kV
Cabina
Secondaria



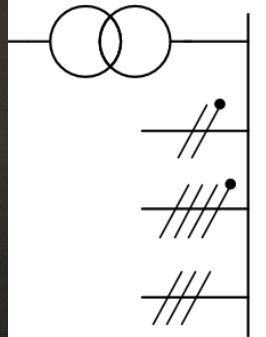
SISTEMA ELETTRICO – UTENTI BT



alamy stock photo



20/0.4 kV

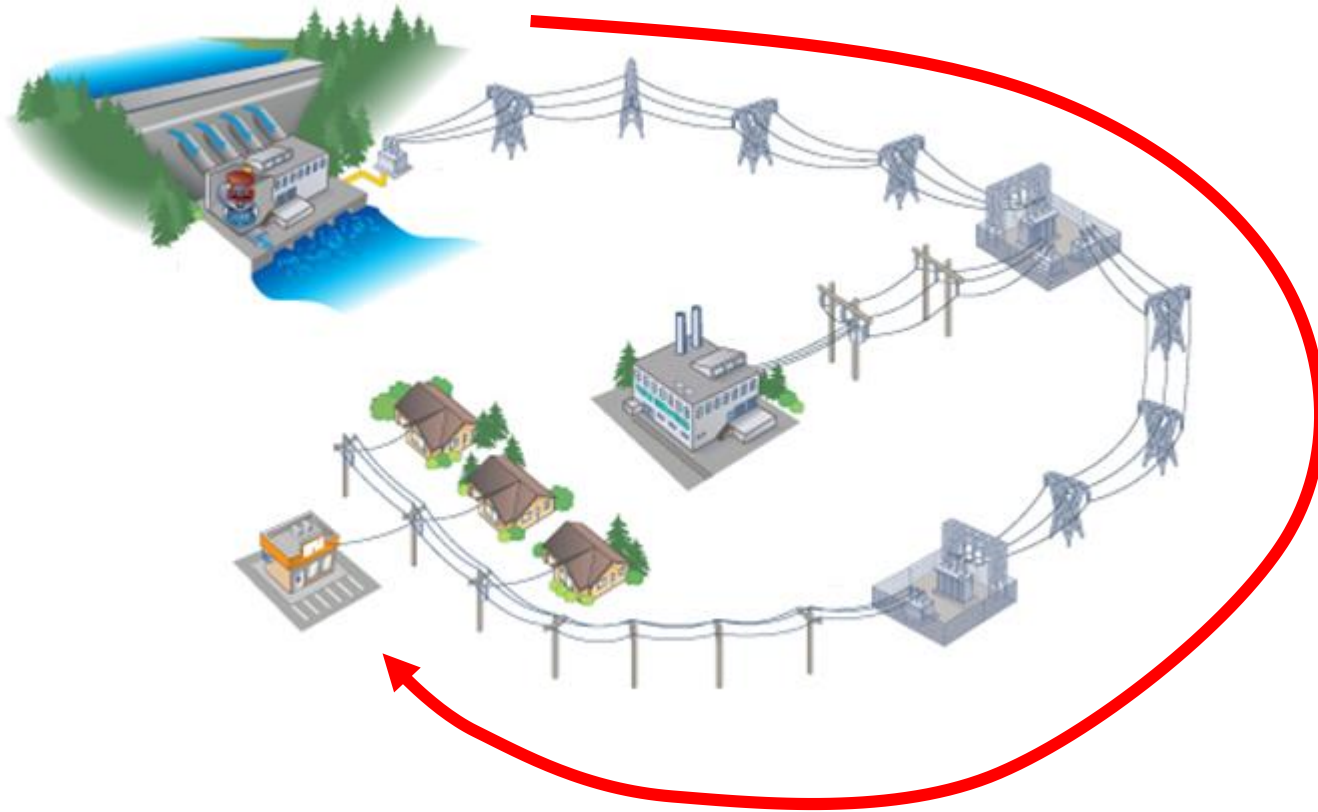


Distribuzione BT



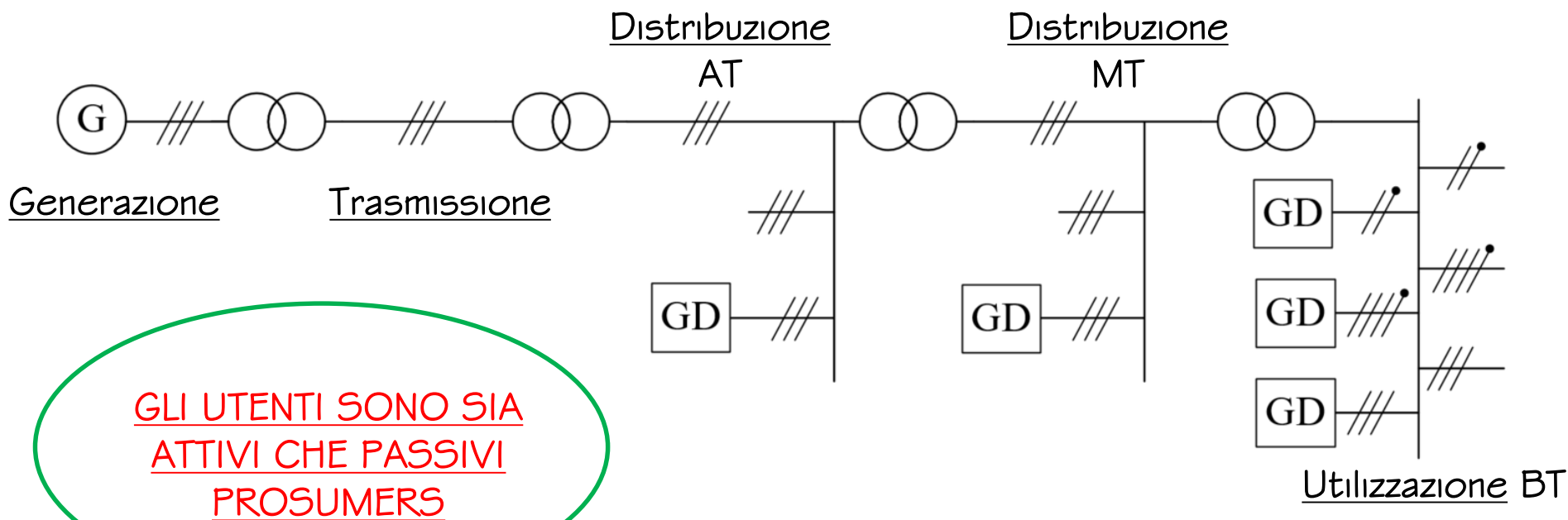
Utenti BT
400 e 230 V

SISTEMA ELETTRICO CENTRALIZZATO

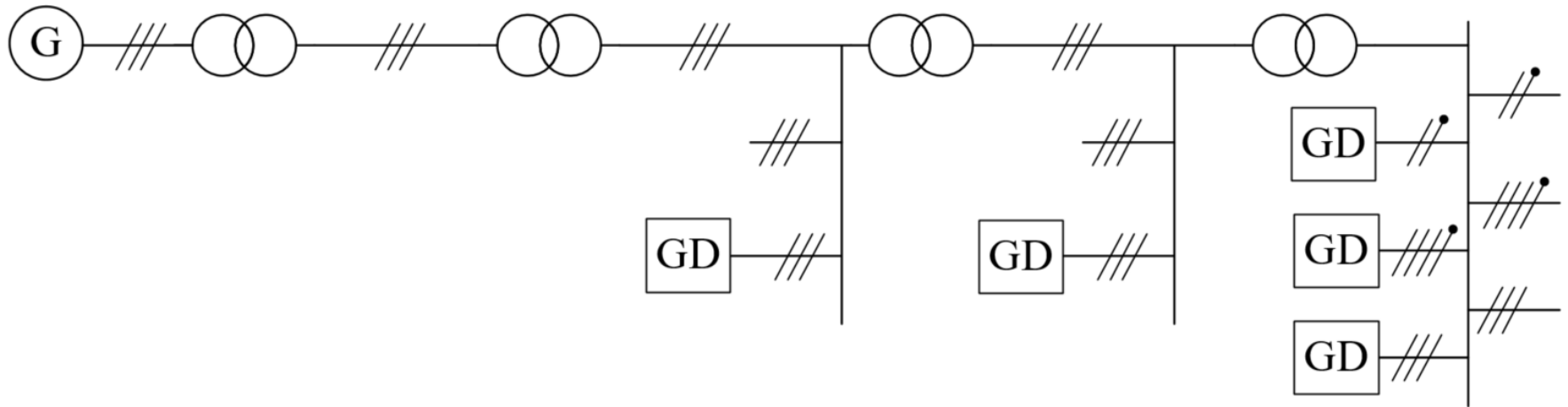


Flusso di potenza unidirezionale

LA GENERAZIONE DISTRIBUITA E IL SISTEMA IBRIDO



GENERAZIONE DISTRIBUITA

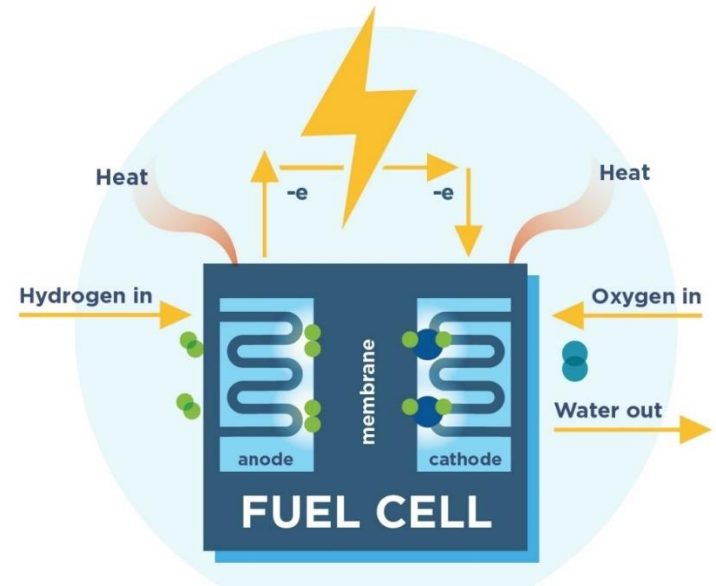


GENERAZIONE DISTRIBUITA

- Taglia limitata
- Connessa a diversi livelli di tensione
- Spesso connessa alla rete di distribuzione sul lato «utente del contatore» - autoconsumo!
- Diverse tecnologie: fotovoltaico, microturbine, celle a combustibile, turbine eoliche, motori a combustione interna
- Permette di ottenere benefici economici, tecnici e ambientali

RITORNO ALLA CORRENTE CONTINUA

Nuove fonti in corrente continua



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RITORNO ALLA CORRENTE CONTINUA

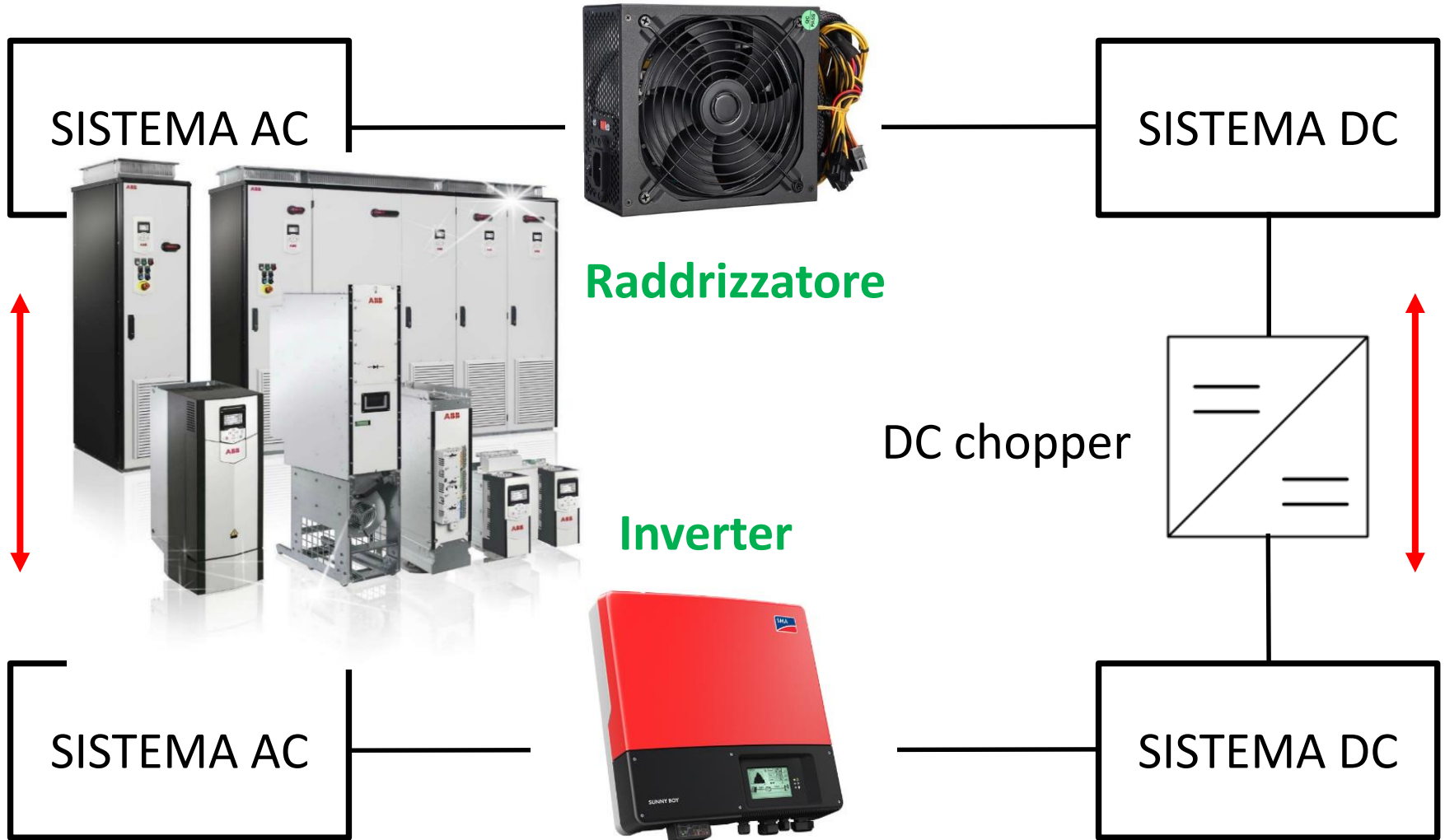
- Un viaggio durato 150 anni ci ha riportati al punto di partenza ...

Generazione distribuita e corrente continua

- Nuovi utilizzatori in corrente continua



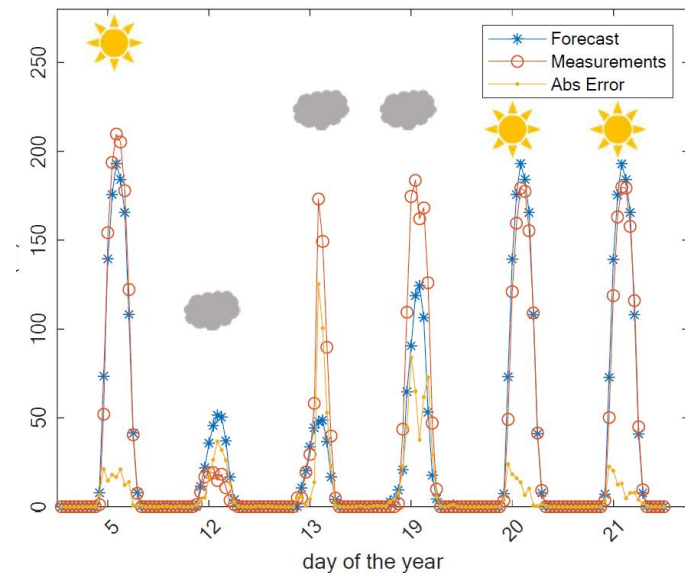
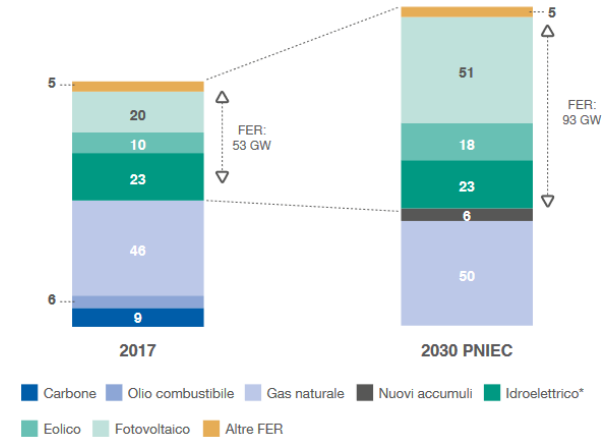
I CONVERTITORI ELETTRONICI



PREVISIONE PRODUZIONE

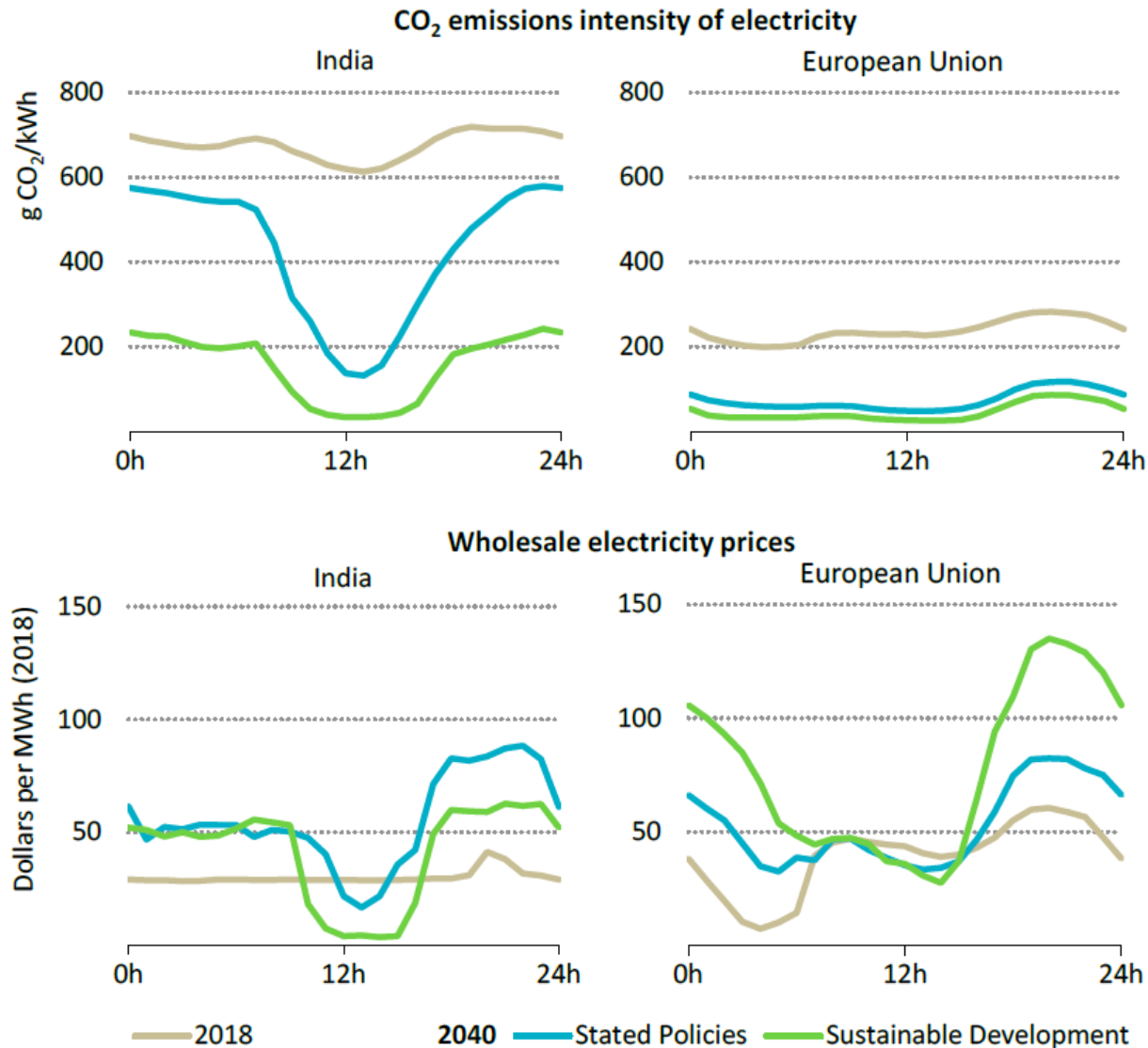
From: **10/06/2020** To: **10/06/2020**

Last update: 10/06/2020 09:00



Trieste 30/06/2020
Alessandro Massi Pavan

PREVISIONE PRODUZIONE

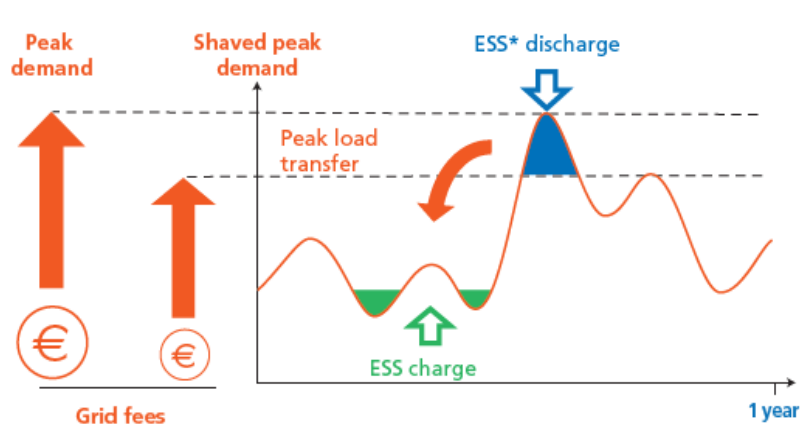


STOCCAGGIO ENERGIA ELETTRICA

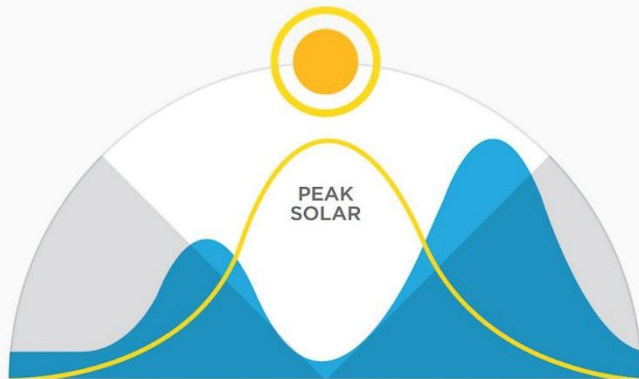
PEAK SHAVING



TIME SHIFT



<https://www.edf-re.de/>



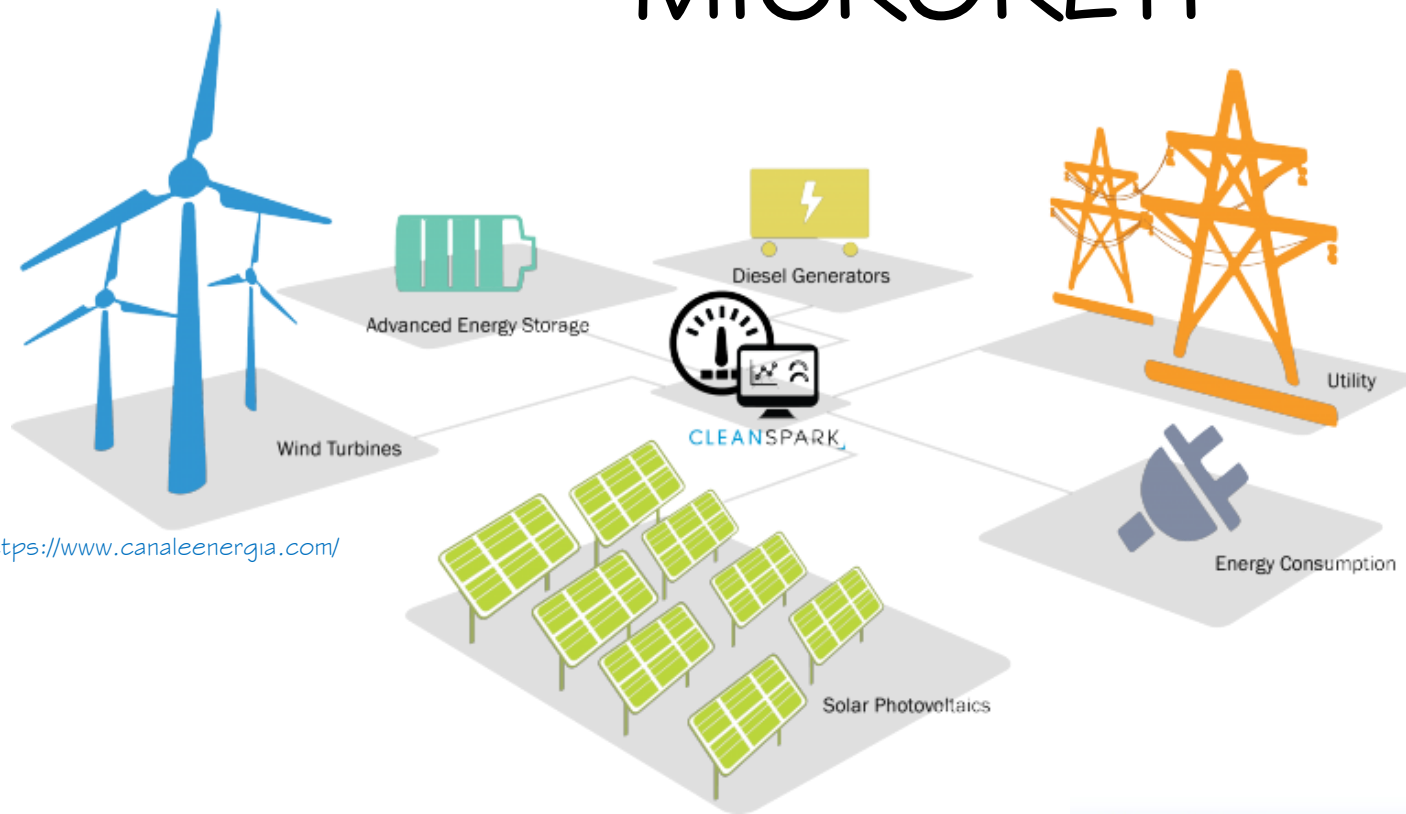
MORNING DEMAND

EVENING DEMAND

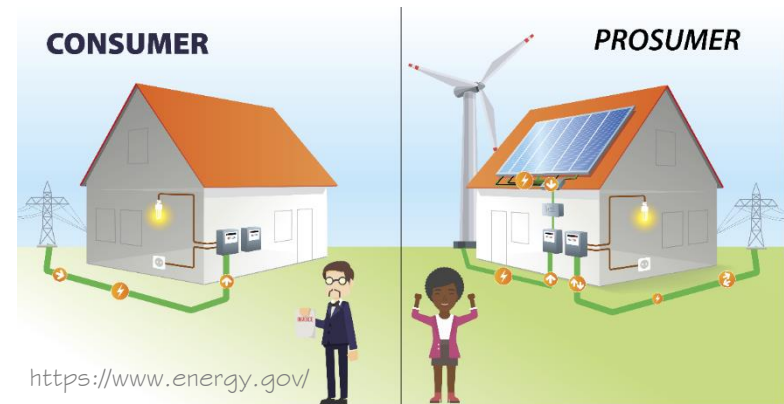


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MICRORETI

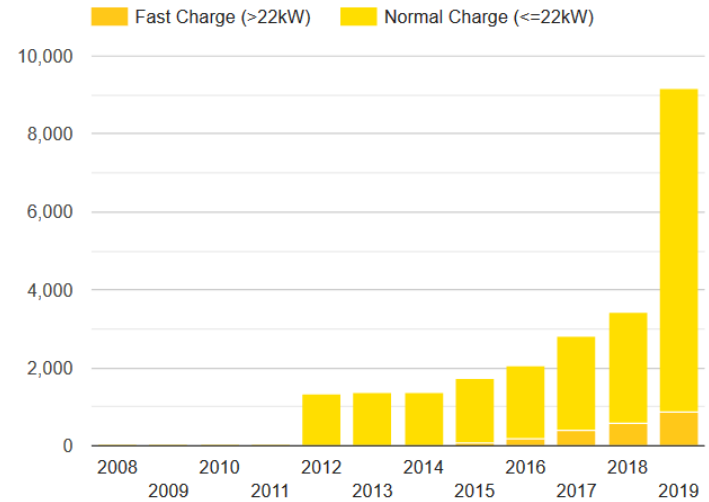
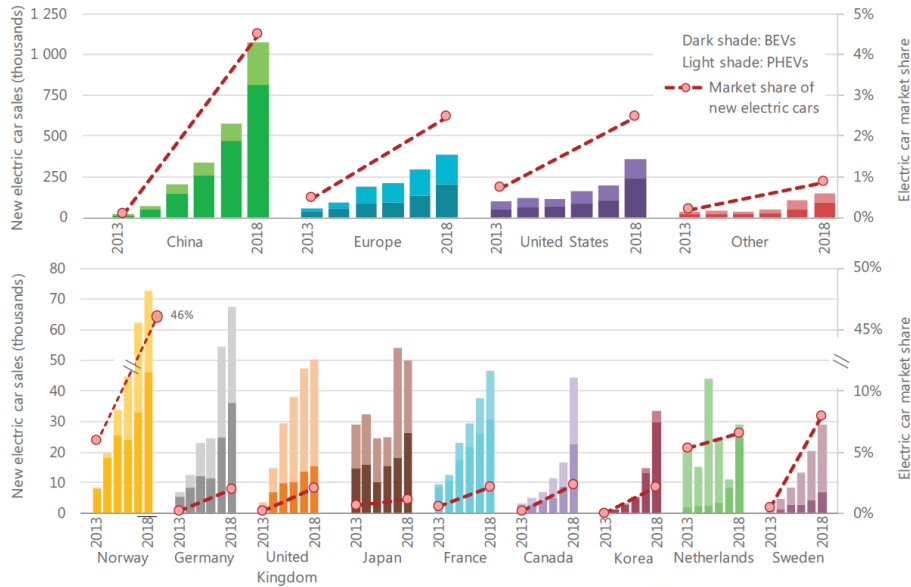


<https://www.canaleenergia.com/>

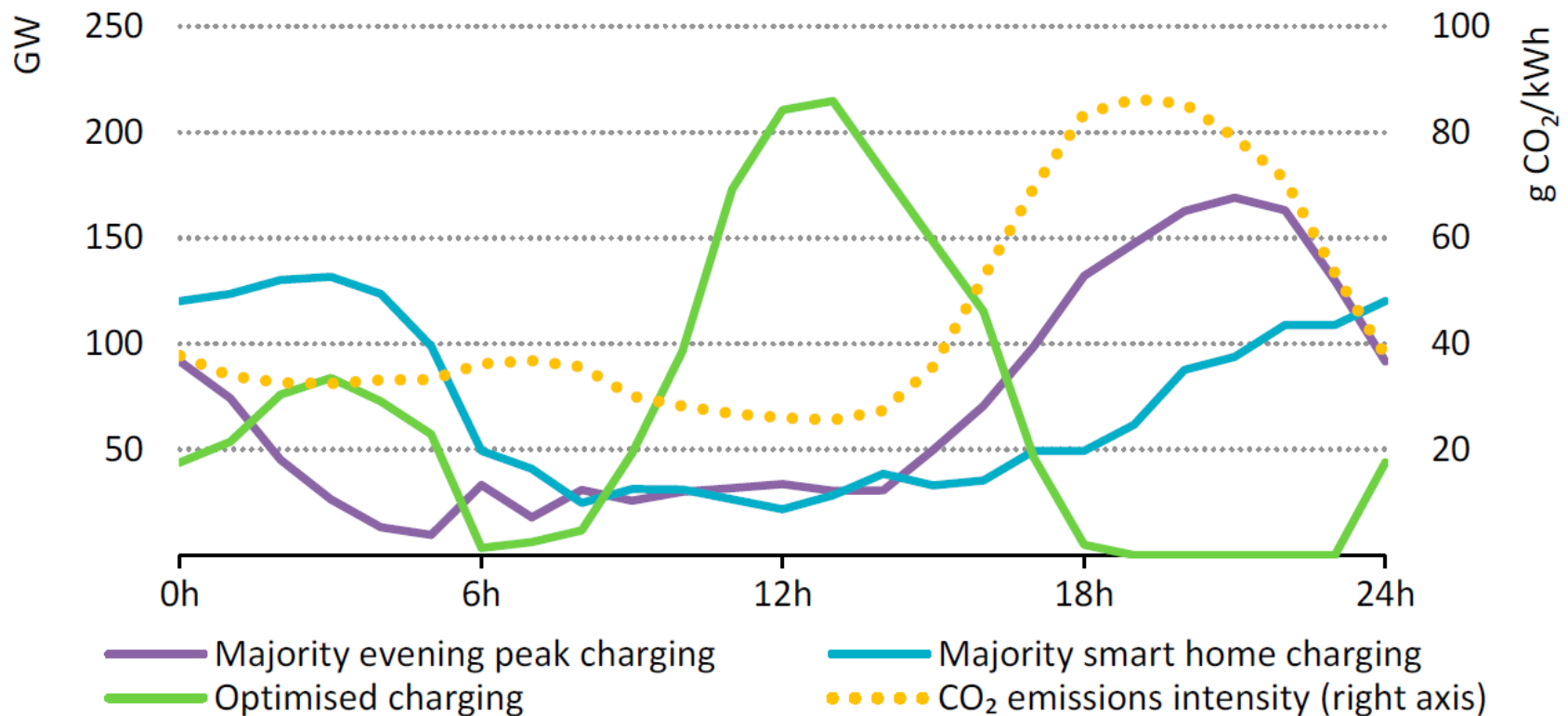


<https://www.energy.gov/>

INTEGRAZIONE CON I TRASPORTI



SMART CHARGING



I veicoli elettrici potranno anche essere utilizzati per dare servizi alla rete elettrica (V2G)

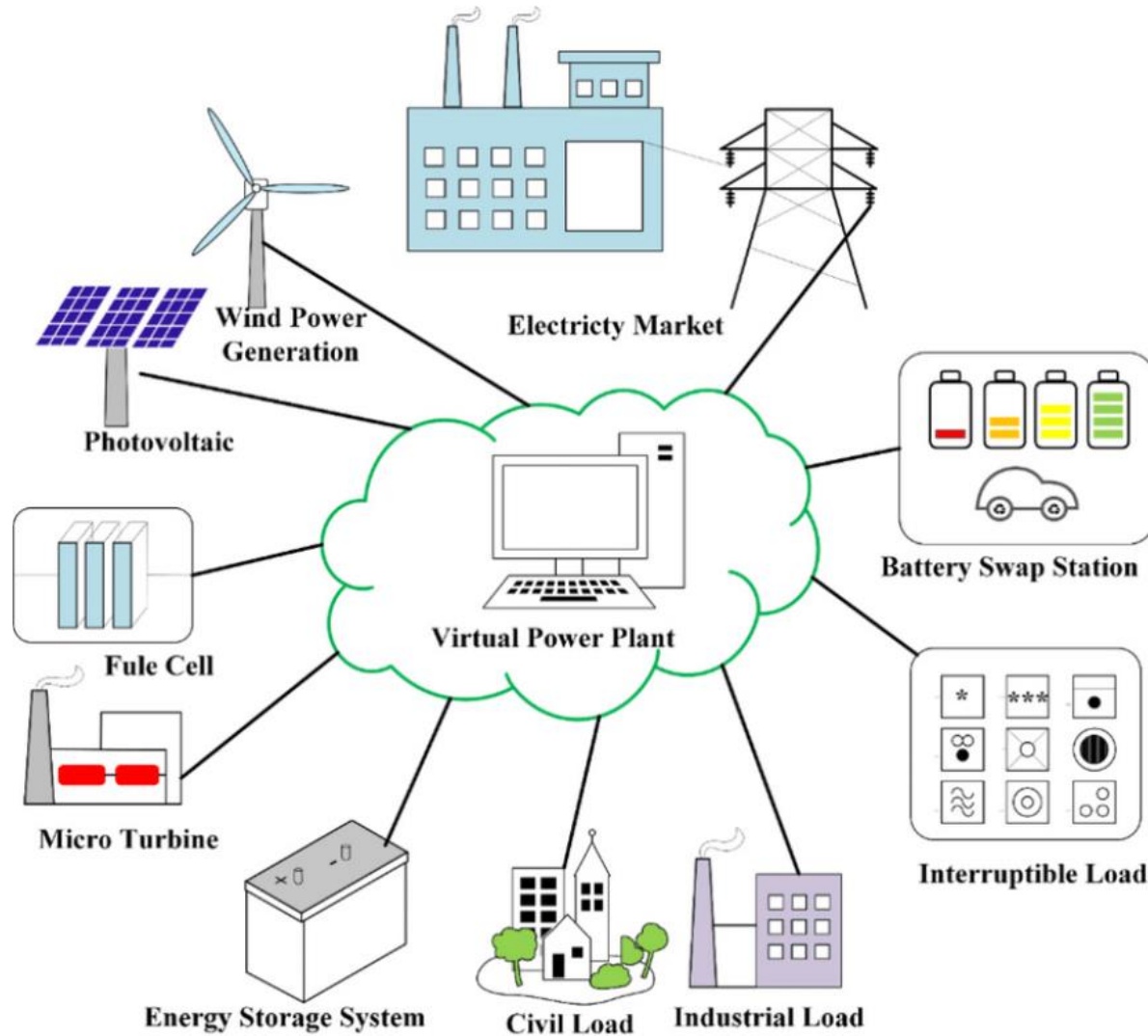
MICRORETI E MOBILITA'



Circa il 70% dell'energia elettrica consumata dal veicolo è rinnovabile!



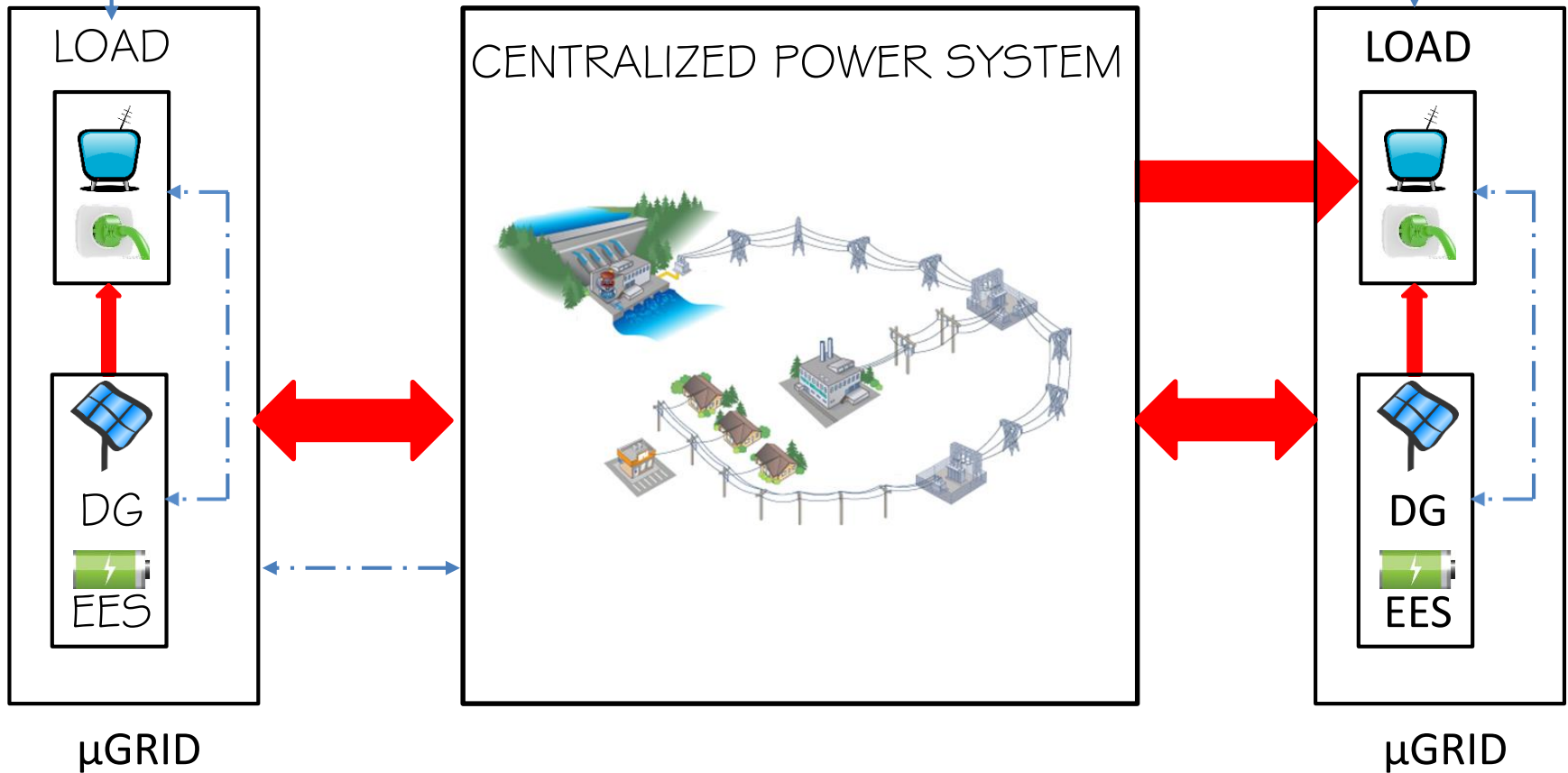
VIRTUAL POWER PLANTS



SISTEMI ELETTRICI SEMPRE PIU' SMART

SMARTGRID

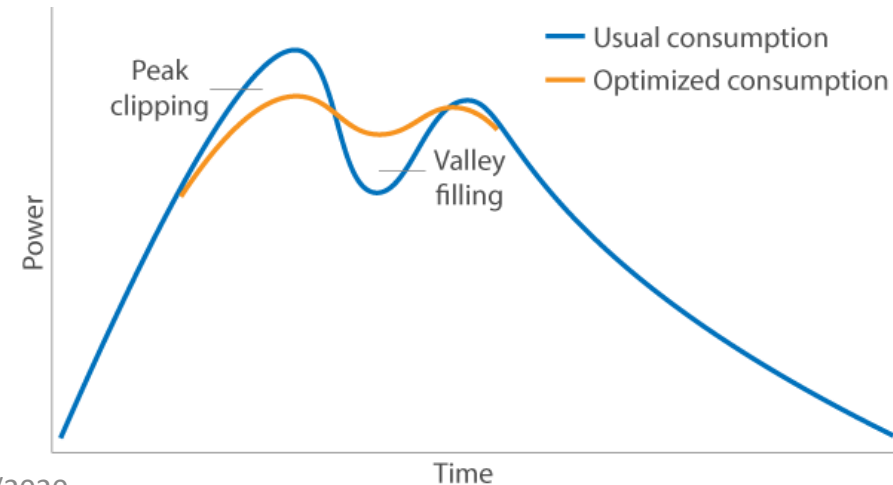
VIRTUAL POWER PLANT



IL RUOLO DELL'UTENTE FINALE

Fasce orarie dell'energia elettrica

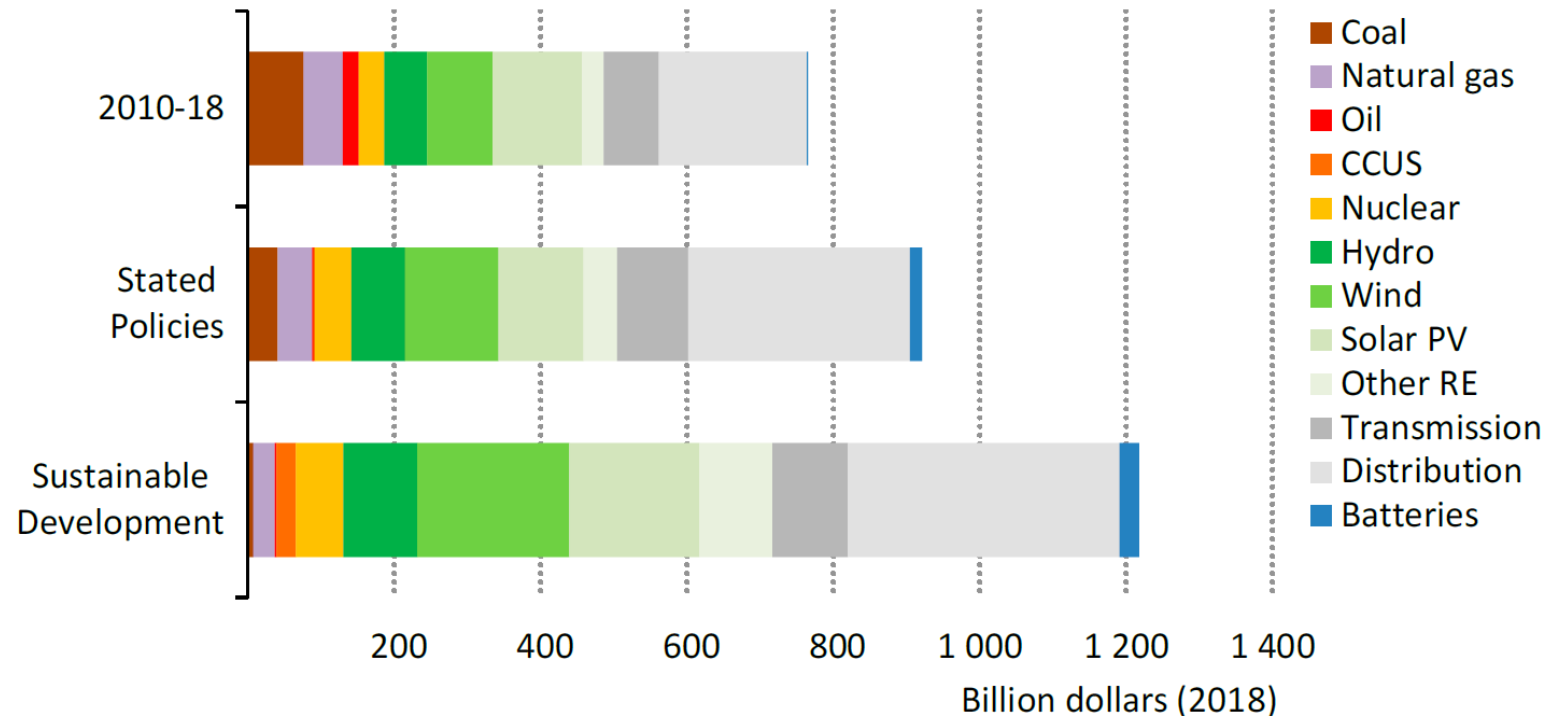
F1 (ore di punta)	dalle 8:00 di mattina alle 19:00 dal lunedì al venerdì, festività nazionali escluse
F2 (ore intermedie)	dalle ore 7:00 alle ore 8:00 la mattina, dalle ore 19:00 alle ore 23:00 dal lunedì al venerdì e dalle ore 7:00 alle ore 23:00 il sabato, festività nazionali escluse
F3 (ore fuori punta)	dalle ore 00.00 alle ore 7.00 e dalle ore 23.00 alle ore 24.00 dal lunedì al sabato, la domenica e festivi tutte le ore della giornata
F23 (o F2+F3)	dalle 19:00 alle 8:00 di tutti i giorni, comprese le domeniche e i giorni festivi. Questa fascia comprende le ore incluse nelle fasce F2 e F3





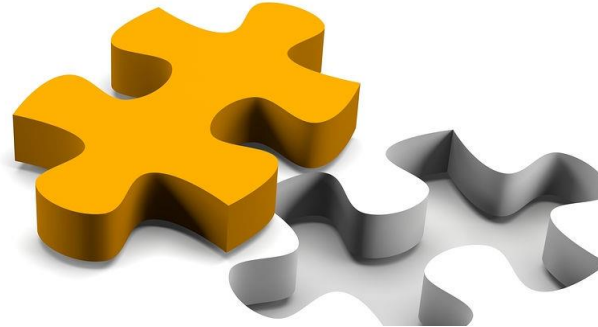
VISUALIZATION

INVESTIMENTI NEL SETTORE ELETTRICO 2019-2040



Il settore elettrico rappresenta dal 50 al 67% degli investimenti globali nel settore energia
Di questi la metà nelle reti

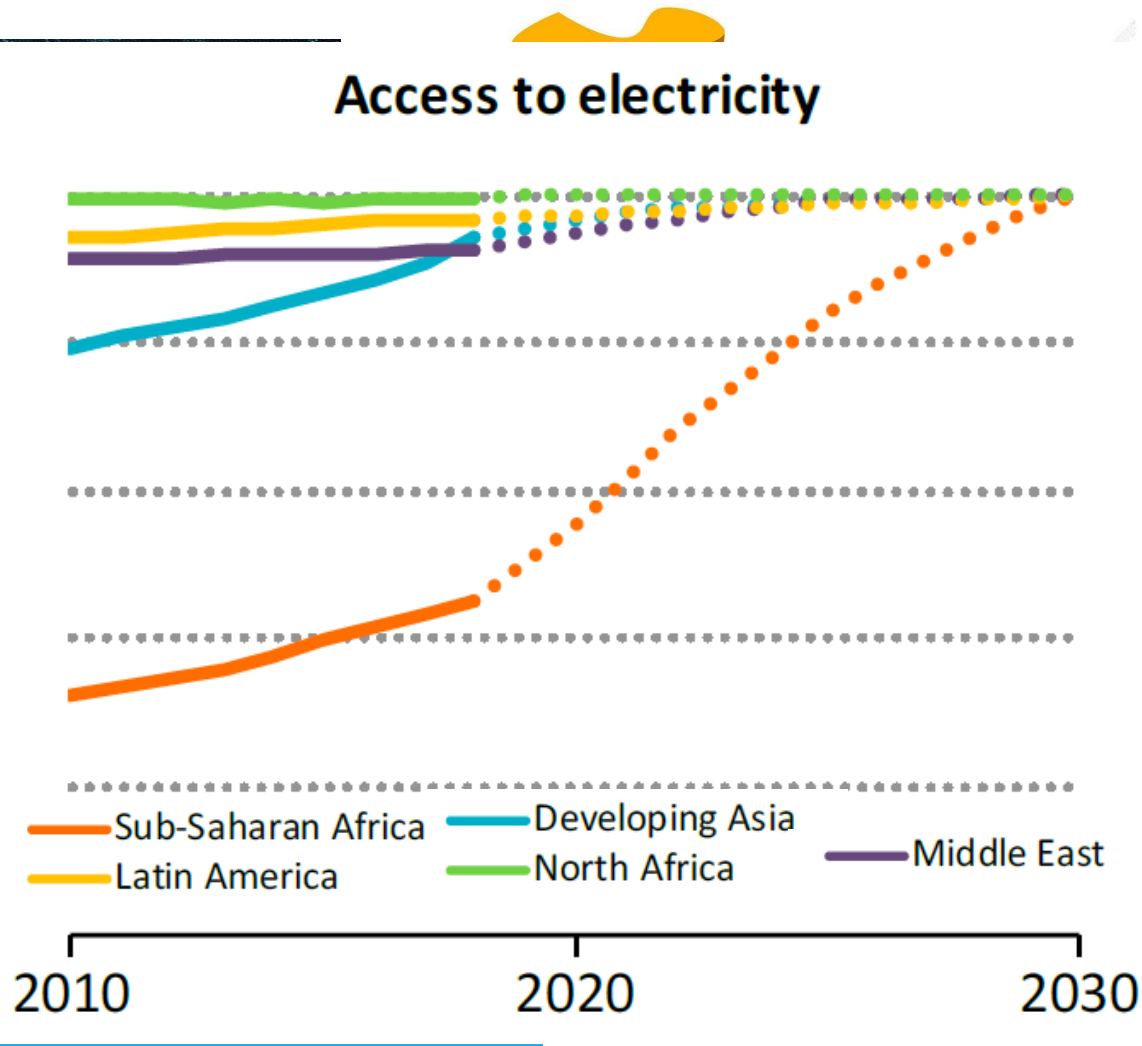
SFIDE ELETTRICHE



ADEGUATEZZA

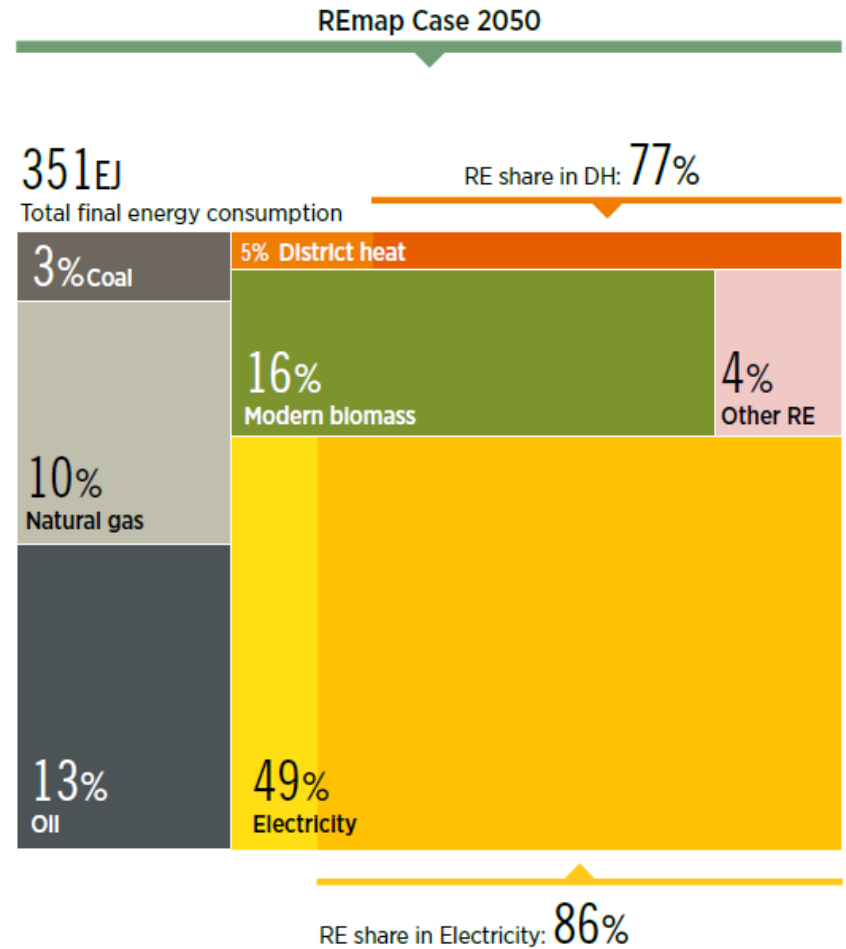
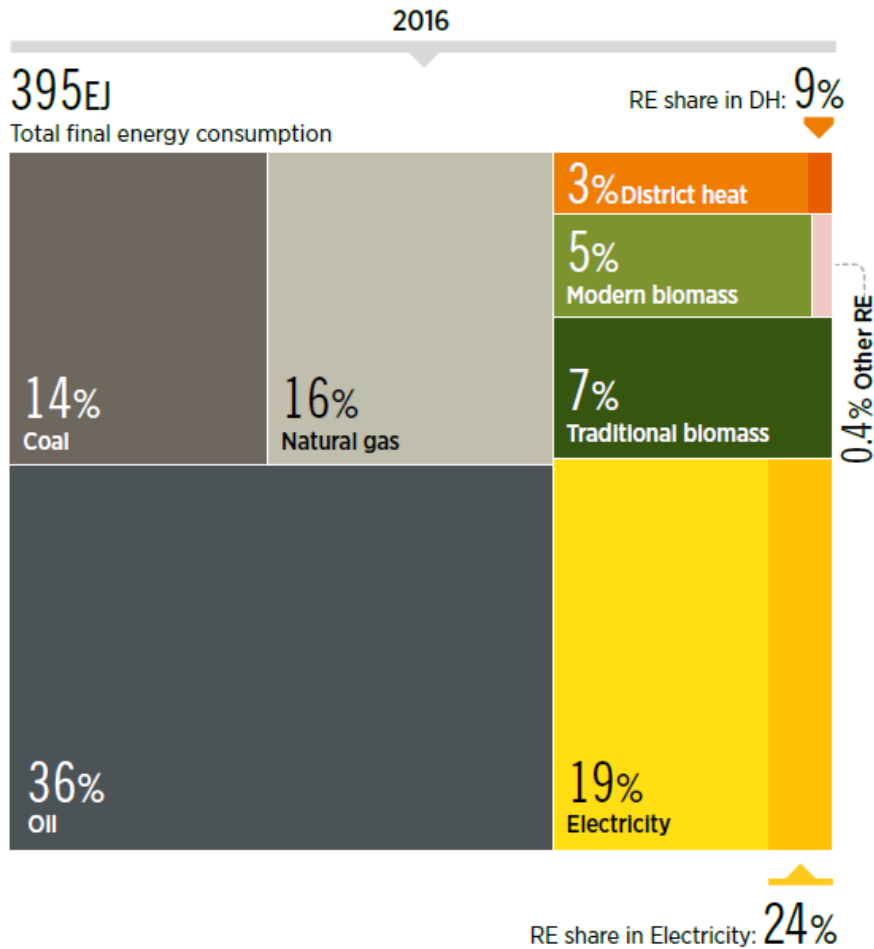


SFIDE ELETTRICHE



SFIDE ELETTRICHE

Total final energy consumption breakdown by energy carrier (%)

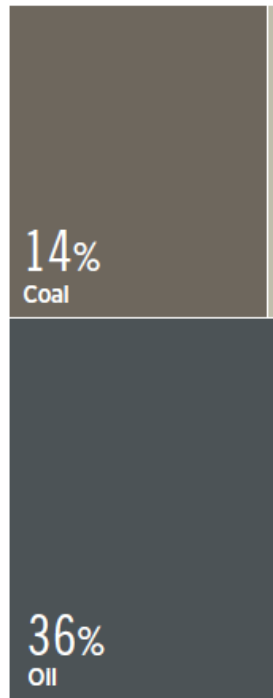


SFIDE ELETTRICHE

Total final energy consumption

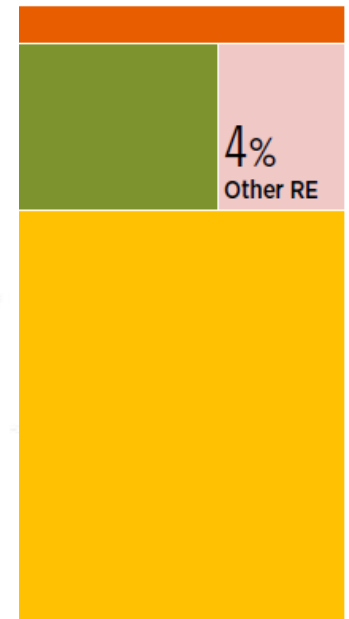
395 EJ

Total final energy consumption



50

Share in DH: 77%



Share in DH: 86%

RETI ELETTRICHE E TRANSIZIONE ENERGETICA

Alessandro Massi Pavan

Martedì 30 giugno 2020



UNIVERSITÀ
DEGLI STUDI DI TRIESTE



Summer School on Energy
Giacomo Ciamician



www.awareenergy.eu

GRAZIE!

apavan@units.it

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TRIESTE