

# La montagna nell'era del cambiamento climatico.

Roma – Teatro Italia  
25 – 26 Novembre  
Congresso Nazionale Club Alpino Italiano



# 101°

CONGRESSO  
NAZIONALE  
CLUB ALPINO ITALIANO



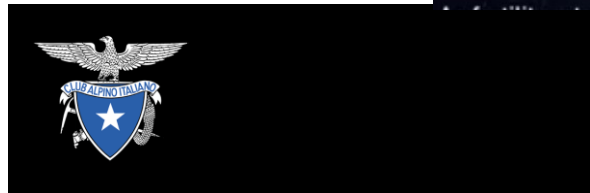
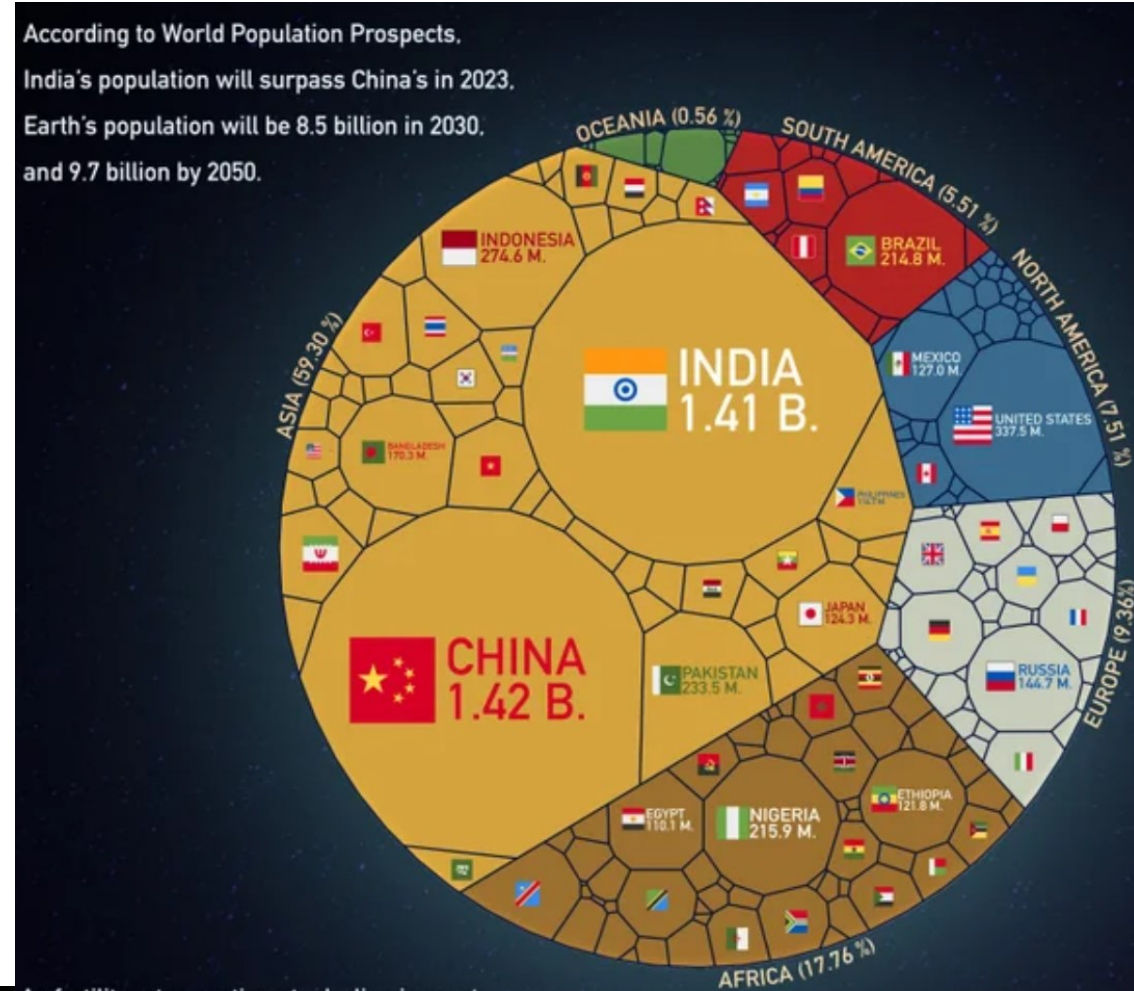
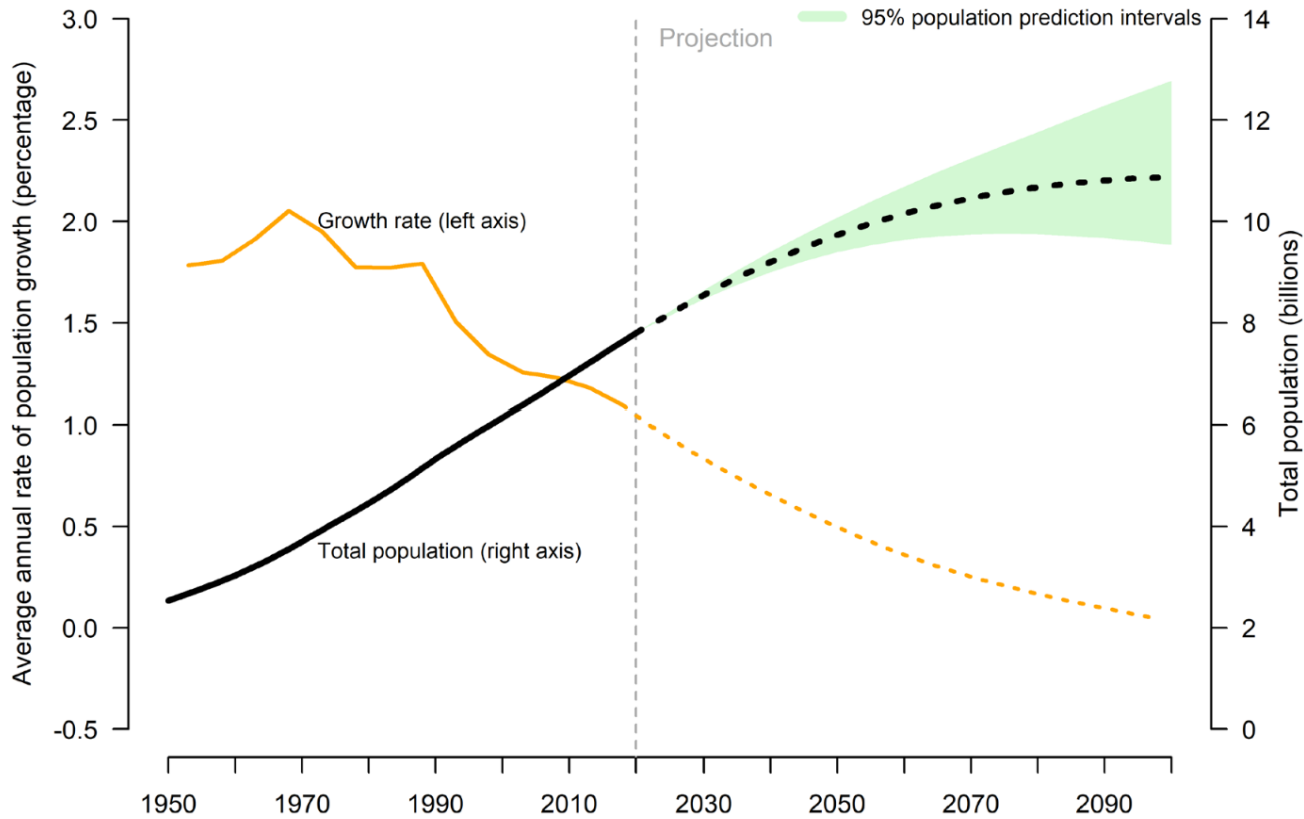
# Il riscaldamento globale in montagna: una tempesta perfetta!



Maurizio Fermeglia - CAAI - Università di Trieste  
[Maurizio.fermeglia@units.it](mailto:Maurizio.fermeglia@units.it)

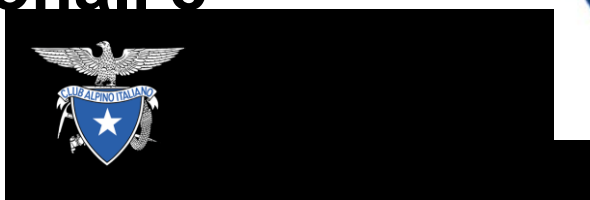


# Il 22 novembre 2022 abbiamo raggiunto gli 8 miliardi di abitanti sulla terra



# La tempesta perfetta di John Beddington

- Aumento **popolazione globale** (da 6.8 miliardi a 8.3 miliardi).
- Richiesta di **cibo** aumentata del 50%, ma produzione non adeguata
- Richiesta di **energia** aumentata del 60% ma produzione non adeguata
- Domanda globale di **acqua** aumentata del 30%, problemi di approvvigionamento acqua potabile
- Riduzione delle **emissioni di gas serra** inferiori alle aspettative - cambiamenti climatici sempre più evidenti
- Scarsità di cibo, energia ed acqua portano a **tensioni internazionali e migrazioni**



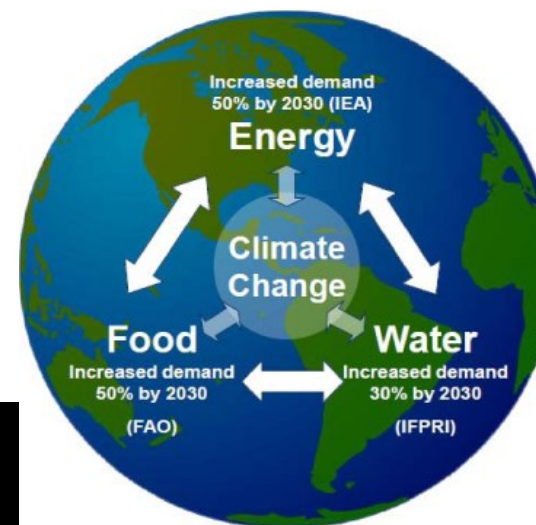
theguardian

News | Sport | Comment | Culture | Business | Money | Life & style |

News > Science

## World faces 'perfect storm' of problems by 2030, chief scientist to warn

Food, water and energy shortages will unleash public unrest and international conflict, Professor John Beddington will tell a conference tomorrow



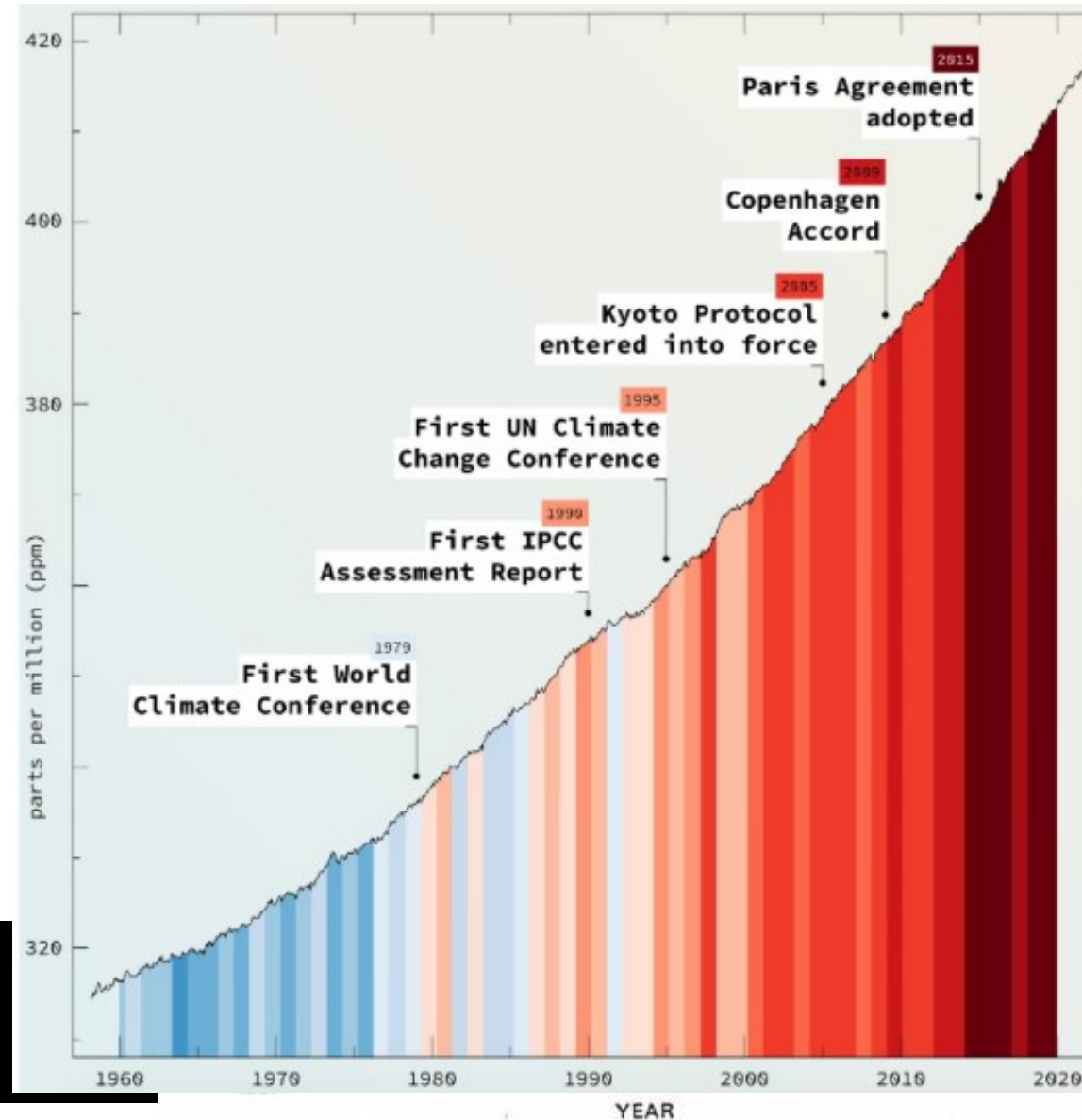
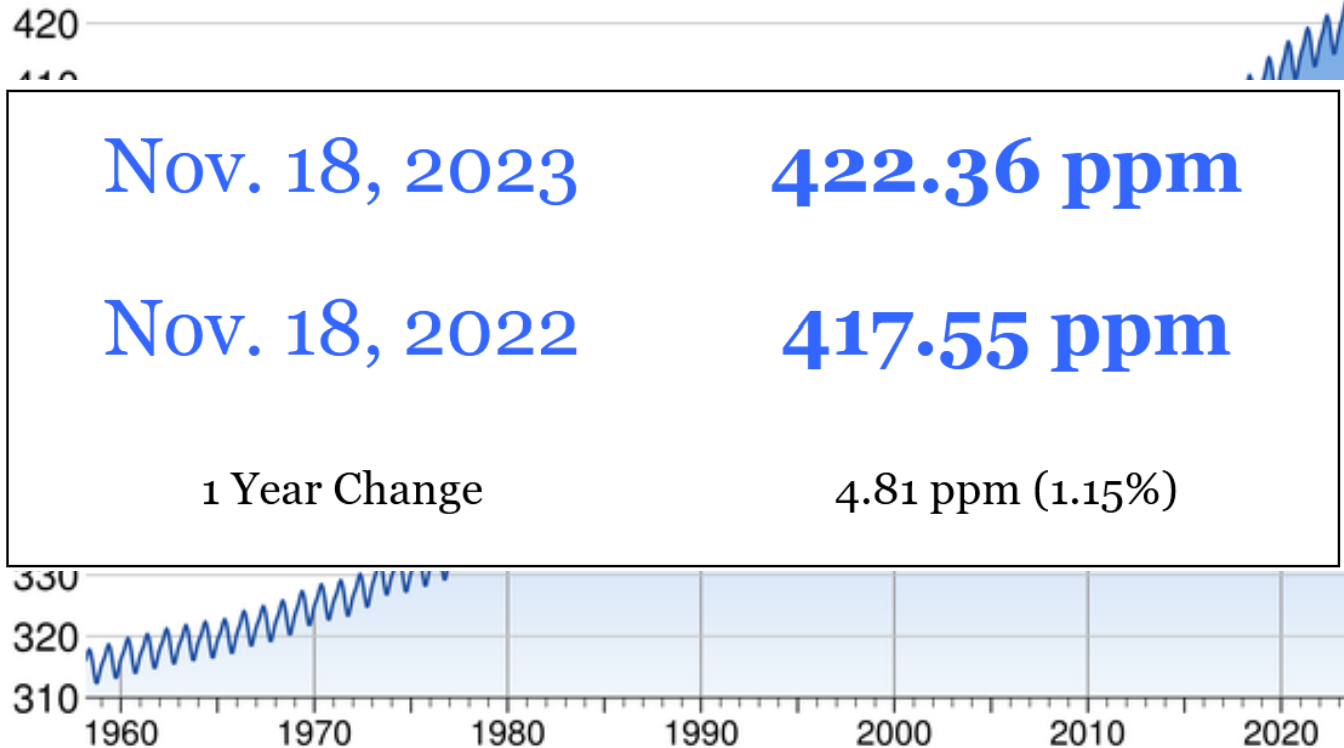
# Aumento concentrazione di gas serra in atmosfera



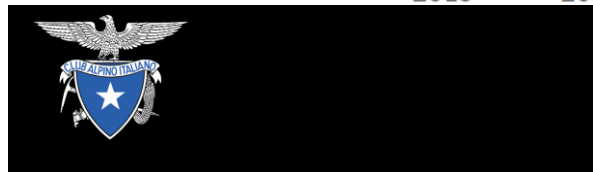
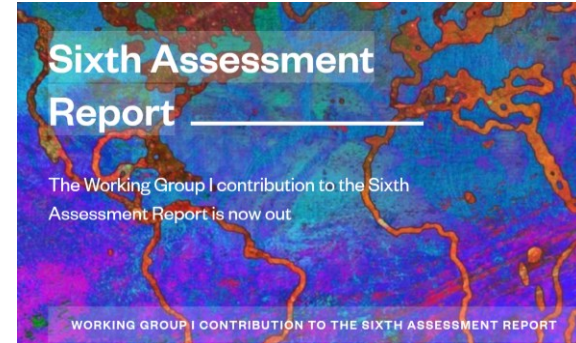
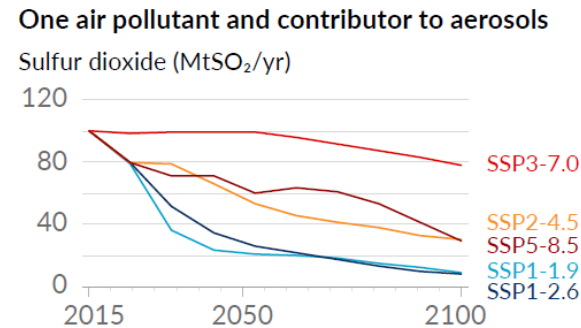
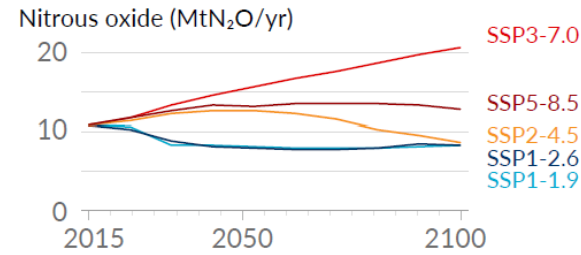
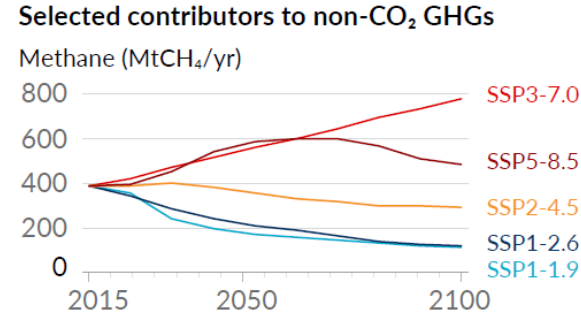
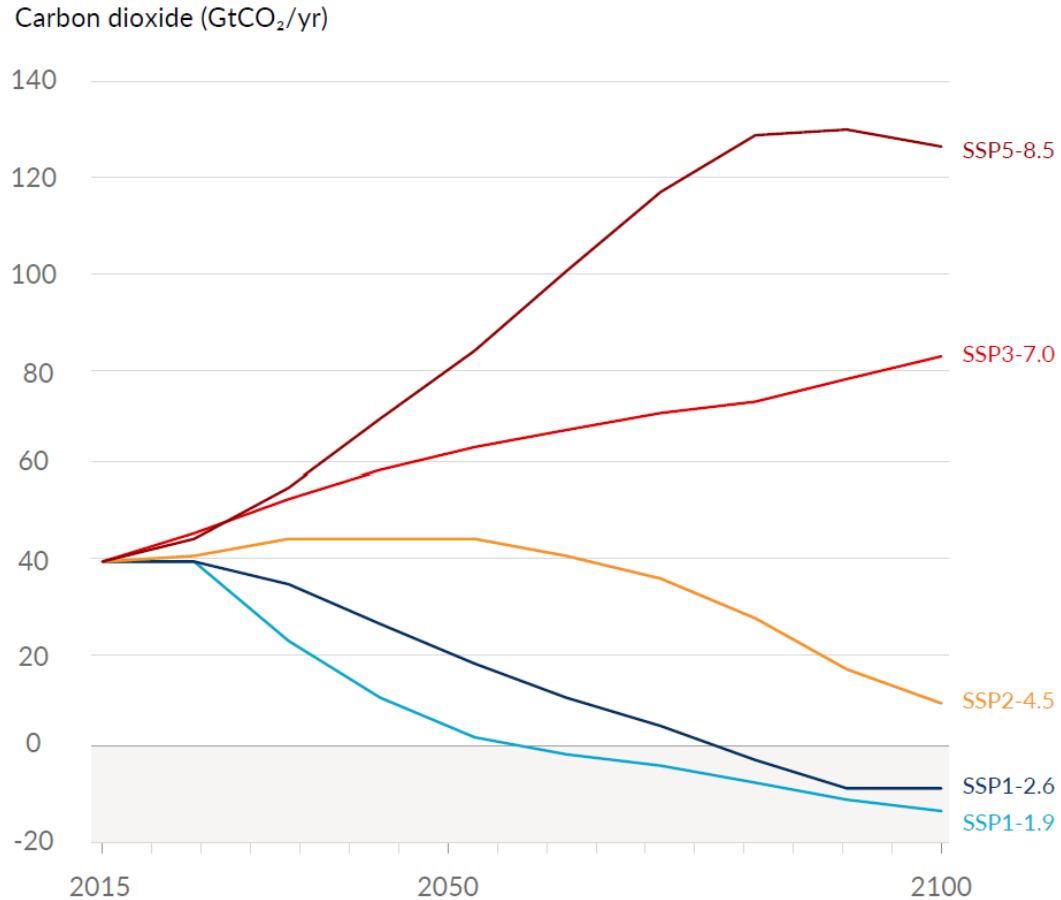
Scripps CO<sub>2</sub> Program



Monthly Carbon Dioxide Concentration  
parts per million

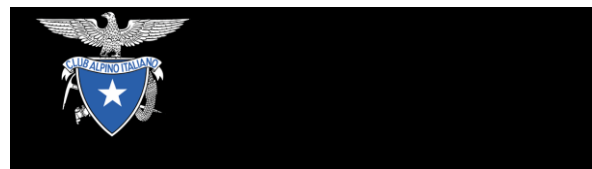
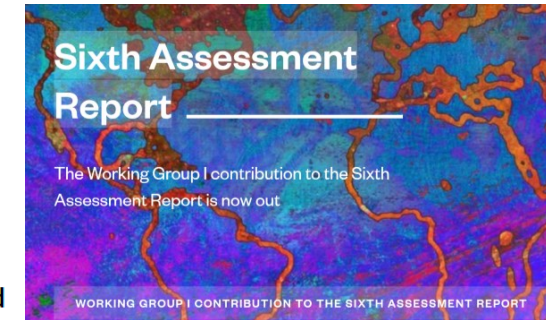
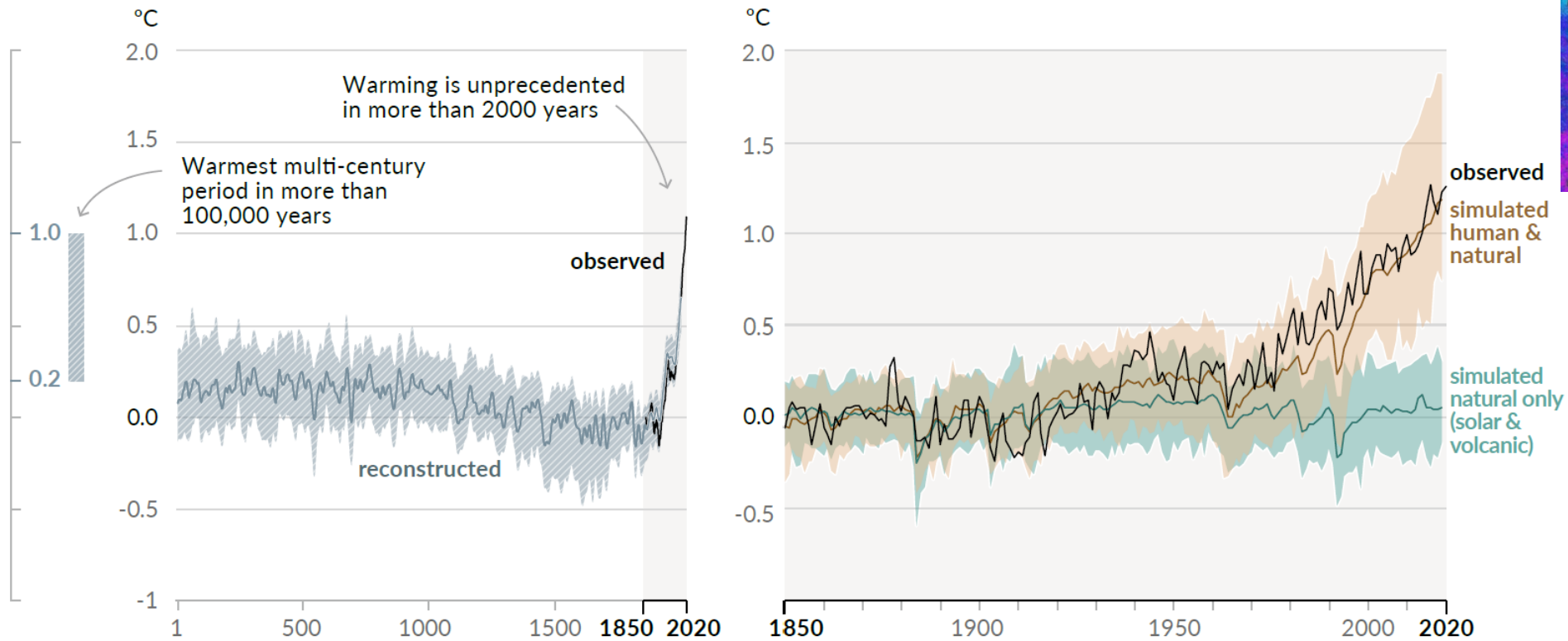


# IPCC: future emissioni annuali di CO<sub>2</sub> ed altri gas per diversi scenari climatici futuri



# IPCC: temperatura della terra è aumentata di circa 1.2° negli ultimi 100 anni

- Sono gli esseri umani che hanno riscaldato il clima del pianeta ad una velocità senza precedenti negli ultimi 2000 anni.



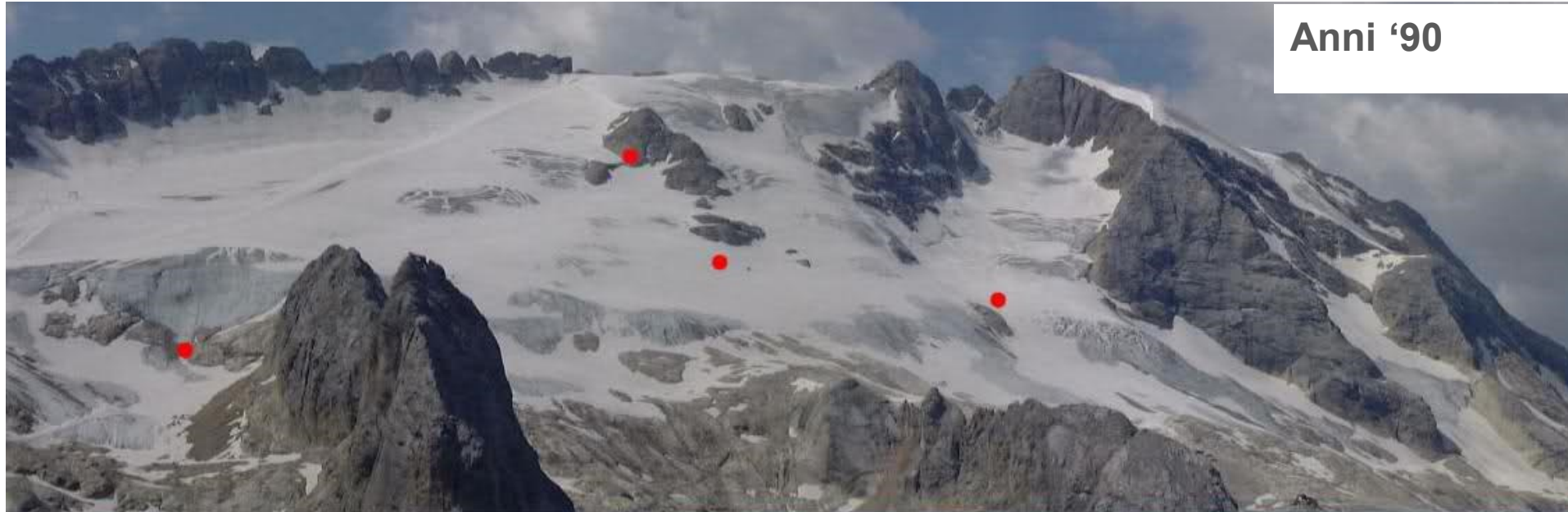
# RCP8.5, alla fine del secolo, EURO-CORDEX







# Il ghiacciaio della Marmolada... già un morto che cammina



Anni '90



anni 2000

# Fusione dei ghiacciai porta a qualche sorpresa ...

AI / **SCIENZA** / Terra e Poli

## Batteri sconosciuti nei ghiacci polari

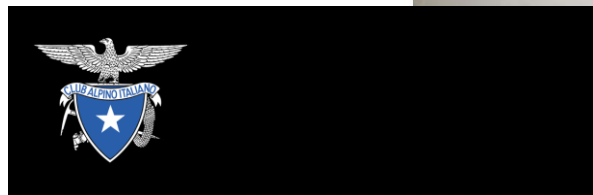


Cambiano visione su  
impronta uomo su clima e  
vita su altri mondi

22 dicembre 2017, 10:18

Redazione ANSA

←  
I ghiacci polari ospitano, a sorpresa, colonie  
di batteri che vivono in condizioni proibitive  
(fonte Pixabay) - RIPRODUZIONE RISERVATA



Naviga :

**R** La Repubblica  Seguiti

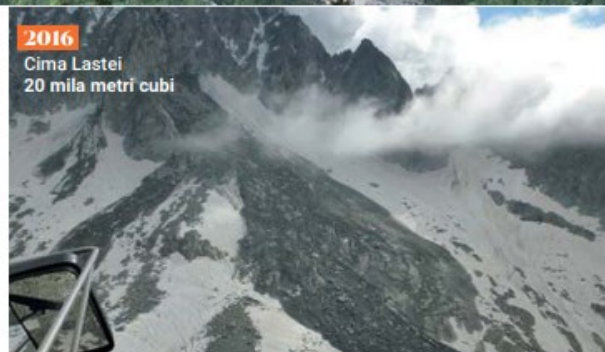
Adamello, tracce della nube di Chernobyl vicine alla  
superficie. Gli esperti: “Vuol dire che ci siamo mangiati  
30 anni di ghiacciaio”

Storia di Tiziana De Giorgio • 3 h fa



# Fusione del permafrost

## Le frane in quota



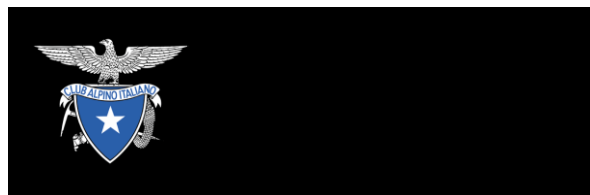
Sempre più caldo

**Più frane sulle Alpi? «È possibile una destabilizzazione significativa delle montagne», ecco perché**



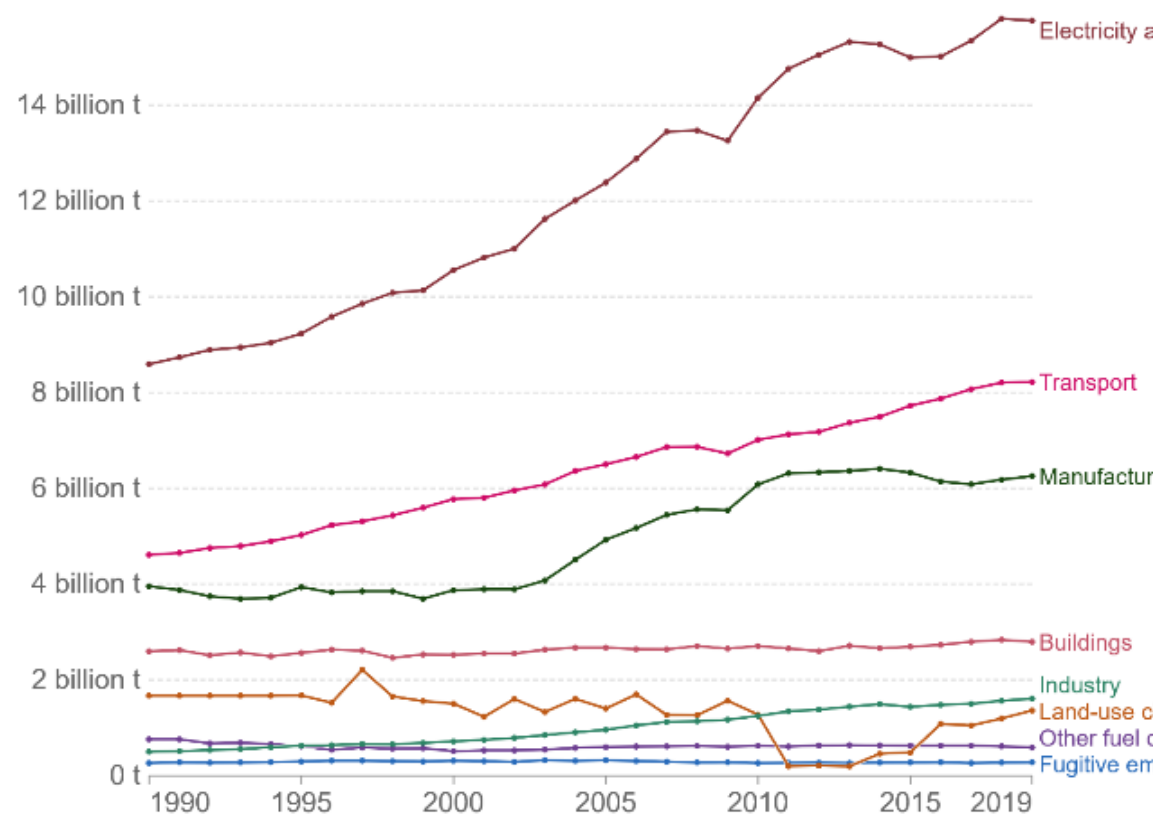
«Centinaia di metri dalla vetta si sono staccati», ha stimato il capo del servizio di soccorso alpino locale di Galtür, Christian Walter, dopo la frana sul massiccio del Fluchthorn tirolese.

KEYSTONE/APA/LAND TIROL

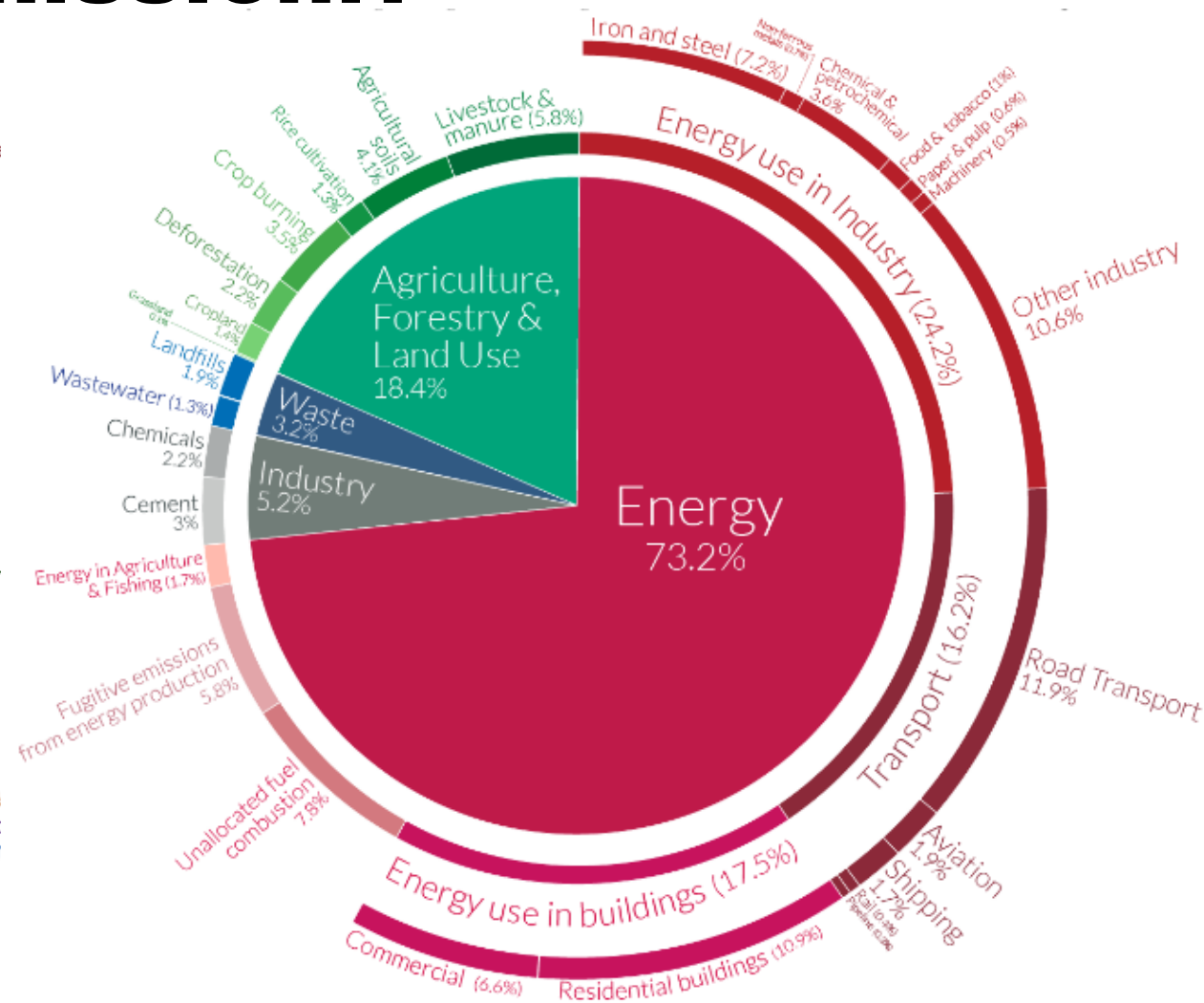


# Da dove vengono le emissioni?

CO2 emissions by sector, World



Source: Our World in Data based on Climate Analysis Indicators Tool (CAIT).  
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY



# Energia: quanta e come ... un pioniere ...



"...if our black and nervous civilization, based on coal, shall be followed by a quieter civilization based on the utilization of solar energy, that will not be harmful to progress and to human happiness."

## SCIENCE

FRIDAY, SEPTEMBER 27, 1912

### CONTENTS

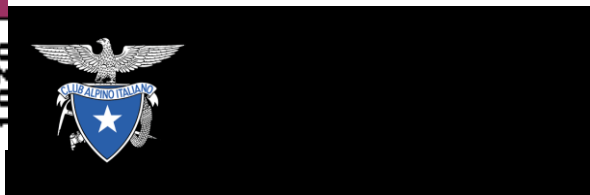
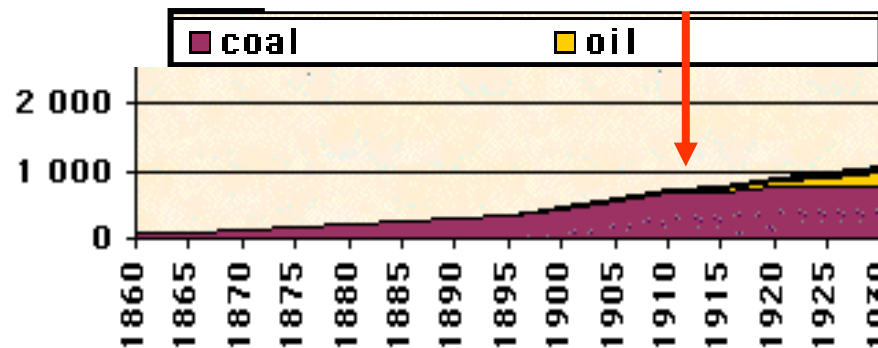
<i>The Photochemistry of the Future:</i> PROFESSOR GIACOMO CIAMICIAN .....	385
<i>The First International Eugenics Congress:</i> PROFESSOR RAYMOND PEARL .....	395
<i>Industrial Education in the Philippines</i> ....	396
<i>Graduates from American Colleges and Universities</i> .....	397

### THE PHOTOCHEMISTRY OF THE FUTURE<sup>1</sup>

MODERN civilization is the daughter of coal, for this offers to mankind the solar energy in its most concentrated form; that is, in a form in which it has been accumulated in a long series of centuries. Modern man uses it with increasing eagerness and thoughtless prodigality for the conquest of the world and, like the mythical gold of the Rhine, coal is to-day the greatest source of energy and wealth.

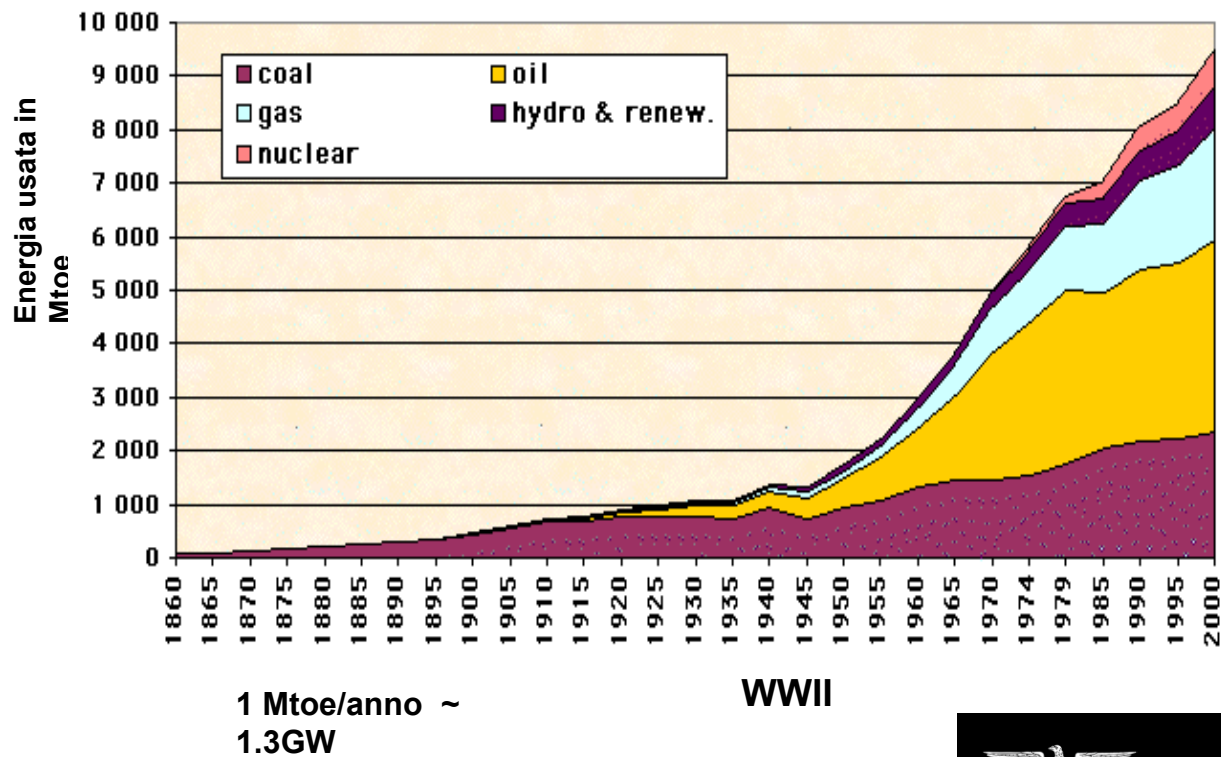
1912  
~ 1 TW

Mtoe/anno



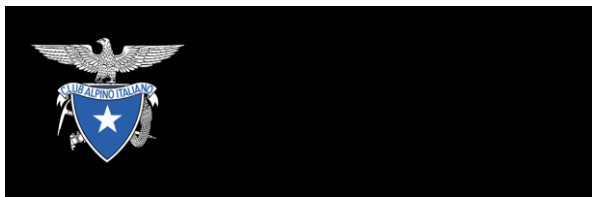
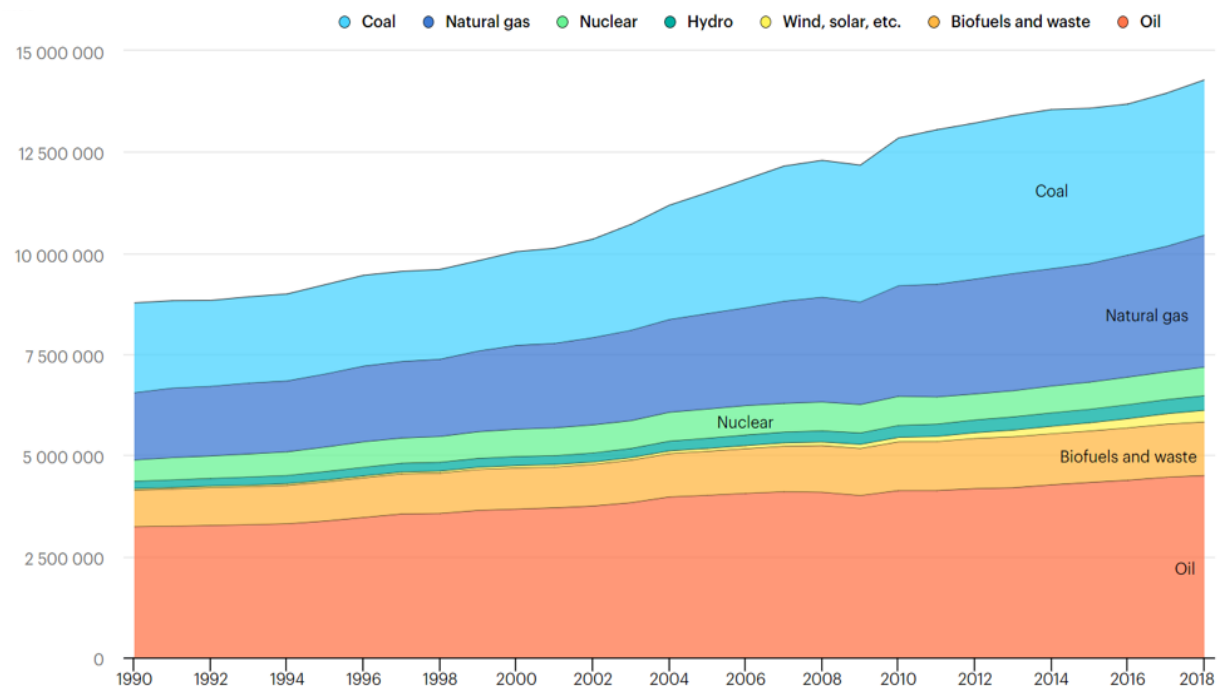
# Ma dopo il 1912 ... nessuna buona notizia!

## Nel 2000 12.3 TW

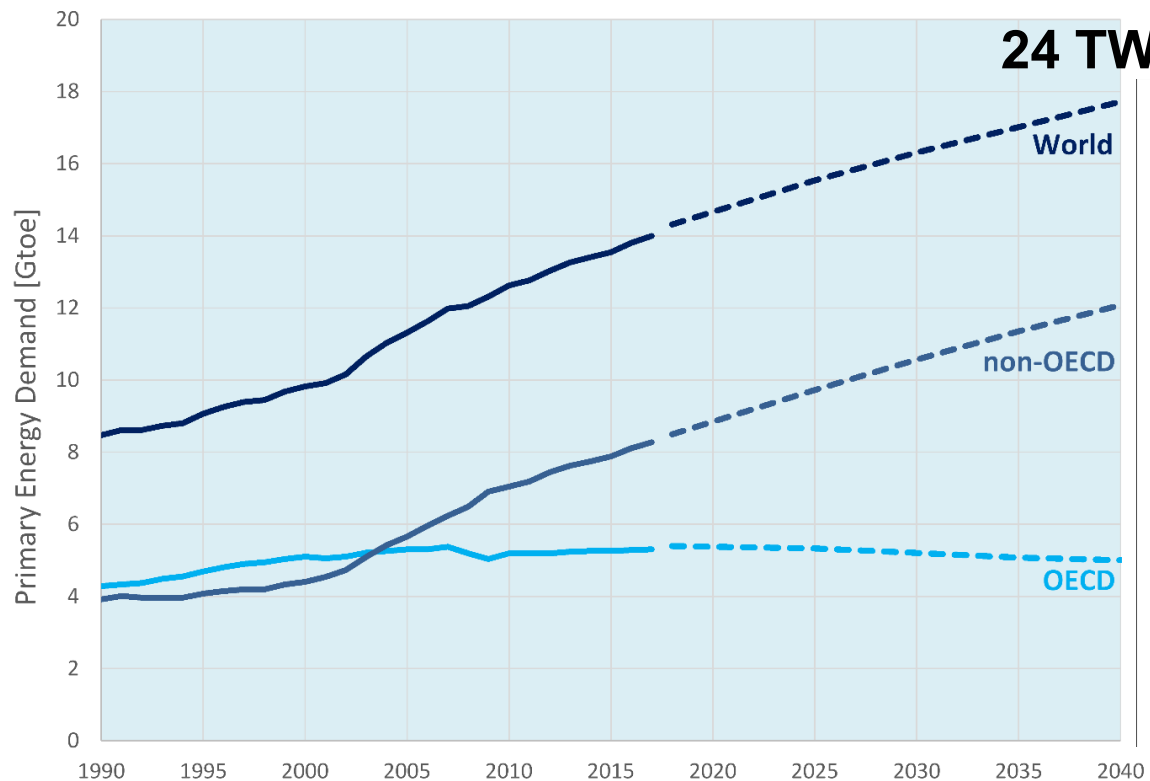


## Nel 2018 19 TW

Total energy supply (TES) by source, World 1990-2018

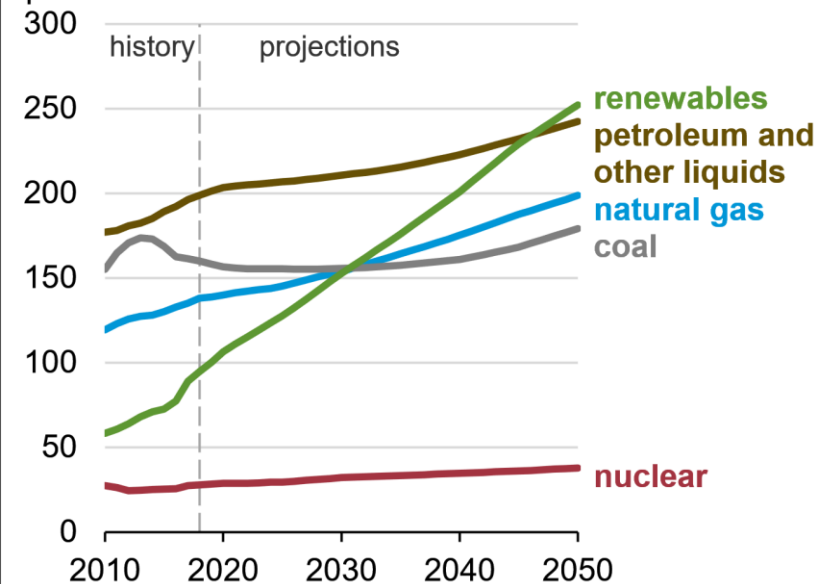


# Proiezioni del consumo primario di energia

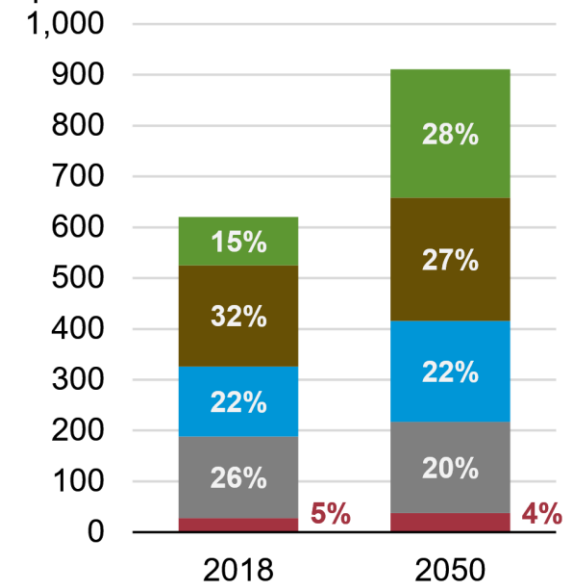


**Global primary energy consumption by energy source (2010-2050)**

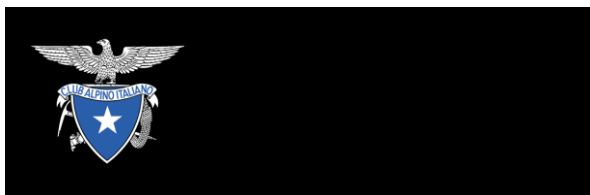
quadrillion British thermal units



quadrillion British thermal units



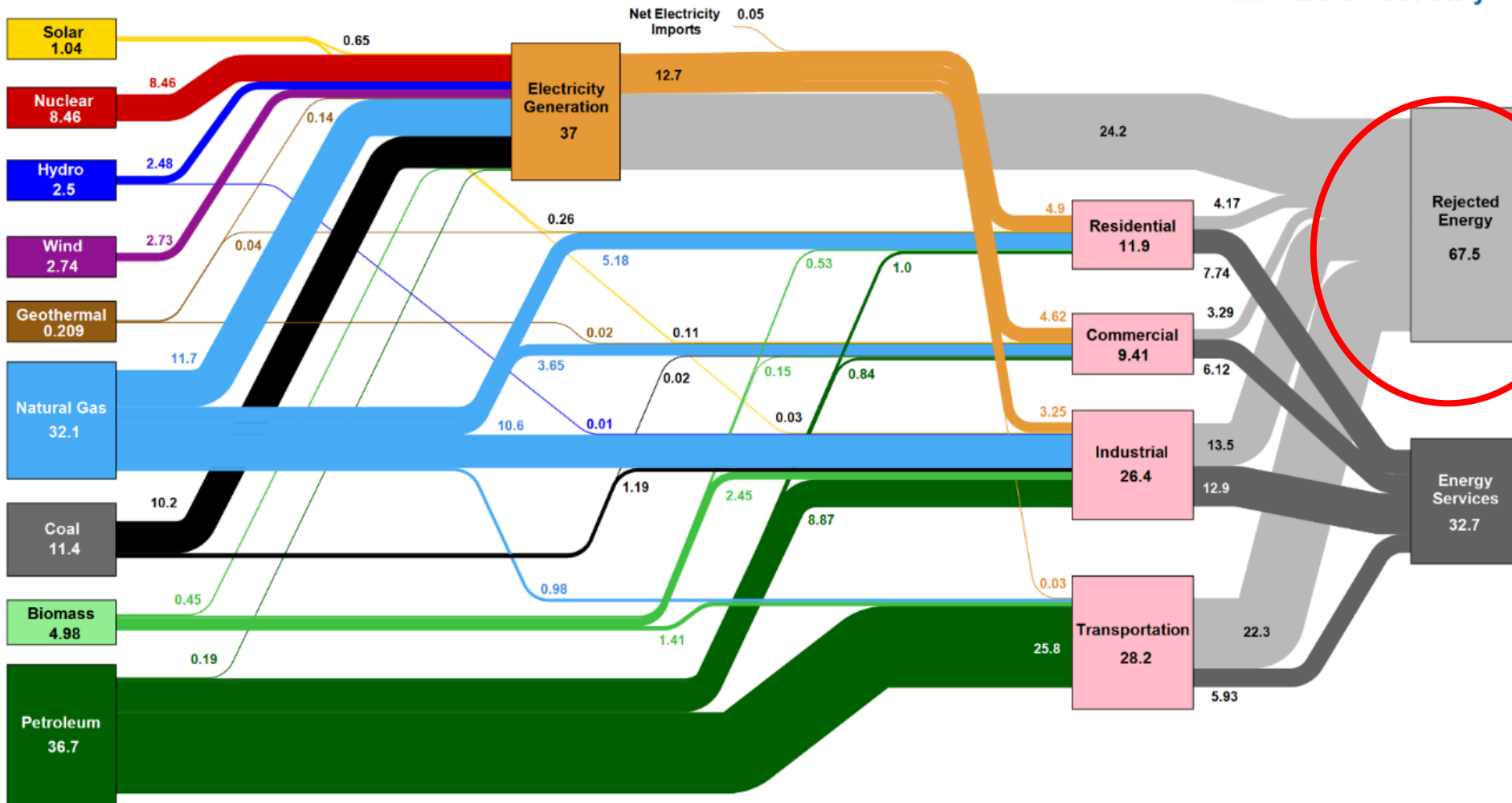
Fonte: U.S. Energy Information Administration (EIA) - 2019





# Dalle fonti di energia ai servizi: sistema energetico USA

Estimated U.S. Energy Consumption in 2019: 100.2 Quads

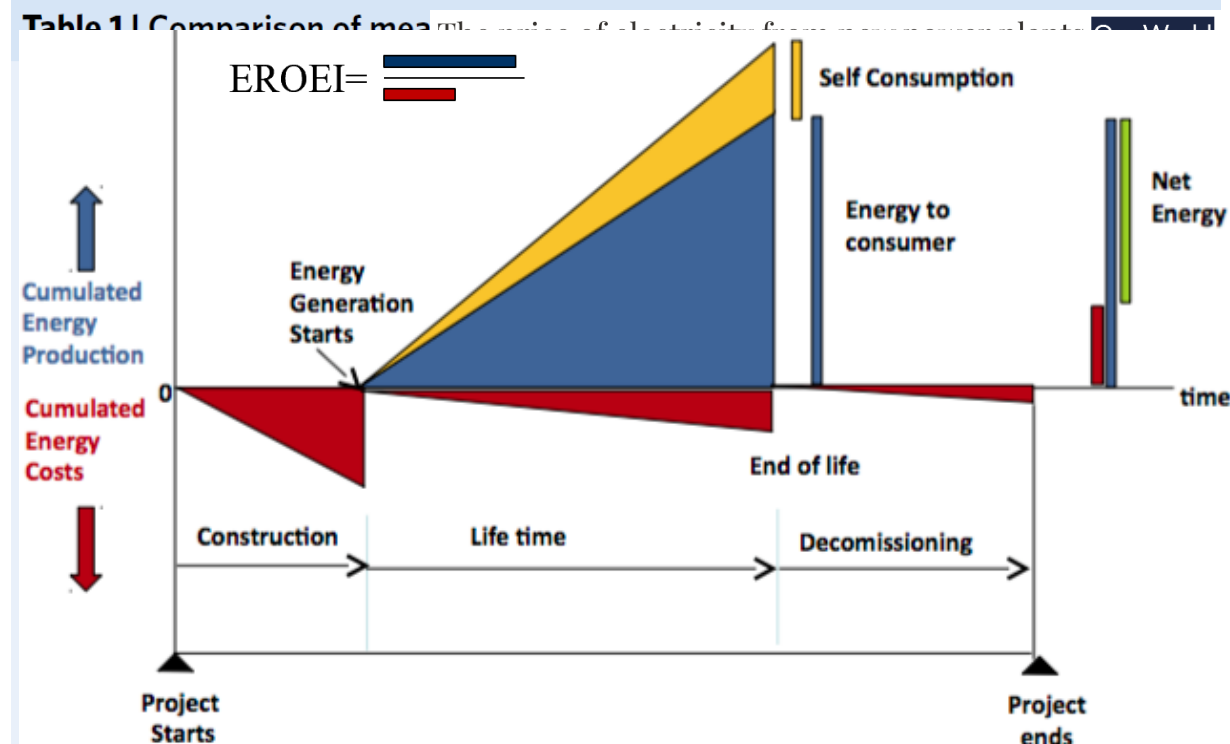
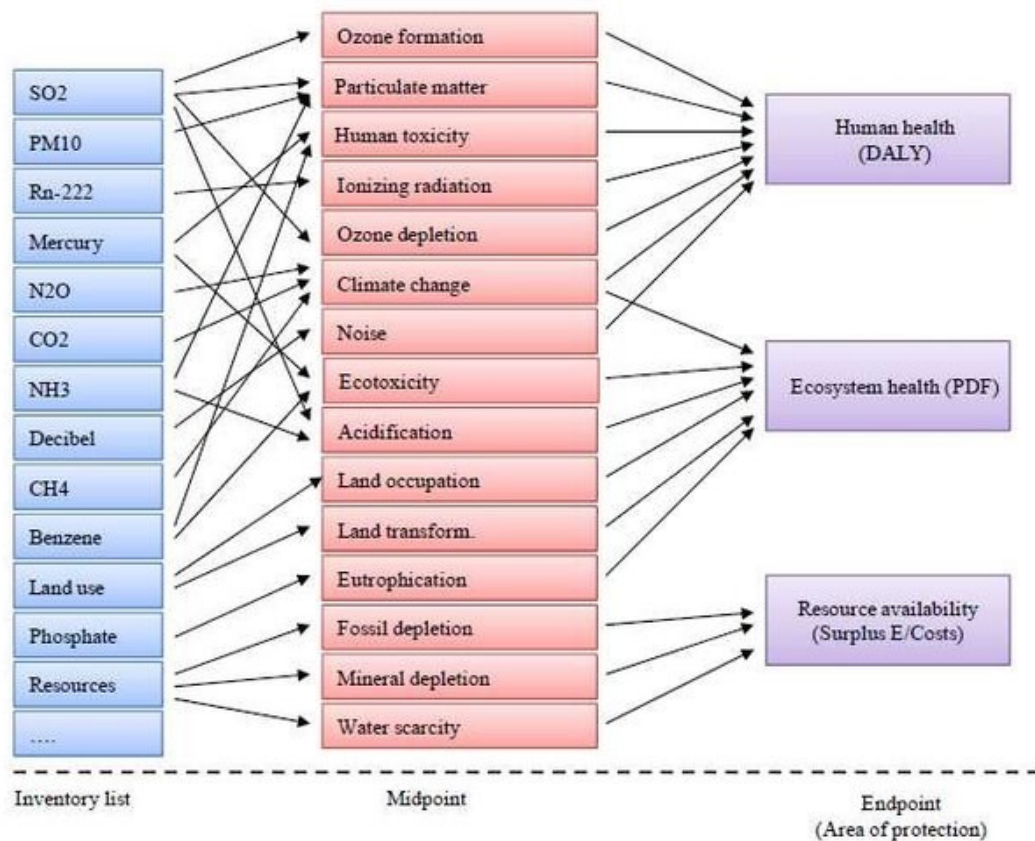


Agire sulla riduzione della domanda ha l'effetto più sensibile!

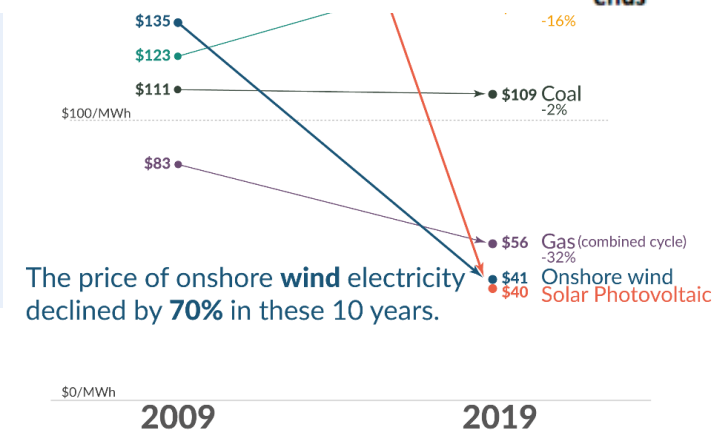
Source: LLNL March, 2020. Data is based on DOE/EIA MRR (2019). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 21% for the transportation sector and 49% for the industrial sector, which was updated in 2017 to reflect DOE's analysis of manufacturing. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

# Indicatori su cui basare le decisioni

- Ritorno dell'investimento energetico – EROEI
- Costo dell'energia – LCOE
- Analisi del ciclo di vita - LCA



- Nuclear
- Hydroelectric
- Geothermal
- Wind
- Solar PV
- Solar thermal



# Alternative??

- Carbone?
  - Non ne parliamo
- Petrolio?
  - Trasporto e petrolchimica
- Gas con CCS?
  - Emissioni CO<sub>2</sub> sopra ai 100 g/kWh e fughe CH<sub>4</sub>
  - impatto ambientale per solventi
  - EROEI si riduce ad 1/3
  - problemi stoccaggio ed uso CO<sub>2</sub>
  - costi del gas e dipendenza geopolitica
- Idroelettrico?
  - Saturato
- Biomasse?
  - Solo marginali (no da biomassa legnosa)
  - basso EROEI
  - biodiversità e ambiente

- Nucleare
  - IV o III generazione ? SMR ?? Fusione ???  
Scorie????
  - Sostenibilità economica (costi e tempi  
costruzione)
  - LCOE 155 \$/MWh (REN 40 \$/MWh) - Basso  
EROEI

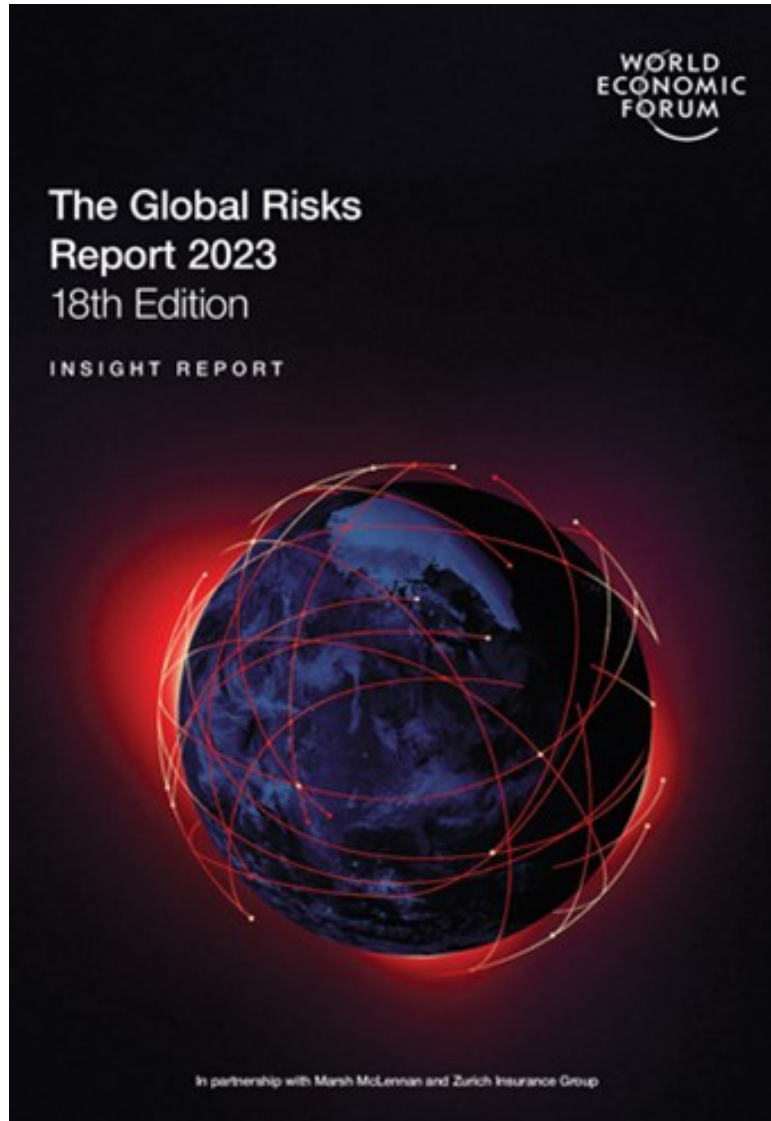


# La terra è un sistema isolato .... ricordiamoci di Ciamician

- ... eccetto che per l'irraggiamento solare
- Solare e eolico
  - Buon EROEI
  - Ottimo LCOE
  - LCA competitivo (riciclo moduli)
  - No emissioni gas serra
  - No import, no costi materie prime
- Sistema 100% rinnovabile
  - Smart grids, batterie, idrogeno digitalizzazione
  - 70 GW elettrici da REN al 2030
- Il problema principale??
  - Tempo
  - No distrazioni



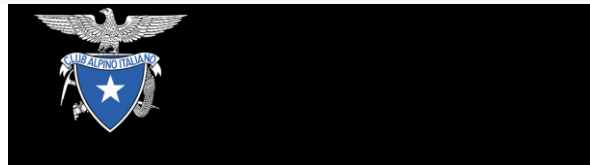
# World Economic Forum: Global Risk Report 2023



	2 years	10 years
1	Cost-of-living crisis	
2	Natural disasters and extreme events	
3	Geoeconomic confrontation	
4	Failure to mitigate climate change	
5	Erosion of social cohesion and polarization	
6	Large-scale environmental incidents	
7	Failure of climate change adaptation	
8	Widespread cybercrime and digital privacy concerns	
9	Natural resource crises	
10	Large-scale involuntary migration	



Risk categories | Economic | Environmental | Geopolitical | Societal | Technological



**La montagna di oggi è diversa da quella di 20 anni fa ...  
... la montagna tra 20 sarà diversa da quella di oggi!!**

