



South Ural  
State University

National Research  
University



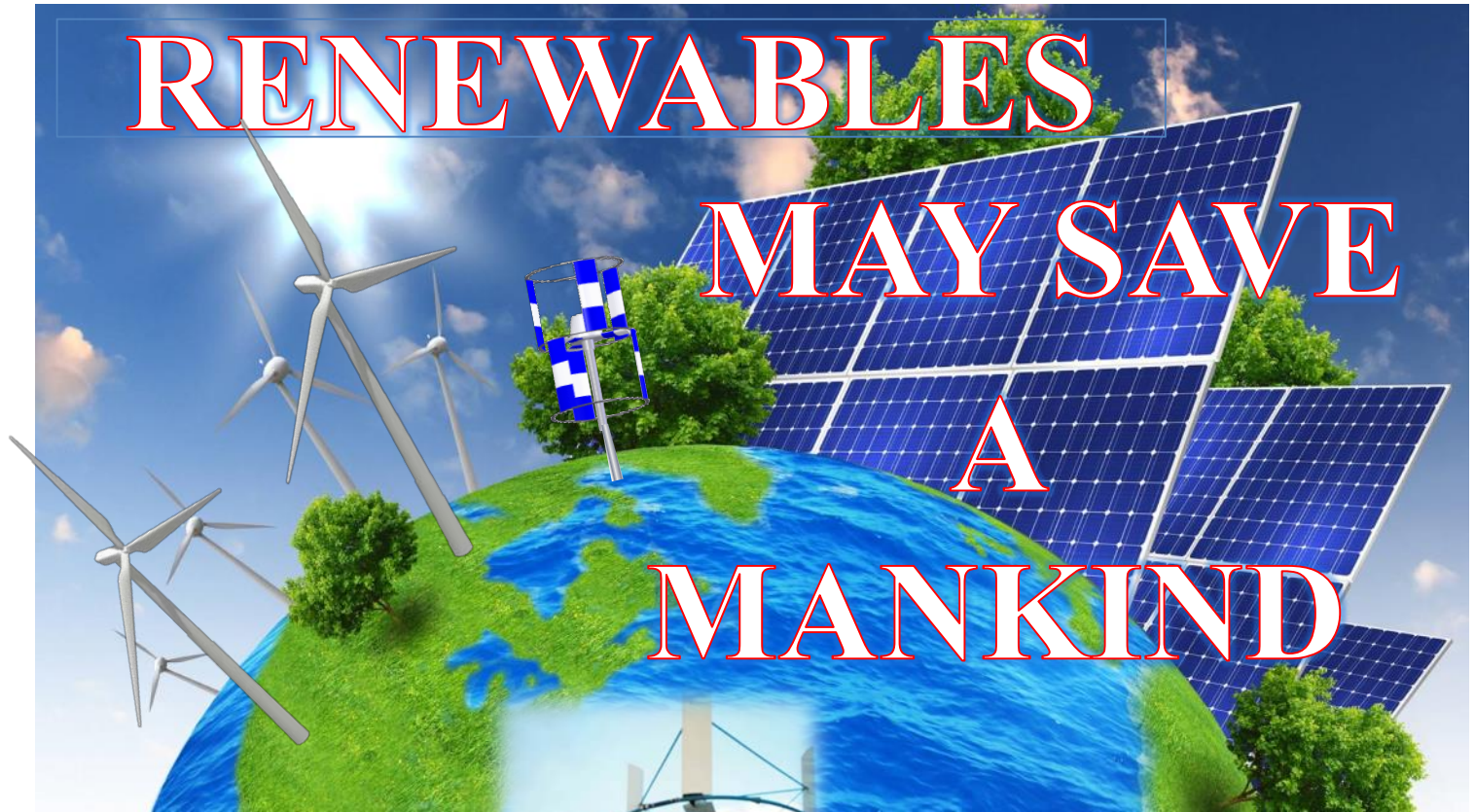
**SOUTH URAL STATE UNIVERSITY**

**RENEWABLES**

**MAY SAVE**

**A**

**MANKIND**



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Director of “Alternative Energy”  
International Innovation Center,  
Chelyabinsk, Russian Federation



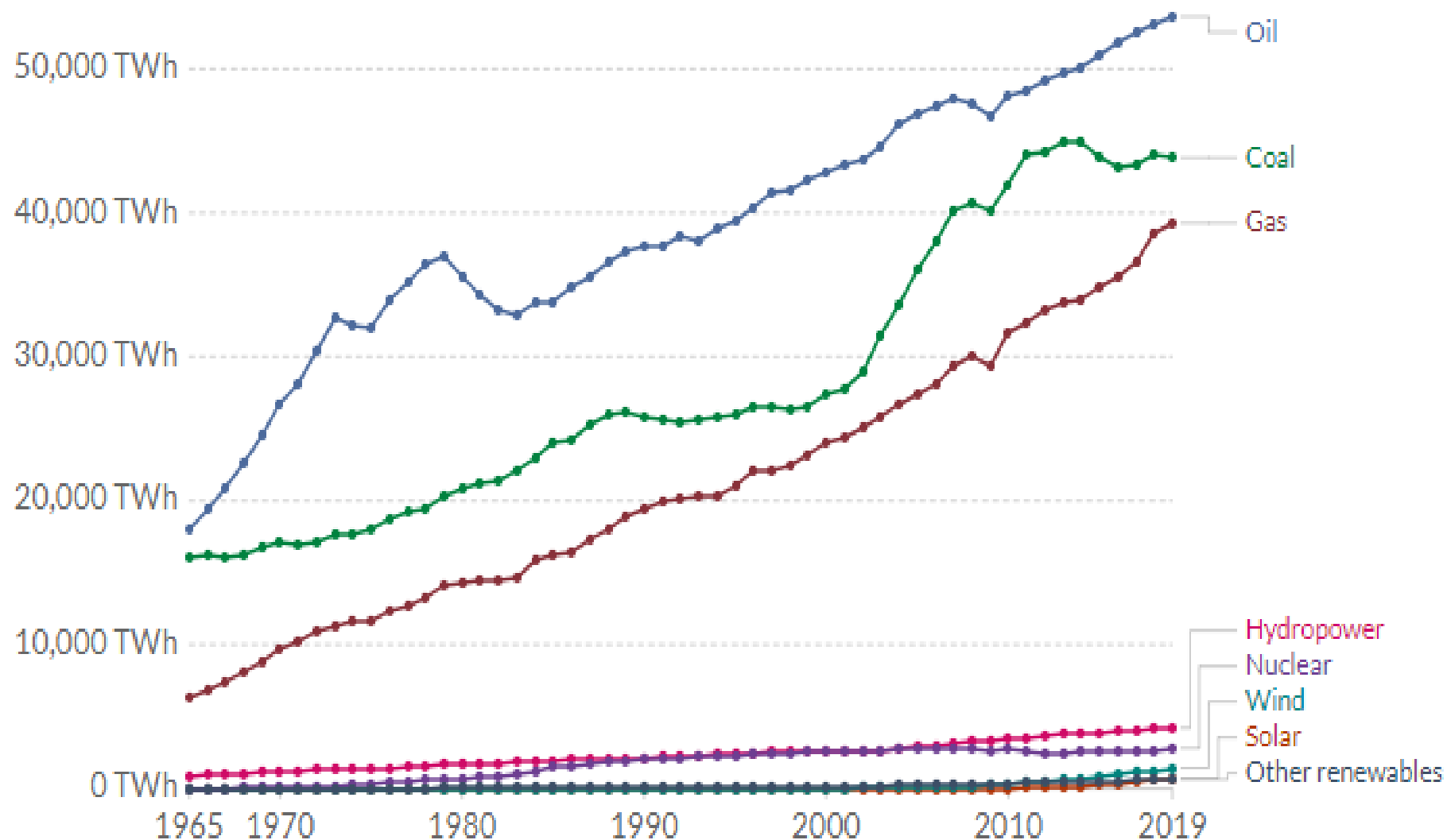
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## Primary direct energy consumption by source

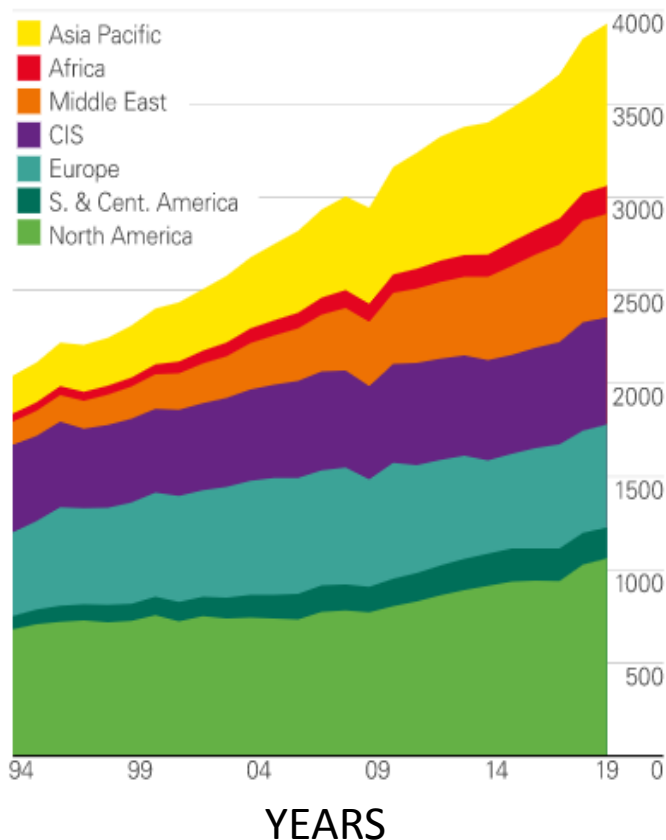


## Natural gas reserves

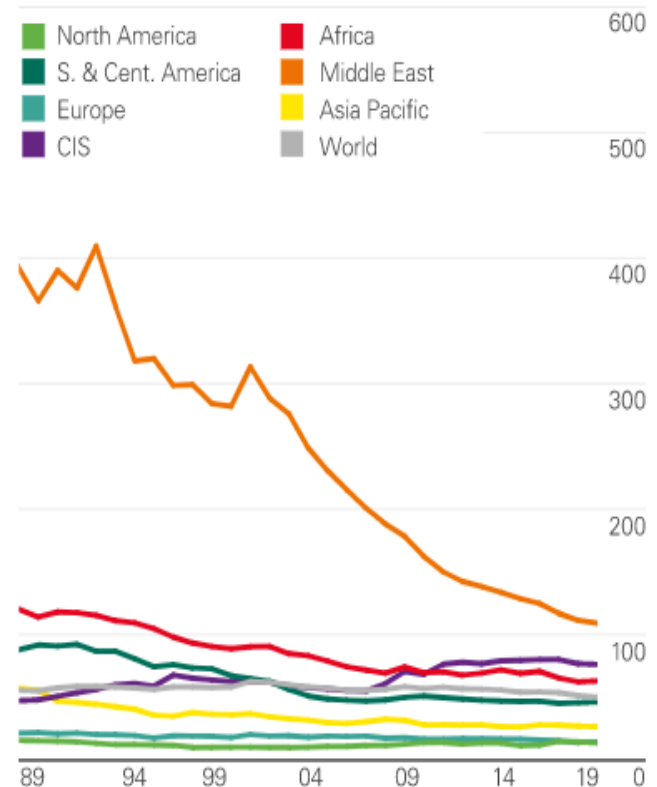
World proved gas reserves increased by 1.7 Tcm to 198.8 Tcm in 2019.

Global natural gas consumption growth averaged 2% in 2019, below its 10-year average and down sharply from the exceptional growth seen in 2018 (5.3%).

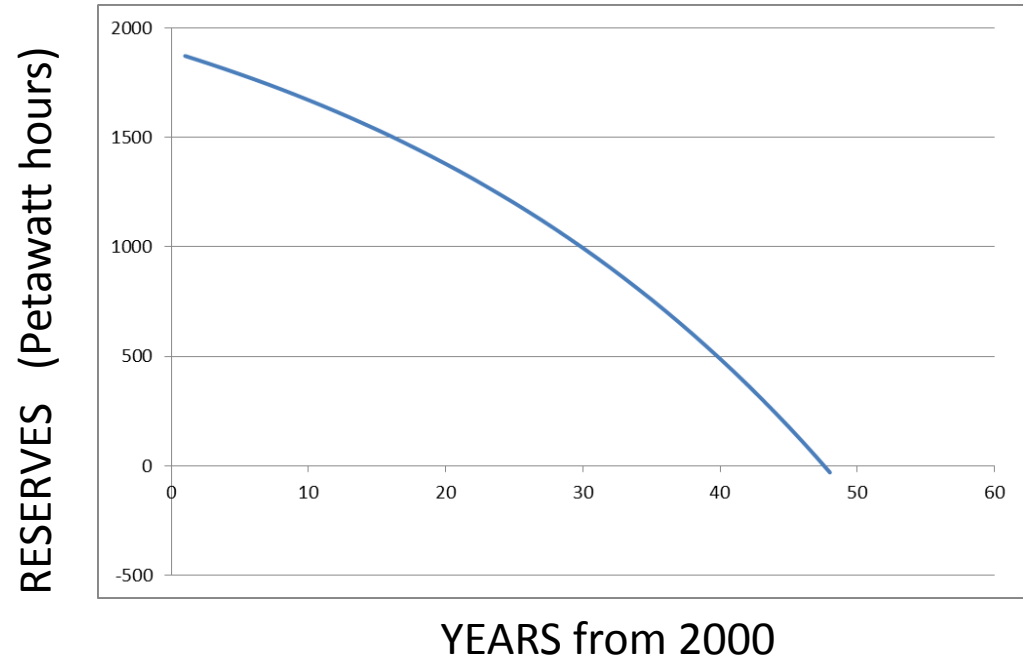
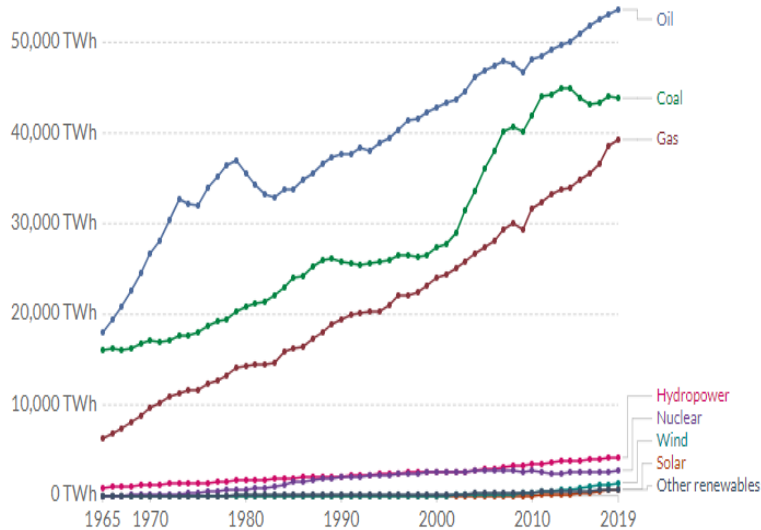
### Natural gas consumption by region (bcm)



### Reserves to production (R/P) ratios



## Natural gas reserves depletion



<https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/natural-gas.html>

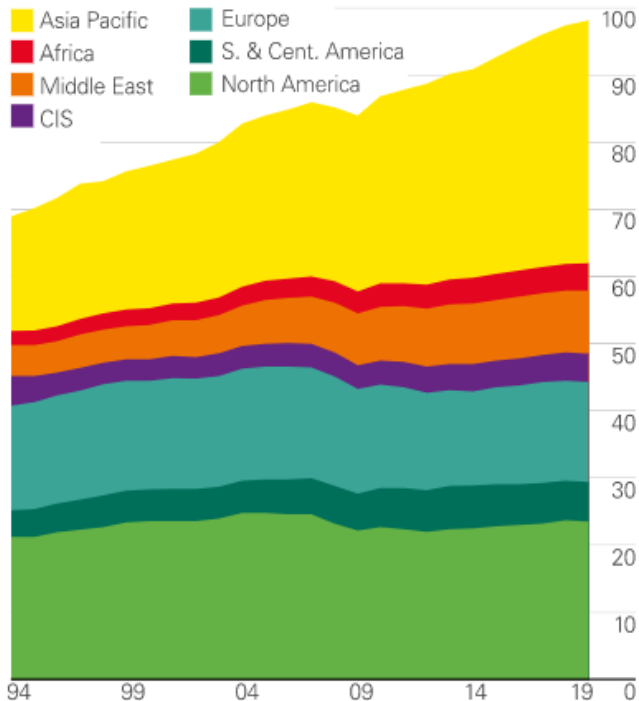
The current global R/P ratio shows that natural gas reserves in 2019 accounted for **49.8 years** of current production.

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## Oil reserves

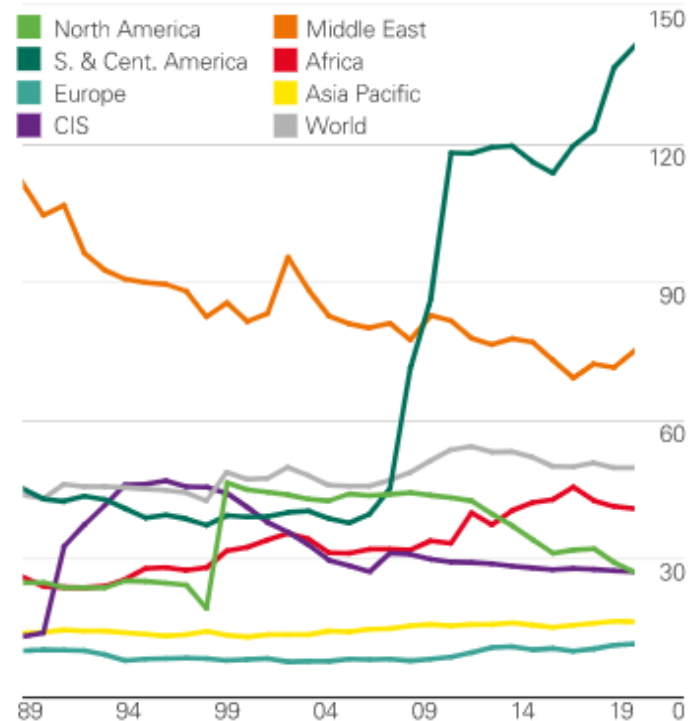
Global proved oil reserves were 1734 billion barrels at the end of 2019, down 2 billion barrels versus 2018.

### Oil consumption by region (million barrels daily)

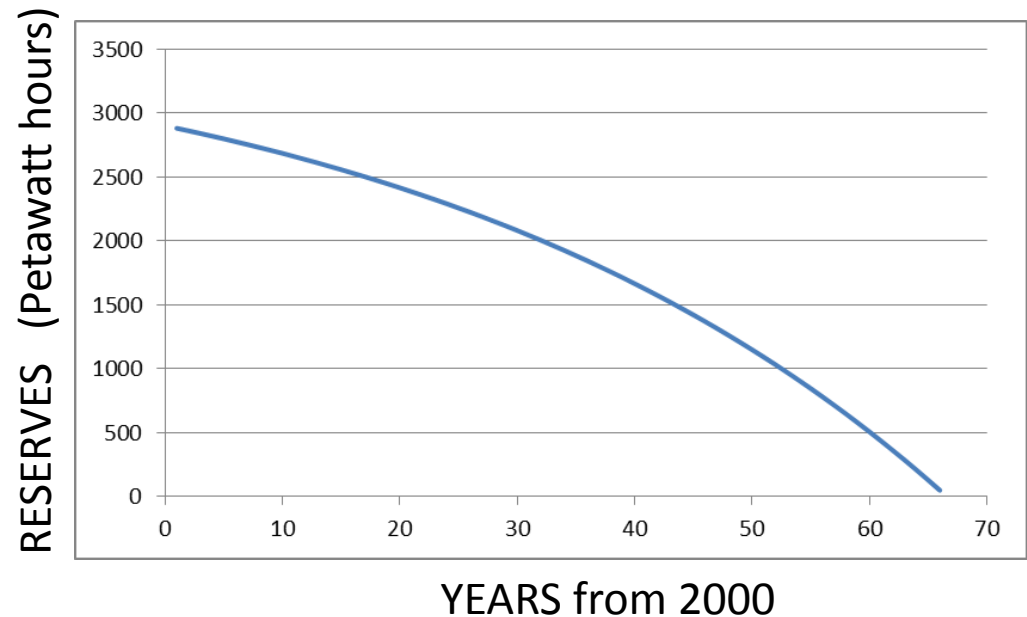
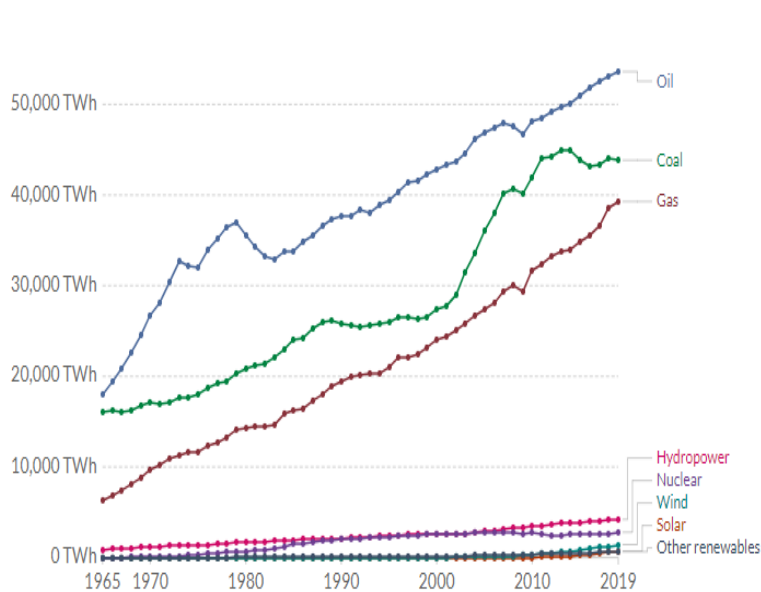


YEARS

### Reserves to production (R/P) ratios



## Oil reserves depletion



<https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/oil.html>

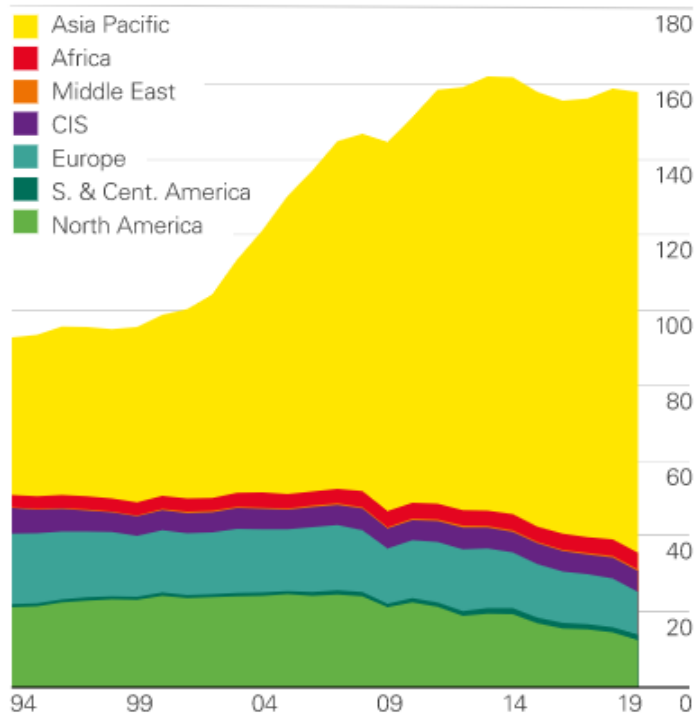
The global R/P ratio shows that oil reserves in 2019 accounted for **50 years** of current production.

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## Coal reserves depletion

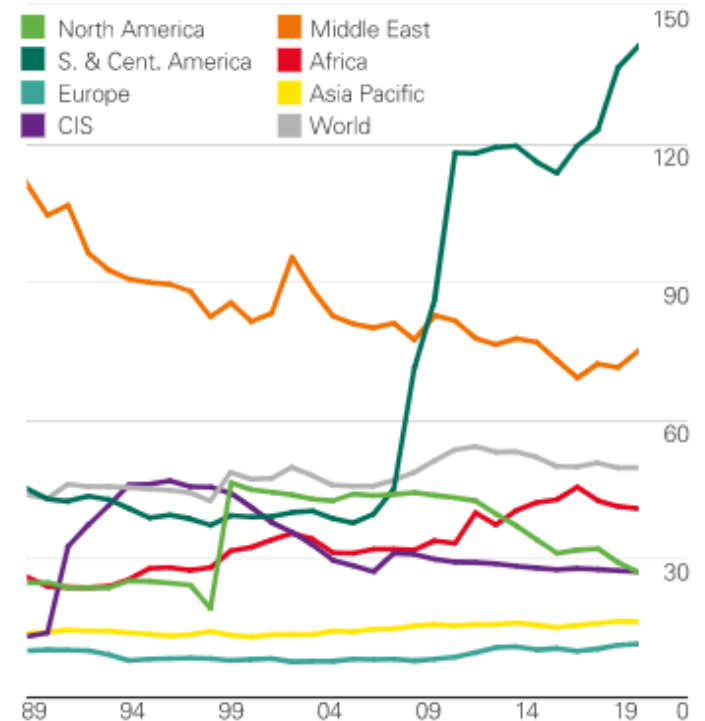
World coal reserves in 2019 stood at 1070 billion tonnes.

**Coal consumption by region (exajoules)**

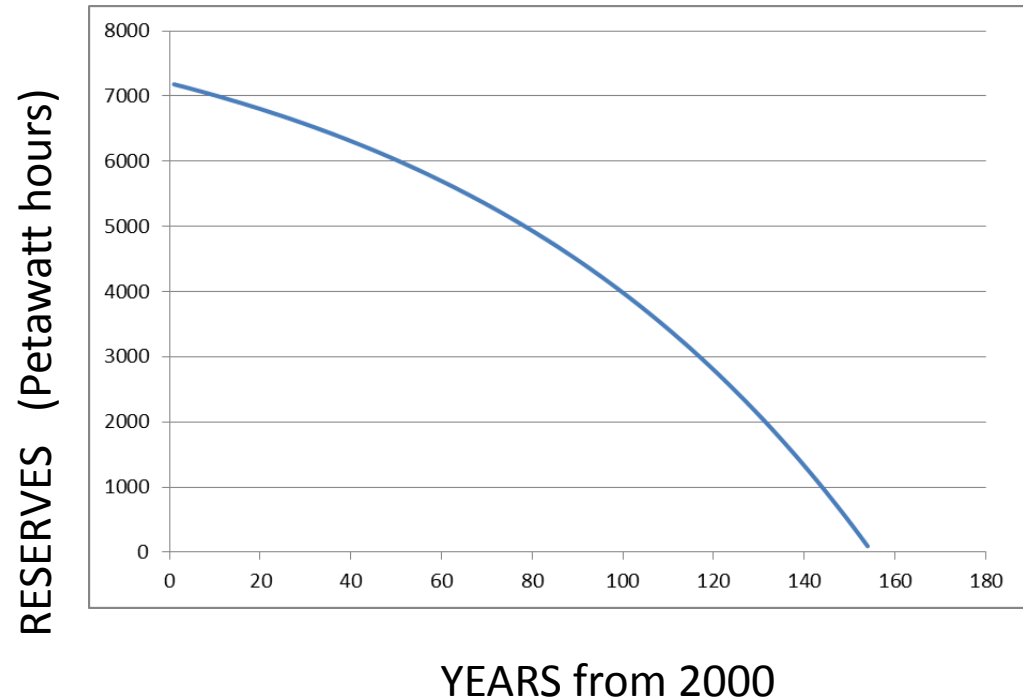
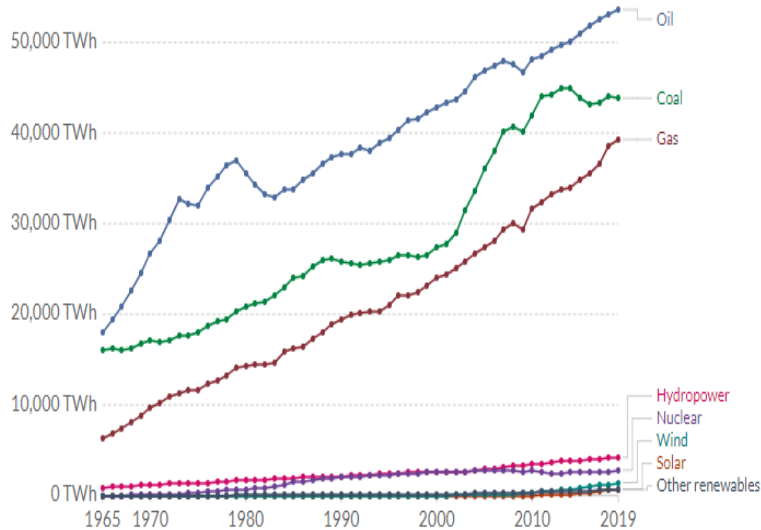


YEARS

**Reserves to production (R/P) ratios**



## Coal reserves depletion



<https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/coal.html>

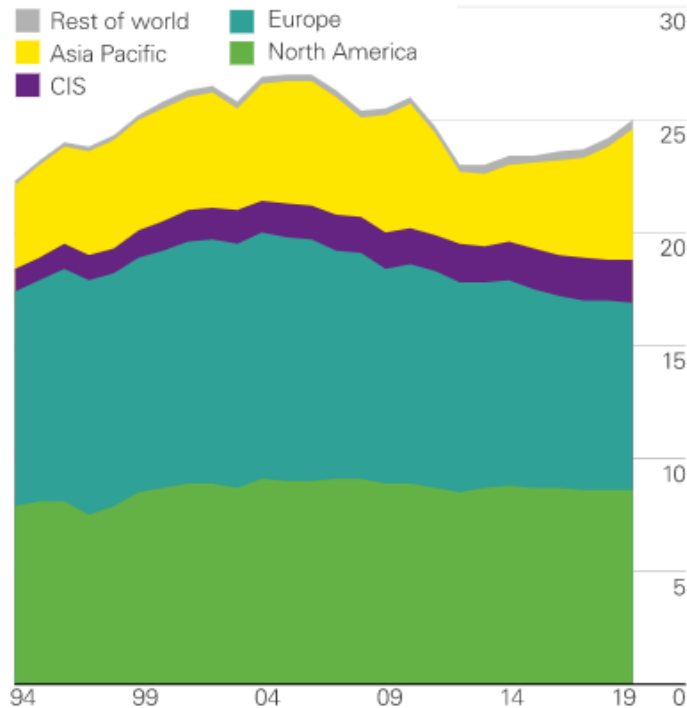
The current global R/P ratio shows that coal reserves in 2019 accounted for **132 years** of current production.

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## Uranium reserves

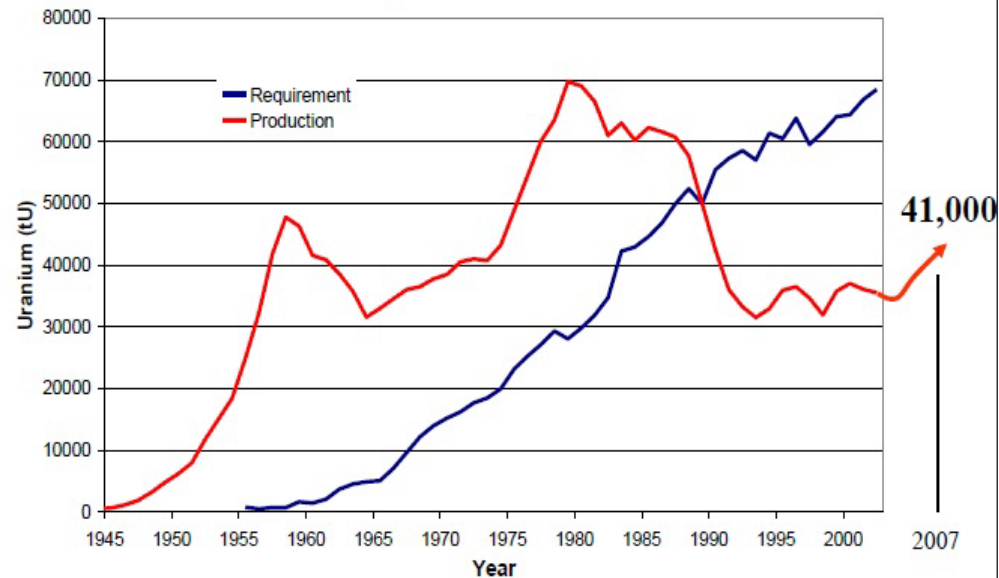
Uranium World proven reserves on 2017:  $5.327 \cdot 10^6$  tons.

### Nuclear energy consumption by region (exajoules)

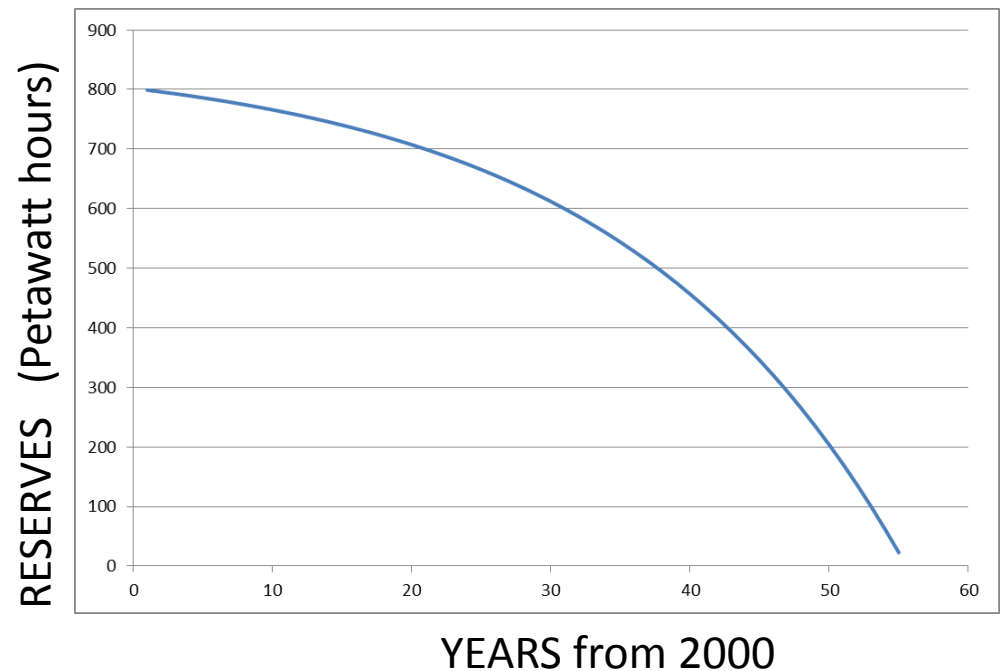
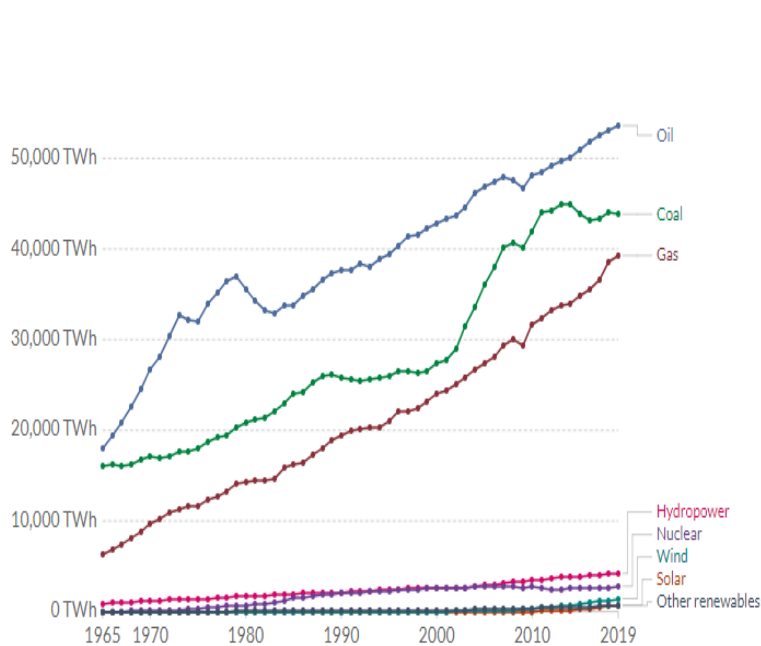


YEARS

### Uranium production vs Requirement



## Uranium reserves depletion



The current global R/P ratio shows that uranium reserves in 2019 accounted for **55 years** of current production.

Open sources report different numbers from 40 to 200 years.

<https://www.fennonen.fi/en/article-page/will-we-run-out-uranium>

<https://www.scientificamerican.com/article/how-long-will-global-uranium-deposits-last/#:~:text=If%20the%20Nuclear%20Energy%20Agency,at%20current%20rates%20of%20consumption.>

## Global Warming

1. Global Warming **is not occurring** and so neither is climate change.
2. Global Warming and climate change **are occurring**, but these are natural, cyclic events unrelated to human activity.
3. Global Warming is occurring as a **result primarily of human activity** and so climate change is also the result of human activity.

No problem at all.

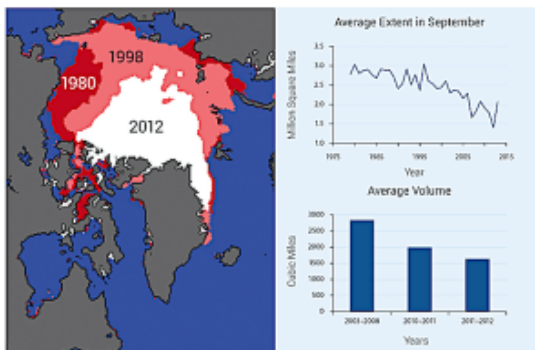
Mankind still cannot control these processes.

**Let's analyse if this is a real threat!**

### Most important climate change impacts are:

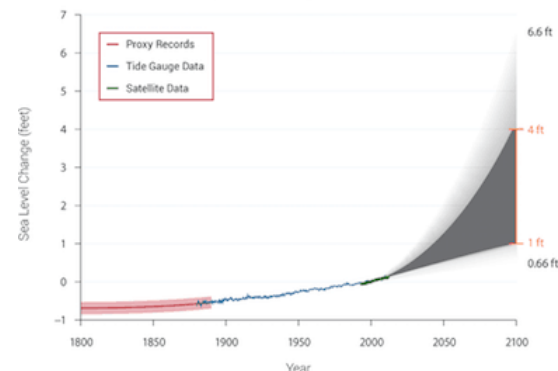
#### Melting Ice

Arctic Sea Ice Loss



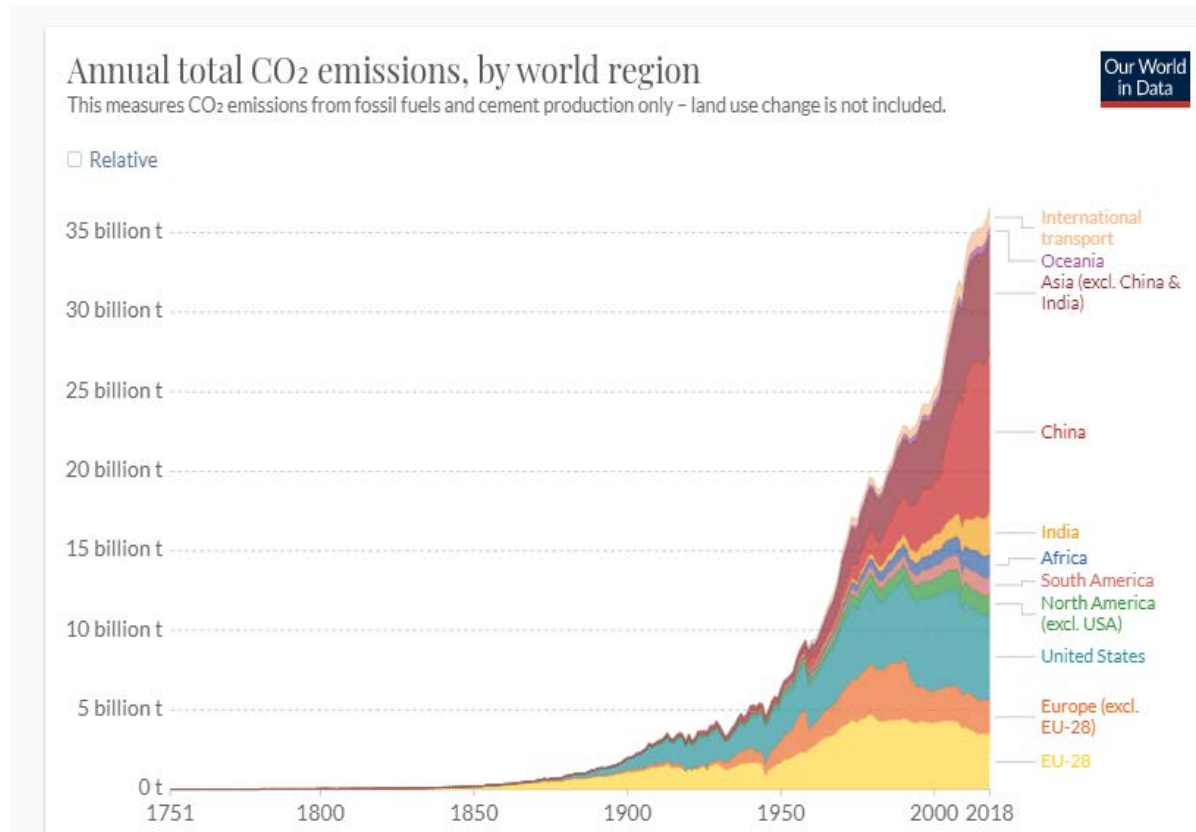
#### Rising Sea Levels

Past and Projected Changes in Global Sea Level



## Green house effect – CO<sub>2</sub> concentration

- Mass of CO<sub>2</sub> in the Earth atmosphere:  $Me = 3.03 \cdot 10^{12}$  MT (metric tons).
- Mass of CO<sub>2</sub> absorbed annually by oceans and photosynthesis:  $Ma = 5.5 \cdot 10^{11}$  MT.
- Mass of CO<sub>2</sub> annual anthropogenic emissions:  $Mae = 0.35 \cdot 10^{11}$  MT  $\approx 8\%$  of  $Ma$ .
- Annual increase of mass of CO<sub>2</sub> anthropogenic emissions:  $Mi = 1.7\%$  of  $Mae$  per year.
- Critical mass of CO<sub>2</sub> in the Earth atmosphere:  $Mec \approx 2 \cdot Me$  MT (or 800 ppm).



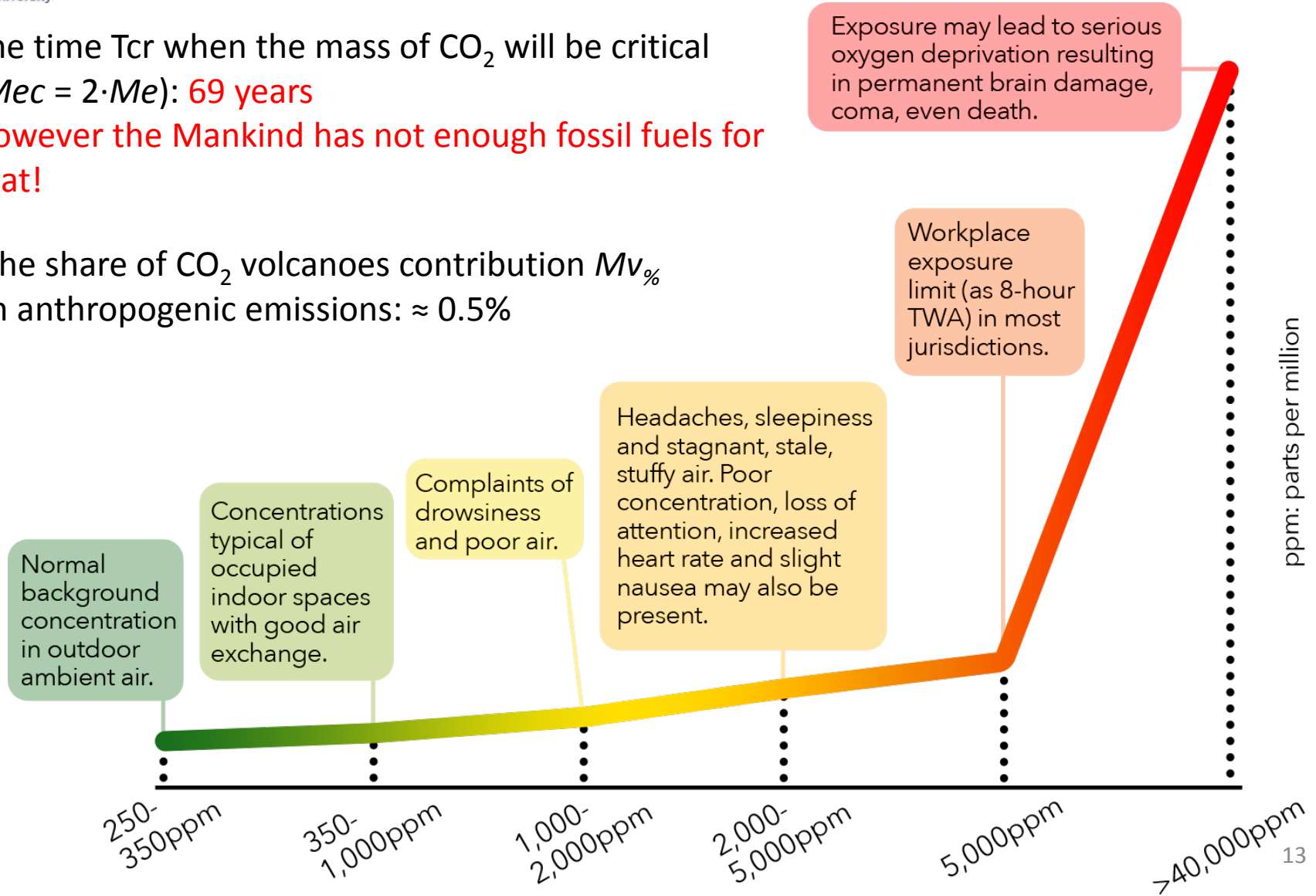
## Green house effect – CO<sub>2</sub> concentration

The time  $T_{cr}$  when the mass of CO<sub>2</sub> will be critical

( $M_{ec} = 2 \cdot M_e$ ): **69 years**

**However the Mankind has not enough fossil fuels for that!**

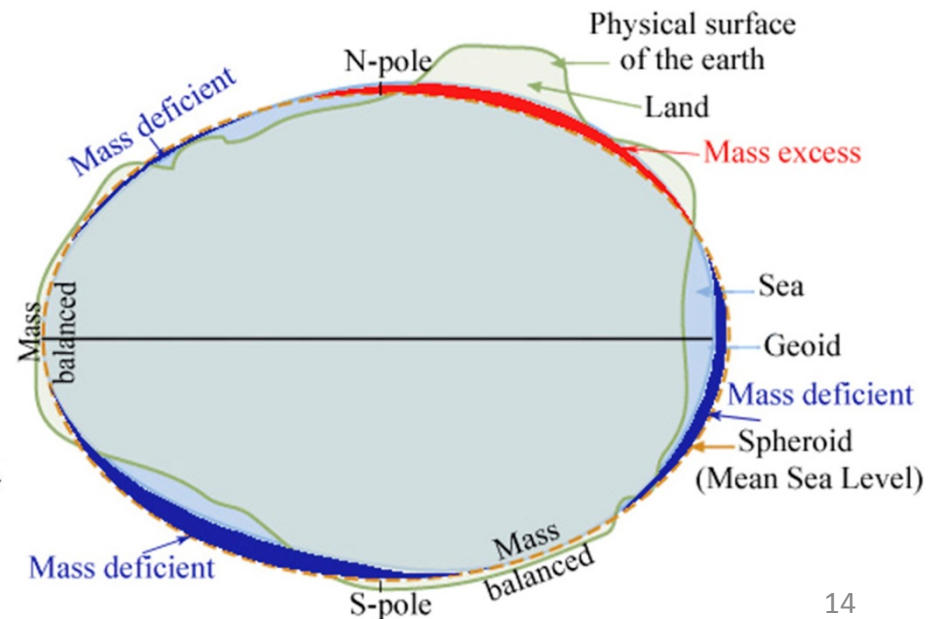
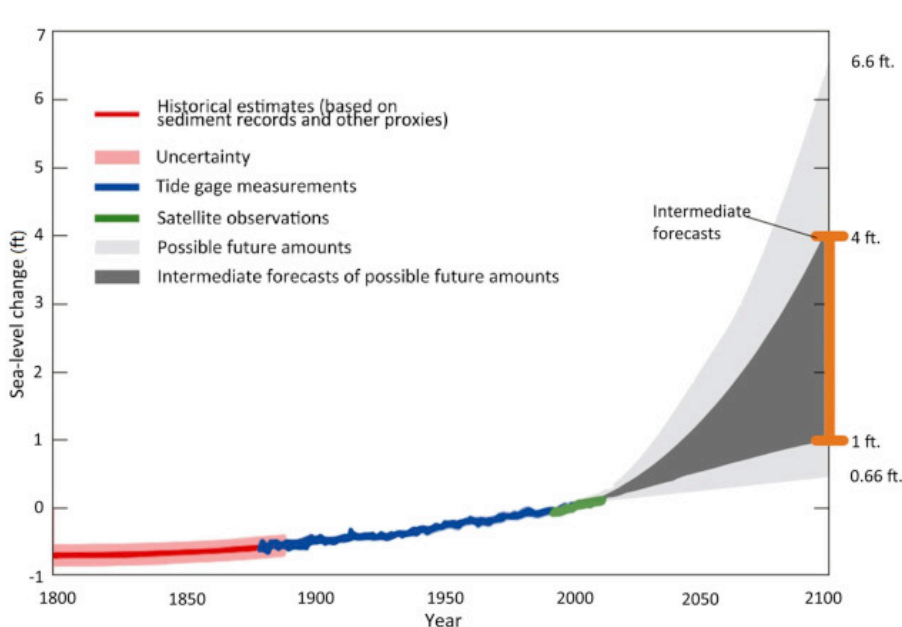
The share of CO<sub>2</sub> volcanoes contribution  $Mv\%$  in anthropogenic emissions:  $\approx 0.5\%$



## Green house effect – Ice melting

- Global ice volume reserve:  $V_e = 30$  million  $\text{km}^3$  (90% in Antarctic).
- Dependence of sea level increase on ice melting:  $L_s = 1$  mm of sea level increase per volume  $V_i = 45 \text{ km}^3$  of ice melting.
- Ice melting rate:  $R = 240 \text{ km}^3$  per year.

The rate of annual sea level increase:  $I = R / V_i = 240 / 45 = 5.3 \text{ mm/year} = 0.0053 \text{ m/year}$



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## Green house effect – Ice melting

For Venice:  $Y_{ven} = H_i / I = 1 / 0.0053 = 188 \text{ years}$

For Maldives:  $Y_{mal} = H_i / I = 1.5 / 0.0053 = 283 \text{ years}$

For Amsterdam:  $Y_{ams} = H_i / I = 2 / 0.0053 = 377 \text{ years}$

For New Orleans:  $Y_{orl} = H_i / I = 3 / 0.0053 = 566 \text{ years}$

For Shanghai:  $Y_{sha} = H_i / I = 6.5 / 0.0053 = 1,266 \text{ years}$

For Hamburg:  $Y_{ham} = H_i / I = 14.5 / 0.0053 = 2,375 \text{ years}$

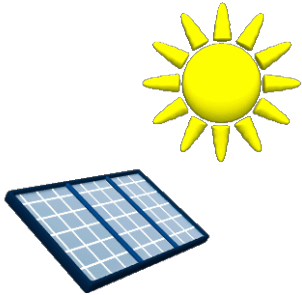
Number of years for melting all ice on the Earth  $Y_e$ :

$$Y_e = V_e / R = 30 \cdot 10^6 / 240 = 125,000 \text{ years}$$

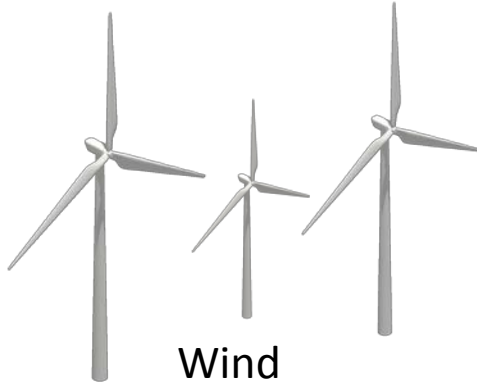
Maximum water level after melting all ice on the Earth  $L_m$ :

$$L_m = V_{Y_e} / Y_{ven} = 125,000 / 188 = 664 \text{ m (approximate)}.$$

## May Renewables Save a Mankind ???



Solar



Wind



Hydro



Bio

Etc...

- Global annual power consumption:  $E_g = 150$  PWh.
- Maximum annual energy consumption per capita (similar to USA):  $E_{fi} = 100$  MW·h/year.
- Annual Wind installation:  $P_{ai} = 55$  GW/year.
- Global Installed Wind power  $P_g = 540$  GW.
- World budget 2017 (turnover):  $\approx \$50 \cdot 10^{12}$

Current global demand of power: **17 TW.** Per capita: 2.3 kW.

Future estimated demand of power (USA level): **80 TW.** Per capita: 11 kW.

Cost for installation of required wind turbines:  $\approx 80,000$  billion dollars.

World budget (turnover):  $\approx 50,000$  billion dollars

**Comparing with current budgets it's IMPOSSIBLE to cover all Mankind demands!**

# Thank you for your attention!

