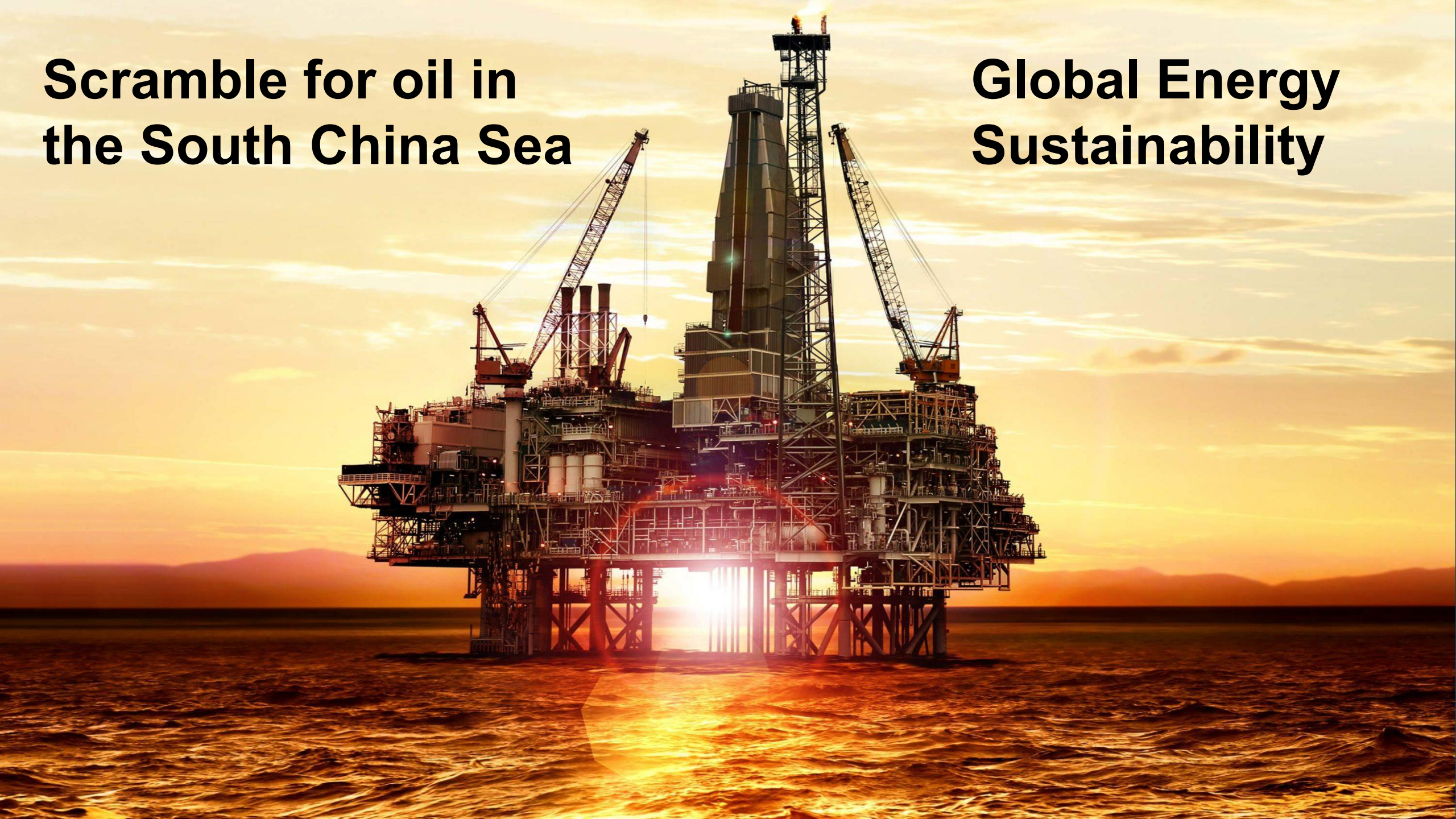
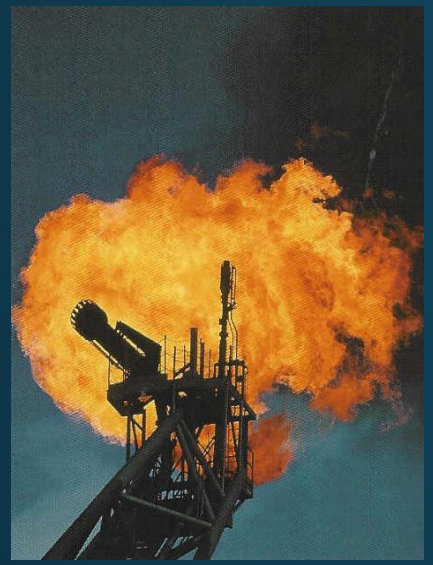
Scramble for oil in the South China Sea

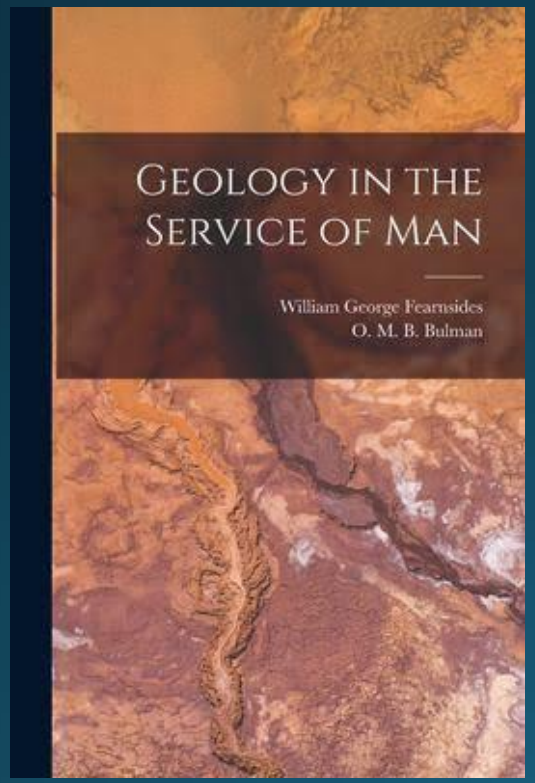
Global Energy Sustainability





Outline

1. SE Asia and the South China Sea
2. Black death to black gold
3. Global energy perspective
4. Sustainable energy options
5. Positive choices for the future

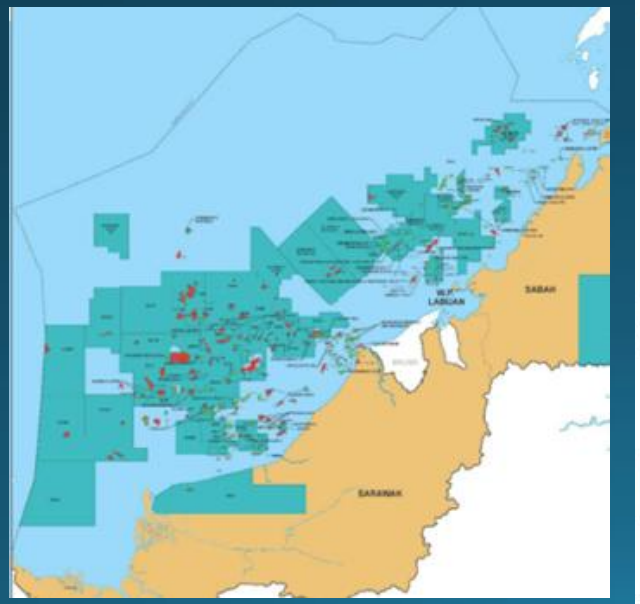


Champion field, Brunei

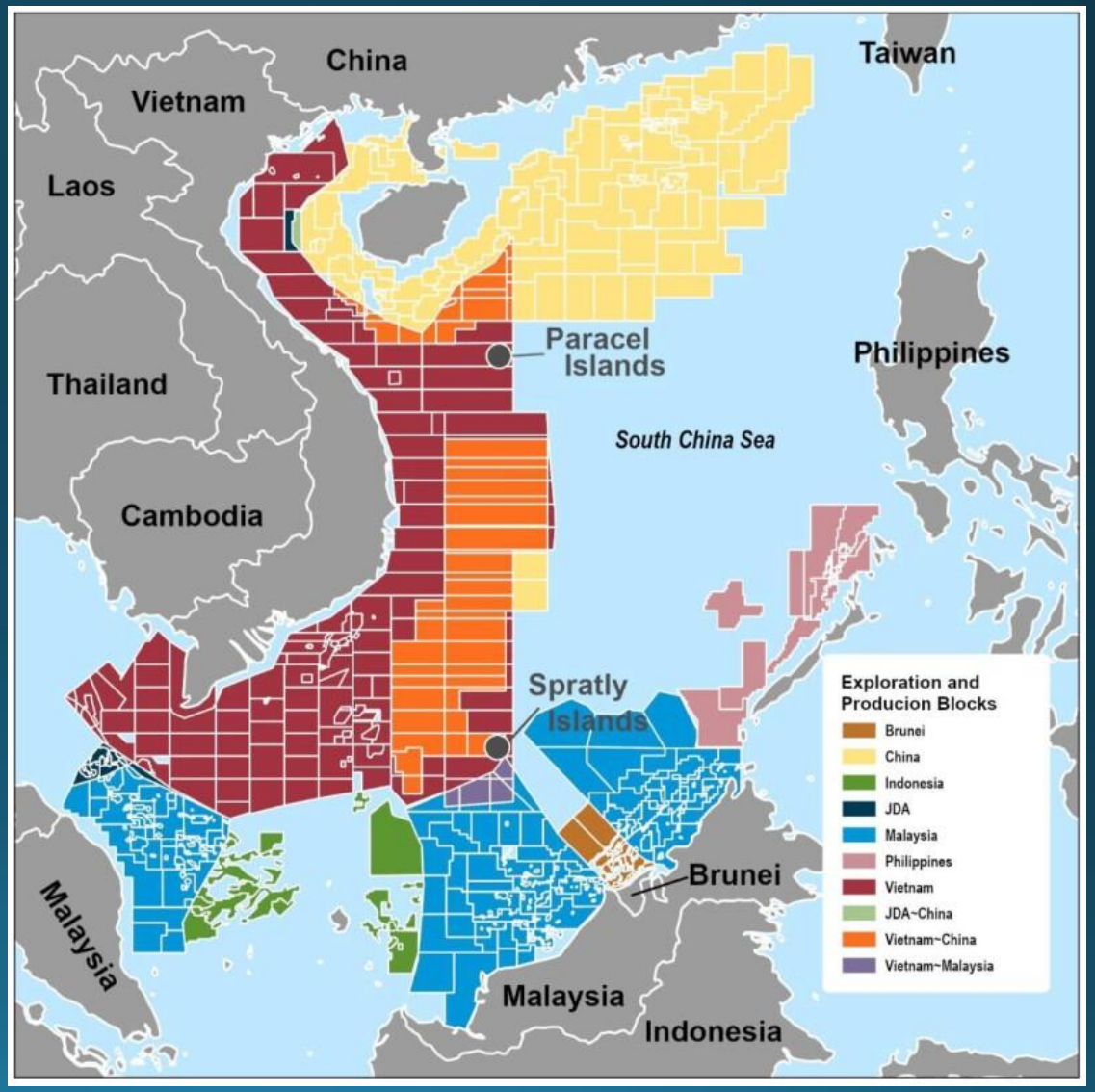
Gas exploration, Vietnam

1. SE Asia & South China Sea

Operating fields



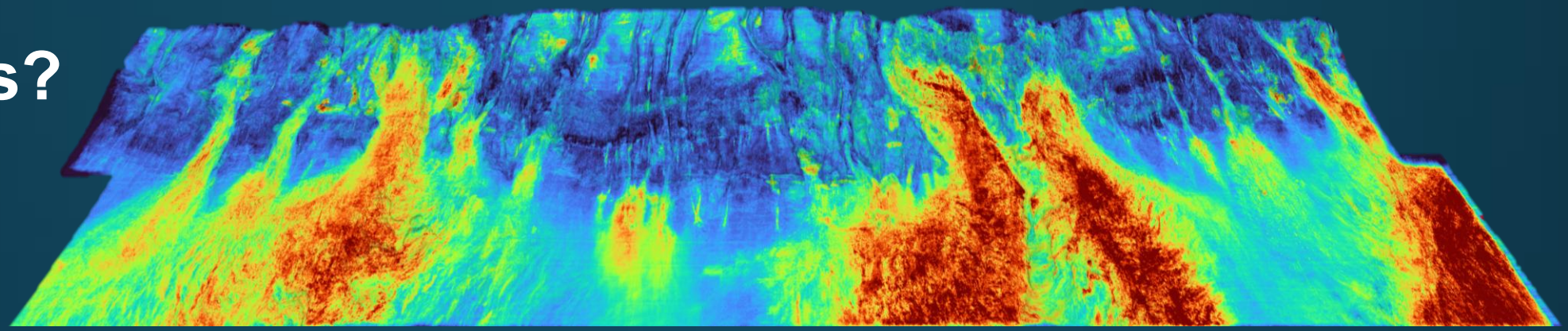
Exploration & production blocks



Dispute behind apparent order

- First oil discovered in Sumatra in 1883
- Today: 200 M bbl oil and 500 M cu ft gas per day
- One of hottest exploration areas in the world
- At least 19 new gas fields across Malaysia, Vietnam, Indonesia and Brunei will be decided in 2025
- These fields have estimated reserves of over 540 billion cubic metres of gas (15% current)
- Over 75 per cent of the fields are located in Malaysia and Vietnam
- China throwing its weight in South China Sea

What is this?

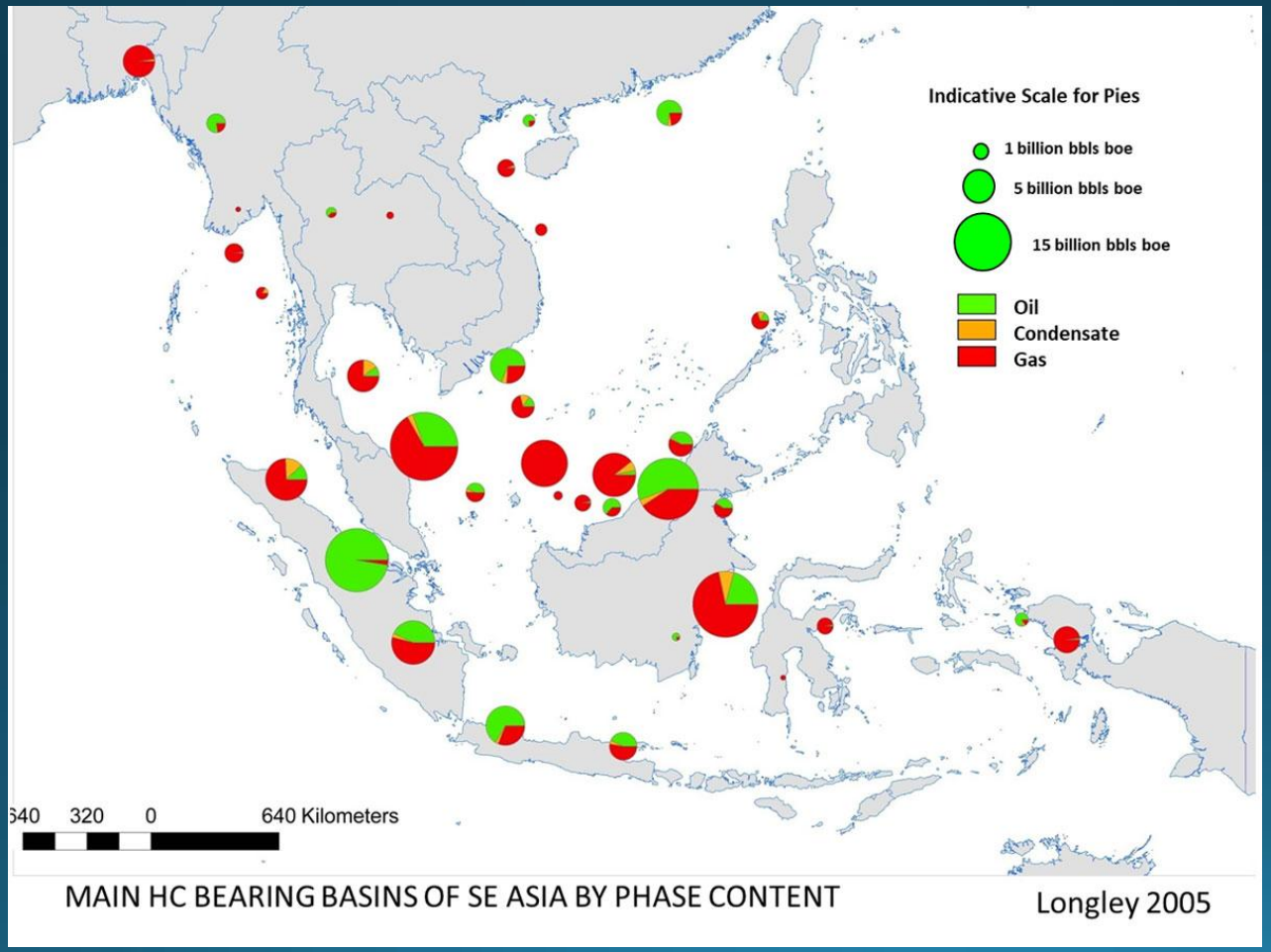


Myanmar
Ministry Energy

Thailand
Ministry Energy
& Resources

Malaysia
Petronas

Borneo
Shell Sarawak



Japan
JNOC

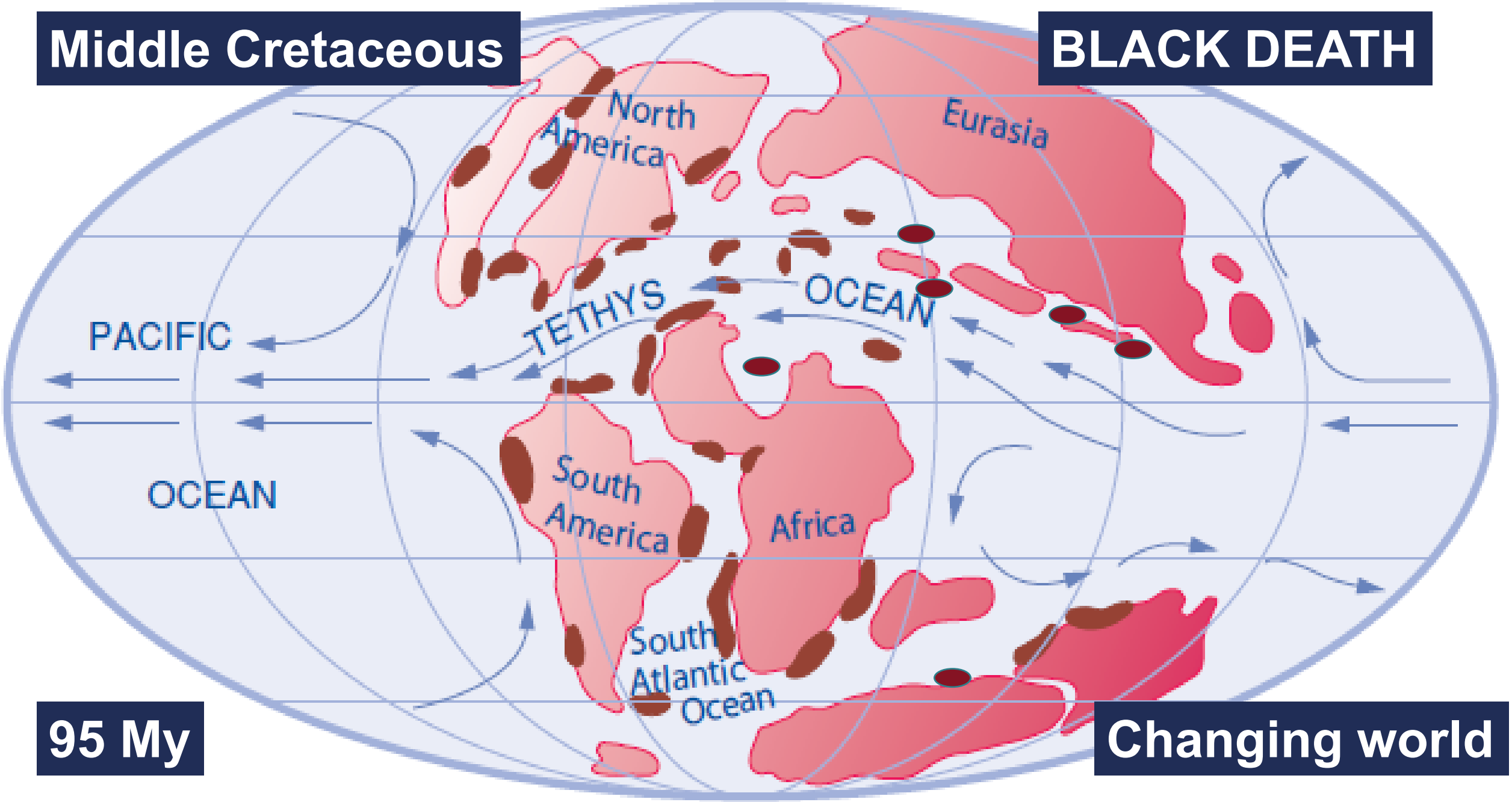
South Korea
KNOC

China
CNOOC
SINOPEC

Papua New Guinea
Larus Energy

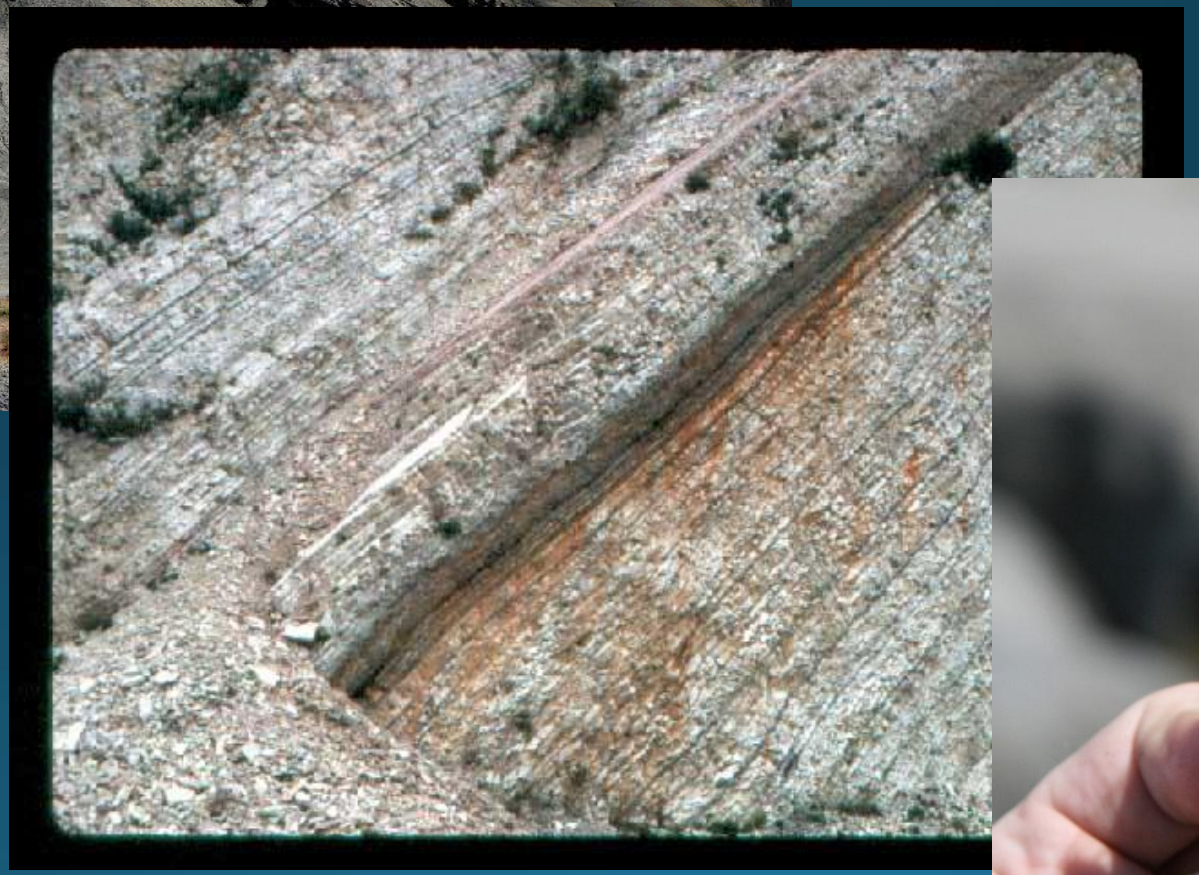
2. Black Death to Black Gold

Diatom plankton


Middle Cretaceous
BLACK DEATH
North America
Eurasia
TETHYS
OCEAN
PACIFIC
OCEAN
South America
Africa
South Atlantic Ocean
95 My
Changing world

Black shales across the world

Mancos Shale, Colorado



Bonnarelli Shale, Italy

Oil shale, Borneo

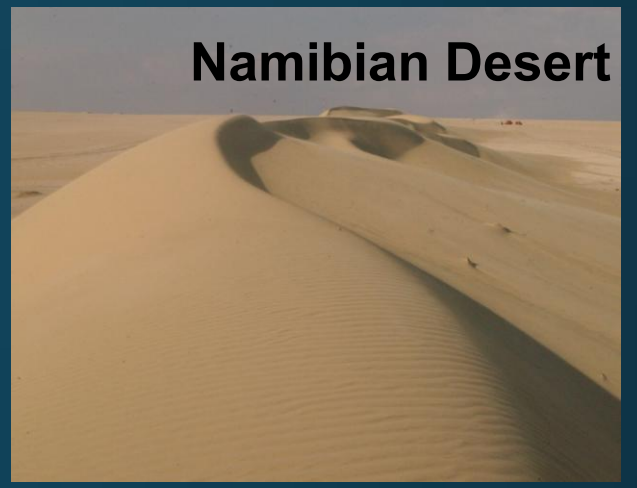
South Atlantic expedition

SE Angola Basin, DSDP 75

Walvis Bay, Namibia


Recife

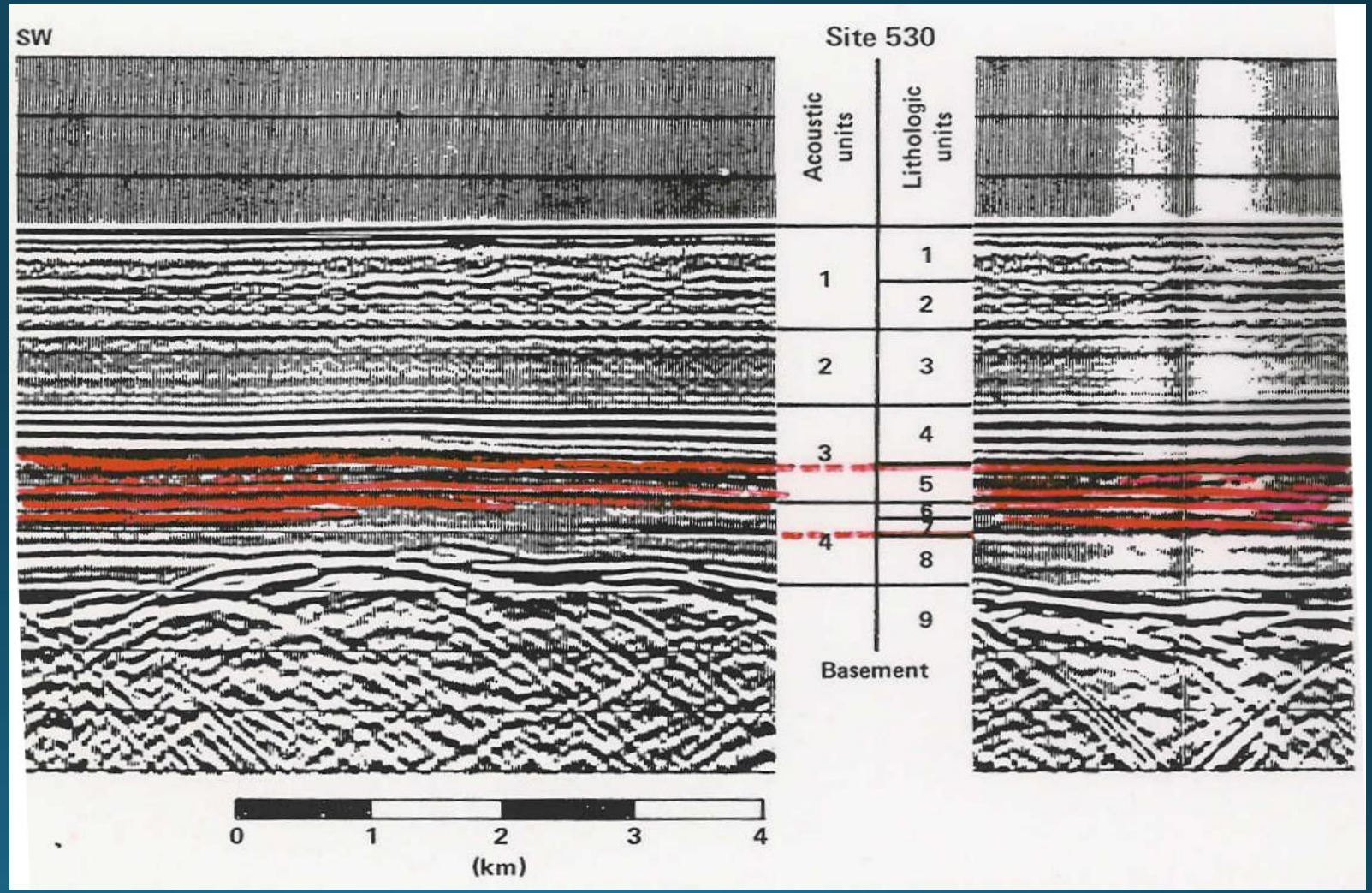

AFRICA
SOUTH AMERICA
AMAZON BASIN
BRAZILIAN HIGHLANDS
KALAHARI DESERT
FALKLAND PLATEAU
FALKLAND ISLANDS
SCOTIA RIDGE


Namibian Desert

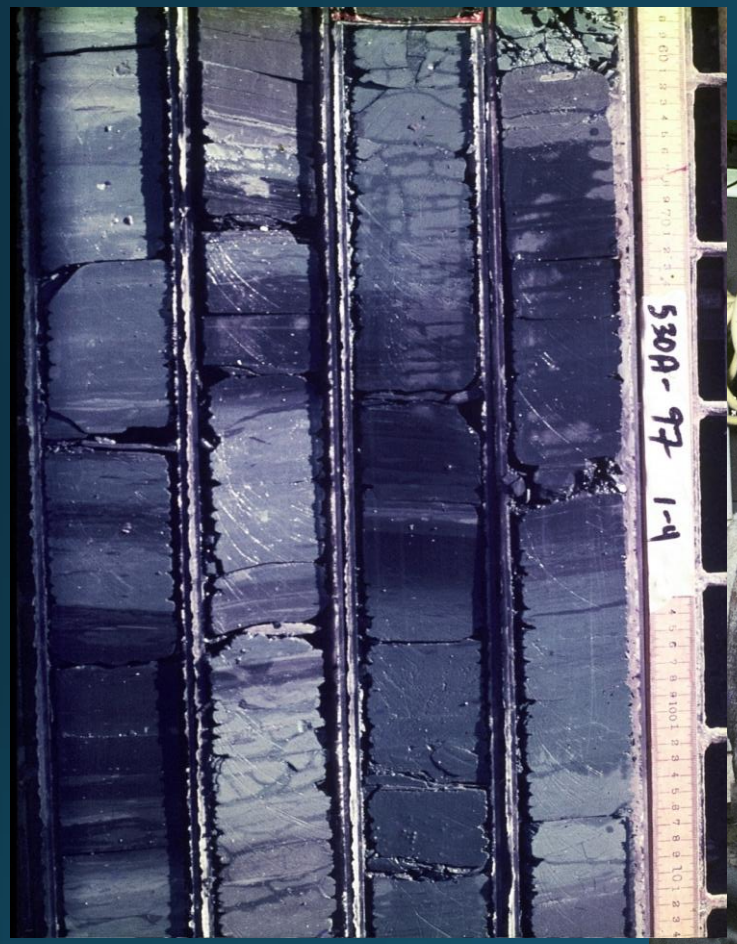

Skeleton coast

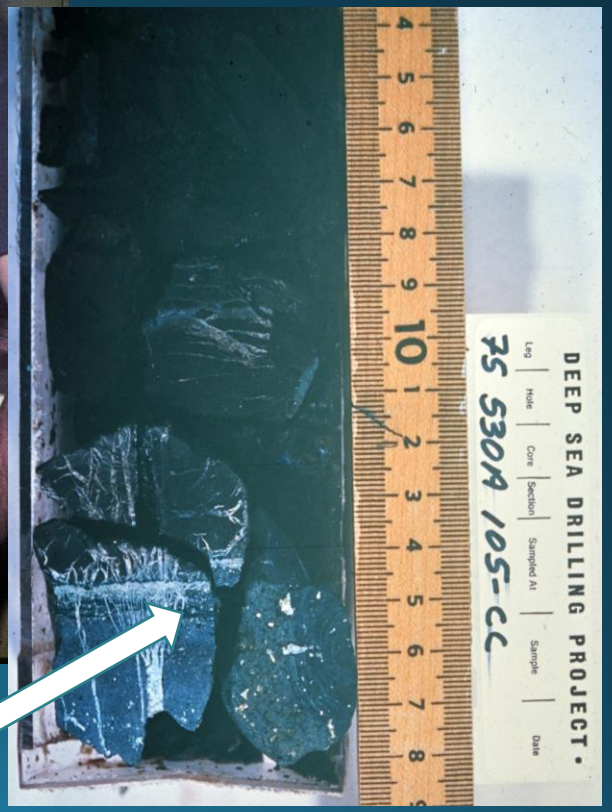

St Helena Island

Site 530: 4600m water depth, 1100 metres penetrated below seafloor to ocean crust



Black Shales discovered in repeated cycles: black/white muds

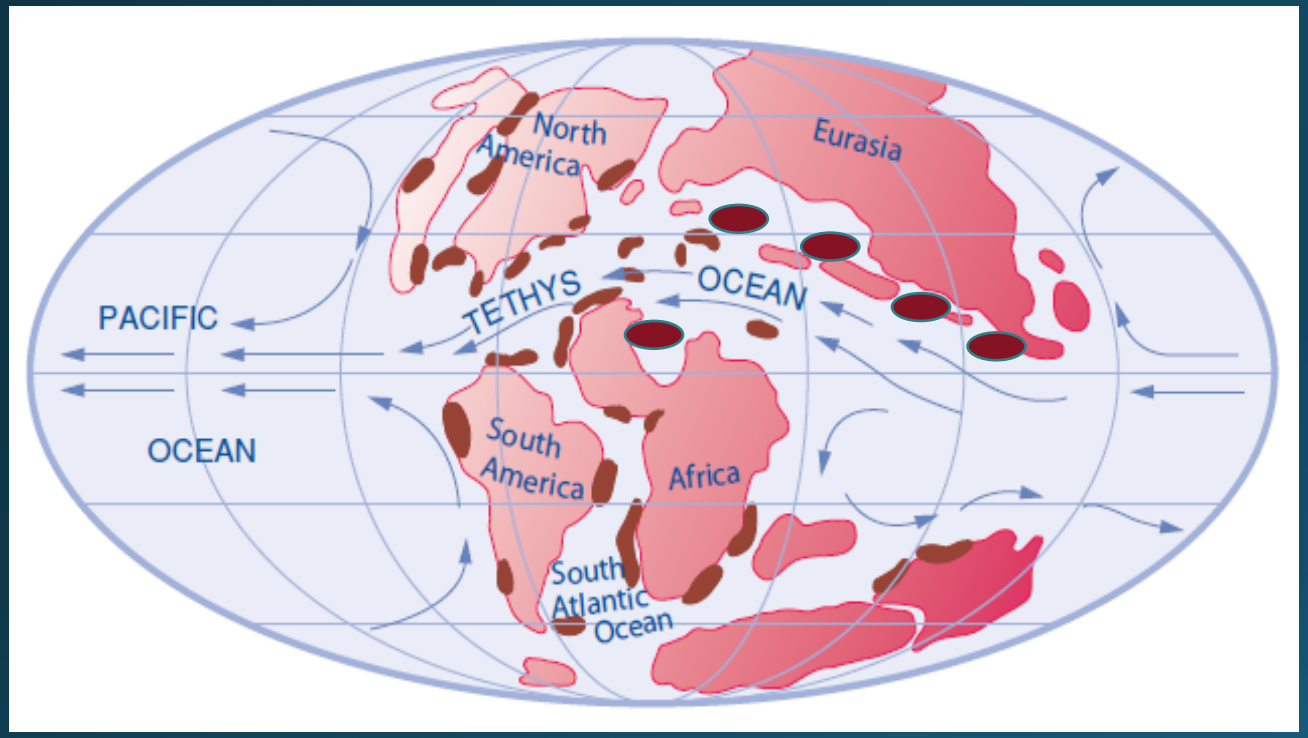


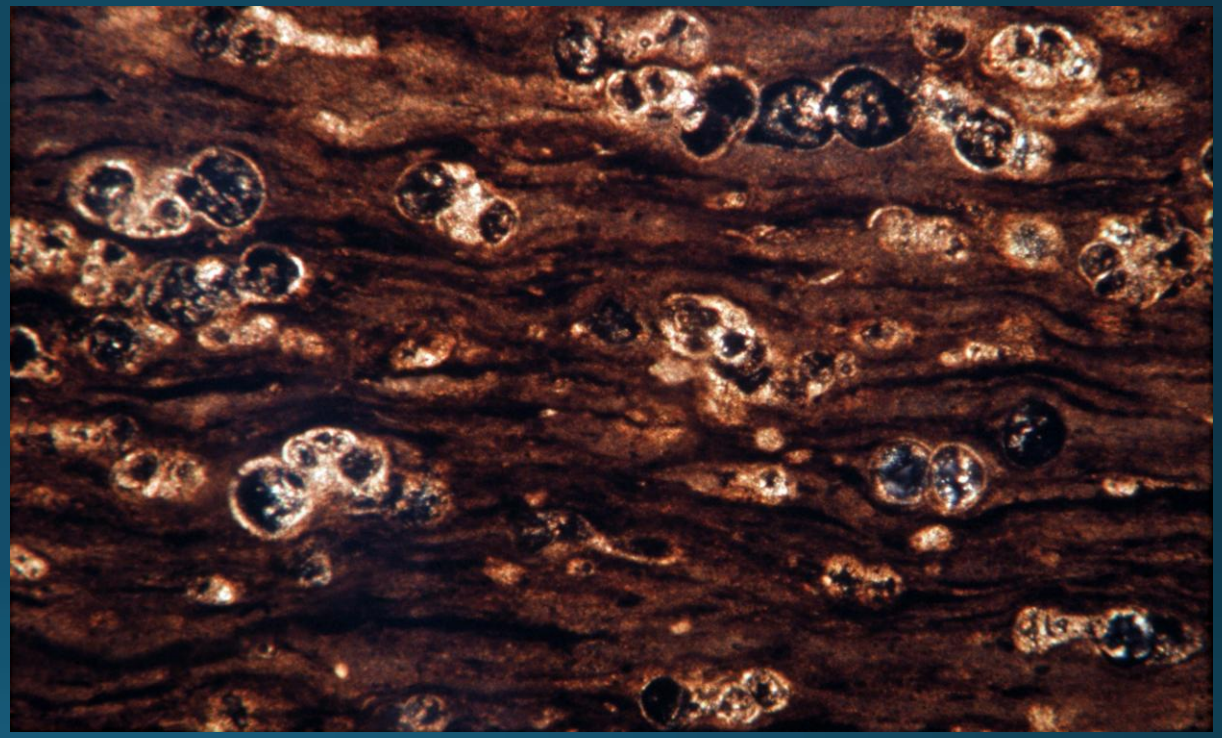


Organic carbon = 3-5%
(maximum 16%)

Ocean crust dated at 110 My

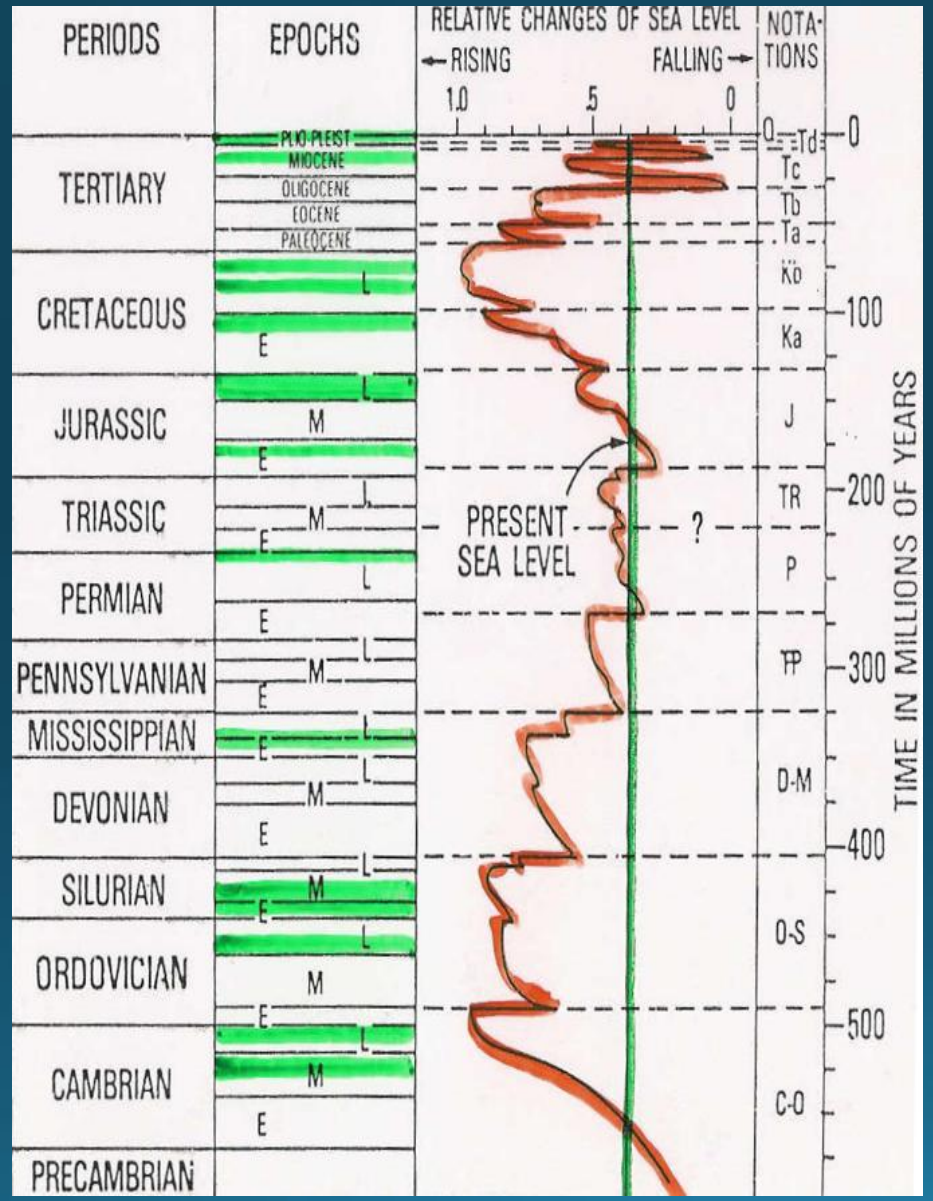
Why black shales preserved when over 90% organic matter destroyed



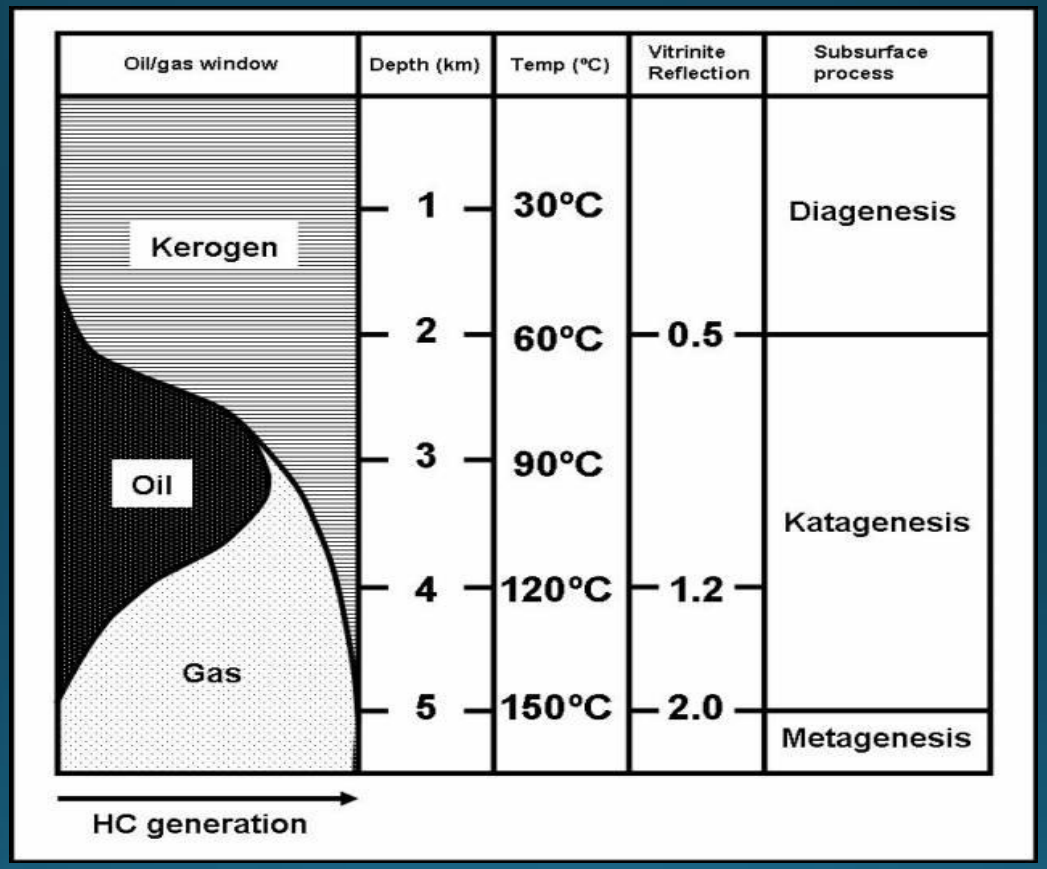


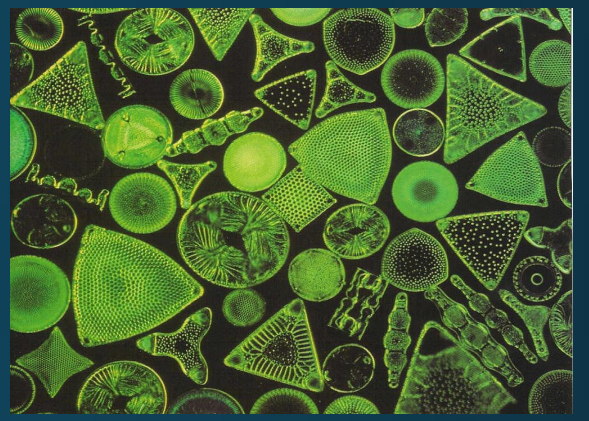
Preservation factors: High Productivity, Low Oxygen, Rapid sedimentation/burial, Fine sediment size, Organic matter type more resistant

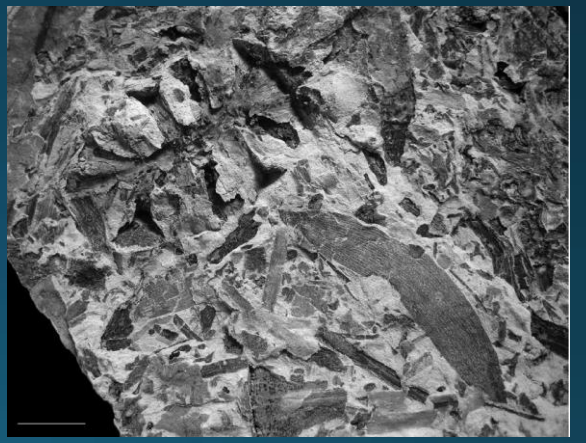
Why important? Black Shales are source rocks for the world's oil and gas



These gigantic carbon sinks fuel the world… the organic matter matures with heat → oil window at 60-120^0 Celsius





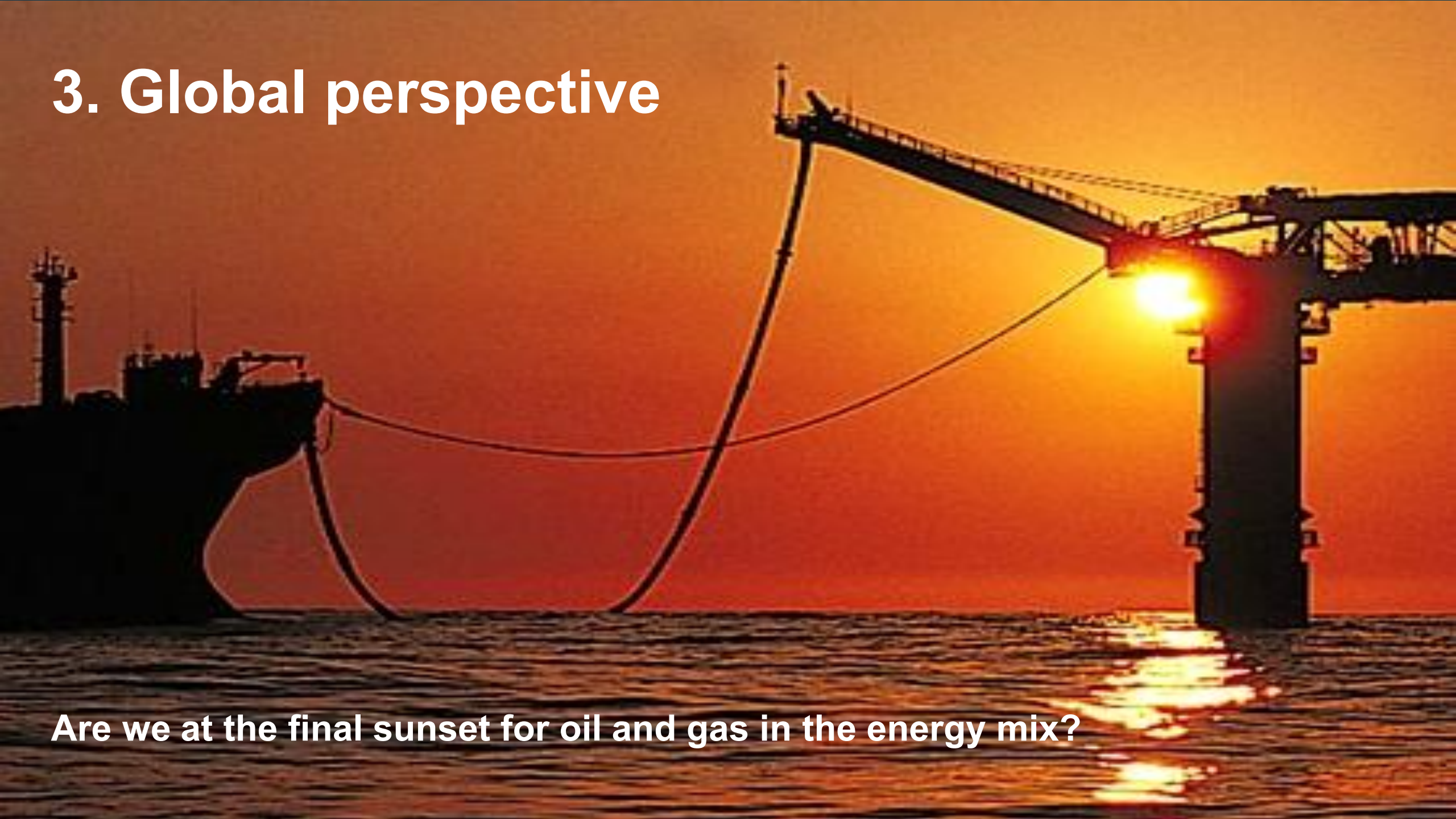


Ocean Plankton yields oil and land plants yield gas

Some exceptions – e.g. Borneo

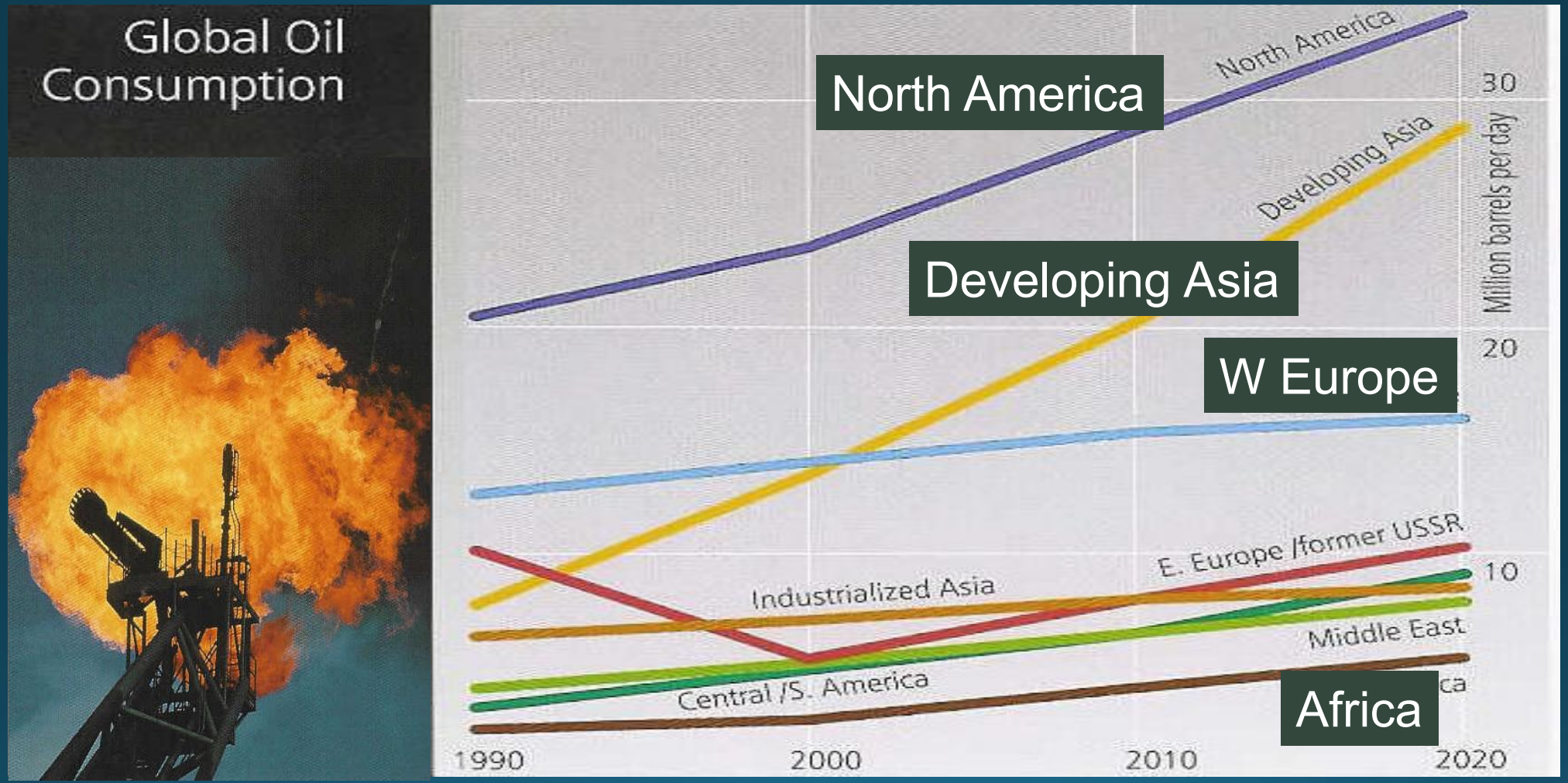

Chimaera Mountain, Antalya Province, Southern Turkey
Filming with BBC in 2013 – flames burning for 2500 years

3. Global perspective



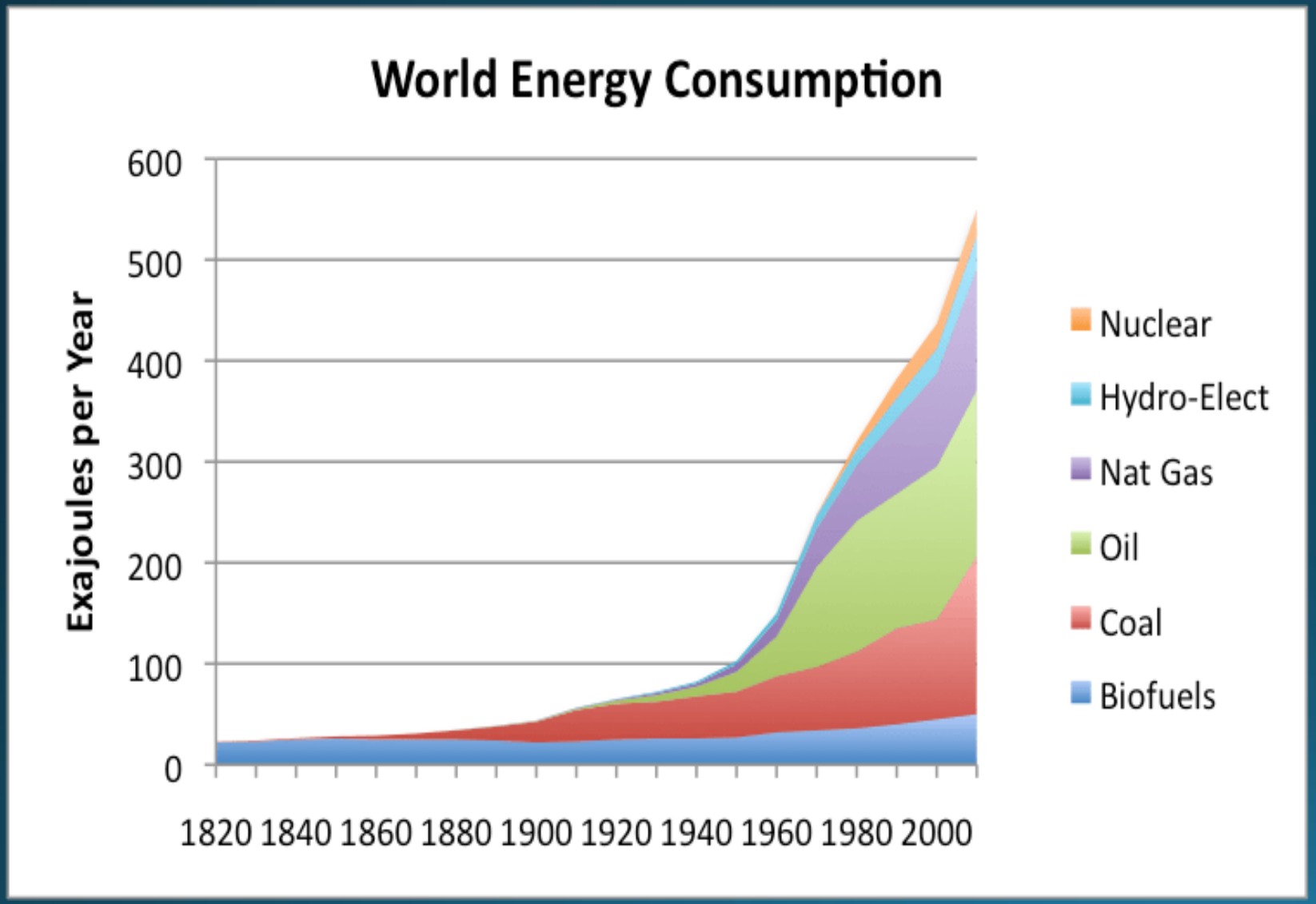
Are we at the final sunset for oil and gas in the energy mix?

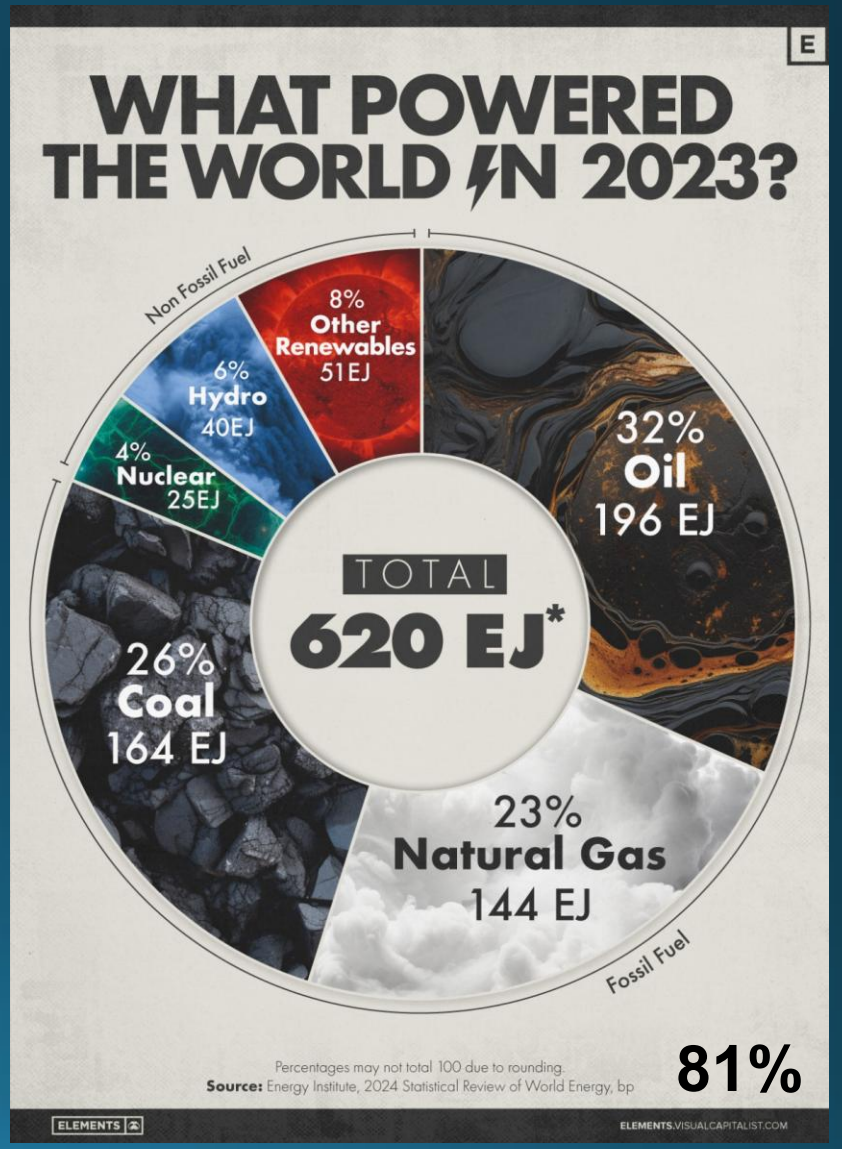
Not yet! We live in an energy-hungry world



It took over 2000 years to use the first trillion barrels of oil
We will use the next trillion in just 30 years from now

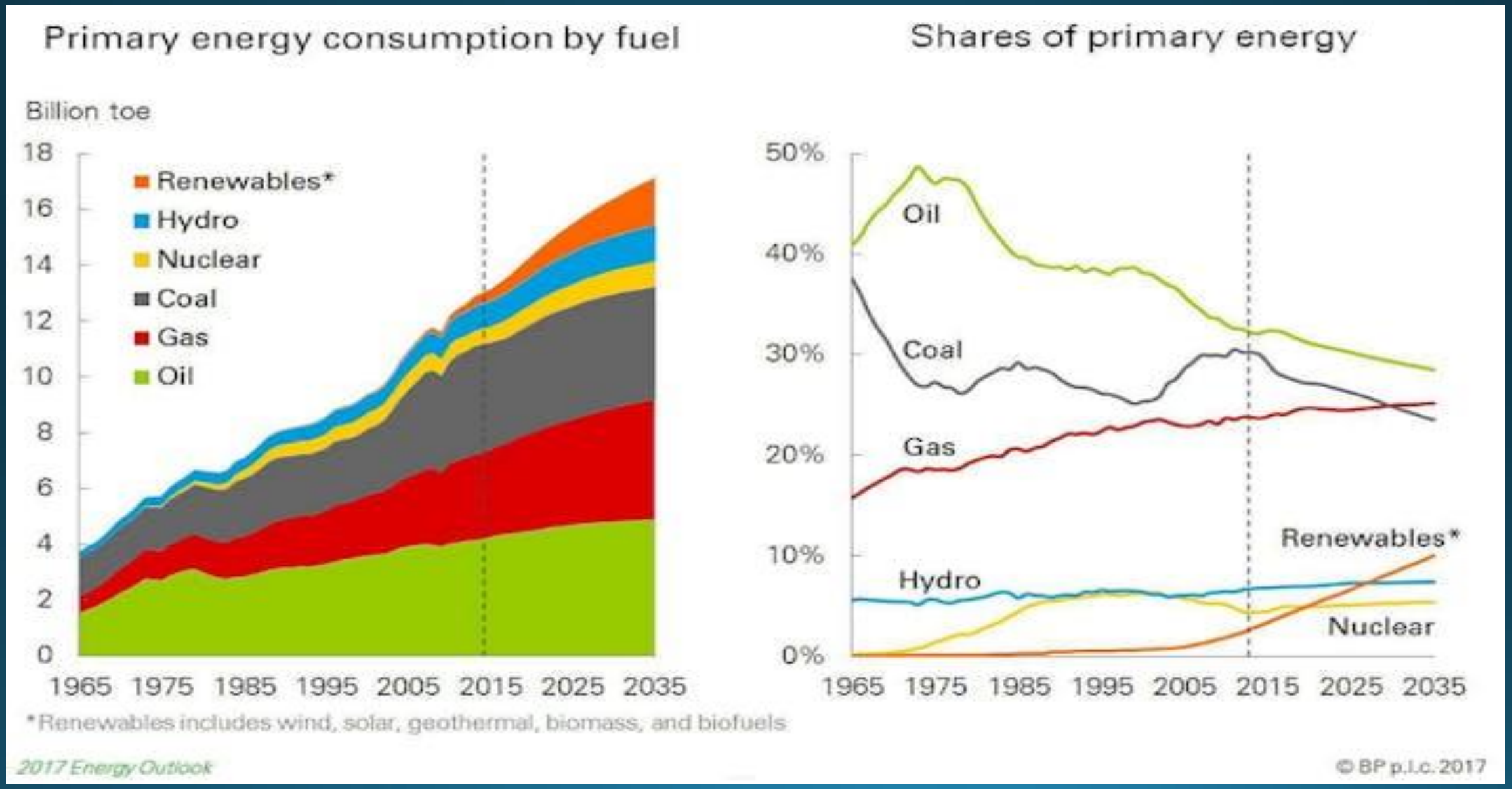
Energy Consumption trends





81%

Energy Outlook 2035

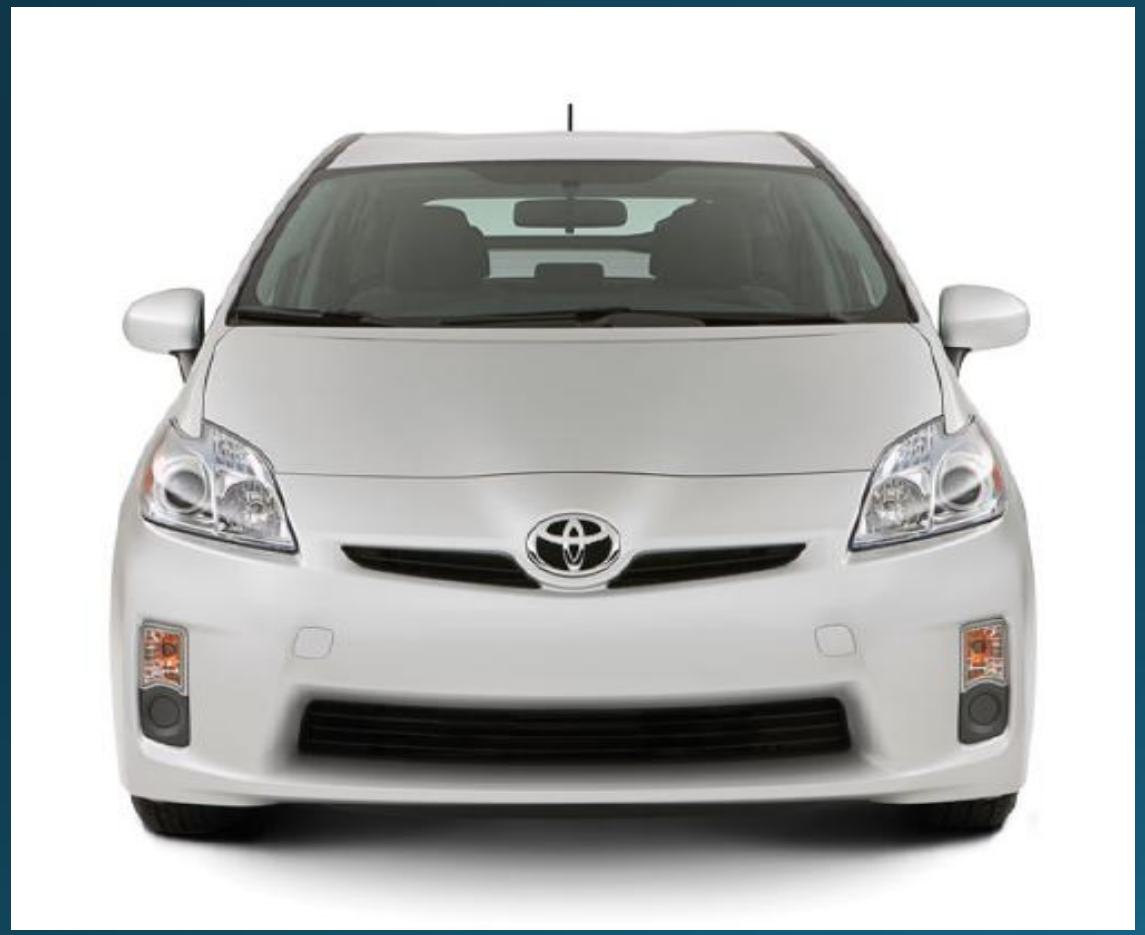


Driven by population growth…

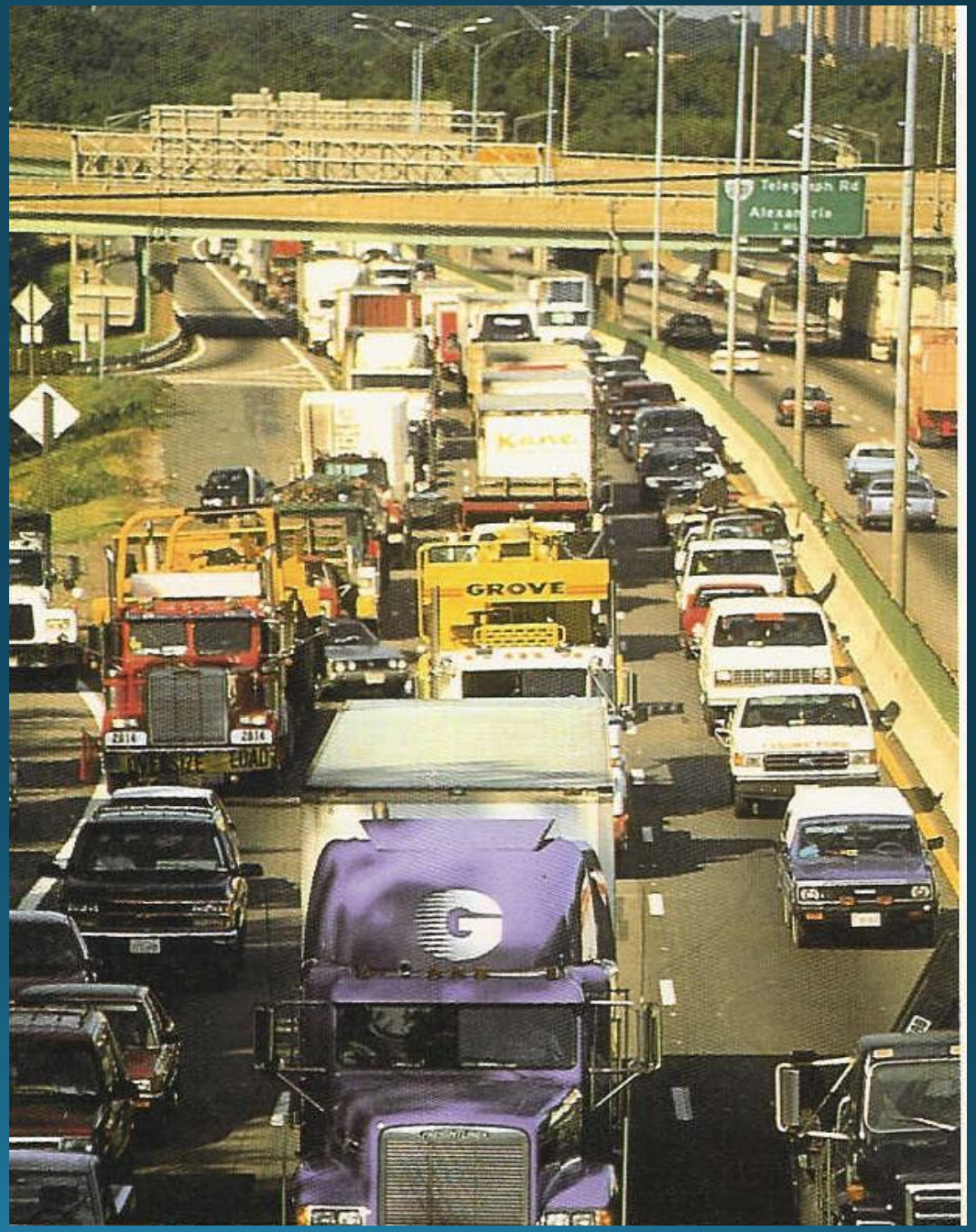
Global population will grow to 9.7 Billion by 2050, 10.3 Billion peak in 2085
India is still growing by 15 Million per year = 30x Edinburgh per year, or 3x Hanoi
SE Asia is growing by 5 Million per year BUT China, Japan, South Korea are all falling in population

And where will the resources come from?

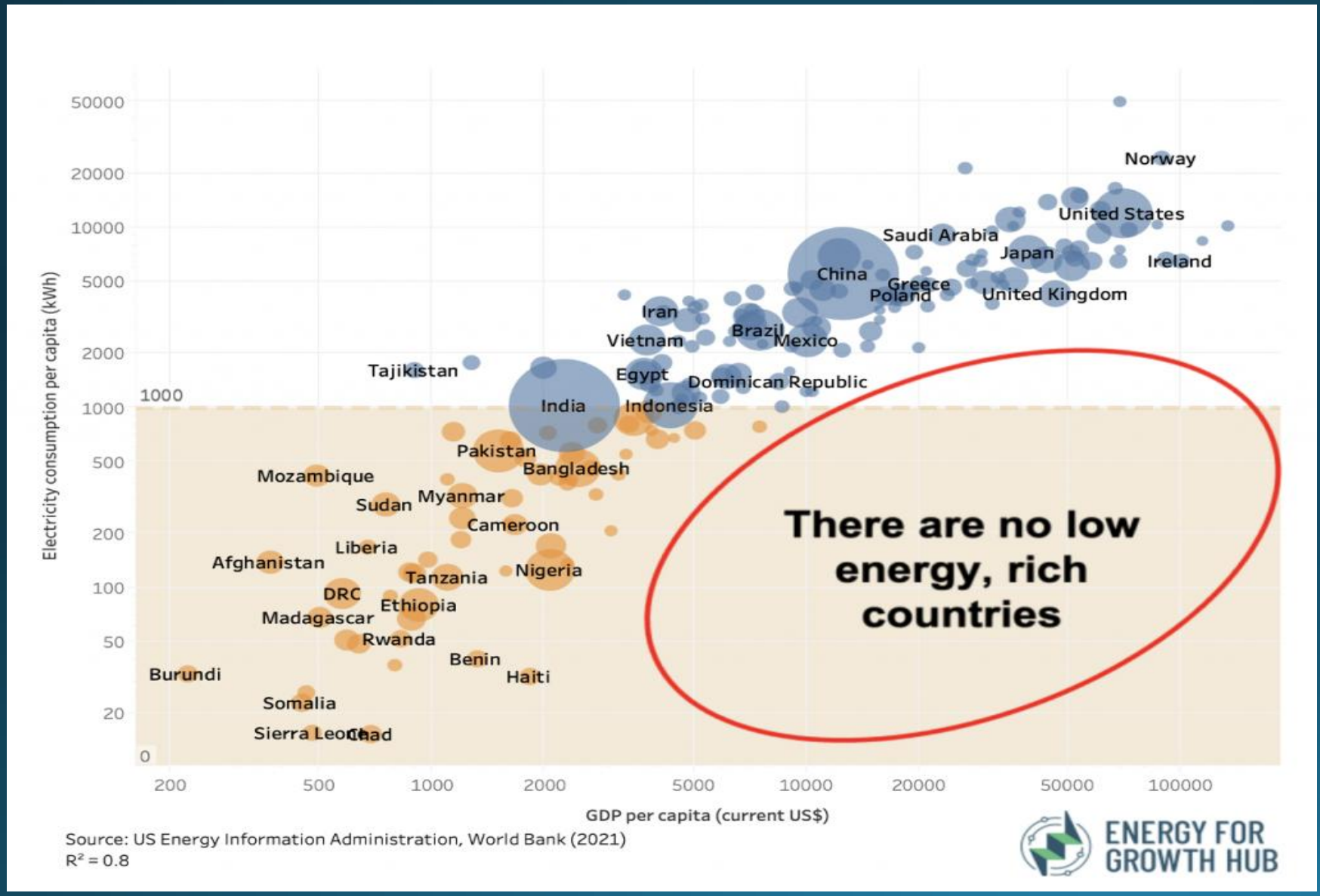
Driven by consumerism…

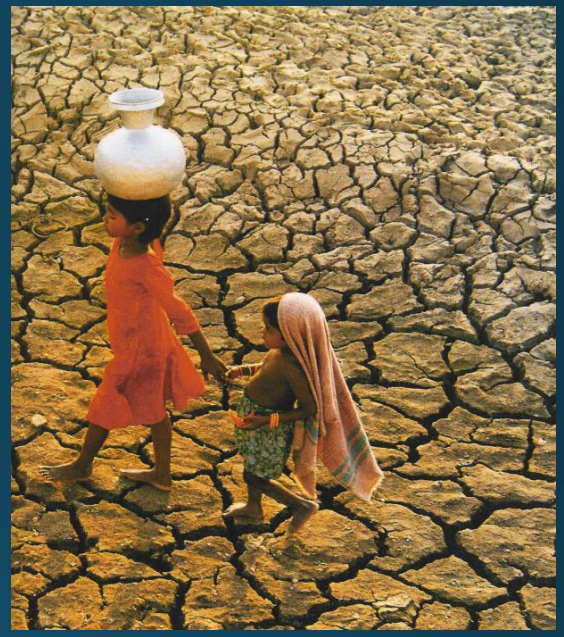


Toyota Hybrid contains 50 kg Copper
All electric cars require 100 kg Copper

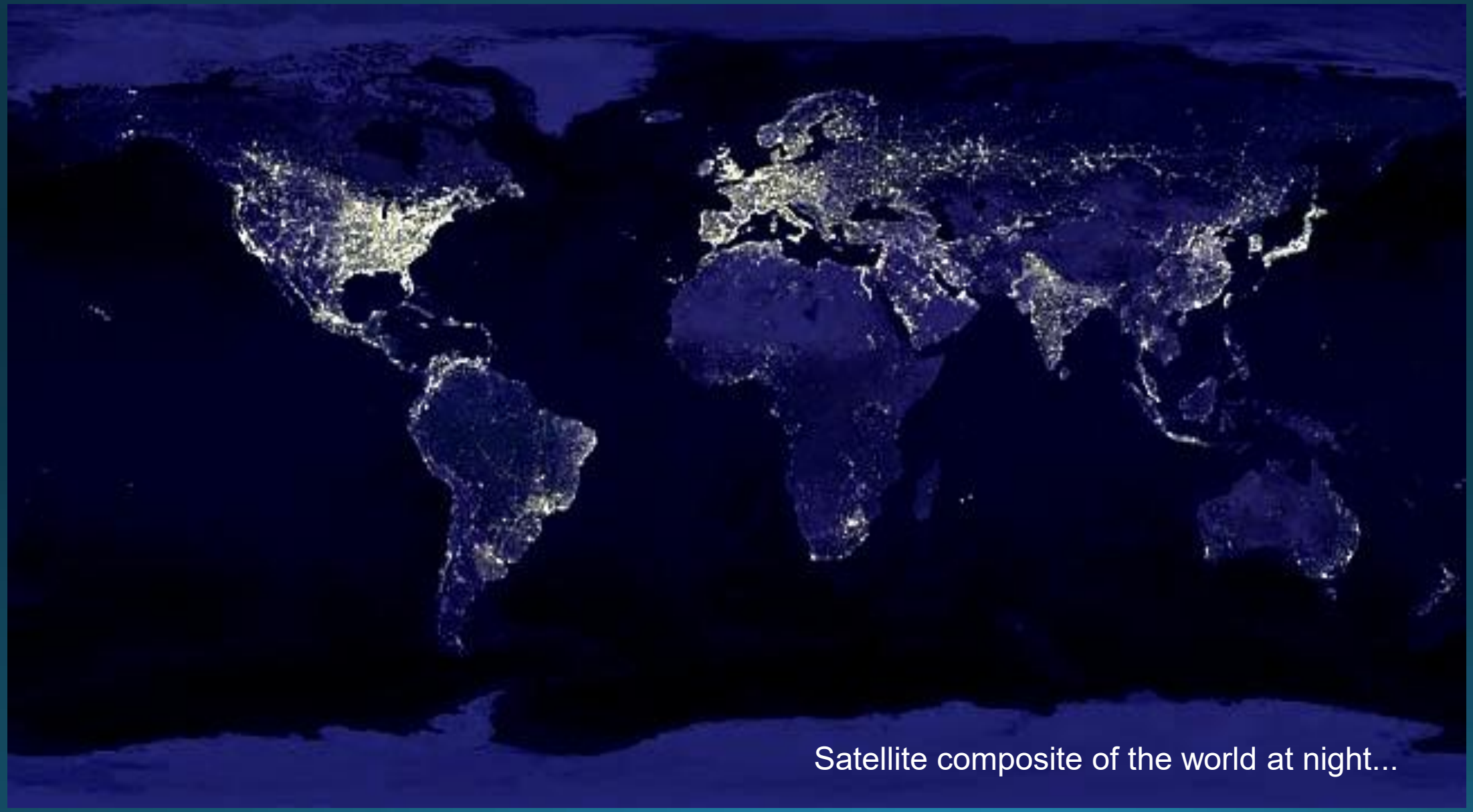


Driven by development needs… Electricity vs GDP per capita





It’s an energy-divided world



Satellite composite of the world at night...

West Yunnan

Forgotten SW China

Colourful minorities

Rural toil

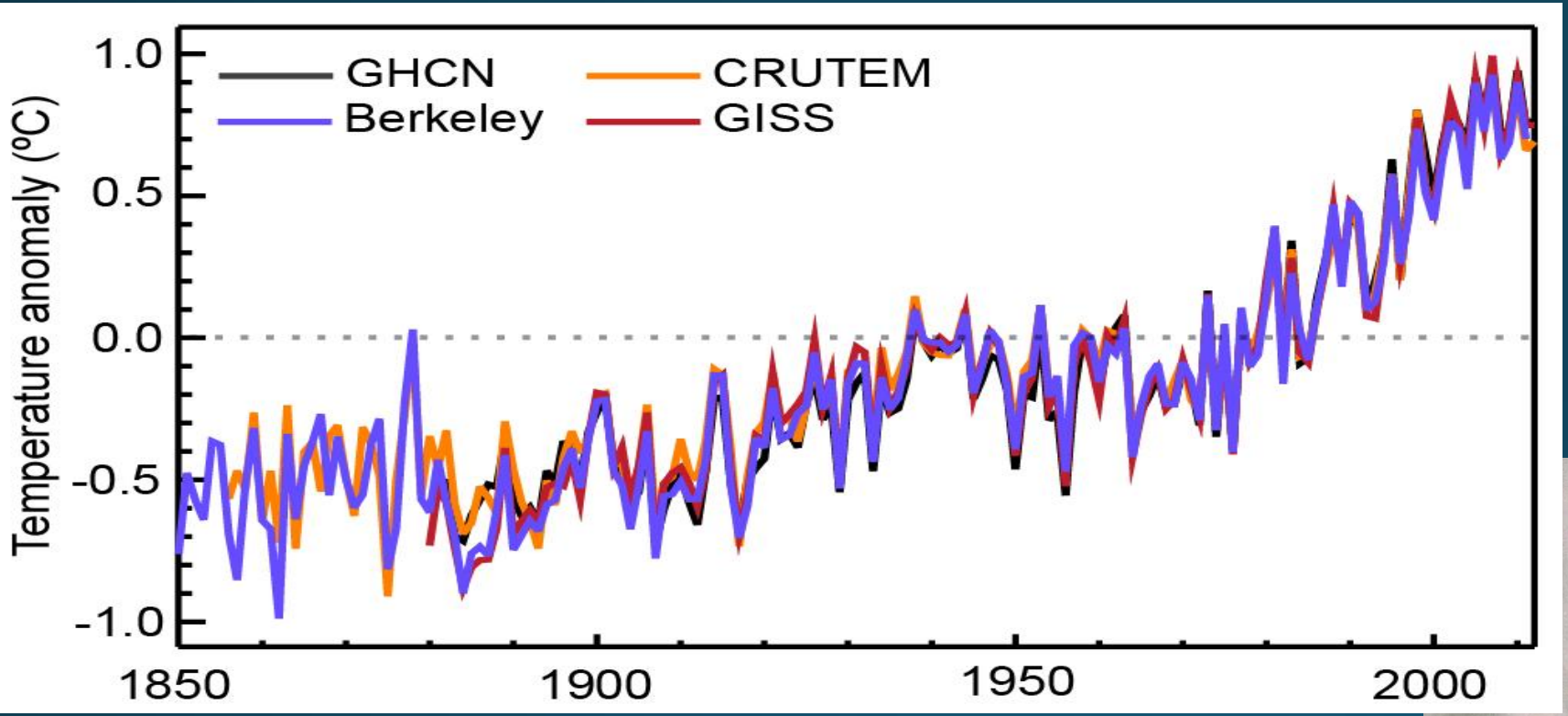
Energy resources

Energy resources & recycling, Yunnan

Valley of hot springs – a geothermal potential

ASSAM, India
Rat hole mining
Largest unregulated coal mines
Desperate people, dire health issues

It’s a warming world – 1.4^0 Celsius since 1850



Precipitation changes, snow/Ice cover decrease, river discharge increase, permafrost melting, ocean acidification and de-oxygenation, extreme weather events increasing…

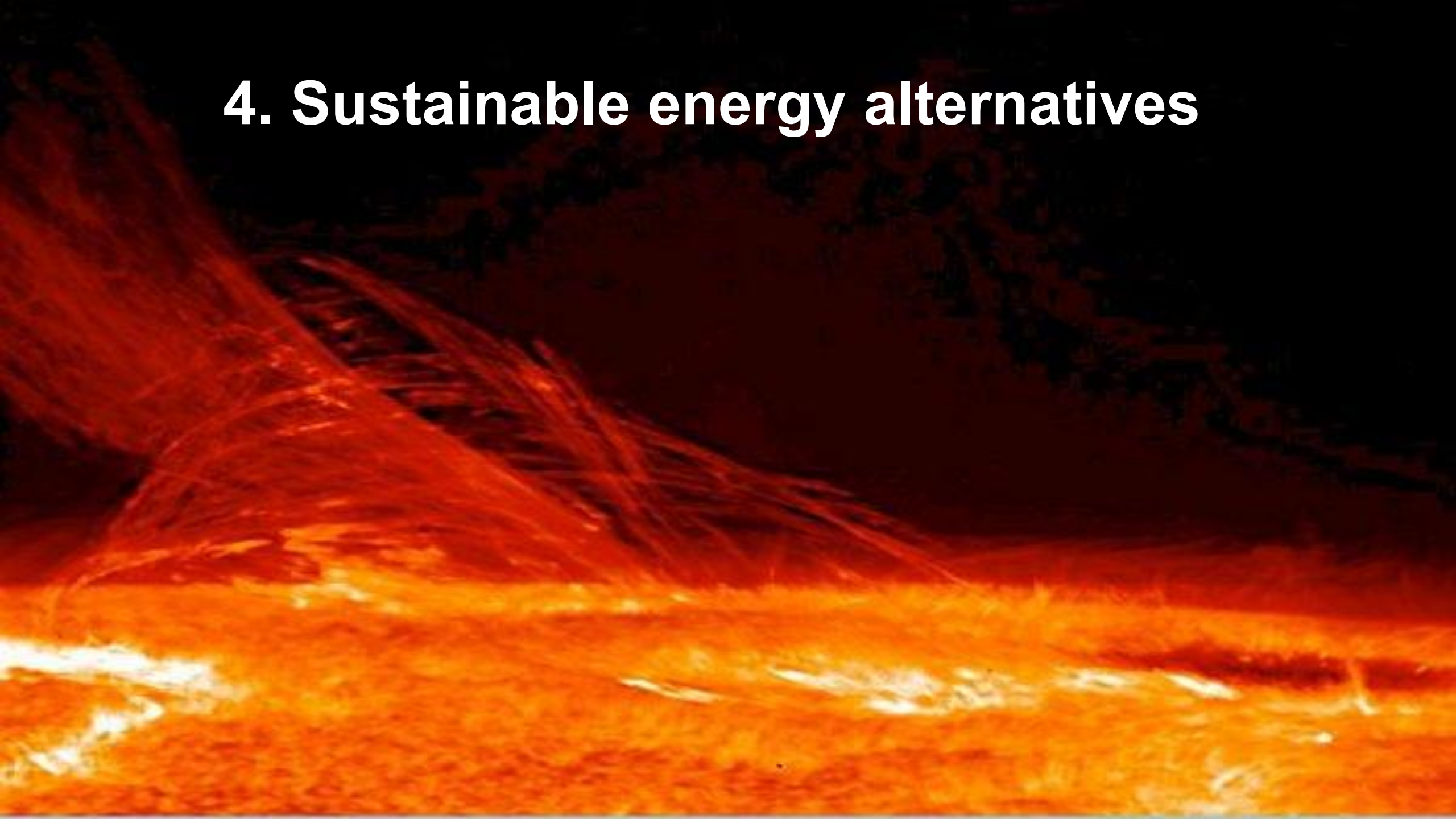
It’s a challenging world…

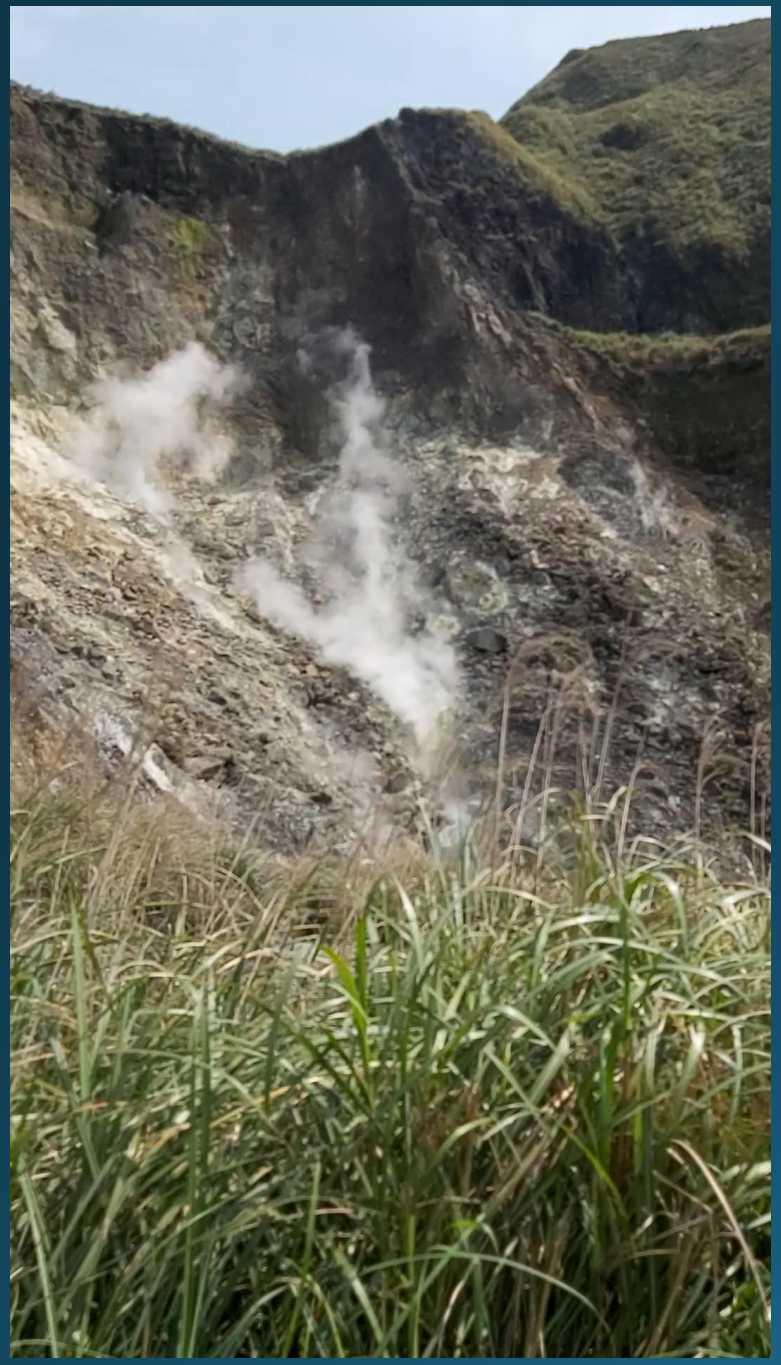
Energy and resource rapid consumption
Growing population and development needs
Resource base finite and non-renewable
Global warming and associated effects
Wasteful practises in the rich-world
Environmental stress on biota

“When you think about it, Dad, your generation has really left the world in a bit of a mess...

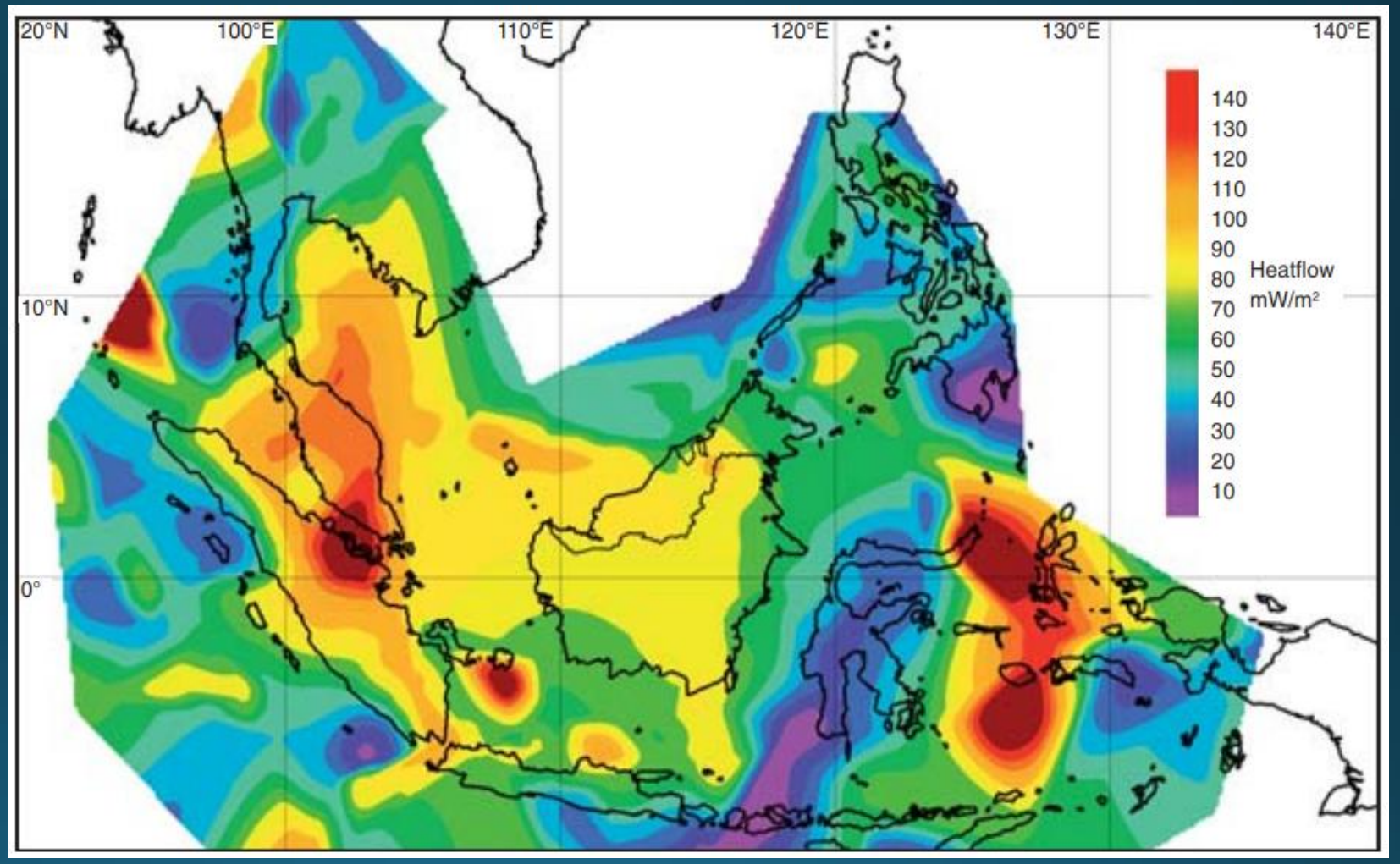
What on earth are *we* going to do about it?”

4. Sustainable energy alternatives



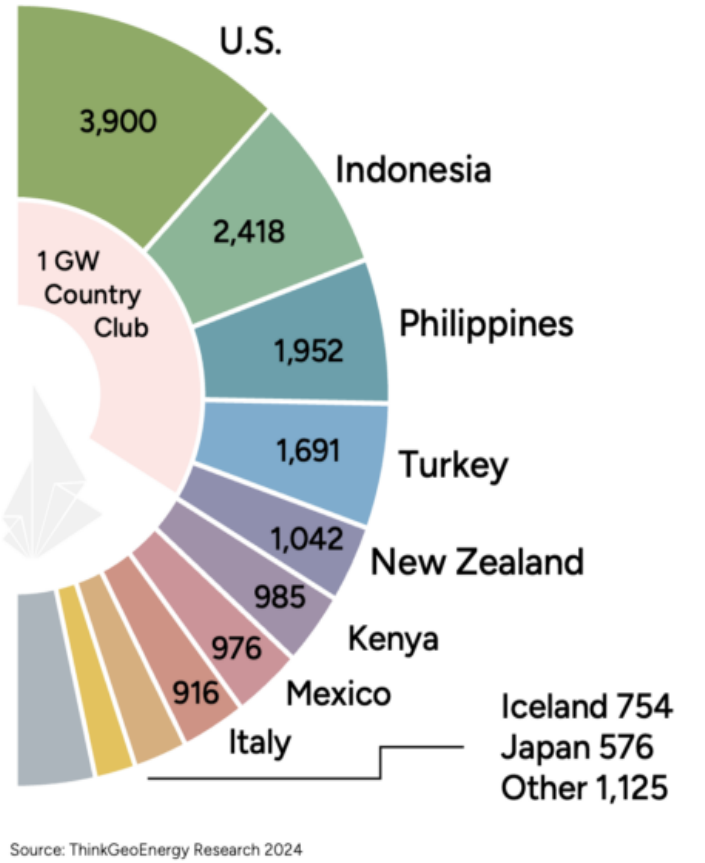


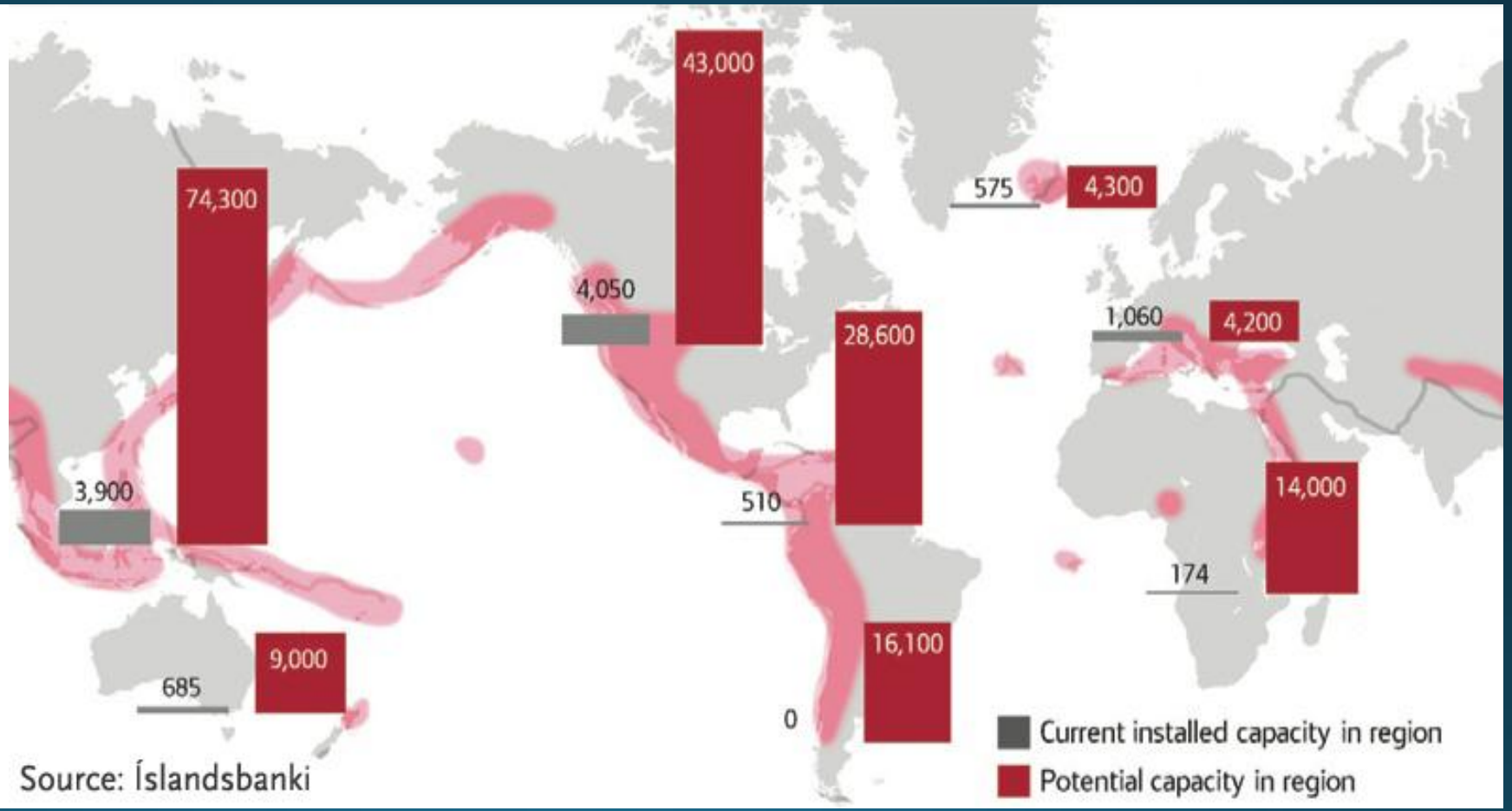
Heat flow map of the SE Asia region



Taiwan, natural heat escape

Geothermal Energy: enormous and highly underexploited resource





SE Asia: huge geothermal resource (~40% of world's potential), first production in 1926!

Easily accessible due to weak and thin lithosphere, but still little used

ASEAN region ***proposes*** 700% increase by 2050

Salak and Darajat Plants, W Java

Makbang Plant, Philippines

Philippines

Indonesia: world's second largest producer
Installed capacity 2418 MW, 6% electricity

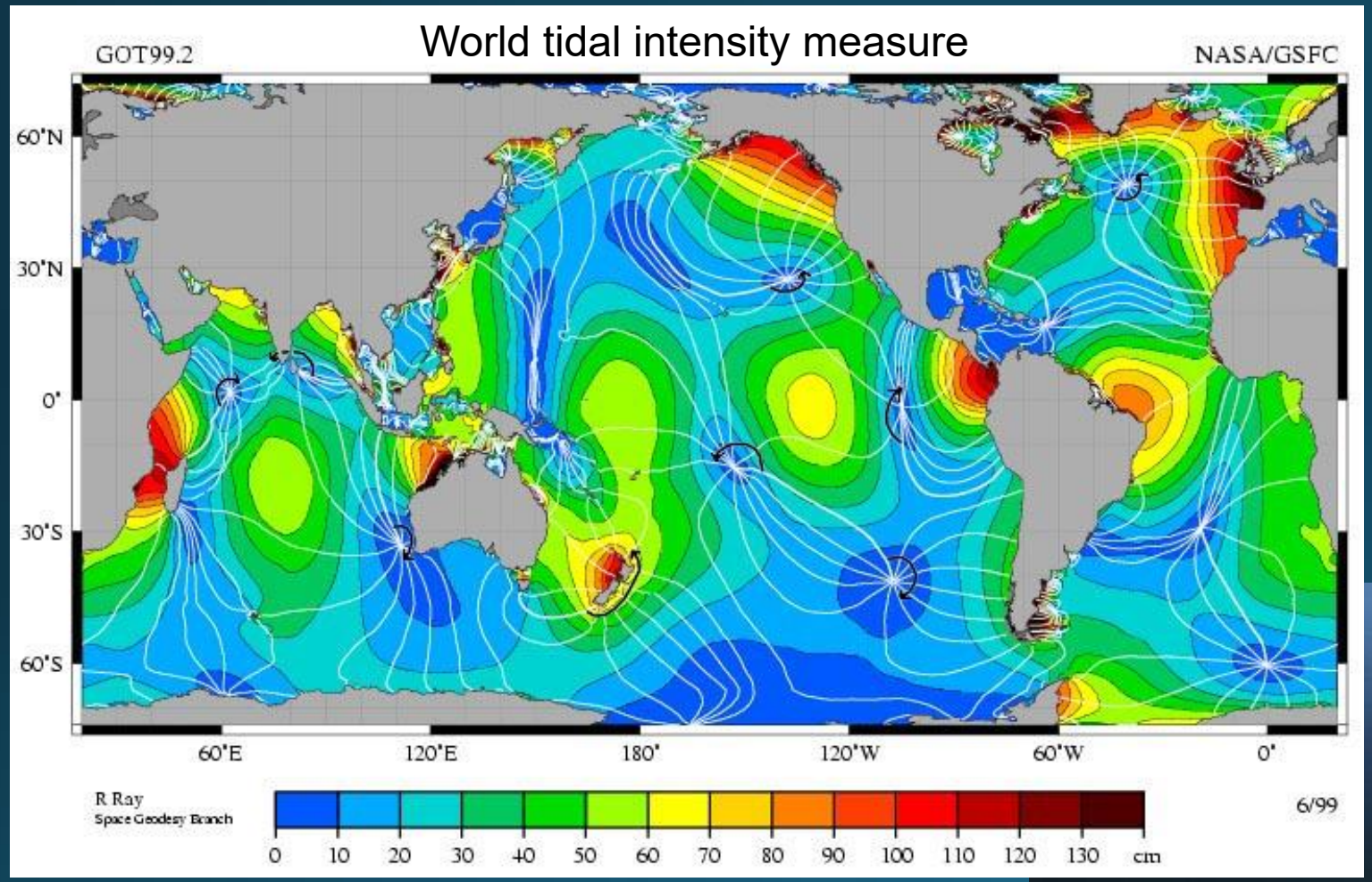
Philippines: worlds third largest producer
Installed capacity of 1944 MW, 14% electricity

BUT fossil fuels still dominate the energy mix (especially coal – 40% Vietnam)

China leads the way

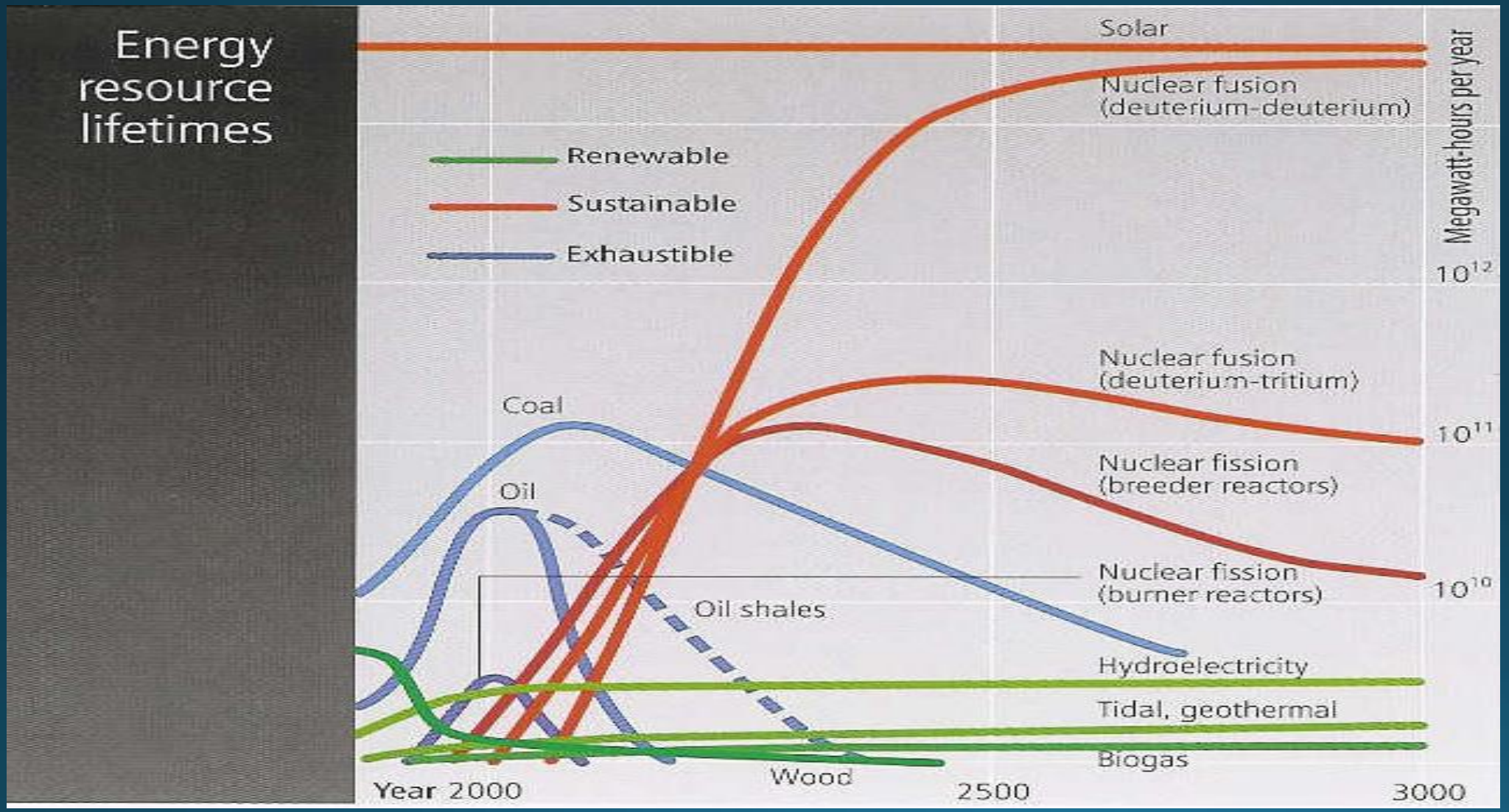
30% electricity from renewables: hydro (16), wind (8), solar (4), biomass (2)
Nuclear power: 55 plants, 22 under construction, 70 planned (5% electricity)

Tidal energy potential…



Jiangxia, China – 4th largest
Capul Island, Philippines - planned

Energy resource lifetimes… and some revised estimates



Infinite

I B yr

I M yr

Infinite

20,000 y oil shale

2500 y coal

Some thoughts

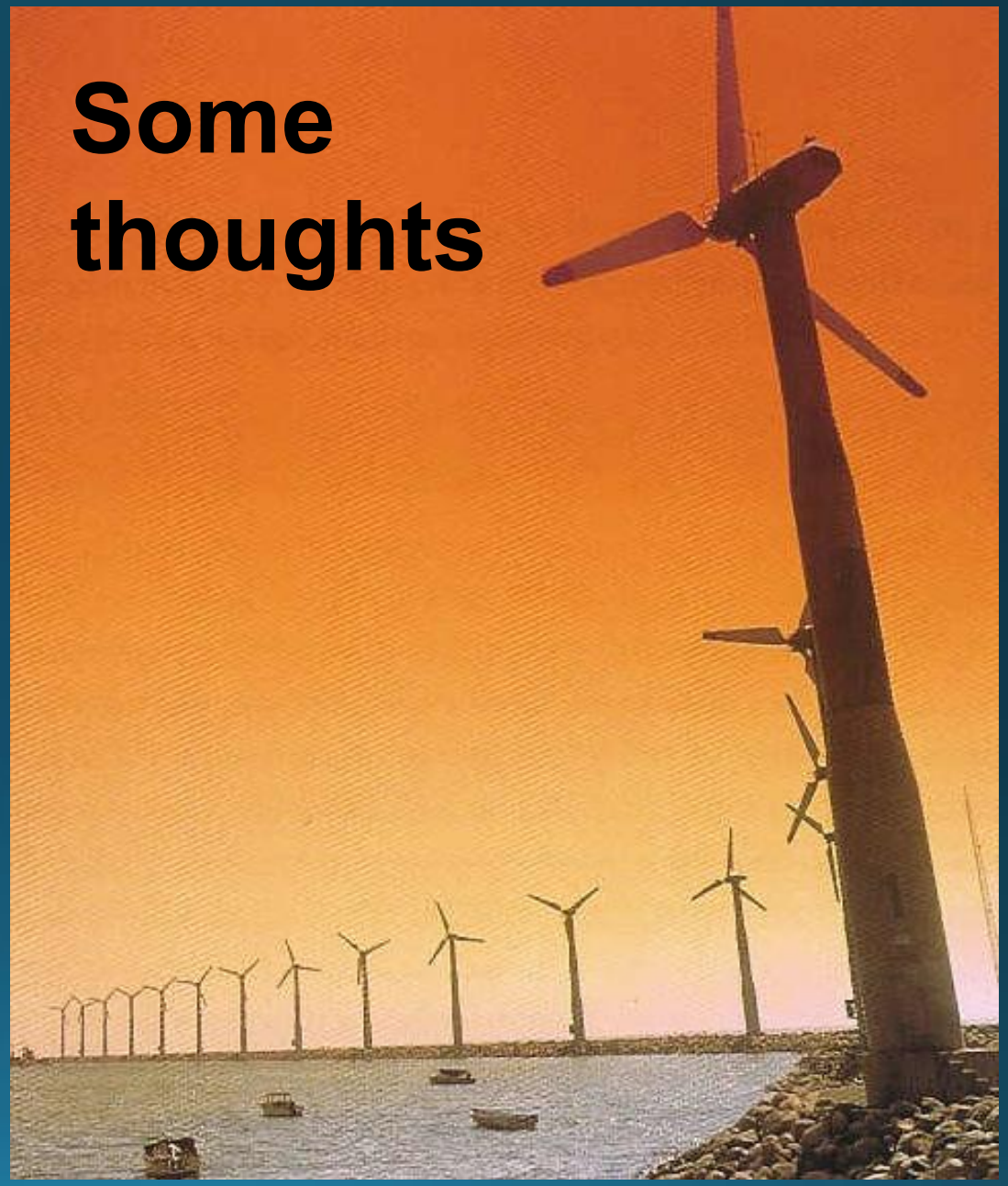
Renewable alternatives abound

Geothermal and enhanced geothermal
Back to nuclear options...and fusion
Hydroelectric, wind, biofuels
Marine energy: tidal, wave, currents...
Solar, solar, solar...

BUT there is no magic bullet

We must recognise energy resource limits
We must ramp-up renewable energy
We must plan for a sustainable future
We must tackle energy poverty
We must reduce resource consumption

We need eenergy tax → research



Questions

Next talk: Mighty Rivers of SE Asia – 8th 1.45 pm