Assocarboni National Congress 2019

The Coal Industry in Today‘s Adverse Global Environment

Dr. Lars Schernikau

HMS Bergbau AG

Rome, 21st March 2019

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HMS and Schernikau, Profile

HMS Bergbau AG – A coal marketing company with focus on Indonesian and South African coal

✓ Listed in Frankfurt, majority owned by Schernikau family.

- Founded by industry veteran Mr Heinz Schernikau (CEO), over 4 decades in coal

✓ Family with several coal and raw material investments in Asia, Africa, Poland, and other parts of the world

- Excellent team in Asia, Europe, Africa, India/Middle East, Americas
- Polish project for underground coal mine with 2+ Bln tons of coal (coking coal and steam coal)
- One of first German company with coal investments in Indonesia with former coal port operations in Kalimantan

✓ The group markets and trades steam coal, coking coal, anthracite, petcoke, ores, cementitious and other products worldwide

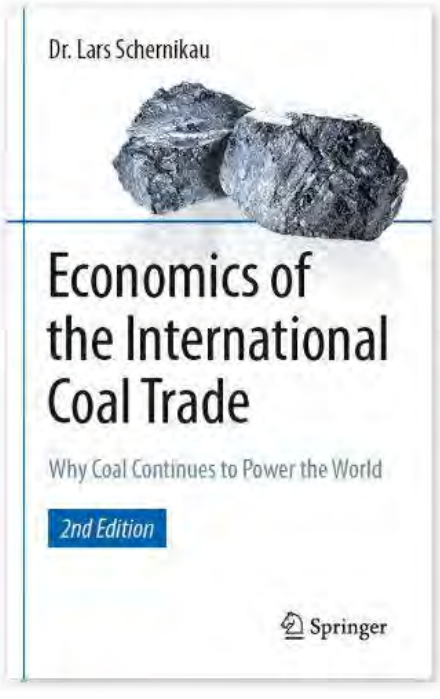
- Active in Atlantic and Pacific markets with exports to power plants, cement factories and industrial/steel plants worldwide

- Established: 1995 in Berlin
- Turnover: 300 Mio. USD
- Majority owner: Schernikau Family

About Dr. Lars Schernikau

Lars Schernikau

- Lives in Singapore and Switzerland, married with 4 children
- Studied in US, France and Germany
- 6+ years at The Boston Consulting Group: M&A, start-ups
- Joined coal business 16 years ago, today focusing on strategy and marketing HMS group's products in Asia, Africa, and Middle East
- Wrote „The Renaissance of Steam Coal" in 2008/2009, published in 2010, and "Why Coal Continues to Power the World", published end 2017 (Springer)
- Serves and served on the board of several coal producers and marketing companies in Europe, Russia, Africa, and Asia

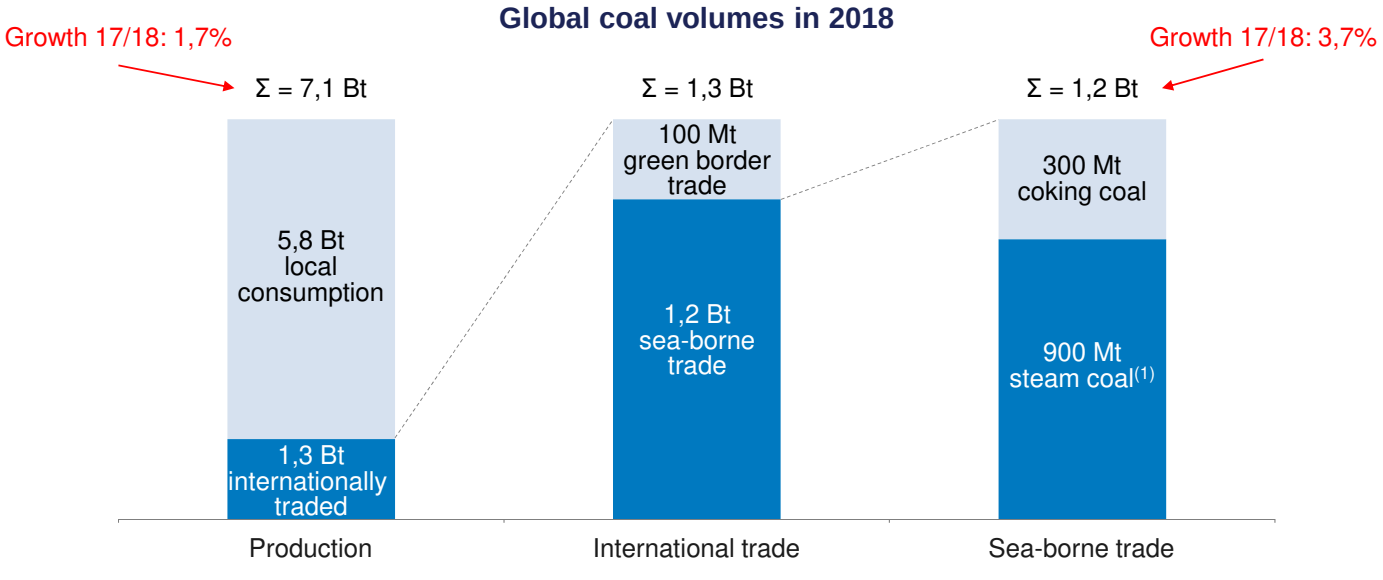


Coal Market

Fossils vs Renewables

Why Humans Warm the Planet

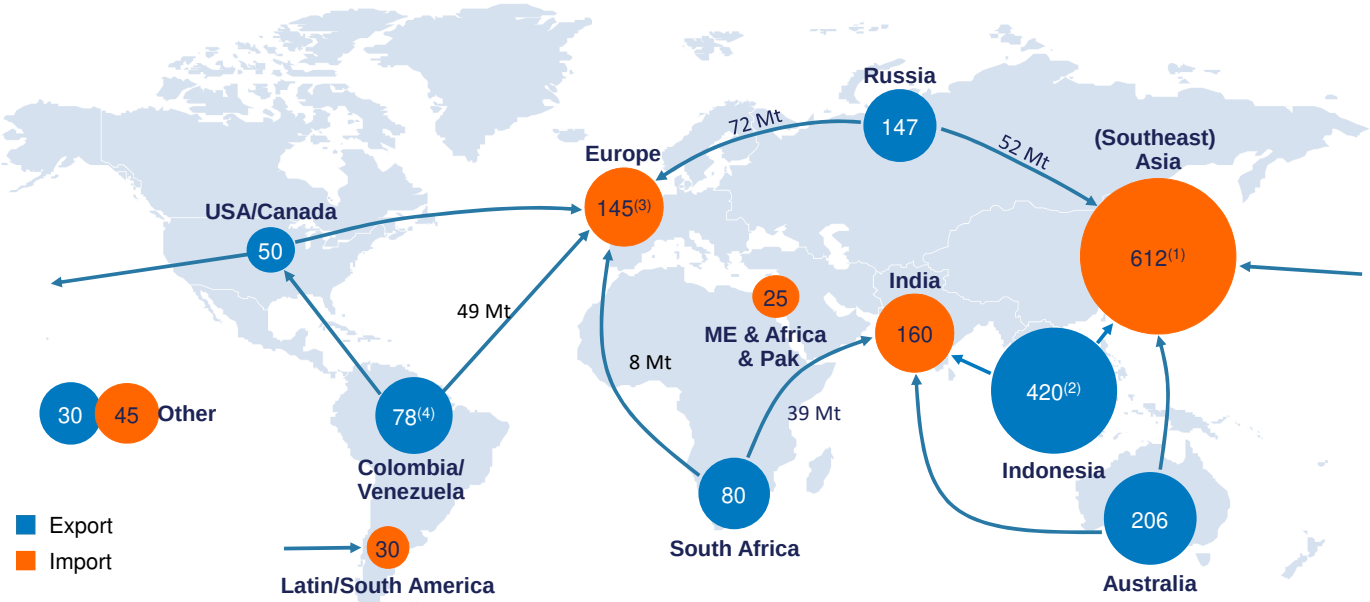
2018 Coal Overview: about 900 Mt International Traded Steam Coal



(1) Excluding subbituminous coal from Indonesia to India/China
Sources: VDKi 2018/19; Schernikau analysis; i206c

About 980 Mt Steam Coal Traded in 2018 (Schernikau)

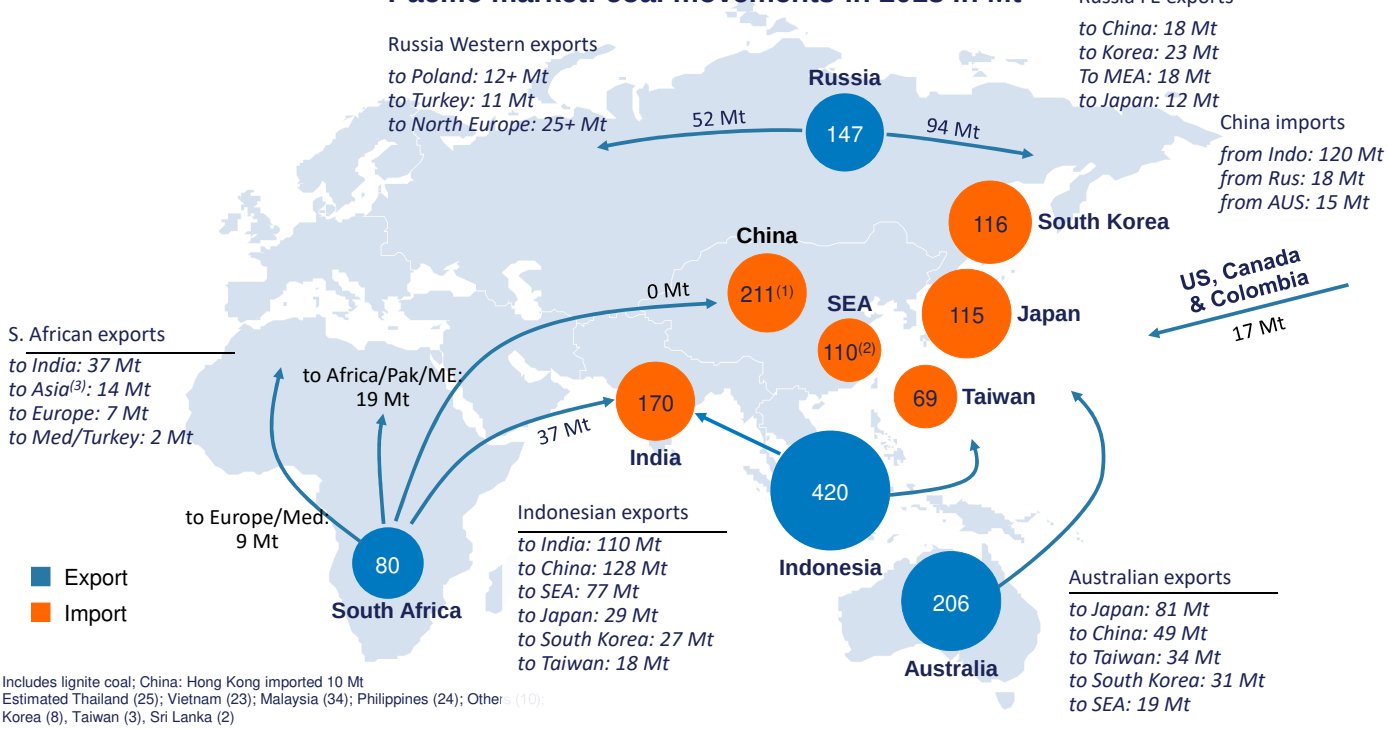
Coal movements in 2018 in Mt



(1) Includes China/HK (including lignite), Japan, Korea, Taiwan, SEA
(2) incl. low CV/lignite steam coal export; (3) Including Main Europe (xx); Turkey (xx), other Med/North Africa (xx)
(4) approx. 2017 exports32 Mt Cerrejon, 32 Mt Drummond; 14 Mt Prodeco, remainder CNR and others
Source: Schernikau research and analysis based on VDKi, Argus, Mercuria, Perret, Chinese Customs Data, and various market research

2018 Asian Steam Coal Trading Distribution (Schernikau)

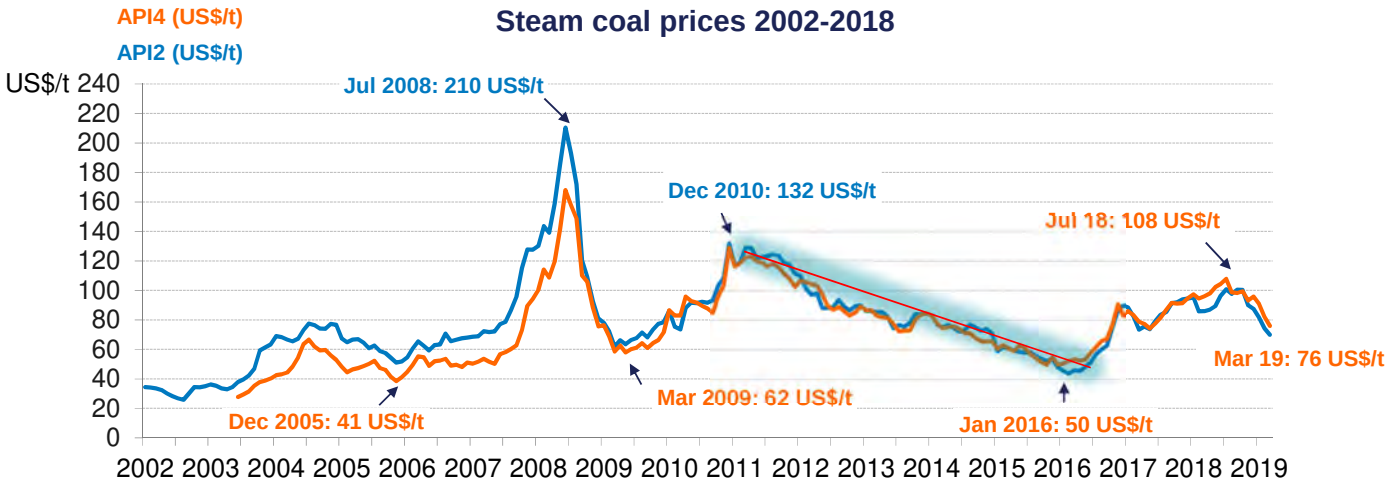
Pacific market: coal movements in 2018 in Mt



1) Includes lignite coal; China: Hong Kong imported 10 Mt
2) Estimated Thailand (25); Vietnam (23); Malaysia (34); Philippines (24); Other (10);
3) Korea (8), Taiwan (3), Sri Lanka (2)
Source: Schernikau research and analysis based on VDKi, Argus, Mercuria, Perret, Chinese Customs Data, and various market research

Coal Indices 2002 until Today

Prices Declined from 2011 until 1H 2016

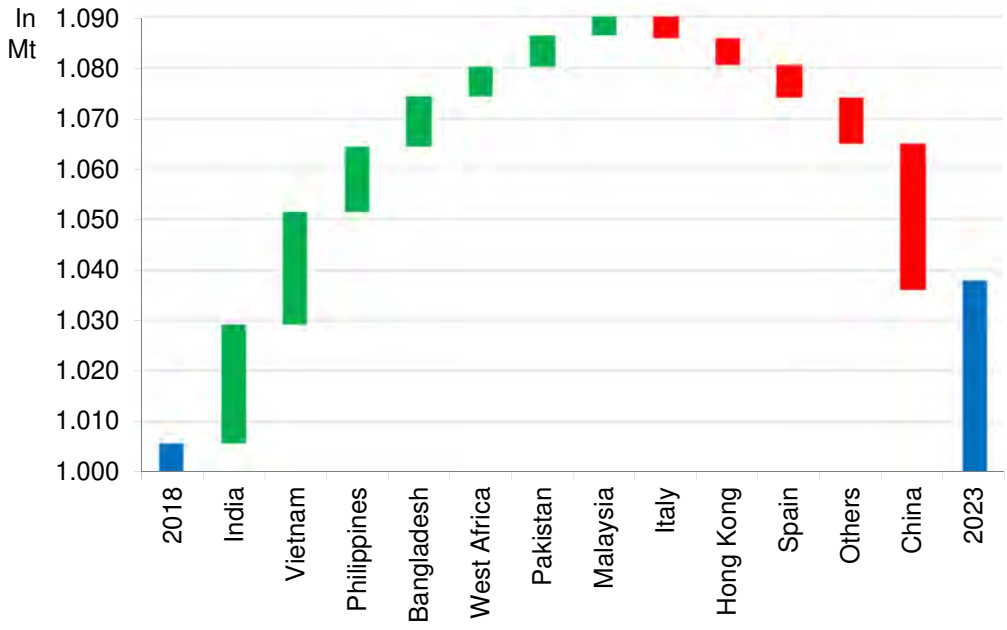


Coal will be around for decades to come…
…and coal prices will be driven by demand and supply

Sources: Schernikau analysis; McCloskey Coal Price Index; i204

Demand Growth and Decline 2018-2023

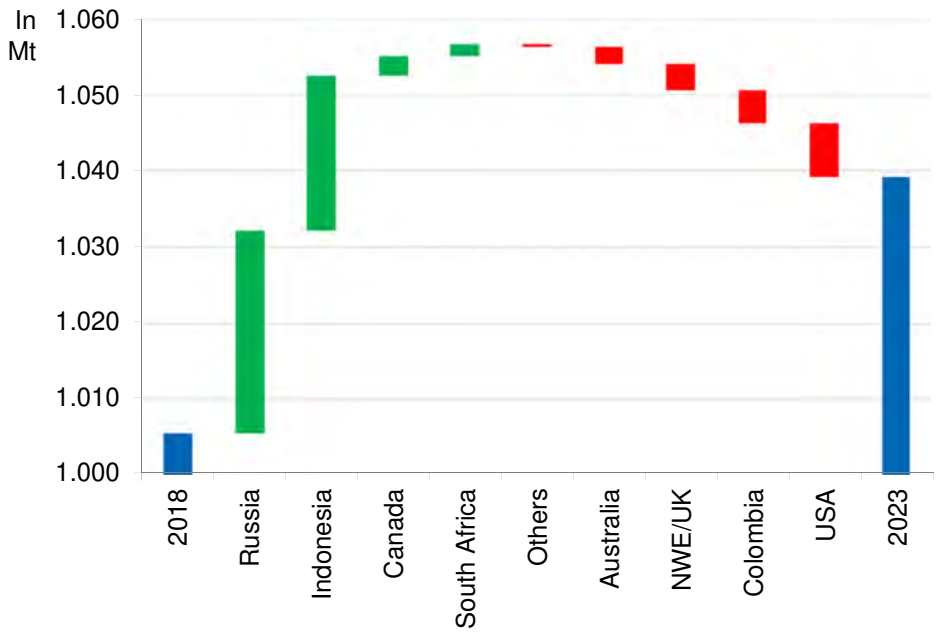
IHS Estimate



Source: IHS market

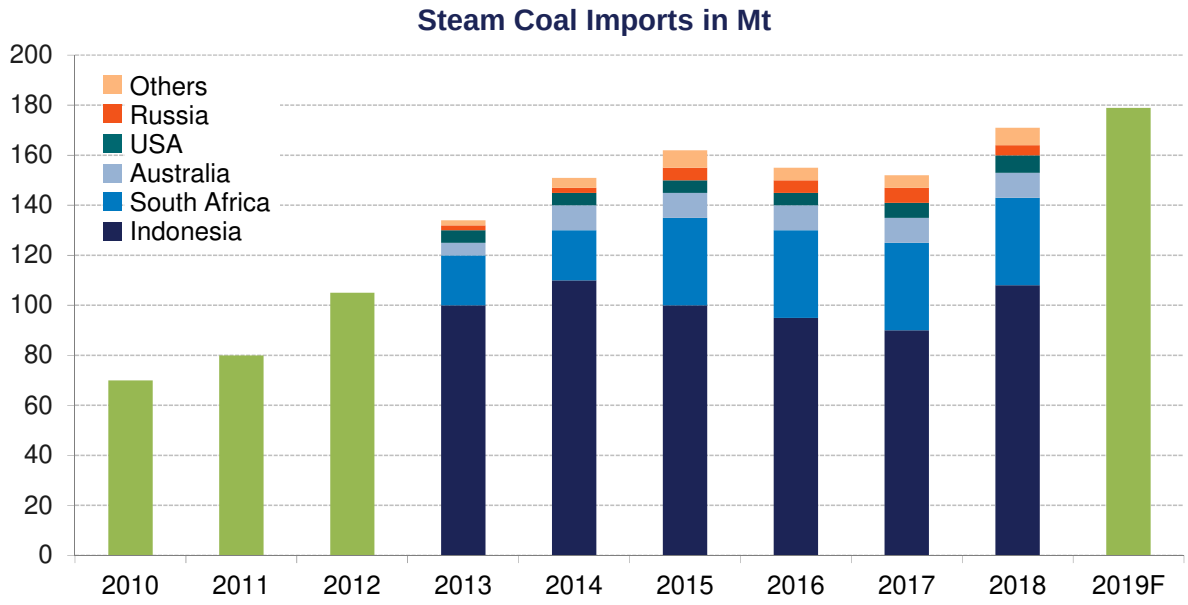
Supply Growth and Decline 2018-2023

IHS Estimate



Source: IHS market

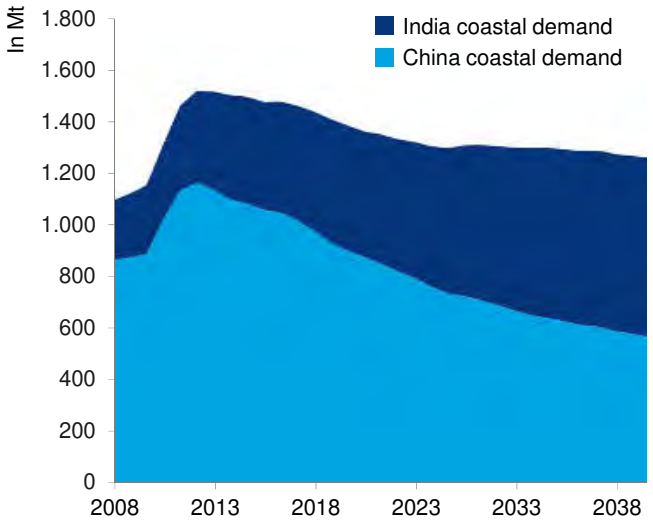
India Steam Coal Imports 2010-2019



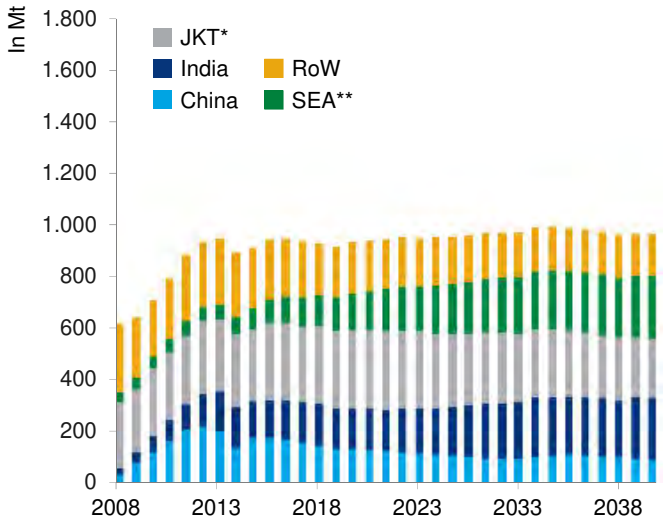
Source: Perret Associates based on Indian Port Authorities, Argus 2019, Whitepaper

India and SEA Will Drive Future Demand for Sea-Borne Thermal Coal

Costal Demand in China and India



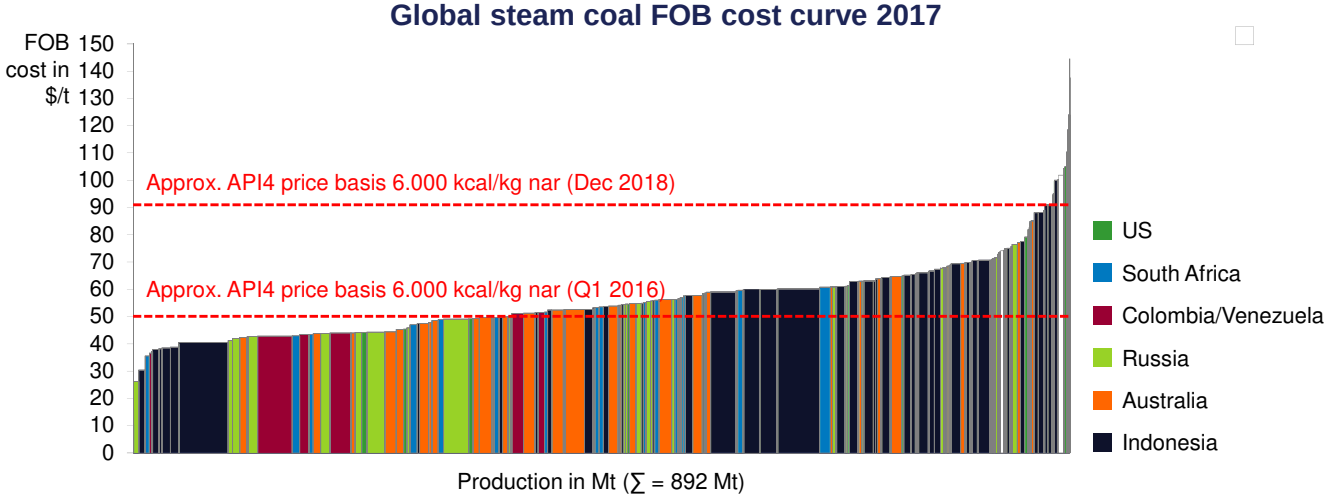
Sea-Borne Thermal Coal Demand



* SEA includes Malaysia, Thailand, Philippines, Vietnam; ** JKT includes Japan, Taiwan, South Korea
Source: Wood Mackenzie

Global Steam Coal 2017 FOB Cost Curve

Global steam coal FOB cost curve 2017

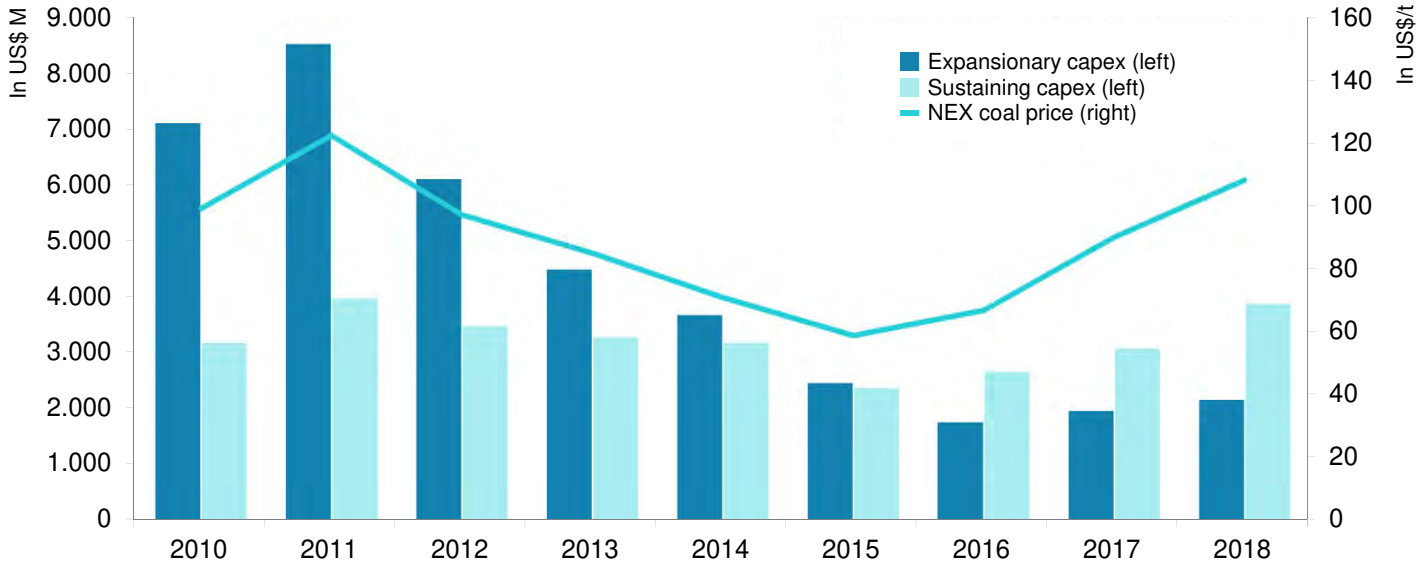


Note: Cost curve data normalized to 6.000 kcal/kg nar calorific value. Cost curve data is provided from the proprietary CRU Australia database. It includes data on larger mines that export steam coal, though it may not be entirely complete. For any questions on the data please contact the author.
FOB cost curve includes royalties on mined coal, all costs associated with mining and processing coal, transport costs within mine and up to FOB, marketing and financial costs, in other words sustaining capital is included.
Source: Schernikau analysis based on CRU Cost Curve 2017; i285c

Investments in Coal Remains Constrained

Supply Growth Limited

Global thermal export mine capital expenditure vs. new castle coal spot price for 6.700 kcal/kg



Source: Banpu based on Wood Mackenzie

Coal Market

Fossils vs Renewables

Why Humans Warm the Planet

„Are You Quite Mad?“

Open Letter to the European Commission President Jean-Claude Juncker.

Tuesday, 12 February 2019 | INEOS Group

Open letter to President Jean-Claude Juncker
President European Commission
European Commission
Rue de la Loi 200
B-1049 Brussels

11th February 2019

Dear President Juncker,

"Are you quite mad?" was the reaction of one well known CEO of a European chemicals company when INEOS publicly announced recently its huge €3 billion petrochemicals expansion in Antwerp in January of this year. The first of its kind for a generation.

Europe, not so long ago the world leader in chemicals, has seen its market share in the last decade alone collapse from 30% world market share to 15%.

Sources: INEOS Chairman Sir Jim Radcliffe open letter to European Commission, 11 Feb 2019; INEOS: 60 Bln Rev, combination of BASF, Degussa, Bayer, Monsanto, any many more

Why Am I Discussing This?

Climate is changing

Deep Hearted Care for Environment

Population

Space Junk

Air Polution

Oceans

Impact of Humans on Earth…
… on Environment

Human Waste

Conflicts

Health

Animal Waste

Terminology

- **Baseload** electricity is the constant, invariable quantity of electricity generated to the grid to meet minimum electricity demands over a period of time (i.e. Nuclear or Coal power)

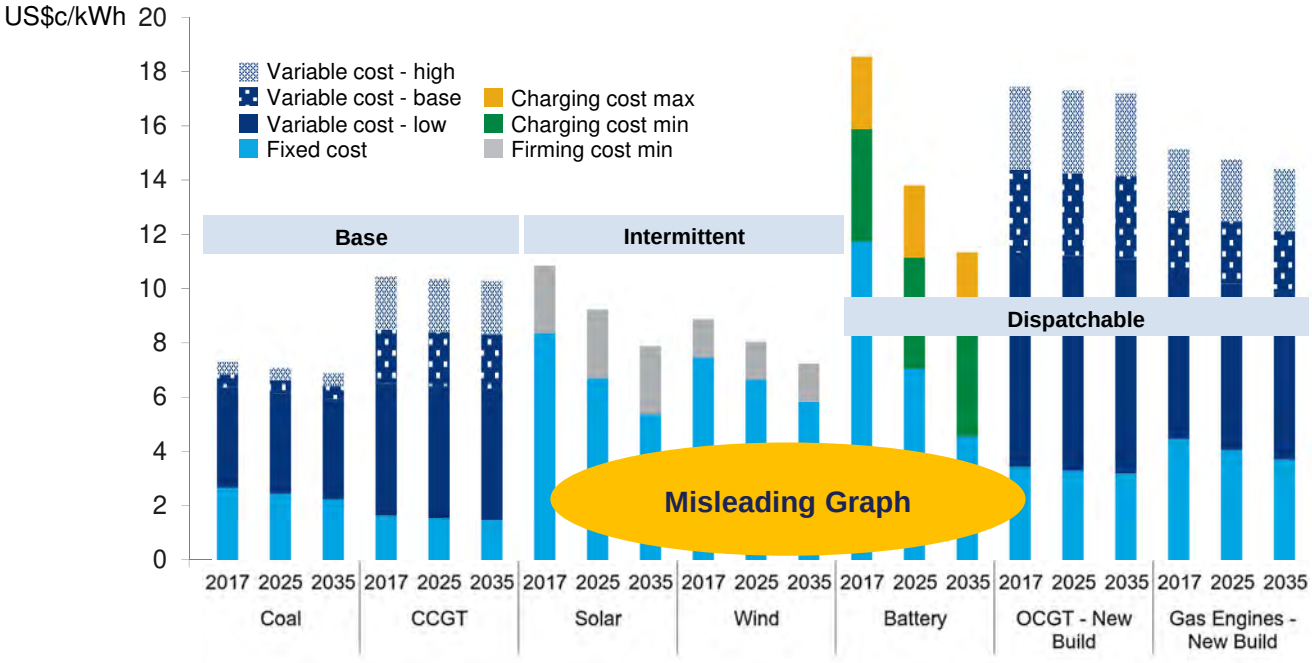
- **Dispatchable** electricity is electricity that can be supplied on demand. This power can be switched on and off, meeting its demand in seconds (i.e. Gas Power or Hydropower, or other renewable with storage system)

- **Intermittent** electricity is electrical energy that is not continuously available due to external factors that cannot be controlled, produced by electricity generating sources that vary in their conditions on a fairly short time scale
  - Wind and Solar power are intermittent, and non-dispatchable without an energy storage system because of wind speeds, cloud cover, and limited daytime hours

Understanding LCOE Is Crucial for New Builds

Batteries Will Be Able to Replace Gas at Peakload by 2035

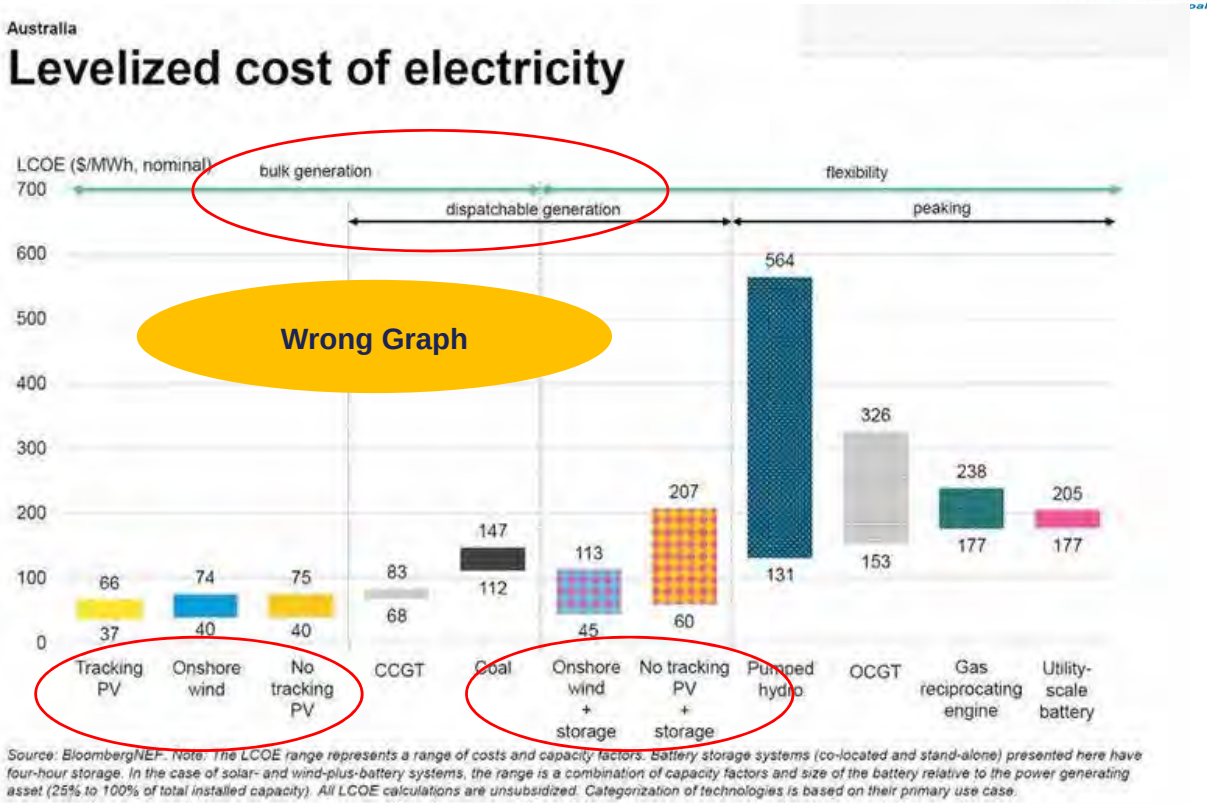
Change in levelized cost of electricity (LCOE) based on SE Asia



Sources: Wood Mackenzie, GTM, MAKE

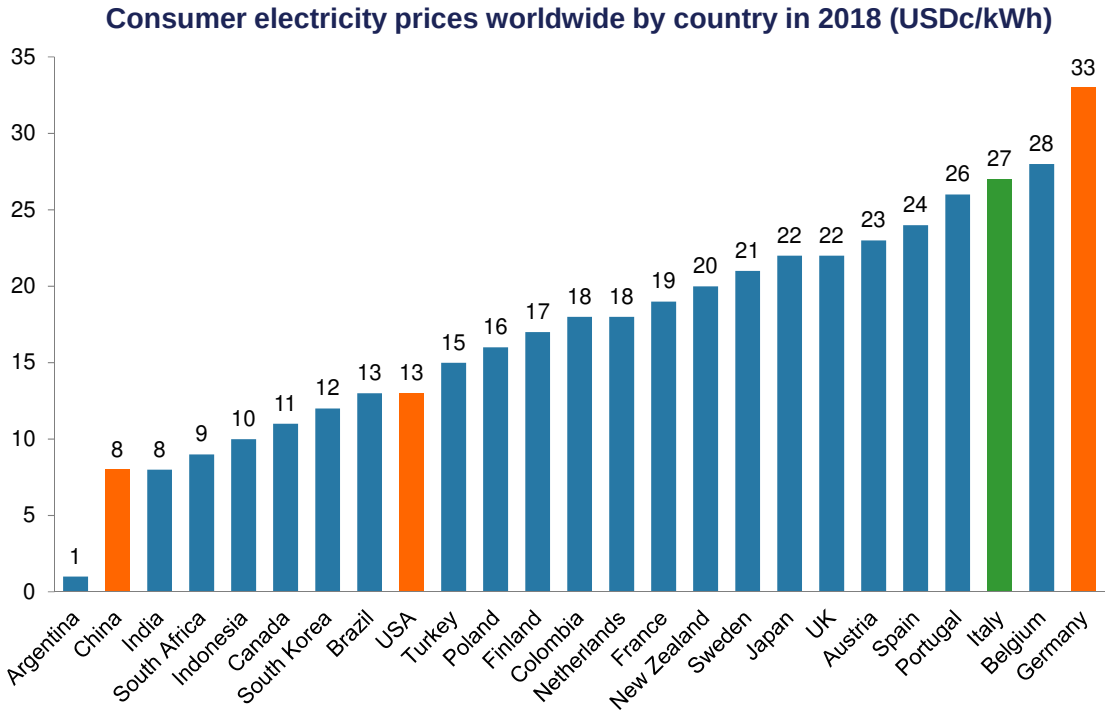
Bloomberg shows a completely different view

for Austrlia only – coal is inflated from 70USD/MWh to 112-147USD/MWh



Sources: BNEF 2018

Germany Is Leading Electricity Costs Worldwide



Note: This statistic shows electricity prices in selected countries worldwide excl VAT
Source: Statista 2019, Release Date October 2018

Analysing Electricity Supply Options (LCOE: 25y, 5% disc. rate)

Solar vs. Fossil Fuels – „off the Grid“

House owners of a new house located near Brooks, in Southeastern Alberta (CA)

Yearly electricity consumption: 8.106 kWh

Off-the-grid supply options(1)

Model A
Fossil-fueled generator
→ **LCOE(2): 14,4¢/kWh (Fuel 8¢)**

Model B
fossil-fueled generator
→ **LCOE(3): 13,6¢/kWh (Fuel 4¢)**

Model C
Solar photovoltaic (PV) panels, 6kW
→ **LCOE(4): 10¢/kWh**

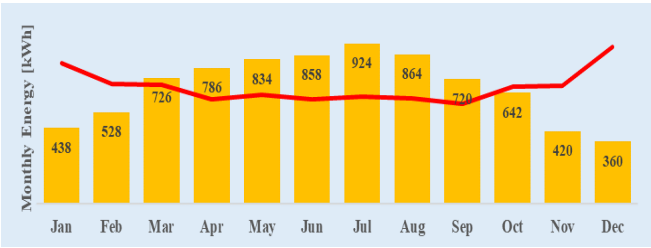
→ ***But: solution needed to balance shortfalls in Winter and surpluses in Summer***

(1) Assumption: Both the cost of the generator and the cost of the fuel, if any, will be paid in a lump sum at the end of each year
(2) Model A generator costs $20.000 and consumes 8¢ worth of fuel for each kWh of electricity produced. The annual payment is $1.420 for the generator plus $648 for fuel, so the NPV of the payment stream at a 5% discount rate is $29.140. Dividing by total kWhs produced (202.650 over 25 years) gives an LCOE for Model A of 14,4¢/kWh.
(3) Model B generator costs more up front ($23.000), but it is more efficient, using only 4¢ worth of fuel per kWh. The annual payment is $1.632 plus $324, which gives an NPV of $27.570 and an LCOE of 13,6¢/kWh
(4) If LCOE to be 10¢/kWh, we can calculate initial cost of $20.250 (since there is no fuel cost). The array has to be 6 kW to match the annual energy requirement, so the initial cost works out to be $3.375 per kw
Source: IN THE DARK ON RENEWABLES. Rebutting Deloitte and Climate Reality – Insights for Investors, Policymakers and the Public, Friends of Science, November 2018

One House in Canada: Options For Balancing Solar Shortfalls

The Monthly View

Solar potential and residential demand in Brooks(1)



In our example, the October to February shortfall is 1.383 kWh

→ 1.383 kWh of storage needed in October

Options

Battery

more than stored in 2.000 typical 50-ampere-hour automobile batteries

Increased capacity of PV array

15 kW instead of original 6 kW
→ about 2½ times larger
→ **LCOE: 25¢/kWh**

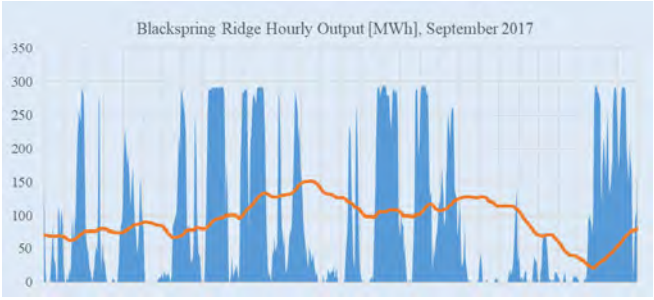
→ ***far higher than the LCOE of the Model B generator, plus generator or battery still needed for nighttime***

(1) Natural Resources Canada provides monthly solar energy potentials for the Brooks area. A PV array having a peak output of 1 kW, multiplying by six gives the monthly kilowatt-hours of production. The total energy output is 8.106 kWh per year, exactly the amount required by the house. The red line shows the monthly electricity use by the house in our example. Not surprisingly. A PV array that produces the right amount of energy over the whole year produces too much in the summer and too little in the winter. From Oct to Feb there is a total energy shortfall of 1.383 kWh, which means there is a 1.383 kWh surplus from Mar through Sept.
Source: IN THE DARK ON RENEWABLES. Rebutting Deloitte and Climate Reality – Insights for Investors, Policymakers and the Public, Friends of Science, November 2018

Energy Density and Variability

The Daily View - Example: Blackspring Ridge Wind Facility in S. Alberta, Canada

Blackspring Ridge Hourly Output (MWh) in September 2017



- 119MW: 166 wind turbines rated at 1.8 MW each
- Spread over an area of 194 km^2
- Production in 2017: 1.014 GWh of energy or about 5.2 GWh/km^2
- Orange line: one-week-moving-average

Energy density

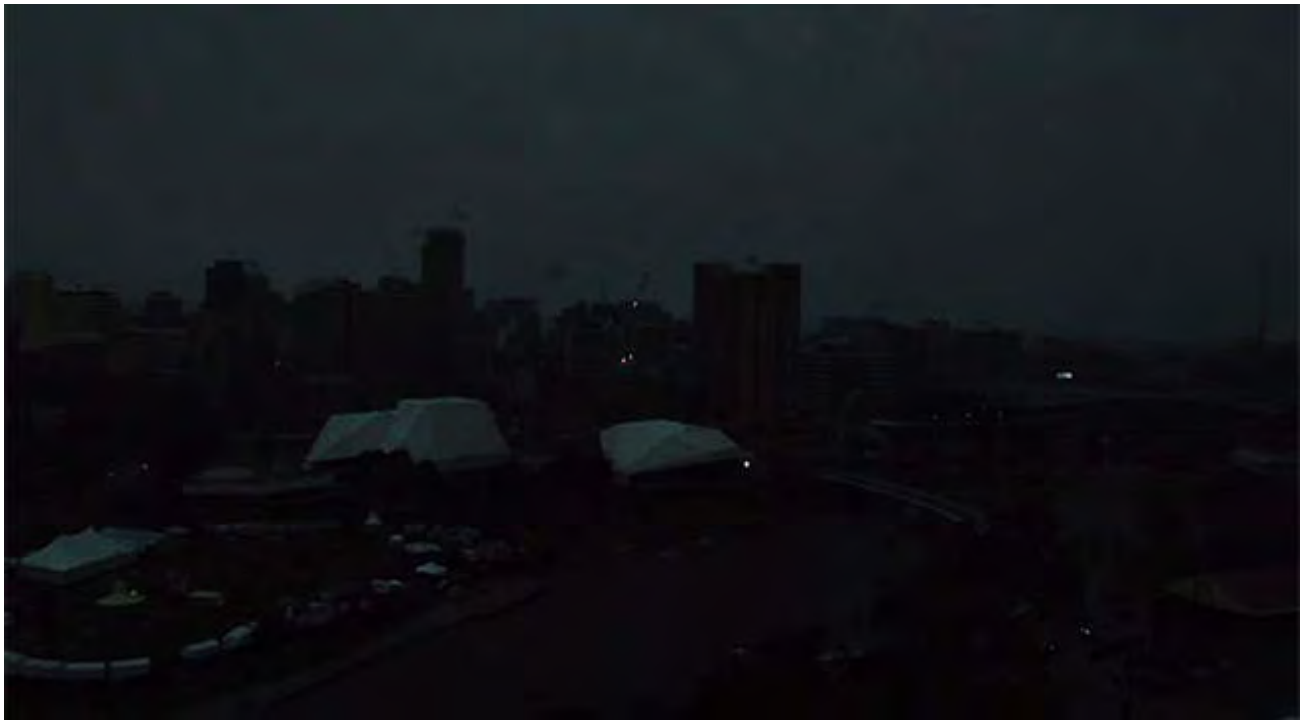
North America's 2017 primary energy consumption of 2.773 Mtoe would require 31.800 similar wind farms occupying 6,2 million km^2, or about three quarters of the contiguous United States.

Energy variability

Since the facility began operations in mid-2014, there were 98 hours in which its output increased by more than 150 MWh from one hour to the next, as well as 94 hours in which its output dropped by more than 150 MWh(1)

(1) The wind farm may produce the amount of energy consumed by the households, but it could only supply those homes in the way we normally think of "supply" if the home-owners don't mind using only the amount of electricity the wind can produce at any moment and are okay with sudden, dramatic increases or decreases in available power.
Source: IN THE DARK ON RENEWABLES. Rebutting Deloitte and Climate Reality – Insights for Investors, Policymakers and the Public, Friends of Science, November 2018

Adelaide, South Australia, September 2016 Blackout



Conclusion – on LCOE and Renewables

- ☑ Very short-term fluctuations today better managed than several years ago **but** wind and solar still only help with real-time balancing when the wind is blowing or the sun is shining – which is not the case.
- ☑ Concept of interconnecting regions not realistic as it falsely assumes that wind always blows somewhere(1)
  - Wind and solar energy can be complimentary but this is not always the case
- ☑ Wind and solar must be fully back-stopped by conventional generation which ***increases overall costs*** and ***reduces efficiency*** of conventional generation
- ☑ Consumers must pay capital costs of conventional generation regardless of how much energy they get from wind and solar
- ☑ **Capital investment in wind and solar facilities must be paid for solely by the fuel-cost savings on conventional generation in order for wind and solar to be truly economic**

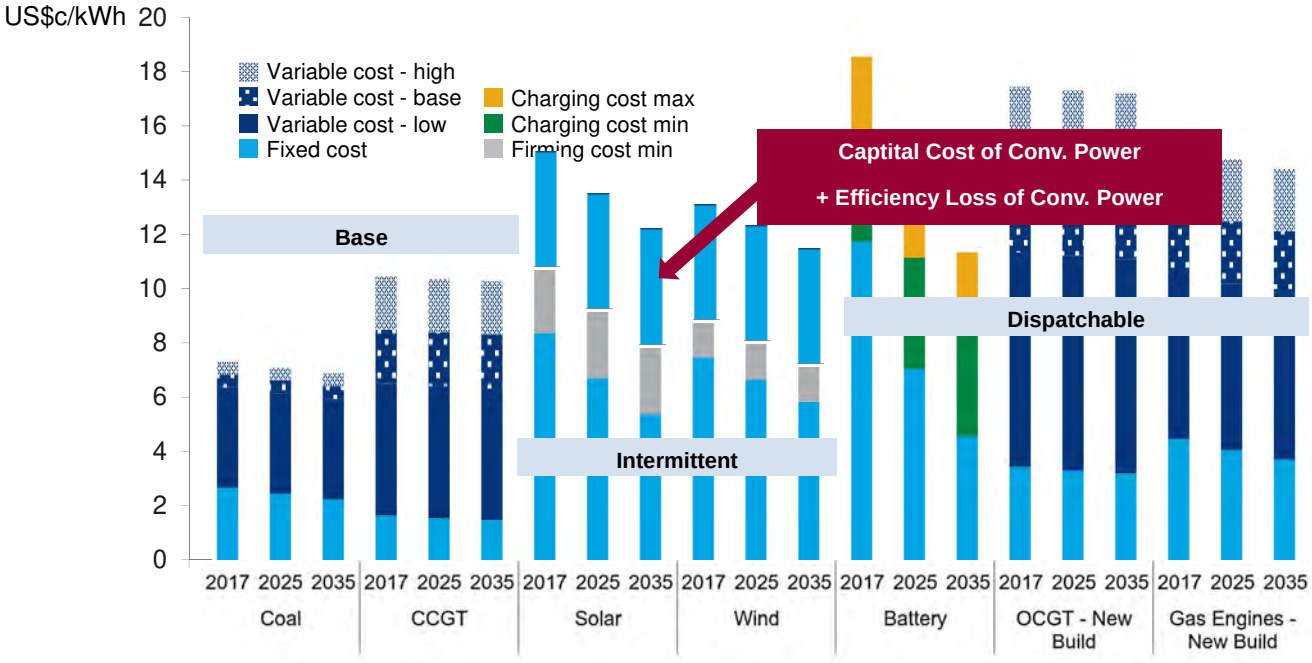
The claim that wind and solar are nearing price parity with conventional generation is wrong

(1) http://euanmearns.com/wind-blowing-nowhere/
Source: IN THE DARK ON RENEWABLES. Rebutting Deloitte and Climate Reality – Insights for Investors, Policymakers and the Public, Friends of Science, November 2018

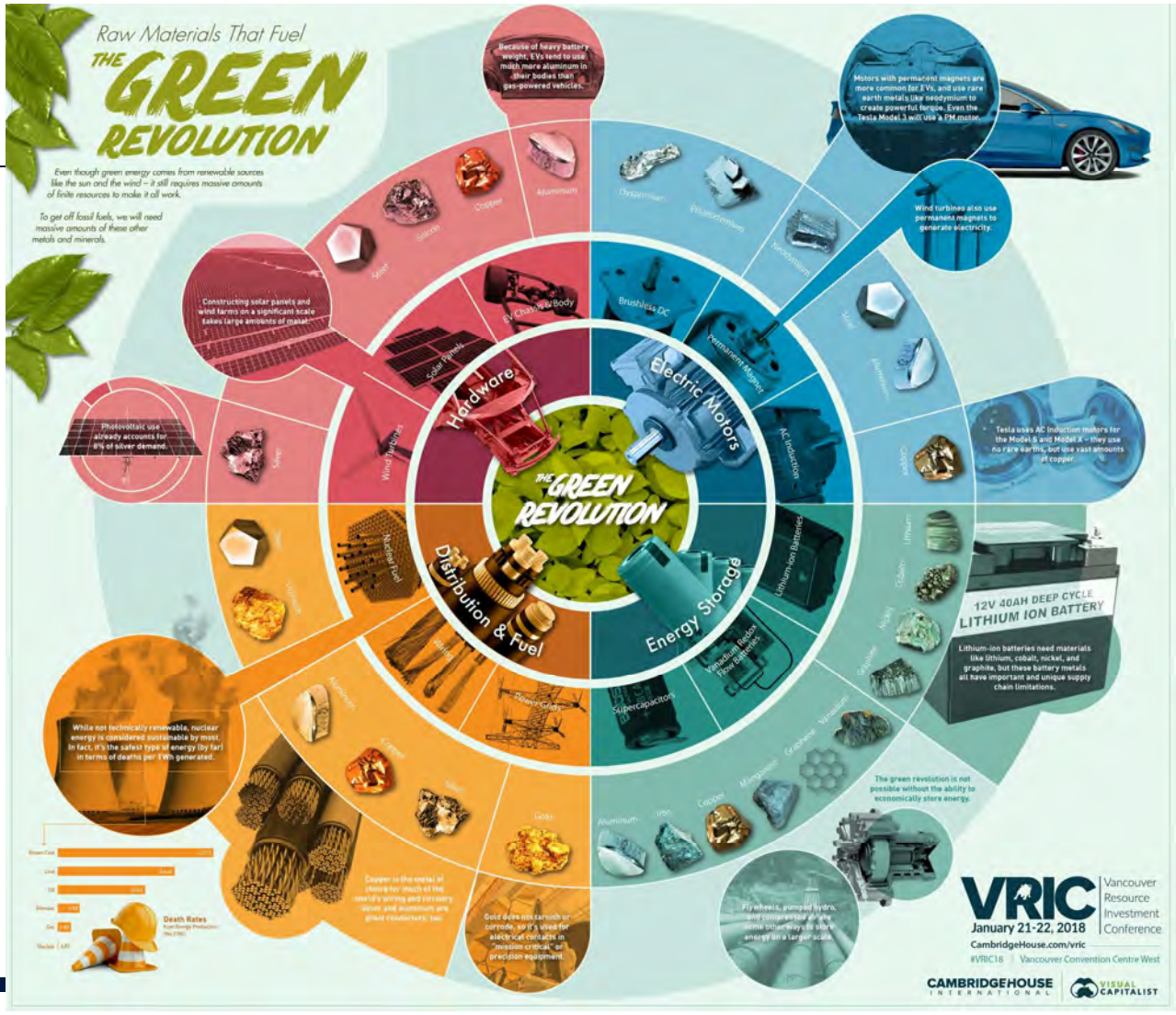
Understanding LCOE Is Crucial for New Builds

Batteries Will Be Able to Replace Gas at Peakload by 2035

Change in levelized cost of electricity (LCOE) based on SE Asia



Sources: Wood Mackenzie, GTM, MAKE



HMS Bergbau AG
coal illuminates life

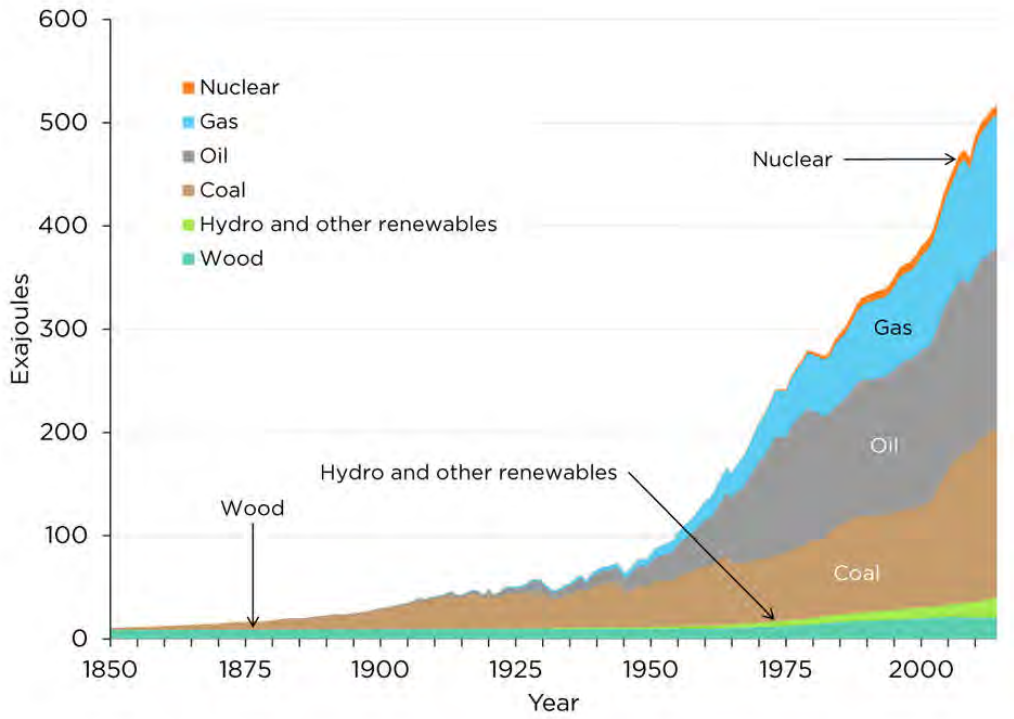
Coal Market

Fossils vs Renewables

Why Humans Warm the Planet

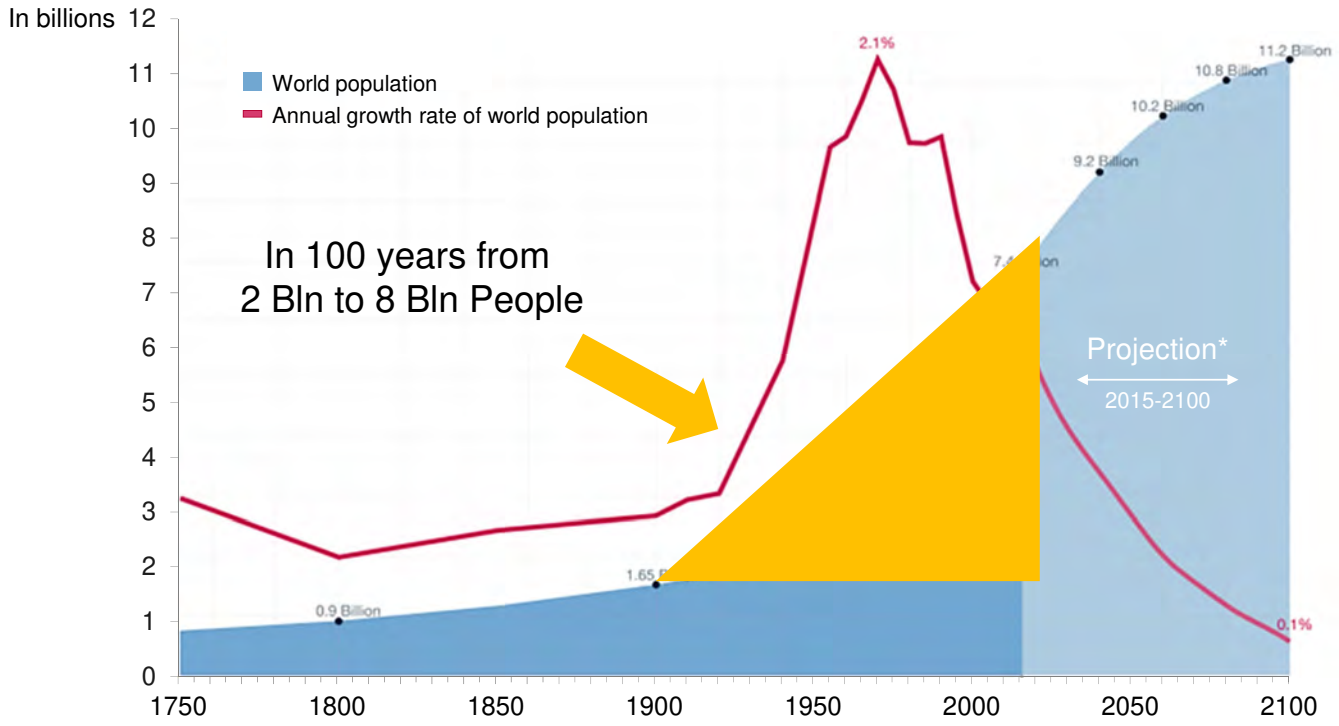
A Life Without Fossils is Decades Away…

… so it is time to embrace them and work with fossils, not against



Note: Primary electricity converted by direct equivalent method.
Source: Data compiled by J. David Hughes. Post-1965 data from BP, ***Statistical Review of World Energy*** (annual). Pre-1965 data from Arnulf Grubler, "Technology and Global Change: Data Appendix," (1998).

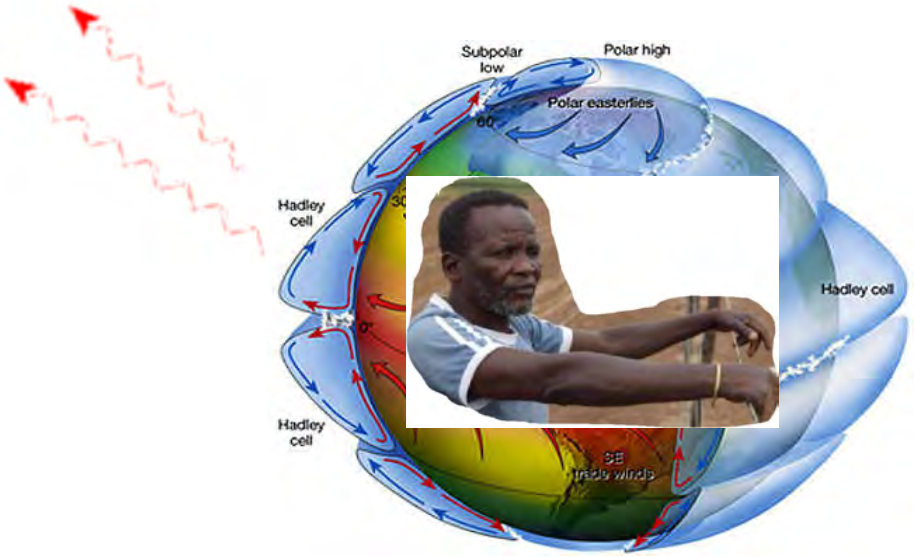
World Population Growth from 1750-2100



Sources: Data from 1750-2015 is taken from OurWorldInData.org series based on UN and HYDE. Projections for 2015-2100 are based on data from UN Population Division (2015) – UN Medium Fertility Variant.

All Produced and Consumed Energy Ends up in Heat

Space



Earth's Biosphere

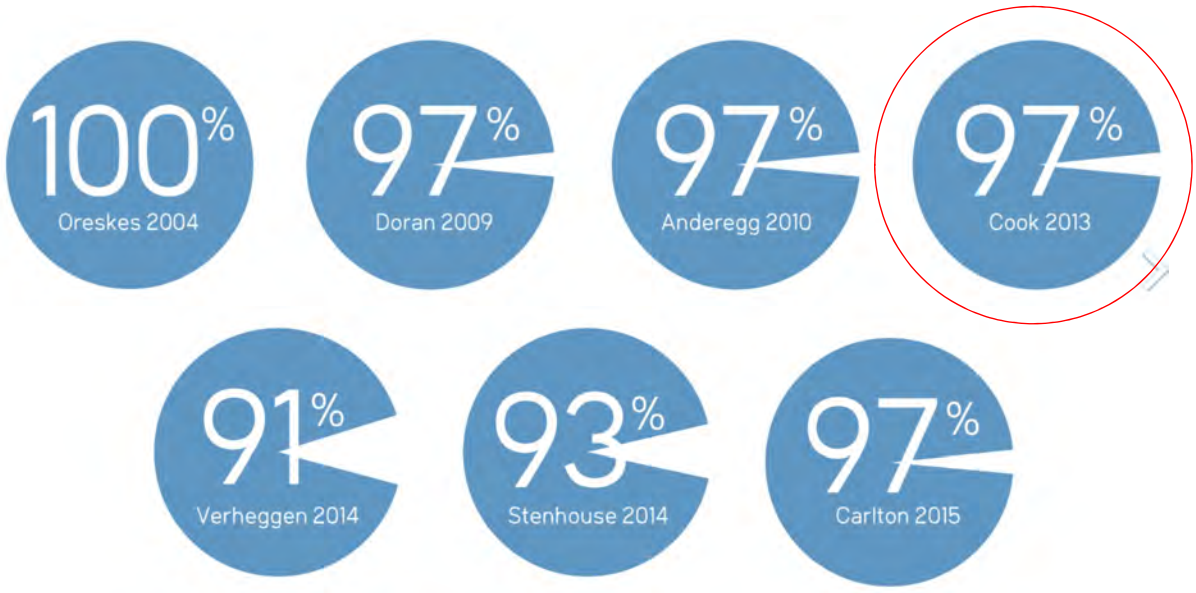
Atmosphere

Heat Island Effect (Cities)

Oceans

Melting Ice

Studies into Scientific Agreement on Human-Caused Global Warming

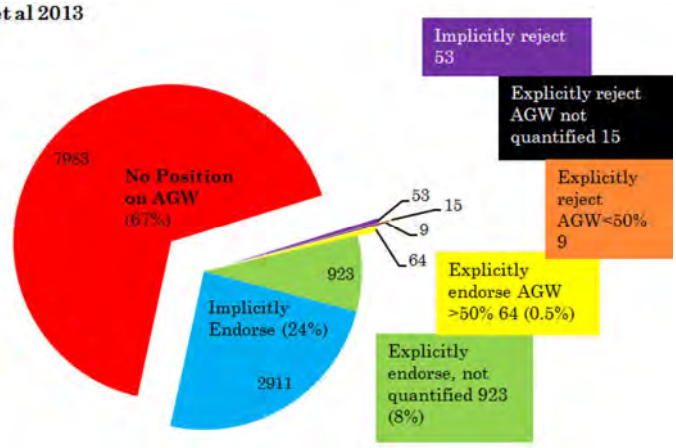


Example: Cook et.al. 2013

11.944 Abstracts Passively Reviewed

Position	% of all abstracts	% among abstracts with AGW position (%)
Endorse AGW	32.6% (3896)	97.1
No AGW position	66.4% (7930)	—
Reject AGW	0.7% (78)	1.9
Uncertain on AGW	0.3% (40)	1.0

Cook et al 2013



64 (0.5%) Explicitly Endorse that Humans (anthropogenic) contribute +50% to warming Earth

No mention of fossil CO_2!!

I, Lars Schernikau (PhD in Coal), am part of the 97% group!

Source: Schernikau Analysis based on Cook et al 2013; Friends of Science "The Science of Statistculation. No Consensus" February 2014

There is limited evidence of changes in extremes associated with other climate variables since the mid-20th century.

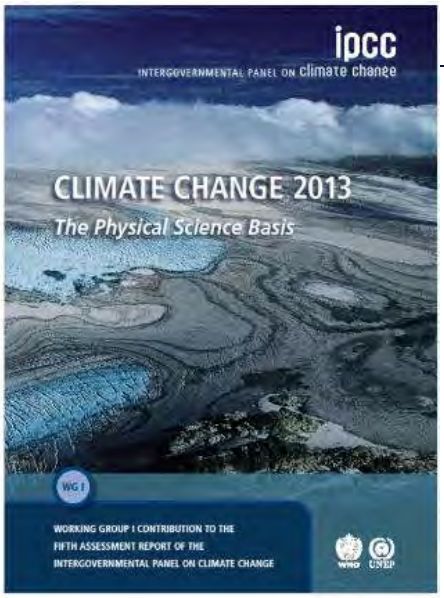
(IPCC Climate Change 2013 pdf page 235)

Recent analyses of changes in severe local weather (tornadoes, thunder days, lightning and hail) in a few selected regions provide no compelling evidence for widespread systematic long-term changes.

(IPCC Climate Change 2001 pdf page 163)

Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences

(IPCC Climate Change 2014 pdf page 7)



No robust trends in annual numbers of tropical storms, hurricanes and major hurricanes counts have been identified over the past 100 years in the North Atlantic basin.

(IPCC Climate Change 2013 pdf page 232)

In summary, *confidence* in large scale changes in the intensity of extreme extratropical cyclones since 1900 is *low*.

Likewise, *confidence* in trends in extreme winds is *low*, owing to quality and consistency issues with analysed data.

(IPCC Climate Change 2013 pdf page 236)

There continues to be a lack of evidence and thus *low confidence* regarding the sign of trend in the magnitude and/or frequency of floods on a global scale over the instrumental record.

(IPCC Climate Change 2013 pdf page 128)

IPPC Comment About Historical Glaciers

IPCC Kommentar zur früheren Ausdehnung der Gletscher weltweit, IPCC AR 5

"There is high confidence that glaciers at times have been smaller than at the end of the 20th century in the Alps (Joerin et al., 2008; Ivy-Ochs et al., 2009; Goehring et al., 2011), Scandinavia (Nesje et al., 2011), Altai in Central Asia (Agatova et al., 2012), Baffin Island (Miller et al., 2005), Greenland (Larsen et al., 2011; Young et al., 2011), Spitsbergen (Humlum et al., 2005), but the precise glacier extent in the previous warm periods of the Holocene is often difficult to assess.

Sources: Prof Riedle, Prof Emiratus University of Erlangen, IPCC AR5

Tens of Thousands of Scientists Actively Sign to withdraw from Paris Agreement

Enclosed is a twelve-page review of information on the subject of "global warming," a petition in the form of a reply card, and a return envelope. Please consider these materials carefully.

The United States is very close to adopting an international agreement that would ration technologies that depend upon coal some other organic compounds.

This treaty is, in our opinion, bas search data on climate change do nc hydrocarbons is harmful. To the co dence that increased atmospheric c mentally helpful.

The proposed agreement would upon the technology of nations thr cially those that are currently attem and provide opportunities to the ove nologically underdeveloped countrie

It is especially important for An zens who have the training necessar data and offer sound advice.

We urge you to sign and return If you would like more cards for use will be sent.

Frederick Seitz

Frederick Seitz
Past President, National Academy of Sciences, U.S.A.
President Emeritus, Rockefeller University

NEWS 10 MAR, 2017

Petition to withdraw from United Nations Framework Convention on Climate Change (UNFCCC)

Dr. Richard S. Lindzen, Professor Emeritus at MIT and a Member of National Academy of Sciences, has announced a petition to the American and to international governments to change course on an outdated international agreement that underlies a number of regulations on minor greenhouse gases: primarily Carbon Dioxide, CO2.

List of Signers By Name

Click on a letter below see a list of signatories, or click here to see them all.

J V W X Y Z

US

, Wilbur A. Aanes, M. Robert Aaron, Ralph F. Abbott, PhD, David J. Abbott, MD, David M. ott, Paul Abbott, Ursula K.

Kyoto, Japan
uld harm the
f mankind.

r greenhouse
gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.

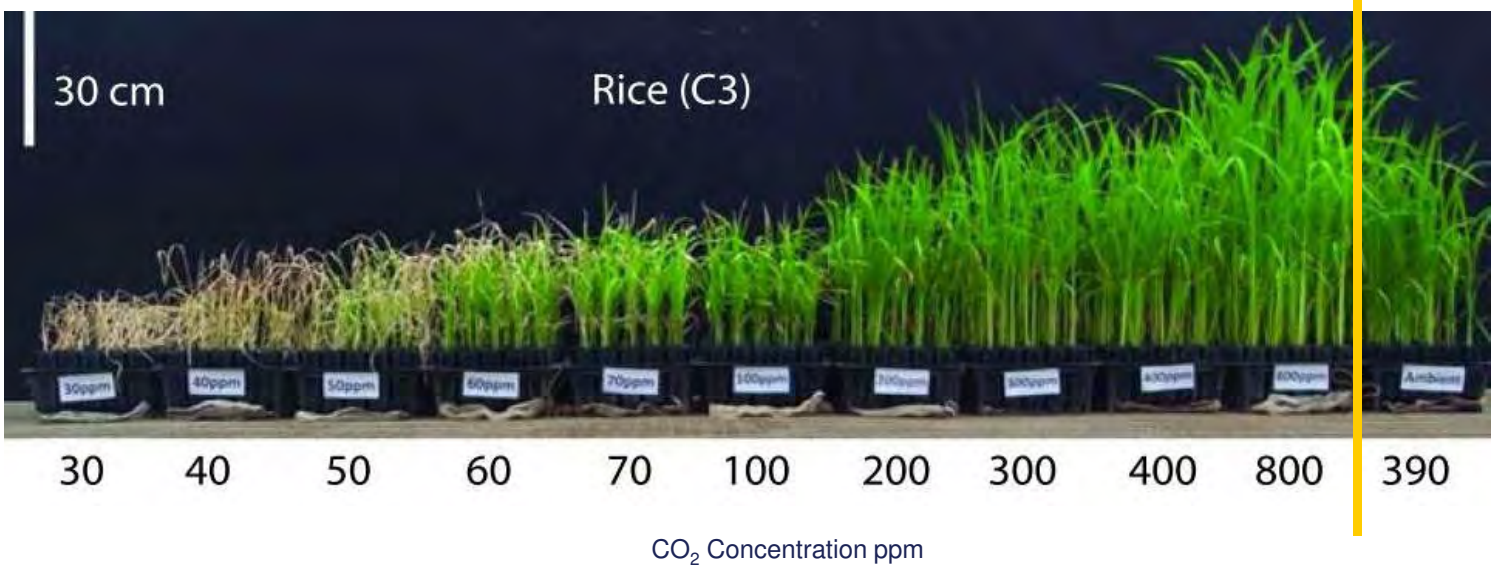
Please sign here

☒ Please send more petition cards for me to distribute.

My academic degree is B.S. ☐ M.S. ☐ Ph.D. ☒ in the field of PHYSICS

Here is What Happens with More CO_2

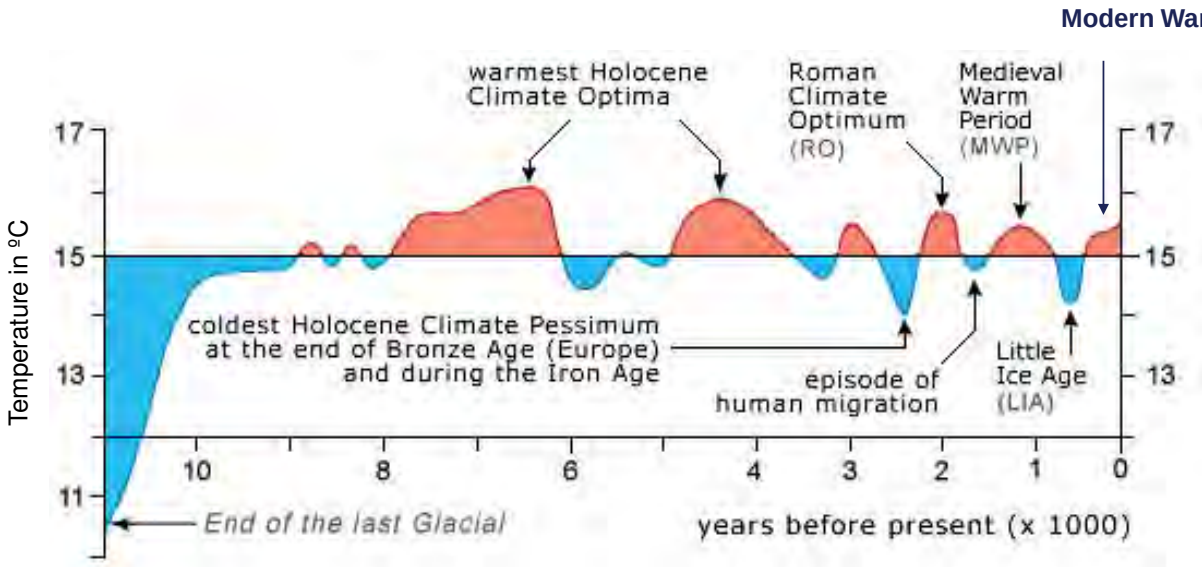
Impact of CO_2 on Rice



CO_2 Concentration ppm

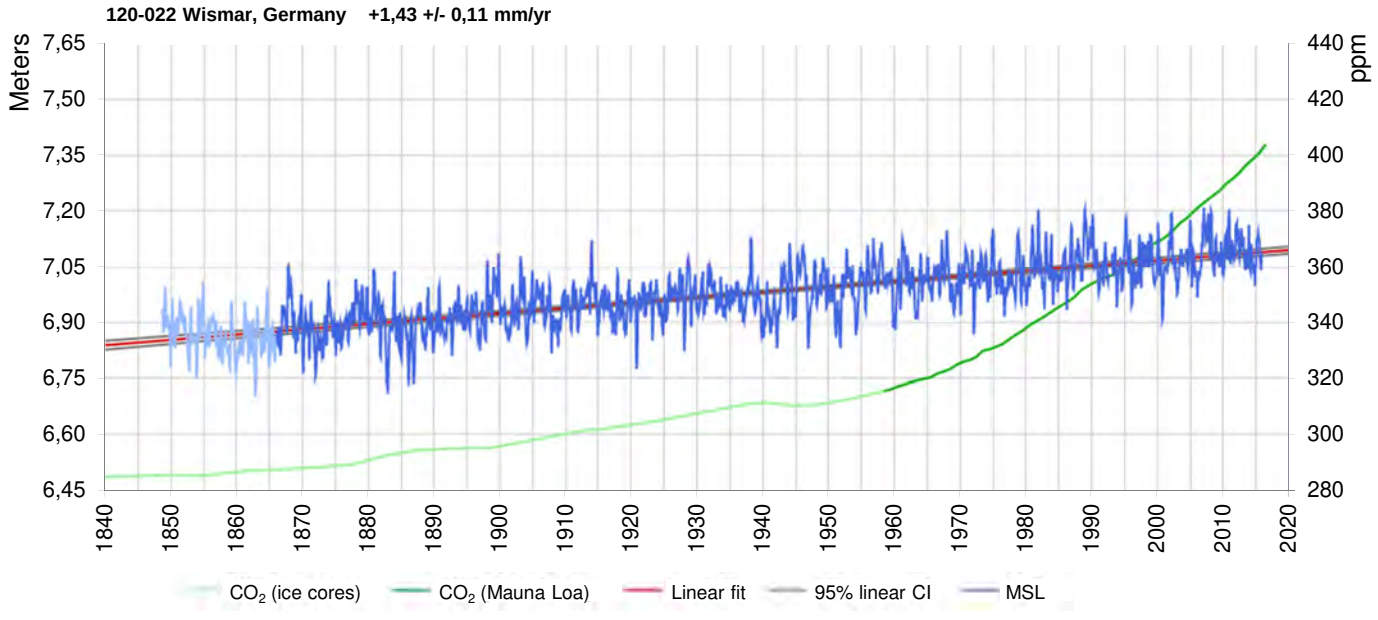
*
Sources: von Caemmerer S, Quick WP, and Furbank RT (2012)

Average Near Surface Temperatures of Northern Hemisphere during past 11.000 years



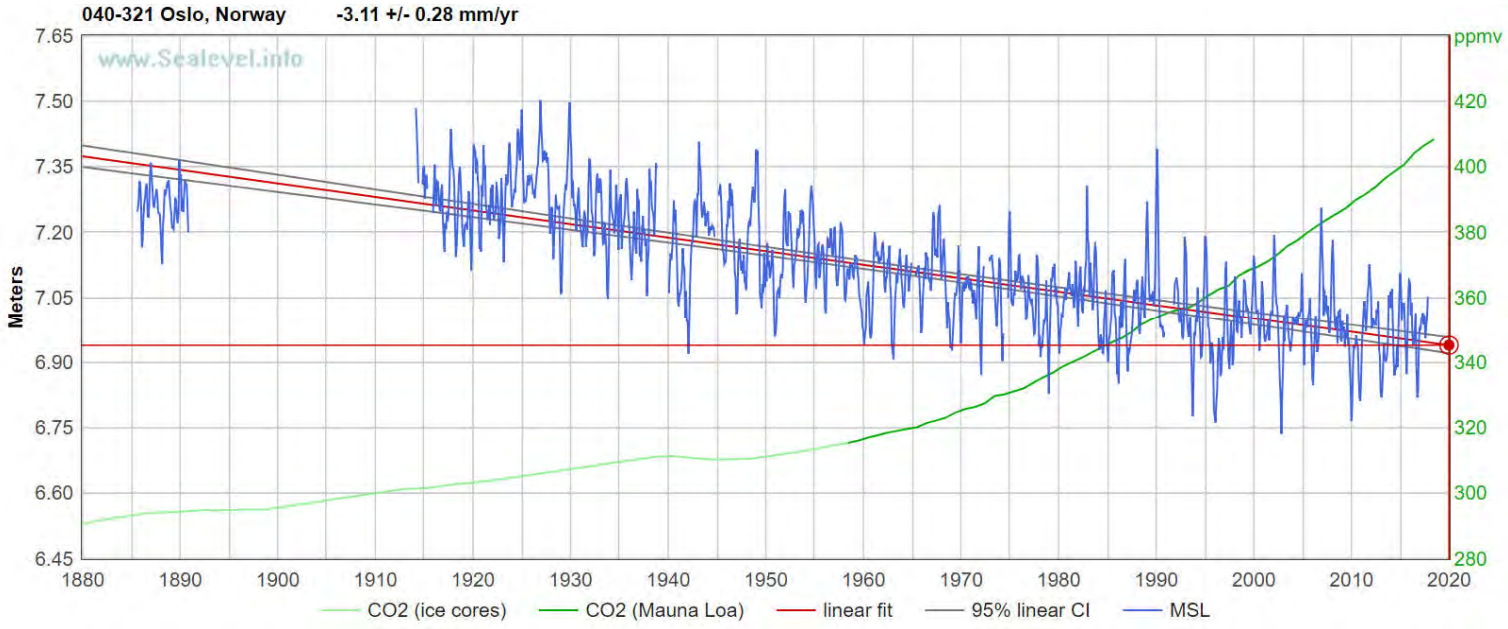
Note: Modified after Dansgaard & Johnson (1969) and Schönwiese (1995)

Germany, Wismar Sea-Level Data 1848-2017



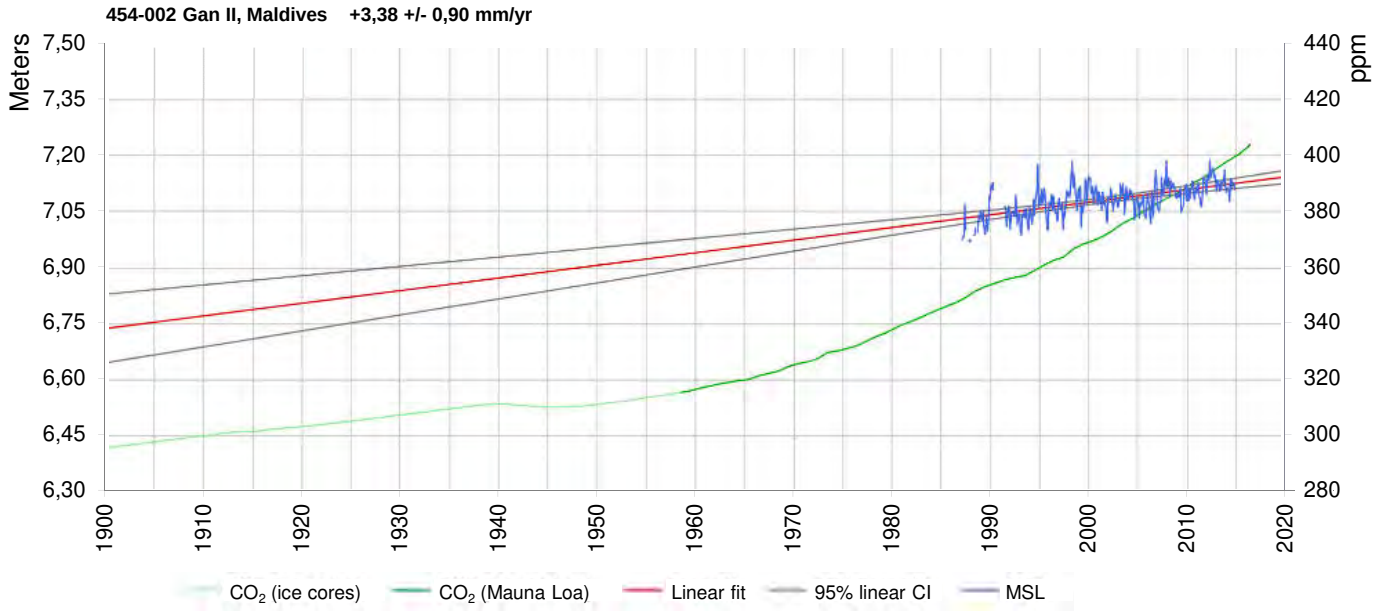
Sources: www.sealevel.info, based on PSMSL, NOAA, Expert Reviewer of IPCC Mr. David Burton

Mean Sea Level at Oslo, Norway (1914 to 2017)



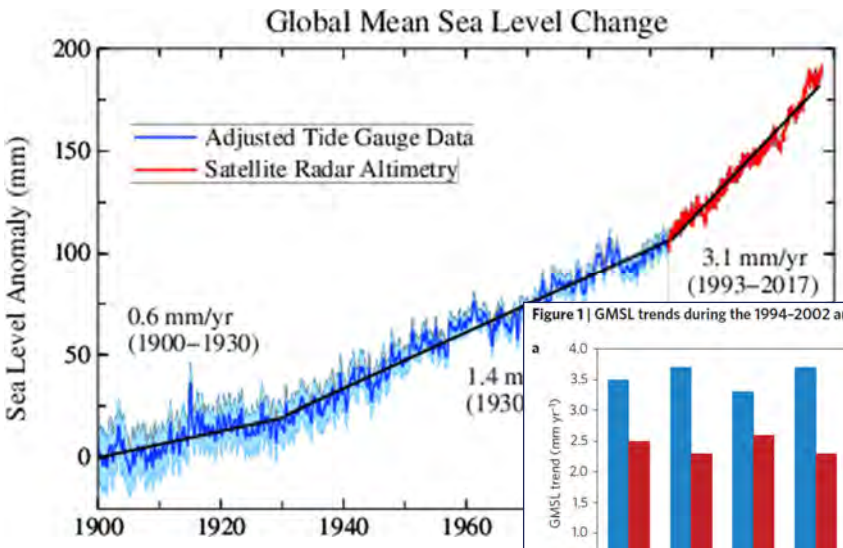
Note: The mean sea level (MSL) trend at Oslo, Norway is -3.11 mm/year with a 95% confidence interval of ±0.28 mm/year, based on monthly mean sea level data from 1885/7 to 2017/12. That is equivalent to a change of -1.02 feet in 100 years. (R-squared = 0.445). The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. By default, the long-term linear trend is also shown, in red, along with its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by NOAA CO-OPS.
Sources: www.sealevel.info, based on PSMSL, NOAA, Expert Reviewer of IPCC Mr. David Burton

Maldives Sea-Level Data 1986-2015

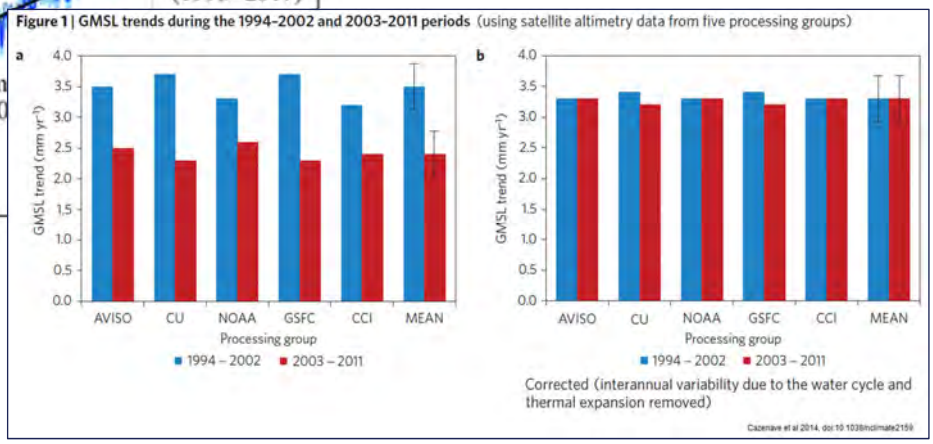


Sources: www.sealevel.info, based on PSMSL, NOAA, Expert Reviewer of IPCC Mr. David Burton

Claimed„Acceleration“ Stems from Changing from Tide Gauge to Satellite



- Satellite measurement are NOT accelerating
- Satellite less reliable than Tide Gauges
- Satellite data is ***“adjusted” upward assuming ocean floor didn’t sink*** 0.3mm/yr (GIA adjustment)
- Satellite data actually showed deceleration, which was corrected to match



Sources: Schernikau analysis based on https://www.sealevel.info/resources.html#satellite, Expert Reviewer of IPCC Mr. David Burton, https://stevengoddard.wordpress.com/2010/11/29/ipcc-sea-level-nature-trick/ and https://www.nature.com/articles/nclimate2159

In Summary

In 150 years, we don’t need fossils anymore
(put things into perspective)

CO_2 is a building block of life, not a pollutant,
it greens our planet

We need investment in Batteries and Conventional Power

Current Renewables not the Solution, but Long-term, Yes

Money is needed for real environmental problems
(Waste and pollution)

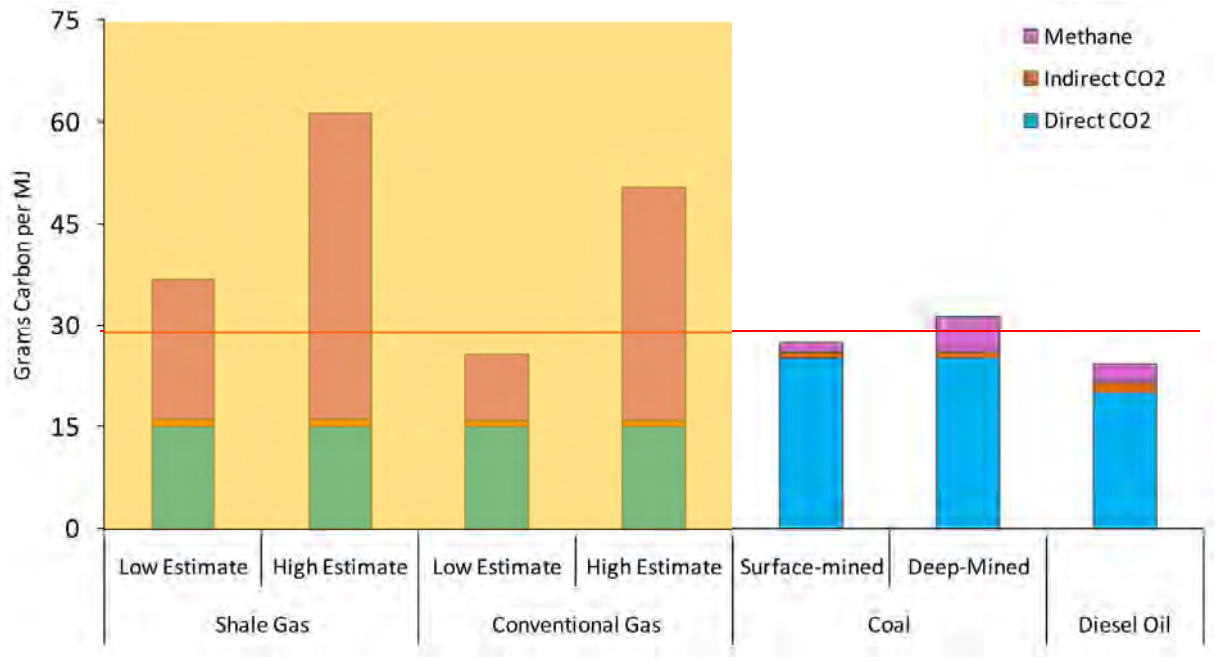
The Power Industry Needs to start this Discussion and not Avoid It!

Thank You

Unused

Gas‘ Total „greenhouse gas“ Emissions Mostly Higher than Coal

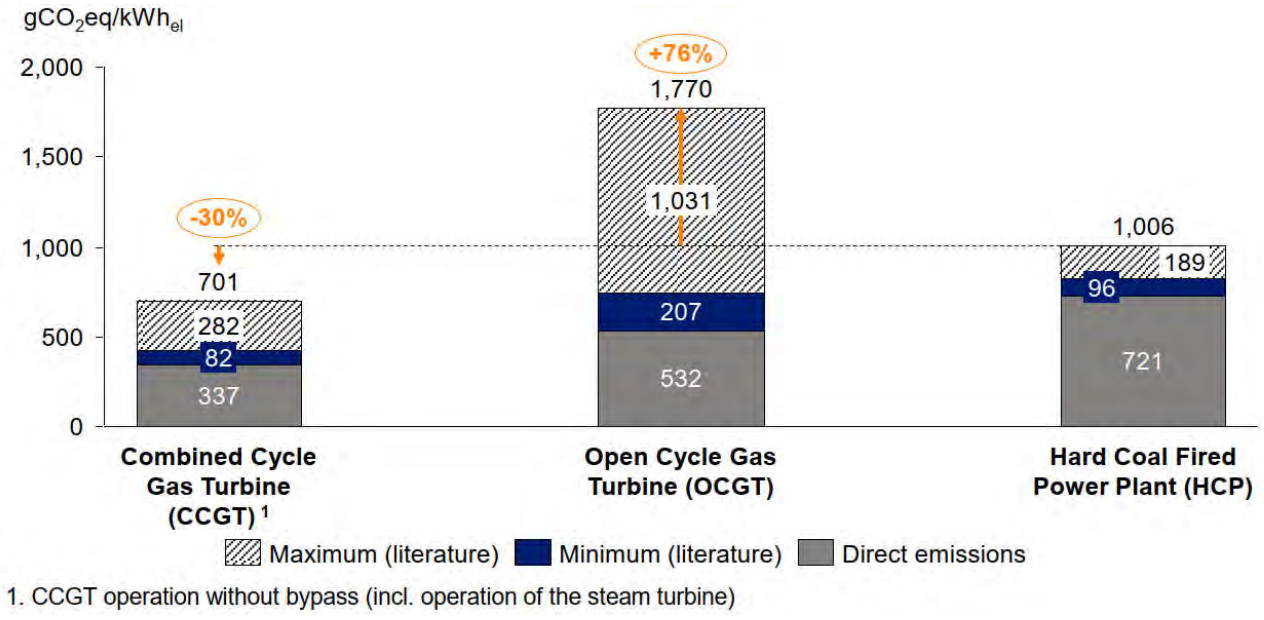
20 year horizon



Note: Estimates include direct emissions of CO2 during combustion (blue bars), indirect emissions of CO2 necessary to develop and use the energy source (red bars), and fugitive emissions of methane, converted to equivalent value of CO2 as described in the text (pink bars). Emissions are normalized to the quantity of energy released at the time of combustion. The conversion of methane to CO2 equivalents is based on global warming potentials from Shindell et al. (2009) that include both direct and indirect influences of methane on aerosols. Mean values from Shindell et al. (2009) are used here. Shindell et al. (2009) present an uncertainty in these mean values of plus or minus 23%, which is not included in this figure

Source: Howarth, Santoro, Ingraffea published in Climatic Change (2011) 106:679–690

Coal vs. Gas - Direct Emissions during Partial Load Operation

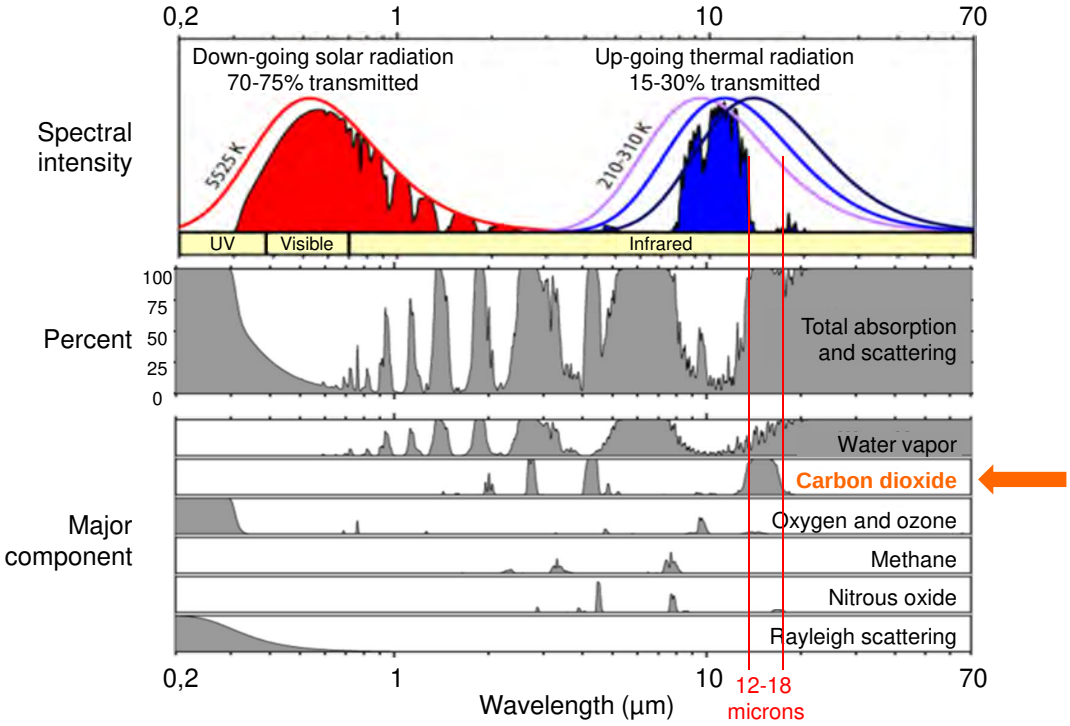


1. CCGT operation without bypass (incl. operation of the steam turbine)

Source: Poyry 2016; German Study on “COMPARISON OF GREENHOUSE GAS EMISSIONS FROM COAL FIRED AND GAS FIRED POWER PLANTS”

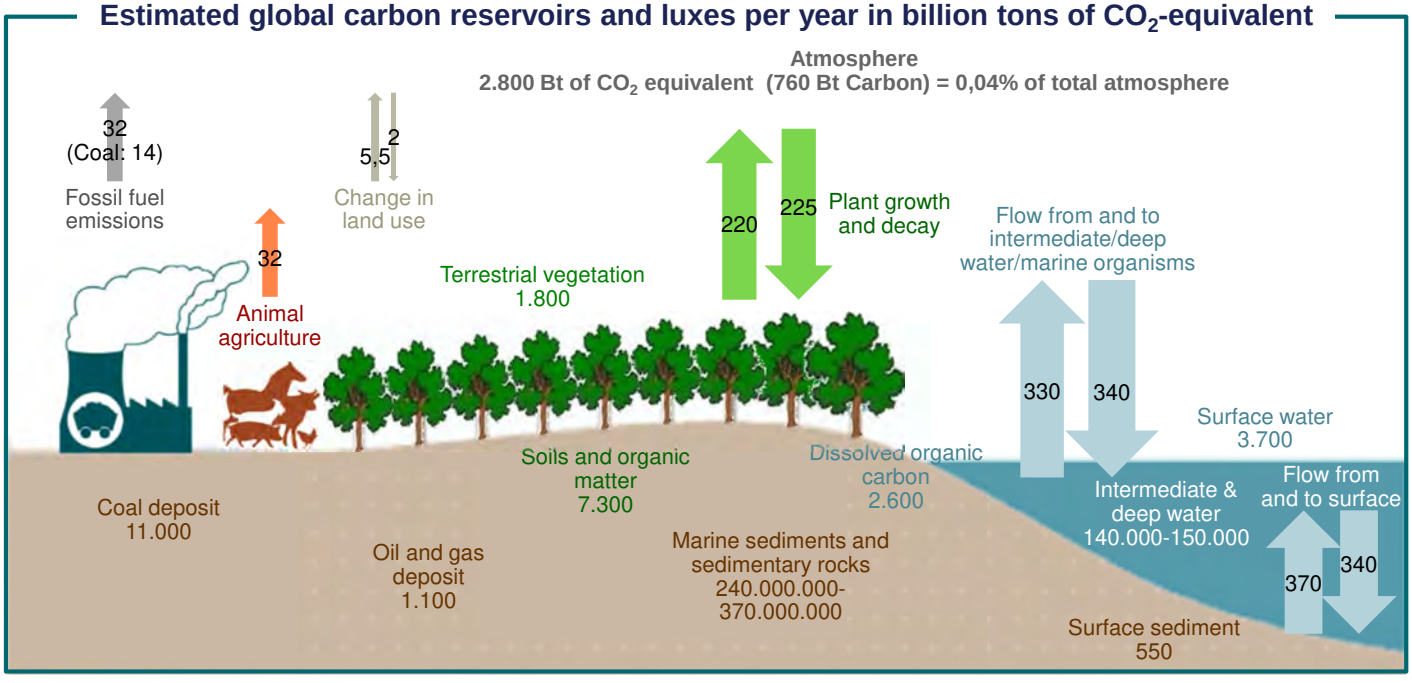
Additional CO_2 Will Not Add Significant Energy to Atmosphere

The Absorption Potential Is Principally Exhausted



Note: This Illustrates „only" the radiation emitted from the surface of planet earth and does not consider the radiation emitted from particles within the atmosphere
Source: Prof W Happer, Princeton based on https://en.wikipedia.org/wiki/File:Atmospheric_Transmission.png

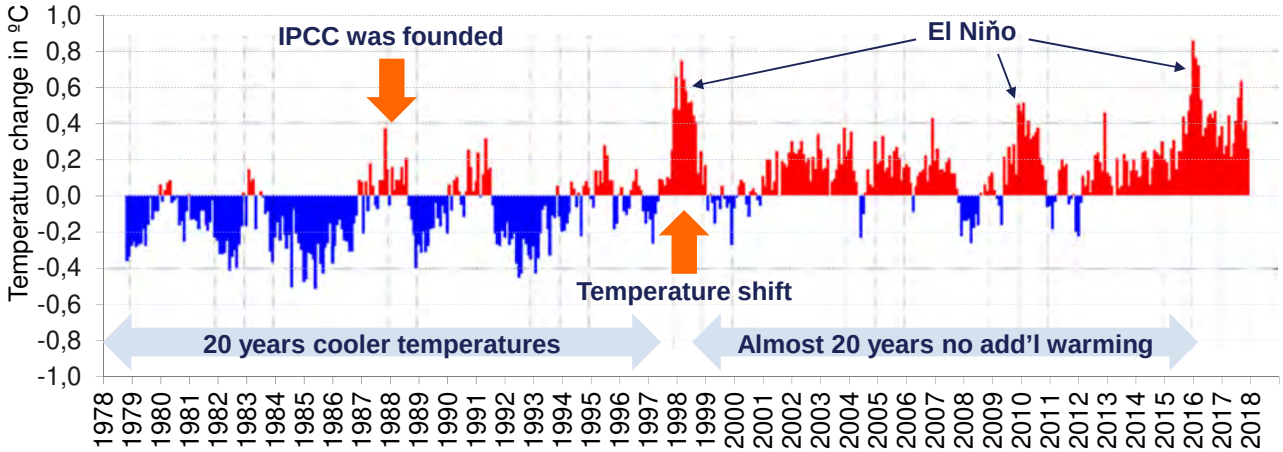
IPCC's Global Carbon Cycle in CO_2-Equivalent



Note 1: Values are in billion tons or giga tons (Gt) of CO_2 (not carbon, conversion done by author), 1 kg C = 3,67 kg CO_2
Note 2: man-made CO2 emissions based on estimates from 2010 to 2012, all other based on estimates from 1989 to 1998
Source: Schernikau analysis based on various research, man-made CO_2 emissions from IEA CO_2 2014 and Cowspiracy 2015, and other numbers from IPCC AR4 and IPCC 2007 and IPCC Special Report LU, LUC&F 2000; i334

Global Temperature Data (1978-2018)

Global temperatures between 1978-2018



Note: Downloaded directly from University website, January 2018; CO_2 concentration continuously increased from about 330 ppm in 1978 to over 400 ppm in 2018, without any noteworthy interruption
Source: University of Alabama in Huntsville; i331