

My dear friends and colleagues,

As a member of our risk strategy department, in the algorithmic trading model review team, I am writing to you because it is increasingly apparent that **we are facing devastating risks in the coming years, without any adequate mitigation or anticipation by the whole financial sector, and therefore our modern industries.**

« After reviewing their computer simulations, the research team came to the following conclusions:

- Given business as usual, i.e., no changes to historical growth trends, the limits to growth on earth would become evident by 2072, leading to "sudden and uncontrollable decline in both population and industrial capacity".
- Growth trends existing could be altered so that sustainable ecological and economic stability could be achieved.
- The sooner the world's people start striving for the second outcome above, the better the chance of achieving it. »

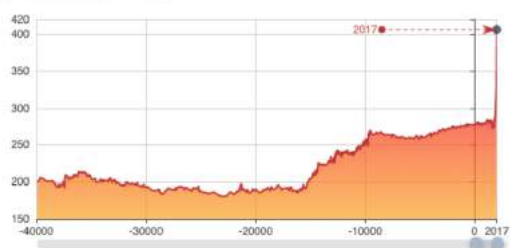
Climate change, its destructive impact on our societies and environment, has been described and detailed for decades. The quote above, warning us on an imminent collapse of our industrial civilisation by the 21st century due to pollution, resource shortage and surpopulation, comes from MIT conclusions solicited by the Club of Rome and published in 1972 [1].

50 years later, this intuition they had, formulated and experienced with the best available knowledge – like any science work is full of controllable doubts they cautiously warned about - has been confirmed and extensively detailed by the international scientific community, sometimes with an excessive conservativeness [49][50].

In their latest report (November 2018), IPCC states that « Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2050 if it continues to increase at the current rate. (high confidence). » Global warming is mainly due to emissions of greenhouse gases in the modern industrial economy [2][3]. As a consequence, Earth's glaciers have melted faster than ever before, playing a major role in raising global average sea levels by 10-20 centimeters in the past hundred years [9]. Europe's biodiversity continues to be eroded resulting in ecosystem degradation: 60% of species assessments and 77% of habitat assessments continue to be in unfavorable conservation status, and a third of humanity is affected by desertification [4]. The Holocene extinction, otherwise referred to as the sixth mass extinction or Anthropocene extinction, is a current event, and is one of the most significant extinction events in the history of the Earth.

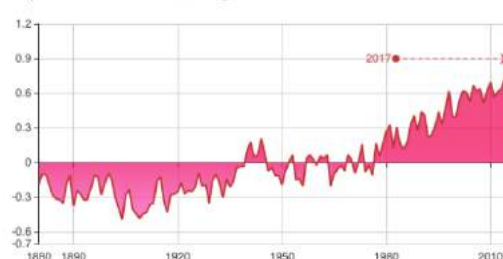
Here are the causes and consequences, from left to right: a world your children and I will live in for most of our lives.

Atmospheric CO2 concentration in the last 40 000 to 800 000 years
in ppm (particles per million)



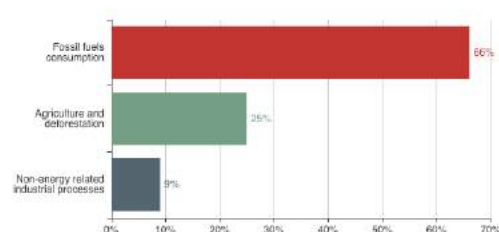
Source: National Oceanic and Atmospheric Administration (NOAA) Ice Core records (data) before 1959 and Mauna Loa records (data) after 1959.

Temperature anomalies
°C compared to 1951-1980 average



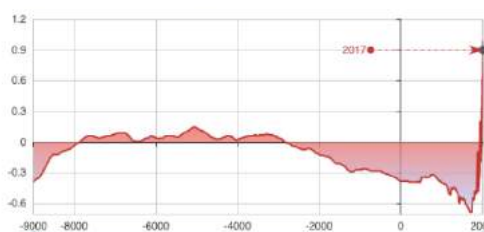
Source: NASA's Goddard Institute for Space Studies (GISS) (data)

Man-made greenhouse gas emissions in 2010
% of total



Source: Accenture Energy Perspectives – Consequences of COP21 for the Oil and Gas Industry, Fig. 12 p14. A fascinating Sankey diagram shows this in much more details [here](#).

Temperature anomalies in the last 11 000 years
°C compared to 1951-1980 average



Source: A Reconstruction of Regional and Global Temperature for the Past 11,300 Years (data) before 1880, NASA's Goddard Institute for Space Studies (GISS) (data) after 1880.

Among others, the most worrying thing is not so much the change itself, but rather **the speed at which this change is taking place**. Historically, a change of 1°C seems to happen in thousands of years - not decades. The Earth is a complex ecosystem, and such disturbance over few decades only will irreversibly make its living conditions impossible, for us.

Today, the risks coming from these several, detailed and indisputable dangers, are largely underestimated, if not overshadowed by our industry, its numerical infrastructure and the academic literature surrounding it [18][28]. Notably since the 2015 Paris Climate Agreement, sustainable finance efforts have been made, both from the private and intergovernmental sectors. Dedicated institutions and extensive reports have been created to inform, suggest solutions to the financial industry, while trying to make a low-carbon economy financially attractive [18][19][67]. Unfortunately these reports and initiatives never investigate the consequences of a drastically limited global carbon budget aligned with a 2°C world [54], or the price equivalent of low-carbon energy on economic growth and long term valuation of green bonds, mainly due to the missing literature and lack of industry-wide cooperation [2][18a][28][48].

None of the answers we collectively addressed since 2015 ever questions the assumption of growth and its limits, especially in fossil fuels dependent societies like ours. Years after the long awaited creations of such green initiatives, why the governors of the Bank of England and Banque de France would they still have to warn us, in **April 2019 : « the global financial system faces an existential threat from climate change and must take urgent steps to reform [...] must be at the heart of tackling climate change [...] has to raise the bar to avoid catastrophe»**? [20][21][22] Supervisors recently urged us to incorporate climate change into our governance and risk management analysis [40], as lately reaffirmed by William Nordhaus, co-laureate of the 2018 Nobel Prize in Economic Sciences « *for integrating climate-change into long-run macroeconomics analysis* » [51], which is a conceptual revolution in regards of shorter-run financial incentives. Years after the appropriate Task Force on Climate-related Financial Disclosures (TCFD) suggested the banks to track their investments' carbon footprints to better address the methodical reduction of Greenhouse Gases (GHG) emissions, nothing has been done to constrain our conflictual growth appetites.

The previous risks have been known for a long time but despite recent promising steps, we still refuse to take our personal responsibilities and collectively question our *raison d'être*.

Despite a permanent media coverage on this ecological crisis we are now used to feel comfortable with, let's share the same basis of relevant knowledge for a common reflexion on the evolution of banking, science and technology in the 21st century.

This report will first present worldwide sources of energy characteristics, and how their consumption relates to our economic growth, in the context of global warming. Then we'll review the economic and scientific consequences of growth in the Anthropocene, including the institutional solutions² conducted so far to fight climate change and meet Paris Agreement. As it can be already anticipated, these volunteer-based solutions have already been proven insufficient to meet intermediary targets, as they do not fall in any constraining framework against selfish behaviors. Consequently, **the latest IPCC recommendations regarding financial, and consubstantial technological, evolutions will be stressed and organized in progressive steps of feasibility to be urgently implemented**. Finally, the current ambitions envisaged by world leading tech giants in the data revolution will be confronted to climate change priorities and necessary cooperation they committed to in 2015, then reiterated after US withdrawal. An essential neuropsychological, and perhaps philosophical perspective ends the report.

² Starting with the banking sector, illustrated by HSBC as a recognized world leader in Sustainable Finance and Green bond issuance, then the regulators, supervisors and central banks' initiatives led since the Paris Agreements. On a side note, we'll recall the shared responsibilities and commitments undertaken by the world leading scientific and technological institutions to collaboratively tackle climate change in the context of an ongoing data revolution.

EXECUTIVE SUMMARY

- Since the Industrial Revolution, human activities have caused a global warming which is likely to reach 1.5°C between 2030 and 2052, if it continues to increase at the current rate. Around 70% of GHGs causing global warming come from burning fossil fuels for energy: oil, coal and natural gas; representing 85% of energy consumed for use in homes, services, industry and transport.
- There is a perfect linear relationship between economic growth and energy consumption, essentially fossil fuels. This strong relationship holds across continents and past decades – remarkably consistent for Asia Pacific regions over the past 20 years. **Decoupling** economic growth from environmental pressure has never been achievable, regardless the recent efforts in renewable energies: globally +2% have been added, not substituted, to fossil fuels, their Energy Return On Energy Invested (EROEI) or full carbon footprints for construction and maintenance are not measured. The relative research is unanimously considered as « unexplored ».
- Given the current state of art on decoupling on the one hand, and the drastic reduction of fossil fuels burning required to meet the Paris Agreements on the other hand, the international scientific community has designed drastic global emissions pathways, as well as several sets of recommendations to collectively follow for the years to come.
- These is only one target to systematically put at the heart of our innovations: **human activities must be carbon-neutral by 2050**, which is absolutely certain to affect global economic growth, then our purpose as we always conceived it. Intermediary target to maximize our chances for 1.5°C consists in 40 - 50% cut in global emissions by 2030. Consequently, we have to leave around two-thirds of known reserves of fossil fuels in the ground to meet our global climate targets, corresponding to less than twenty years of consumption at current rates.
- We, as HSBC, and more broadly one of the 29 systematically important banks, should all be perfectly knowledgeable about the major findings from IPCC, adopt a cooperative mindset towards central banks, supervisors, and regulators' recommendations, and massively contribute to the technological innovation needed to sustain life in a 2°C world.
- More than geological hard evidences, IPCC's 2014 assessment report already argued: « **Effective climate change mitigation will not be achieved if each agent (individual, institution or country) acts independently in its own selfish interest** (see [International cooperation](#) and [Emissions trading](#)), **suggesting the need for collective action** [...] *financing such adaptive activities remains an issue, particularly for poor individuals and countries.*» In November 2018, they renewed this essential behavioral change to facilitate actions and responses consistent with limiting global warming to 1.5°C will require: « **International cooperation [and] partnerships involving non-state public and private actors, institutional investors, the banking system, civil society and scientific institutions (very high confidence).** » This concept is opposed to the dominant financial and corporate culture of free and undistorted competition.
- Voluntary guidelines established so far by a few financial institutions, supervisors and central banks: ICMA Green Bond Principles (2015), the Task Force on Climate-related Financial Disclosure (TCFD) recommendations (2017), the Network for Greening the Financial System (NGFS)'s recent « Call for Action » (2019); respectively (1) highlight a critical knowledge gap to insure positive social and environmental returns of green bonds, (2) stress the growing need for systemic and widespread disclosure across sectors of their climate-related risks, mainly full carbon footprint, and (3) encourage central banks, supervisors, financial institutions to build in-house capacity and to collaborate within their institutions, with each other and with wider stakeholders to improve their understanding of how climate-related factors translate into financial risks.
- None of the previous ever wondered how to « drastically » incentivize 1.5°C policies and sanction strategies violating this constraint, in a fully cooperative framework; or ever mentioned how deeply global economic growth and banking will be affected in a carbon neutral world by 2050. Deliberately or unconsciously, our actions are not consistent with the promises we made, repetitively signed and acknowledged, to preserve at our best the next generation from an irreversible « tragedy of horizon » to quote Mark Carney.
- 3 gradual sets of actions, directly inspired by the IPCC, TCFD, and NGFS recommendations, will also be rephrased and presented contextually. They consist in 3 verbs : **TEACH** massively – **RESEARCH** abundantly – **ACT** courageously.

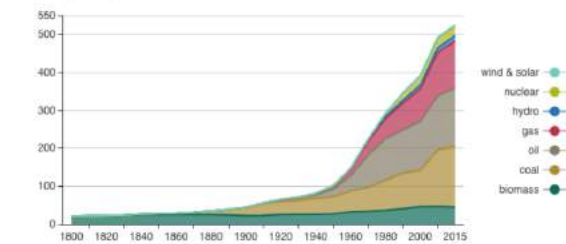
I. ENERGY & GROWTH

- What is energy ? The property that must be transferred to an object to perform work on, or heat, the object;
- As such and due to the second law of energy's conservation: human beings have to exploit sources of energy existing in its environment : it is called primary energy because freely available (wind and coal for instance are equally 'free'); [6]
- Their actual cost « only » comes on the human work needed to extract and spread this primary source of energy, hence the more concentrated and storable, the cheaper;
- Among those primary energy, there is a family of particularly powerful ones: oil, coal and natural gas;
- It took nature about 5 millions years to create the fossil fuel the world consumes in one year, and our modern way of life is mainly dependent on these resources [7a][7b]

FOSSIL FUEL

Historically the world's energy has come from burning trees (biomass) for heat and tool manufacturing. However, the invention of an efficient steam engine by James Watt in 1784 meant humans were now able to convert existing fossil fuels (coal, and later oil and gas) into intensive mechanical work (lifting heavy objects or turning the wheels of a train). Furthermore, it enabled humans to build machines to dig up even more fossil fuels, enabling an exponential growth of our energy usage. [8][54][55][56] Although difficult to predict, at the current rate of production there are 114, 53 and 51 years left of coal, natural gas, and oil reserves respectively [54][55].

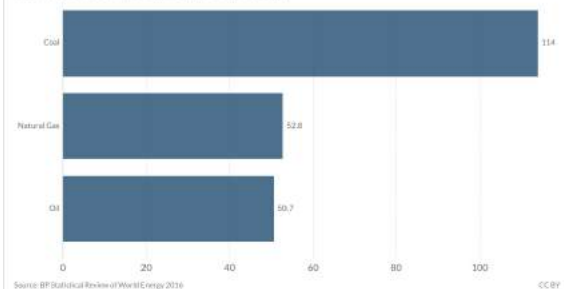
World primary energy consumption since 1800
in EJ (exajoules)



Source: Our World In Data (data)

Years of fossil fuel reserves left

Years of global coal, oil and natural gas left, reported as the reserves-to-product (R/P) ratio which measures the number of years of production left based on known reserves and annual production levels in 2015. Note that these values can change with time based on the discovery of new reserves, and changes in annual production.



Source: BP Statistical Review of World Energy 2016

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OIL

Oil is **unique** because:

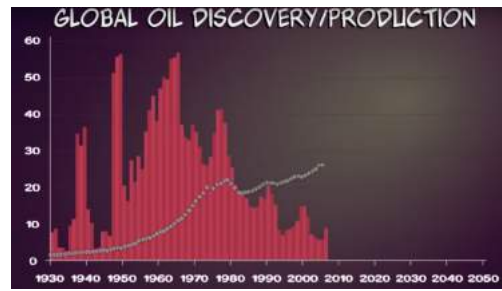
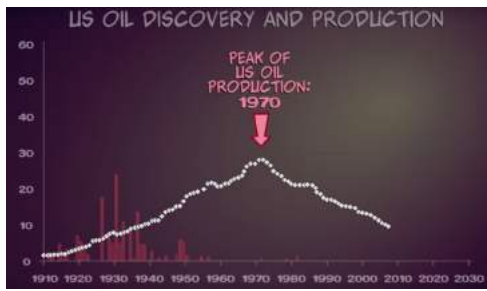
- Energy dense (1 barrel almost amounts 3 years of human labor);
- Liquid at room temperature;
- Easy to transport;
- Jouable in small engines;

Oil's **Energy Return On Energy Invested (EROEI)** was equal to 100 at the time of its first extractions (late 19th). Then it became increasingly complex to extract, was imported for farther. Crude is heavy, the quality is worsening which requires an higher investment: today oil's EROEI is close to 10.

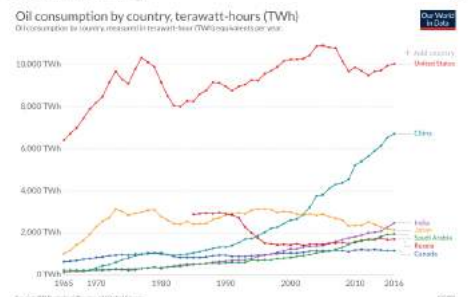
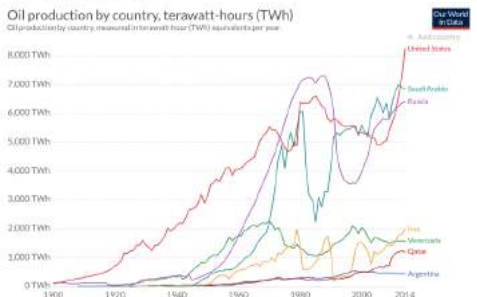
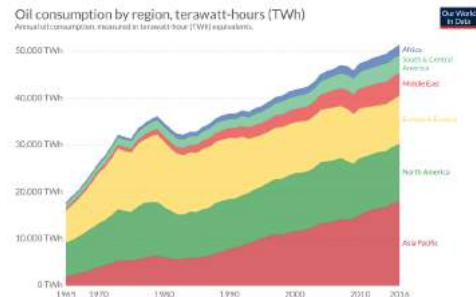
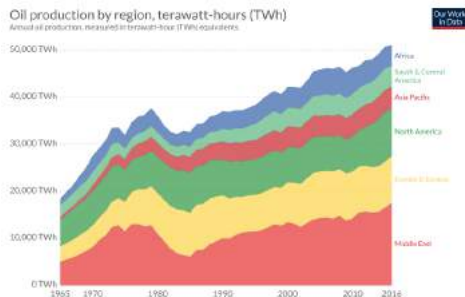
Since 1860, geologists have discovered over 2 trillion barrels of oil. The world approximately consumed half (today, the world consumes 30 billion barrels a year). It takes typically 40 years after the peak of discovery for a country to reach its peak of production, after which it enters a permanent fall.

In 50's, Shell's geophysicist M. King Hubbert predicted America's oil production will peak in 1970's, 40 years after the US's peak of discovery. Few believed him but his prediction actually came true³. [7a][55]

³ Although it is indisputable that any given raw material on Earth cannot be extracted forever, and consequently reaches a peak at some point, this is not our main issue for the decades to come as we'll see later.



From this point, Americans have been increasingly dependent on imported oil, making it vulnerable to supply disruptions (economical meltdown in 1973 and 1979 due to oil chocks). In 1960s, 6 barrel of oil were found for every one used, in 2000s the world consumes 3-6 barrels for 1 found. Once peak for oil production is reached, demand will outstrip supply and price will become highly volatile. Suburb areas and any communities were designed on the assumption of plentiful oil and energy. Same for modern agriculture system, water distribution, medicine or military forces, as well as petrochemical that are essential in the manufacture of countless products including plastic our daily lives depend on. Urbanisation and global warming have enjoyed a symbiotic relationship over the past two centuries. As their populations increased, cities began to devour the electricity produced by traditional fossil-fuel power plants. This led to further urbanisation, and greater demand for power.



Across the past decades, the United States (8k TWh), Saudi Arabia (7k TWh) and Russia (6k TWh) accounted for nearly half worldwide's production; while it is consumed at 14% by China (36% for Pacific Asia) and 20% by the US, for an equivalent worldwide's consumption and production of 50k TWh. If we look at the consumption per capita, US becomes third behind Saudi Arabia and United Arab Emirates.

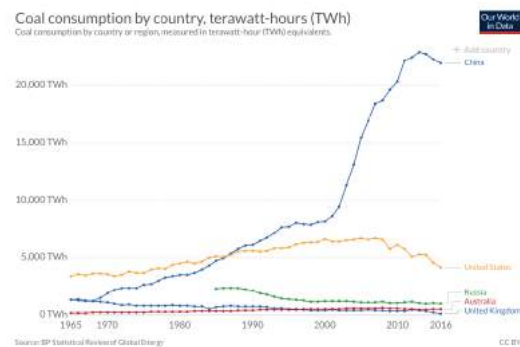
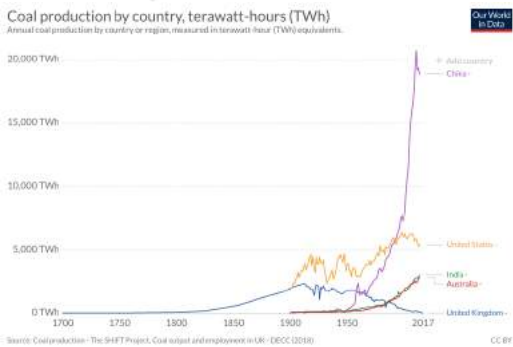
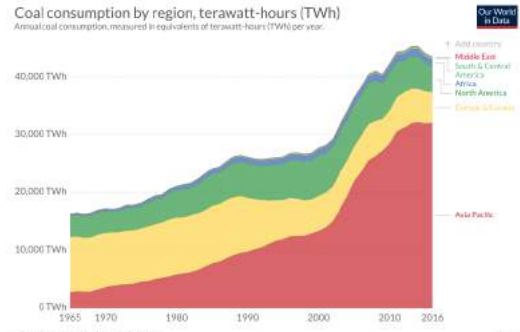
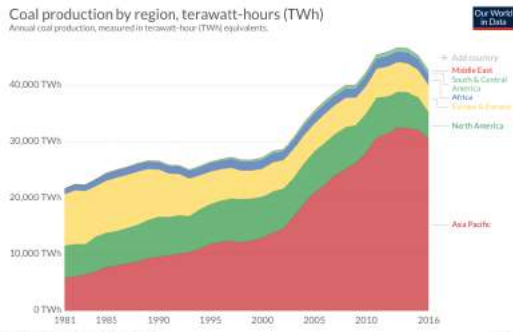
Prices equivalent with other forms of energy: Order of magnitude as compared to human work or wind power [6]



Energy equivalent of 150 slaves working 7/24 for an average citizen in OECD country.

COAL

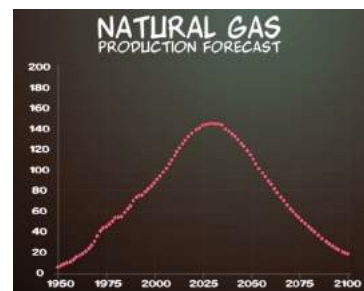
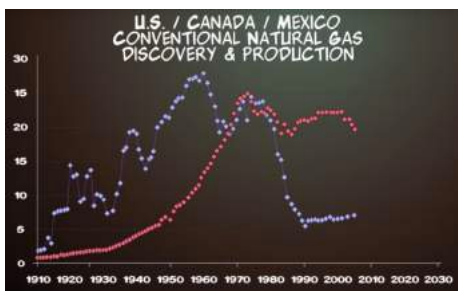
- Coal has accelerated the Industrial Revolution of Great Britain and extended their international influence in the 18th century [7b]. Today, the majority of global coal production has been sourced from the Asia Pacific region, **with 5 to 6-fold growth over the last 30 years**. Almost 75% of the global coal reserves are produced and consumed in Asia Pacific [55]. Although too early to confirm, global coal production appears to have peaked over the years 2013-14, with several years of declining production since. This would represent a significant peak in global energy, with coal being the first fossil fuel energy source [11][55].

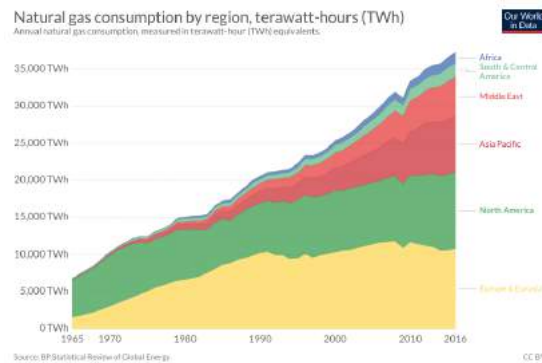
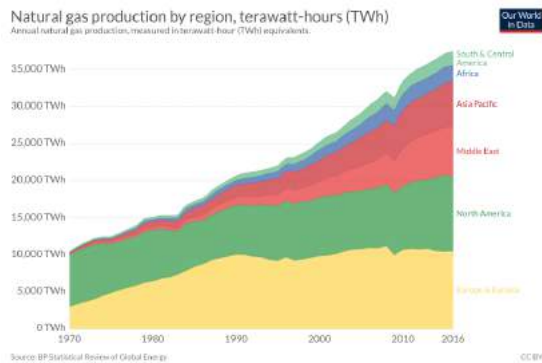


- In 2016, global production and consumption of coal in China alone accounted for 40% and 50% respectively, with a spectacularly consistent production rate of +10% from the late 1990s to 2011.
- Coal exists in vast amount, generates almost half of the planet's electricity. The claim on US having enormous stocks of coal is a fallacy as it fails to account increasing demand and falling quality (less energy dense)
- In the long run, coal and oil could cost the world trillions of dollars. Coal alone may cost Australia billions, whereas costs to some smaller companies or cities could be on the scale of millions of dollars. The economies most damaged by coal (via climate change) may be India and the US as they are the countries with the highest **social cost of carbon**. [10]

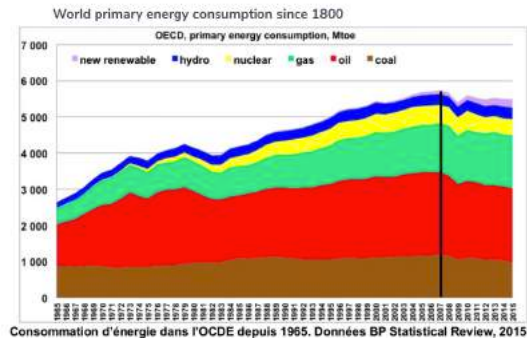
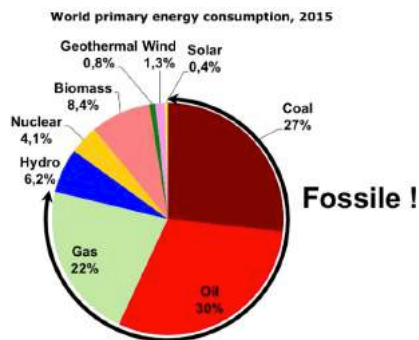
NATURAL GAS

- Natural gas discovered alongside oil and coal, the US conventional gaz peaked in 1950s, production in early 70s. Even with unconventional gaz, there might be a peak in global production from 2030 [7a] resulting in 50 years left of reserves[54].





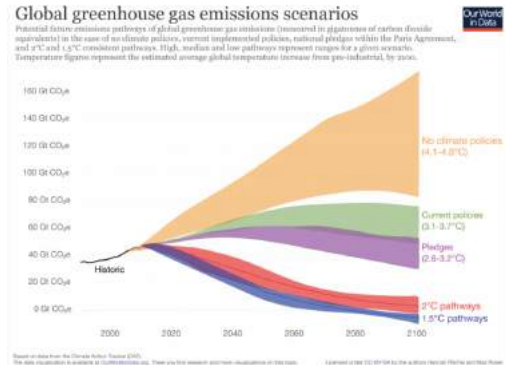
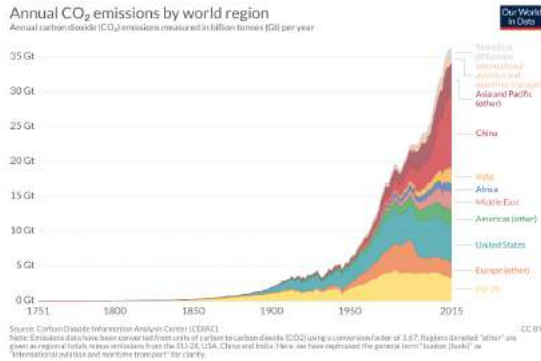
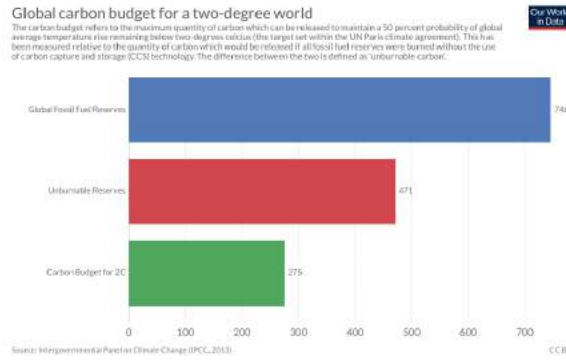
WORLD ENERGY MIX , GREENHOUSE GAS (GHG) EMISSIONS AND REMAINING « CARBON BUDGET »



- +80% of our world energy consumption comes from fossil fuel [6][18d2][54][55][56]
- +60% for the share of total electricity production from fossil fuels [55]
- Across the past 20 years, « renewable » energy did not substitute to fossil and **added an extra contribution of 2% in the global mix.**
- Most recent studies do acknowledge several wrong attempts at predicting fossil fuel's peak of production based on Hubbert's theory [54]: « The difficulty in attempting to construct these curves is that our discovery of reserves and technological potential to extract these reserves economically evolves with time. If we look at trends in proven fuel reserves, we see that our reported **oil reserves** have not decreased but *increased* by more than 50 percent, and **natural gas** by more than 55 percent, since 1995. This fact, combined with changes in rates of consumption means that predicting 'peak fossil fuel' is highly uncertain. »

However, whilst depleting reserves could become a pressing issue 50-100 years from now, there is another important limit to fossil fuel production: climate change. Carbon dioxide emissions remain trapped in the atmosphere for long periods of time, building up an atmospheric stock that leads temperatures to rise.

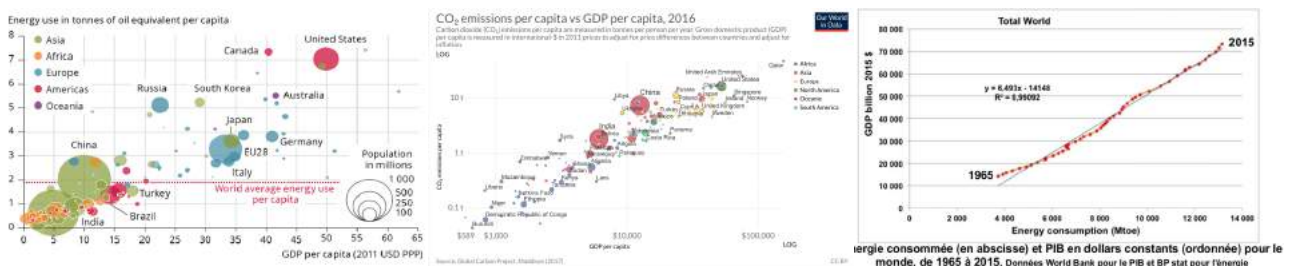
To keep average global temperature increase below two degrees celsius (as has been agreed in the UN Paris Agreement), we can thus calculate the cumulative amount of carbon dioxide we can emit while maintaining a probability of remaining below this target temperature. This is what we define as a 'carbon budget'. In the latest IPCC report, the budget for having a 50 percent chance of keeping average warming below two degrees celsius was estimated to be approximately 275 billion tonnes of carbon (as shown in the chart below, dated of 2013, in GtCO₂). We also presented the annual CO₂ emissions and global GHG emissions scenarios [8].



Here's ***the crucial factor***: if the world burned all of its currently known reserves (without the use of carbon capture and storage technology), we would emit a total of nearly 750 billion tonnes of carbon. **This means that we have to leave around two-thirds of known reserves in the ground** if we want to meet our global climate targets. However, it is important to keep in mind that this in itself is a simplification of the global 'carbon budget'. As discussed in detail **by CICERO's Glen Peters**, there is actually a variety of possible carbon budgets, and their size depends on a number of factors such as: the probability of staying below our two-degree warming target, the rates of decarbonization, and the contribution of non-CO₂ greenhouse gases. **For example, if we wanted to increase the probability of keeping warming below two degrees celsius to 80 percent, we would need stricter carbon limits, and would have to leave 75-80 percent of fossil fuels untouched, corresponding to less than ten years left at current rates.** The quantity of fossil fuels which we would have to abandon is often referred to as 'unburnable carbon'. According to a widely-quoted study by **Carbon Tracker**, there is significant potential for this unburnable carbon to result in major economic losses. If capital investment in carbon-emitting infrastructure continues at recent rates, it estimates that up to 6.74 trillion US\$ (nearly twice the GDP of Germany in 2016) would be wasted over the next decade in the development of reserves that will eventually be unburnable. The study defines this as 'stranded assets'⁴.

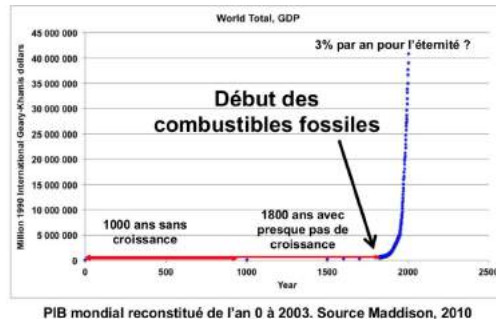
RELATIONSHIP WITH ECONOMIC GROWTH ?

Scatterplot of economic growth, measured as GDP per capita, versus energy use in tonnes of oil equivalent per capita (2011) [12] (left hand side); CO₂ emissions per capita (2016) [73] (middle), along with the most realistic model to explain global growth versus energy consumption from 1965 to 2015 [6](right hand side).

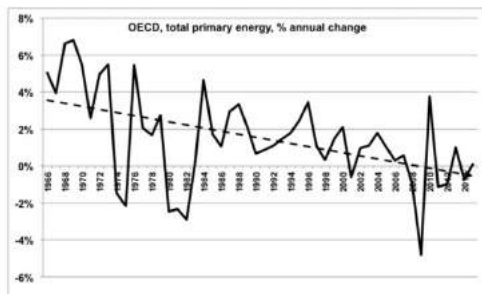


⁴ See also The Economist Intelligence Unit, **[“The Cost of Inaction: Recognising the Value at Risk from Climate Change,”](#)** 2015

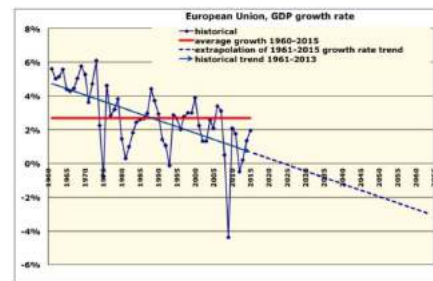
Below is what global growth means in terms of GDP when observed from 2000 years ago, where the apparition of fossil fuels discoveries (industrial revolution) has been highlighted.



Which is similarly consistent in terms of rates for primary energy procurement in OECD countries (left hand side) and growth counterpart (right hand side) in European Union. The series are representing a rate, hence the dashed line an acceleration, **energetically leading the European continent to durable negative growth rates territories from 2020.**



Taux de croissance de l'approvisionnement énergétique de la zone OCDE depuis 1965. Calculs Jancovici sur données BP Statistical review

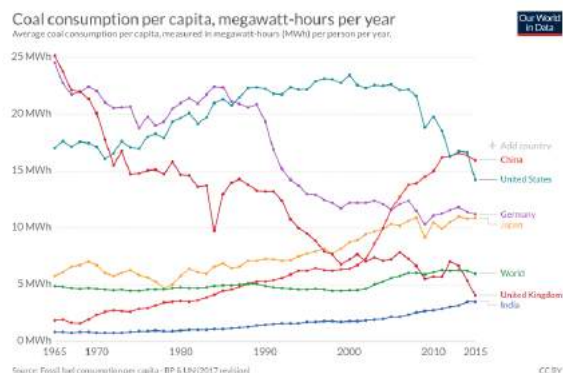
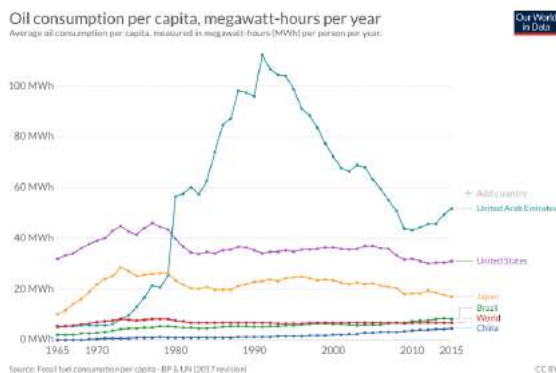


Taux de croissance du PIB européen sur la période 1960-2015 (bleu), de la moyenne sur la période (rouge), de la tendance passée (bleu plein), et de la prolongation de la tendance (pointillé). Calculs Jancovici sur données World Bank

At the cross-section of economic and environmental fields, **decoupling** refers to an economy that would be able to **grow** without corresponding increases in environmental pressure. In many economies, increasing production (GDP) raises pressure on the environment. An economy that would be able to sustain **economic growth** without having a negative impact on the environment would be said to be **decoupled**.

In its book called « *Illusion Financière* » (2013) – *Financial illusion* – [35] Gaël Giraud, PhD, former quant and Chief Economist of the French Development Agency (AFD) writes :

« Over the last century, a considerable part of the economic growth of industrialized countries was mainly due to an increase in per capita fossil energy consumption. **Of the 3% average increase in GDP per capita during the Glorious Thirties, about 2% came from the increase in oil, coal and gas consumption;** only 1% from technological progress, the "managerial revolution" of the 1990s, stress at work, etc. Since the second oil crisis in 1979, the world economy has hardly managed to increase its per capita consumption of fossil energy. This is very clear, in particular, for oil on the following chart (flat red line on the left hand side represents the world's oil consumption per capita since 1965).



This is probably the most convincing explanation for the fact that annual growth in world GDP per capita has averaged only 1% since the 1980s. If we persevere in the eco-energy scheme inherited from the second industrial revolution (begun around 1880), and with traditional extraction techniques, we are therefore probably condemned, at the global level, to the sluggish growth regime we have known since the second oil crisis: 1% growth per year, on average. »

A few preliminary conclusions can already be drawn here:

- Most of our economic activity relies on energy consumption, and since the 70's : GDP = kWh;
- This energy is a primary one, meaning it only cost the human work necessary to extract it from the ground, and is 80% composed with three million years of old fossil fuels: oil, coal and gas;
- Thanks to this energy we've been experiencing a spectacular sensation of power from the first industrial coal extraction in Britain in the 18th, followed by American oil (most drilled country ever since then) in the late 19th, contributing to the two industrial revolutions, consolidating our civilization and in return marking the start of irreversible changes on the biosphere equilibrium;
- As the old fossil fuels are finitely available like any other raw material or mineral in the nature, these unique sources of energy we keep extracting at an ever growing pace will necessarily reach their maximum of discovery. This maximum is generally followed 40 years later by a peak of production's rate (everything else being equal regarding the ever growing global demand and demography) mechanically leading to a decrease in growth rate.
- Regardless of the date at which these fossil fuels will inevitably reach their peak of production, **we have to leave around two-thirds of known reserves in the ground** if we want to meet our climate agreements.
- No other comparable substitute has been found so far...

OVERVIEW OF RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

Strictly speaking, as energy is the world's transformation: energy ceases to be « clean » if no longer used in infinitely small proportions. Let's have a brief overview of what is contained in the pink component of the below chart (historical worldwide energy mix since 1860):

- **Wind power:** high EROEI, but intermittent;
 - **Hydropower:** reliable but limited areas and not easily replicable
 - **Geothermal:** plants uses knew hotspots close to the surface of the earth (limited such areas) might supply 10% of US based load electricity by 2050.
 - **Wave:** power restricted to costal areas, energy density varies from, region to others, transport is challenging, also salty oceans is corrosive to turbines
-
- **Biofuels:** (fuels that are grown) wood has low energy density, grows slowly, biodiesel and ethanol made of crops (low EROEI), corn for ethanol (1/10 of US oil need by 2020: 3% of land; 1/3: whole food park)
 - **Hydrogen:** extracted from natural gas, coal or water which use more energy that generate from hydrogen (unlikely as economy)
 - All the world's **photovoltaic** solar panels (2012) generate as much electricity as two coal power plants, 2.5 tons of coal are used in manufacture of a single solar panel ; 360 000 km² to meet current world's demand (2007: 10 km²)
 - **Concentrated solar power:** (solar thermal) has great potential but low number is operating, also mainly in hot regions, requiring a costly full transport on longue distances
 - **Uranium (nuclear) :** replace the 10 terawatts the world currently generates from fossil fuels, would require 10 000 nuclear plants. At that rate, the known reserves of uranium would last only from 10 to 20 years.

All these alternatives need oil for machinery or require material such as plastic produced from oil.

Also with the current state of art : intermittent and diffuse renewable energies **will be** much more expensive than fossil fuel. Lastly, do not substitute to fossil fuels but being added to our consumption. Electricity mix in US: 2,5% from renewables. No modern infrastructure is adapted to such changes.

When we hear about amazing new tools or inventions, we must always ask ourself:

- Does it make sense commercially speaking?
- What's its energy density?
- Can it be stored, easily distributed?
- Is it reliable or intermittent ?
- Can it be scaled to a national level?
- Do we have the engineering workforce ?
- EROEI?
- What are the environmental impacts?
- Recall that large number can be deceptive (1 billion barrels of oil = global demand for 12 days as of 2012..)



« The world needs explosive growth in renewable energy for the next three decades, but even that probably won't be enough to forestall catastrophic climate change »[72] writes Bloomberg in 2019.

What can be done in the face of these alternative energy shortcomings? Many believe the crisis can be avoided by :

- **Conservation:** makes you save money, not planet, if some reduce oil use, it will draw down demand hence price allowing others to buy it cheaper. See fashion for engine using less energy: will paradoxically lead to more energy consumption e.g. W. Jevons British 19th economist, realizes better steam engines make coal a more cost effective fuel source, which led to the use of more steam engines, increasing total coal consumption.)
- **Technology:** is NOT energy, it can just channel energy into work but cannot replace it, also consumes resources (e.g. computers require 1/10th of the energy to make a car), more advanced ones may make the situation worse, as many require rare minerals (also approaching limits) 97% of world's rare earth are produced by China (most in a single mine in Mongolia : air craft, HE magnets and hard drives, laser, shielding for nuclear reactors, CD, hybrid vehicles or car batteries...) they might restrict it as demand soars
- **Smart growth** illusion as uses non renewables metals and minerals in ever increasing quantities including rare earth
- **Recycling** requires energy and not 100% efficient, a large portion is lost forever as waste electric cars and hybrids
- **Substitution** many economists believe free markets and technologies will allow nature substitutions BUT they're all limited (hence incompatible with growth) and do not account time needed to transit (2 decades for oil peak)
- **Vote**
In 2016, *post-truth* was chosen as the [Oxford Dictionaries' Word of the Year](#) due to its prevalence in the context of that year's [Brexit referendum](#) and media coverage of the [US presidential election](#). **Post-truth politics** is a [political culture](#) in which debate is framed largely by [appeals to emotion](#) disconnected from the details of [policy](#), and by the repeated assertion of [talking points](#) to which factual rebuttals are ignored. Their widespread propagation due to social networks has dramatically affected our relationship towards politics and truth in all social categories (see Science & Technology section).

Since then in the US and Europe, there has been a global rise of intimidating speeches, focus on immigration and security as the main source of our current energetic crisis, plus widespread lack of anticipation. Politicians reaching power and momentum in the industrialized world mainly advocate for an increase on fossil intensive military or surveillance spendings. Open confessions of climate change denial, lack of post fuel resilience strategies and primary resources limitations in a context of raising global demand and population. Economic downsides of a 2°C due to the

consideration of a carbon budget are never mentioned [58]. Also largely compatible with current form of deregulated financial markets and documented conflicts of interests [13][14][36][14][36]. **None of them ever mentioned the physical limits to economic growth, which is the common root of systemic lies.** Worldwide mainstream economists are reputedly known for having missed, or deliberately hidden, the causes of 2007-2008 subprime crisis; they were wrong again when they predicted a global collapse for both Brexit and US election (the UK/US homemade and imported sources of energies were settled hence assuring relatively stable growth horizons). They are now when they distract attention away from climate change and exclusively focus the debate between nationalist or liberal policies, both based on systemic denying of consensual science. [13][14][36] Denying the ecological crisis ongoing and its irreversible deadlines, or not being courageous enough to treat it as such, will have the same devastating consequences.

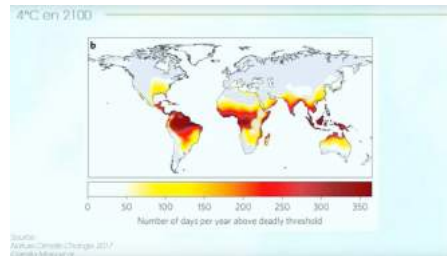
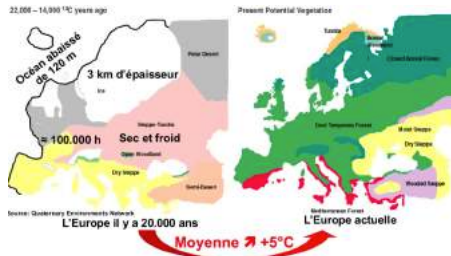
From Le Monde (9 July 2019) « A recent poll shows how much the 160,000 Tory adherents who will designate their future leader and therefore the Prime Minister are in tune with the American President. 46% of them think that the danger of global warming has been "exaggerated" and 56% that "Islam threatens the British way of life". In fact, 54% (compared to 43%) believe that the American president would make a good prime minister, underlining the risk of a "trumpisation" of the UK under Boris Johnson. »

To conclude this section on energy characters and growth limitations in the current ecological crisis, it is crucial to take a historical step back, that will be echoed later on. Let's remind this insightful « ecological awareness » dated from late 18th century. The beginning of coal industrial extraction in the UK marks the exploitation of CO2 intensive fossil fuels. Back in these days, the price of wood skyrocketed everywhere in Occidental Europe, as forests always more stressed to supply our early industrialization are vanishing.

Scientists were concerned about deforestation and related disasters: erosions, floods, landslide, and already, climate change. Coal extraction hence became a miracle solution. An ecological solution against forest crisis. This happened 200 years ago. Britain invested abundantly in tis industrial development : steam engines, foundries, gas plants; but also organic materials from abroad. Oleaginous from West Africa, rubber from Amazonia and Malaysia, exotic woods from Chile and Peru. Last but not least to feed the gigantic textile industry, beating heart of industrial revolution: cotton; colossal amount of cotton from Northern America, collected with sweat and blood. [7b]

II. FINANCIAL, SCIENTIFIC AND TECHNOLOGICAL CONSEQUENCES OF INDUSTRIAL GROWTH IN 2020

20.000 years ago, global temperature averaged 5 less °C and actual Poland, Germany or Scandinavian countries were covered by 3 kilometers of ice (left hand side) [6]. If we reach +4°C by 2100: Venezuela, Guyana, Democratic Republic of Congo, Cameroon, Bangladesh, Indonesia and probably Hong-Kong will no longer be livable (right hand side) [4].



Let's not forget what is suspended for thousands of years ahead of us. From 0 to 15kms all around the earth: 1400 billions of tons of carbon dioxide have been emitted since the beginning of industrial age [7b]. If tomorrow morning we were to eliminate all man-made CO₂ emissions, within a century 40% of the atmospheric surplus we have created will still be there, and within 10,000 years more than 10% will still be there. Because of this considerable (chemical) inertia of CO₂ in the air, whatever we do now, the consequences of climate change will increase for centuries to come. [6b]. According to John Scott, Zurich Insurance Group's Head of Sustainability Risk, in June 2019 to a panel of financial professionals : «We need to act urgently [...] 2°C ambition is not sufficient, there is an existential threat to human being [...] a 3°C world is not insurable as the pool of capital is uncountable».

According to the international scientific community, climate change effects on human life though the intensification of natural disasters, air pollution, soil erosion and mass extinction are already felt and will keep intensify in the **next 10 years** at most, before it becomes uncontrollable [2][18h].

The Limits to Growth, guideline published in 1972 for finance, research and international policy of governance to integrate environmental and human factors to avoid an irreversible collapse, has been systematically ignored over the past 50 years. The cold war didn't allow such an ideological shift, then global terrorism replaced it.

Over the past centuries, we've been building complex and auto-referencing fields of knowledge, institutions or infrastructures, unanimously taking abundant energy-dense resources for granted. In my humble opinion, this is the worst damage we collectively addressed to our humanity and intelligence. Due to the highest standards of cautiousness modern science and research require, we are totally missing the point drawn by IPCC [67]. Let's also highlight the alarming political constraints surrounding the most credible international scientific panel, as some critics have contended that the IPCC reports tend to be conservative by consistently underestimating the pace and impacts of global warming, displaying only the "lowest common denominator" findings [49][50].

WORLD SCIENTISTS' WARNING TO HUMANITY

INTRODUCTION Human beings and the natural world are in a critical state. Human activities affect Earth and cause irreversible damage to the environment and an critical situation. If not checked, many of our current practices and actions will be irreversible and will be passed on to future generations and the planet and animal kingdoms, and may, in other words, bring about the end of the world as we know it.

THE ENVIRONMENT The environment is suffering critical stress. The atmosphere has warmed, sea levels have risen, and ice sheets are melting. Air pollution near ground level, and acid precipitation, are already causing widespread injury to humans, animals, and crops.

Water Resources Widespread depletion of aquifers, groundwater depletion, and other natural water resources threaten the ability of the world's surface water to sustain life.

WHAT WE MUST DO This increasingly heated crisis must be addressed immediately.

1. We must bring environmentally damaging activities under control to restore and protect the integrity of the earth's systems we depend on. We must, for example, never again have large-scale, uncontrolled storage activities to get greenhouse gas concentrations to live lives in absolute poverty without enough to eat, and one in ten million across nations.

2. We must take on a few decades more before the chance to avert the crisis we now confront will be lost and the prospects for humanity irreversibly diminished.

Is it Too Late for Sustainable Development?

Demist Mendonça thinks so. Forty years after his book *The Limits to Growth*, he explains why

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American Institute of Biological Sciences

World Scientists' Warning to Humanity: A Second Notice

William J. Ripple, Christopher Wolf, Thomas M. Newsome, Mauro Galetti, Mohammed Alangir, Ehsan Crist, Mahmoud I. Mahmoud, William F. Laurance, 15,384 scientist signatories from 184 countries

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Nasa-funded study: industrial civilisation headed for 'irreversible collapse'?

Natural and social scientists develop new model of how 'perfect storm' of crises could unravel global system

MIT Technology Review

Climate Change May 7

Human activity is threatening one million species with extinction

Le Monde

Le cri d'alarme de 15000 scientifiques pour sauver la planète

IL SERA BIENTÔT TROP TARD...

nature

NEWS - 04 OCTOBER 2018

IPCC says limiting global warming to 1.5 °C will require drastic action

Humanity has a limited window in which it can hope to avoid the worst effects of climate change, according to climate report.

Today wars are looming, hundred of millions are starving despite fundings, every 5 seconds a child below 10 dies from malnutrition whereas our industry can produce food for 12 billions individuals [29]. Drought, poverty and violence linked to human-caused global warming have accelerated large scale migration to Europe from the Middle East and Africa [30]. Mozambique's recent disaster confirmed climate change would hit the poor first, and hardest [31], as also suggested by the world map of extreme heating above. According to IPCC's summary for policy makers (2018):

D.6.1. Social justice and equity are core aspects of climate-resilient development pathways that aim to limit global warming to 1.5°C as they address challenges and inevitable trade-offs, widen opportunities, and ensure that options, visions, and values are deliberated, between and within countries and communities, without making the poor and disadvantaged worse off (*high confidence*)

One climate crisis disaster happening every week, UN warns in July 2019 [60]. Catastrophes such as cyclones **Idai** and **Kenneth** in Mozambique and the **drought afflicting India** make headlines around the world. But large numbers of "lower impact events" that are causing death, displacement and suffering are occurring much faster than predicted, said Mami Mizutori, the UN secretary-general's special representative on disaster risk reduction. This is not about the future, this is about today. Our activities threaten life under all its form, everyday, everywhere in the world.

Problem is : if we can't yet feel it with our bare hands due to such a privileged position, misery doesn't really exist. At least, not significantly enough to ask ourselves where and how do these daily energy sources, countless high-tech devices came from and were created.

Everything surrounding us is designed in such a way we could not escape « smoothly » from such an *aliénation*. We pretend to have global ambitions, as the world's local bank, but deliberately miss our shared humanity.

Let's recall the most crucial part of the first international agreement to date, to limit the damages of the ongoing collapse:

At COP 21 in Paris, on 12 December 2015, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future.

- Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
- Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
- Making **finance** flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

Since then, the world's most powerful economy has decided to withdraw from the Paris Agreement without any risk of international sanctions, and its economy is in better shape than ever [36].

Choice is simple, at least in its terms: either we drastically constrain our addiction to growth and start rethinking our societies from scratch in a controllable manner today, or we'll see later, no matter what.

We should all be convinced the later is not a valid answer for anyone working in the risk department of a systemically important bank. It is a criminal mindset according to the dominant influence banking has had across the past 200 years on industrial civilisation and the very way it shaped our agonizing nature and societies.



Nothing perceptible at any relevant scale: neither in trainings to climate change awareness, cross-sectional and industry-wide brainstorming on the future priorities of our societies, psychological support to help us facing this disturbing reality, collaborating with our supervisors to measure and address this amplifying crisis as the biggest risk faced by humanity (naming it appropriately and keep repeating as we're now comfortable with apocalyptic terms). GHGs emissions reach their all time high every year. The most respected literature on any given dominant field is reflecting the fantasies allowed by our industrial societies: endless. Although from a high level perspective, the figure on the left presents the EU GHGs per sectors in 2014.

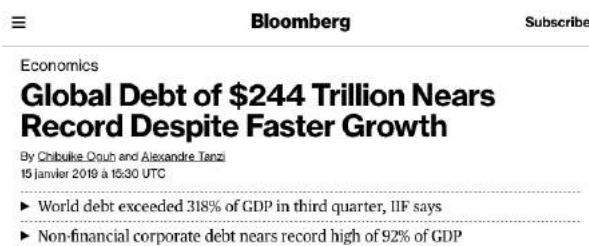
⁵ Obviously not taking into account our importations' carbon footprint [73] : Electricity (26%)+Transports (21%)+Industry (18%) = 65%

ECONOMICS AND FINANCE

Financial system is based on the assumption of growth, which requires an increasing supply of energy to support it. Banks lend money they don't have, and in effect creating it. Borrowers use this the newly created loan money to grow their businesses and pay back the debt with an interest payment which requires more growth.

Without new and even larger generations of borrowers to produce growth and thus pay off these debts, the world economy would collapse: like a Ponzi scheme it expands or dies.[7a]

Partly through this debt system, the effect of economic growth have been spectacular on our standards of living : GDP, life expectancy, water use, literacy, urban population, telecommunications, tourism increased dramatically.



Across the past few years, global debt became the main official reason for not massively investing into a life saving, ecological transition. Still from Gaël Giraud's « *Illusion Financière* » [35] :

« ***A bank is perfectly entitled to lend money that it does not have in its accounts, and that it therefore creates at the very moment it lends.*** Unlike a mortgage company, for example, which does not have this right. A bank, on the other hand, is not allowed to create money beyond certain ratios that depend on its own funds and minimum reserves (Bâle III) [...]

If commercial banks are the world's largest banknote printing press, and if you are convinced that using the printing press is a crime, then the first offenders are not the governments but private banks. Conversely, if running the printing press is not a crime, then the ecological transition has some chance of being financed. [...]

A commercial bank may create *ad libitum* credit until the cost of creating additional credit exceeds its expected return, taking into account the interest rate at which it refinances itself with the central bank (or markets) and the capital adjustment cost of this additional creation. Reserve, liquidity and capital constraints therefore affect the profitability of a loan but not the amount of loans a bank can grant. [...]

Does this mean that a bank can create an arbitrary amount of money? No: someone has to want to borrow this money from it. [...] This is where the banking sector *stricto sensu* and the financial sector work together [as] the financial sector, thanks to the deregulation that began in the 1980s, is developing financial strategies that promise astronomical leverages. Which require that those who want to benefit from these promises... get into debt with the banks. [...]

Under these circumstances, **why do so many bankers deny that they have the power to create money *ex nihilo*?** Because once this has been understood, banks will no longer be able to hide behind the difficult international context or the Basel III standards to reduce the amount of credit they grant: **if they choose to reduce their credit, it is in order to preserve their profits.** This implies that the possible *credit crunch* that could result from the implementation of Basel III will not come from the blindness of regulators, but from the appetite of banks, their managers and shareholders. This credit crunch has already begun, so the threat posed by some banks to try to dissuade the regulator from imposing Basel III rules has largely already been realized.[...]

The consequences of these remarks are decisive for future European policy. We can indeed anticipate that the quantitative easing monetary policies pursued by central banks (Fed, Bank of England, Central Bank of Japan, ECB, etc.) to flood the banking sector with liquidity at zero cost will not be sufficient to revive the European economy. Why? Because manipulating the monetary base (i.e. the mass of "central bank" money created by the central bank for second-tier banks) does not, as such, make it possible to control the quantity of money that banks make available to the real sector of the economy. »

Why are such heterodox but still rigorous approaches of economic and finance so hard to find ?

From an academic perspective, bibliometric data on the functioning of economic science reveal the functioning of major economic journals and attest that the debates have died out in this discipline [32]. Unlike equivalent international journals in other social sciences, these journals publish a considerable proportion of authors from the university to which they belong and are characterized by low citations of works from other social sciences, allowing a strong bias of auto-referencing mainstream economics.

Having this documented assumption in mind, let's proceed to a broad overview of the actions undertaken by the banking sector to tackle climate change and ecological crisis, illustrated by one of the world leader in Sustainable Finance: HSBC.

1/ WHAT HAVE WE DONE SO FAR?

At the scale of HSBC

A - [Sustainable Finance](#) commitments made in *November 2017* [18a]:

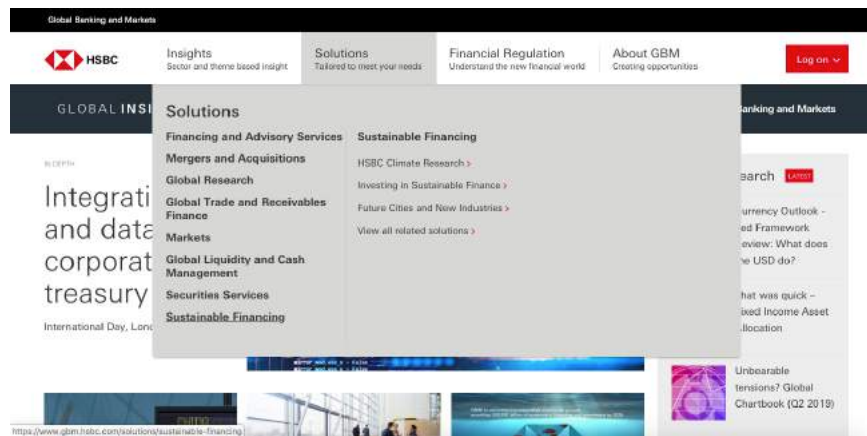
1. Providing USD100bn of financing and investments by 2025 to develop clean energy, lower-carbon technologies, and projects that contribute to the delivery of the Paris Climate agreement and the UN SDGs. « We define **sustainable finance** as any form of financial service that integrates environmental, social and governance (ESG) criteria into business or investment decisions ». (see part B)
2. Sourcing 100 per cent of our electricity from renewable sources by 2030, with an interim target of 90 per cent by 2025. This means sourcing 100 per cent renewable energy via direct investment or direct purchase agreements that in turn help the financing of new renewable energy projects
3. Reducing our exposure to thermal coal and actively managing the transition path for other high-carbon sectors. This means discontinuing financing new thermal coal mines or new customers dependent on thermal coal mining
4. Adopting the recommendations of the [Task Force on Climate-related Financial Disclosures](#) ⁶(TCFD) report 2018. This will help us identify and disclose climate-related risks and opportunities across our businesses (see part C)
5. Lead and shape the debate around sustainable finance and investment notably with the [Center of Sustainable Finance](#).(see part D)

B - HSBC Global Banking and Markets [18b]:

« Ideas and capital flow around the globe, driving growth and disrupting the status quo. New trade routes are developing, placing emerging economies in the spotlight and creating opportunities for companies and financial institutions worldwide.»

Here is a snapshot of the home page, where it is worth noticing how this public information has been organized: **Insights, Solutions** and **Financial Regulation**. Regarding the latter, it is acknowledged that *« there is an unparalleled level of regulatory reform taking place globally across financial services. These reforms aim at reducing global markets systemic risk by making them safer. Regulations involving restructuring banks, increasing tax transparency or strengthening capital requirements, are being drawn up and rolled out. »* Interestingly, this unprecedented set of regulations (market structure, bank structure, tax transparency, capital and liquidity) does not mention once an industry-wide roadmap to tackle climate change.

⁶ The Task Force on Climate-related Financial Disclosures is a private-sector led task force, chaired by Michael R. Bloomberg with support from the Financial Stability Board, which provides a global standardized framework on climate disclosures.



Consequently, this topic is left at the discretion of each bank, and HSBC dedicated one of its Solutions - to meet our client's «*specific growth ambitions and financial objectives*» - to **Sustainable Financing**. Here are highlighted : the extremely large investments required to meet the climate challenge (**between \$700bn and \$1000bn per year**⁷), the extremely key role to be played by the private sector and the vital momentum on climate change to be maintained and implemented.

There are 6 areas of focus suggested by the bank for its clients:

1. **Financing a Sustainable Project:** advertising our leading position as global underwriters of Green, Social and Sustainability Bonds, plus our various memberships to related committees or working groups. HSBC aims to maintain its leading role in their development, highlighted just recently with a tailored **Green and Sustainability Bonds**'s page⁸ on the Fixed Income investors website.
2. **Investing in Sustainable Project:** where we underline our expertise to help investors them enrich their sustainable investment portfolios through a wide investment universe ranging from equities, currencies and fixed income to structured and derivative products. We learn that « *HSBC's Climate Investor Intelligence Committee gathers frequently to capture insight on market themes and leverage our research capabilities to explore innovative investment ideas* », most probably optimizing a risk-adjusted return on investment, arbitrarily contained by our own definition of ESG. As the green bond market continues to develop, HSBC aims to maintain a leading role in its development, highlighted recently with **HSBC's \$1 billion commitment to a Green Bond portfolio**.
3. **HSBC Climate Research:** team aims to provide the best analysis of climate change and its implications for economies, industries and sectors. There are three areas of focus (most of the proposed reports are unaccessible):
 - *Financing a 2°C world* : capital allocation to deliver the transition to a low-carbon world and the building of resilience to the impacts fo climate change
 - *Climate policy* : emissions reduction and how achieve the decoupling of energy use from economic growth and the decarbonizing of the energy mix
 - *Climate impacts* : to embed resilience to shifting temperature norms and water availability and to weather extremes and sea level rise
4. **Green and Sustainable bonds:** leads to the **Fixed Income investors** general website
5. **Supporting sustainable growth:** leads to the HSBC ESG Update dated of April 2019 (see below part C)
6. **Future cities and new industries:** deals with the factors that are reshaping our cities and driving change in the economic landscape : unplanned, extreme urbanisation and hyper-connectivity. The dedicated solutions notably explore the massive investment needed in the global infrastructure for the coming years⁹, coupled with HSBC's expertise on asset optimisation, capital raising and funding as well as cost effective access to financing.

⁷ « According to the Climate Bonds Initiative, global green finance needs to reach **\$1tn by the end of 2020** and continue to grow each year thereafter. »[59] . Previous estimation of \$0.7 tn from World Economic Forum Green Investment report (2013)

⁸ Notably providing HSBC's Green Bond framework to be detailed later on

⁹Outlook forecasts USD94 trillion by 2040 to keep pace with profound economic and demographic changes across the globe, rises to USD97 trillion if it is to add the UN Sustainable Development Goals (SDGs) of universal provision of clean water, sanitation, and electricity.

Focus on Green and Sustainability Bonds

HSBC Green Bond Framework (November 2015): « HSBC research into the opinions of the scientific community indicates that the evidence for warming of the climate system is unequivocal and that anthropogenic drivers are likely to have been the key cause. Delaying the implementation of mitigation measures will seriously challenge the probability of achieving 2 degrees warming objectives. Hence the time to act is now. [...] Furthermore HSBC recognises and supports the move to a low-carbon economy, which will help reduce climate change and benefit communities in the long term. HSBC has established specialist business teams to identify opportunities and to support its clients by financing low-carbon business – the goods and services that will thrive in and accelerate this transition to a low-carbon future.» It is worth noticing HSBC's Green Bond Framework is consistent with the [ICMA Green Bond Principles](#)¹⁰

HSBC is a member of the **International Capital Market Association's (ICMA) Executive Committee for the Green Bond Principles (GBP)**, which are a set of voluntary standards for issuers of green bonds.

The International Capital Market Association or ICMA, is a self-regulatory organization and trade association for participants in the European capital markets. They define **Green Bonds** as any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects¹¹ and which are aligned with the four core components of the GBP : 1. Use of Proceeds 2. Process for Project Evaluation and Selection 3. Management of Proceeds 4. Reporting .

Then the use of proceeds for an HSBC Green Bond, notably the considerations of eligibility, are very similar to the GBP's:

- Requirement from the business or project to demonstrate sustainable values and practice to the core of its operations
- Assessment of whether the funds are applied to Eligible Sectors¹²:
 - Renewable Energy
 - Energy Efficiency
 - Efficient Buildings
 - Sustainable Waste Management
 - Sustainable Land Use
 - Clean Transportation
 - Sustainable Water Management
 - Climate Change Adaptation
- Businesses and projects that are involved in nuclear operations, weapons, alcohol, gambling/adult entertainment are excluded from the green bond financing.
- Where a business derives 90% or more of revenues from activities in Eligible Sectors, it is considered as eligible for financing from HSBC Green Bond proceeds..
- .. so long as this financing does not fund expansion into activities falling outside the Eligible Sectors.

This last cautiousness is fundamental. Indeed, as rightfully recognized in HSBC's framework : « businesses and projects may benefit the environment in important ways but also degrade it in others» as for instance « fossil fuels *may* be used by eligible businesses and projects within an Eligible Sector.»

To mitigate this conflict of climate interest « HSBC's assessment of environmental sustainability benefits will consider the balance of impacts in determining overall net benefit. Moreover, HSBC will exercise its professional judgement, discretion and sustainability knowledge in determining eligibility of businesses and projects for the Use of Proceeds of an HSBC Green Bond issue. In consideration of [fossil fueled] eligible businesses and projects, HSBC will be cautious and consider the net sustainability benefits.»

Finally, the governance process consists in a « **Green Bond Committee (GBC)**, made up of sustainability experts, senior directors and managers. Additionally, HSBC's has vast internal knowledge and expertise on climate change which will be employed in decisions made with regards to HSBC's Green Bond. »

¹⁰ From ICMA latest report (June 2018) : « The Green Bond market aims to enable and develop the key role that debt markets can play in funding projects that contribute to environmental sustainability. The Green Bond Principles (GBP) promote integrity in the Green Bond market through guidelines that recommend transparency, disclosure and reporting. They are intended for use by market participants and are designed to drive the provision of information needed to increase capital allocation to such projects. »

¹¹ The GBP explicitly recognise several broad categories of eligibility for Green Projects, which contribute to environmental objectives such as: climate change mitigation, climate change adaptation, natural resource conservation, biodiversity conservation, and pollution prevention and control.

¹² These categories correspond with those outlined by the Green Bond Principles, 2015

The framework concludes with a statement on its ongoing development where: « It is recognised that the definition of what constitutes green lending is subject to interpretation and, in many cases, requires a complex assessment of the balance of resulting environmental impacts to deliver a scientific result. Determinations of what constitutes an eligible green lending, is therefore recognised to be the subject of some discussion [...] Constructive feedback and input on the HSBC Green Bond Framework is therefore welcomed with a view to better meeting the objectives of investors and ultimately supporting a greater beneficial sustainability impact from the Use of Proceeds of Green Bonds in a manner consistent with HSBC's commitment to its wider stakeholders. »

« **Second opinion** » from **CICERO**¹³ (November 2015): « Based on an overall assessment of the activities that will be financed by the green bond, HSBC's Green Bond framework gets a **dark green shading**¹⁴. In our assessment we were in some doubt because not all projects will be made available to the public and the framework lack procedures for impact reporting. However the Green Bond framework has a strong governance structure where lifecycle analysis will be applied and rebound effects will be taken into account. »

This overall notation is provided by CICERO following a « likelihood of meeting objectives of a low carbon and climate resilient future » attributed to each of the Eligible Sectors listed above, based on HSBC's description.

HSBC policies¹⁵ and internal governance structure, through lifecycle analysis, are highlighted as strengths. No substantial weaknesses have been found but there two pitfalls concerning (1) the risk that some « green » projects could include projects that may not represent significant improvements over the status quo; (2) the lack of appropriate environmental impact reporting as an important tool to enhance transparency in regard to the projects economic risk from climate change and the environmental effectiveness of the projects.

Therefore, CICERO's rating was not affected by the methodology to be used by HSBC « to ensure that the net impact of [green bonds] is significantly positive », neither by the definition of the key performance indicators or impact reporting metrics needed to insure positive social and environmental returns for its stakeholders.

HSBC Green Structured Bond Report (November 2018): recalls our « responsibility to direct flows of capital and to help manage the low-carbon transition more broadly. Equally we have a duty to help the green finance markets, and to contribute to the design and development of the new products that the global economy will need – including green bonds» as well as our commitments to the ICMA Green Bond Principles and the Task Force on Climate-related Financial Disclosures' (TCFD) recommendations.

The 2018 IPCC's report [2] is mentioned as an invitation to « bring to sharp focus the colossal scale of change required from energy systems, agriculture, cities and industries to contain the rate of climate change. Carbon dioxide emissions would need to be cut by 45 percent from present levels by 2030, and be eradicated completely by 2050. »

Then are detailed the Green Bond market's opportunities, followed by reporting evaluation, criteria and selection procedures. The first part reveals that our 2018 **Sustainable Financing and ESG Investing report** [18e] found 61.4 per cent of investors globally have an ESG strategy, with financial returns as the biggest driver of adoption. As such, it is considered unsurprising, that in 2017 global issuance of green bonds topped \$155 billion in 2017, almost double the \$82 billion logged in 2016 by the Climate Bonds Initiative.

The reporting evaluation and selection process consists in a the « following clear and consistently applied guidelines, as defined below: »

- A definition of green finance/lending has been developed and approved for the purposes of identifying, monitoring and reporting green finance activity across the bank

¹³ Center for International Climate and Environmental Research - CICERO - is an independent, not-for-profit, research institute, providing Second Opinions on institutions' framework and guidance for assessing and selecting eligible projects for green bond investments, and assesses the framework's robustness in meeting the institutions' environmental objectives. The Second Opinion is based on documentation of rules and frameworks provided by the institutions themselves (the client) and information gathered during meetings, teleconferences and e-mail correspondence with the client.

¹⁴ Characterizes projects and solutions that are realizations today of the long-term vision of a low carbon and climate resilient future. Typically this will entail zero emission solutions and governance structures that integrate environmental concerns into all activities.

¹⁵ HSBC follows the OECD guidelines for multinational enterprises, the UN Global Compact (a voluntary initiative based on commitments to implement universal sustainability principles and to take steps to support UN goals) and the Equator Principles.

- Once a green project is identified by the local banker, if the finance/lending is considered to fit within the tighter green bond Eligible Sectors definitions of the Green Bond Framework, the bankers are prompted to complete a form that details the specifics of the client and the associated green finance/lending
- Once identified, green finance/lending is reviewed by Group Sustainability which considers conformity to HSBC's Green Bond Eligible Sectors. Sustainability risk including physical, transition and liability risk is also reviewed to ensure only those deemed acceptable are considered for HSBC Green Bond allocation recommendation
- Finally the project details, together with Group Sustainability recommendation are submitted to the GBC for their ratification of inclusion or exclusion as use of proceeds of the respective HSBC Green Bond

The reporting criteria are finally summed up in the following template of a Green Structured Bond Progress Report:

| HSBC Green Structured Bond Progress Report | | | | | | |
|--|---|--|--|--|-------------------------------------|--|
| Green Structured Bonds Details | | | | | | |
| Issuer | HSBC France SA | | HSBC France SA | | | |
| Issue Date | 20 November 2017 | | 06 December 2017 | | | |
| Currency | EURO | | EURO | | | |
| Tenor | 15 years | | 15 years | | | |
| Issued Amount | 40,000,000 | | 50,000,000 | | | |
| ISIN | FR0013294352 | | FR0013298189 | | | |
| Use of Combined Proceeds | | | EUR (numbers are rounded to the nearest m) | | | |
| (A) | Amount Disbursed to Eligible Green Projects | 90 | 100% | | | |
| (A) | Energy Efficiency (EE) | 40 | 44% | | | |
| (A) | Sustainable Waste Management (SWaste) | 50 | 56% | | | |
| HSBC business area | Type of Project, per HSBC Green Bond Framework Eligible Sector List | Project description | Geography | Loan committed as at 30/06/2018 EUR (numbers are rounded to the nearest m) | Asset supported | Renewable Energy installed capacity – predictions/projections made by our clients in public sources for the full project |
| Loan | Energy Efficiency | Roll-out and installation of Smart Metres | UK | EUR 40m | 50m Smart Metres by the end of 2020 | c.10% reduction in energy usage & c.15% reduction in total waste generation |
| Loan | Sustainable waste management | Construction of a new anaerobic digestion facility | UK | EUR 50m | Anaerobic digestion facility | c.3m cubic metres of Bio Gas produced p.a. |

There is still no mention of the methodology used by HSBC « to ensure that the net impact of [green bonds] is significantly positive », neither a definition of the key performance indicators or impact reporting metrics needed to insure positive social and environmental returns for its stakeholders.

C - Environmental, Social and Governance Update of April 2019 [18c]:

This ESG Update – the fourth produced so far – shines a light on our progress regarding the way we « measure our environmental, social and governance performance. This helps us understand the impact of our actions on people and the planet. »

Sustainalytics, an external agency which assess companies on their ESG performance has rated the bank as an « average performer » in 2018. In line with our commitments to improve our ESG performance, HSBC has set a 2020 target of gaining recognition as an « ESG outperformer » from Sustainalytics. As « it is important not only to mark the progress we continue to make in many areas, but also to be candid in acknowledging where we have more to do. »

Then in the first paragraphs our latest update : « As Group Chief Executive, my overriding priority is to create stronger relationships with all our stakeholders – and it is part of our ambition to create what we call the **healthiest human system in our industry**. If we can do that, and live up to **our wider societal obligations**, then we believe we will materially improve all aspects of HSBC's performance and **safeguard the future** of the organisation **for generations to come**. » John Flint

It can be appreciably noticed that our most **strategic priority** is to « Accelerate growth from our Asian franchise¹⁶; be the leading bank to support drivers of global investment: China-led Belt and Road Initiative and the transition to a low-carbon economy.»

This most strategic priority is associated with **four targets by end 2020**: (1) High single-digit revenue growth per annum from Asia franchise (2) Market share gains in eight scale markets (3) No.1 international bank for Belt and Road Initiative (4) \$100bn in sustainable financing and investment.

Our strategy

Our international network, access to high growth markets and balance sheet strength help us to deliver long-term value for our stakeholders. This strong combination of strategic advantages supports our strategy, enabling us to connect customers to opportunities.

Return to growth and value creation

We entered the next phase of our strategy in 2018, focused on growth and creating value for our stakeholders. In our June 2018 *Strategy Update* we outlined eight strategic priorities to deliver growth, improve returns, empower our people, and enhance our customer experience. Each priority has a target or set of targeted outcomes by 2020.

|  Deliver growth from strength | Strategic priorities ¹ | Targets by end of 2020 |
|---|--|---|
| | 1 Accelerate growth from our Asia franchise; be the leading bank to support drivers of global investment: China-led Belt and Road Initiative and the transition to a low-carbon economy | High single-digit revenue growth per annum from Asia franchise Market share gains in eight scale markets ² No.1 international bank for Belt and Road Initiative \$100bn in sustainable financing and investment ¹¹ |
| | 2 Complete the establishment of the UK ring-fenced bank and grow market share | Market share gains |
| | 3 Gain market share and deliver growth from our international network | Mid to high single-digit revenue growth per annum from international network ¹⁴ Market share gains in transaction banking |

The remaining panel of strategic priorities or targets does not mention any more climate-related issue. However, further details on the environmental component of our ESG approach point out that:

- We support the global transition to the low-carbon economy through our own sustainable operations and by supporting our customers with their transition. For instance in our ambition to provide **\$100bn of sustainable financing, facilitation and investment by 2025, we have delivered a cumulative total of \$28.5bn since 2017**, 56% and 28 % in Europe and Asia respectively;
- We maintain robust climate-related risk management, covering sensitive sectors, such as energy, palm oil and forestry, as signatory to the Financial Stability Board of **TCFD**

Let's sum up the dedicated chapter : **Supporting sustainable growth**, starting with some key figures:

- \$28,5bn cumulative progress since 2017 / \$100bn of sustainable financing to be provided by 2025
- 29% signed renewable electricity from power purchase agreements / 100% of our electricity renewable by 2030
- +2,300 employees given sustainability training in 2018 (compared with 1,300 in 2017) out of 235,000
- Multiple awards: Green Bond Issuer, Asia's Best Bank for Sustainable Finance, Integrated Provider of Climate Change

Our sustainable business part recalls our achievements as one of the biggest issuers for green, social and sustainable, our training sessions and refers to the details evoked previously.

Then our approach to climate risk management starts as follows : « The transition to a low-carbon economy will occur over a multi-year horizon and it will take time for sectors currently dependent on fossil fuels to adapt. While it is acknowledged there **should be a significant and immediate reduction in the use of coal to generate power**, other traditional sources of energy, such as oil and gas, have a longer term role during the transition. Developing countries may also need more time to adjust as they balance sometimes competing sustainable development goals. » In 2018 we updated our energy policy [18f] and : « set out our position with respect to new project financing of coal-fired power, greenfield projects in the oil sands, offshore Arctic drilling and due diligence requirements. » HSBC's exposure to coal mining represents 4% of our total exposure to mining and metals sectors in 2018 (\$0.8bn). We have adopted a new

¹⁶ It is worth noticing that the percentage of customer accounts (by value) reaches 35%, 3% and 10% for Hong-Kong, Mainland China and the rest of Asia respectively. Also in HSBC annual results 2018: 90% of reported profit before tax comes from Asia.

methodology¹⁷ for the identification of exposures to the metals and mining sector in order to align with our TCFD disclosure.

Here are the recommendations of TCFD adopted by HSBC as in its 4th Commitment in Sustainable Finance¹⁸:

Task Force on Climate-related Financial Disclosures ('TCFD')

We all have a role to play in limiting climate change and supporting the transition to a low-carbon economy, and we are a signatory to the disclosure recommendations by the Financial Stability Board's task force. This represents our second disclosure under the framework.

Governance

Mitigating climate change is a key priority for our senior leadership, with sustainable finance metrics included in the Group's strategic priorities. In 2018, there were two presentations on sustainability to the HSBC Holdings Board, two to the Group Audit Committee, four to the Group Risk Committee, and two to the HSBC Group Management Board. Senior leadership have engaged with regulators, industry associations and non-governmental organisations on this topic, such as through the Bank of England consultation on climate change, the Group Chairman's participation in the One Planet Summit and the Group Chief Executive's designation as a World Economic Forum climate leader. A summarised list of HSBC's sustainability-related memberships is available at: www.hsbc.com/our-approach/measuring-our-impact/sustainability-memberships.

Strategy

Supporting the transition to a low-carbon economy is a key part of HSBC's strategy, and new products have been offered to facilitate this, along with a pledge to provide \$100bn of sustainable finance by 2025. To date, we have reached \$28.5bn of that goal. For further information, see page 28. We recognise many clients across sectors are making significant shifts towards the low-carbon economy. During 2019, we intend to develop new metrics to help measure these activities, with an aim to publish in next year's disclosure.

We believe education of our people is crucial on this topic. We gave sustainability training to more than 2,300 employees during 2018 and launched a sustainability online learning programme for all employees globally, with content developed in collaboration with the University of Cambridge Institute for Sustainability Leadership.

We report on the emissions of our own operations via CDP (formerly the Carbon Disclosure Project). This is available, as well as other information related to the sustainability of our own operations, at www.hsbc.com/our-approach/measuring-our-impact.

Risk management

We are increasingly incorporating climate-related risk, both physical and transition, into how we manage and oversee risks internally and with our customers. Climate risk is now included as a theme in our 'Top and emerging risks report' to ensure that it receives monthly management oversight via the Risk Management Meeting of the Group Management Board ('RMM') (see page 30). In addition, our Board-approved risk appetite statement contains a qualitative statement on our approach to sustainability, which will be further expanded in 2019 to include climate risk explicitly.

We have a number of sustainability risk policies covering specific sectors. In 2018, we updated our energy policy to limit the financing of high-carbon-intensity energy projects, while still supporting energy customers on their transition to a low-carbon economy. From the release of the new energy policy in April 2018 until the end of 2018, HSBC financed no new coal-fired power plants.

Transition risk, in the context of climate change, is the possibility that a customer's ability to meet its financial obligations will deteriorate due to the global movement from a high-carbon to a low-carbon economy. HSBC is working to embed transition risk into

its day-to-day credit risk management. The aim is that over time, each wholesale counterparty will receive a client transition risk rating based on their susceptibility to, and ability to manage transition risk.

We have identified six higher transition risk sectors based on their contribution to global carbon dioxide emissions. These sectors are: oil and gas; building and construction; chemicals; automotive; power and utilities; and metals and mining. Over time we may identify additional sectors as having higher transition risk depending on a variety of factors, including country-level carbon dioxide reduction plans per the Paris Agreement.

The table below presents our exposure to the six higher transition risk sectors. These figures capture all lending activity, including environmentally responsible customers and sustainable financing. Further details on our approach to the quantification of exposures can be found in footnote 37 on page 67. This is expected to evolve over time as we develop new climate-related metrics.

Next steps

HSBC's TCFD disclosures will continue to evolve and expand over time. In line with TCFD recommendations, our *Annual Report and Accounts* will start to disclose the additional climate risk-related metrics relating to our portfolio for specific sectors, as the availability of sufficient, reliable and relevant customer data permits.

| Sector | % of total wholesale loans and advances to customers and banks in 2018 ¹⁷ |
|---------------------------|--|
| Oil and gas | ≤ 3.9% |
| Building and construction | ≤ 3.8% |
| Chemicals | ≤ 3.9% |
| Automotive | ≤ 3.4% |
| Power and utilities | ≤ 3.0% |
| Metals and mining | ≤ 2.8% |
| Total | ≤ 20.8% |

Total wholesale loans and advances to customers and banks amount to \$668bn.

¹⁷ For footnotes, see page 67.

¹⁷As explained in footnote 37 on page 67 of the Annual Report and Accounts 2018 : « Amounts shown in table include green and other sustainable finance loans, which support the transition to the low-carbon economy. The methodology for the quantification of our exposure to higher transition risk sectors will evolve over time as more data becomes available and is incorporated in our risk management systems and processes.

Counterparties are allocated to the higher transition risk sectors via a two-step approach:

1° Where the main business of a group of connected counterparties is in a higher transition risk sector all lending to the group is included irrespective of the sector of each individual obligor within the group.

2° Where the main business of a group of connected counterparties is not in a higher transition risk sector only lending to individual obligors in the higher transition risk sectors is included. »

¹⁸ Same content across both the Annual Report and Accounts 2018, and April 2019 ESG Update currently reviewed

Task Force on Climate-related Financial Disclosures

In December 2015, on the same month than the COP 21 summit, the Financial Stability Board (FSB) established the **Task Force on Climate-related Financial Disclosures** to undertake a coordinated assessment of what constitutes efficient and effective disclosure and design a set of recommendations for voluntary company financial disclosures of climate-related risks that are responsive to the needs of lenders, insurers, investors, and other users of disclosures.

June 2017 – The Task Force released three key documents that serve as building blocks to describe and support implementation of the Task Force’s recommendations.

Key features from the [Final Report: Recommendations of the TCFD](#) are : Adoptable by all organizations; Included in financial filings; Designed to solicit decision-useful, forward-looking information on financial impacts; String focus on risks and opportunities related to transition to lower-carbon economy.



One of the Task Force’s key recommended disclosures focuses on the **resilience of an organization’s strategy**, taking into consideration different climate-related scenarios, **including a 2° Celsius or lower scenario**. **These scenarios are those designed by the COP21 agenda, signed by nearly 200 countries in December 2015. HSBC and many other top financial institutions made a commitment towards this cooperative agenda.**

As we can clearly notice in the above figure from the Final Report, HSBC’s previous summary forgets to mention the Metrics and Targets component of the TCFD, although being the core element of the four recommendations. Beyond internal « metrics used by the organization to assess climate-related risks », the one **quantitative metric** suggested by the Task Force consists in **GHG emissions (Scope 1. and 2., and if appropriate, Scope 3.)**, and the related risks.

These **3 GHG emissions scope levels** are defined as follows:

1. Refers to all direct GHG emissions.
2. Refers to indirect GHG emissions from consumption of purchased electricity, heat, or steam.
3. Refers to other indirect emissions not covered in Scope 2 that occur in the value chain of the reporting company, including both upstream and downstream emissions. Scope 3 emissions could include: the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g., transmission and distribution losses), outsourced activities, and waste disposal.

Interestingly, in the Supplement guidance for the Financial Sector from [Annex: Implementing the Recommendations of the TCFD](#), there are detailed expressions of one commonly shared concern across banks, insurance companies, asset owners and managers: **Carbon Footprinting and Exposure Metrics**. For instance, portfolio’s exposure to carbon-intensive companies, expressed in tons CO₂e / \$M revenue ; or the absolute greenhouse gas emissions associated with a portfolio, expressed in tons CO₂e, and many other promising foundations.

Although the percentage of companies disclosing climate-related information has increased, but overall is low and the Task Force has no further leverage to enforce companies to comply.

D - Center of Sustainable Finance [18d]:

When it comes to our dedicated center of sustainable finance, created in November 2017, there is one high level figure regularly highlighted : « published over 40 reports and articles covering key themes including low-carbon transition, climate risk and disclosure, and green financial centres.»

Let's focus on some of the latest reports:

A Call for Action, Climate Change as a Source of Financial Risk (April 2019) [18d1]: This is probably the most crucial one, as this report recalls a milestone recently achieved by central banks and supervisors to help financing the transition to low carbon economy consistent with the 'well below 2°celsius' goal set out in the Paris agreement.

At the Paris "One Planet Summit" in December 2017, eight central banks and supervisors established a **Network of Central Banks and Supervisors for Greening the Financial System (NGFS)**. Since then, the NGFS has grown to 40 Members and 6 Observers, representing 5 continents. The Network's purpose is to help strengthening the global response required to meet the goals of the Paris agreement and to enhance the role of the financial system to manage risks and to mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development. The NGFS published on 17 April 2019 its **First Comprehensive Report "A call for action"** which proposes first recommendations aiming at facilitating the role of the financial sector in achieving the objectives of the 2015 Paris Agreement .

According to our Center of Sustainable Finance, this reports « sets out climate change-related risks as a source of financial risk and outlines six recommendations, **particularly for central banks and financial supervisors** (see also next section on this topic) to take initial steps to ensure the stability of the financial system. The report aims to build knowledge in the main gaps of identifying, measuring and managing climate risks in the financial system. »

The recommendations are:

- (1) Integrate climate-related risks into financial stability monitoring and micro-supervision
- (2) Integrate sustainability factors into own-portfolio management
- (3) Bridge the data gaps
- (4) Build awareness, intellectual capacity and encouraging technical assistance and knowledge sharing
- (5) Achieve robust and internationally consistent climate and environment-related disclosure
- (6) Support the development of a taxonomy of economic activities

Fragile Planet. The Politics and Economics of the Low-carbon Transition (May 2019) [18d2]: To decarbonize the world, some countries are better equipped, politically and economically. HSBC's multi-factor analysis of 67 countries¹⁹ identifies the global leaders across developed and emerging markets, to highlight those with a « competitive advantage as the world progresses with a low-carbon transition ».



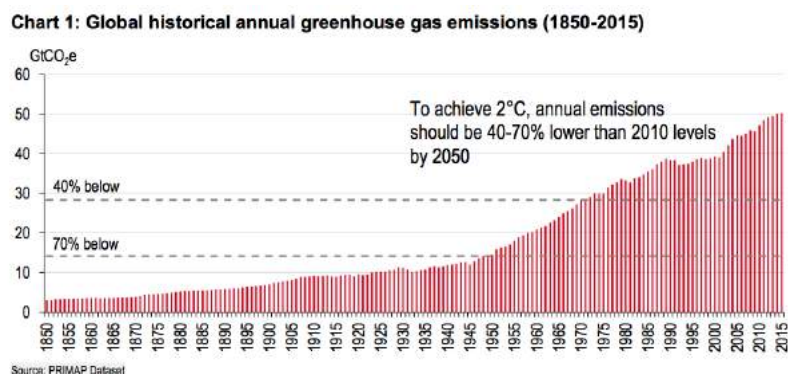
Seven countries are best placed for the low-carbon transition – we call these the ‘HSBC Climate-Seven Group of Countries’ or ‘C-7’, led by Germany. European states dominate the higher rankings, with the US in 6th, and MENA and other hydrocarbon economies prevalent at the bottom of the table. There are also three best-placed EM states : Czech Republic, China and Korea.

¹⁹ Covering 80% of the world's population and 94% of GDP

Our findings are based on an analysis of the following five areas, incorporating 29 indicators:

1. **Carbon intensity²⁰ (15%) + Fossil fuel dependance²¹ (20%) : Energy, carbon and the macro economy**
2. **Potential to respond²² (15%) + Decarbonization policy outlook²³ (15%) : Policy & institutions**
3. **Corporate climate revenues and clean-tech relevant industries²⁴ (35%) : Climate opportunities**

1. The first group of indicators starts to recall this fundamental figure : over 85% of energy consumed for use in homes, services, industry and transport, comes from burning fossil fuels. Around 70% of GHGs come from burning fossil fuels for energy, and are still rising²⁵.



We measure the **carbon intensity** of a country per its domestic economic activity and per capita levels, as well as the extent to which it is moving towards clean energy. We start with metrics to look at a country's emissions per capita, per unit of GDP, the share of non-fossil fuel energy, and emissions from land use change and forestry per GDP to integrate an understanding of the importance of agriculture and other activities which can have a significant impact on a country's overall net emissions profile. **France, Switzerland and Spain** lead across the combination of these macroeconomic climate factors.

Then we look at shares of GDP and exports coming from **fossil fuel based activity** and how these shares have changed over time. We also factor in oil and gas reserve sizes and average lifecycle production costs, acknowledging that low-cost producers are more likely to generate potential in a 2°C-aligned world, given fossil fuels will still be used in harder-to-decarbonise sectors, such as shipping, aviation and petrochemicals. **Kenya, Jordan and Lebanon** come out on top overall. **Kuwait, Saudi Arabia and Oman** are the three countries with highest earnings from fossil production, predominantly oil in these cases. 15 of our sample of 67 countries are net exporters of hydrocarbons, in economic terms. Nigeria, Kuwait and Qatar have heavy dependence on exports although these shares have declined in the last ten years. Even in a world aiming for net zero emissions later this century, the use of *some* fossil fuels in certain harder-to-address sectors is foreseen. These emissions can be offset, given that the earth – particularly forests - can absorb some carbon dioxide. And so we argue that those who can produce oil and gas at the lowest cost are likely to continue to take profit from the sector²⁶. Thus we include a metric to capture which countries we believe are better placed to sell oil and gas in a world which is moving away from fossil fuels. This is a single datapoint - a ratio of reserve to breakeven-prices in 2030, which we abbreviate to **R/B-2030**.

R/B-2030: Via this methodology, we are able to rank countries on this R/B-2030 ratio to argue which are **economically better placed to meet global demand for oil and gas beyond 2030**. A higher numerator –

²⁰ Share of alternative energy (20%) + Change in alternative energy (10%) + Emissions pc (20%) + Change in emissions pc (10%) + Emissions per GDP (20%) + Change in emissions per GDP (10%) + Other greenhouse gases pc, including LULUCF (10%)

²¹ Fossil revenue as a share of GDP (30%) + Change in fossil revenue (10%) + Share of fossils in exports (30%) + Change in fossils in exports (10%) + Fossil reserves to breakeven ratio (R/B 2030) (20%)

²² GDP p.c (15%) + Public debt burden (15%) + Sovereign wealth fund per capita (5%) + Equity risk premium (15%) + Income inequality (12.5%) + Tertiary education enrollment (12.5%) + Control of corruption (12.5%) + Rule of law (12.5%)

²³ Emissions reduction policy (70%) + Government effectiveness (30%)

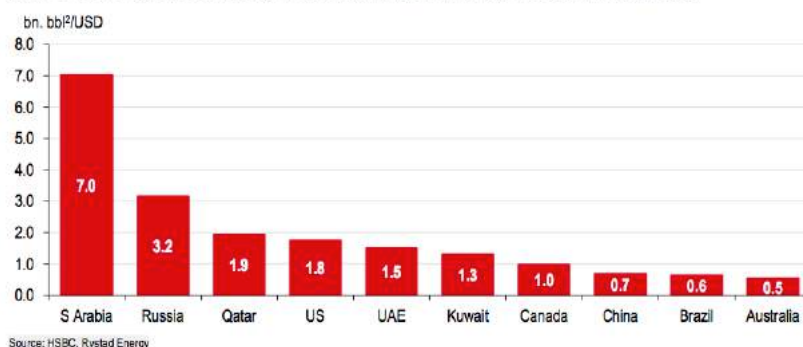
²⁴ Absolute levels (10%) + Relative to GDP (10%) + Change in absolute level (10%) + Change in relative to GDP (10%) + Momentum of absolute revenues (10%) + Momentum of relative revenues (10%) + Green Complexity Potential (40%)

²⁵ The International Energy Agency (IEA) reported that 2018 CO₂ emissions were the highest yet

²⁶ We assume thermal coal use is eradicated in a world aiming to meet Paris Agreement warming targets, and so do not credit countries here for coal reserves

reserves – gives a higher ratio, as does a small denominator – breakeven prices. **Saudi Arabia** comes through with the highest R/B-2030 ratio, having both large reserves and a low weighted average breakeven cost of production across these – i.e. we conclude that Saudi Arabia is best placed to find economic upside in providing oil and gas in a lower carbon world. **Canada** has under one third of the 2P reserves in 2030 and a little over twice the average breakeven, meaning it has a much lower ratio. Below chart shows the ten countries which have the highest R/B-2030, with Canada is 7th place.

Chart 2: Oil & gas reserves-to-breakeven ratio of the top 10 countries (2030e)



2. Regarding the second group of indicators, we start looking at the **potential of countries to respond** – via metrics which consider financial resources, social metrics and institutional quality metrics which we believe can guide how prudently a country will use its wealth in relation to its long-term sustainable development, including mitigation of climate change. **Norway** tops the list in terms of potential to respond, followed by **New Zealand** and **Australia**, and then the other three larger Nordic economies.

Next, we look forward in an attempt to understand how countries are placed to address climate change. To understand this, first we consider **pledges made towards achieving Paris Agreement goals**. We use a point-scoring method for the pledges countries made towards the Paris Agreement, also incorporating the existence of long-term targets and carbon pricing schemes. Additionally we use the World Bank’s Government Effectiveness indicator to understand, in which countries, governments are more likely to be able to turn policy into reality. To differentiate between the Paris Agreement pledges, we have developed a basic scoring system, outlined in the below table, which focuses on countries’ ambition for emissions reduction, inclusion of sector-measures and targets, and any climate adaptation plan the countries have set as per their NDCs/ INDCs²⁷.

Table 1: Emissions reduction policy - scoring methodology

| Metrics | Score |
|--|---------------|
| GHG emissions | 0-8 |
| - No quantitative target | 0 |
| - Conditional target | 1 |
| - Weak relative target | 2 |
| - Strong relative target | 3 |
| - Weak absolute target | 4 |
| - Moderate absolute target | 5 |
| - 2°C aligned | 8 |
| Sectoral contribution explained (no/yes) | 0/1 |
| Adaptation plans (no/yes) | 0/1 |
| Long term targets (no/yes) | 0/1 |
| Carbon pricing (no/yes) | 0/1 |
| TOTAL | Max 12 |

Source: HSBC, UNFCCC. Note: GHG pledges, adaptation plans, sectoral contributions as per NDCs, carbon pricing as per national policies and long term targets as per country communication to UNFCCC

Overall, European countries dominate in terms of decarbonisation policy outlook, with **Germany** on top – with only Canada (9th place), the US (14th) and New Zealand (13th) permeating the top-20 from outside the region. Of the top 20, Slovenia and the Czech Republic are considered non-DM.

3. The third group of indicators deals with which countries are better placed to benefit economically from producing technologies and products where demand will be driven by a decarbonising world. We see the transition as an

²⁷ Scores on the absolute emission target for EU countries are based on 2030 targets under the effort sharing mechanism for non-ETS sectors: targets ranging between 36%-40% (inclusive) relative to 1990 levels are identified as 2°C aligned, 14%-35% as moderate and 0-13% as weak targets. The same classification of target range largely holds for the non-EU countries. Relative emission targets are either based on the emission intensity of GDP, emission per capita or business as usual (BAU) projection. These targets are difficult to score as the projected emissions are loosely defined. Countries with a relative target of 25% or more are broadly identified as having strong relative targets and the rest as having weak relative targets.

opportunity for those able to sell the products and technologies which allow it to happen. Indeed, **we believe those countries which can generate more revenues as the global economy decarbonises are likely to be among the most resilient.** In this section, we seek to identify in which countries there are companies earning more revenues from climate change aligned themes. Plus, we look forward and ask which countries have parallel industries to clean-tech production necessary to the transition, suggesting the green industrial opportunities that are likely to be the easiest to transition into, given what a country already knows how to do.

We also consider Green Complexity Potential - a metric from the University of Oxford Institute for New Economic Thinking. This considers path dependency of industrial development – enabling us to build in a consideration of which countries are more likely to be able to make the products the world needs for the low-carbon transition, given what they produce today.

Overall, we find **China, Germany and the US** are the countries **best-placed to make profits as the world moves towards a lower-carbon future.** At the other end of the spectrum, countries which are economically more dependent on fossil fuel production, particularly in the MENA region, as well as poorer countries, populate the lower end of our rankings.

Concluding thoughts: We believe it is important for investors to understand which countries are best-placed for the low-carbon transition. The economic outlook over the next few years may create challenges in terms of climate transition. Our economics team expects global growth to continue to be just shy of 3% per year over the next decade with much of this growth (70%) to come from the emerging world. These parts of the world are getting steadily wealthier, causing changes in individuals' consumption patterns: more towards car ownership, air travel and energy consumption more broadly. Across the emerging world we expect millions of people to move to cities over the next decade and even more to rise to middle class status.

This *growth* will likely increase global trade volumes at a steady basis, with more trade taking place between emerging markets. For all of the concerns surrounding trade protectionism in recent years, many parts of the world have been signing multilateral trade agreements which will help to lift trade flows. Unless trade policy turns even more protectionist, global trade volumes should keep increasing. This continued expansion in energy demand, consumption and urban populations means that the need to transition to a lower-carbon energy mix will only get more pressing. And as the world addresses climate change risks by decarbonising human activities and reducing use of fossil fuels, we think some countries will have a competitive advantage. We believe those with the policies, institutional quality, economic diversity and low-cost energy resources, will have lower cost burdens in achieving 2°C-aligned economies and enjoy revenue benefits associated with driving the world down this pathway.

Those are excellent initiatives as they demonstrate the willingness to financially structure our answer to climate change. However ...

- Notions of EROIE are critically missing, as well as the adaptation cost of infrastructures to be aligned with decreasing fuel production.
- From our Sustainable Financing and ESG Investment report [18e] : « *Decisions about ESG investing and financing are increasingly financially driven. 74 per cent of investors cite financial returns a key factor in their decisions about ESG while two thirds of issuers consider tax incentives important.* » **This is not a valid metric.** Concluding thoughts from the « Fragile Planet » report above seems to deplore the effects – pressing needs to decarbonize the world – whose causes they cherish – business indisputable assumptions to keep increasing energy-intensive global trade volumes and growth needs. These are not the accountable mindsets solicited by the NGFS.
- In the related Data Dictionary [18a] « *Unlike financial accounting standards, there are currently limited industry standards or globally recognized established practices for measuring performance of this type [e.g. ESG]. We expect standards and definitions to be developed and evolve over time. We also expect innovation to lead to the creation of new products and services* » We hazardously emitted products with metrics defined out of a **clueless literature.**
- According to the perfect relationship between total primary energy consumption and economic growth in China, coupled with its energy mix [56], near 90% fossil fuels based which is identical to the global trend: **it is impossible for China, like any other industrialized country, to remain any close from its historical growth rate in a low carbon world.**

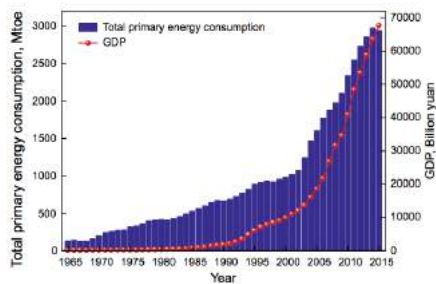


Fig. 1 Total energy consumption and GDP in China. *Data source* BP Statistical Review of World Energy (2016) and NBS China Statistical Yearbook (2015)

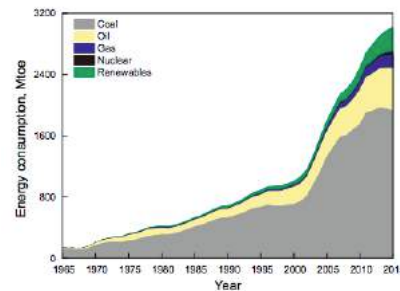
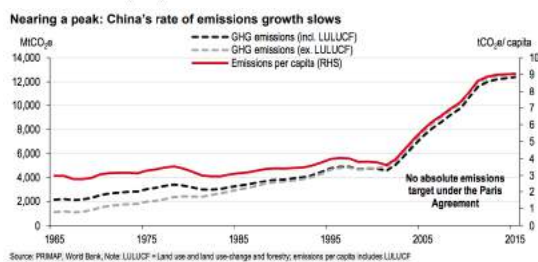
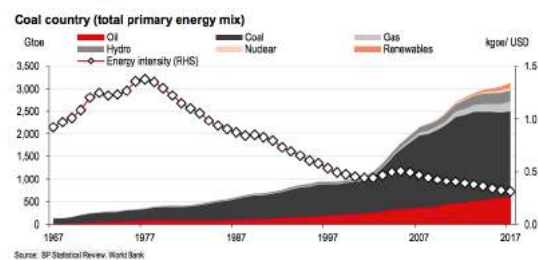


Fig. 3 History of China's energy consumption by different fuel types, 1965-2015. *Data source* BP Statistical Review of World Energy (2016) and NBS China Statistical Yearbook (2015)



Source: PRIMAP, World Bank, Note: LULUCF = Land use and land-use change and forestry; emissions per capita includes LULUCF



Source: BP Statistical Review World Bank

* * *

Concerning the efforts to be initiated by the financial industry offered by NGFS, HSBC's Center of Sustainable Finance summary mentions that « central banks and supervisors only » are concerned whereas they explicitly:

- « encourages central banks, supervisors **and financial institutions** to build in-house capacity and **to collaborate within their institutions, with each other and with wider stakeholders to improve their understanding of how climate-related factors translate into financial risks and opportunities.** » in Recommendation n°4
- mention that « Recommendations n°5 and 6 do not fall directly within the remit of central banks and supervisors but point to actions that can be taken by policymakers to facilitate the work of central banks and supervisors. **Parts of the recommendations may also be applicable to the private sector.** »

Picking winners and losers amongst hydrocarbon states: Even in a 2°C world, we are very likely to use some oil and gas, particularly in sectors where it is technologically much harder to replace them, including aviation and shipping (see The second frontier, 15 January 2019) as well as petrochemicals.

- Harder to replace but how hard to reduce? Why is this possibility never evoked, or even worse, considered as indisputable?

In **Zero Carbon City** report (July 2019) : « The growth of the city will continue, but the rise in carbon emissions and the consequent temperature increase must not. »

- Can we imagine that the first assumption might be something to curb as well? Assuming an irresistible growth of the city around the world similar to current infrastructure might be a key part of the problem.

« Managing these challenges (energy demand, construction boom, infrastructure pressure, behavioural change for corporate investors and citizens) while also pushing for a **zero-carbon growth model** will define the activities of hundreds of cities across the world for the next several decades. »

- What does a zero growth model means? Which available documentation are we referring to?

* * *

In the FT dated of 5 June 2019, Philippe Le Houérou, chief executive of the IFC, a member of the World Bank Group, writes : « *In little more than a decade, annual green bond issuance has grown from zero to nearly \$170bn. In 2019, global issuance is expected to reach a record \$200bn. That growth is impressive, [...] Yet green bonds remain a small sliver of the \$100tn global bond market [...] Along with other capital market participants, we have worked to develop guidelines and procedures for the green bond market as a member of the **Green Bond Principles** Executive*

Committee. **The Green Bond Principles were established in 2014 to promote market discipline, transparency and to avoid “greenwashing”.** At the World Bank Group, we have committed to investing and mobilising \$200bn over five years to support climate business and pledged to increase climate finance to an average of 35 per cent of our direct annual financing commitments.» [...] « [IEC and HSBC launch first climate fund for ‘real economy’ issuers](#), expected to catalyse at least \$500m to \$700m in private capital to support a diversified portfolio of climate-smart investments, largely through a mix of bonds from manufacturing, agribusiness, services, infrastructure and sub-sovereign issuers, in addition to a smaller allocation of financial-institution bonds. » [59]

Despite this recent headline on our collaboration with a member of the World bank Group to launch climate fund for real economy issuers, the total forecasted amount is still far from enough.

To sum up, the set of actions undertaken by HSBC, as an illustrative example of the whole banking sector:

- (1) Mainly consists in issuing green bonds with misdefined ESG metrics, recognized as such by the bank itself, but also their second opinion providers, as the whole literature and enhanced cooperations are missing;
- (2) The governance of these bonds are volunteer-based without any constraining targets or commitments enforced by a regulator or independent institution;
- (3) If we were to assume these bonds to be clearly aligned with the *drastic* reduction of GHG emissions suggested by Paris Agreement and IPCC, the amount of \$100bn by 2025 is far from enough, by several order of magnitude, although HSBC is among the few world leaders (annual average investment needs in the energy system of around 2.4 trillion USD₂₀₁₀ between 2016 and 2035, according to IPCC in 2018);
- (4) There is no mitigation strategies concerning fossil fuel based financial products, neither any tracking tool or methodology of their full-stack carbon footprint and/or GHG emissions. Critical lack of constraints, even in the problematic formulation itself, within a context of voluntary-based committees of governance and qualitative only criteria (e.g. Green Bond Principles);
- (5) There is no consistent cooperative strategy, neither internal (between the sustainable center and ALL the remaining employees), nor external (between investment banks for such projects not to be in competition with each other or fossil fueled ones, more profitable) ;
- (6) Never acknowledge how hard, if not illusory, decoupling economic growth from fossil fuel energy is, hence never suggest at any time that growth could be compromised in an imminent carbon neutral world.

June 2019 – Despite significant efforts undertaken by the TCFD, from their [2019 Status Report](#) :

« **Based on a recent report issued by the IPCC, urgent and unprecedented changes are needed to meet the goals of the Paris Agreement.**

The report warns limiting the global average temperature to a maximum of 1.5°C “require[s] rapid and far-reaching transitions in energy, land, urban and infrastructure [systems] (including transport and buildings), and industrial systems.”

In fact, according to a recent [United Nations Environment Programme report](#) on emissions, global greenhouse gas emissions have to peak by 2020 and decline rapidly thereafter to limit the increase in the global average temperature to no more than 1.5°C above pre-industrial levels.

However, based on current policies and commitments, “global emissions are not even estimated to peak by 2030—let alone by 2020.”

As a result, governments and private sector entities are considering a range of options for reducing global emissions, which could result in disruptive changes across economic sectors and regions in the near term. »

Voluntary guidelines have evidently failed to contain financial and industrial growth within internationally accepted boundaries and cooperative guidelines.

Therefore, if civil society wants to keep having trust in scientific and regulatory institutions: drastically dissuasive sanctions, legal and economic, must be enforced to make companies comply with their (1) full GHG emissions disclosures, and (2) reduction pathways compatible with 2°C world.

At the scale of regulators, supervisors and central banks

• 40 years ago

The climate crisis that is now leading us to a global shipwreck could have been largely resolved more than 30 years ago. This is demonstrated by New York Times journalist Nathaniel Rich in a survey called « Losing Earth: A Recent History. »

1979 – Two reports by U.S. government scientists conclude that our dependence on fossil fuels could cause global warming of 2°C to 3°C, resulting in melting Arctic ice, reduced access to clean drinking water and major effects on agricultural production. Alerted by these worrying findings, President Jimmy Carter's government²⁸ is commissioning a synthesis report to guide the decisions of the world's leading economic power, which is also the world's largest emitter of greenhouse gases (GHGs). This « [Charney report](#) » confirms the warming scenario, while stressing that a "wait-and-see policy may mean waiting until it is too late" to avoid the worst of climate change. In short, we must act. And quickly.

Despite attempts to block the fossil fuel industry and some heavyweights in the US economy, the international community reached a "broad consensus" at the end of the 1980s to conclude an "ambitious" climate agreement, based in particular on the momentum given by the Montreal Protocol, signed to combat the "hole" in the ozone layer.

This treaty, whose final phase of negotiations took place in November 1989 in the Netherlands, proposed a freeze on global GHG emissions at 1990 levels, followed by a 20% reduction by 2005. And it was "binding" on States, contrary to the Paris Agreement.

Unfortunately, succeeding to Carter's efforts to understand the meaning of the recession in the US that followed two oil crisis in a decade, Ronald Reagan states his first inaugural address: « In this present crisis, Government is not the solution to our problem. Government is the problem. »

Industrial lobbies then organized against the environmental movement and environmental regulations. A new wave of financial globalization fostered by the arrival of Margaret Thatcher in the UK and Ronald Reagan in the US is reviving the world in a new acceleration that will lead it to where we are today.[7]

As early as 1980, an Exxon official, Henry Shaw, insisted on the need to fight against any restrictions imposed on oil companies. **"We have every interest in launching a very ambitious defensive program. Because there is a good chance that legislation will be put in place that will affect our activities,"** he writes in an internal note quoted in *Losing Earth*.

The spokespersons of the fossil sector are therefore initially working to raise doubts in public opinion, but also within the American political class. In other words, we repeat that science is not as formal as we would like to believe.

Since the publication of this historic report 40 years ago though, nothing has contradicted the major conclusions of the scientists who participated in its preparation. However, the same interlocking policies have been applied by the most powerful nations since then: « Privatisation, deregulation, lower taxes for business and the rich, more power for employers and shareholders, less power for workers »[61][62]

• Today

The New York Times

Climate Change Poses Major Risks to Financial Markets, Regulator Warns

The financial sector must be at the heart of tackling climate change

A new report from the Network for Greening the Financial System shows the industry is key to achieving a low-carbon economy

Mark Carney, François Villeroy de Galhau and Frank Elderson

Wed 17 Apr 2019 06:00 BST

One of the founding contemporaneous speeches comes from **Mark Carney: Breaking the tragedy of the horizon – climate change and financial stability (29 September 2015, ten weeks before the COP21 summit) [67]**

He opens his speech with the following : « Research tells us with a high degree of confidence that:

²⁸ « **Human identity is no longer defined by what one does, but by what one owns. But we've discovered that owning things and consuming things does not satisfy our longing for meaning. We've learned that piling up material goods cannot fill the emptiness of lives which have no confidence or purpose.**» 15 of July 1979, Jimmy Carter.

- In the Northern Hemisphere the last 30 years have been the warmest since AngloSaxon times; indeed, eight of the ten warmest years on record in the UK have occurred since 2002;
- Atmospheric concentrations of greenhouse gases are at levels not seen in 800,000 years; and
- The rate of sea level rise is quicker now than at any time over the last 2 millennia.

Climate change is the Tragedy of the Horizon. We don't need an army of actuaries to tell us that the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix.

Once climate change becomes a defining issue for financial stability, it may already be too late. »

Then are presented three broad channels through which climate change can affect financial stability:

- First, **physical risks**: the impacts today on insurance liabilities and the value of financial assets that arise from climate- and weather-related events, such as floods and storms that damage property or disrupt trade;
- Second, **liability risks**: the impacts that could arise tomorrow if parties who have suffered loss or damage from the effects of climate change seek compensation from those they hold responsible. Such claims could come decades in the future, but have the potential to hit carbon extractors and emitters – and, if they have liability cover, their insurers – the hardest;
- Finally, **transition risks**: the financial risks which could result from the process of adjustment towards a lower-carbon economy. Changes in policy, technology and physical risks could prompt a reassessment of the value of a large range of assets as costs and opportunities become apparent.

This speech also initiate : « the idea to establish an industry-led group, a **Climate Disclosure Task Force (later called TCFD)**, to design and deliver a voluntary standard for disclosure by those companies that produce or emit carbon. **Companies would disclose not only what they are emitting today, but how they plan their transition to the net-zero world of the future.** The G20 – whose member states account for around 85% of global emissions²⁸ – has a unique ability to make this possible. »

Moreover: «**Static disclosure** is a necessary first step. There are two ways its impact could be amplified:

- First, governments, potentially sparked by COP21, could complement disclosure by **giving guidance on possible carbon price paths**. Such a carbon price corridor involves an indicative minimum and maximum price for carbon, calibrated to reflect both price and non-price policy actions, and increasing over time until the price converges towards the level required to offset fully the externality²⁹. Even if the initial indicative price is set far below the “true” cost of carbon, the price signal itself holds great power. It would link climate exposures to a monetary value and provide a perspective on the potential impacts of future policy changes on asset values and business models.
- Second, **stress testing** could be used to profile the size of the skews from climate change to the returns of various businesses³⁰. This is another area where insurers are at the cutting edge. Your capital requirements are based on evaluating the impact of severe but plausible scenarios. You peer into the future, building your defences against a world where extreme events become the norm. This stress-testing technology is well-suited to analysing tail risks likely to grow fatter with time, casting light on the future implications of environmental exposures embedded in a wide range of firms and investments. Stress testing, built off better disclosure and a price corridor, could act as a time machine, shining a light not just on today's risks, but on those that may otherwise lurk in the darkness for years to come. »

Here is how the speech is concluded « Our societies face a series of profound environmental and social challenges. The combination of the weight of scientific evidence and the dynamics of the financial system suggest that, in the fullness of time, **climate change will threaten financial resilience and longer term prosperity. While there is still time to act, the window of opportunity is finite and shrinking**³¹. Others will need to learn from Lloyd's example in combining data, technology and expert judgment to measure and manage risks. The December meetings in Paris will work towards plans to curb carbon emissions and encourage the funding of new technologies. **We will need the market to work alongside in order to maximise their impact. With better information as a foundation**, we can build a virtuous circle of better understanding of tomorrow's risks, better pricing for investors, better decisions by

²⁹ For instance, the report of the Canfin-Grandjean Commission (2015) discusses the merits of an indicative price corridor with a maximum and minimum price that can be increased over time. See www.elysee.fr/assets/ReportCommission-Canfin-Grandjean-ENG.pdf

³⁰ These skews could be upside or downside, depending on business model and the point in the transition path.

³¹ Already our failure to act since 2010 has increased the task – since emissions persist – and the pace of decarbonisation required – for instance see <http://site.thomsonreuters.com/corporate/pdf/global-500-greenhousegases-performance-trends-2010-2013.pdf>

policymakers, and a smoother transition to a lower-carbon economy. By managing what gets measured, we can break the Tragedy of the Horizon. »

Three years later, in 2019, it seems like nothing has changed despite the COP21 and CDFT's creation :

- « The global financial system faces an existential threat from climate change and must take urgent steps to reform, the governors of the Bank of England and France's central bank have warned»[20].
- Network for Greening Financial System and its first comprehensive report emission in April 2019 [16], briefly discussed previously, needed to push ahead the enforcement of previous initiatives. Private sector is deeply solicited, on a voluntary basis which has shown its structural shortcomings with TCFD.
- At the same time, Sarah Breeden, head of international bank supervision at the Bank of England states «that time is running out to prevent catastrophic climate change and previous efforts to combat the problem have been nowhere near vigorous enough » [40] She urged our industry to incorporate climate change into our governance and risk management analysis.
- UK Parliament declared a climate change emergency on the 1st of May 2019, following a series of protests from environmental activist group Extinction Rebellion. [17] Paris has followed two months later. Concretely, an IPCC Paris will be launched with experts for the measures taken by the City Hall. They will be consulted and take "a constant place in the implementation of climate policies ». There will also be a Climate Academy to raise public awareness and support environmental projects. [65]
- Role of central banks cannot be independent anymore and climate change must urgently be integrated into long-run macroeconomic analysis (2018 Economics Nobel Prize, [William Nordhaus](#)), see also [Nicholas Stern](#) for relevant directions and despite shallow initiatives from the academic world

At the scale of investors



LONDON (Reuters) - Investors managing more than \$34 trillion in assets (14 times France' GDP), nearly half the world's invested capital, are demanding urgent action from governments on climate change, piling pressure on leaders of the world's 20 biggest economies meeting this week. In an open letter to the "governments of the world" seen by Reuters, groups representing 477 investors stressed "the urgency of decisive action" on climate change to achieve the Paris Agreement target. Almost 200 nations agreed in Paris in 2015 to limit the global average temperature rise to well below 2 degrees Celsius above pre-industrial times. Current policies put the world on track for at least a 3C rise by the end of the century.[68] **June 26, 2019**

PARIS (Les Echos) - July 10, 2019 [70] French president hosted eight of the world's leading asset managers: BlackRock, Goldman Sachs, BNP, HSBC, Natixis, Amundi, State Street and Northern Trust. This event follows the France led « One Planet Summit » initiated in 2017 to integrate climate issues into investment strategies. Les Echos has called the latest meeting a « Mini Davos at the Elysée » as the Director General of the Saudi Sovereign Fund, as well as his Kuwaiti and Norwegian counterparts, were also present. Overall, near \$18 trillion in assets were represented on this day. The charter published last year includes a set of positions and good practices aimed at promoting « a common understanding of the main principles, methodologies and indicators related to climate issues ». According to Les Echos, **each of the signatories is free to apply them according to its legal and fiduciary constraints**, the most important thing being to initiate a favorable dynamic, in the spirit of the Elysée. One of the **main barriers to the widespread use of green investments remains the lack of recognized indicators and methodologies** :

« *We are looking to develop **common standards at the global level**. This is an important project. People are impatient, but I think we're on the right track. **Within five to ten years we will have reliable and quality indicators***» says Larry Fink. The first necessary step to truly democratize green investment, concludes the article.

* * *

The Task Force on Climate-related Financial Disclosures, setting out recommendations for helping businesses disclose climate-related financial information is not evoked. Unfortunately in 2017 TCFD recommendations: « The Task Force acknowledges the challenges and limitations of current carbon footprinting metrics, including that such metrics should not necessarily be interpreted as risk metrics. **Nevertheless, the Task Force views the reporting of weighted average carbon intensity as a first step and expects disclosure of this information to prompt important advancements in the development of decision-useful, climate-related risk metrics.** In this regard, the Task Force encourages asset owners and asset managers to provide other metrics they believe are useful for decision making along with a description of the methodology used. The Task Force recognizes that some asset owners and asset managers may be able to report the weighted average carbon intensity and other metrics on only a portion of their investments given data availability and methodological issues. Nonetheless, increasing the number of organizations reporting this type of information should help speed the development of better climate-related risk metrics. » [74]

For Blackrock's CEO, it is like these words never existed. Unfortunately, the whole industry thinks and acts alike.

2/ WHAT MUST BE DONE URGENTLY?

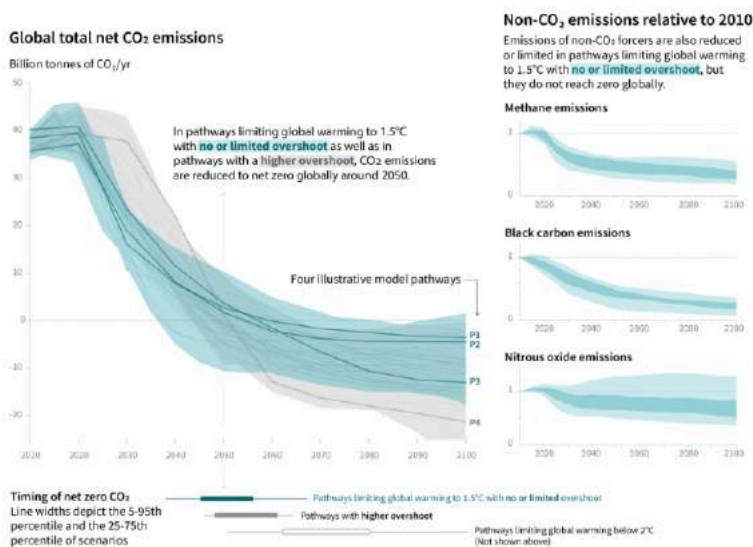
From IPCC perspective (November 2018)

The previous should probably have been started and intensified over the past 50 years. Now it is critically late. It was doable but contradicted our growth targets, hence we consciously decided to ignore it.

Now the situation is dramatic and « requires drastic action » according to IPCC. We did not treat it like a crisis as it was not called as such, let's call it an emergency now, and adapt our actions accordingly. Here is presented below the commitment we all met for the 30 years to come. This is our sole and unique compass for the rest of our lives if we pretend to be guided and to believe in science.

Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO₂, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM.3b.



And here are the only consensual ways that have been found and will concern directly the financial sector to meet this historical goal :

Focus on the Financial Sector's Responsibilities

The detailed study can be found in Chapter 4 : Strengthening and Implementing the Global Response / Section 4.4 : Implementing Far-Reaching and Rapid Change / Subsection 4.4.5: Strengthening Policy Instruments and Enabling Climate Finance:

« This section describes the size and nature of **investment needs and the financial challenge over the coming two decades in the context of 1.5°C warmer worlds**, assesses the potential and constraints of three categories of policy instruments that respond to the challenge, and explains the conditions for using them synergistically. »

This subsection consists in the following parts :

- The core challenge: cost-efficiency, coordination of expectations and distributive effects
- Carbon pricing: necessity and constraints
- Regulatory measures and information flows
- Scaling up climate finance and de-risking low-emission investments
- Financial challenge for basic needs and adaptation finance
- Towards integrated policy packages and innovative forms of financial cooperation

Here are the corresponding summaries for policy makers:

D.5. Limiting the risks from global warming of 1.5°C in the context of sustainable development and poverty eradication implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes (*high confidence*). [T–R–A]

D.5.1. Directing finance towards investment in infrastructure for mitigation and adaptation could provide additional resources. This could involve the mobilization of private funds by institutional investors, asset managers and development or investment banks, as well as the provision of public funds. Government policies that lower the risk of low-emission and adaptation investments can facilitate the mobilization of private funds and enhance the effectiveness of other public policies. Studies indicate a number of challenges, including access to finance and mobilization of funds. (*high confidence*). [R–A]

D.5.2. Adaptation finance consistent with global warming of 1.5°C is difficult to quantify and compare with 2°C. Knowledge gaps include insufficient data to calculate specific climate resilience-enhancing investments from the provision of currently underinvested basic infrastructure. Estimates of the costs of adaptation might be lower at global warming of 1.5°C than for 2°C. Adaptation needs have typically been supported by public sector sources such as national and subnational government budgets, and in developing countries together with support from development assistance, multilateral development banks, and United Nations Framework Convention on Climate Change channels (*medium confidence*). More recently there is a growing understanding of the scale and increase in non-governmental organizations and private funding in some regions (*medium confidence*). Barriers include the scale of adaptation financing, limited capacity and access to adaptation finance (*medium confidence*). [R–A]

D.5.3. Global model pathways limiting global warming to 1.5°C are projected to involve the annual average investment needs in the energy system of around 2.4 trillion USD₂₀₁₀ between 2016 and 2035, representing about 2.5% of the world GDP (*medium confidence*). [A]

D.5.4. Policy tools can help mobilize incremental resources, including through shifting global investments and savings and through market and non-market based instruments as well as accompanying measures to secure the equity of the transition, acknowledging the challenges related with implementation, including those of energy costs, depreciation of assets and impacts on international competition, and utilizing the opportunities to maximize co-benefits (*high confidence*). [T–R–A]

D.5.5. The systems transitions consistent with adapting to and limiting global warming to 1.5°C include the widespread adoption of new and possibly disruptive technologies and practices and enhanced climate-driven innovation. These imply enhanced technological innovation capabilities, including in industry and finance. Both national innovation policies and international cooperation can contribute to the development, commercialization and widespread adoption of mitigation and adaptation technologies. Innovation policies may be more effective when they combine public support for research and development with policy mixes that provide incentives for technology diffusion. (*high confidence*) [R–A]

D.5.6. Education, information, and community approaches, including those that are informed by indigenous knowledge and local knowledge, can accelerate the wide-scale behaviour changes consistent with adapting to and limiting global warming to 1.5°C. These approaches are more effective when combined with other policies and tailored to the motivations, capabilities and resources of specific actors and contexts (*high confidence*). Public acceptability can enable or inhibit the implementation of policies and measures to limit global warming to 1.5°C and to adapt to the consequences. Public acceptability depends on the individual's evaluation of expected policy consequences, the perceived fairness of the distribution of these consequences, and perceived fairness of decision procedures (*high confidence*). [T–R]

D.7. Strengthening the capacities for climate action of national and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support the implementation of ambitious actions implied by limiting global warming to 1.5°C (*high confidence*). International cooperation can provide an enabling environment for this to be achieved in all countries and for all people, in the context of sustainable development. International cooperation is a critical enabler for developing countries and vulnerable regions (*high confidence*). [A]

D.7.1. Partnerships involving non-state public and private actors, institutional investors, the banking system, civil society and scientific institutions would facilitate actions and responses consistent with limiting global warming to 1.5°C (*very high confidence*). [T–R–A]

D.7.2. Cooperation on strengthened accountable multilevel governance that includes non-state actors such as industry, civil society and scientific institutions, coordinated sectoral and cross-sectoral policies at various governance levels, gender-sensitive policies, finance including innovative financing, and cooperation on technology development and transfer can ensure participation, transparency, capacity building and learning among different players (*high confidence*). [T–R–A]

D.7.3. International cooperation is a critical enabler for developing countries and vulnerable regions to strengthen their action for the implementation of 1.5°C-consistent climate responses, including through enhancing access to finance and technology and enhancing domestic capacities, taking into account national and local circumstances and needs (*high confidence*). [T–R–A]

Significant suggestions to courageously limit the severity of our collapse gradually

Here are some suggestions by level of constraints to gradually consent to, as inspired by the above official summaries:

Minimum level: [T]EACH

- Share formation to all employees through a state of climate emergency planning. Not accepting would result in an alarming incapacity to integrate the most advanced and complete pieces of robust science and associated regulatory knowledge. Softest form of denying : refusing to call it and treat it like an EMERGENCY. Sustainable financing's concerns should not be reserved to a few as everyone needs to fully understand its causes and consequences on our daily lives. Scientific institutions should obviously be involved and concerned about the literature shift to trigger as soon as possible (see Research).
- Come to the conclusion the change will have to be drastic, and to be led from the most privileged worldwide (energetically/economically wise), from the richest industries in the richest countries. This might require psychologic support for those who can afford it. Keep in mind such progressive downgrading of our standards of life will take place soon or later anyway : *"If you don't take change by the hand, it will take you by the throat"* as Winston Churchill remarkably illustrated.
- Every living soul in the next 10 to 20 years will be affected in an even more dramatic way (in the industrialized countries: global recession, unemployment, psychologic support for the ever growing, powerless contemplation of various forms of misery, violence and destruction in the world).
- Honestly address our common emergency : *«The energy and climate transition will mean revising traditional financing decisions to **drastically shift support to sectors that will “decarbonize” the economy and to accompany energy-intensive sectors as they reduce their GHGs emissions.** »* [53]

Medium level: [R]ESEARCH

- Once we've shared this life-changing realization, make sure everyone understands the false illusion of unilateral sustainable growth through tactical « green investment » only: critically misses (1) current infrastructures' entire dependance on fossil fuels ('full-stack' carbon footprint not systematically assessed and disclosed) coupled with quality deterioration and carbon budget to meet Paris Agreements; (2) more subtle forms of pollution like contaminated water and soil depletion³²; (3) investment collaboration and financial industry-wide cooperation. IPCC's 2014 assessment report already stated *« **Effective climate change mitigation will not be achieved if each agent (individual, institution or country) acts independently in its own selfish interest (see [International cooperation and Emissions trading](#)), suggesting the need for collective action [...] financing such adaptive activities remains an issue, particularly for poor individuals and countries**»* [48] implying that the richest industries in the richest countries will have to courageously lead the way.
- Quantitative Finance literature: Risk neutral measure and assumptions on long-term valuation are fundamentally wrong, in their current form. Not effective anymore over 10, 15 years at very best (fundamentally do not question limited resources or energy depletion, quality deterioration of raw materials, carbon budget and consequent degrowth, plus (trade) war tensions), not adapted to current situation. Should profoundly wonder the purpose of their objective functions and the commonly used assumptions in financial industry. Further research or investment in the field are urgently needed, send such a message to target schools. Too much hazardous abstractions at HF scale. From John Scott, Zurich Insurance Group's Head of Sustainability Risk, in June 2019: *« Climate models are fundamentally*

³² [Great Pacific garbage patch](#), [Sargasso Sea](#), [Carcinogenic pesticides](#)

different from capital models as the former plans over decades and centuries while the latter is empirically designed to track short term ambitions.»

- Universities (masters in finance or economics): Collaborate to share immediate formation, then guidelines after multidisciplinary assessments towards decarbonization and resilient, autonomous infrastructures.
 - Investment and Portfolio Management at Imperial College Business School (M.Sc in Finance), lecture on commodities: backwardation, contango, term structures... but the economic - growth past and future relationship, coupled with their concomitant limitations in the coming years, have not been invoked.
 - Quantitative Finance Research at both Imperial and X/UPMC (world leading institutions) must start shifting their whole modeling and valuations literature towards IPCC and COP21 (perhaps TCFD) aligned objectives.
 - Mainstream economics, as currently taught across imminent universities, should generally both: (1) investigate more closely the « revelations of widespread conflicts of interest, at think-tanks, and among academic experts » documented after the subprime crisis [32], as well as the structure of economical and political systems (2) trigger the shift from their neoclassical approach, inherited by industrial revolution, towards a genuine multidisciplinary approach, recognizing its status of social science and natural systems constraints [33][34][35]
 - Students from Ecole Polytechnique, followed by other top French Grandes Ecoles created a student Manifesto « Wake up call on the environment » notably asking for social and environmentally inclusive approaches of economics, and stressed their willingness to have COP21 aligned employers [4]
 - The Shift Project has recently launched a national call in France to train all higher education students in climate and ecological issues [53b]
- Research is totally disconnected from industry : we cannot properly catch up, even with PhDs and top quantitative finance backgrounds, we only aim at optimizing profit in an increasingly convoluted way, abstracting away most of the literature (which is by essence, biased). Ecological economics or sustainable biophysics look like promising transitional directions.
- The entire economical or financial literature has been built upon the assumption of long term growth and adaptation is very challenging, as acknowledged by HSBC : « *Unlike financial accounting standards, there are currently limited industry standards or globally recognized established practices for measuring performance of this type [e.g. ESG]. We expect standards and definitions to be developed and evolve over time. We also expect innovation to lead to the creation of new products and services* » [18a, Data dictionary of Commitment 1] – TCFD also proposed promising grounds to commit to (see p.23).
- « Risk adjusted return » or « constrained optimization » to be defined based on the most essential features to maintain human life (the «return» component: life expectancy, levels of literacy...), consistently constrained by biodiversity (the «risk » component, aligned with eradication of GHGs, soil and water pollution above levels Earth cannot absorb).
- Start systematic accounting of the **energy cost as main budget for trading backtests and simulations or other computationally intensive models, both in-house or cloud servers (see Science & Technology), which will reduce a non necessary amount of noise in trading exchanges – otherwise to clearly justify how this ‘liquidity efficiency’ will contribute to meet global GHGs emissions pathways.**

High Level: [A]CT

The following has to be collaboratively discussed and agreed, within a state of climate emergency committee, composed with :

- A. The [29 systematically important banks](#), reuniting 11 countries, +90% of the richest, most polluting ones: United States (8), China (4), France (4), United Kingdom (3), Japan (3), Switzerland (2), Germany (1), Italy (1), Netherlands (1), Spain (1), Canada (1);
- B. Members of the IPCC, knowledgeable about the banking sector (might involve broader members of the UN 17 Sustainable Development Goals program);
- C. Regulators, Supervisors and Central Banks (TCFD + NGFS);
- D. Dominant technology companies (at least American GAFAM + Chinese BATX), as they capture the major part of future growth expectations, expressed by their market cap.

- Start group-wide discussions on the **meaning and purpose of our work in a carbon neutral world by 2050**. Given the current state of art on eco-decoupling³³ on the one hand, and the drastic reduction of fossil fuels burning required to meet Paris Agreements on the other hand, come to the conclusion and massively spread the word of a drastic **degrowth for the generation to come**. The more we wait, the more brutal it will be. This is unfair towards new generations. Might involve, at first, salary and revenue freezing then decreasing targets to symbolically align with Zero Net emission curves (might be proportional to eco-carbonic coupling i.e. 85%, might allocate corresponding funds in psychological supports, trainings to resilience, IPCC future works, climate-aligned regulation, support decarbonizing sectors but also energy intensive ones, or any other collaborative investment platform where we could all tackle the transition with our skills and preferences). There is no chance to meet Paris Agreement if we don't do it all at once, due to the deregulated arbitrage opportunities we contributed to spread globally and systematically. Is a market-fixed carbon price likely to be more effective than a worldwide carbon taxation to progressively refine, knowing the possibilities for collusion, price fixing and other well-documented manipulations' scandals?
- Design **cooperative mitigation and resilience strategies for the next decades**, not wait for other banks and supervisors to come at us, immediately declare a state of emergency with a financial-wide cooperation to drastically apply degrowth and transitional group-wide policies across systemic banks and tech giants, aligned with COP 21, IPCC recommendations and validated by them (only worldwide credible and organized panels to date).
- A war has begun, and since the states will not be able to make it profitable in the long term by plundering cheap resources, even in a sinister attempt to make profits at any cost [26], banks will have no interest in lending - provided that the limits of growth are finally integrated into our models, at least conceptually - to entire countries that will want to fight if there is no possibility of repaying the loan. We must **sign and honor this unbreakable promise to forbid large-scale violence** for the third time in a century;
- **GDP must be imminently replaced** by the only known and consensual metric of optimization: **GHGs emissions reduction per capita**, taking into account drastic constraints on growth needs and consumptions from most industrialized countries. To refine with gradual steps over the coming decades in collaboration with supervisors and IPCC. Acceptance will be the hardest part from the richest countries, but assumptions of economic growth are not valid anymore when they ignore physical laws and biological constraints. Propose a **worldwide standard on investments and pricing taking into account a « full-stack » carbon footprint and suitably align global consumption with the remaining carbon budget** [54]. See [Carbon Tracker](#), [TCFD Annex](#) or [IPCC dedicated sources \(4.4.5\)](#) as the only existing worldwide suggestions to enrich.

³³ Impossible so far as renewables are added on top of fossil fuels, they do not substitute, and they need fossil fuels plus other non-renewables to be built and maintained over time

- As a step forward to keep in mind, define **worldwide accepted metrics** taking into account various forms of **human-generated pollutions** (soil, water) plus other negative externalizations **beyond Earth's capacity to absorb them**, in addition to GHGs emissions. Start thinking about the way to organize a **global rationing of primary energies**, aligned with our remaining carbon budget and measurable Earth's capabilities (e.g. of new metric to represent the wealth of nations once we've reached a large adaptation phase : biosphere diversity).
- More generally, **any large scale investment or disruption should be approved by an independent and international regulatory commission**, mainly composed with independent scientists like IPCC, such that a given project should have a delimited impact on GHGs. Worldwide scientists will obviously not assess those « disruptive » projects from scratch, as they should come with an extensive description of their potential environmental impacts, at the best of the corporation's knowledge. Such systematic « precautionary principles » cannot be ignored by powerful industries and fought by lobbyist as they provenly did in the past few periods of wide ecological awareness [61][75]. It is an actual crime against humanity, more broadly against nature and generations to come, and will be widely recognized as such. Soon or later, it will, like any other previous forms of institutional oppression.

General Motors streetcar conspiracy

From Wikipedia, the free encyclopedia

The notion of a **General Motors streetcar conspiracy** emerged after General Motors (GM) and other companies were convicted of monopolizing the sale of buses and supplies to National City Lines (NCL) and its subsidiaries. This led to allegations that this was part of a deliberate plot to purchase and dismantle streetcar systems in many cities in the United States as an attempt to monopolize surface transportation.

Between 1938 and 1950, National City Lines and its subsidiaries, American City Lines and Pacific City Lines—with investment from GM, Firestone Tire, Standard Oil of California (through a subsidiary), Federal Engineering, Phillips Petroleum, and Mack Trucks—gained control of additional transit systems in about 25 cities.^[3] Systems included St. Louis, Baltimore, Los Angeles, and Oakland. NCL often converted streetcars to bus operations in that period, although electric traction was preserved or expanded in some locations. Other systems, such as San Diego's, were converted by outgrowths of the City Lines. Most of the companies involved were convicted in 1949 of conspiracy to monopolize interstate commerce in the sale of buses, fuel, and supplies to NCL subsidiaries, but were acquitted of conspiring to monopolize the transit industry.

The screenshot shows a New York Times article from 1998. The title is "INDUSTRIAL GROUP PLANS TO BATTLE CLIMATE TREATY" by John H. Cushman Jr. The article discusses industry opponents of a treaty to fight global warming who have drafted an ambitious proposal to spend millions of dollars to convince the public that the environmental accord is based on shaky science.

- **Sanction international policies denying unanimously accepted scientific conclusions and recognized regulatory guidelines:** the very minimum if we want to keep having trust in science, its contribution to any climate change policy (both public and private) and the regulatory body. For instance, following their withdrawal from Paris Agreement, by 2025 the US is set to achieve half of the reductions it pledged in 2015, suggests a new analysis [37]. Deep emissions cut are required to avoid 2°C but if all government targets were in the US range, warming would exceed 4°C, which is simply unlivable and correspond to an ultimate world war [4], meaning « this is not just an American problem » [39] and voluntary principles have been proven inefficient to urge actual commitments. A recent article backed by Facebook's Head of AI [41]: *«On 14 June [2019], President Donald Trump took one of his biggest steps yet to dismantle an important part of [the checks and laws' system insuring that international policies are guided by knowledge] in the United States: an executive order that federal agencies should cut the number of advisory panels by at least one-third. This is not just another of his ill-informed policies [...]. It is the government making itself stupid. Ignoring, suppressing or manipulating science advice has been a pattern of this administration; now the very committees that provide that advice are being eliminated. Scientists must sound the alarm. »* It should not be allowed to be skepticism anymore, as it's a denial of robust science, confirmed and refined over the last 30 years: *climate negationism* has to be punished by the law just like any other form of denial of unanimously confirmed facts.
- **Start orienting most of remaining funds for self-sufficiency** (no returns first, then negative return) **for « developing » countries** (e.g. quantified by the difference between the average kWh resources per capita and what inhabitants currently receive) **and western resilience**, sent from the top to the bottom as a powerful symbol of sincerity and awareness of current state of human conditions and parts of our responsibilities (see IPCC but also Neuropsychological section)
- **Assign officially new directives to central banks**, oriented towards (1) the stability of massive and long term climate change investments (green bonds to take into account the previously mentioned carbon tracker) [35][51], (2) working with regulators and supervisors to sanction strategies that do not disclose their GHG exposures or do not have a documented reduction strategy, (3) the necessity to remain as clear, fair and transparent as possible along the process to be positively embraced by the concerned citizens.

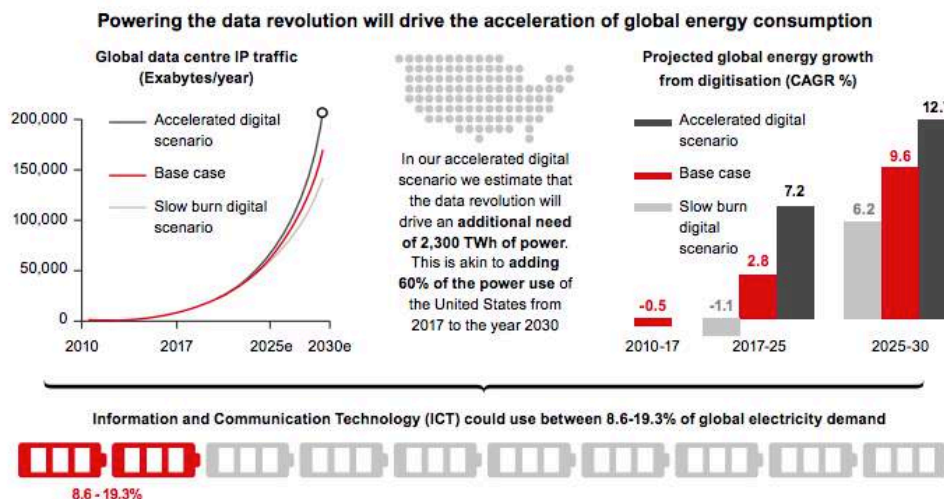
SCIENCE & TECHNOLOGY

RESEARCH IN THE DATA REVOLUTION

This topic deserves a special position in this report mainly due to the increasing « tech’s raid on the banks » as suggested by The Economist’s cover and Financial Times’ article, both dated of May 2019. « China’s biggest technology groups have won approval to launch digital banks in Hong Kong in a long-awaited assault on the financial sector that threatens local players such as HSBC and Standard Chartered and heralds future challenges in London and New York. Tencent and Alibaba were granted banking licences by the Hong Kong Monetary Authority, along with Xiaomi, the world’s fourth-largest smartphone maker, and Ping An, the world’s largest insurer, in what the city’s banking regulator called a “milestone”.» [42]



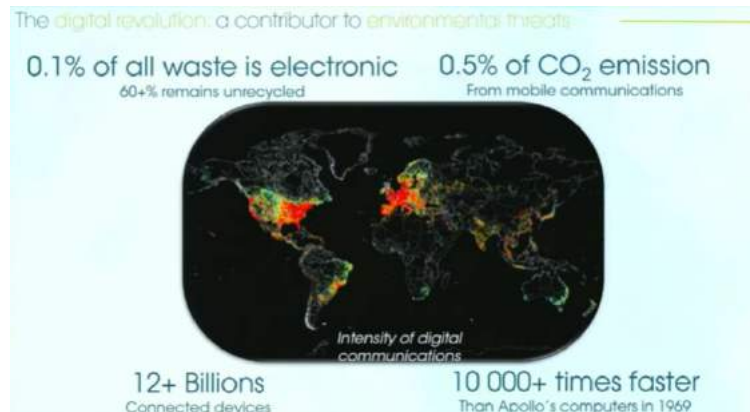
Powering the data revolution: The strains facing global electricity (July 2019) [18d2]:



From the executive summary, it is explicitly admitted that digitalisation, including the Industrial Internet of Things (IIoT) and artificial intelligence (AI), will require twice as much as electricity by 2030 to 3,900 TWh. Rapid adoption of electric vehicles (EVs) and take off in virtual reality (VR), autonomous vehicles (AV) or blockchain may take this total to 6,200TWh. Rising power consumption may strain power grids and could slow down the pace of the data revolution. The new technologies require huge data manipulation, made possible by increasingly sophisticated hardware, even larger and more powerful data centers and the next generation of communication network infrastructure (5G) which is arguably at the beginning of a tumultuous growth trajectory. HSBC believes the challenge of powering such a data revolution is

under-appreciated and the topic is under-researched : « **We think the power consumption risk of growing data usage are under-explored** » This previous was extracted for the latest report of HSBC's center of Sustainable Finance.

- 1 email with attachment = Bulb on for one hour (CO2 emissions)
- **Digital technology now emits 4% of the world's greenhouse gases (as much as aviation), and its energy consumption is increasing by 9% per year [4][71]**
- According to Yann LeCun « **In OECD countries, producing 1 kWh of electrical energy produces 500g of CO2 on average. An 8-GPU machine consumes roughly 3kW. Running this machine for one day will emit 36kg of CO2. A transatlantic roundtrip flight is about 1000kg of CO2 per person. So you can run an 8-GPU box for about a month for the equivalent of a transatlantic roundtrip.** »



We are still in community gathering GAFAM to back COP 21 objectives despite 2017 US withdrawal [38], demonstrating their willingness to tackle climate change. Hence there is a fundamental data governance to organize such that environmental ones are open, owned by human community as a whole, and collaboratively enriched and analyzed.



One example suggested by [4] : « Tools for monitoring air pollution are needed everywhere. As they are local, we will know pollution sources, we will understand them and thus, if we know how to measure we know how to improve decision-making. »

Solution recently developed : **nano-sensors**.

According to Emmanuel Bacry, Chief Scientific Officer of the French Health Data Hub, but also Head of Health/Data projects at Polytechnique (June 2019) : « There is an extremely high carbon impact of the computing cloud. We need to organize these clouds, optimize the digital supply chain, knowing that in 1 year, 80% of Internet traffic will come from streaming. It would be no sense in saying no to AI, especially because it can help, but above all it **MUST be regulated**.

Beyond the quantity of data (health card reimbursement database, 66 million in France vs. 8 million for the largest American mutuals), quality is essential (young rich and healthy for the US mutual), data bias is fundamental³⁴. The crossing of sources via platform with the health hub between the French state and Polytechnique (genomes, radio,...) increases the power of the data tenfold. If we can only link it to the basis of the APHP: the most beautiful health base in the world (except perhaps Asia), the stakes are as high as in ecology: no platform yet. The challenge would be to achieve the link between databases in: air, weather, urban planning, energy consumption, consumption. Cartography, urban planning, social sciences on demography, fundamental to cross disciplines. Unlike health data, which are individual and therefore confidential, environmental data are open! »

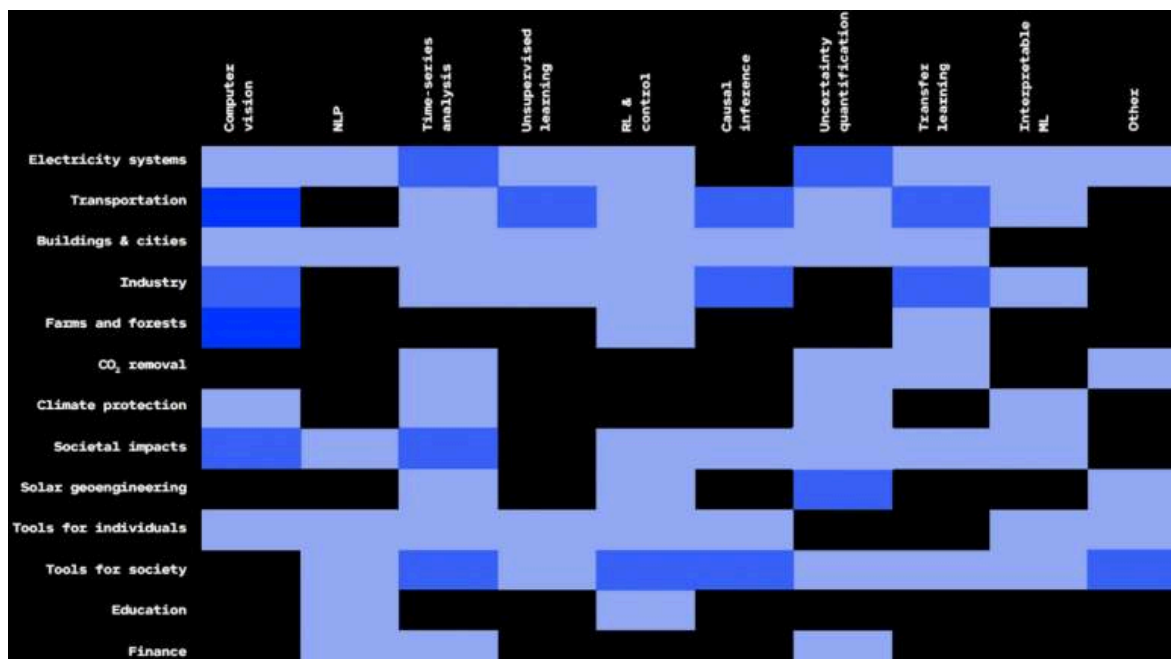
³⁴ Confirmed even further recently in June 2019 with the **ethnicity** component, [MIT AI tool can predict breast working equally well for white and black patients](#)

4.4.4. Enabling Technological Innovation (IPCC 2018)

Table 4.9 | Examples of technological innovations relevant to 1.5°C enabled by general purpose technologies (GPT). Note: lists of enabling GPT or adaptation/mitigation options are not exhaustive, and the GPTs by themselves do not reduce emissions or increase climate change resilience.

| Sector | Examples of Mitigation/Adaptation Technological Innovation | Enabling GPT |
|-----------------------------------|---|--------------------------------------|
| Buildings | Energy and CO ₂ efficiency of logistics, warehouse and shops (GeSI, 2015; IEA, 2017a) | IoT, AI |
| | Smart lighting and air conditioning (IEA, 2016b, 2017a) | IoT, AI |
| Industry | Energy efficiency improvement by industrial process optimization (IEA, 2017a) | Robots, IoT |
| | Bio-based plastic production by biorefinery (OECD, 2017c) | Biotechnology |
| | New materials from biorefineries (Fornell et al., 2013; McKay et al., 2016) | ICT, biotechnology |
| Transport | Electric vehicles, car sharing, automation (Greenblatt and Saxena, 2015; Fulton et al., 2017) | Biotechnology |
| | Bio-based diesel fuel by biorefinery (OECD, 2017c) | ICT, biotechnology |
| | Second generation bioethanol potentially coupled to carbon capture systems (De Souza et al., 2014; Rochedo et al., 2016) | Biotechnology |
| | Logistical optimization, and electrification of trucks by overhead line (IEA, 2017e) | ICT, biotechnology |
| | Reduction of transport needs by remote education, health and other services (GeSI, 2015; IEA, 2017a) | Biotechnology |
| Electricity | Energy saving by lightweight aircraft components (Beyer, 2014; Faludi et al., 2015; Verhoef et al., 2018) | Additive manufacturing (3D printing) |
| | Solar PV manufacturing (Nemet, 2014) | Nanotechnology |
| | Smart grids and grid flexibility to accommodate intermittent renewables (Heard et al., 2017) | IoT, AI |
| Agriculture | Plasma confinement for nuclear fusion (Baltz et al., 2017) | AI |
| | Precision agriculture (improvement of energy and resource efficiency including reduction of fertilizer use and N ₂ O emissions) (Pierpaoli et al., 2013; Brown et al., 2016; Schimmelpfennig and Ebel, 2016) | Biotechnology, ICT, AI |
| | Methane inhibitors (and methane-suppressing vaccines) that reduce livestock emissions from enteric fermentation (Wedlock et al. 2013; Hristov et al. 2015; Wollenberg et al. 2016) | Biotechnology |
| | Engineering C3 into C4 photosynthesis to improve agricultural production and productivity (Schuler et al., 2016) | Biotechnology |
| Disaster Reduction and Adaptation | Genome editing using CRISPR to improve/adapt crops to a changing climate (Gao, 2018) | Biotechnology |
| | Weather forecasting and early warning systems, in combination with user knowledge (Hewitt et al., 2012; Lourenço et al., 2016) | ICT |
| | Climate risk reduction (Upadhyay and Bijalwan, 2015) | ICT |
| | Rapid assessment of disaster damage (Kryvasheyeu et al., 2016) | ICT |

Most complete piece of work achieved so far by the worldwide AI|ML community (June 2019):



Some of the biggest names in AI research have laid out a road map suggesting how machine learning can help save our planet and humanity from imminent peril. The report covers possible machine-learning interventions in 13 domains,

from electricity systems to farms and forests to climate prediction. Within each domain, it breaks out the contributions for various sub-disciplines within machine learning [28].

Here are just 10 of the “high leverage” recommendations from the report:

1. Improve predictions of how much electricity we need
2. Discover new materials
3. Optimize how freight is routed
4. Lower barriers to electric-vehicle adoption
5. Help make buildings more efficient
6. Create better estimates of how much energy we are consuming
7. Optimize supply chains
8. Make precision agriculture possible at scale
9. Improve deforestation tracking
10. Nudge consumers to change how we shop

Financial part is unfortunately very limited to the mention of broad topics like climate investment and climate analytics in a single page, again acknowledging that « **To date, the field of climate finance has been largely neglected within the larger scope of financial research and analysis** ».

* * *

Google has opened its first Africa Artificial Intelligence lab in Ghana in 2019 [43]. However, given the current efforts operated by industrial countries to reduce their greenhouse gases emissions, Ghana will no longer be livable by 2100. Here is one exemple, among many others, of a well-intentioned initiative to provide developing world with most advanced technology, but resulting in a major priority misstatement given the climate crisis to be tackle immediately.

Similarly for **Libra (Facebook’s cryptocurrency) with a much wider ambitions** : Supervisors and regulators have an essential role to play in monitoring global financial institutions towards their incorporation of climate change crisis ongoing. Might be contradictory from Facebook, officially signing the « We are still in » project, to complicate regulators’ work even more with a new global disruption which is not aiming at solving climate crisis. [44] [45]

Also Yann Le Cun, Facebook’s Head of AI and co-recipient of 2018 Turing Awards, thoughtfully condemned the dangerous path taken by US to deny science panels, nature and laws of physics. This is a judicious position to be pushed forwards regarding any worldwide disruptive policies, including corporations’ ones.



In this article [41], the author also wrote : « Scientists must sound the alarm. » Unfortunately they already did, and several times. No one listened and we’re still listening to the wrong people.

Similarly with **5G deployment (key equipment manufacturer and China’s technical R&D lead in 5G being Huawei)** in Europe, leading to an inevitable growth of the infrastructure costs [46]. According to a recent European Parliament survey « 5G is more complex than previous wireless technologies and should be considered as a long-term project to solve technical challenges and develop a clear business case. » [47] « The lingering security concerns of the EU

member states, principally France, Germany, the UK and Poland as well as the USA and Japan have stalled its endeavors to participate in the largest commercial rollouts for 2020. » Again, policymakers are already overwhelmed by climate risks to be incorporated in major corporations' governance, any new disruptive tool should extensively justify its ecological necessity.

* * *

Let's recall one of the dedicated IPCC's recommendation :

D.5.5. The systems transitions consistent with adapting to and limiting global warming to 1.5°C include the **widespread adoption of new and possibly disruptive technologies and practices and enhanced climate-driven innovation.** These imply **enhanced technological innovation capabilities, including in industry and finance.** Both **national innovation policies and international cooperation can contribute to the development, commercialization and widespread adoption of mitigation and adaptation technologies.** Innovation policies may be more effective when they combine public support for research and development with policy mixes that provide incentives for technology diffusion. (*high confidence*)

« Governments of the world » are regularly targeted by central banks [67] or worldwide investors [68] to lead the drastic changes we need. However, beyond the private sector responsibilities already largely recalled, one must keep in mind the point made on **vote** in the section Energy & Growth, where we already highlighted the danger coming from post truth politics and their widespread propagation through social networks.

As such and probably despite their willingness, tech giants have an unprecedented influence on voters. The **Facebook–Cambridge Analytica data scandal.** Indeed, it revealed that Cambridge Analytica had harvested the personal data of millions of people's Facebook profiles without their consent and used it for political advertising purposes. It has been described as a watershed moment in the public understanding of personal data and precipitated a massive fall in Facebook's stock price and calls for tighter regulation of tech companies' use of data. [69]

How does high-tech raise the question of resources even more acutely? Arbitration is a function of the degree of progress in technical sophistication. Between having a plough and having draft animals or not, it is obvious that the comfort differential for the human species is enormous. But our current technical aids bring us totally marginal gains in comfort. For example, we have just developed **robots to park your car at the airport.** Georgescu-Roegen's sentence becomes particularly relevant here. Do we really have to go make holes in the ground, add CO₂ to the atmosphere, remove corals, create water stress, simply because we're lazy to park our cars when we go on a plane - which is itself only an element of comfort? We have used our time and resources to obtain a totally marginal increase in comfort for the human species at the expense of a much less marginal increase in pressure on the environment. That is why we must be able to make the arbitration that is implicit today explicit, and make people around us understand that an additional robot to park an additional car in an additional car park when we take an additional plane, it is also an additional source of poverty, wars, misfortune, threat to democracy...

Interestingly, if we recall the historical perspective towards « ecological awareness » having led, potentially with a deep sincerity, to underground coal extraction for solving an eyes-catching deforestation, the parallel is troubling.

The progress achieved through modern science and technology is astonishing, especially since the emergence of the so-called « Fourth paradigm of science » which is Data Intensive Scientific Discovery [57] and its necessary infrastructure.

« The 1400 billion tons of INVISIBLE CO₂, trapped in the lower atmosphere, are there. Biodiversity is declining, the major CO₂ emitters are now the richest 20% of the planet. The way of life developed since the beginning of the 19th century by the bourgeoisie of industrialized and colonizing countries has become the globalized daily life of a fifth of our world.

Today coal consumption continues to grow, oil production has surpassed the 100 million barrel per day mark. Then we realize that the production of solar panels is extremely demanding in terms of mining products, and our digital infrastructure is more and more energy-intensive. The promise of saving the planet through these so-called green

technologies and dematerialization is increasingly reminiscent of the promise to save forests and climate with coal from the early 19th century. » [7b]

NEUROPSYCHOLOGICAL PERSPECTIVE

Our brain is not programmed to represent the ecological crisis : « Accustomed to linear evolution, the brain of a non-mathematician man does not grasp one of the particularities of exponential growth: its speed. This inability to be intelligent is one of the elements that allows us to understand the evolution of our ecological consciousness. Our brain intuitively makes us perceive the ecological apocalypse, although foreseeable over a 50-year horizon, as a possible event in an extremely distant future. »[63]

According to Sébastien Bohler, doctor of neurosciences : « This incoherence of habit in the face of evidence comes from the deep structure of our brain. One of the structures buried in our brain is called the **striatum**. He sends us dopamine, therefore reward, or pleasure, when we perform simple tasks: eating, having sex, elevated social status, having recognition (domination), having as much information as possible about our environment, and minimizing his efforts (seeking as much comfort as possible).

If striatum has allowed the human species to survive, it can also get carried away. Today, in our society of plethora, food, sexual content, ways of feeling more important than others, sources of information and comfort, are produced at the industrial level in an unlimited way. So our striatum can consume as much as it wants, and the problem is that it has no stop function, no brake. He will therefore take everything that is offered to him by this industrial system, and this is where we can switch to permanent addiction: sexual addiction, addiction to food, addiction to social networks... Commercial strategy born in the early 1920s.

Solution? Stimulate other areas by changing societies. If the social norm values sobriety, altruism, sharing, slowness in lifestyle habits, then our striatum will give us pleasure in that. But for it to become a social norm, it must be valued. That is, individuals who behave in this way are considered to be the leaders of our societies.

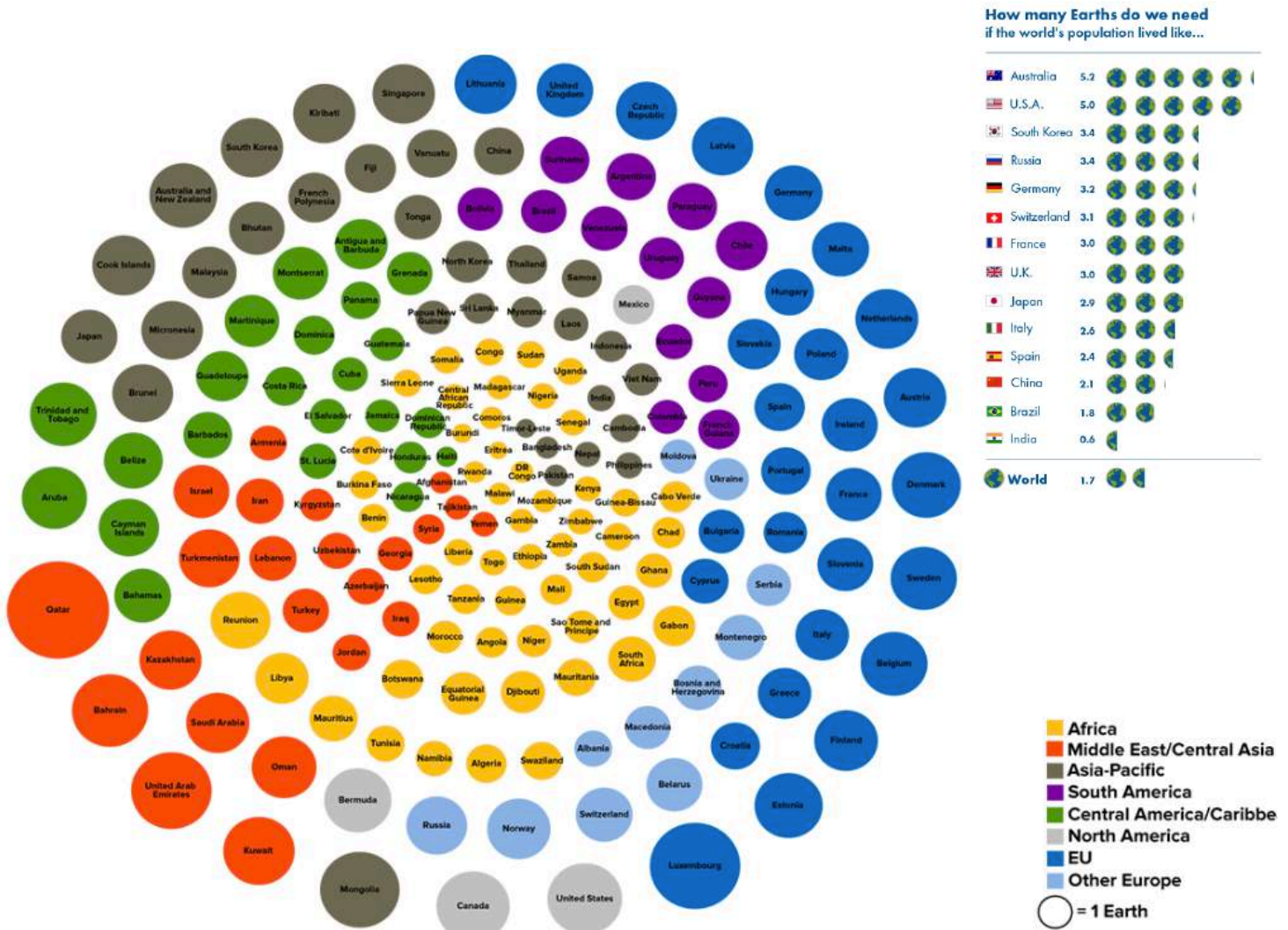
Unlike the accumulation of goods, the pleasure of giving is the only one that does not fade, that does not diminish as it is repeated. This could potentially be a sustainable solution, discovered in an international journal at the end of 2018.

Above the striatum is the cerebral cortex. This is what we use to build rockets and smartphones. **Our societies have used their cerebral cortex to make intelligence, technology, but the cortex also has the ability to create consciousness.** Consciousness is not intelligence, it is another capacity, underdeveloped in our countries with high industrial and technological value. We must move from a technological civilization to a civilization of consciousness. For the civilization of consciousness can turn on itself, and consider paths that have never been imagined. »

This other argument, presented by three economists from the French Development Agency: « *Consumption inequalities are also a driving force behind carbon-intensive consumption behaviour. We know that the desire to imitate social behaviour considered superior is one of the main determinants of consumption patterns, a phenomenon of mimicry that accelerates the dynamics of intensive emissions when the reference is the last percentile, i.e. the richest 1%. » [64]*

CONCLUSION

How many Earths would we need if the world's population lived like... [66]



Each year, the Earth Overshoot Day (EOD) is getting earlier and earlier. In 2019, for the first time since the metric was created, the EOD will be in July. On the **29th of July 2019**, humanity's resource consumption for the year exceeds Earth's capacity to regenerate those resources that year. In other words humanity would need +1.7 Earths.

When The Club of Rome published their alarming report in 1972, humanity barely needed more than 1 Earth with a EOD close to the last day of December. The strength of their intuition, despite a relatively more sustainable world, is astonishing. Equally is our consistent stubbornness since then.

The collapse of modern civilisation through energy shortages, resource depletion, top soil loss and pollution are all symptoms of the whole single larger problem: **growth**. Almost none of us ever profoundly questioned this background assumption and civilization's goal. Its modern form and ideology being the dominant free market and deregulated capitalism. As financial system demands endless growth, reform is unlikely to succeed.

Our very purpose is at stake.

Science and technology became so sophisticated and powerful in recent human history that the handful tech giants, like systemically important banks, now have a centralized, worldwide influence like no empire ever dreamed of. This leads to unbelievable responsibilities in solving a global crisis and immediately shift away from this irreversible path to an ultimate World War.

It will require tremendous sacrifices.

How can we imagine the least developed, equipped and resourceful industries (countries or individuals) will lead such drastic changes? What extra sources of energy do they have to achieve them? Is there any chance to tackle this unprecedented challenge if the most powerful institutions do not fully collaborate, still follow their usual competitive and irrational growth-aligned agenda?

If the above technologies pushing farther our numerical carbon footprint are necessary to tackle climate change or ease regulators' work on the matter, they should be thoroughly justified before any precipitated launch. Such information have not been disclosed so far.

It is no longer permissible today to doubt the collapse of life.

Hence the most relevant question we should all ask ourselves consist in a single alternative : do we want to keep developing new phones, supercomputers, sophisticated trading strategies, in a world where the very essence of life is compromised?

As highlighted in [52] and to balance the intentionally quantitative tone used in this letter, here's how the Committee for the Prize in Economic Sciences in Memory of Alfred Nobel [put it, as they praised Mr Nordhaus's work](#):

« Given the large uncertainties about future climates, *thinking about appropriate policies involves – explicitly or implicitly – taking a stance on risk and uncertainty. Likewise, any policy considerations involve taking a stance on discounting.* Since the effects of carbon emissions are much more long-lived than humans, it becomes critical to value the welfare of future generations. On both accounts, **moral values may be necessary to complement scientific measurements.** *What models can do is to translate different value judgments into different paths for policy.* »

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