CLIMATE CHANCE 2019

GLOBAL OBSERVATORY
ON NON-STATE
CLIMATE ACTION

SECTOR-BASED BOOK

SYNTHESIS REPORT ON CLIMATE ACTION BY SECTOR

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PRESENTATION

Climate Chance

Since 2015, the Climate Chance Association is participating in the mobilization against climate change. It is the only international organisation that aims to bring together all the non-state actors recognized by the UN (the 9 groups of actors: lo-cal authorities, companies, NGOs, trade unions, scientific community, agricultural, youth, indigenous peoples and women organisations), to develop common priorities and proposals and to strengthen stakeholders dynamics through networking (thematic coalitions, summits, ac-tion portal).

The Observatory and the "Sector-based Book"

In order to strengthen the action of non-state actors and give credibility to climate stabilisation scenarios, the Climate Chance Association launched in 2018 a Global Observatory of Non-State Climate Action, which aims to explain the evolution of greenhouse gas emissions, by crossing national public policies, with sectoral dynamics, strategies of private actors, local public policies, and all the actions undertaken by non-state actors at the local level.

In this book, we propose a synthesis of the recent literature and the ongoing trends of actions, to explain the evolution of GHG emissions in the following sectors : energy production, transports, buildings, industry, waste, and land uses.

The Climate Chance Association and its Observatory are supported by

2019 global trends and context

Following the first 2018 Synthesis Report on non-state climate action, a synthesis on major action trends and initiatives led by non-state actors since the adoption of the Paris Agreement in December 2015, this second edition aims to evaluate (based on available data), the difficulties and progress achieved, by identifying the drivers of the greenhouse gas (GHG) emissions trajectories. This 2019 "Sector-based Book" focuses on evolutions that occurred in the main sectors of GHG emissions, from energy production to waste, building, transport, industry and land use.

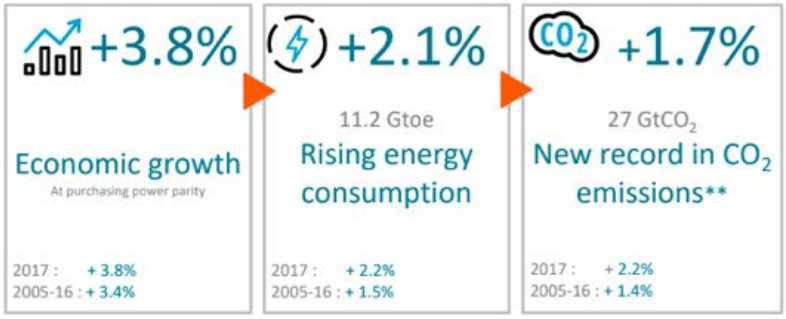
Rising emissions

This analysis of non-state actors' action is carried out in a context of growing emissions, which increased by 1.7% in 2018 among G20 countries, compared to 2.2% in 2017 (Enerdata 2019 – fig. 1). This continued increase, after several years of stagnation, shows that the world is unable to decouple GDP growth from emissions. In 2018, as Enerdata reveals, it is indeed sustained economic growth within the G20 (+3.8% on average) mainly driven by non-OECD countries, which explains the continuation of this trend.

FIGURE 1

KEY CLIMATE-ENERGY FIGURES OF THE G20 IN 2018

Source: Enerdata, Global Energy Trends 2019



* G20 countries account for 80% of global energy consumption
** Energy-related CO_2 emissions from energy combustion (> 80% of CO_2 emissions)

While progress is being made in most sectors, particularly in terms of efficiency in the use of energy in transport or construction, its effect is systematically offset or even cancelled out by population growth and the energy demand of the emerging middle classes accessing lifestyles with a high carbon footprint.

$MtCO_2$	2015	2016	2017	2018	Variation 2015-2018
G20	30118,5183	29950,6533	30385,113	30893,5882	2,6%
Argentina	201,6008	202,0471	196,3659	193,4334	-4,1%
Australia	409,6533	423,971	423,5875	427,8005	4,4%
Belgium	110,9841	109,5163	108,8281	110,1653	-0,7%
Brazil	521,8266	481,3963	490,5235	463,4401	-11,2%
Canada	628,3793	616,4979	613,9583	622,3531	-1,0%
China	11029,1624	11032,5768	11228,048	11522,7633	4,5%
France	338,4186	337,1804	341,7709	328,978	-2,8%
Germany	795,1003	799,0262	n.a.	n.a.	
India	2268,8873	2291,1702	2411,3838	2511,7137	10,7%
Italy	356,8434	353,7822	349,1947	346,7473	-2,8%
Japan	1231,8102	1222,1986	1205,7341	1178,7374	-4,3%
Mexico	475,424	478,7246	478,1192	470,2729	-1,1%
Russia	1836,7345	1809,9151	1931,4605	2006,4048	9,2%
Saudi Arabia	577,7807	573,3661	578,8289	553,2072	-4,3%
South Africa	430,4121	436,1328	433,2059	440,7758	2,4%
South Korea	692,3866	709,3655	n.a.	n.a.	
Turkey	374,9792	398,5889	433,0105	442,4108	18,0%
United Kingdom	422,9749	398,3288	n.a.	n.a.	
United States	5242,3552	5138,5619	5072,6829	5212,5859	-0,6%
Indonesia	526,9565	524,0286	n.a.	n.a.	
European Union	3578,7179	3563,0488	3573,0972	3503,1762	-2,1%

Difficult trends to reverse in all sectors

Overall, global GHG emissions (+1.7% in the G20) grew at a slower pace than energy demand (+2.1%), as a result of the decarbonation of the energy mix, which remains too slow. Fossil fuels still account for 80% of the total.

ELECTRICITY PRODUCTION is responsible for two-thirds of overall emissions of the energy production sector, coal is the first cause in China and in India. Fossil electricity production, particularly coal (two-fifths of production but three-quarters of its emissions from the electricity sector in 2018), represents about 80% of the growth in emissions of the electricity sector. In the United States, shale gas is increasingly replacing coal because of extreme weather conditions. Gas consumption jumped 10%, and despite Trump's promises on the "Beautiful Clean Coal", the share of coal, less and less competitive, fell from 28% in 2018 to 25% in 2019. According to the US Energy Information Administration, this share will continue to fall to 22% in 2020. Together, these three countries are responsible for 85% of the increase, while some others have experienced a decrease in their energy production emissions, notably Germany, Japan, Mexico, France of the United Kingdom (IEA, 2019). The Observatory wrote a case study dedicated to the UK's decarbonation model in the 2019 Synthesis Report. The impact of Chinese electricity emissions, was also the subject of a case study in the 2018 Synthesis Report and remains considerable. Their emissions cancel out the efforts of the rest of the world: in the first six months of 2019, the world (excluding China), saw its coal-fired electricity

generation capacity decrease by 8.1 gigawatts (GW), but over the same period, China developed its own capacity by nearly 35 GW (Global Energy Monitor, 2019).

Although some countries (such as in Europe and European Union) have changed their taxes to reduce public support for fossil fuels, they received record subsidies in 2019, mainly in China, Iran, Russia and Mexico. As for the United Kingdom, which has committed itself to getting out of coal by 2025, with real results, it has at the same time increased its subsidies to export of fossil energy projects by a factor of 11 in one year. Nevertheless, the projections revealed by the IEA on 20th November 2019, based on investment projects already planned, show an appetite for gas, oil and even coal in the coming years. This is completely incompatible with compliance with the Paris Agreement. By 2030, the States expect coal and oil and gas production to be 17%, 10% and 5% higher than what is required to comply with the nationally determined contributions under the Paris Agreement.

"United Kingdom has remarkably reduced its share of coal, but multiplied by factor 11 the subsidies to fossil energy exports"

THE OTHER MAJOR SECTORS are not showing any more signs of improvement. The analysis we develop in this 2019 Synthesis Report, particularly on sectors that were not explored in the 2018 edition - building and waste - follow the same general trends. The global appetite for the same mode of development leads to an almost mechanical increase in emissions, with obviously an important role for the political authorities, which strongly influence the behaviour of various actors. Sometimes, decisions taken for any other reason may even have significant indirect, even structural, impacts on a sector's emissions. The decision of Asian countries, led by China, to close their borders to Western waste has forced European and American cities to adapt their own treatment capacities, and Asian countries to strengthen their sorting practices in order to supply their equipment. Eventually leading to an amendment to the "Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal", the international treaty designed to reduce the movement of hazardous waste between countries. As plastic waste is now classified as hazardous, it allows developing countries obtaining information on the waste entering their territory and, if needed, to refuse their entry. We study that in the "Waste" case study, a sector explored for the first time, even if it is one of the areas where it is often difficult to quantify the changes presented in CO_2 tonnes.

IN THE BUILDING SECTOR (28% of emissions - IEA, 2018), the explosion in the number of square metres built but also the multiplication of uses, primarily for air conditioning, is ruining the progress made in terms of envelope efficiency. For example, the number of air conditioners in service, which has already increased by 40% since 2010, 15% of which in 2018 could rise from 1.6 billion today to 5.6 billion in 2050. In this context, European or Japanese energy efficiency requirements, which make their equipment 25% more energy efficient than that of the United States, are obviously not enough to reverse the trend.

IN THE TRANSPORT SECTOR (24% of emissions - IEA, 2018), vehicle performance and the penetration of electrification and biofuels are being wiped out by the growth in international trade and maritime traffic, the explosion in air traffic (which is expected to double again by 2037) and the vogue for SUVs (sport utility vehicles). These hybrids between minivans and 4x4s are so fuel-greedy that they are causing a big concern, all the way up to the International Energy Agency. Indeed, they were the second largest source of increased CO_2 emissions in the world between 2010 and 2018, ahead of heavy industry, heavy lorries, aviation and even maritime transport, and their growth is offsetting progress in engine weight reduction and efficiency. We explore this in the "Transport" fact sheet 2019. In it, we highlight, in connection with the case studies of these two countries, the role of the German government, which under pressure from its automobile industry, succeeded in autumn 2018 in curbing European ambitions in terms of pollution standards applied to new vehicles, and conversely, the Norway's voluntarism where the development of a concerted policy between all actors enabled a record penetration of electric mobility.

THE RAVAGES OF DEFORESTATION (10% of global GHG emissions) continued in 2018 with 12 million hectares lost. According to Global Forest Watch, the Democratic Republic of Congo, Brazil and Indonesia are among the countries that lost the most primary forest in 2018, although the latter significantly reduced its level of deforestations over the past two years, with some effectiveness of laws to protect humid forests. Ghanaian forests are under pressure from farmers, especially the cocoa industry. In Brazil, the deforestation rate increased by 60% between 2017 and 2018. Loggers and farmers, who practice burning, undoubtedly perceived President Bolsonaro's speeches and decisions on forest protection laws as an incentive. According to the National Institute of Space Research (INPE), deforestation in the Amazon increased by 278% between July 2018 and July 2019. On the other hand, some national decisions have a positive influence on the evolution of emissions.

Renewable production is growing without replacing fossil production

Driven by a steady decline in their production costs (by 75% since 2010 for photovoltaic, 20% for onshore wind power and 50% for battery electricity storage systems) **RENEWABLE ENERGIES** continue their sustained development. **With 13% of extra capacity installed, they produced 27% of the world's electricity, behind coal but ahead of gas and nuclear power.** According to the IEA, installed renewable capacity is expected to increase by 50% between 2019 and 2024 and solar energy, almost away more competitive than coal, will become the leading source of electricity by 2040. The future of the global climate continues to be largely determined by this race between fossil fuels and renewables; if the latter did not caught up in 2018, they strengthened their positions though. The role of the major public and private financial actors, which we explore in our 2019 "Finance Book", will be crucial for the outcome of this competition. In 2019, State Development and Investment Corp., the Chinese sovereign wealth fund, and the Swiss bank UBS notably announced the end of their investments in coal plants (IEEFA, 2019). Faced with this reality, actors are organising the decline in conventional production by separating growing activities (renewable, services, etc.) from fossil

assets. This transition is coming to an end for the German company RWE, which has divested itself of many fossil assets to become the 3rd largest renewable producer in Europe.

"Historical actors organize the decline of conventional power production separating their growing activities (renewables, etc.) from fossil assets"

The action of the various non-state actors, from economic investments by companies to the daily choices of each one, is strongly influenced by national regulatory frameworks and this synthesis report therefore also focuses on the evolution of legislation. On this point, the synthesis report exposes many encouraging signals. The development of electric renewables production is based on, for instance, an increasing amount of auction systems from major distributors, which is a clear sign of the economic competitiveness of these productions: they were organised with the help of 48 countries in 2018 (compared to 29 in 2017), including, for the first time, Benin and Kenya. These two countries' commitments were already highlighted in our 2018 edition of the non-state climate action report.

Since recently, China has introduced solar and wind quotas in electricity consumption, and the United States reinstated, in 2018, a 30% tax credit for the installation of domestic wind energy systems. New economic models enhance the decentralisation of production, our report details a number of them, without of course claiming to be exhaustive, by stating in our "Local Action Book", the importance of the legislation carried by local governments, in particular the federal states. In India, the "roof rental" - used 10% of solar roof installations - makes it possible for owners to provide their roofs to developers who will sell them the electricity produced at a lower rate than public electricity. With net metering (adopted at national level by Indonesia in 2018, but also by 38 American states), a small producer who is also a consumer can deduct from his electricity bill the excess production he feeds into the grid. The possibility for individuals, public bodies, small businesses or farmers to produce their own energy is growing. Germany is a pioneer in this field, but the Netherlands has nearly 500 citizen power cooperatives, 85 of which were created in 2018.

Multi-stakeholder sector-based initiatives

As well as the major sectors where government strategies and decisions and the dynamics of non-state actors constantly intersect, specific sectors are building new global roadmaps to reduce their emissions and organise this evolution over time, closely followed by states. This is true for instance for the maritime and air transport sectors, both out of the scope of the Paris Agreement, and whose emissions can hardly be put down to one country or another.

In 2016, the International Civil Aviation Organisation, dubbed OACI, therefore adopted an off-setting programme called CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation). This programme is supposed to enable the organisation to achieve carbon neutrality by 2020 through offsetting and to halve its emissions by 2050 compared to 2005. This target seems very ambitious in view of the evolution of traffic. Many airlines in 2019, have witnessed an improvement in carbon intensity of their operations (Turkish Airlines, Lufthansa, JetBlue, etc.) which is far from offsetting the increase in demand. As a result, global aviation CO_2 emissions have risen by 32% over the past five years, reaching a total of 900 million tonnes of CO_2 in 2018 (ICCT, 2019).

In maritime transport, the 173 member states of the International Maritime Organisation (IMO) agreed in April 2018, to reduce their greenhouse gas emissions by 50 per cent by 2050, compared to 2008 levels. While the current trajectory shows that this target is not about to be met, some companies are making progress, such as Maersk, which has reduced its emissions by 41% since 2008. In Norway, civil society's contestation and the increasingly stringent legislation on GHG and air pollutant emissions from ships are prompting companies in the sector to quickly convert their ships to hydrogen and electricity (see 2019 case study).

Cement, which accounts for around 6% of GHG emissions, is interesting, and we mention it for the first time. Cement manufacturers have launched several initiatives. Created in 1999, under the auspices of the World Business Council for Sustainable Development, the Cement Sustainability Initiative was taken over in 2019 by the Global Cement and Concrete Association, that was initially created by 38 companies in early 2018 and represents about one-third of global production. The Association published recommendations for emissions accounting in October 2019 (GCCA, 2019). To date, the only progress recorded is a 1% decrease in the carbon intensity of global production between 2014 and 2018, a rate that must be doubled in order to meet the goals of the Paris Agreement.

Citizens: mobilisation, legalisation, and behavioural changes

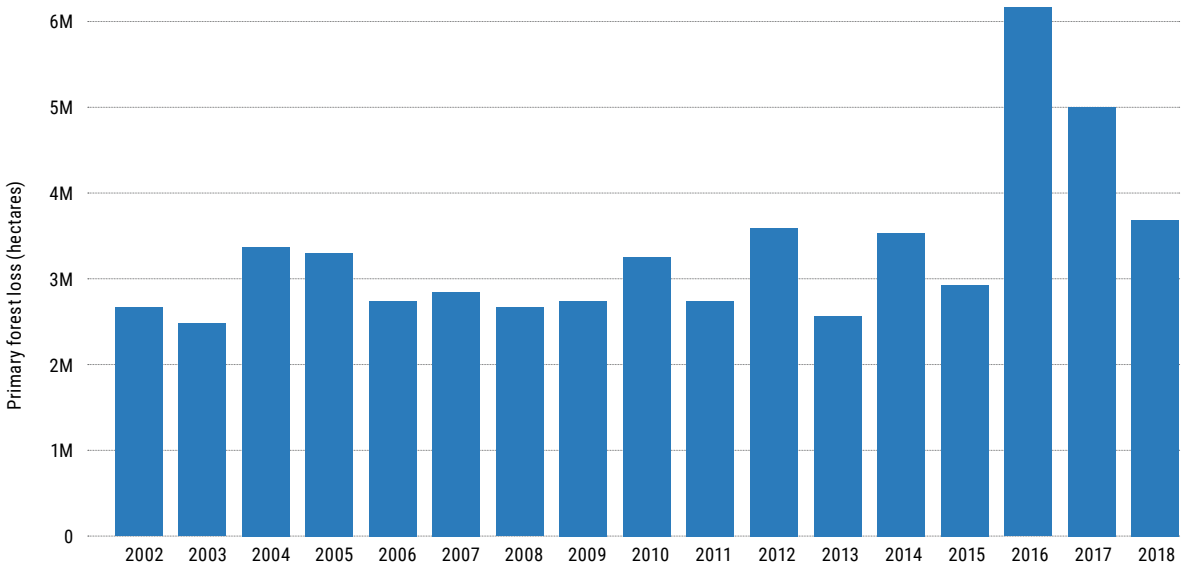
In 2019, mobilisations around climate issues really took off. In response to the upsurge in extreme events, the publication of reports highlighting the impacts of climate change on topics as diverse as health, food security, migration flows, and the alarmist projections of many scientists in recent months, climate marches, school strikes and other challenges to specific projects have thrived. Citizens and especially young people are now in the forefront through movements such as Youth for Climate or Extinction Rebellion and are rebelling against the delay in the fight against climate change for which they hold states responsible. Greta Thunberg is undoubtedly the non-state actor of the year.

Mobilisation of citizens also resulted in climate-related legal affairs: a trend that we highlighted last year, notably buttressed by UNEP in 2017, and which has been strengthened this year. Disputes between citizens and States over their inability to respect their political and legal commitments to reduce emissions or adapt; there are also disputes between cities and States, and disputes led by cities against the European Commission or against companies in singled out sectors (such as oil companies).

By 2018, there were more than 1,000 litigation cases in 25 countries, including over 600 in the United States alone. German farmers opposed the Berlin Administrative Court on the grounds of non-compliance with the 2020 targets, the sharing of European efforts (Effort Sharing Decision) and the Paris Agreement. In November 2018, the Quebec collective Enjeu filed an application in the Superior Court seeking recognition of the federal government's infringement of several rights protected by the Canadian Charter of Rights and Freedoms (right to life, right to security of the person, right to live in a healthy environment that respects biodiversity, right to equality).

FIGURE 2

GLOBAL ANNUAL TROPICAL PRIMARY FOREST LOSS (HECTARES) - *Source: Global Forest Watch, 2019*



But the question is also to analyse the impact of these court decisions. In December 2018, the European Union Court ruled in favour of the cities of Paris, Brussels and Madrid, noting that the Commission could not relax the limits on nitrogen oxide emissions and derogate from the Euro 6 standard by raising the cap and allowing diesel cars to exceed the maximum level of nitrogen oxide emissions allowed. In our 2018 Synthesis Report, we highlighted the landmark court decision of the Colombian Supreme Court, which declared the Amazonian forest a "subject of law" and required the Colombian State to implement concrete measures for its protection, including the creation of an "Intergenerational Pact for Life in the Colombian Amazon" (Pacto Intergeneracional por la Vida del Amazonas Colombiano-PIVAC). One year later, as the deforestation of the Colombian Amazon remained out of control and the measures ordered by the court decision had not been implemented (El Espectador, 2019), Colombia signed last September, with six other Amazonian neighbouring States, the "Leticia Pact" by which they committed themselves to effective measures for its protection (Mongabay, 2019).

The decision taken in 2015 in the landmark case between the NGO Urgenda and the Netherlands, ordering the authorities to reduce their emissions by at least 25% by 2020 (despite the EU's 20% target), was confirmed in October 2018. The Dutch authorities have announced that they are appealing to the Court of Cassation, while specifying that this procedure has "no impact on the government's commitment to reduce CO_2 emissions by 25% by 2020".

Other mobilisations by NGOs and residents have also presented brilliant results. For instance, the several coal projects were abandoned, including the Mong Kok coalmine project in Burma (Myanmar Times, 2019), the Celukan Bawang power plant in Indonesia (Chinadialogue, 2019) and the Merrimack power plant in the United States (ABC, 2019).

But beyond these challenges, citizens are changing their own behaviour: the "Meatless Mondays" that first started in 2003 in the United States had a snowball effect, taking place in the canteens of schools, campuses, hospitals, etc. in 40 different countries. In terms of transport, it was in Sweden that the Flygskam (literally, "shame to fly") was born, accompanied by the "staycation" trend (staying in your city for the holidays). Closer to home, the 4.7% decline in private car transport in

Ile-de-France since 2010 is a striking sign. Globally, the first ever drop in new car sales, as well as the strong growth of single-electric light vehicles (ELVs) in cities around the world, are also weak yet encouraging signals.

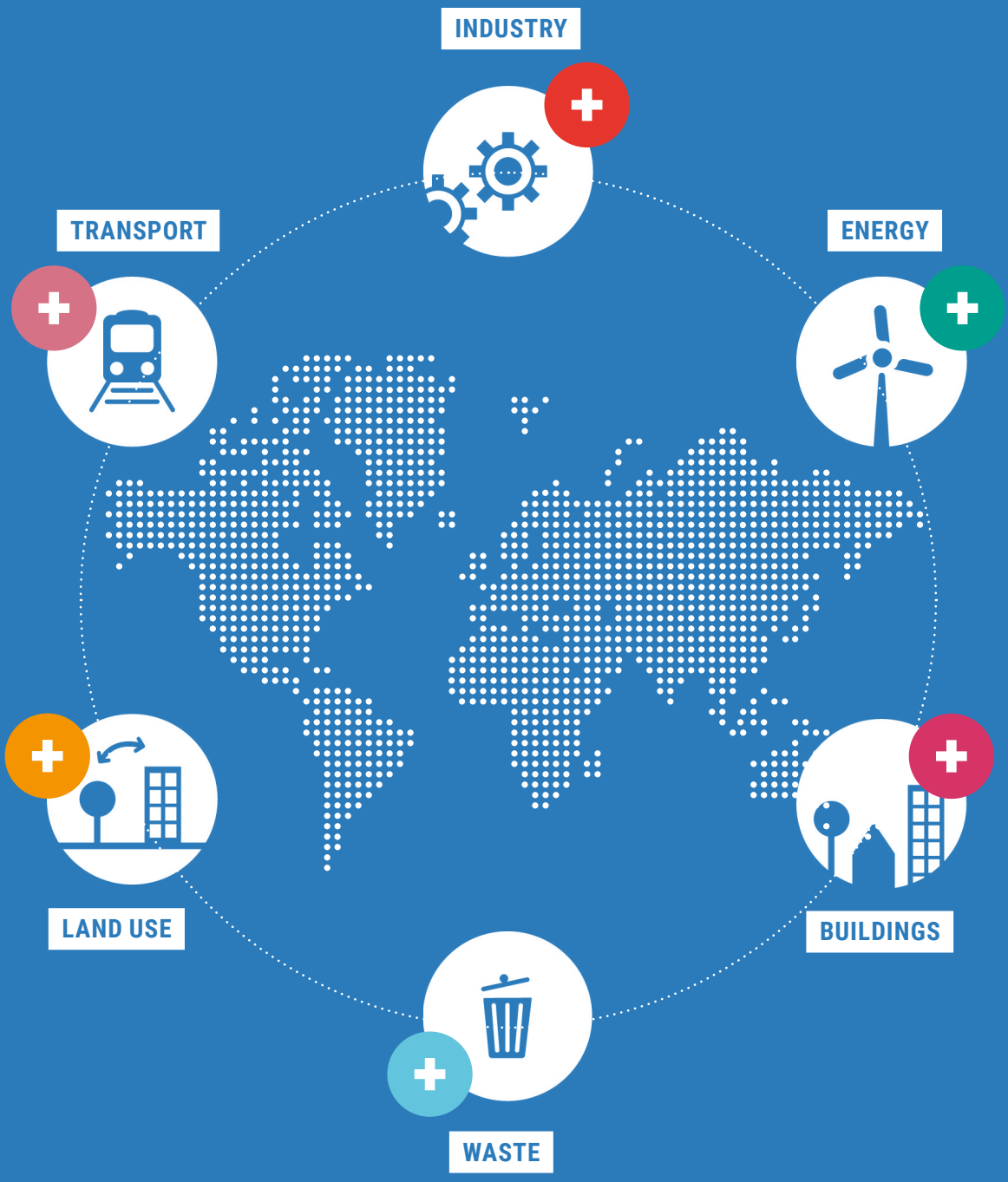
Carbon neutrality: the right compass?

The concept of carbon neutrality, barely mentioned in the Paris Agreement, has since then entered many legislations. It is now France's target, since the Energy-Climate Law was voted in November 2019. At European scale, the 28 have not yet reached any agreement on this objective, but it is already largely shared by many non-state actors, in particular by local governments (Bristol, Paris, Copenhagen, etc.) and private sector actors. **During the Climate Action Summit in New York in September 2019, more than 100 cities joined 77 countries and 93 companies to commit to carbon neutrality by 2050, i.e. a net-zero balance between GHG emissions and absorptions.**

Ambitious is the intention and may be seen as a real willingness to respond to what is at stake with climate change. But this 2050 carbon neutrality target is also an open door to the temptation to postpone indefinitely effective choices on the gross cut of emissions, to the benefit of mere narrative on bright horizons... This is precisely the ambition of Climate Chance Observatory's Synthesis Report, to analyse the reality of actions taking place right now, as in a race against time any delay can hardly be caught up.

"Targeting carbon neutrality by 2050 leaves the door open for the temptation to postpone effective decisions on cutting gross emissions"

KEY FINDINGS PER SECTORS



ENERGY

Electricity production Changes in the sector have yet to deliver results

Electricity production – Changes in the sector have yet to deliver results

Author • **Thibault Laconde** • *Independent, Energie-Developpement*

Electricity takes a special place in the fight against climate change: as well as being the cause behind one third of the world's greenhouse gas (GHG) emissions, it is now responsible for the decarbonation of other sectors – such as transport and building – via their electrification. However, it is not clear how the electricity sector will assume this role. Deeply shaken by the prompt evolution of technologies and by the new players in the energy sector, emissions from the electricity sector are on the rise.

Key takeaways

In 2018, the fall in carbon intensity in the global electricity mix was more than offset by the growth in demand and entailed an increase in emissions by 2.5%. The electricity sector emitted 13 billion tonnes of CO_2 equivalent, higher than the past record dating back to 2013.

Energy policies are still globally contradictory, with a significant increase marked on one side by subsidies for fossil fuels, and on the other, by support schemes for renewable energies that are attempting to adapt to the rapid fall in costs.

Many historical companies are facing major difficulties and are trying to restructure, often by moving away from fossil fuel activities. At the same time, the rapid evolution of technologies and business models is encouraging the emergence of new entrants.

Local authorities have significant means of action in their local areas and are often ahead of the top echelons in terms of renewable energy development and energy saving.

When a regulatory framework and favourable economic models exist, the diffusion of renewable energies helps citizens, alone or in cooperatives, to regain responsibility over electricity production.

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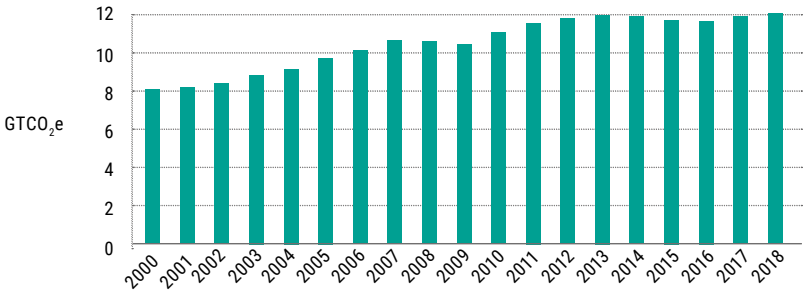
1. Record emissions in 2018, led by demand

• A REAFFIRMED UPWARD TREND IN EMISSIONS • According to the International Energy Agency (2019), global CO_2 emissions in the electricity sector increased by 2.5% in 2018. They broke their 2013 record by reaching 13 billion tonnes. Other sources indicate a more moderate incline, for example +1.55% according to Enerdata (2019). In any case, this increase reaffirms the one dating back to 2017 (+1.80%) and already seems to indicate that the slight fall recorded between 2013 and 2016, was transitory. It remains well below the record growth rates record in 2000 (+7.13%) or 2010 (+5.96%).

FIGURE 1

GLOBAL CO_2 EMISSIONS IN THE ELECTRICITY AND URBAN HEATING SECTORS

Source: Enerdata, 2019



Emissions in the electricity sector represent a third of overall CO_2 emissions worldwide (excluding land use). This share of emissions has been stable since the 2000s, but represents 4 gigatons of extra emissions each year.

These emissions are very unequally distributed: the 6 biggest worldwide emitters – China, United States, India, European Union, Russia and Japan – represent a little less than half of the world's population but are responsible for three quarters of emissions (tab. 1). Within these different countries, emissions from the electricity sector have gone through diverging evolutions: in the European Union, emissions fell for the sixth consecutive year (-6.1% in 2018), Japanese emissions also plummeted in 2018 (-5.2%) but remained well above the level they were before the Fukushima accident, emissions rose moderately in Russia (+1.3%) and, for the first time since 2014, in the United States (+1.4%), growth in China and India was much faster (+6.5% and +3.7% respectively).

• A CLEARLY GROWING DEMAND FOR ELECTRICITY • The rise in emission levels in 2018 is mainly due to a significant increase in consumption that more than offsets carbon intensity gains (emissions per kilowatt hour). In 2018, electricity consumption increased by 3.8% compared to the previous year, meaning an extra 940 TWh (BP Statistical Review, 2018). This incline is higher than approximately one point recorded in 2017 (+2.9%) and than the decade average from 2007 to 2017 (+2.5% per year on average). **Meanwhile, the world population increased by just 1.1% (World Bank, 2019), implying that the net rise in electricity consumption per inhabitant was around 2.7% in 2018.**

The rise in electricity consumption is, for some part, the result of progress in electrification: between 2006 and 2017, the share of the world population with no access to electricity fell from 18.8 to 12.6%. This underlines that in one decade, almost 1.2 billion more electricity consumers emerged. **In 2018, the number of people lacking access to electricity, became for the first ever, inferior to 1 billion.**

The accelerating demand for electricity in 2018 seems to be linked to the rise in temperatures. According to the International Energy Agency, the fifth rise is due to metalogical phenomena: 2018 holds the record for the fourth hottest year ever recorded, but also the coldest winter in North America, entailing a rise in demand for air conditioning and heating.

TABLE 1

GREENHOUSE GAS EMISSIONS ($MTCO_2E$) FROM ELECTRICITY AND HEAT PRODUCTION FOR A SELECTION OF COUNTRIES - *Source: Enerdata, 2019*

	2005	2010	2015	2017	2018
China	2305,488	3292,299	3948,346	4254,748	4530,193
United States	2434,352	2281,617	1919,25	1771,294	1796,071
India	494,7406	676,243	909,5331	899,58	932,5217
European Union	1294,427	1173,351	997,6048	952,3303	893,7546
Russia	530,6007	544,9056	536,2284	515,7106	522,5599
Japan	381,7015	384,0677	451,9649	491,1148	465,6653
South Korea	156,5134	239,1376	251,4225	271,9302	279,2012
Germany	305,4974	288,8348	277,6279	263,8934	252,0987
South Africa	199,9852	233,1898	218,8225	224,6639	225,5217
Australia	197,1889	204,4021	180,8268	181,9446	176,7844
Saudi Arabia	108,1311	142,6024	162,3195	157,2292	158,2128
Iran	92,2516	126,4519	148,8455	157,0611	156,4146
Indonesia	71,3734	92,8861	128,8858	136,0399	145,3454
Canada	119,9076	101,5088	87,9146	81,1549	77,6367
United-Kingdom	171,9498	152,0129	99,4837	66,2651	59,3549
Chile	15,4717	24,504	32,5759	33,865	31,3038
France	37,4486	40,1996	21,8158	29,2797	21,7557
Finland	16,8819	25,2224	12,8184	12,7636	n.a.
Ghana	1,0067	3,0235	3,2831	2,7152	n.a.
Fiji	0,275	0,3336	0,3907	0,396	n.a.
Ethiopia	0,0096	0,0551	0,0032	0,0022	n.a.

FOR BETTER UNDERSTANDING

AIR CONDITIONING AND ELECTRICITY CONSUMPTION

Air conditioning is very energy-intensive and uses refrigerants that contribute significantly to the greenhouse effect in the event of a leak. It has a high carbon footprint: worldwide, it is responsible for 12% of emissions in the residential and tertiary sectors. In some countries this share is much higher: in Saudi Arabia, for example, it reached 73%.

Electricity consumption linked to air conditioning is also very variable depending on the temperature. It contributes to raising peak electricity consumption during the hottest days and hours and therefore requires maintaining expensive production capacity to meet this demand. Globally, less than a third of households are air-conditioned, but the number of air conditioners being used has increased by 40% since 2010. Taking advantage of particularly hot summers, sales even jumped 15% in 2018 alone. In the hottest countries, the equipment rate is still only 8%. It is therefore likely to increase sharply as these countries develop and temperature rise as a result of global warming. China illustrates this risk: the rate of air conditioning equipment reaches 60% in 2018 and the resulting electricity consumption has increased by almost 12% on average since 2000. On the hottest days, air conditioning can account for 50% of the electricity demand.

The effect of air conditioning on electricity consumption can, for some part, be limited by energy efficiency norms. It is for this reason, for the same power, air conditioners sold in Europe

and in Japan consume 25% less electricity than those for sale in China and the United States. However, the possible improvements in equipment efficiency, estimated at around 50%, are far from enough to compensate for the expected increase in the equipment rate, which could more than triple by 2050.

Source: Sebi, 2019

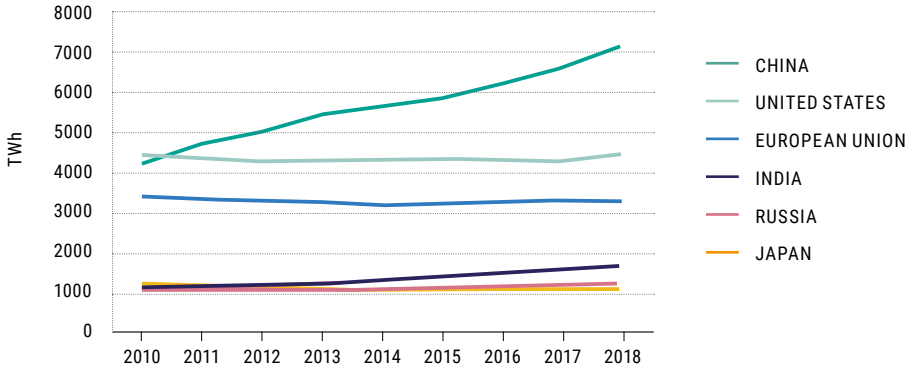
BOX 1

In 2018, the United States and China were responsible for 70% of growth in electricity consumption. In China, consumption increased by 8.5%, much faster than in 2017, due to both demand for air conditioning and industrial demand notably to produce construction materials. In the United States, consumption rose by 4% after many years of stable levels. It even reached a new record – this growth is mainly due to demand for heating and air conditioning.

In India, consumption increased by 5.4%, nearly twice as slow as in 2017. This increase is a result of demand for air conditioning and progress for access to electricity. In Europe and in Japan, demand grew by 1%. Some countries like Australia, witnessed a decline in their electricity consumption in 2018 (IEA, 2019a).

FIGURE 2

EVOLUTION OF ELECTRICITY PRODUCTION - *Source: Enerdata, 2019*



The highest demand growth rates were in the least developed countries because of the combined effect of demography, economic growth and the electrification: 57% in the Comoros, +23% in Liberia, and +18% in Ethiopia... **The differences in per consumption per inhabitant between different countries remain colossal:** electricity consumption is, for example, around 0.1 MWh per capita in Liberia and 1.2 in India, compared to 5.1 in China, 6.4 in the European Union and 13.6 in the United States (Enerdata, 2019).

• A DROP IN CARBON INTENSITY DESPITE INCREASED USE OF COAL • The carbon intensity of electricity production is a second factor explaining the evolution of emissions. **In 2018, carbon intensity of global electricity decreased by 1.8%, limiting the impact of rising consumption.** Emissions over the entire life cycle (Table 2) take into account emissions during electricity production but also upstream (construction of installations, transport of fuel, etc.). They allow a more equitable comparison of the different sectors, but they can vary greatly depending on the assumption used, for example, fugitive emissions[1]:

1 Climate Chance, 2018 Synthesis Report, Fugitive emissions: a blind spot in the fight against climate change

TABLE 2

EVALUATION OF GREENHOUSE GAS EMISSIONS DURING ENTIRE LIFE CYCLE BY PRODUCED KILOWATT HOUR

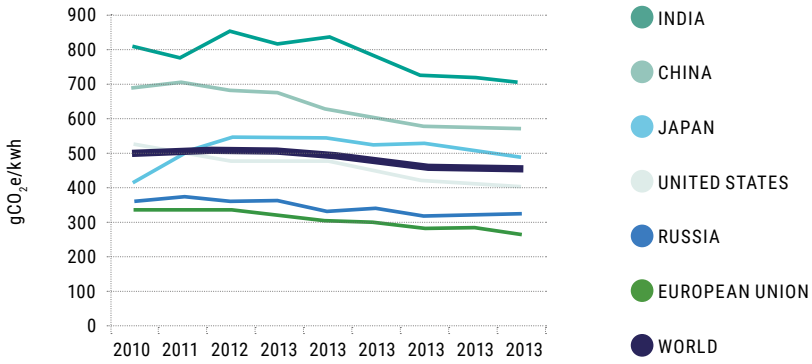
Source: IPCC, 2014

	Greenhouse gas emission during the entire life cycle
Coal	675 à 1689 gCO_2e/kWh
Coal + CCS[2]	70 à 290 gCO_2/kWh
Oil products	510 à 1170 gCO_2e/kWh
Gas	290 à 930 gCO_2e/kWh
Nuclear	4 à 110 gCO_2e/kWh
Solar photovoltaic	18 à 180 gCO_2e/kWh
Wind power	7 à 56 gCO_2/kWh

The share of each source of production (or electricity mix), defines the carbon intensity, is generally communicated as the amount of GHGs involved in producing one kilowatt-hour of electricity. In 2018, carbon intensity of the world's electricity mix fell by 8.4 gCO_2e/kWh. It recorded significant progress in most of the world's biggest economies: -5.7% in the European Union, -1.8% in the United States, -1.6% in India and 1.1% in China...

FIGURE 3

CARBON INTENSITY OF THE ELECTRICITY MIX - *Source: Enerdata, 2019*



This global decrease in carbon intensity can be credited to renewable energies and on a smaller scale, to nuclear energy. **In 2018, renewable production increased by 449 TWh, more or less equally divided between solar, wind power and hydroelectricity, enabling to face almost 45% of growth in demand. This progress means that renewable energies represent a record share of 27% of the world's electricity production.** As a whole, renewables were the second source of the planet's electricity in 2018, behind coal but in front of gas and nuclear.

Nuclear production increased by 87 TWh, mainly as a result of the commissioning of new reactors in China and the restarting of Japanese reactors that were stopped since the Fukushima incident. Overall, decarbonated energies are at the origin of 37% of global electricity.

2 Climate Chance, 2018 Synthesis Report, Carbon capture and sequestration: a solution that is struggling to materialise

TABLE 3

WORLD ELECTRICITY MIX IN 2018 AND EVOLUTION FROM 2017 TO 2018 - *Source: IEA, 2019a*

		Production (TWh)	Evolution 2017-2018	Share in the mix
Fossil	**Coal**	10 116	+2.6%	38%
	Oil products	903	-3.9%	3%
	Gas	6 091	+4.0%	23%
Fissiles	**Nuclear**	2 724	+3.3%	10%
Renewables	**Biomass and waste**	669	+7.4%	3%
	Hydroelectricity	4 239	+3.1%	16%
	Solar PV	570	+31.2%	2%
	Wind	1 217	+12.2%	5%
	Other	144	+4.2%	1%

Despite of this progress made, fossil electricity production has continued to increase by 457 Wh in 2018. This growth (259 TWh) comes mainly from coal plants. This increase confirms the reversal of the decline observed in 2015 and 2016, a trend already highlighted last year. It is responsible for most of the growth in global emissions from the electricity sector in 2018 (IEA, 2019).

The growth in coal consumption is mainly in Asia (China, India, Vietnam, Turkey...) while industrialised countries are seeing their consumption decline. This is particularly the case in the United States where coal-fired power generation has fallen by 62 TWh. Globally, coal accounts for about two-fifths of electricity production but is responsible for the emission of more than 10 billion tonnes of CO_2, or three-quarters of the sector's emissions.

2. Exacerbation of political contradictions

In 2018, $1,800 billion were invested in energy supply. The majority of these funds ($775 billion) went to the electricity sector (IEA, 2019). More than 70% of these investments come from public decisions either because they come directly from state-controlled organisations, or because they respond to financial incentive mechanisms (IEA, 2018). Public policies therefore play a decisive role in shaping the sector.

• INCREASING SUBSIDIES FOR FOSSILS FUELS • 2018 marked the year when a significant increase in subsidies for fossil fuels occurred. In the electricity sector, subsidies grew from 116 to 143 billion dollars. The progress made since the 2012 record (145 Mds$), has now almost completely been wiped out. Countries who subsidise fossil electricity are China (25 Mds$ in 2018), Iran (17), Russia (14) and Mexico (14) (IEA, 2019c).

Despite of this negative evolution, partly due to the desire to limit the effects of and upward trend in energy prices, many countries undertook reforms of their energy taxation in order to reduce subsidies for fossil electricity consumption. Examples include Argentina, where fossil fuel subsidies fell by 35% in 2017, notably as a result of electricity tariff reform, and the European Union, which has undertaken to eliminate all subsidies to electrify sources emitting more than 550 gCO_2e/kWh by 2025 (IEA/OECD, 2019).

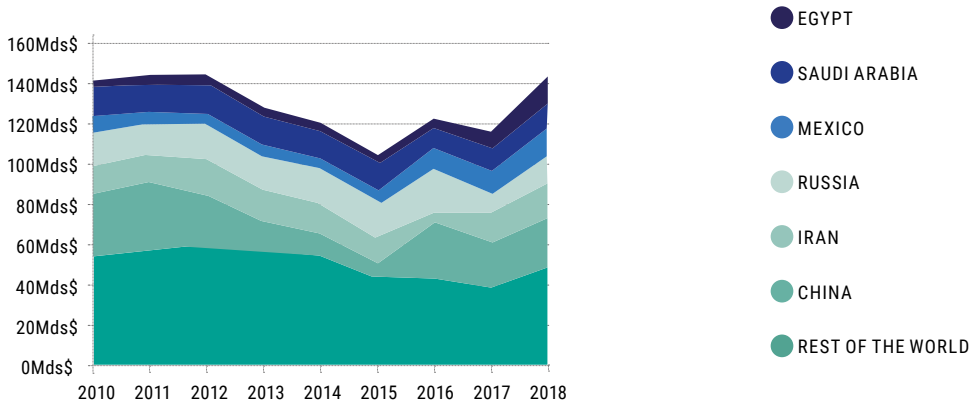
Even though this support contributes to unbalancing public budgets and disproportionately benefits the wealthier classes who consume more energy (Shirai, 2017), their reform met with violent reactions in 2018 and 2019, particularly in France and Ecuador.

In addition to direct financial incentives, governments have many ways to support fossil fuels: price controls, quotas, subsidised loans, guarantees, direct investment, research and development, technical restrictions, etc. (IEA/OECD/World Bank, 2010). In the United States, for example, the government is pursuing an aggressive policy of weakening fossil project standards with the stated objective of supportive coal-based power generation (AP, 2019). Support for exports is another indirect aid: in the United Kingdom, for example, the amount of support for exported fossil energy projects has increased 11-fold one year to £2 billion (The Guardian, 2019).

FIGURE 4

EVOLUTION OF SUBSIDIES FOR FOSSIL FUELS

Source: IEA, 2019c



FOR BETTER UNDERSTANDING

TAX AND CARBON MARKETS

Policies in favour of fossil energies are partly compensated by the implementation of increasingly diffused carbon markets or taxes. Carbon taxes were introduced since the 1990s in Denmark, Finland and Norway. These pioneers were then joined by Chile, Colombia, France, Iceland, Ireland, Japan, Mexico, Portugal, South Africa, Switzerland and the United Kingdom. The level of these taxes is sometimes very high: 139 dollars per tonne of CO_2 in Sweden, 101 in Switzerland and 77 in Finland…

In addition to the European system, carbon markets were also established in states such as Kazakhstan, South Korea or New Zealand. The Chinese market will be set up in 2020. At provincial or communal level, carbon markets exist in Canada, China and the United States. These markets typically result in a price from 5 to 20 dollars per tonnes of CO_2. They usually target emissions of large installation, in particular electricity plants that cannot be relocated. The smaller emissions (from vehicles, SME…) are generally ignored and their activities – exposed to international competition – are sometimes exempted or attributed free carbon credits.

Canada is implementing a flexible system for its provinces: provincial governments must reach a nationally set floor price through the mechanism of their choice. The national floor price is currently at 20 Canadian dollars per tonne and will be increased by 10 dollars per year until it reaches 50 Canadian dollars (approximately 40 USD) in 2022.

Globally, carbon taxes and markets still only cover 15% of emissions. This share will reach 20% once the Chinese market is put into service.

Source: Coady, 2019

BOX 2

• RENEWABLE POLICIES • Renewable energy sources have seen a dramatic reduction in costs, making them less dependent on public support mechanisms. The cost of solar photovoltaic projects has dropped by 75% since 2010. The decline represents 20% for onshore wind energy and 50% for battery electricity storage systems. For offshore wind energy, the decrease is less visible, but the increase in the use rate and drop in financing costs have nevertheless made calls for tenders more competitive (IEA, 2019a).

This trend should result in an accelerated development of renewable capacities: according to the International Energy Agency (2019b), the installed amount of renewable power should double between 2019 and 2024. Solar energy in particular should almost globally become more competitive than coal and could become the first source of electricity on the planet by 2040. However, a public intervention remains necessary to ensure that the development of renewables results in a considerable fall in fossil production (IEA, 2018). In particular, schemes for public guarantees are still useful for reducing the financing cost of projects with weak government spending (IDDRI/Agora Energiewende, 2019).

According to REN21 (2019), 162 countries set renewable electricity production objectives in 2018 where 135 of them set up an incentive regulatory framework. **As seen last year, the trend towards a shift from feed-in-tariffs to an auction system is being confirmed. In 2018, 48 countries held auctions for the construction of new renewable capacities, compared to 29 in 2017.** The first auction, for a 25 MW project was in Benin, whereas Kenya announced the adoption of this system. One of the advantages of this system is that it makes it possible to pursue simultaneously economic (e.g. India, which requires 50% of components to be manufactured locally) or social (e.g. El Salvador required developers to reinvest 3% of project revenue locally REN21, 2017) objectives. In return, more complex specifications make this mechanism less accessible to small and medium-sized enterprises and non-professional developers (farmers, individuals, local cooperatives, etc.).

Other incentive tools can be used, notably quotas that require certain actors to use a minimum share of renewable energy. As part of the reform of its renewable energy support policy, China in particular recently enforced solar and wind quotas for electricity consumption (IEEFA, 2018).

These mechanisms can be completed by non-regulatory measures or tax instruments. The United States reinstated a 30% tax credit for the installation of residential wind power systems (Residential Renewable Energy Tax Credit).

Compared to the electricity sector, the growth of renewable energies remains slower in the production of heat and cooling (REN21, 2019) where support policies are less ambitious and much less widespread (IRENA, 2018).

3. Economic actors: between restructuration and innovation

The swift evolution of technologies and policy development has created significant imbalances in the electricity sector. This situation forces historical companies to restructure, sometimes with difficulty, but also offers opportunities for new entrants.

• AN ACCELERATION AT THE EXPENSE OF HISTORICAL ACTORS • The electrical sector is characterised by long life spans: the development of an electricity plant or a grid often requires over a decade of work, and their use lasts up to 50 years. Companies from the sector were therefore traditionally considered as very stable, but since the 2000s, their evolution has sped up and shaken up long-term strategies.

Evolution of energy policies is a big constraint for companies in the sector. **The last two decades were marked by many privatisations and this trend continues with the intention of projects to go public by the Romanian electricity producer Hidroelectrica in 2020 (**Balkan Green Energy News**, 2019), the Nepal Electricity Authority (**The Himalayans Times**, 2019) or Energy Efficiency Services in India (**Deal Street Asia**, 2019).** But even when completely or partially privatised, enterprises from

the sector are generally submitted to public control whose temporality is much shorter than that of their investments.

FOR BETTER UNDERSTANDING

ELECTRIC INFRASTRUCTURE AND CLIMATE RISKS

The 8th November 2018, a fire broke out in the north of California. It spread over 62,000 hectares before finally being controlled. It destroyed almost 19,000 buildings and 85 people lost their lives. Damage amounts to over $10 billion. This is the most serious fire in California's history. The fire was triggered by an incident on a power line owned by PG&E, the state's main electricity producer. Unable to meet its responsibility – which will be formally established in May – the company went bankrupt in January 2018. As the exceptional drought in California greatly aggravated the fire, this bankruptcy was sometimes referred to in the media as "the first bankruptcy caused by climate change".

In Autumn 2019, the similar meteorological situation entails a new high risk of fires. To avoid having to be responsible, PG&E and other Californian electricity producers made the radical choice of cutting off power to a large part of the state: at the end of October, up to 3 million inhabitants were without electricity. This situation is extreme but not that rare: several recent examples illustrate the vulnerability of electricity infrastructure to effects of climate change[3].

Source: Financial Times, 26/10/2019

BOX 3

In addition to the regulatory environment, funding pressures continue to increase. In 2019, State Development and Investment Corp., the Chinese sovereign fund (Bloomberg, 2019) and the Swiss bank UBS (IEEFA, 2019) announced the end of their investments in coal plants. The effect of this disinvestment varies depending on where the capital used comes from. In China, for example, there are limits as electricity producers do not depend on the main international investors (SCMP, 2019).

The evolution in prices has also accelerated with the growing competition in renewable energies. The fall was reflected in British calls for tenders: the first one in 2015 resulted in a tariff between £123.47 and £129.38 /MWh for offshore wind projects, the second in 2017 between £64.40 and £83.72/MWh and in 2019 the rate fell to £39.65/MWh (Financial Times, 2019). Records are also being broken for solar energy (PV Magazine, 2019). The increasing competitiveness of renewable energies leads to a decrease in margins that can harm investment capacities, it can also lead developers to arbitrate at the expense of performance and innovation (IEA PVPS, 2018).

Lastly, companies are confronted with a rapid technological evolution. This is relevant to the growing share of renewable energies that question the traditionally centralised electricity system. Other innovation contributes to the rapid change in the system's functioning and the needs to which it must respond smart grid, batteries, electrification of mobility...

3 See sectoral case study on "Electric Systems" in Climate Chance & Comité 21 (2019). "Adaptation Book", 2019 Synthesis Report on Adaptation Action. Global Observatory on Climate Non-State Action.

EXPERIENCE FEEDBACK

TATA POWER'S CORPORATE STRATEGY

he Indian conglomerate Tata is active in the electricity sector through its subsidiary Tata Power. The company currently has a fleet of 10,000 MW, over 70% of which is composed of coal-fired power plants. The most important is the Mundra power plant (4,150 MW), the country's third largest power plant. This power plant, which began operating back in 2012, is powered by imported coal and has suffered heavy financial losses: $119 million in fiscal year 2016-2017. On the other hand, in the same year, renewable generation made an operating income of $249 million.

In response to this situation, Tata Power has virtually stopped developing its fossil fuel fleet: since Mundra was put into service, it has increased by only 68 MW, while the hydroelectric farm has increased by 246 MW and the new solar and wind power installations by up to 2,000 MW. The company has also committed to not building any more coal-fired power plants, despite the fact it wants to continue to develop its fleet through acquisitions.

In February 2019, Tata Power inaugurated India's first large-scale battery storage facility, built in partnership with Mitsubishi and AES India. The company is also investing in the deployment of smart meters and charging points for electric vehicles.

Source: IEEFA, 2019

BOX 4

The brisk emergence of these new constraints results in sub-optimal investments. Some historical actors have therefore become unsuited and need to be impaired. This effect is mainly visible in Europe and the United States, where thermal and nuclear power plants are closed before the end of their technical lifetime. This is particularly the case for some of the largest coal-fired power plants in the United States – Navajo (2,250 MW), Bruce Mansfield (2,490 MW), Paradise (2,175 MW) (Scientific American, 2019) and in the UK with Cottam (2,008 MW), Eggborough (2,000 MW) (Powerstations.uk, 2019). Even among recent investments, some have followed short-term logic that leads to imbalances: according to the IEA (2018), production capacity is in excess of 350 GW, especially in Asia and the Middle East, while elsewhere funds are lacking, particularly to develop and modernise networks[4].

• RESTRUCTURING OF HISTORICAL ACTORS • For the historical actors in the electricity market, these developments have had the primary consequence of catastrophic losses. European electricity producers recorded asset depreciation of 34.7 billion euros in 2015 and 23 billion in 2016 - or 8% of their capitalisation in the latter year (EY, 2018). Some companies have been more affected than others: for RWE (€3.7 billion in 2016) and Engie (€2.7 billion), the depreciation represent a third of the capitalisation.

Facing the situation, a new strategy has emerged that consists in the organisation of the decline in conventional production or even the splitting of companies in order to separate regulated (networks or growing (renewable, services...) activities from fossil assets. This transition is coming to an end for RWE, which has let go of many fossil fuels to become the 23rd largest renewable producer in Europe. The company is committed to achieving carbon neutrality by 2040 – a goal that was unimaginable jut five years ago (Financial Times, 2019). The transformation has been welcomed by investors: RWE's share price has doubled in just 18 months. A similar restructuring seems to be taking shape for EDF in France or Eskom in South Africa.

As a result of these restructurings, many mergers and acquisitions are taking place in the electricity sector. In 2019, for example, American distributor Emera Maine's acquisition by Canada's

4 The case study on Ghana illustrates this paradox.

Enmax for $1.3 billion the acquisition of 724 MW of wind power and batteries by AEP from Sempra for $1.1 billion and the acquisition by China's CGN Energy International of Enel's solar and wind energy assets in Latin America for $783 million (EY, 2019).

These changes in the electricity sector indirectly affect suppliers, and in particular manufacturers of fossil power plants equipment. The market for gas turbines, for example, has been halved in 3 years, from 58 GW in 2015 to 29 in 2018 (Nasdaq, 2019). This decline in orders has forced specialists in the field, such as GE, Siemens or Mitsubishi Heavy Industries, to consolidate and reduce their activities (Nikkei Asian Review, 2018).

• NEW ENTRANTS, NEW ACTIVITIES • Historical actors' difficulties create encouraging conditions for the entry of new actors in power generation. The first category of new entrants to mention is existing companies whose activity may be complementary (energy producer, large consumers, etc.) but which are not encumbered by the liabilities of the historical actors and can therefore create a competitive offer by taking into account the transformations underway. One example is the oil company Total, which has invested €6 billion in electricity production and marketing since 2015, becoming France's third largest electricity company. The company aims to increased its renewable fleet by a factor of 10 to achieve 25 GW in 2025 (Investir, 2019).

The second category of new actors in the electricity sector is directly related to the need for innovation and new skills. These can be companies from sectors undergoing electrification, such as car manufacturers – for example Volvo, which has partnered with Vattenfall to install and maintain charging points for buyers of its electric vehicles (Reuters, 2018) – or technology companies and start-ups taking advantage of the digitalisation of the sector to offer new services and new business models. These include the Nest project, Google's sector specialised in home automation, which is destined to create a virtual power plant in California by adjusting the heating level of its users (Green Tech Media, 2016).

Traditional electricity producers are closely interested in these new companies either through acquisitions (for example, Innogy's acquisition of the start-up known as Belectric) or through partnerships or incubators (RWE New Ventures, AEP illuminationLAC, etc.). For example, Enel has evaluated 4,000 young companies and acquired stakes in 180 of them (Smart Energy International, 2019).

FOR BETTER UNDERSTANDING

METERS AND INVOICES

Access to the grid and the ability to market its production is a crucial step for renewable projects. For small projects, such as domestic projects, this often involves the net metering system: the producer who is also a consumer can deduct from its electricity bill the excess production it feeds into the grid. This mechanism is often put in place to stimulate the development of small rooftop solar projects, or less frequently, small wind turbines.

Net metering can be implemented at national level: Indonesia adopted this system in 2018. However, it generally requires the replacement of electricity meters and therefore local intervention. This system is therefore often used by local authorities, which is the case in the United States. In the US, it has been adopted by 38 states, the District of Columbia and the American territories of Samoa, Puerto Rico and the Virgin Islands.

The need for new meters created opportunities for electronics manufacturers, such as Schneider Electric or GE Grid Solutions, but also for local companies. In Ethiopia, for example, the new meters are being built by Ethiopia Electrometer, a joint venture of the Egyptian El Sewedy Electrometer and Ethiopian Electric Power Corporation. Local manufacturers also exist in Zambia, Brazil, India, etc.

Source: REN21, 2019 ; IEA-PVPS, 2018a

BOX 5

4. Local level: a rising actor in the energy transition

As highlighted in the Climate Chance Synthesis Report from 2018[5], the role of local actors – communities, individuals, associations, cooperatives – is not declining but seems to be changing scale. This change is illustrated by citizen-led movements on climate change: these movements have revived protests against specific projects – such as the Mong Kok coal mine project in Burma (Myanmar Times, 2019), the Celukan Bawang power plant in Indonesia (Chinadialogue, 2019) and the Merrimack power plant in the United States (ABC, 2019) – but they also have the ambition to influence national and international policies.

• FROM CONSUMER TO PRODUCER, FROM CUSTOMER TO COMPETITOR • The development of renewable energies opens the possibility of a new field of action since the decentralisation of energy production allows local actors to play an active role and re-appropriate electricity production. It is therefore technically possible for individuals, public bodies, small businesses or farmers to produce their own energy: for an individual, for example, solar energy on the roof, wind energy or biogas for a farmer, heat from a solar water heater or heat pump... The customers of the historical electricity producers tend to become their competitors (Vernay, 2019).

FOR BETTER UNDERSTANDING

NEW BUSINESS MODELS FOR THE INDIAN SOLAR INDUSTRY

The production of solar photovoltaic electricity requires an initial investment that represents a significant obstacle for non-professional actors. In India for example, the cost of a solar system is about 75,000 rupees (€950) per kilowatt while the average monthly income is about 10,000 rupees. The payback period is also relatively long: 9 to 10 years for a residential installation. The development of solar for roofs thus requires the elaboration of new business models. "Roof rental" systems have emerged, an idea that enables owners who do not have the ability to invest in a solar installation to make their roof available for developers. The latter then sells the electricity produced to the owner at a lower rate than public electricity. Around 10% of Indian solar roof installations use this system.

Leasing systems also exist where the owner pays rent for a fixed period of time before becoming the official owner of the installation. Paradoxically, the rapid decline in the cost of solar projects undermines this scheme, as rent can quickly become excessive in relation to the price of a new installation. Some states in India have therefore designed a special framework to secure these investments: Gujarat, for example, guarantees to feed-in tariff for solar production over a 225-year-period. *Source: Goel, 2016 ; Singh & al., 2019*

BOX 6

The cooperative association of production and co-financing by local savings enable to facilitate the development of these projects and their change of scale. In the Netherlands, for example, there are just under 500 citizen-powered cooperatives, of which 85 were created in 2018. They reach 70,000 households, or nearly 2% of the country's population (Hier Opgewekt, 2019). These activities can be based on new digital tools that facilitate networking and exchanges between individuals: in 2018, Som Energia, Catalonia's first renewable cooperative, will rely on the Decedim participative platform to organise its general assemblies and debates, attracting several thousand participants (Energycities, 2019).

While falling prices have helped to remove economic barriers for these projects, regulatory and institutional barriers continue to exist. The creation of an appropriate legal framework, the

5 Climate Chance (2018) « Sector-based action » Book 1 of the annual Synthesis Report of the Global Observatory on Non-State Climate Action

simplification of procedures and consultation with other actors in the electricity sector, in particular network operators, are also part of the conditions for success.

• LOCAL AUTHORITIES, COMPLEMENTARY TO STATES AND INNOVATIVE • In terms of decarbonation of electricity and heat, local authorities are often ahead of the game. Local governments have regulatory powers that can be used to support the energy transition of their areas, but they can also act through their purchases or the management of their real estate. They are also responsible for supplying public services to inhabitants and maintaining contractual relations with the electricity producers and the largest consumers in their area, this provides them with direct means of action that states do not have.

The development of renewable energies appears to be a major focus of local authorities' action. By the end of 2018, at least 100 cities were more than 70% supplied with electricity from renewable sources, including Aukland (New Zealand), Dar es Salaam (Tanzania), Nairobi (Kenya) or Seattle (USA) (CDP, 2018). About 40 of these cities are 100% supplied with renewable electricity and many others want to join them. Among the local authorities that have committed to achieving 100% renewable electricity by 2018 are Kassese (Uganda), which has set this target for 2020, Lismore (Australia) for 2023, Sumba Island (Indonesia) for 2025, Fukushima (Japan) for 2040 and Paris for 2050 (REN21, 2019).

This trend is also taking place in the United States, where federal policy encourages federal states and cities to replace state action. In 2018, renewable energy quotas were mainly used; the State of New Jersey adopted a 50% quota by 2030 (Renewable Energy World, 2018). Connecticut set a target of 40% for the same year (Utility Drive, 2018). In Nevada, a 50% quota in 2030 was adopted by referendum (American Wind Energy Association, 2019). The District of Columbia, for this part, has set itself the goal of achieving 100% renewable electricity by 2032 (Utility Drive, 2018).

California has also set a target of 100% renewable electricity by 2045 based on increasing renewable energy quotas (DSIRE, 2018). It also used its regulatory power by imposing the installation of domestic solar panels when revising construction standards. This requirement, a first in the US, will apply to most new homes from 2020 (California Energy Commission, 2019).

The rationalisation of energy use in buildings and public services made available makes it possible to reduce consumption emissions an operating cost. Controlling electricity demand is therefore an important area of action for local authorities. Many examples exist in these areas. The city of Madrid has partnered with the electricity producer Acciona to deploy an energy management system and improve efficiency of 400 public buildings (Acciona, 22/02/2019). In Chennai, in India, replacing traditional sodium vapour streetlights with LED lighting has reduced emissions by 650 tonnes of CO_2 per year and saved nearly 14 million rupees (€170,000) (C40, 2019).

Beyond their own buildings and activities that fall under their jurisdiction, local authorities can influence electricity consumption in their local areas, often via public- private partnerships. The Building Efficiency Accelerator, implemented as part of the Sustainable Energy for All initiative, is an example of this type of global partnership. It supports fifty cities and regions in the implementation of local energy efficiency policies, particularly in the areas of standardisation, renovation and financing (Building Efficiency Accelerator, 15/08/2019).

FOR BETTER UNDERSTANDING

THE GROWING ROLE OF EUROPEAN LOCAL AUTHORITIES IN THE ELECTRICITY SECTOR

In Europe, the energy transition is accompanied by the growing role of local authorities in their electricity sector. The participation takes very varied forms but is generally more direct control by cities over power generation and grid management through public companies or boards or public-private partnerships. Germany has been a pioneer in this process, with, for example, the

"re-municipalisation" of energy in Hamburg in 2009 or Stuttgart in 2011. Between 2005 and 2015, over 70 new communal electricity companies (Stadtwerke) were created. This movement was enhanced thanks to the expiration of many concession contracts, by a political ad citizen mobilisation in favour of regaining ownership of these activities and by the German authorities' large autonomy, but also by growing dissatisfaction with the management of private operators. In France or in Scandinavian countries, it is also frequent that cities have control over the local electricity system. In other European countries such as Greece or Ireland, are much less advanced in this sector, although the role of local initiative is becoming increasingly important. Direct control over activities or networks is not always the chosen solution. In France, for example, the Occitanie region chose to create a "Regional Energy and Climate Agency" to implement the regional energy transition policy, as a public energy investment and project owner. At the same time, there is a transfer of skills from the national level to communities, increasing their roles in energy and climate policies. This decentralisation is identified as facilitating the exchange of information and interaction with citizens.

Source: European Committee of the Regions, 2018 ; Energy Cities, 2017

BOX 7

The electricity sector is currently going through its most spectacular transformation since its emergence over a century ago (IEA, 2019). This change is technological and economic, but it also entails a redefinition of roles, the outcome of which still seems uncertain but will be crucial for the long-term development of the sector. Among the main emerging trends there are: the loss of influence of historical companies to new actors and the growing importance of local initiatives in relation to state planning.

Please do not hesitate to share with us any additional information, reports of data via the following email address: contribution@climate-chance.org

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TRANSPORT

Two Steps Forward, One Step Back

Two Steps Forward, One Step Back

Author • **Sudhir Gota** • *Independent Consultant*

The transport sector currently emits about 9.7 Gt carbon-dioxide equivalent. Estimates suggest that if current trends continue unabated, the global transport sector CO_2 emissions could still increase to 10 to 18 Gt in 2050. However, literature also suggests that it is possible to decarbonise the transport sector for realising the Paris Agreement targets. So, considering the magnitude and intensity of the transformation required – are we on the right track?

This 2019 global transport profile collects, consolidates and synthesise the most recent data to help untangle the various strands of the transport sector. The ambition is to provide a status of global climate action related to the transport sector and identify the synergies between the State and non-state actors (NSA) activities and bring critical messages to the international community to drive ambition within the transport sector. Our assessment suggests that the transport sector is still at a crossroads. There are some mixed signals about the pace and direction of change in the transport sector; however, encouraging signs are now evident. There has been a groundswell of collaborative actions in recent decades, and the forces of change in the transport sector are becoming strong. We may be very close to a tipping point.

Key takeaways

In 2018, global transport emissions raised by 1.2%, i.e. its lowest increase since 2011. Asia is the driving region of global transport demand and emission, recoring a 3.4% surge in emissions from 2017 to 2018.

For the first time in the last decade, global vehicle sales reduced by modest -0.6% when compared with 2017. There is growing momentum for banning diesel or high-emitting vehicles (Bristol, London), maintain bans despites political shifts (Madrid) or limit urban sprawl to reduce motorised transport demand (Onagawa).Passenger transport in cities is at a cusp of a new disruption – shared mobility.

Recent years' fuel economy improvements of new cars have slowed down due to the rapid decline of diesel car sales and growing consumer demand for bigger, high-emitting cars (SUV). Policy support for increasing the share of biofuels in road transport remained relatively static, but electricity is increasingly becoming the "fuel" of choice in the transport sector. Japan is also investing a lot in hydrogen-fueled vehicles.

Global railway network has known in 2018 its greatest expansion in the last 20 years with a 0.9% increase. Despite carrying about 8% of total transport demand in passenger-kilometre and tonne-kilometre travel respectively, railway emitted less than 3% of transport carbon emissions. Electrification of railways records heights in Asia and Russia, especially in passenger transport. However, railway network expansion and mode shift from roads and aviation for passenger and freight transport have remained limited.

While the aviation industry plans a carbon-neutral growth from 2020 (CORSIA), global aviation flights, fuel consumption and CO_2 emissions have been quickly growing from 2017 to 2018. Aviation transport demand is steadily expanding in most regions of the world. GHG emissions have risen by 32% over the last 5 years. Some "weak signals" appear though: more and more carbon efficient airlines; Sweden's demand for flights is on the slope; Norway has set biofuel use targets in the industry. However, current trends keep far off track 2050 targets.

Although having peaked in 2008, international shipping carbon emissions are back on the rise in 2018, following a growth in merchandise trade volume and shipping capacity. However, stringent upcoming environmental regulations around air pollution and carbon emissions necessitate major technological shifts and new sets of policy instruments in the shipping industry. Some of the major ports of the world are now leading efforts applying environmentally differentiated port fees.

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2 ROAD TRANSPORT: ACCELERATING MOBILITY ON THE VERGE OF DISRUPTION
3 RAILWAY SECTOR: WILL SLOW AND STEADY WIN THE DECARBONISATION RACE?
4 NTERNATIONAL SHIPPING: AT THE CROSSROADS OF ECONOMIC AND ENVIRONMENTAL CHALLENGES
5 AVIATION SECTOR: FLIGHT SHAME IN THE AGE OF CLIMATE CHANGE

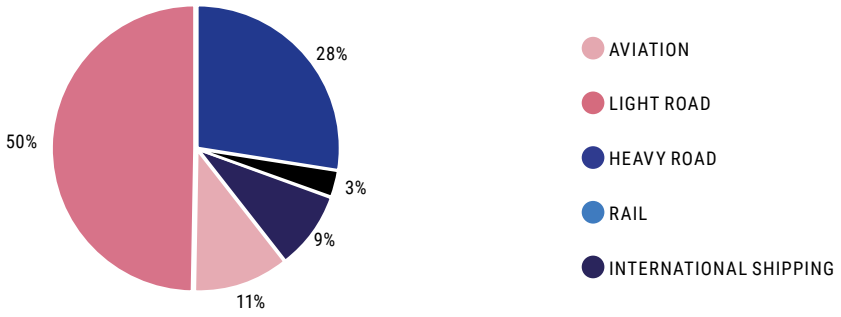
1. Global transport limate action now: the urgency of action

• THE TRANSPORT SECTOR IS RIPE FOR RADICAL REFORM • The Paris Agreement ambition to limit global climate change to well below 2 degrees Celsius has profound implications for the transport sector. With the rising demand for transport services, how will the sector tackle the challenge of climate change?

In 2017, the transport sector accounted for 24% of direct CO_2 emissions from fuel combustion, or 7.8 Gt (IEA, 2018a). Measured on the more comprehensive well-to-wheel basis and including all greenhouse gas emissions, transport emitted about 9.7 Gt carbon-dioxide equivalent (CO_2-eq)[1] in 2018. Since 2017, global transport sector carbon emissions have increased by 1.2% with Asia accommodating an immense intensity of growth with 3.4%. Most of the transport carbon emissions are from the road sector, which constitutes about three-quarters of transport carbon emissions (fig.1). Over the past two decades, the road transport sector has contributed about 80% of the increase in total transport sector CO_2 emissions.

FIGURE 1

TRANSPORT CARBON EMISSIONS IN 2018 - *Source: Author Quantification (see footnote 1)*



If current trends continue unabated, the global transport sector CO_2 emissions could still increase to 10 to 18 Gt in 2050 (Gota, S. et al., 2018). However, the Paris Agreement calls for rapid decarbonisation of the transport sector with the carbon emissions reduced to 2-3 Gt by 2050. Given this massive scale, decarbonisation burden on the transport sector is exceedingly high. Action by national governments is critical, but on its own, it cannot ease the decarbonisation burden of the transport sector. Thus, there is a need for diversifying the transport sector's climate change governance, i.e. all levels of government and non-state and subnational actors such as regions, states, cities, companies, investors, civil society organisations, and cooperative initiatives individually and collectively take urgent and effective action to decarbonise the transport sector.

This 2019 global transport profile synthesises the most recent data to help untangle the various strands of the transport sector. The ambition is to provide a status of global climate action related to the transport sector and identify the synergies between the State and non–state actors (NSA) activities and bring critical messages to the international community to drive ambition within the transport sector. The report follows a segmented approach analysing the status of emissions and demand in each sub-sector followed by State and non–state actors response. This status review covers challenges of both passengers (car, rail and air) and freight transport (road, rail and international shipping). The range of action is illustrated through on the ground examples from 2017-2018.

1 Author computations are based on IEA ("ETP 2017" n.d.), "Energy Transition Outlook 2018 | DNV GL" n.d.; International Transport Forum 2019, "The World of Air Transport in 2018— Presentation of 2018 Air Transport Statistical Results" n.d., "Greenhouse Gas Studies 2014" n.d.

TO BETTER UNDERSTAND

SYSTEMS APPROACH TO TRANSPORT SECTOR DECARBONISATION

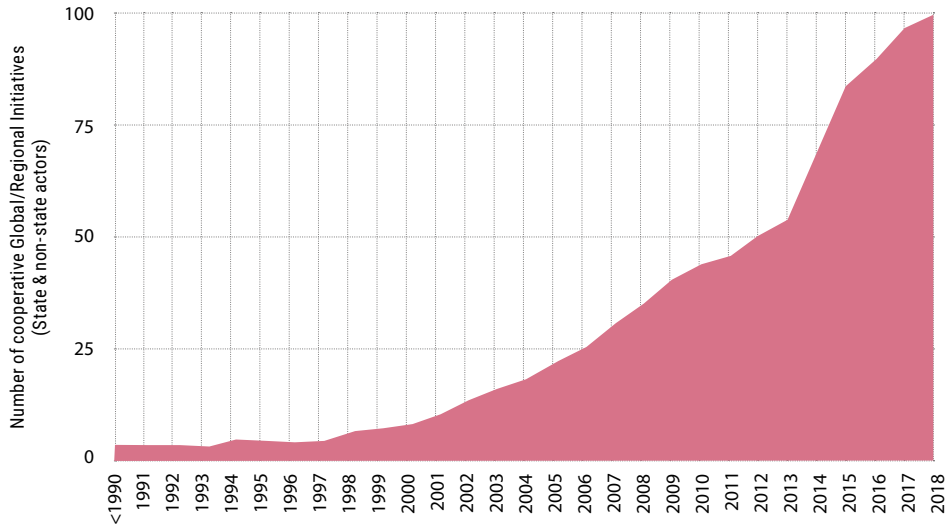
Transport carbon emissions are the result of a complex mix of human behaviour, economic growth, public policy and transport regulations. There exists no silver bullet to decarbonise transport sector; instead, it is a systems approach with a range of strategies and initiatives that must be embraced in a comprehensive manner covering all modes of transport, across all regions by all stakeholders. A typical transport low-carbon policy response includes a combination of 'Avoid' strategies, which reduce the need to travel (e.g. transport demand management); 'Shift' strategies, which move transport trips to more efficient modes (e.g. public transport improvements); and 'Improve' strategies, which increase the efficiency of existing trips (e.g. fuel economy standards, decarbonising fuel).

BOX 1

The review suggests some mixed signals about the pace and direction of change in the transport sector; however, encouraging signs are now evident. There has been a groundswell of collaborative actions in recent decades, and the forces of change in the transport sector are becoming strong. There exist more than 100 international cooperative initiatives (continually growing) within the transport sector (fig.2). Most of these initiatives consider multiple-modes (46%) and cover both passenger and freight transport (67%) and include a combination of 'Avoid', 'Shift' and 'Improve' approach (50%), i.e. ICI's are holistic partnerships based on systems approach (Box 1).

FIGURE 2

DEVELOPMENT OF 100 COOPERATIVE INITIATIVES IN THE TRANSPORT SECTOR - *Source: Author*

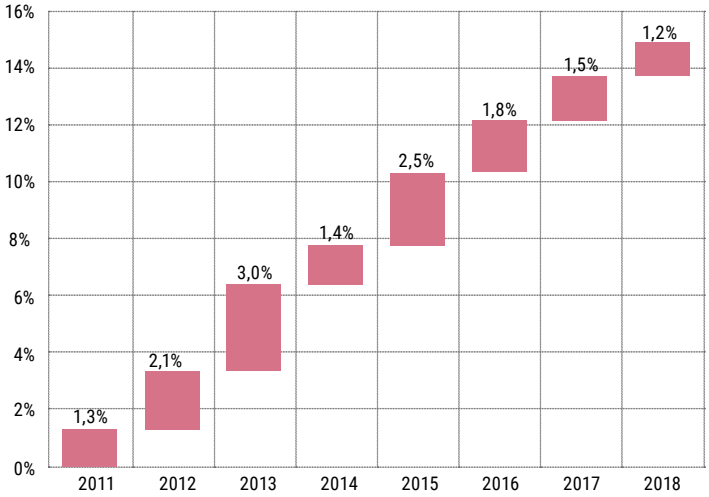


The review confirms that non–state actors initiatives covering both individual action and partnerships with other actors and, with national governments, have a vital role to play in driving ambition and delivering action. Trends reveal the continued, encouraging and growing role of NSAs in global transport decarbonisation agenda. However, while climate action is increasing, there is little overall change in the transport emissions trajectory. However, an immediate lack of emission performance does not in itself suggest failure (fig.3). As the case studies illustrate - policies, regulations and NSA initiative's effectiveness are increasing over time due to better awareness and capacity. The role of the non-state actors in this transformation (especially in setting agenda) has been critical.

NSAs' initiatives could accelerate implementation and increase the effectiveness of national policies through the impact on other development benefits such as air pollution, health impact, traffic and parking congestion, accident fatalities, productivity loss, noise pollution and energy security.

FIGURE 3

GLOBAL TRANSPORT CO_2 EMISSIONS (DIRECT) YEAR-ON-YEAR GROWTH - *Source: Author, based on Enerdata*



Stakeholders must act together to establish a sustainable and low carbon vision for the transport sector, a vision that can be operationalized at the regional, national, city and company levels for different modes. Governments must now seize the opportunity provided by the non-state actor initiatives and create the right policy, financial and institutional framework to scale-up development and deployment of sustainable low carbon transport policies and projects.

2. Road transport: Accelerating mobility on the verge of disruption

• Globally, road transport accommodates nearly about 78% and 23% of total passenger and freight transport demand.
• In 2018, for the first time in the last decade, global vehicle sales reduced by modest -0.6% when compared with 2017.
• Passenger transport in cities is at a cusp of a new disruption – shared mobility.
• Despite the rise in demand for transport services, energy efficiency policies and measures have restricted energy consumption growth. However, in recent years, the fuel economy improvements of the new light-duty vehicles (LDVs) has slowed down due to the rapid decline of diesel LDVs sales and growing consumer demand for SUVs.
• Currently, only about 38 countries have established fuel economy standards for LDVs.
• For Heavy-duty vehicles, only Canada, China, Japan, the United States and India have established standards.
• While the policy developments on fuel decarbonisation in the transport sector are focused mainly on the road sector, the road transport sector lags other energy sectors in the energy transition.
• In 2018, policy support for increasing the share of biofuels in road transport remained relatively static but electricity is increasingly becoming the "fuel" of choice in the transport sector.

TO BETTER UNDERSTAND

SUSTAINABLE TRANSPORT FACILITATES SUSTAINABLE DEVELOPMENT GOALS

Sustainable transport is a cross-cutting theme in the 2030 Agenda for Sustainable Development. It supports the achievement of at least 8 of the 17 Sustainable Development Goals (SDGs) and makes direct and indirect contributions to at least 13 SDG targets. During the first quadrennial reporting cycle from 2016 to 2019, 156 Voluntary National Reports (VNRs) were submitted by 143 countries. Out of these 156 VNRs, nearly 92% of the submitted have highlighted transport sector indicating the enabling role of the sector. However, only 30% of VNRs have included explicit references to sustainability transport impacts (e.g. poverty alleviation, zero hunger, women empowerment and access to education). Most references highlight transport infrastructure, energy use and road safety issues. Further, only 20% of VNRs reported on specific transport targets focusing mostly on infrastructure and energy use, implying a general lack of balanced strategic planning for sustainable transport development. Linkages between sustainable development and climate change provide a compelling rationale for climate action in the transport sector. Transport sector review of VNR's indicate that countries often do not acknowledge the importance of co-benefits of sustainable low-carbon transport policies including air pollution reduction, enhanced health protection, reduced traffic and parking congestion, diminished accident rates, improved productivity, reduced noise pollution and increased energy security among other benefits (SLoCaT, 19/09/2019).

BOX 2

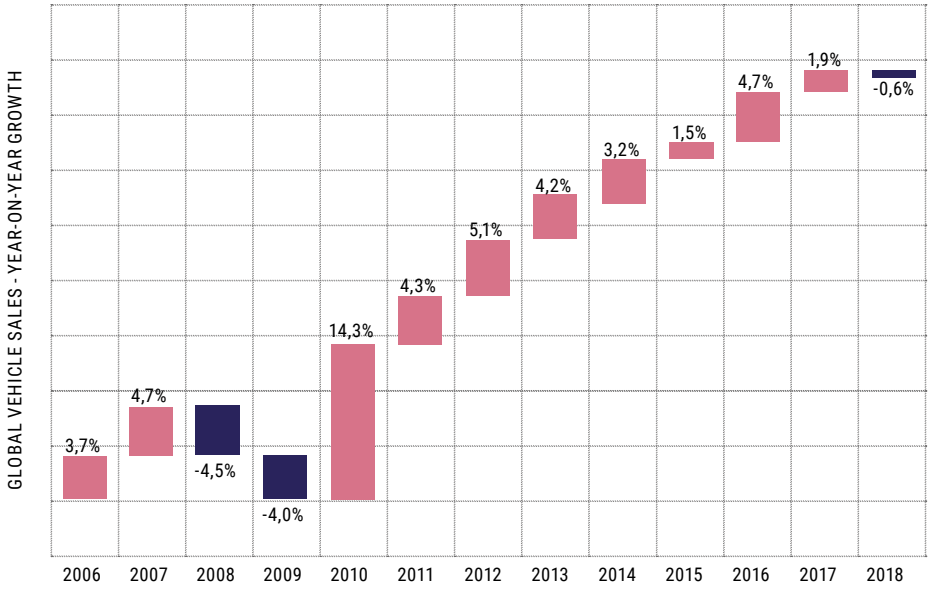
• STATE OF PLAY: TRANSPORT DEMAND • Globally, road transport accommodates nearly about 78% and 23% of passenger and freight transport demand (passenger-kilometre travel and trillion tonne-kilometre travel). Historically, growth in the demand for both passenger and freight road transport has been closely correlated with growth in economic activities. The current global road transport mobility of close to 44 trillion passenger-kilometre travel and 32 trillion tonne-kilometre travel (IEA, 2017).

The OECD countries share in road transport mobility is about 30% and 40% for passenger and freight transport. Further, urban transport share in total passenger and freight road transport is

about 60% and 10%. The current mode share of urban mobility (in passengers kilometre) is estimated to be private transport, i.e. Cars and two-wheelers – 67%, public transport (bus) – 30%, shared mobility (uber, grab taxi, bike share, etc.) – 1% and active transport – 2%(International Transport Forum, 2019)[2].

FIGURE 4

GLOBAL VEHICLE SALES GROWTH - *Source: OICA Data*



Research indicates that road transport demand is growing significantly in non-OECD countries where private vehicles are becoming a preferred mode of travel. Currently, there are about 2.2 billion vehicles on the road (IEA, 2017). Nearly 90% of the cars, trucks, motorbikes and buses on the road today rely on engines fuelled by oil (IEA, 2018a).

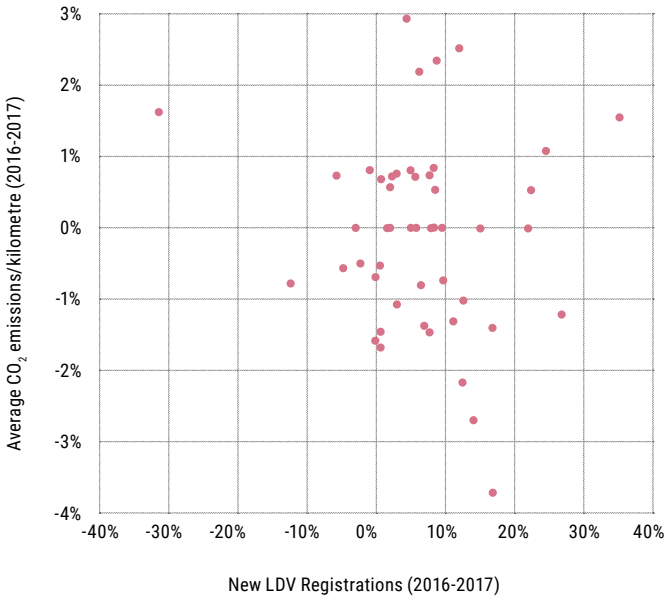
For the first time since the 2008 global financial crisis, global vehicle sales reduced by -0.6% when compared with 2017 (fig.4) (OICA, 2018). Vehicle sales reduced in many OECD and non-OECD countries - China (-3%), United Kingdom (-6%), Mexico (-7%), Sweden (-6%), Australia (-5.6%), Saudi Arabia (-19%), Philippines (-14.4). Overall in 2018, nearly 79 million passenger cars were sold worldwide, slightly less (-0.8%) when compared to 2017 results (Piazza 2018). However, the downward trend was not universal around the world -for example -Myanmar (114%), Nigeria (107%), Azerbaijan (100%) indicating that there exists great diversity in the mobility pattern among different geographical regions and income levels.

• STATE OF PLAY: FUEL EFFICIENCY • In 2018, despite policies on road transport demand management, modal shift and energy efficiency, the road transport energy demand had increased with an annual growth rate of 1.3% (from 2017). When compared to 2016, Poland (24%), India (13%), Nigeria (13%) China (9%) & Netherlands (9%) had the highest intensity of growth in road transport energy consumption. In 2018, the road transport sector accounted for an estimated 77% of global transport sector energy demand in 2018 (DNV-GL, 2018).

2 Several case studies show that ride-hailing companies often lead to more motorized passenger transport and more greenhouse gas emissions as users shifted from using public transport to private ride-hailing services https://escholarship.org/uc/item/4vz52416

FIGURE 5

AVERAGE CO_2 EMISSIONS / KILOMETRE OF LDV'S LDV REGISTRATION GROWTH (2016-2017) - *Source: IEA and GFEI*



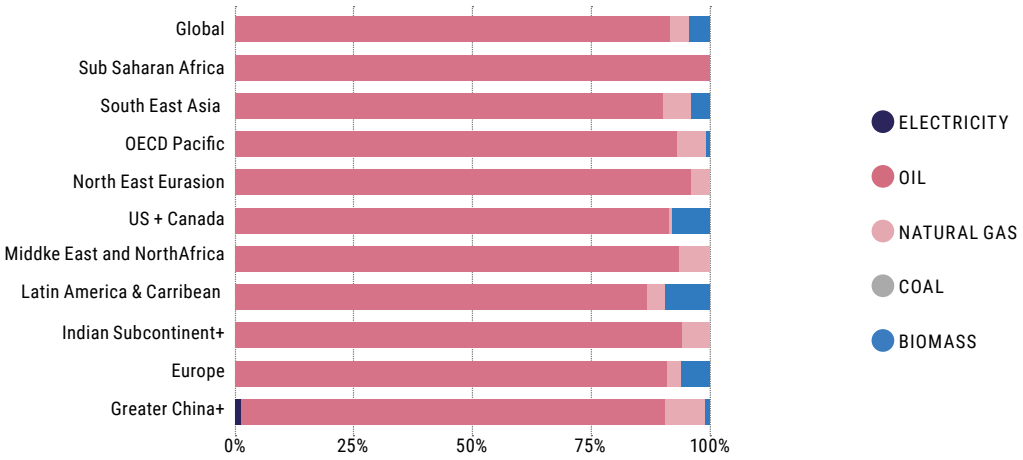
The global average fuel economy of new light-duty vehicles (LDVs) in 2017 is estimated to be about 7.2 litres per 100 kilometres (of gasoline-equivalent). The average fuel economy improvement rate of new LDVs between 2015 and 2017 slowed down to about 1.4% per year, which is lower when compared with the annual historical improvements, i.e. 2% from 2005 to 2010 and 1.5% from 2010 to 2015. However, surprisingly, since 2011, the average fuel economy of new LDVs in emerging economies improved at a faster rate (2.0%) when compared with advanced economies (1.3%). The slowing down of fuel economy improvements is mainly due to rapid decline of diesel LDVs sales in several major vehicle markets, most notably in Europe, growing consumer demand for larger vehicles especially in non-OECD countries (GFEI, 2018) (fig.5). The Sport Utility Vehicles (SUVs) share in total car sales increased from 17% in 2010 to 39% in 2018 (Cozzi, L., Petropoulos, A., 15/10/2019) resulting in 0.55 Gt of CO_2 increase during the last decade. International Energy Agency (IEA) has estimated that since 2010, SUVs were the second-largest contributor to the absolute increase in global CO_2 emissions after the power sector.

• STATE OF PLAY: FUEL DECARBONISATION • At present, the road transport sector is one of the least diversified energy end-use sectors due to the high emphasis on energy density. In 2018, about 92% of road transport modes were powered by petroleum products with limited uptake of biofuels such as ethanol and biodiesel (4.3%), natural gas (3.9%) and electricity (0.3%) (fig.6). However, the rapid deployment of biofuels in Sweden and Brazil has ensured that oil share in road transport energy consumption was reduced to below 80%. In total energy consumption, gasoline and diesel have a share of 52% and 41%.

Gasoline share in transport energy consumption has been gradually reducing. In 2005, gasoline constituted about 57% of road transport energy consumption. In 2018, it reduced to 52%. Since 2017, gasoline, diesel, natural gas, electricity and biofuels consumption in road transport has increased by 0.4%, 1.5%, 10.2%, 7.6% and 4.7% respectively (fig.7). High intensity of growth was observed in China (electricity 8.5%), Republic of Korea (biofuels 60%) & Brazil (natural gas 12%).

FIGURE 6

ROAD TRANSPORT ENERGY CONSUMPTION BY FUEL TYPE (2018) - *Source: DNV*



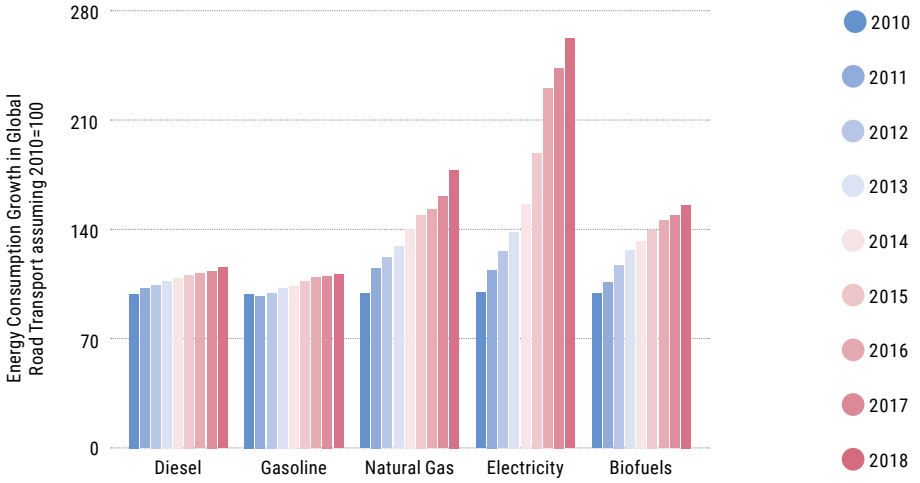
In 2018, natural gas was the fastest-growing fossil fuel in the transport sector. Natural gas consumption in the transport sector is increasing at a rapid pace a result of policy-driven efforts to promote compressed natural gas (CNG) and LNG fuelled vehicles. It releases less carbon than diesel. However, new research confirms that some natural gases, like methane, leak as they move through the supply chain, which significantly reduces the benefit of switching fuel. (Brogan, C., 28/01/2019)

Although the share of electric mobility in energy consumption is still small (0.3%), the electric road vehicle fleet is expanding quickly. In 2018, close to 96% of the electric vehicle fleet on the road was two-and-three wheelers. Cars, bus and light commercial vehicles only constituted about 2%, 0.2% and 0.1%. The low-speed electric vehicles which are significantly smaller than electric cars constitute about 1.8% of the total electric fleet (IEA, 2019b). In 2018, the global electric car fleet exceeded 5.1 million, i.e. reached 0.6% of the total passenger car fleet and electric two & three-wheelers on the road exceeded 300 million. China is the world's largest electric car market with over 1 million electric cars sold in 2018 (IEA, 2019b).

Biofuels remain the foundation of national renewable transport policy frameworks. Transport biofuel production expanded 7% year-on-year in 2018 to reach 88 Mtoe (152 billion litres) (IEA, 2019). Most of the biofuel consumption in road transport is through blending at low percentages (typically less than 10% by volume) with fossil fuels. Growth in the use of biofuels as a fuel decarbonisation strategy remains hindered by policy and investment uncertainties related to the availability of feedstock and lifecycle emissions. Out of the total consumption, advanced biofuels from non-food crop feedstocks like hydrotreated vegetable oil from waste oil and animal fat feedstocks had less than 10% of the share.

FIGURE 7

ROAD TRANSPORT ENERGY CONSUMPTION GROWTH BY FUEL TYPE - *Source: Enerdata*



• POLICIES AND ACTIONS: TRANSPORT DEMAND IN THE AGE OF DISRUPTION • The stakeholder response to transforming travel demand involves the use of "Avoid" strategies to reduce travel through e.g. urban planning, logistics redesign and by behavioural changes and to induce a modal shift from the most energy and emission-intensive mode (i.e. cars, road freight) towards more environmentally friendly modes – walking, cycling, public transit, railways, waterways (see: Climate Chance, Global Transport Profile 2018).

Passenger transport in cities is at a cusp of a new disruption – shared mobility. Shared mobility is bringing new players and business models into play. Globally, the majority of the urban passenger trips are below 5km. These trips are highly competitive in time and costs with shared modes or micro-mobility modes (for example, e-scooter, docked bikes, dockless bikes, e-bikes). Since 2015, stakeholders have invested more than $5.7 billion in micro-mobility start-ups (like Ofo and Mobike in China and Citi Bike and Jump Bikes in the US) with about 85% of investments in China alone (McKinsey & Company, 2019).

Venture capital-backed ride-hail companies like Uber and Lyft acquired Jump Bikes and Motivate in the U.S respectively. In the US alone, the shared micro-mobility trips in 2018 were about 84 million trips which were double the number of trips taken in 2017 (National Association of City Transportation Officials, n.d.). Currently, more than 1,600 bike-sharing programs were in operation (entirely by the private sector) globally, with more than 18 million bicycles available for public use (The Bike-Sharing Blog, n.d.).

There are several bigger ride-sourcing and ride-sharing options available for the commuters – Uber, Didi Chuxing, Grab, Lyft, Ola. The global ride-sharing market is valued at about USD 51 billion in 2017 and is anticipated to grow to about 220 billion by 2025 ("Global Ride Sharing Market 2019, By Type, Expanse, Ownership, Business Model, Demographic and Growth Opportunities to 2025 - Reuters" n.d.). Uber, which started in 2010 and now facilitates mobility in 21 countries, completed a total of 10 billion trips in 2018 (Uber, 24/07/2018).

Theoretically, use of shared modes should catalyse a shift away from traditional private modes (two-wheelers, cars) leading to significant climate, air pollution and health benefits. However, the impact of these disruptions in urban passenger transport are uncertain at best (International Transport Forum, 2019).

The rise in income levels and due to increasing disruptions from shared-mobility modes including falling trip costs due to the growing availability of low-cost shared mobility services is also leading to a significant shift away from traditional high capacity modes like buses and rail transit.

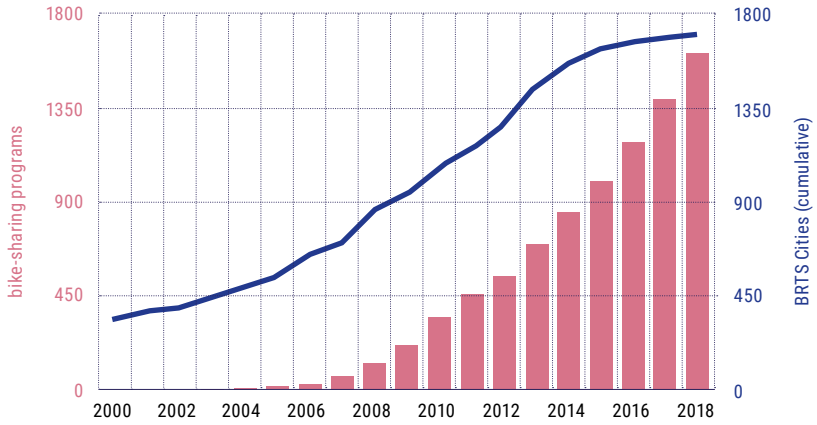
In 2018, for the first time, only 343 kilometres of new rail transit was built which is significantly lower than the global decade average of 650 km/year (ITDP, 26/07/2019). In 2018, the Bus Rapid Transit System increase stagnated at 5059km (in 170 cities) with only a marginal increase in 2018 globally (Global BRTData, n.d.) (fig.8).

In 2019, New York City lawmakers passed a proposal to introduce congestion charging in the city similar to London, Singapore and Stockholm. The proposal set to begin in 2021 and aims to raise $1bn annually by charging around $11 per car trip (BBC News, 17/04/2019). Congestion charging induces travel behaviour change reducing demand for travel using private modes.

In April 2019, London introduced an Ultra-Low Emission Zone (ULEZ) with strict emissions standards that penalise the mobility of non-compliant vehicles. This ULEZ is in addition to the central Congestion Charge zone introduced 2003. The sustainable transport mode share (walking, cycling and by using public transport) has increased from 53% in 2000 to 64% in 2017. In 2018, the London Mayor's Transport Strategy committed to the bold ambition to achieve about 80% of all trips in London by sustainable transport modes by 2041.

FIGURE 8

GLOBAL GROWTH IN BIKE SHARING AND BRTS - *Source: Global BRTData and The Bike-Sharing Blog*



Addressing urban sprawl could lead to multiple development benefits. Research indicates that achieving compact growth, as opposed to urban sprawl, can generate $17 trillion in economic savings globally between now and 2050 (WRI, 15/11/2018). A good example could be Onagawa in Japan which has banned the construction of new buildings except for houses from its outskirts in order to reduce trip distance between residences, jobs and other frequent daily trip destinations (World Economic Forum, 24/04/2019).

In Singapore, the Land Transport Master Plan 2013 set out goal is to increase the peak hour public transport mode share to 75% by 2030. In October 2017, the Land Transport Authority (LTA) of Singapore announced that its vehicle growth rate would be reduced to zero (from 0.25%), effective February 2018. In 2018, vehicle sales reduced by -18% when compared to 2017. The critical policies implemented to reduce urban transport demand include urban planning (smart growth), electronic road pricing (ERP), vehicle quota system, public transit policies, and improving walking and cycling facilities. In 2018, the peak hour public transport mode share reached 67% (Ministry of Transport of Singapore, n.d.). The public transport ridership increased by 0.7% in 2016-2017 and 3.8% in 2017-2018 (Public Tableau, 2019)

• POLICIES AND ACTIONS ON FUEL ECONOMY: SUV'S PLAYING SPOILSPORT • Research indicates that for countries which have established fuel economy regulations and/or fiscal incentives, the improvement in fuel economy is on average 60% faster than countries without such policies (IEA, 2019).

Efficiency policy progress has historically been slower in road transport sector when compared with other sectors like buildings and industry. However, the global road vehicle fleet is increasingly being covered by fuel efficiency standards. Currently, about 38 countries have established fuel economy standards for LDVs - Brazil, Canada, China, India, Japan, Mexico, Saudi Arabia, South Korea and the United States, as well the 28 countries of the European Union (SLoCaT, 2018).

Research indicates that setting Heavy-duty vehicles (HDVs) fuel economy standards yield highest benefits in fuel economy as they consist of less than 5% of the global on-road vehicle fleet but 40% of its energy consumption (ICCT, n.d.)For HDVs, only Canada, China, Japan, the United States and India (which combinedly account for around 40% of total road transport fuel consumption) have established standards, while, the European Union, Mexico, and South Korea are actively developing fuel economy programs. As of 2017, 50% of global HDV sales were in countries with HDV fuel efficiency standards (IEA, 2018b).

TO BETTER UNDERSTAND

WHAT IS THE FUTURE OF VEHICLE FUEL ECONOMY STANDARDS IN THE US?

In 2018, the USEPA and National Highway Traffic Safety Administration proposed revised fuel economy and emissions regulations under the Trump administration to phase out aggressive targets implemented during the Obama administration. During previous President Barack Obama's administration (in 2012), automakers were given a fuel efficiency target of 54.5 mpg for cars and light trucks under the corporate average fuel economy (CAFE) by 2025. The stringent standards were found to be technically and economically feasible by several institutions like EPA, NHTSA and several non-state actors. However, in 2018, the USEPA and National Highway Traffic Safety Administration found the 2025 target costs exceeding the benefits. The new regulations, i.e. "One National Program Rule" will enable the federal government to provide national uniform fuel economy and greenhouse gas emission standards for automobiles and light-duty trucks. The new standards would permanently freeze the current standards at the 2020 level through 2026 and revoke California's long-standing authority to set its own, more stringent tailpipe standards and limit other states from following suit. The proposed rollback would be fought legally in the courts by non-state actors.

BOX 3

Globally, in 2016, the incremental amount invested in more energy-efficient vehicles was estimated to be about 60 billion USD (World Bank, 2019). The State and non – state actors have played a pivotal role in supporting government policies and actions on fuel economy. The Global Fuel Economy Initiative (GFEI) was established to assist governments and stakeholders in improving vehicle fuel economy. The GFEI is a partnership of the IEA, United Nations Environment Program (UNEP), International Transport Forum of the OECD (ITF), International Council on Clean Transportation (ICCT), Institute for Transportation Studies at University of California Davis, and the FIA Foundation. Since its launch in 2009, GFEI has worked to raise awareness of the fuel economy policies, coordinate and share research and analysis, and offer country policy support. The GFEI has facilitated the development of fuel economy policies and regulations in about 70 countries. However, latest GFEI status report indicates that currently, no countries or regions are on track to meet the 2030 GFEI target (the annual improvement rate of new LDVs need to increase to 3.7% per year to reach the global fuel economy initiative's 2030 target).

The GFEI initially developed a 2050 target of improving the average fuel economy of the global LDV fleet by at least 50% by 2050 ('50by50'). These fuel efficiency gains were estimated to be worth $2 trillion by 2050. Independent assessments reveal that GFEI LDV targets alone could deliver about

300 to 600Mt/year of CO_2e reduction by 2030 globally. (Hsu et al., 2019).

In 2019, GFEI revised the 2050 target with an ambition of ensuring complete transformation of the world's vehicle fleet to zero-emission vehicles. The GFEI targets could deliver a reduction of about 30% reduction by 2050 from a 2005 baseline.

Several examples exist at national, sub-national, company and corridor level

- In 2019, GFEI revised the 2050 target with an ambition of ensuring complete transformation of the world's vehicle fleet to zero-emission vehicles. The GFEI targets could deliver a reduction of about 30% reduction by 2050 from a 2005 baseline.
- Several examples exist at national, sub-national, company and corridor level
- In 2019, the Ministry of Economy, Trade and Industry (METI) in Japan and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in Japan revised the Standards for automobiles in Japan. The new fuel-efficiency standards for 2025 require manufacturers to enhance the fuel efficiency by approximately 13.4% for trucks and other heavy vehicles and by approximately 14.3% for buses from the FY2015 fuel efficiency standards as a reference, respectively (METI, 29/03/2019).
- In 2018, UN Environment supported seven countries in the Economic Community of West African States region to develop a regional roadmap for fuel economy with a target of average automotive fuel economy of 5 litres per 100 km by 2025 for newly imported passenger cars in the region (UN Environment, 2018).
- In 2019, GIZ and UN Environment helped ASEAN Secretariat develop a regional roadmap for fuel economy improvement in ASEAN countries. The roadmap developed in consultations with government, private and civil society members, identifies regional vision, goals and targets and provides recommendations to ASEAN countries to develop national roadmaps. (The ASEAN Secretariat, 2019).
- Working with SmartWay, U.S. trucking companies saved about $33.4 billion on fuel costs (cumulative savings), contributing to lower trucking operating costs and higher profits. EPA's SmartWay program helps US and Canada companies advance supply chain sustainability by facilitating penetration of fuel-efficient technologies and by measuring, benchmarking, and improving freight transportation efficiency. Between 2009 and 2016, the Smartway initiative has also resulted in a cumulative savings of 70,000 short tons of fine particulate matter and about 1.7 million short tons of nitrogen oxides emissions thus reducing air pollution (US EPA, 2016).
- In 2017, In East Africa, the UNCTAD, CCAC and UNEP assisted the Northern Corridor to develop a green freight strategy. The corridor targeted improvement in fuel economy (litres per ton-km) for trucks by at least 5% by 2021 (CCAC, 2017).

• POLICIES AND ACTIONS ON FUEL DECARBONISATION: IS FUTURE ELECTRIC ? • Achieving needed increases in renewable energy in the road transport sector will require implementing fuel diversification policies and strategies. Over the last decade, policy developments in the transport sector are mainly focused on road and railway sectors. In 2018, the biofuel blending mandates existed in at least 70 countries. However, no additional countries adopted biofuel mandates in 2018, but some countries have renewed their mandates and strengthened them (REN21, 2019).

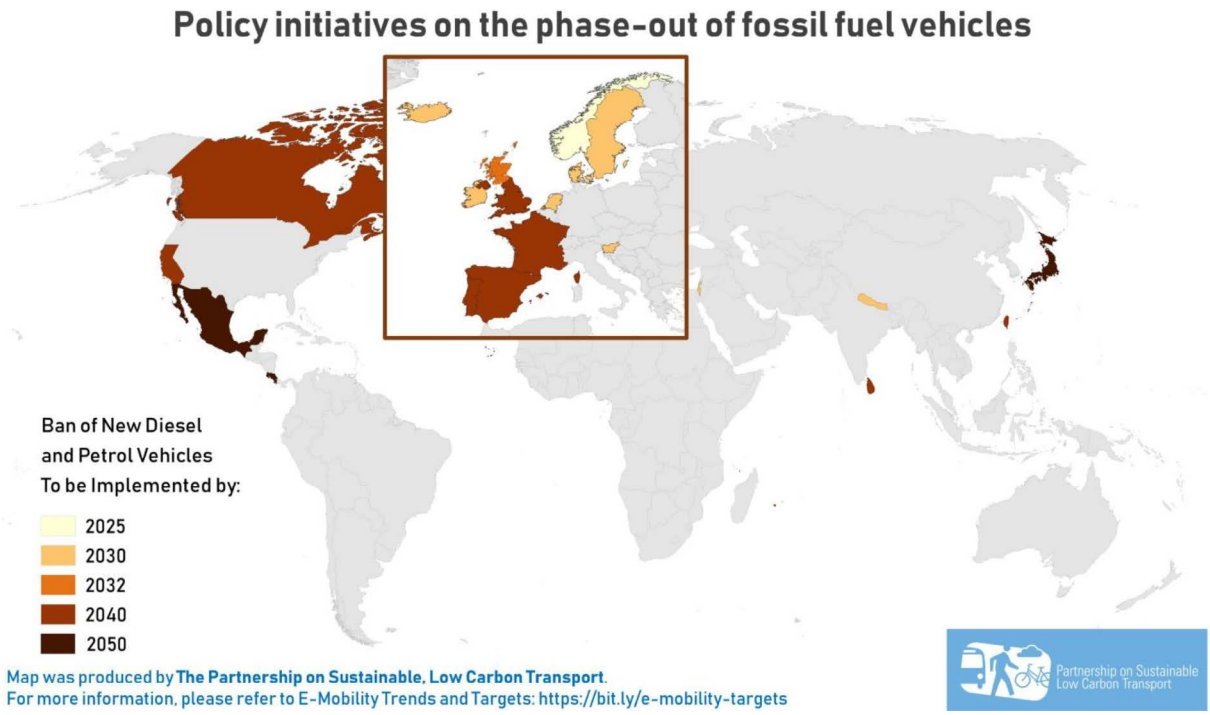
In 2018, India implemented the National Policy on Biofuels-2018. The policy mandates an indicative target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030 (Press Information Bureau, 24/06/2019). In 2019, Finland approved a new target of 30% biofuels in road transport by 2030 and use of advanced biofuels target of 10% in 2030 (Biofuel International Magazine, 07/02/2019). In 2018, Stockholm became one of the world's first capital with 100% fossil-free bus services using biofuels and biogas. Currently, fossil-free biodiesel like rapeseed oil methyl ester and hydrogenated vegetable oil are used in 64% of the buses in Stockholm (Biofuel Express, 10/04/2019).

Electric vehicles have now become a cornerstone of the fuel decarbonisation strategy in the road transport sector. Policies continue to have a significant influence on the transformation of global electric vehicle ownership. At the national level, several countries have announced plans

to phase-out fossil fuel vehicles and shift to electric vehicles. Leading examples are highlighted in the map below (fig.9).

FIGURE 9

PHASING OUT FOSSIL FUEL VEHICLE TARGETS - *Source: SLoCaT*



NSA's response to the national government's commitment to phasing out fossil fuel-powered vehicles and on electric vehicle penetration increasingly confirms the escalating momentum for electrification of transport. Cities are now taking the lead in implementing low emission zones, registration, and vehicle access restriction policies with creating new infrastructure for charging facilities that promote low emission vehicles such as electric vehicles. For example, Shenzhen electrified its entire public transit bus fleet with 277 electric buses in 2012 to 16,359 electric buses in 2017. Currently, it is the world's first 100% electrified bus fleet and is more prominent than New York's, Los Angeles's, New Jersey's, Chicago's and Toronto's electric bus fleets combined (WRI, 04/04/2019).

The private sector is playing a leading role in driving electric vehicle deployment through its manufacturing, procurement and investment decisions. Recent announcements by vehicle manufacturers, stakeholders in automotive supply chains and fleet operators are increasingly becoming more ambitious with intentions to electrify the transport system. For example, Flipkart, which is one of India's largest e-commerce companies, is on track to replace 40% of its urban delivery vehicles with all-electric vehicles by March 2020. Some recent announcements made by the State and non-State actors have been documented by SLoCaT (SLoCaT, 2018).

TO BETTER UNDERSTAND

CITIES SPEARHEADING ELECTRIC VEHICLE TRANSFORMATION

In 2018, the Global EV Pilot City Programme was launched with the ambition to build a network of at least 100 cities over an initial period of five years, to work together on the promotion of electric mobility. The programme encourages the replication of best practices with information exchange among cities. (International Energy Agency 2019)

Country	City
Canada	Calgary, Halifax Regional Municipality, Montréal, Stratford, Surrey, Richmond, Winnipeg, York
Chile	Santiago de Chile
China	Beijing, Rugao, Shanghai, Shenzhen, Yancheng
Finland	Helsinki, Espoo, Oulu, Tampere, Vantaa
Germany	Offenbach am Main
India	Pune
Japan	Aichi, Kanagawa, Kyoto, Tokyo
Netherlands	Amsterdam, the Hague, Rotterdam, Utrecht and Metropolitan Region Amsterdam
New Zealand	Christchurch, Haurak
Norway	Oslo
Sweden	Stockholm
Thailand	Betong, Nonthaburi
United Kingdom	Coventry, Dundee, London
United States	New York City

BOX 4

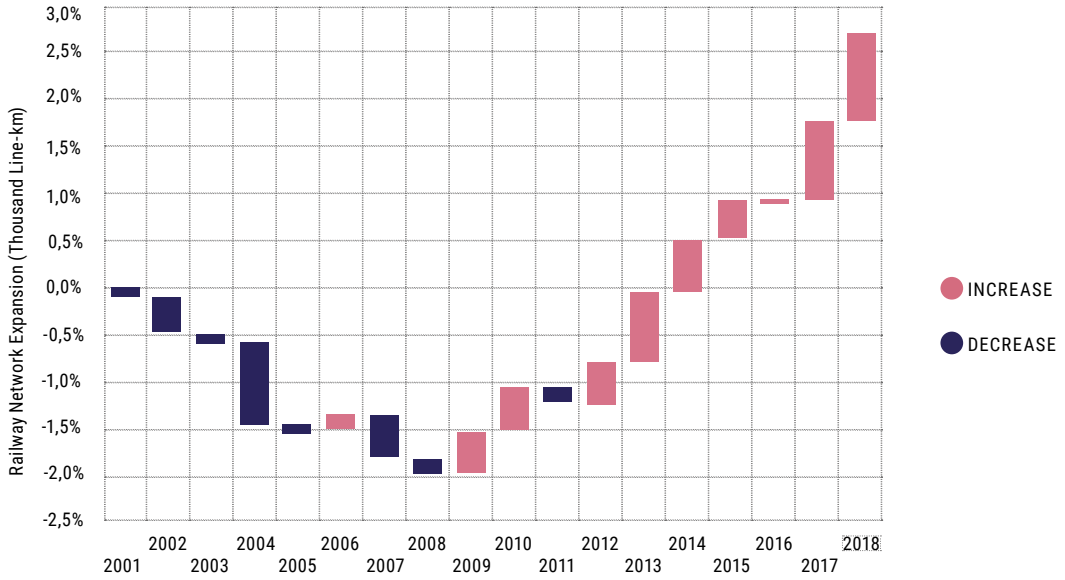
Electric vehicle carbon benefits will not be realised without the alignment of policymaking across the energy system, i.e. decarbonisation of power generation systems. In recent years, countries are intensifying efforts to increase renewable energy use in power generation. In 2018, renewable energy of 181 GW was newly installed (REN21, 2019). In 2018, as more electricity was generated from renewable energy, electricity consumption in the transport sector also increased due to policies and actions.

3. Railway sector: will slow and steady win the carbonisation race?

• In 2018, despite the railway carrying about 8% of total transport demand in passenger-kilometre and tonne-kilometre travel respectively, it emitted less than 3% of transport carbon emissions.
• 2018 have seen the highest expansion of the global railway network in the last 20 years with just a 0.9% increase.
• Electric railways are emblematic of the changing face of the transport sector. However, railway network expansion and mode shift from roads and aviation for passenger and freight transport have remained limited.

FIGURE 10

GLOBAL RAILWAY NETWORK EXPANSION - *Source: SLoCaT, World Bank and IEA*



• STATE OF PLAY • Rail transport demand is slowly and steadily expanding in most regions of the world, especially in metropolitan cities and for intercity transit. In terms of activity – rail carries about 8% and 8% of total transport demand for passenger-kilometre and tonne-kilometre travel respectively.

Railway activity increased significantly in recent years, mostly driven by high-speed railways, metros and high capacity commuter rail networks. In 2018, a surge of high-speed rail activity in China and urban transit (metro and light rail) growth in Asia led to annual growth of railway network expansion of 0.8% (highest in the last two decades). The majority of railway network expansion is in high-speed rail and urban transit systems when compared with the conventional heavy railway system. Since 2000, high-speed railway, metro and light rail system network has increased by 741%, 67% and 50%. In contrast, the conventional heavy rail system has decreased by 1% (in line-kilometres) (fig. 10).

By 2018, more than 200 cities globally have constructed metro systems, their combined length exceeding 32,000 km and light rail systems add another 21,000 km of track across more than 220 cities (IEA, 2019a). Since 2008 Beijing Olympic Games, when the first high-speed rail line in China was launched, between Beijing and Tianjin, China alone has added more than 29,000 km of high-speed lines (as of 2018) with design speeds ranging from 200 to 350 km per hour (kmph).

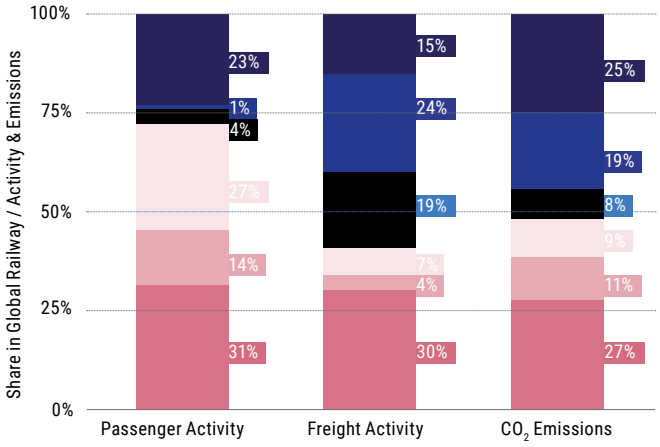
Carbon emissions from railway transport are estimated to amount to 247 million tonnes in 2018,

representing about 2-3% of transport global CO_2 emissions (IEA, 2019a) Rail transport (passenger and freight) generates a low level of externalities and produces much lower CO_2 emissions and energy consumption per passenger-km or tonne-km than road transport and aviation.

Railways currently play a significant role in China, United States, European Union, India and Russia (fig. 11). China alone contributes about 31% of global rail passenger activity, 30% of global freight rail activity and 27% of global railway CO_2 emissions (IEA, 2017). Since 2010, railway passenger activity (in passenger kilometres) has increased by 54%, freight activity (in tonne-kilometres) has reduced by 2% and railway diesel CO_2 emissions have reduced by 40% (National Bureau of Statistics of China, 2018).

FIGURE 11

SHARE IN GLOBAL RAILWAY ACTIVITY AND EMISSIONS (2017) - *Source: IEA*



• POLICIES & ACTIONS • If the railways did not exist, i.e. If all current passenger and freight rail traffic are shifted to road vehicles, global GHG emissions could increase by 1.2 $GtCO_2$-eq, or 12% more than total emissions from transport today (IEA, 2019a). Rail transport can significantly contribute towards the decarbonisation of the transport sector, by shifting passengers and freight from road and air transport to railways. Further, this decarbonisation process can be intensified by expanding electrification of railways and using renewable energy sources to generate electricity and by improving operational efficiency.

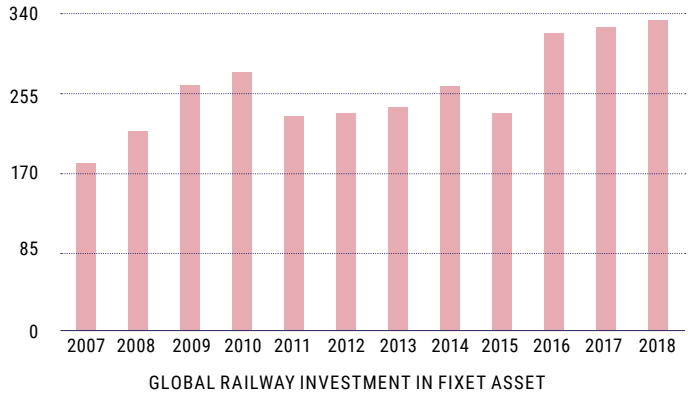
IEA has estimated that the global railway network needs to increase at an annual rate of 2.7% to adequately contribute to Paris Agreement decarbonisation requirements. With such an effective network, modal shift to the magnitude of 12 trillion passenger-kilometres from aeroplanes, cars and two/three-wheelers, and 7 trillion tonne-kilometres from trucks could be possible by 2050 (IEA, 2019a).

State and non-state actors have contributed to the decarbonization of the transport sector by combining modal shift strategies with multiple other strategies such as energy efficiency, switching to fuels with low or net-zero carbon emissions, improving operational efficiency and by ensuring that road transport and aviation subsidies are removed, and passenger and freight travel pays for their external costs. All stakeholders, rail organisations, policymakers and civil society can take actions to reverse the declining modal share of railways.

Achieving modal shifts require substantial investments (fig. 12). Globally, since 2016, more than 300 billion US$ annually is being invested in railways fixed assets (Global Infrastructure Hub, 19/09/2017). However, the investment is insufficient, and the research indicates that the average annual investment needed in the global rail infrastructure exceeds 600 billion until 2050 (IEA, 2019a).

FIGURE 12

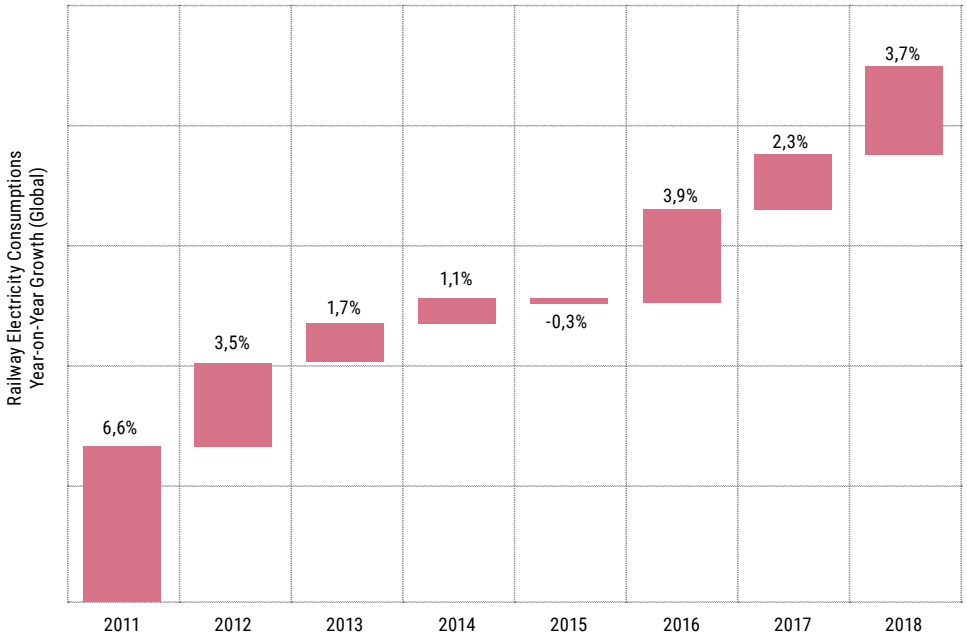
GLOBAL RAILWAY INVESTMENTS IN FIXED ASSETS - *Source: Global Infrastructure Hub*



Many countries such as Bangladesh, China, European countries, India, Japan, Lao People's Democratic Republic and Namibia have established railways mode share targets indicating increased railway investments. In 2019, China is set to invest a record $125bn in improving railways. This investment is 6% more than 2018, and 10% more than was initially planned (Global Construction Review, 21/01/2019) India is set to operate innovative, dedicated Freight Corridors by March 2020 which will induce a significant shift from the freight movement. In 2017, Indian Railway Finance Corporation Limited (IRFC) issued their first Climate Bonds Certified Bond worth USD500 million from international investors. The proceeds of the bond are being used to finance eligible Green Projects under the Dedicated Freight Corridor (Climate Bonds Initiative, 2017).

FIGURE 13

GLOBAL RAILWAY ELECTRICITY CONSUMPTION GROWTH - *Source: Enerdata*



Railways have the highest share of electrification among different modes of transport. As of 2018, over a quarter of railway lines have been electrified (344,000 km) (Mass Transit Mag, 19/04/2018). Electricity now represents around one-third of the energy used globally by the railway sector, with

40% of rolling stock powered by electric traction. (SLoCaT, 2018). The use of electricity in railways worldwide went from 17% to 47% (measured as a share of final energy consumption) between 1990 and 2018. In 2018, railway electricity consumption increased by 3.7% with the highest intensity of growth in China (8%), India (6%), Kazakhstan (5%) and Uzbekistan (5%) (fig. 13).

Passenger rail transport is significantly more electrified than rail freight transport in almost all regions. Currently, three-quarters of passenger movements and half of the freight movement on railways rely on electricity. However, the intensity of electrification of railway network varies significantly among countries, i.e. from 1% in North America to 50% in Russia. The degree of electrification in Asia has risen substantially in the last few years, i.e. 34% share in 2013 to 47% in 2017.

TO BETTER UNDERSTAND

SINGLE GAUGE RAILWAY (SGR) CORRIDOR IN EAST AFRICA

On 1st October 2009, Kenyan and Ugandan governments signed a memorandum of understanding for the construction of the Single Gauge Railway (SGR) corridor from Mombasa to Kampala. On 28th August 2013, Rwanda came on board, andWthe three governments (Kenya, Uganda and Rwanda) signed a Tripartite Agreement commitment to build the Single Gauge Railway (SGR) corridor. The planned 1,500km-long railway was expected to be completed by 2018. South Sudan later joined as an interested stakeholder in the project with proposal to the line to Juba. However, by 2019, only a fraction of Single Gauge Railway (SGR) corridor is built and operational. Kenya has completed the first phase of the project linking Nairobi and Mombasa and has initiated construction of second phase from Nairobi to Naivasha. All the other phases are delayed due to funding constraints, and the future is uncertain.

Majority of the freight is transported via roads (>90%). One of the primary targets stipulated in the 2013 Mombasa Port Community Charter was to ensure at least 35% of railway freight mode share by 2018. However, due to delay in railway construction and the lack of intermodal coordination has worked to the competitive advantage of road transport. The railway freight mode share has dropped significantly over the last decade. However, latest data reveals that with the limited section of the railway opened, i.e. from Nairobi and Mombasa, the mode share of railways increased from 6% (2015) to 12% (2018).

BOX 5

TO BETTER UNDERSTAND

ALSTOM IN MOTION

In 2019, Alstom presented a new strategic plan AiM – "Alstom in Motion" for 2023. Among the objectives for 2025, the energy consumption of solutions offered to its clients should be reduced by 25%. Alstom is currently developing entirely new types of fuel cell trains. The train would be emission-free with significantly lower noise levels. Alstom is also developing a new generation of high-speed electric trains, which will be able to carry up to 750 people and will consume 35% less energy than the previous generation of trains. The energy efficiency target will be achieved through innovations on the trains themselves but also the infrastructure and the services offered. Alstom will for instance further reduce the weight of the trains and the resistance to motion. Optimised HVAC systems is scheduled to be implemented for the different market segments through the use of CO_2 sensors or similar and heat pumps will be proposed.

BOX 6

The NSA's agenda to improve the railway system has been led globally by the International Association of Public Transport (UITP) and International Union of Railways (UIC). The UITP brings together all public transport stakeholders and all sustainable transport modes. It has over 1,500 stakeholders, i.e. member companies that are public transport authorities and operators, policy decision-makers, research institutes and the public transport supply and service industry. The UITP has committed a mode share target, i.e. UITP's Declaration on Climate Leadership as part of the Marrakesh Partnership proposes to double the market share of public transport by 2025 (UITP, n.d.).

The UIC has the mandate of bringing railway companies together and promoting rail transport with its 200 Members in over 100 countries. In 2010, the UIC set two aspirational targets for increased rail activity: passenger transport to increase market share by 50% in 2030 and 100% in 2050, compared to 2010 levels; and freight transport to match the activity level of road transport by 2030 and to exceed road freight volumes by 2050 ("Energy and CO_2 Emissions" n.d., 2).

Some recent examples of railway decarbonisation initiatives are

- In 2018, India announced complete electrification of its rail network by 2022 (Nanda 2018). Russia announced that withdrawal of diesel locomotives was a strategic priority and announced an investment of €2bn over three years for the electrification of the railway network (Ltd n.d.).
- The United Kingdom in 2018 announced complete elimination of diesel trains by 2040. In response, the Rail Safety and Standards Board set up a Decarbonisation Task Force and launched a competition, with a total prize of £2 million to be awarded to the research teams exploring novel solutions to the problem("Consortium Seeks to Eliminate Freight Train Carbon Emissions" n.d.).
- In 2018, the French National Railways SNCF announced a carbon neutrality strategy by 2035. The strategy includes the development of electric operation thanks to agrofuels with the introduction of hybrid trains from 2020, experimentation with hydrogen train in 2022, and the elimination of diesel traction by 2035 ("SNCF Aims for Carbon Neutrality by 2035" 2019). In 2018, Carbon disclosure project initiative proposed railway companies - Deutsche Bahn and Canadian National as leaders in decarbonisation, i.e. two of the 137 companies across several sectors that were recognised for climate leadership in CDP's Climate Change A-List. (CDP, 2018).

FEEDBACK EXPERIENCE

RAIL LINE IN HAMPSHIRE IS WORLD'S FIRST TO BE POWERED BY SOLAR FARM

From August 2019, about 130 solar panels of a total capacity of 30kW at the trackside site will supply renewable electricity to power the signalling and lights on Network Rail's Wessex route. This pilot project represents the first attempts with solar units by-passing the main electricity grid to directly power the railway's traction system. The Riding Sunbeams' 'First Light' demonstrator project is a collaboration between Climate Action 10:10, Community Energy South Network Rail and Imperial College London. The project is funded by Innovate United Kingdom and the Department for Transport. Climate Action, 2019

BOX 7

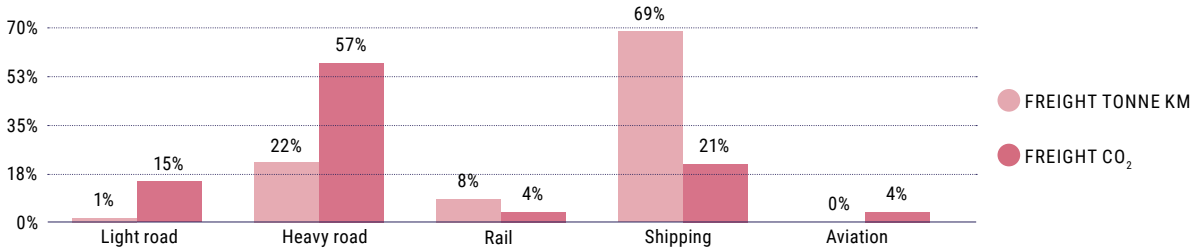
4. International shipping: at the Crossroads of Economic and Environmental Challenges

• International shipping is a small but growing contributor to transport carbon emissions.
• Non-state actors are taking the lead in reducing international shipping emissions. However, rapid growth in trade activity could diminish the impact of climate mitigation efforts.
• Stringent environmental regulations around NOX, SOX and CO_2 emissions necessitate major technological shifts and new sets of policy instruments in the shipping industry.

• STATE OF PLAY • International Shipping demand is steadily expanding in most regions of the world due to growing international trade and the global economy. About 80% of global trade by volume and over 70% by value are carried by the international shipping industry (UNCTAD, 2018). In terms of activity – shipping carries about 70% of total freight demand in tonne-kilometre travel (SLoCaT, 2018). However, international shipping is a small but growing contributor to global GHG emissions. GHG emissions from international maritime transport are estimated to amount to 870 million tonnes of CO_2 in 2018, representing about 9% of transport global CO_2 emissions.

FIGURE 14

GLOBAL FREIGHT ACTIVITY AND EMISSIONS - *Source: Author based on IEA, UNCTAD, ICAO and DNV*



Shipping, by far, is already the most carbon-efficient form of freight transport as it carries close to 70% of freight activity (in tonne-kilometres) but emits only 21% of the total freight CO_2 emissions.

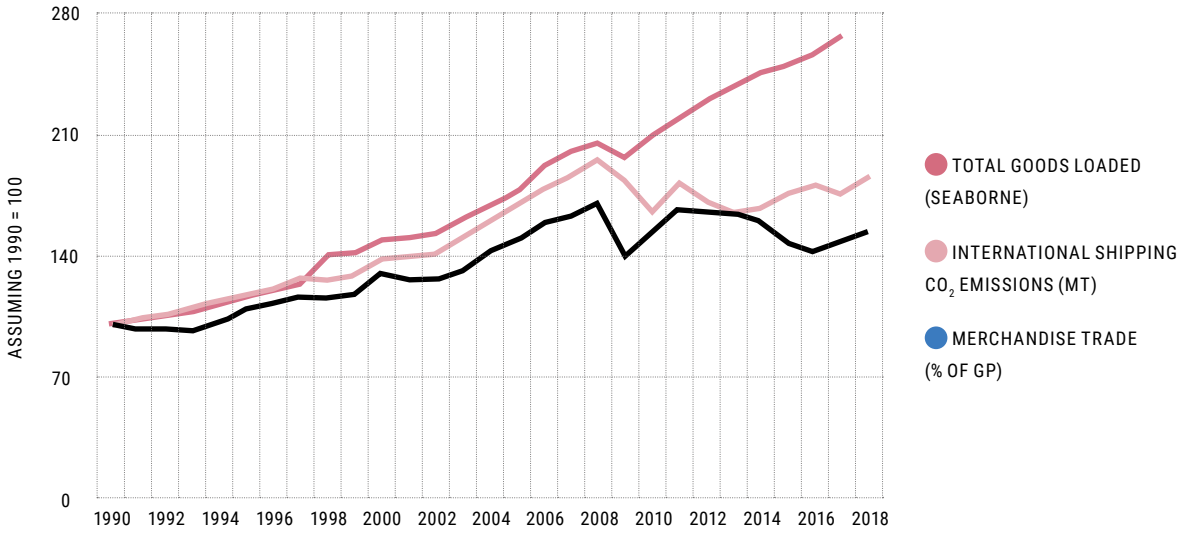
In 2018, World merchandise trade volume increased by 4%, GDP by 6%, shipping capacity (in deadweight ton) by 3.3% and international shipping CO_2 emissions by 6% (compared to 2017). However, the international shipping CO_2 emissions have stabilised since peaking in 2008 (916 Mt) and have reduced by 5% since 2008 (fig. 15).

Overall freight activity in ton-miles generated by seaborne trade in 2018 amounted to an estimated 60 trillion tonne-miles, i.e. an increase of 4% since 2017 (UNCTAD, 2018). In 2018, crude oil trade contributed 23% to total sea-borne freight activity while major and minor dry bulks contributed nearly one-half. The containerised shipments contributed only about 16% of total sea-borne freight activity.

FIGURE 15

GLOBAL GROWTH IN INTERNATIONAL SHIPPING (TRADE AND EMISSIONS)

Source: Author based on IEA, UNCTAD, World Bank and IMO



International shipping is one of the significant contributors to global air pollution. A significant share of SOx and NOx are emitted from international shipping and which have global effects on health and the environment. In 2015, about 16% or 61,000 premature deaths with an estimated health impact of 160 billion dollars were attributed to air pollution from international shipping activity (ICCT, 22/03/2019).

The current state-of-art projections reveal that the international shipping freight transport could grow at a compound annual growth rate of 3.6% through 2050 leading to a near tripling of maritime trade volumes by 2050 (International Transport Forum, 2019). Such a massive increase in shipping demand could translate into a high increase in energy consumption and CO_2 emissions. It has been estimated that depending on future economic, trade and energy developments, shipping CO_2 emissions could grow by between 50% and 250% by 2050 (Greenhouse Gas Studies 2014, n.d.).

Carbon emissions from international shipping not being included explicitly within the Paris Agreement as it was considered challenging to allocate emissions to specific countries. However, despite shipping being carbon-efficient, growing international shipping CO_2 emissions could risk undermining the objectives of the Paris Agreement and the efforts of other sectors, i.e. would necessitate much deeper reductions from all other sectors. The Paris Agreement's temperature goals imply that all sectors, including international shipping, need to completely decarbonise by 2050 (IPCC, 2018).

• POLICIES & ACTIONS • Essential to unlocking solutions to transformative changes in the international shipping industry is the building of multi-stakeholder coalitions and partnerships. In 2018, after two decades of climate-related consultations and initiatives, the United Nations International Maritime Organization (IMO) finally adopted an initial ground-breaking strategy sets out a vision to reduce GHG emissions from international shipping and phase them out, as soon as possible in this century. The strategy includes a specific reference to "a pathway of CO_2 emissions reduction consistent with the Paris Agreement temperature goals" and considers the following initial targets:

• Carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships: The current EEDI mandate requires an annual energy efficiency improvement of the fleet of only 1% on average between 2015 and 2025.

• **Carbon intensity of international shipping to decline:** To reduce CO_2 emissions per transport work, as an average across international shipping, by at least **40% by 2030**, pursuing efforts towards **70% by 2050**, **compared to 2008**; and

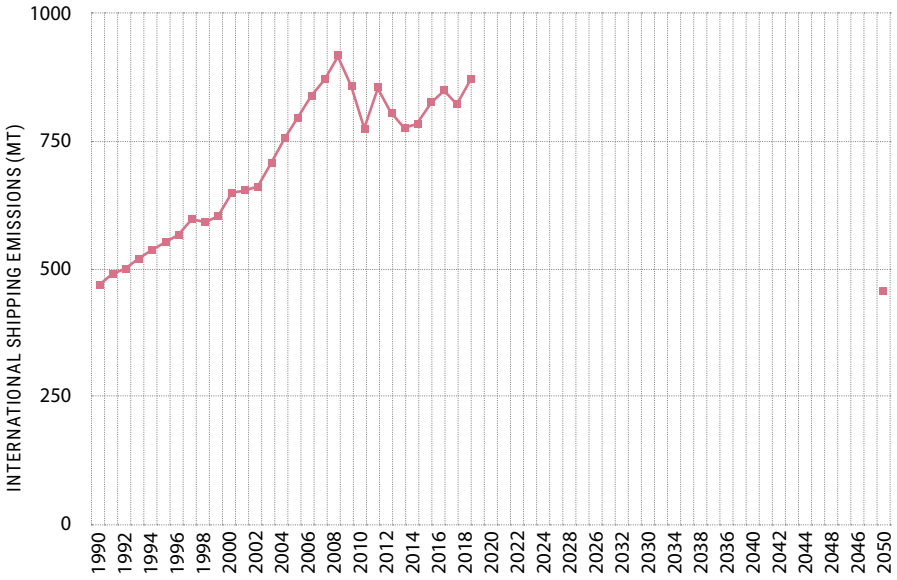
• **GHG emissions from international shipping to peak and decline:** To peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by **at least 50% by 2050 compared to 2008** while pursuing efforts towards phasing them out.

The initial strategy (which is consistent with the IEA's beyond two-degree scenario) is due to be revised by 2023 based on the feedback by the member states and considering the data and information from 2018 implemented IMO CO_2 Data Collection System (IMO, n.d.) and the next IMO GHG Study, which is currently in progress.

TO BETTER UNDERSTAND

INTERNATIONAL SHIPPING IN 2050

In order to reach IMO target of at least 50% reduction by 2050 compared to 2008, the international shipping emissions need to reduce at an annual rate of about 2% (from 2018). However, International Energy Agency's state of art projections (Beyond 2°C Scenario) reveal that with full deployment of technologies that are already available or in the innovation pipeline, the GHG emissions from international shipping could be reduced at an annual rate of 1.3%. Clearly more efforts are required urgently.

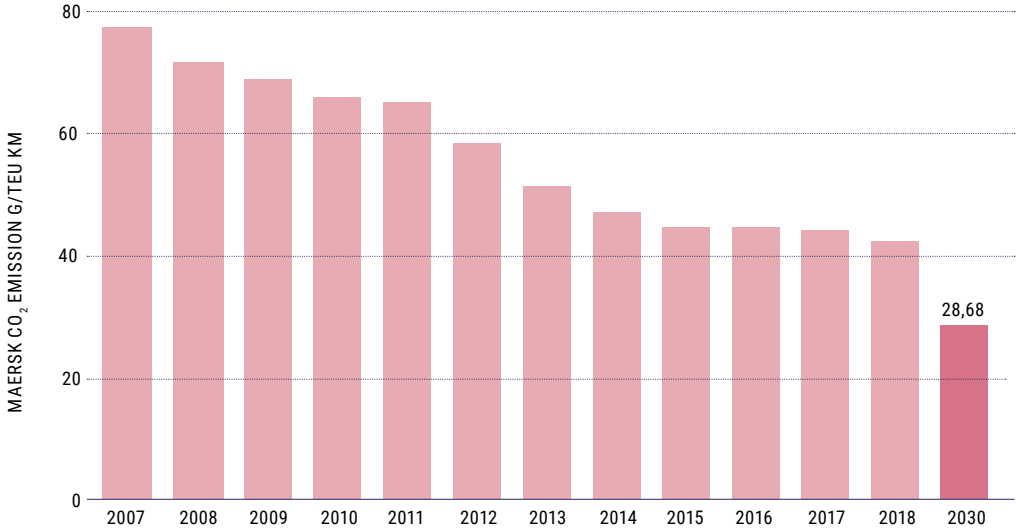


BOX 8

IMO has initiated efforts for facilitating information sharing, technology transfer, capacity building and technical cooperation to support the implementation of the initial strategy. In 2019, The IMO-Norway GreenVoyage-2050 project was launched. The GreenVoyage-2050 is a partnership between IMO and the Government of Norway to demonstrate and test technical solutions for reducing GHG emissions in shipping (IMO, 13/05/2019). The initiative aims to develop National Action Plans, catalyse private sector partnerships, provide technical assistance, support technology transfer and deliver pilot green technology demonstration projects.

FIGURE 16

MAERSK CO_2 EFFICIENCY AND TARGET - *Source: Maersk*



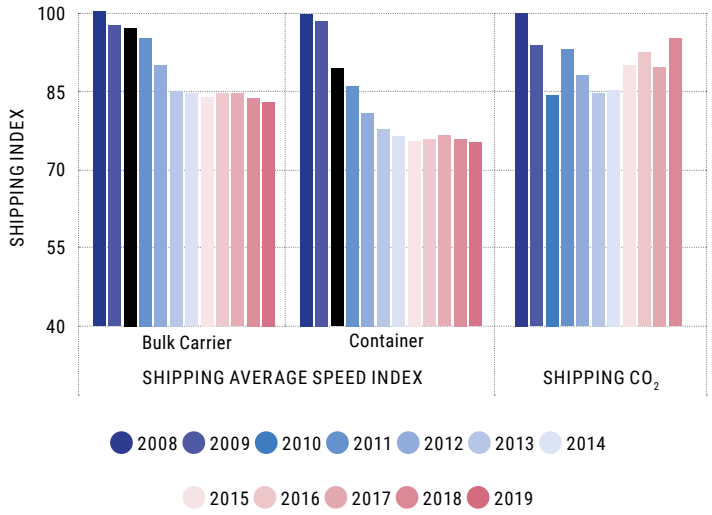
In 2017, European Union and IMO combined five Maritime Technologies Cooperation Centres (MTCCs) in targeted regions into a global maritime technology centre network to provide leadership in promoting ship energy-efficiency technologies and operations, and the reduction of harmful emissions from ships. International shipping is also a significant source of air pollutants like NOX, SOX and black carbon emissions. From January 1, 2020, the IMO regulates sulphur limit applicable to all marine fuels used across the world (excepting those ships using exhaust gas cleaning equipment or alternative fuels) to be reduced from 3.5% to 0.5% resulting in a significant transformation of the shipping industry. Introduction of the global 0.50% sulphur limit in 2020 would result in significant reductions in the amount of sulphur oxide, particulate matter, NOX and black carbon emissions emitted by international shipping. Black carbon is a significant contributor to international shipping's climate impacts (ICCT, 2017). Thus, a systems approach with multi-stakeholder coalitions and partnerships is essential in international shipping.

TO BETTER UNDERSTAND

VOLUNTARY OR MANDATORY SPEED LIMITS FOR SHIPPING?

Research indicates that reducing ship speed (slow steaming) by 10% could lead to a 27% reduction of the ship's emissions. If that is the magnitude of impact, is mandatory speed limits for Shipping essential for decarbonisation?

In 2019, in an open letter to the IMO's member states, 120 shipping companies (mainly operating in the bulk trade) have officially backed imposing mandatory speed limits for ships to reduce immediate GHG emissions from international shipping. France and Greece have officially supported mandatory speed limits at sea to reduce fuel consumption and carbon emissions from the existing fleet. In 2019 EU funded CE Delft's research established that use of speed optimisation and speed reduction as a short-term measure is essential for reaching 2030 shipping CO_2 emissions target (CE Delft, 2019). The study established that a limit on speeds at 20% below the 2012 average would reduce CO_2 emissions by 24-34% compared to business as usual in 2030. However, the major container shipping lines like Maersk and Hapag Lloyd have disagreed with the proposals(Lloyd's Loading List, 09/05/2019). Member countries Denmark, Germany, Brazil, Chile, Saudi Arabia and Spain have cautioned IMO with regards to the challenges of imposing mandatory speed limits for shipping, i.e. economic impact on trade and could also reduce incentive for innovation to drive deeper carbon savings (Climate Home News, 06/05/2019). Some critics have even argued that mandatory speed reduction could also lead to demand for new ships and a modal shift with higher aggregate greenhouse gas emissions in the case of time-sensitive cargos, particularly in the short sea segment (Lloyd's List, 24/04/2019).



BOX 9

Along with the shipping technologies, ports play a critical role in facilitating the reduction of shipping emissions. In 2018, close to 30 of the 100 largest ports (mostly in OECD countries) in terms of total cargo volume handled (in tonnes) and container volumes handled provided environmentally differentiated port fees to reduce CO_2 emissions from the international shipping (International Transport Forum, 17/04/2019) In 2019, ports of Stockholm give rebates in all three ports; Stockholm, Nynäshamn and Kapellskär, based on a vessel's score in Clean Shipping Index based on the SOx, NOx and CO_2 emissions from the ship (Clean Shipping Index, 2019).

In 2018, A.P. Moller – Maersk, which is the world's largest container shipping company, established one of the first shipping company ambition for net-zero CO_2 emissions from own operations by 2050 (fig. 16). Maersk established this target using guidance from Science Based Targets Initiative

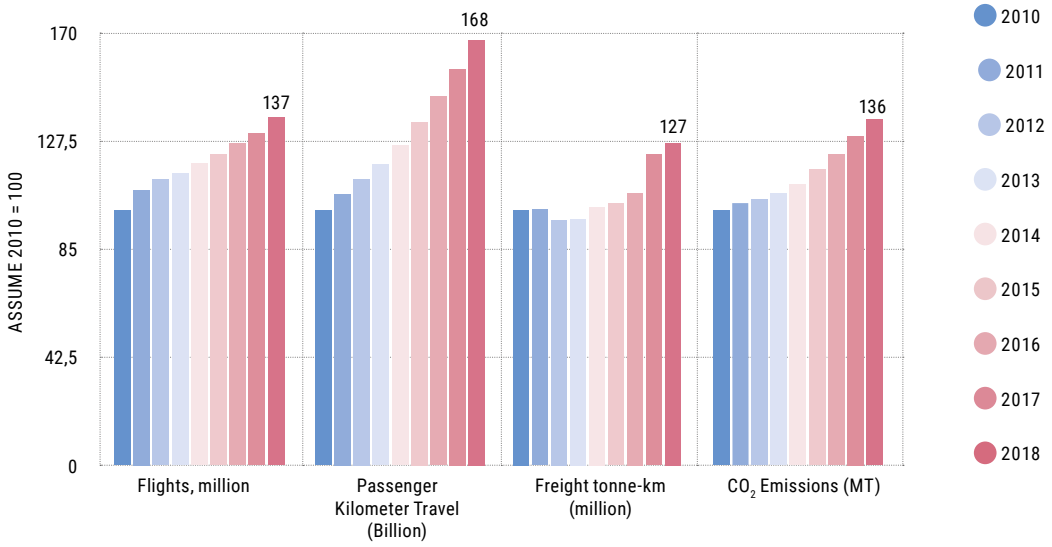
(Science Based Targets, n.d.). Maersk has also established an interim target of 60% relative reduction in CO_2 emissions by 2030, against a 2008 baseline. The company, over the last decade, has reduced emissions and improved its efficiency by 41% (compared to 2008). To reach the 2050 target, Maersk would need to have carbon-neutral vessels commercially viable by 2025-2030 given the 20-25-year lifetime of a ship.

In 2019, to improve the role of maritime finance in addressing global climate and environmental challenges, a coalition of non-state actors launched Poseidon Principles Association (Global Maritime Forum, n.d.). The Poseidon Principles establish the first global framework to measure the carbon intensity of shipping finance portfolios and are consistent with the policies and ambitions of the IMO, i.e. 50% reduction in GHG emissions by 2050 compared to 2008.

In 2019, 60 companies within the maritime, energy, infrastructure and finance sectors, supported by key governments launched Getting to Zero Coalition (Global Maritime Forum, n.d.). The main objective of this coalition is to ensure that deep-sea zero emissions vessels are a commercially viable and scalable reality by 2030.

FIGURE 17

AVIATION GROWTH IN ACTIVITY & EMISSIONS - *Source: ICAO*



TO BETTER UNDERSTAND

INDUSTRY AMBITIONS FOR 2050 ARE STILL OUT OF REACH

In order to reach ATAG's "aspirational" target of at least 50% reduction by 2050 compared to 2005, the aviation emissions need to reduce at an annual rate of about 3% (from 2018). However, International Energy Agency's state of art projections (Beyond 2°C Scenario) reveal that with full deployment of technologies that are already available or in the innovation pipeline, the GHG emissions from aviation could be reduced at an annual rate of 2.7%. Clearly more efforts are required urgently to scale-up mitigation efforts in the aviation industry.

BOX 10

5. Aviation sector: flight shame in the age of climat change

• Aviation is a growing contributor to global GHG emissions.
• Non-state actors are taking the lead in reducing international aviation emissions. However, rapid growth in flying activity is diminishing the impact of climate mitigation efforts in the aviation industry.
• Existing climate policies for aviation will not deliver any significant emission reductions.

• STATE OF PLAY • Aviation transport demand is steadily expanding in most regions of the world. In terms of passenger and freight activity, aviation carries about 13% and 0.1% of total transport demand respectively. **In 2018 when compared to 2017, the flights, passenger activity (kilometres travelled), freight activity (tonne-kilometres travelled), fuel consumption and aviation CO_2 emissions increased by 4.7%, 7.1%, 3.6%, 5.6% and 5.2% respectively** (ICAO, 2018).

However, translating the economic growth of aviation market into carbon emission impact is fettered by uncertain data. Most of available data is produced by the industry itself, which is reluctant to communicate precisely on fuel consumption and other key figures to figure out the global impact of the sector over carbon emissions. As a consequence, it is hard to provide a clear and reliable picture of the real impact of the sector on CO_2 global emissions.

Aviation is thus still presented as a small but a growing contributor to global GHG emissions, i.e. a share of about 9% of transport carbon emissions in 2018. **According to the latest International Council on Clean Transportation estimates, global CO_2 emissions from the overall airline industry (including passenger, belly freight and dedicated freight) reached 918 $MtCO_2$ in 2018, recording a 32% growth over the last five years** (ICCT, 2019). Nearly 65% of the aviation emissions are from international aviation, with domestic aviation contributing 35%.

Within commercial aviation, passenger transport accounted for 81% of carbon emissions, and freight had a modest share of 19% of aviation carbon emissions. Aviation emissions are growing significantly in the Asia-Pacific region. The aviation traffic within the Asia and Pacific region already constitutes a large share of global domestic aviation-related carbon emissions (29%, increasing by 3.1% over 2017), and 25% of global total aviation-related CO_2 emissions, increasing by 3.8% from 2017 to 2018. In contrast, European domestic aviation emissions increased by 0.4% and Latin American domestic aviation-related carbon emissions decreased by 3.7%.

However, globally the aviation emissions are expected to continue to grow with aviation demand increasing at 4.3% annually, requiring some 39,200 new passenger and dedicated freighter aircraft over the next 20 years (Airbus, 2019). International Civil Aviation Organization (ICAO) estimates that a massive increase in demand without stringent mitigation policies could result in aviation emissions increasing by 300-700%.

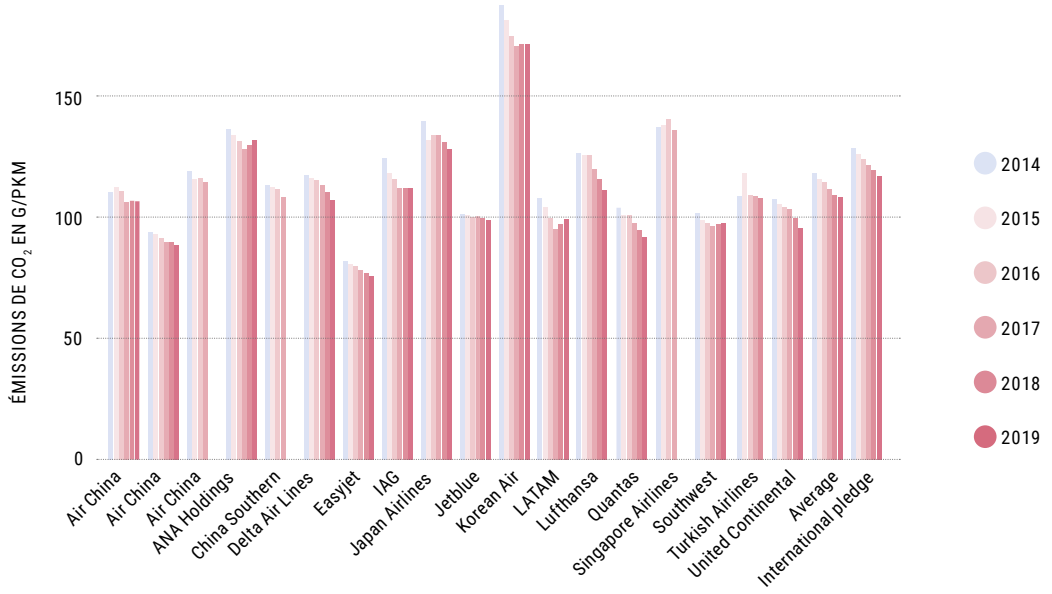
• POLICIES & ACTION • Aviation is one of the few sectors which set a modest global emission reduction targets before the Paris Agreement. However, the Carbon emissions outgrew limited mitigation efforts within the sector resulting in high growth in emissions. Aviation emissions could be reduced by reducing aviation demand, shifting to slower mode of transport i.e. railways, by deployment of efficient technology, including low-carbon fuels, by more efficient aircraft operations, retrofitting new technologies in aircrafts, airport infrastructure improvements, including modernized air traffic management systems and by utilising a comprehensive global market-based measure, to offset the required aviation emissions gap (IATA, n.d.)

In 2009, The International Air Transport Association (IATA) which is the trade association for the world's airlines, representing some 290 airlines set following targets to reduce climate impact - 1.5% annual improvement in fuel efficiency until 2020, carbon-neutral growth from 2020 and a halving of emissions by 2050 when compared with 2005. However, since 2005, aviation carbon emissions have already grown by 39%. Among private sector companies, several airlines have improved their carbon efficiency, i.e. 6% less CO_2 to transport one passenger one kilometre than the worldwide

average in 2015 (fig. 18). For example, In 2018, IAG which combines leading airlines in the United Kingdom, Spain and Ireland delivered 65,000t of CO_2 savings due to fuel efficiency program (changes in operating procedures and on-board weight savings)(International Airlines Group, n.d.). However, data shows that in many airlines, the improvement is below the requirements of existing climate pledge ("Overview of the TPI – Transition Pathway Initiative" n.d.).

FIGURE 18

CARBON EFFICIENCY OF AIRLINES - *Source: Transition Pathway Initiative*



Since 2016, Domestic aviation emissions are included in the Paris Agreement in national pledges. Emissions from domestic aviation operations (domestic flights, non-aircraft airport operations, etc.) are subject to country-specific actions and therefore fall under the scope of the United Nations Framework Convention on Climate Change (UNFCCC). However, only 5% of Nationally Determined Contributions (NDCs) identifying specific transport modes have identified aviation as a carbon mitigation sector. (Gota, S. et al. 2016). International aviation is not included in the Paris Agreement as it was considered challenging to allocate emissions to specific countries. Instead, the international flights, which account for around 65% of the aviation industry's CO_2 emissions, are covered by UN's ICAO Carbon Offsetting and Reduction Scheme for International Aviation, or (CORSIA).

The ICAO which is a UN specialised agency to reach consensus on international civil aviation Standards and Recommended Practices and policies have agreed on a resolution for a global market-based measure to address Carbon emissions from international aviation as of 2021. The CORSIA aims to stabilise CO_2 emissions at 2020 levels by requiring airlines to offset the growth of their emissions after 2020 (Carbon Brief, 04/02/2019)Research, however, indicates that the existing international climate policies being implemented for aviation will not deliver any significant emission reductions (Larsson et al., 2019).

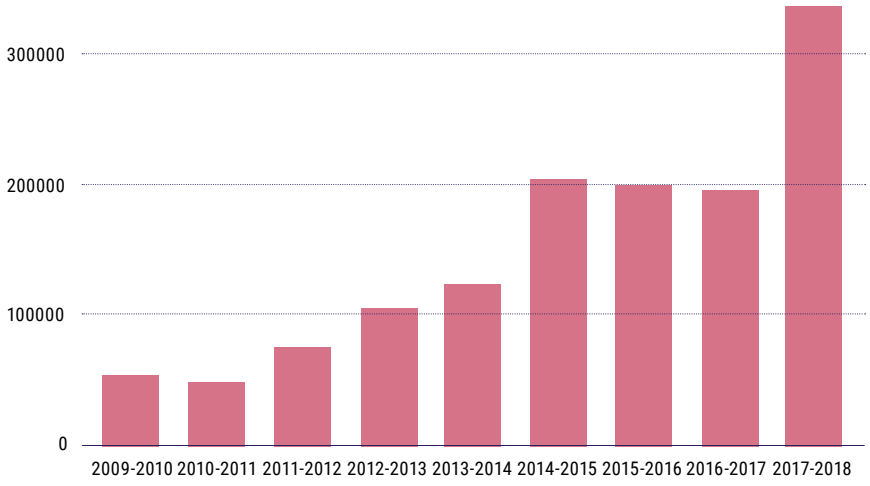
In 2019, China and Russia criticised CORSIA agreement's objective for capping international aviation emissions suggesting that the agreement unfairly penalises by increasing costs for emerging and developing countries (Al-Jazeera, 25/09/2019)

In 2019, France announced plans to implement an eco-tax on all flights leaving the country, which will increase passenger fares from 2020 (Airport Technology, 2019). In 2018, Norway announced the world's first biofuels national target for aviation. From 2020, 0.5% of all fuel sold in Norway should be advanced biofuels (for both domestic and international aviation), to reach 30% in 2030. (*Reuters* 2018).

TO BETTER UNDERSTAND

AIRPORT CARBON ACCREDITATION

Airport Carbon Accreditation, launched in 2009, is an authoritative industry standard for certifying carbon management at airports. It facilitates transformation by providing a common framework and tool for active carbon management at airports with measurable tools. It covers operational activities that contribute the most to carbon emissions. In this initiative, there are 284 airports, in 68 countries with about 43.4% of the global air passenger traffic. Over the past decade, this initiative has reduced over a million tonnes of CO_2 emissions.



TONNES OF CO_2 REDUCED - *Source: Airport Carbon Accreditation*

BOX 11

In 2008, a coalition of 28 airlines had formed a group called the Sustainable Aviation Fuel Users Group (SAFUG) to support the development, certification, and commercial use of lower-carbon renewable fuels, derived from environmentally and socially sustainable sources. With several airlines committing for biofuels, the aviation biofuel production in 2018 accounted to about 15 million litres in 2018 which is still less than 0.1% of total aviation fuel consumption (IEA, 18/03/2019).

For Reducing aviation emissions, the behavioural change induced by the Swedish Flygskam ('Fly shame') campaign to reduce air travel is becoming prominent. The 'flight shame' campaign considers flying as a source of guilt and shame because of its climate change impact. Due to the campaign and introduction of the per trip aviation tax in 2018, Sweden's domestic aviation emissions annual growth reduced to 3.4% (2017-2018) from 7.3% (2016-2017). Estimates suggest that about 23% of Swedish citizens have reduced or modified their travel plan due to its climate impact (WWF, 21/03/2019).

In the United Kingdom, the Fellow Travellers project has proposed a frequent flyer levy (FFL) that aims to reduce the Carbon impact of aviation equitably by progressively tax frequent flying, thereby constrain demand for flights, while at the same time distributing flights more equally across the income spectrum (afreeride.org, n.d.)

The airport industry accounts for about 5% of the total air transport sector's total carbon emissions ("Airport Carbon Accreditation" n.d.). In 2019, ACI EUROPE, the trade association which includes 500 members with 194 airports run by 40 airport operators across 24 European countries handling 62.5% of European air passenger traffic (in 2018) committed to becoming net-zero for carbon emissions under its control by 2050 (Greenaironline.com, 26/06/2019).

Please do not hesitate to share with us any additional information, reports of data via the following email address: contribution@climate-chance.org

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BUILDING

Orchestrating the building sector's actors to decrease emissions further

Orchestrating the building sector's actors to decrease emissions further

Author • **Rod Janssen** • *Consultant EnergyinDemand*

We spend 80% of our time in buildings, and the way they are designed (light, quality of air, space, volume) influences our wellbeing and health. Everyone has some form of relationship with buildings for shelter, eating, recreation, worship, work, and much more.

The building sector contributes nearly 40% to global energy-related annual CO_2 emissions. These emissions are decreasing since 2016, due to the reduction of carbon intensity of power generation for the consumption of electricity & heat (indirect emissions of building), although direct emissions from direct fuel consumption have kept increasing over the last 3 years.

This comprehensive profile reviews the building sector at a global level. It looks at the current emissions, energy consumption, and how they have evolved in recent years, before looking at some of the key policies that are driving improvements. It then examines the myriad of non-state actors' strategies, and how they are building upon that policy foundation to achieve significant impact. National regulations, policies, and financing tools greatly impact the trajectory of the sector, but the wide range of actions required in the building sector, from construction to end-use, implies the support and enhancing of companies, local governments and citizen initiatives: local regulations and info points, deep renovation of private utilities, multi-stakeholder label systems and financial schemes, etc.

Everybody is affected in one way or another by buildings – we are born in them, live in them, work in them, and more often than not die in them, yet the layman probably knows less about them than almost anything else that affects his life.

Richard Reid, The Book of Buildings, 1984

Key takeaways

Buildings contribute almost 39% of global greenhouse gas emissions and 36% of global final energy use in 2017 (GRS, 2018). If their overall emissions are decreasing since 2016 thanks to the power sector's decarbonisation, direct GHG emissions of residential and tertiary have increased respectively by 4% and 3% from 2017 to 2018 (Enerdata);

Energy use keeps growing, by 5% between 2010-2017, mainly due to rising electricity demand (space cooling and appliances). Improvements in building envelopes and system performances are not fast enough to offset strong population (9%) and floor area (17%) growth (Global Status Report, 2018);

On the national perspective, building codes only exist in 69 countries (not always covering the entire buildings sector), and building certification programmes in 85 countries. Both are mostly voluntary but increasingly depend on regulatory policies;

Local governments, businesses, and research actors address the fragmentation of the building sector to enable the implementation of regulations: public-private consortiums, replicable solutions (ex. Renovation passports). They facilitate together several platforms: CLASP, Building Efficiency Accelerator (BEA), BuildUpon, GABC, etc. ;

Cities play a major role in the coordination of local sectors, tending to ensure a public service for renovation/building, by informing, certifying private provisions, and co-financing citizen-led projects. This coordination is sometimes ensured by business associations like in New-Zealand or Denmark;

Initiatives such as EP100 or Clean Energy Ministerial (CEM) give an overview of companies' efforts towards reducing GHG emissions of the building sector. The Green Buildings Councils, independent organisations composed of the building sector's professionals, support companies in 70 countries and through more than 50 identified assessment tools.

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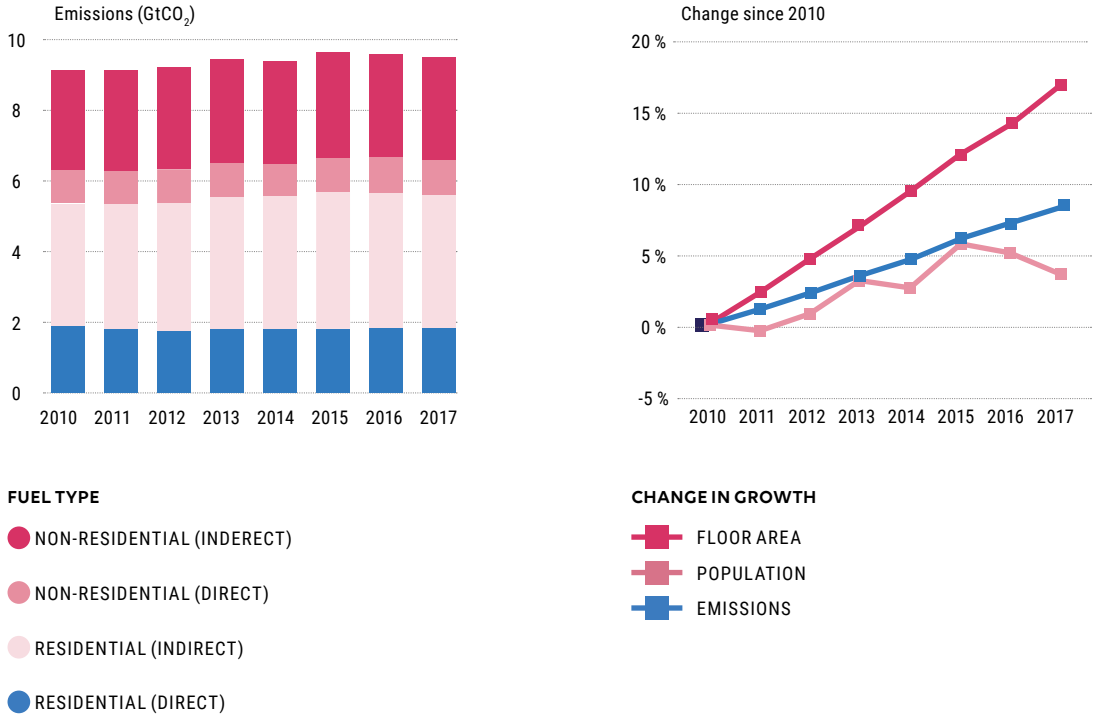
1. Current global trends show the growing issue of building

• GREENHOUSE GAS EMISSIONS PEAKED TEMPORARILY • Buildings come in all shapes and sizes to suit our purpose[1]. Including the emissions of the construction industry, in 2017 buildings[2] accounted for 36% of global final energy use and 39% of energy related carbon dioxide (CO_2) emissions: 28% come from operational emissions, from the energy needed to heat, cool and power them, and the remaining 11% from manufacturing and construction.

FIGURE 1

GLOBAL BUILDING ENERGY-RELATED EMISSIONS BY BUILDING TYPE AND CHANGE IN INDICATORS, 2010-17

Source: GABC, Global Status Report 2018, Data derived from IEA.



GHG emissions from residential and tertiary buildings are decreasing since 2016 after steady increase since 2010 (fig. 1 left) even if population and floor area keep increasing (fig. 1 right). This drop is largely due to the decrease of indirect emissions - emissions from power generation for the consumption of electricity & heat - according to the Global Status Report 2018 "*Power sector decarbonisation and enhanced energy efficiency in buildings have helped to stabilise the influences of population and floor area growth on buildings sector emissions.*"

Conversely, direct emissions (direct consumption of natural gas and petroleum for heating and cooking) have both increased between 2017 and 2018 by 4% for residential and 3% for tertiary (fig. 2 & 3). For residential emissions, while they dropped in Europe and North America in large part because of the implementation of a wide range of policies, they increased in all other regions and globally overall, representing additional 80 $MtCO_2$. The biggest increase is observed in Asia and in particular China. The building sector represents 25% of China's GHG emissions and 20% of total energy consumption. It more than tripled between 2001 and 2016, from 300 million tons of coal equivalent to 906 MtCe (C40, 2019). Looking at the mere emissions of the residential sector, in 2018 the country is responsible for 60% of the continent's GHG emissions and 33% of global residential emissions.

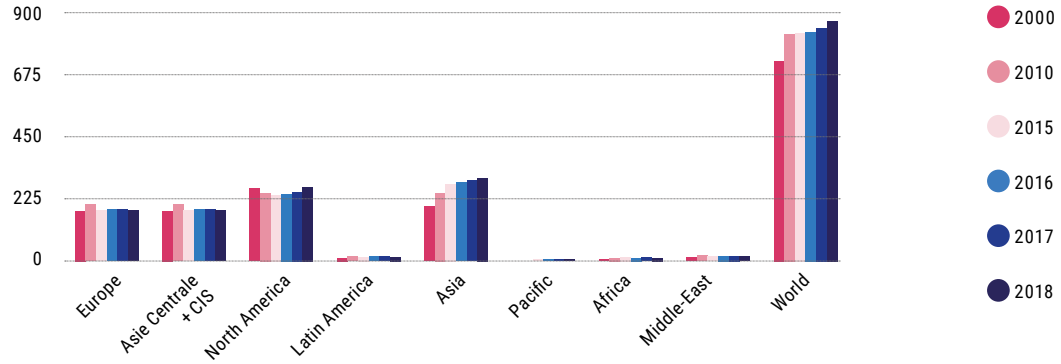
1 Residential: single family dwellings, multi-family dwellings. Tertiary: commercial buildings, public buildings (administration, education, health, etc.). Other: worship, sports facilities, agricultural, industrial, garden

2 This includes construction and operation.

FIGURE 2

CO_2 EMISSIONS FROM HOUSEHOLDS FROM FUEL COMBUSTION PER REGIONS (2000-2017)

Source: Enerdata, 2019



The following figure (fig. 3) shows CO_2 emissions in the tertiary sector[3]. Unlike the household sector, the tertiary sector experienced growth in all regions. In 2018, this sector's emissions increased by 3% in comparison with 2017, representing an additional 26.5 $MtCO_2$.

FIGURE 3

TERTIARY GHG EMISSIONS FROM FUEL COMBUSTION PER REGION (2000-2018) - *Source: Enerdata, 2019*

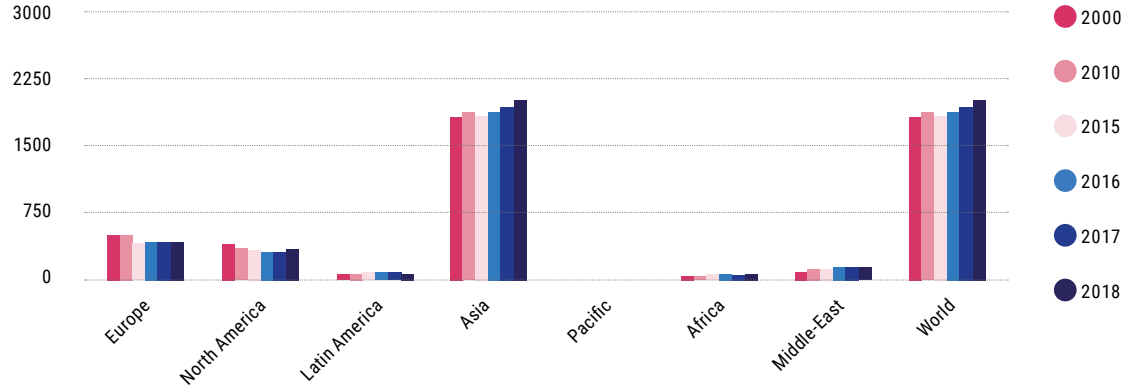


Table 1 shows examples of countries with noticeable emission trends. The biggest increase in 2018 can be observed in the United States with +11%, followed by Australia (+6.7%). Emissions dropped importantly between 2000 and 2010 in Ukraine, France, and Germany, but the reduction slowed down the last 3 years

3 The tertiary sector is made of: the market services sector (trade, transports, financial operations, business services, personal services, accommodation and food service activities, real estate, information-communication); the non-market sector (public administration, education, human health, social work activities). The perimeter of the tertiary sector is therefore defined by complementarity with agricultural and industrial activities (the primary and secondary sectors). Source: https://www.insee.fr/en/metadonnees/definition/c1584

TABLE 1

SELECTED COUNTRIES CHANGE IN CO_2 EMISSIONS IN HOUSEHOLDS 2000-2018

Source: Enerdata, 2019

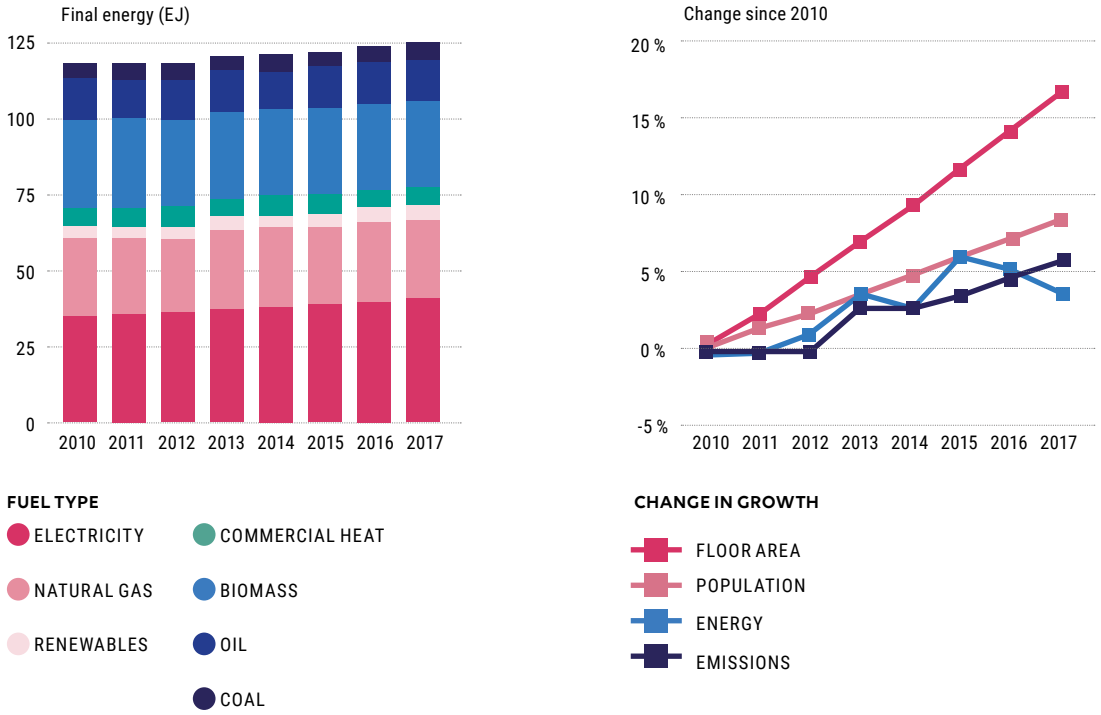
	2000	2010	2015	2016	2017	2018	Variation 2000-2018	Variation 2017-2018
Australia	10,5737	11,5558	12,6809	13,2787	14,8016	15,796	49,4%	6,7%
Belgium	26,4732	25,7318	27,0351	25,3108	22,2467	22,462	-15,2%	1,0%
Brazil	21,3721	19,1802	19,8105	20,3536	20,4448	20,3428	– 4,8%	– 0,5%
Canada	84,6933	76,5345	71,3984	74,3622	75,5962	79,3049	– 6,4%	4,9%
China	275,8543	386,2973	417,8855	477,9473	551,9025	583,3968	111,5%	5,7%
Ukraine	43,6704	43,5325	36,5797	36,3759	24,4794	24,7133	– 43,4%	1,0%
France	85,6797	85,6026	83,7177	80,2088	69,5449	69,6787	– 18,7%	0,2%
Germany	170,3719	167,5786	150,6225	147,5964	142,1489	132,667	– 22,1%	– 6,7%
India	72,6839	81,8401	93,1515	98,7867	115,4603	120,4364	65,7%	4,3%
Indonesia	34,925	29,1913	19,9822	22,8785	24,9913	25,456	– 27,1%	1,9%
Iran	86,0514	120,9504	120,1794	122,9178	134,9393	141,8731	64,9%	5,1%
Japan	150,6262	146,9846	131,6424	131,5893	116,6715	113,9308	– 24,4%	– 2,3%
Mexico	26,1987	24,8574	23,7453	22,7523	21,484	20,4722	– 21,9%	– 4,7%
Russia	165,2834	145,1662	137,028	122,2711	170,9629	179,0666	8,3%	4,7%
South Africa	8,8911	24,1191	13,8445	26,0827	20,7826	22,0834	148,4%	6,3%
South Korea	61,4547	54,6009	54,8796	53,3167	55,2676	56,6425	– 7,8%	2,5%
Turkey	25,228	35,3291	47,8898	48,1249	57,2707	51,9365	105,9%	– 9,3%
UK	107,0428	99,5598	104,1151	94,3215	85,9196	89,1125	– 16,8%	3,7%
United States	596,0206	514,0945	541,9114	525,1451	498,6349	553,3767	– 7,2%	11,0%
Vietnam	6,5948	9,7991	10,8749	10,7334	11,8829	n.a	80,2% (2000-17)	-

• ENERGY USE KEEPS ON INCREASING DUE TO POPULATION AND FLOOR AREA GROWTH •

The building sector is a major energy consumer, with about 125 exajoules in 2017. By comparison, in 2017, final energy consumption of the United States amounted to 63 exajoules, India 24.7 exajoules, France 6.4 exajoules, and the world 406 exajoules (IEA Statistics, 2017). The evolution of final energy use shows a constant growth of 5% between 2010 and 2017. The growth in electricity use is adding up to other sources of energy (fig. 4) and is driven by space cooling and electrical appliances, that grew respectively by 20% and 18% over the same period.

FIGURE 4

GLOBAL FINAL ENERGY CONSUMPTION OF THE BUILDING SECTOR BY TYPE OF FUEL, AND INDICATORS (2010-2017) - *Source: Global Status Report, 2018. Data issued from IEA.*



Yet, energy intensity by end use systems (heating, cooling, ventilation, lighting, appliances, cooking equipment and miscellaneous plug loads) is decreasing (except for cooling), meaning that improvements in building envelops and systems performance are not fast enough to offset strong population (9%) and floor area (17%) growth (Global Status Report p.13, 2018).

FOR A BETTER UNDERSTANDING

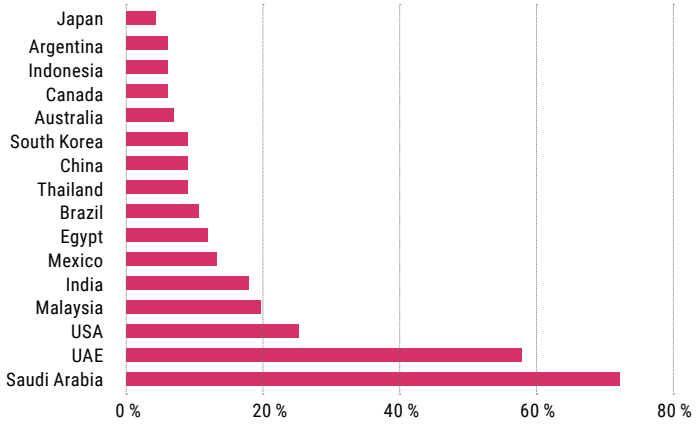
FUTURE OF AIR-CONDITIONING

In September 2019 Enerdata provided a relevant insight on the current trends of energy consumption of cooling systems. They find that "the AC consumption of the 20 most prosperous countries has increased by around 400 TWh over the last three years (2015-2018), as temperatures have been on average 6% higher than normal over the cooling period: this excess consumption is equivalent to the present yearly consumption of buildings in Africa". They have also quantified that a 1°C increase raises the electricity consumption for air conditioning by around 15%.

The report also provides countries' insights experiencing a rapid growth "*in half of the G20 countries: by more than 12%/year over 2000-2018 in China, India, Indonesia and Turkey, and in a range of 6 to 10%/year in Australia, Brazil, Canada, the EU, Saudi Arabia and South Korea. Only in the US and Japan, where the market is reaching saturation, is the progression much slower.*"

FIGURE 5

SHARE OF AIR CONDITIONING IN HOUSEHOLD ELECTRICITY USE (2018)



Ultimately, one of the key finding is that ownership of AC appliances is weakly linked with climate (i.e. the number of cooling degree days), but rather with the level of household incomes (ex. US, or Japan), as well as with cultural habits such as in China where ownership level is high given its average income.

Source: Enerdata, « Future of Air-Conditioning », 2019

BOX 1

It is useful to look at energy use in buildings more carefully. In this regard, the IEA estimates that building energy use globally increased by 0.8% since 2016 and that it increased by 20% between 2000 and 2017. It also provides global recent analysis on main trends in energy use[4]:

- Energy use per square metre[5] has reduced each year since 2000 at average annual rate of 1.6% (by 25% since 2000). This has happened while floor area increased 3% per year;
- Energy consumption for space cooling has nearly doubled since 2000 even though countries facing the most extreme temperatures and growing population are not equipped yet;
- Growth in energy use in buildings has primarily been in emerging economies – Brazil, China, India, Indonesia, Mexico and South Africa;
- Energy efficiency improvements have saved almost 14 exajoules[6] of additional energy use in buildings and appliances since 2000.

Also important as far as energy use in buildings is concerned[7]:

- The global average building energy use per person which has remained practically constant since 1990, at just less than 5 MWh per person per year.
- Advancement of deep energy renovations (e.g. 30% to 50% improvement in building envelope performance) of existing buildings also remains sluggish, particularly in OECD countries. The rate of annual building energy renovations also needs to improve considerably, from rates of 1% to 2% of existing stock per year today to more than 2% to 3% per year by 2025.
- According to the IEA, constructed floor space in buildings worldwide has increased by 65% since 2000, reaching nearly 240 billion m^2 in 2018.

4 IEA, Energy Efficiency 2018, p. 82.

5 Energy Intensity is measured by the quantity of energy required per unit output or activity, so that using less energy to produce a product reduces the intensity. While, energy consumption is the amount of energy or power used.

6 Representing slightly more than final energy consumption of Japan in 2017 (12,6 Exajoules in 2017 according to IEA statistics).

7 IEA, Energy Technology Perspectives 2017, p. 96.

2. Global policy framework is expanding but remains mostly voluntary

Many countries and regions have bundled the range of policy into building/renovation strategies alone or in combination with other policies to address climate or energy policies, like in the European Union for example. All these instruments can be either mandatory or voluntary. As is shown below, there is a global tendency towards more mandatory instruments.

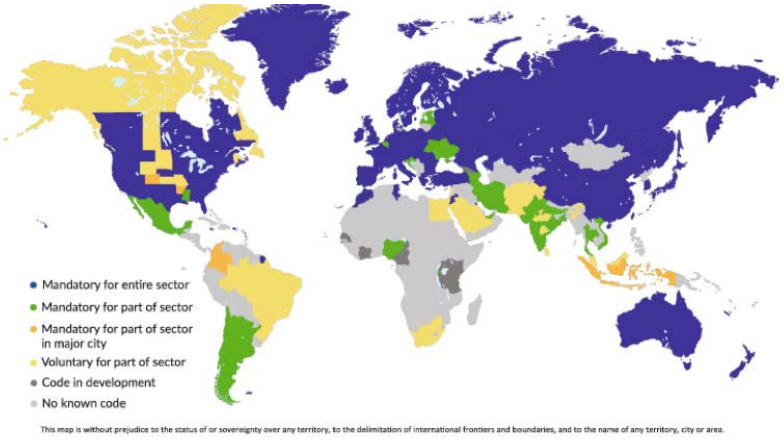
The IEA states[8] that globally, in 2017, 34% of energy consumption in buildings was covered by mandatory codes and standards. This was divided into 32% of residential and 43% of non-residential buildings energy use. This included end uses and the IEA states that for lighting and cooling, 80% of energy use was covered by mandatory measures.

• NATIONAL ENERGY CODES FOR NEW AND EXISTING BUILDINGS • Building energy codes, also known as "energy standards", for buildings, "thermal building regulations", "energy conservation building codes" or "energy efficiency building codes", are key policy instrument used by governments to reduce the energy consumption of buildings (IEA definition). Such codes consist of a set of mandatory minimum energy performance requirements designed to regulate energy use in buildings. They cover both new buildings and existing ones undergoing renovations or alterations. Architects and engineers use the functional energy requirements stated in building energy codes to design buildings that meet the required standards. **A recent analysis shows that mandatory and voluntary building energy codes exist in 69 countries worldwide, meaning that nearly two thirds of countries still do not have mandatory building energy codes that cover the entire building sector, including many developing economies despite high construction rates (Global Status Report p.36, 2018).** The following (fig. 6) map provides a visual survey of the use of building energy codes.

FIGURE 6

BUILDING ENERGY CODES BY JURISDICTION 2017-2018

Source: Global Status Report, 2018. Data retrieved from IEA, Energy Efficiency Policies: Buildings



Building codes are often the responsibility of national governments, but they can also be the responsibility of regional governments (states, provinces, Länder) or even cities. For example, the American Council for an Energy-Efficiency Economy (ACEEE) has recently highlighted the number of US cities that have taken steps to reduce energy waste in buildings by improving these codes. 9 of them have adopted stricter building codes since 2017, while others advocated for their states to adopt more stringent standards, and 8 others adopted efficiency requirements (American Council for an Energy-Efficient Economy, 2019).

8 IEA, Energy Efficiency 2018, p. 87.

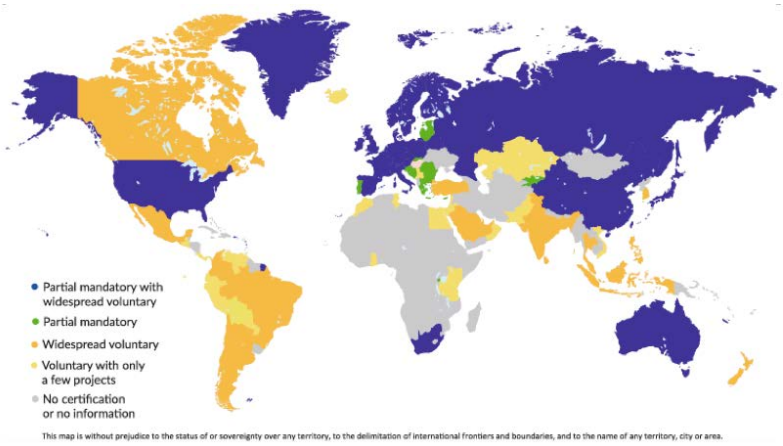
• ENERGY CERTIFICATION AND RATING SYSTEMS • According to the Energy Performance of Buildings Directive 2010 (Article 2) of the European Union "energy performance certificate" is a certificate recognised by a Member State or by a legal person it has designated which indicates the energy performance of a building or building unit. As for the International Partnership for Energy Efficiency Cooperation (IPEEC), rating schemes are the combination of rating tools and their supporting programmatic elements. Schemes are used to underpin labelling and/or disclosure programmes, and as a mechanism to determine minimum energy performance standards for buildings[9].

There can be performance standards for buildings as a whole or for individual technologies. These can include minimum energy performance standards. Many standards are organised by governments (e.g. Energy Star in the USA, Ecodesign in the EU) but they can also include non-state actors (e.g. LEED standards introduced by U.S. Green Building Council, or BREEAM by the Building Research Establishment in UK).

A building certification can prove a valuable driver to promote energy efficiency. Building energy certification includes programmes and policies that evaluate the performance of a building and its energy service systems. The 2018 Global Status Report of GABC shows that there are currently 85 building certification programmes, mostly voluntary. LEED and BREEAM, mentioned above, for example are voluntary (fig. 7).

FIGURE 7

BUILDING ENERGY CERTIFICATION PROGRAMMES BY JURISDICTION (2017-2018) - *Source: Global Status Report, data from IEA*



• REACHING BUILDING USERS: INFORMING & FINANCING • Information comes in many forms to consumers (building dwellers) and the energy service industries (from architects through to installers). For end users, there can be information programmes and energy advice. Energy advice consists in packaging energy efficiency-related advice and services such as technical, financial and/or installation, in one single place to one or more audiences (primarily consumers and members of the service supply chain). The main purpose is to create a convenient and interactive means for the target audience(s) to receive relevant advice and take advantage of multiple, energy-related services at one time[10].

Information can include energy audits and inspections that provide information to help the consumer. It can also include training and capacity building.

Financing renovations (particularly ambitious ones) has been a perennial problem for policy-makers and the wider climate and energy community, because the consumer seldom has enough self-financing to undertake a major renovation. The renovation sector normally depends on external

9 BEET Report 5, p. 8.

10 https://www.wec-policies.Enerdata.eu/Documents/cases-studies/WEC-case-study-one-stop-shop.pdf

financing to supplement self-financing. Many sources of funding exist. These range from government support schemes to commercial banks to energy service companies (ESCOs). There can also be support for new buildings (green mortgages, support for net zero energy buildings, etc.).

The following diagram (fig. 8) shows the range of main financial instruments in Europe[11], coming from both governmental and non-governmental sources. A full range of schemes is available, in order to match the needs of every consumer.

- Government support schemes;
- Private sector (e.g. commercial banks, specialised energy efficiency funds) – These range from green mortgages (described below) to normal commercial loans and mortgages;
- ESCOs – Energy service companies often provide financing through energy performance contracts. Schemes such as the Investor Confidence Project[12] de-risk projects through a form of certification. that helps some financial institutions accept to finance the measure;
- Green mortgages for new buildings that meet certain sustainability criteria draw an increasing interest.

FIGURE 8

TYPES OF FINANCIAL INSTRUMENTS SUPPORTING THE ENERGY PERFORMANCE OF BUILDINGS.

There have been initiatives such as UNEP Financial Initiative (UNEP FI) and the European Union's support for the Energy Efficiency Financial Institutions Group (EEFIG) designed to bring financial institutions closer to energy efficiency activities and to encourage them to be more pro-active in financing energy efficiency measures in buildings.

11 BPIE, *State of play of financial instruments*, Brussels, 2012, p. 8.

12 https://europe.eeperformance.org/. There is a growing number of such schemes in many countries.

EXPERIENCE FEEDBACK

THE ENERGY EFFICIENCY FINANCIAL INSTITUTIONS GROUP

In 2016, a consortium was formed to pursue EEFIG report's conclusions and create an evidence base that would de-risk energy efficiency investments for a new and emerging number of financial institutions entering this market. EEFIG is supported by a consortium of partners including COWI, BPIE, EnergyPro, NTUA, FraunhoferISI and Climate Strategy & Partners. On 30th November 2016, EEFIG's De-risking Energy Efficiency Platform (DEEP) was launched with over 7,800 projects in an open-source, pan-EU database to improve the sharing and transparent analysis of existing energy efficiency projects in Buildings and Industry. On 22nd June 2017 the EEFIG Underwriting Toolkit was launched during the EU Sustainable Energy Week. The toolkit is aimed specifically at financial institutions that are looking at ways to design better financial products for energy efficiency investment projects. All of EEFIG's reports, analyses and evidence base can be accessed from the main menu toolbar above.

Source: http://www.eefig.com/

BOX 2

3. Non-State actors' contribution to buildings' performances: overcoming the fragmentation of the sector

There is a potential for significant GHG emissions and energy demand reductions in both new and existing buildings. **In OECD countries, the building stock is growing at a fairly low rate and the emphasis is more on existing buildings. In emerging economies with a high growth rate, much new construction is still underway and the emphasis is more on improving the energy performance of new buildings.** Most importantly, as buildings last for decades and even centuries, they are large emitters of GHG emissions both because of the quality of their envelope and the usage of activities that will take place inside them during their whole life cycle.

National governments have a key role in setting building policy, but implementation frameworks are more complex and imply many actors:

Policy instrument	Governmental Actors	Non-governmental Actors
Building codes for new buildings or existing buildings	National, Regional	To a limited extent
Energy labelling/certification/performance standards	National, Regional, Local	Yes
Information services	National, Regional, Local	Yes
Financing	National, Regional, Local	Yes

FOR A BETTER UNDERSTANDING

THE GLOBAL ALLIANCE FOR BUILDINGS AND CONSTRUCTION (GLOBALABC)

With 123 members, including 29 countries and almost 100 non state organisations, the **GlobalABC** is the leading global platform to increase action towards a zero-emission, efficient and resilient building and construction sector. **The GlobalABC is hosted by the United Nations Environment Programme (UNEP)** and focuses on raising ambitions to meet the Paris climate goals and mobilising all actors along the value chain. The GlobalABC's working groups focus, among other thing, on public policies and finance. The GlobalABC develops the annual Global Status Report, which keeps track of annual progress, highlights good practice examples and forges pathways towards a zero emission, efficient and resilient building and construction sector developed with and for countries in four major regions. The GlobalABC has also developed a Guide for Incorporating Buildings Actions in NDCs with and through member countries' insights on effective NDCs for transforming the building and construction sector. The GlobalABC published in 2016 a global roadmap towards zero emission, efficient, and resilient buildings, which is being regionalised upon three major regions (Africa, Asia, and Latin America).

The GlobalABC has also sparked several national alliances for vertically integrated action transforming the building and construction sector, and has led six national governments **(Argentina, France, Germany, Mexico, Morocco, and Switzerland)** to pursue ambitious sector plans and strategies through their Global Call for Low-carbon, Energy Efficient and Resilient Buildings presented at the Clean Energy Ministerial in May 2018.

Source: GlobalABC

BOX 3

Many institutions are involved in promoting improved energy performance of buildings, by addressing the fragmentation of actors that characterises the building and construction sector. Some work with municipalities, others with the buildings industry and others interact with consumers (owners, renters, etc.). Actions closest to the consumer are usually most effective and that seldom implies the national/federal government, but coming from regional and local governments, private service providers such as product distributors and installers of equipment, architects and other planning entities, consumer associations, not-for-profit organisations and many more. The following are some examples of organisations operating at the local level, followed by others at the global, national or regional levels.

• PROVIDING INFORMATION AND SUPPORTING ACTORS' COORDINATION •

1. Guidance and One-Stop-Shops

Many cities provide coordination services, setting up a complete public service for building performance. They often provide advice through info points or hotlines coming along with subsidies for households. Fribourg Im Bisau offered free advice to more than 500 households with its "Eco-energy Renovations" programme that encourages owners to carry out refurbishment works: more than 10% of the buildings in Freiburg were subsidised during the programme, for a total spending of €550,000 in 2018. Seixal in Portugal has launched several public campaigns for energy efficiency and offers companies free analysis of their consumption trends and ways to reduce it. The city has even organized the Annual Renewable Energies Exhibition to enable inhabitants to explore possible alternatives and investments opportunities (Seixal, 2019). **To better guide residents and companies, some local governments certify private suppliers.** The Western Cape province and the city of Cape Town (South Africa) together implement the Energy Security Game Changer programme that aims

to reduce by 10% the electricity demand from the national grid by 2020. This includes simulating solar water heaters installation and accredited private suppliers. 46,000 installations and additional subsidies for poorest households were thus allowed in 2017 (Cape Town, 2017).

One-stop-shops **can be set up by local governments, at the national level or by businesses organisations. There is no single definition nor interpretation of energy efficiency information centres, services or 'one-stop shops'**. According to a World Energy Council report, ''one-stop shops' facilitate energy saving actions through provision of advice and practical implementation services/assistance. They are a subset of 'energy efficiency information centres'" (World Energy Council, 2016).

Energy Cities' project Innovate supports one-stop-shops and energy retrofit packages for homeowners in 11 target territories, including advice, tailored financial recommendations, coordination with suppliers and monitoring of the services. One of them is the municipality of Aradippou in Cyprus which tests, through the one-stop-shop, a new financing scheme and business models for renovation, that have been already set up and tested for PV solar in collaboration with the Cyprus Cooperative Bank.

One-stop-shops are also offered by business organisations like in New Zealand and Denmark:

- New Zealand Sustainability Trust, a not-for-profit organisation , provides advice, resources, services that influence and improve the well-being and sustainability of households, communities and businesses in the city of Wellington, New Zealand. Specific programmes vary depending on funding, but currently include advice, installations, training and seminars, recycling facilities, and a shop for sustainable products (World Energy Council, 2016).
- BetterHome (Denmark) is an industry-driven one-stop-shop model, which has proven successful in boosting demand for holistic energy renovations in Denmark since the model was launched in 2014. It was profitable after just three years, with 200 projects in 2016 and is expected to continue its growth. It offers "a burden-free renovation process, enabled by training and digital tools for the installers thanks to its network of 3500 installers (from 105 organisations), five banks and mortgage providers and four utilities. The target group mainly comprises single-family houses constructed between 1950 and 1990" (BPIE, 2017).

2.Facilitating public-private partnerships

Consortium and public-private partnerships are particularly efficient to address the fragmentation of the sector. The platform Building Efficiency Accelerator (BEA) promotes public-private collaboration in constructing low-carbon buildings. 253 cities benefited from phase I (2015-2017) via the organisation of nine events worldwide and 18 local events, and webinars followed by more than 1,000 participants. Phase II, launched in 2018, seeks to extend the platform's network and to strengthen partnerships with cities by developing private sector engagement and facilitating the support and financing of projects. BEA now gathers 30 businesses and organizations that work with more than 50 local and sub-national governments members (BEA Tracking Progress, 2019). One of the platform members, Eskişehir Metropolitan Municipality, Turkey, is involved in public-private partnerships including businesses, NGOs, and research organisations to improve building efficiency. The city engages through greener municipal buildings (extra 30 to 60% of energy savings than national regulation requirements) or energy audits (WRI, 2019).

EXPERIENCE FEEDBACK

CLASP, AN EPICENTRE OF COLLABORATIVE, AMBITIOUS EFFORTS FOR APPLIANCE EFFICIENCY

CLASP, a not-for-profit organisation based in Washington DC, holds many roles in international fora focused on appliance energy efficiency, for example the Super-efficient Equipment & Appliance Deployment Initiative, United for Efficiency, and the Efficiency for Access coalition. It also comes as a support for contries through several programmes (like the Association of Southeast Asian Nations and the Economic Community of West African States, etc.). For example, Kenya is in the process of implementing its first minimum energy performance standards for appliances, including refrigerators and room air conditioners. In collaboration with the Kigali Cooling Efficiency Program, CLASP has partnered with the Kenyan Energy Regulatory Commission to support their recently approved energy performance standards for ACs and on labelling and policy compliance (CLASP, 2019).

BOX 4

3. Digital tools to help citizens reduce their energy consumption

Several examples in the 2018 and 2019 annual reports of Climate Chance have highlighted the use of digital tools by cities or countries to involve citizens in their energy efficiency strategies.

- The metropolis of Grenoble has recently launched a digital platform, Metro Énergie27, allowing every citizen to consult their consumption of gas, electricity, district heating and water, to benefit from advice and information encouraging them to consume less and better and to reduce their energy bill. This platform is experimental and developed and supported by many actors of the territory (GEG, ALEC, City-zen project, etc.).
- Portugal has also set up Brain-e, a free social network designed to control its energy consumption in a simple and interactive way. The platform provides guidance on how to save energy, information on market prices, consumption forecasts and potential for energy production.In Milton Keynes (UK), The Community Action Platform for Energy (CAPE) project aims to reduce the energy bills of the city's inhabitants by reducing energy consumptions from buildings. The project uses an interactive website that provides satellite imagery data and information for making more energy decisions

• LOCAL REGULATIONS AND LABEL SYSTEMS •

1. Green Building codes

Green Building Councils are independent, non-profit organisations made up of businesses and organisations working in the building and construction industry. As members of World GBC, they work to improve green building in their own countries and unite with other Green Building Councils to achieve environmental, economic and social goals on a larger scale. Currently, there are about 70 members Green Building Councils around the world.

More than 50 rating tools are administered by Green Building Councils and deliver certification to companies and other organisations based on their energy performance. For instance, the India GBC rating system - IGBC Green New Buildings rating system® is designed primarily for new buildings. New buildings include (but are not limited to) offices, IT parks, banks, shopping malls, hotels, airports, stadiums, convention centres, libraries, museums, etc. (India GBC, 2019).

Other projects could be highlighted:

- BUILD UPON is the world's largest collaborative project on building renovation – bringing together over 1,000 organisations, across 13 countries, at over 80 events in 2016-17. The World Green Building Council's European network in collaboration with eight cities and partners launched in May 2019 BUILD UPON² is strengthening the effectiveness and implementation of the national building renovation strategies required by the EU Energy Performance of Buildings Directive (EPBD) in 8

pilot cities covenant signatories have pledged to completely decarbonise their existing building stocks by 2050. They will develop and test a multi-level renovation impact framework detailing a series of milestones and measurable progress indicators including emissions reductions, increased employment and improved health.

- In September 2018, the WGBC has launched the Net Zero Carbon Buildings Commitment to inspire and promote climate leadership action from businesses, governments and NGOs globally. The Commitment currently has 51 signatories: 22 businesses and organisations, 23 cities, and 6 states and regions. Many of these committed businesses have already obtained certifications from building rating systems in their country. The latest signatory, Brandix, the first Sri Lankan company and first apparel manufacturer to sign up, achieved the highest LEED Platinum rating.

EXPERIENCE FEEDBACK

A CONSORTIUM TO MONITOR THE IMPLEMENTATION OF BUILDING EFFICIENCY CODE IN BOGOTÁ

In Colombia, Bogotá has become the first subnational jurisdiction in the country to implement national Resolution 549/15. Through the Building Efficiency Accelerator, Bogotá publicly committed to implementing a building energy code, with official support from multiple city departments. It was then determined that the Colombian national green building policy could not be implemented without collecting additional information on building efficiency in the city, to develop clear pathways for compliance. A consortium of the Consejo Colombiano de Construcción Sostenible Partnership, Bogotá city officials, Building Efficiency Accelerator and the Pacific Northwest National Laboratory then assessed how to adapt, adopt, and implement the national green building guidelines into a usable construction code. Bogotá also enlisted Colombian university researchers, utility executives and construction leaders to collect data and will work with the national government to improve the existing national policy and provide assistance to other cities to ease the process of adoption in other parts of the country. (GABC, 2018).

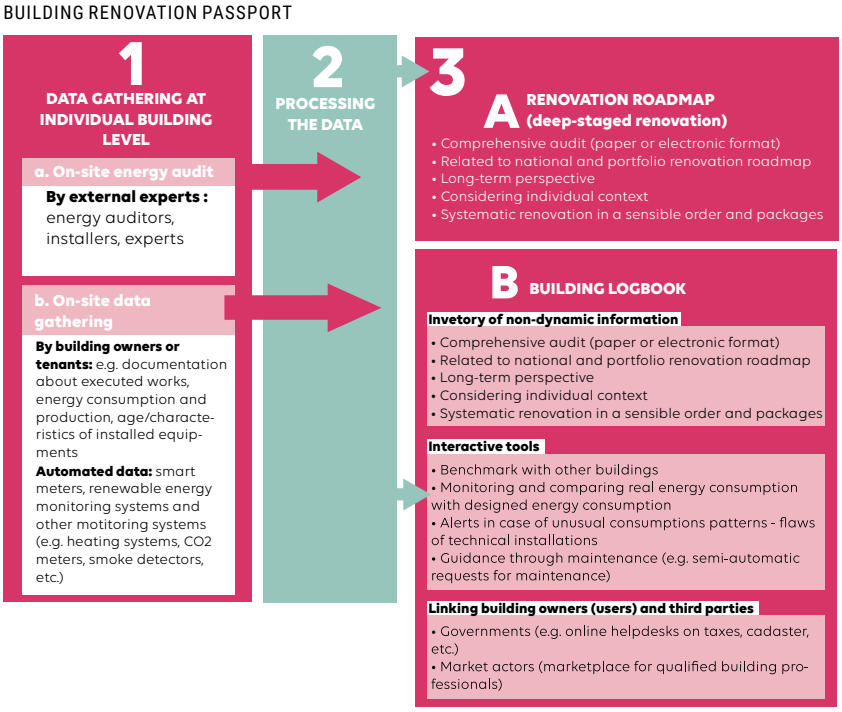
BOX 5

C40 Building Energy 2020 Programme helps 50 cities to take action and develop policies that rapidly reduce emissions from existing buildings or to adopt planning requirements and building codes. In China, where buildings account for 25% of GHG emissions, the programme supports the cities of Beijing, Fuzhou, Qingdao, and Shanghai (Changning District) by piloting and developing low carbon building codes, developing energy benchmarking and quota systems, retrofitting municipal and residential buildings, and replacing dirty fossil fuel heating systems with cleaner renewable alternatives.

FIGURE 9

BUILDING RENOVATION PASSPORT - OVERVIEW OF ITS COMPONENT

Source: BPIE



2. Building Renovation Passports

Building renovation passports are a relatively new concept but they could gain interest globally. The result is a user-friendly long-term roadmap that owners can use to plan deep renovations and get an up-to-date screenshot of the building across its lifetime, with information on comfort levels (air quality, better daylight, etc.) and potential access to finance. The Buildings Performance Institute Europe provides details on three examples in Belgium, France and Germany[13]. The following diagramme gives an indication of the process (fig. 9).

For one example, in France, the organisation "Experience P2E" was created to oversee the development of *Passeport Efficacité Énergétique* (P2E) supported by many private organisations. Founding members of P2E are the Shift Project, Cercle Promodul, EdF, Saint-Gobain and Schneider Electric. The concept is based on the development of an individual building roadmap proposing the necessary measures for the buildings to reach the level required by French legislation for all buildings by 2050. The Shift Project highlighted a number of market barriers that the Energy Efficiency Passport intends to address, such as insufficient energy-price and regulatory signals; lack of long-term objectives and planning; quality and complexity of the offers by building professionals; green value not materialised enough, and a lack of guarantee mechanisms and certification of works. The programme targets 16 million private houses in France and aims at the massification of energy performance renovation. After a pilot phase of 3 years and over one hundred owners using the platform, 54% have realized the works recommended by the passport, but only a third said they were not satisfied and underlined the lack of monitoring of renovations and their effectiveness.

While the building renovation passport is a relatively new concept and is still being experimented in Europe, it globally seems promising over time.

3. Utility obligations

Energy utilities have been involved in programmes to improve energy efficiency for many years. They first became active after the first oil crisis in the 1970s. The United States became the most active country after the passing of the Public Utility Regulatory Policies Act (PURPA) in 1978.[14] The IEA in its 2017 energy efficiency report stated that such programmes have grown from 12 in 2005

13 More information is available from BPIE, Building Renovation Passports: Customised roadmaps towards deep renovation and better homes, Brussels, 2016, p. 28.

14 It was meant to promote energy conservation (reduce demand) and promote greater use of domestic energy and renewable energy (increase supply).

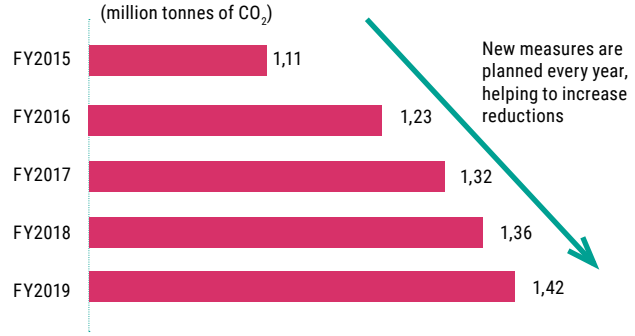
to 45 by 2016. By 2016, this had risen to 45, with programmes in all six continents.[15] "*Rather than setting standards for individual end-uses or industries, utility obligations require energy companies to deliver energy efficiency outcomes – typically energy savings, but in some cases carbon emission reductions or fuel poverty reductions.*"

The European Union has introduced an obligation in its Energy Efficiency Directive but not all member states have gone for it, as they were allowed to have alternative measures. Obligated energy companies can have programmes focusing on fuel poverty and social housing and in those cases, there can be measures directed towards the building envelope. Such is the case in the UK with the Energy Company Obligation Scheme (ECO)[16].

EXPERIENCE FEEDBACK

THE RESULTS OF PHASE I OF TOKYO-CAP-AND-TRADE-PROGRAMME

The Tokyo-Cap-and-Trade Programme, established in 2010, covers about 1,300 commercial and industrial establishments with energy consumption exceeding 6,000 MWh a year and a floor space above 5,000m^2. Selected as one of the transformative action programs (TAP) of ICLEI, it accounts for 20% of Tokyo's emissions and 40% of emissions from the commercial and industrial sector (IETA 2018). The results of Phase I (2010-2014) were particularly encouraging, showing a decrease of 12.7% over this period, i.e. a total cumulative reduction of 12.27 $MtCO_2eq$. The evaluation report shows a reduction of 26% since the baseline year (2002-2007) from 16.50 $MtCO_2eq$/year to 12.13 in 2016 (TMG ETS 2018). Phase II is aiming for a reduction of 15 to 17% between 2015 and 2019 but has so far only achieved a 1% decrease per year between 2015 and 2017. During the second stage, any facility that fails to carry out the order will be publicly named and subject to penalties (up to JPY 500,000 [USD 4,528]) and surcharges (1.3 times the shortfall).



The recent evaluation shows that the programmes led companies to take measures every year to reduce emissions (fig. 9).

Source: https://icapcarbonaction.com/en/news-archive/612-emissions-reductions-continue-in-tokyo-cap-and-trade-program

BOX 6

4. Local regulations

Local governments can use their local legislation to introduce regulations on energy efficiency and complement the national one as shown in the analyses in 2019 of the (Copenhagen Centre on Energy Efficiency:

- In Argentina, Rosario's Ordinance 8757/2011 was established to regulate the city's energy consumption for thermal comfort, including both space heating and cooling, by setting maximum allowed values for thermal transmittance for both new and existing buildings with floor area of more than

15 IEA, energy efficiency report 2017, p. 47.

16 https://www.ofgem.gov.uk/environmental-programmes/eco

300 m². The *Red Argentina de Municipios frente el Cambio Climático* – the Argentine Network of Municipalities against Climate Change (RAMCC) –promotes such actions through a task force on building efficiency and retrofitting of public buildings, or street lighting.

- In Vietnam, Da Nang has three city-wide plans on building performance that complement the national policies and programmes, in addition to the implementation of the Vietnam Energy Efficiency Building Code (VEEBC). In September 2017, the city adopted 'the Directive on Buildings EE', which stipulates responsibilities of various municipaldepartments into the implementation of VEEBC and the Law 'On Economical and Efficient use of Energy'.
- The State of Sonora in Mexico adopted a Law in 2019 to establish the Energy Commission of the State of Sonora that states that municipalities have the authority to implement the necessary regulations to improve energy efficiency of local buildings.

In the United States, where residential and tertiary buildings emitted around 553 $MtCO_2$, the information portal *Building Rating* recently mapped current local legislation for buildings (fig. 10):

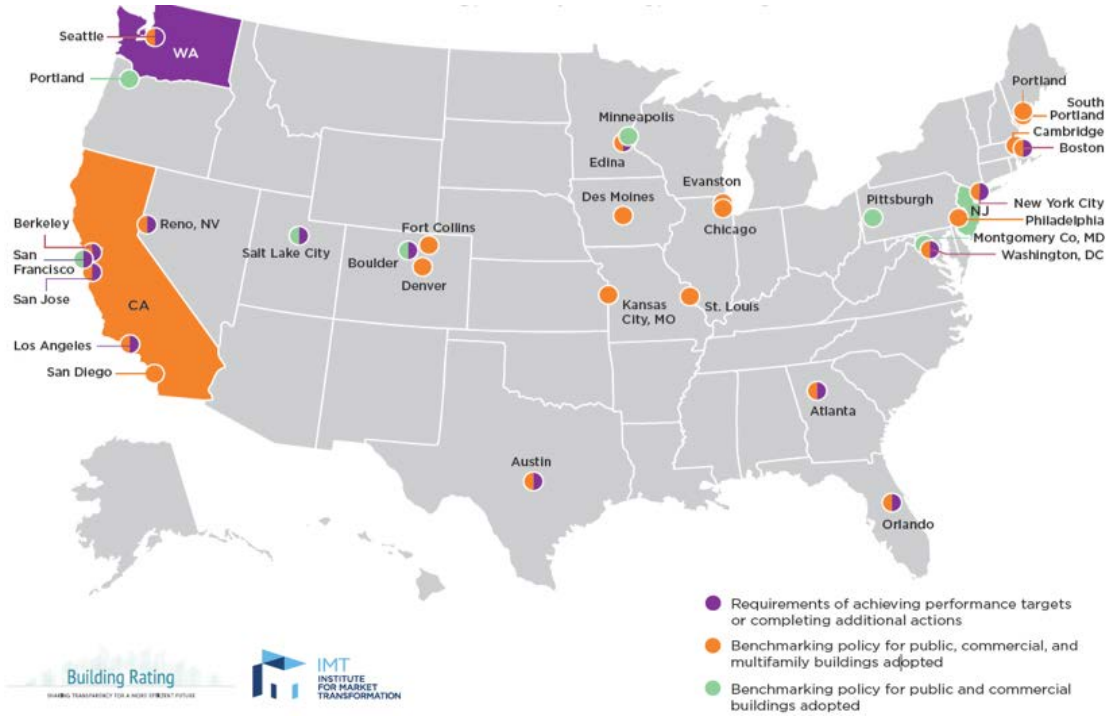
On the other hand, Rocky Mountain Institute's Residential Energy Plus team has identified in United States:

- 9 cities and 1 state have passed one or more efficiency standards for rentals policies and 7 more cities and 1 more state are in progress. Efficiency standards for rentals ensure that landlords upgrade the efficiency of their residential properties as a prerequisite for renting a property.
- 2 cities and 1 state (California) have passed zero-energy construction policies (through density bonuses and other incentives for zero-energy construction). 2 more cities and 2 states have publicly announced their progress on passing the policy.

The map is available online and regularly updated (Rocky Mountain Institute, 2019).

FIGURE 10

U.S. CITY, COUNTY, AND STATE POLICIES FOR EXISTING BUILDINGS: BENCHMARKING, TRANSPARENCY, AND BEYOND - *Source: © Copyright 2019 Institute for Market Transformation, updated 6/2019*



• ENERGY EFFICIENCY: MEASURING COMPANIES' EFFORTS •

1. Energy saving strategies within companies

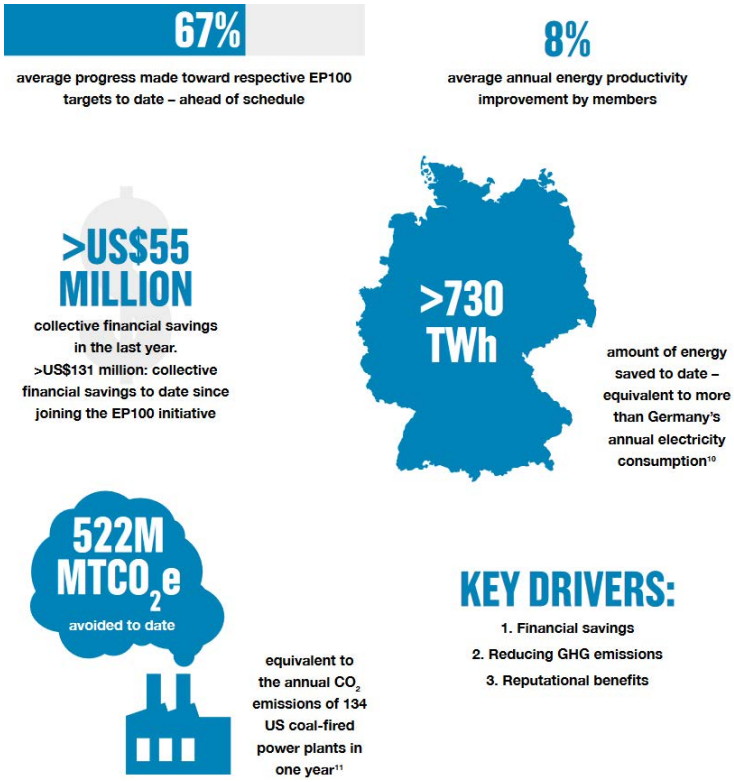
Reporting on companies' efforts to reduce energy demand on a comprehensive manner and allowing comparison remains complex. The 2018 Emissions Gap considers that only 13% of the international climate initiatives reported on the Global Climate Action Platform are related to buildings (UNEP, 2018).

- EP100, a reporting initiative delivered by the Climate Group in partnership with the Alliance to Save Energy, now brings together 50 leading companies with over US$382 billion in combined revenue (The Climate Group, 2019). In 2019, based on 23 compagnies, the initiative was able to measure the following achievements (fig. 11). The main drivers reported by companies is financial savings, followed by GHG reductions and reputation.
- The Clean Energy Ministerial (CEM) is a high-level global forum that aims at promoting policies and programmes, improving clean energy technology, sharing lessons learned and best practices. The platform presents close to 200 cases of industries implementing certified energy management system such as ISO5001 through the mapping of energy flows, training for employees, investment in more efficient materials, etc. For example, *Wyeth Nutrition* in Ireland improved its energy efficiency by 38%, and *Qingtongxia Aluminum Industry Stock Co., Ltd.* by 14% between 2014-2018.
- Other initiatives address the energy demand of appliances and equipment. United for Efficiency initiative administrated by UNEP assesses countries' policy and potential savings by types of equipment (lighting, cooling, transformers, motors, etc.) and tries to address priorities and perspectives of key stakeholders – consumers, businesses, civil society and officials.

FIGURE 11

MEASURED PROGRESS OF THE 23 MEMBERS OF THE INITIATIVE

Source: The Climate Group, 2019



EXPERIENCE FEEDBACK

HONG KONG STANDARDS AND LABEL FOR COMPANIES AND HOUSEHOLD APPLIANCES

As buildings account for about 90% of electricity consumption in Hong Kong, there is great potential to improve energy efficiency and reduce its greenhouse gas emissions by promoting energy efficiency in buildings. In addition to the code imposing energy efficiency standards for new buildings and renovation projects, the HK region introduced a mandatory Energy Efficiency Labelling Scheme (MEELS) in 2008, progressively extended to all household appliances: in 2015 to washing machines and dehumidifiers and in 2018 to televisions, storage type electric water heaters and induction cookers. Its 2015 upgrade should enable an annual saving of 300 million kWh. Furthermore, the region is asking companies within its borders to produce and publish their carbon footprint on the Carbon Footprint Repository platform, on which 83 companies are already present.

Source: Gov HK 2019

BOX 7

2. Nearly zero energy buildings

In the 2010 EU Energy Performance of Buildings Directive (Article 2), a nearly zero energy building "*means a building that has a very high energy performance, as determined in accordance with Annex I of the Directive. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby*". The concept is gaining interest, especially in Asia:

- The Hong Kong Zero Carbon Partnership (ZCP) is a group of public and cross-sector stakeholders for zero carbon buildings which was established in 2015. It was carried out as a project (Hong Kong 'Zero Carbon Building Partnership' for Enhancing Public and Stakeholder Engagement) lead by the University of Hong Kong, funded by Construction Industry Council (CIC) to enhance the public and stakeholders engagement in delivering the zero carbon buildings (see at Honk Kong Zero Carbon Partnership).
- India – CII-Indian Green Building Council (IGBC) has announced its plans to popularise the 'Net-Zero Energy Building Movement' in India, which aims at promoting energy efficiency. IGBC Net-Zero Energy Building rating system enables the assess the energy requirements of such building. The rating system is designed for both new and existing buildings, both for air-conditioned and non-air-conditioned buildings (The Hindu Business line, 2019).

• FINANCING SCHEMES FOR MARKET TRANSFORMATION • Green mortgages mentioned above are gaining attention worldwide. One interesting initiative takes place in Romania. The Romanian Green Building Council has co-developed with a leading regional bank an innovative Green Mortgage product that rewards energy efficiency and environmental responsibility. The preferential financing allows the project developer to invest early in essential green design and other solutions and rewards the homeowner with a better-quality home and a lower monthly total cost of ownership. The Green Mortgage applies only for buildings certified by RoGBC within the Green Homes programme.[17]

Under the Clean Development Mechanism, emission-reduction projects in developing countries can earn certified emission reduction credits. These saleable credits can be used by industrialised countries to meet part of their emission reduction targets under the Kyoto Protocol. A project in South Africa, initiated by a non-profit organisation, stands out in improving the energy performance of buildings. The Kuyasa CDM Pilot Project retrofitted 2,309 low-cost homes with solar water

17 For more information, go to http://www.rogbc.org/en/projects/green-mortgage

heaters, insulated ceilings and energy efficient lighting in Khayelitsha, Cape Town (South Africa). It was South Africa's first internationally registered Clean Development Mechanism (CDM) project and became the first Gold Standard Project in the world.[18]

FIGURE 12

GREEN MORTGAGES SYSTEM OF THE ROUMANIAN GREEN BUILDINGS COUNCIL

Source: The Climate Group, 2019

CONCLUSION

The building sector contributes nearly 40% of global energy-related annual GHG emissions. There is considerable potential to reduce those emissions and thus contribute to meeting long-term climate objectives. That potential can be achieved through improving the energy performance of both new buildings and existing buildings through a combination of measures addressing the envelope and how energy is used throughout the building.

The policy framework for improving the energy performance of buildings is largely the responsibility of national governments and has been steadily developing towards regulatory policies. While the main policy framework comes from national governments, the impact depends on the activities of non-state organisations and individuals.

Achievement has to occur through the actions of many organisations, industries and individuals, with a few mentioned here. They provide relevant leads to address the fragmentation of the building and construction sectors and support households or companies in engaging with deep renovation actions. Consumers need to be at centre of any approach to "improve" buildings – buildings are complex systems. While they need a technical fix, they definitely need a human "fix" too. This is true whether it be a building renovation passport, a one-stop information shop, a green mortgage, or any other tool. Consumers – owners, renters and users – are key to success.

Please do not hesitate to share with us any additional information, reports of data via the following email address: contribution@climate-chance.org

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INDUSTRY

Awaiting technological breakthroughs

Awaiting technological breakthroughs

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Globally, industrial activities are responsible for the direct emission of around 7.6 billion tonnes of CO_2, plus an extra 5 billion tonnes of indirect emissions. This represents about a quarter of global greenhouse gas (GHG) emissions. While industry is considered a sector in its own right, it encompasses a wide range of activities, both in terms of the technologies used and their organisation. In this case study, we focus on 2 sub-sectors: cement and chemicals.

Key takeaways

There is often a lack of data to assess emissions from sub-sectors, with estimates diverging significantly depending on the assumptions and perimeters used. Cement remains the 3rd largest source of CO_2 with fossil fuel combustion and land use (from 1.5 to 2.2 $GtCO_2$ in 2017), and the chemical industry is the one with the highest consumption of petroleum products (1.25 $GtCO_2$ in 2017);

Short-term emission gains can be achieved through the dissemination of good practices or more efficient technologies, but achieving long-term objectives generally involves technological breakthroughs that are still very uncertain and lack maturity. However, few actions seem to result from well-established diagnosis;

In cement plants, carbon intensity is improving. However, emissions can only be reduced by capturing carbon or reducing clinker consumption, and industry invests less in research and development than other sectors (6% per year);

The growing demand for chemicals, particularly plastics, is sparking an increase in the emissions from the sector. However, the priority for industries seems to be indirect emissions, at the use and end-of-life stage of their products, where actions are currently more implemented by end-user and authorities;

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1 . Cement – A set diagnostic, few implemented actions

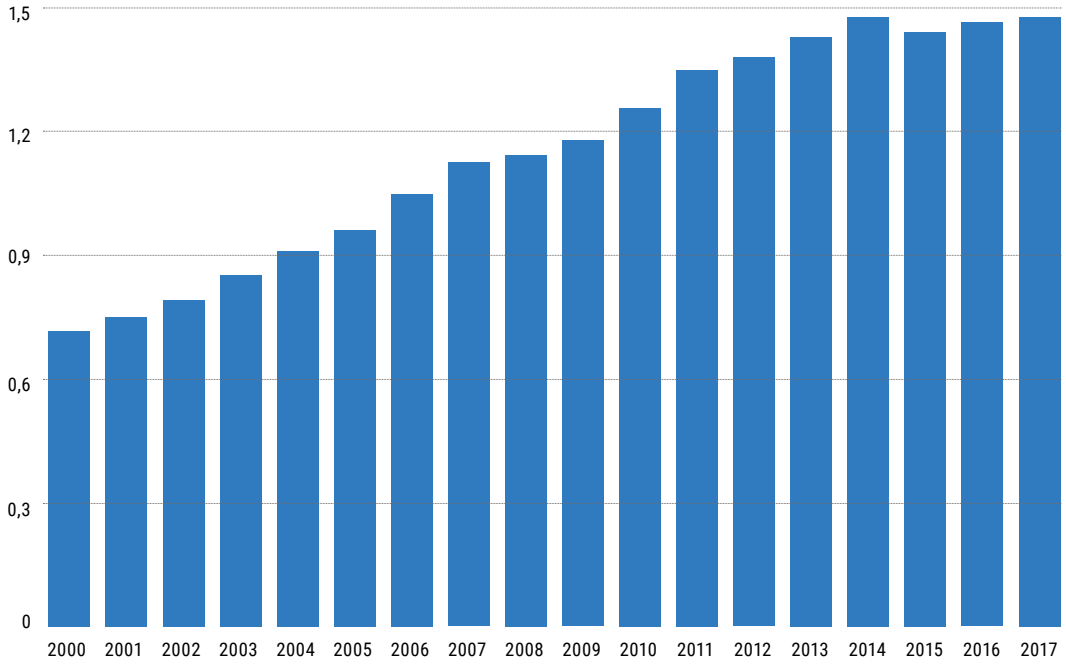
• UNCERTAIN BUT STABLE EMISSIONS SINCE 2014 • Emissions from cement production have 2 main causes. About three-fifths of GHG emissions come from limestone decarbonation or "clinkerisation"[1], an operation that is necessary to produce an essential component of cement, clinker. **This chemical reaction is the third largest anthropogenic source of CO_2 after fossil fuel combustion and deforestation and land use.** The remaining two-fifths are related to the energy used in the production process.

Emissions from cement production have 2 main causes. About three-fifths of GHG emissions come from limestone decarbonation or "clinkerisation" , an operation that is necessary to produce an essential component of cement, clinker. This chemical reaction is the third largest anthropogenic source of CO_2 after fossil fuel combustion and deforestation and land use. The remaining two-fifths are related to the energy used in the production process.

FIGURE 1

EVOLUTION OF CEMENT PRODUCTION EMISSIONS IN BILLIONS OF TONNES OF CO_2

Source: Le Quéré, 2018b



Cement production and associated emissions peaked in 2014 after a long period of rapid increase due to a rise in production levels: world production increased fourfold since 1990 and 50 times since 1950 (USGS, 2019). This growth has been particularly rapid in China, where production grew by a factor of 11 since 1990. Cement production is now equivalent to half a ton per person per year.

1 Limestone and clay are both cooked at a very high heat to produce clinker, which releases CO_2

• NEW POLITICAL AND FINANCIAL PRESSURES • Many big cement producing countries have taken initiatives to reduce emissions from the sector, notably through improved energy efficiency (IEA, 2019):

• As part of its 13th five-year plan, China has set itself the target of reducing the energy intensity of clinker production to 0.85 MWh per tonne (compared to the global average of 0.94 in 2016). If this target is met, Chinese cement production is expected to approach the highest levels of energy efficiency currently available in 2020.

• In Europe, the European Committee for Standardisation recently received a mandate to develop a low-carbon cement standard.

• India established a market system ("Performance, Achieve, Trade") to encourage energy efficiency in energy-intensive industries, including cement (BEE, 2018). Between 2011 and 2015, 85 cement plants participated, saving 9% of the sector's energy consumption.

Although they were much less a target than coal or hydrocarbons, cement climate issues are starting to gain investors' attention. In mid-2019, a coalition of investors representing more than 2 trillion assets called on four multinational building materials companies (Irish company CRH, French-Swiss company LafargeHolcim, German company HeidelbergCement and the French company Saint-Gobain). They call for greater transparency on emissions and a roadmap compatible with the objectives of the Paris Agreement (IIGCC, 2019).

• BUSINESS COMMUNITY INITIATIVES STUCK AT THE EVALUATION STAGE • The weight of the clinkerisation reaction in the cement industry's emissions makes it particularly difficult to reduce them. This can be seen, for example, in Germany: the German Cement Manufacturers' Association has invested in the energy efficiency of the 46 member plants and the use of alternative low-carbon energies, particularly biomass, but has only achieved a very slight reduction in emissions. These have remained virtually unchanged since the 2000s, at around 0.6 tonnes of CO_2 per tonne of cement produced (VDZ, 2018).

Based on data reported by companies on its platform, the CDP estimated in early 2018 that the carbon intensity of cement production had decreased by 1% per year over the last 4 years. The rate of this decline is to more than double to reach a trajectory compatible with the objectives of the Paris Agreement (CDP, 2018). Indian cement manufacturers stand out with a lower proportion of clinker in their cement due to the use of waste from other industries (scoria, ash) as alternative materials.

EXPERIENCE FEEDBACK

TOWARDS ZERO-EMISSION CEMENT IN NORWAY?

In 2013, with its German owner HeidelbergCement, the cement producer Norcem Breivik, from the south of Norway, set the target of becoming the world's first zero-emission cement producer. Ever since, solutions have been put to the test – all include the use of carbon capture and sequestration[2].

The cement plant has replaced 70% of its fossil fuels with waste – paper, textiles, plastics and hazardous waste – which can be incinerated when temperatures reach over 1,000°C required to manufacture the cement. The use of these alternative fuels can reduce the plant's emissions by one third. But emissions from the clinkerisation reaction occur regardless of the energy used and must be captured and sequestered.

A study carried out in 2016 showed that this solution was feasible. In 2018, funding from the Norwegian government made it possible to launch the in-depth study and planning of the project. One of the particularities of the project is to seek to create carbon capture modules that are less expensive than the tailor-made projects that have been implemented so far. The captured CO_2 should then be transported by ship to be injected into offshore hydrocarbon pockets in partnership with Total and Shell. The final investment decision is expected in 2020 or 2021 for an entry into service before 2024. The cost of the project is estimated at NOK 11.2 billion, or just over €1 billion.

Source: NORCEM; EURACTIV, 2018

BOX 1

On a global scale, many competing initiatives exist. The Cement Sustainability Initiative was created in 1999 and placed during 20 years under the auspices of the World Business Council for Sustainable Development. Their first report, released in 2002, identified climate change as a major line of action and drafted a roadmap to reduce GHG emissions (Aggeri, 2017). This initiative was taken up once again in 2019, by the Global Cement and Concrete Association, an association created at the beginning of 2018, gathering 38 companies representing around one third of world production. These work streams notably include energy efficiency and evaluation of emissions from the cement production industry: in October 2019, the association published recommendations for measuring emission levels (GCCA, 2019).

In July 2018, the World Cement Association, which brings together over 50 cement producers from 30 different countries, organised its first forum on climate chance. **These works concluded that currently available technologies could achieve the 50% of emission reductions necessary to respect the Paris Agreement. They are still being shared too slowly.** In October 2018, the association published a plan defining 5 priority action directions (WCA, 2018):

- The evaluation and publication of GHG emissions with the development of protocols adapted to the implementation of trainings;
- Efficient use of cement and the reduction of emissions from buildings during the life cycle;
- Use of energy from waste to make cement, with the creation of an exchange platform to share knowledge and good practices in the domain;
- Technological innovation for carbon capture, information systems, and new types of cement and binders;
- The implementation of an approach for distinguishing products, and innovative economic models.

Lastly, the Concrete Sustainability Council is a certification body for the environmental and social performance of cement plants and their supply chains. It currently certifies 160 installations in 8 countries. **Despite these initiatives and a consensus on the need for innovation to achieve lower**

2 Climate Chance (2018). Carbon capture and sequestration: a solution that is struggling to materialise. Rapport 2018 de l'Action Climat. Global Observatory on Non-Sate Climate Action

emissions products and processes, the share of revenues devoted to research and development (R&D) among cement manufacturers is lower than in other industries, with an investment of 6% on average (CDP, 2018).

2 . The chemical sector – The issue of unidentified indirect emissions

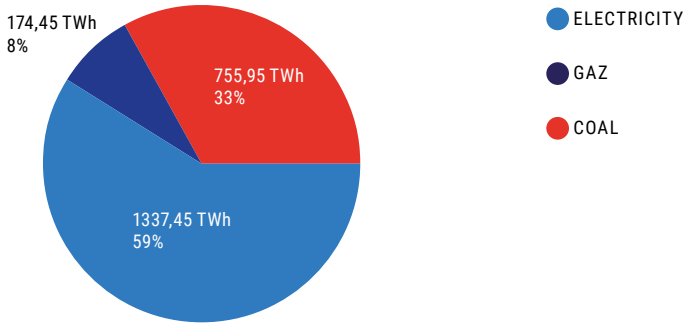
• THE EVOLUTION OF EMISSION HIDES THE WEIGHT OF INDIRECT EMISSIONS • Direct emissions from the chemical sector were estimated at 1.25 billion tCO_2e in 2017. These emissions are on an upward trend: they increased by 2% between 2016 and 2017 (IEA, 2019). **This growth is mainly due to a dynamic demand, particularly for plastics and their precursors (+5% between 2016 and 2017), while demand for nitrogen fertilisers is relatively stable.** Demand for methanol, an intermediate product used in the production of plastics and fuel additives, is the fastest growing: +7% between 2016 and 2017.

The chemicals and petrochemicals sector is composed of a complex set of interdependent sub-sectors. The production of its finished products, particularly plastics and fertilisers, involves the production of many intermediate products, generally from hydrocarbons. The sector is also characterised by the coexistence of small companies, emitting a few tonnes of CO_2 per year (e.g. fine chemicals), and giant factories (e.g. petrochemicals). **However, despite the diversity of processes and actors, most emissions and energy consumption are attributable to a small number of products: chlorine production by chlor-alkali process, for example, is responsible for 40% of the sector's electricity consumption (IPCC, 2018).**

The chemical sector is the largest sector in terms of oil (14% of world production) and gas (8%) consumption. Coal can also be used, like in China. These fossil fuels are used approximately equally for energy production and as raw materials for chemical reactions. Using them as raw materials means emissions downstream, at the use stage (use of fertilisers in agriculture) or at the end of life stage (waste incineration), which are not included in direct emissions from the sector. This is why although it is the largest consumer of fossil energy, chemicals is only the third most emitting industrial sector after cement and metallurgy.

FIGURE 2

ENERGY CONSUMPTION OF THE SECTOR EXCLUDING RAW MATERIALS- *Source: IEA, 2019*



• CLIMATE ACTIONS LED BY USERS OR PUBLIC AUTHORITIES • The production use and end-of-life of chemicals pose many environmental problems. The International Energy Agency (2018) recently published recommendations, including more effective regulation of GHG emissions from the sector. It also calls for better accounting of emissions and energy consumption as well as more transparency.

Many initiatives already exist to reduce the carbon footprint of the chemical industry, both in terms of direct emissions and in terms of product use and end-of-life. In India, for example, some sectors

are covered by the "Performance, Achieve, Trade" mechanism to encourage energy savings (EEB, 2018). This is the case, for example, for fertiliser production: between 2012 and 2015, the 29 participating plants exceeded their target by 70%.

Downstream emission reductions generally entail a more efficient use of the products, and better recycling. This is the case for plastic when it is re-used and recovered when at the end of its life-cycle. Some countries, like South Korea, Germany and Norway, have taken regulatory measures to limit the landfilling of plastic in favour of recycling or energy recovery (incineration with energy recovery for electricity or heat production).

FOR A BETTER UNDERSTANDING

LIMITING EMISSIONS FROM THE OUTSET BY REDUCING PLASTIC

Some disposable plastic products such as disposable bags, straws, or cups have acquired a symbolic place. These products are regularly targeted by environmental protection organisations, such as the Plastic Pollution Coalition, which brings together over 1,000 organisations in 60 countries, and their omnipresence on a daily basis makes them a visible issue for consumers and employees. In Great Britain, the "Straw Wars" campaign refers to restaurants and bars the are committed to abandoning plastic straws.

Restrictions related to the use of these products are increasingly frequent: 127 countries have, for example, a legislation regulating in one way or another, the use of plastics bags. Rwanda, for example, which was a precursor, banned plastic bags in 2008 (Jeune Afrique, 31/05/2019).The European Parliament adopted, in June 2019, the directive on “the reduction of the environmental impact of certain plastic products”. In addition to new obligations concerning waste sorting, recycling of plastic bottles, and consumer information and awareness, it aims to reduce the use of single-use products, by means of marketing restrictions for certain disposable products, including straws.

In some cases, restrictions are adopted at the sub-national level: Prince Edward Island, for example, became the first Canadian province to ban single-use plastic bags in July 2019 (Radio Canada, 07/10/2019). A similar legislation has since been passed in Victoria and Nova Scotia. The Union of Municipalities of New Brunswick, with a total of 60 municipalities, passed a resolution calling on its provincial government to take the same action (Arcadie Nouvelle, 07/10/2019).

BOX 2

Activities from the chemical industry are interdependent and require many inputs; local authorities can therefore play an organisational role in their development policies. In its strategic plan for 2018-2020, the Port of Antwerp, for, example, plans to develop exchanges of materials and energy between the petrochemical industry and companies developing renewable chemistry. 90 hectares - previously occupied by an automobile plant - will be reallocated to these activities (La Tribune, 2018).

• LIMITED PROSPECTS FOR EMISSION REDUCTIONS • Despite emissions, the chemical sector presents itself as having a negative net contribution to total emissions from the economy. As early as 2009, the International Council of Chemical Associations, which represents 90% of the world's chemical industry's turnover, estimated that one tonne of CO_2 emitted by the chemical industry prevented an average of 2.1 to 2.6 tonnes of CO_2 emissions in the rest of the economy (ICCA, 2009). **This interpretation remains at the heart of the communication strategy of the ICCA and its members on the fight against climate change. The association encourages companies in the sector to quantify the emissions that their products can avoid (ICCA, 2016) and regularly updates a guide for this type of study (ICCA, 2017).**

This discourse is visible in fertilizer production: the International Fertilizer Association (IFA) presents itself primarily as contributing to combating the effects of climate change and indicates that its emissions "can be considered negligible" (IFA, 2018). The IFA carries out some actions, for example, it invites members to communicate their energy and emissions performance in order to carry out comparative studies.

More concrete actions exist in other sub-sectors. The European Plastics Manufacturers' Association, for example, is committed to making efficiency improvement and developing recycling and reuse with the objective of achieving a 60% recovery rate for packaging plastics by 2030 and 100% by 2040. An annual report is to be released from 2019 onwards to report on progress (Plastics Europe, 2018). In 2016, over a quarter of European plastic was landfilled (PlasticsEurope, 2018), compared to less than 10% in Japan or Korea.

Generally speaking, the dissemination of good practices and more efficient technologies can lead to rapid emission gains but is insufficient to comply with the long-term objectives of the sector (Griffin, 2018). For example, a European Commission study estimates that the European chemical sector should reduce its emissions by 80-95% by that date (JRC, 2017).

Major efforts in research and innovation are therefore essential to reduce the carbon footprint of processes used by the chemical industry (Dechema, 2017). The use of alternative raw materials to hydrocarbons is also a possible solution. In Australia, for example, fertiliser manufacturer Yara Fertilisers has partnered with Engie to study the use of hydrogen produced from renewable electricity in its Pilbara plant; this project could begin in 2021 (The West Australian, 2019). The sector could also use carbon dioxide captured on its own facilities or in other industries to reduce its emissions or even create negative emissions (IEA, 2018).

CONCLUSION

In both the chemical and cement industries, short-term emission reductions via the diffusion of more efficient technologies are possible, but the initiatives of the actors seem for the moment to be restricted to diagnostics. A clean break seems necessary to achieve the mid-century objectives, but the diffusion of such solutions is, for the moment, hard to imagine[3]...

Please do not hesitate to respond to this document, or to suggest any relevant additional reports or data by writing to the following address: contribution@climate-chance.org

3 Voir Climate Chance (2018), « Cahier 1: L'action sectorielle », Bilan 2018 de l'action climat non-étatique.

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WASTE

A sector led by local action under international tension

A sector led by local action under international tension

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Despite being responsible for around 5% of global GHG emissions, the impacts of waste on climate are less taken into consideration than the local environmental damage waste generates. However, in recent years, plastic pollution and its impact on ecosystems – to the point of being identified as a characteristic in the Anthropocene by some researchers (Zalasiewicz, J. & al., 2016) –, Asian countries' refusals to be the "world's landfill", or even the insistent question of recycling electronic compounds has brought waste issues to the top of the public, economic and geopolitical agendas. Here is an overview of initiatives that, over the past two years, have focused on reducing production and improving waste management.

Key takeaways

Solid urban waste (the only reliably measurable type of waste) represents 5% of global emissions, it is mainly generated by poor management techniques: decomposition in open landfills, open burning… Only 19% of the approximately 2 billion waste products produced worldwide each year are recycled.

Taken aback by South Asian governments' bans on the import of foreign waste, North American and European cities are adjusting their treatment capacities in a hurry. In China, the loss of imported waste is pushing the State and large cities to enhance and foster recycling practices to feed treatment plants (currently under-exploited) with local waste. Under pressure, the international community amended the 1989 Basel Convention, reclassifying plastics as "hazardous waste".

By sanctioning Apple and Samsung for planned obsolescence in October 2018, the competing Italian authority provided legal support to calls for extended manufacturer responsibility in the digital sector. Although barely operational, the voluntary commitments that were later made by GAFA – as well as those from the e-cigarette sector – do not signal much progress towards a more circular electronic economy. In the food industry, the fight against food waste is morphing into a growing market for new, evolving platforms (TooGoodToGo, Phenix…).

In Europe, "zero-waste" movements are transforming domestic lifestyles and are in certain cases beginning to form activism groups (PlasticAttack). In Russia, unprecedented local mobilisations take place against reforms of deficient treatment circuits. In Latin America and in Africa, "informal collectors" formally gather in cooperatives.

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1. Waste production and management: a critical climate issue

• GLOBAL TRENDS IN WASTE PRODUCTION • The release of the What a Waste 2.0 report (WAW 2.0, 2018) by the World Bank in the summer of 2018 made its mark in the waste sector, and to this day is the baseline report on the estimation of global trends in waste generation. The World Bank estimates that municipal solid waste production amounted to 2.01 billion tons in 2016, at least a third of which will have gone through no environmentally-correct form of waste management. This represents 0.74 kg per person and per day. This figure rises to 7-10 billion tons if industrial, construction and demolition waste are included, according to estimates in the IEA's Global Waste Management Outlook (GWMO, 2015).

With 1.6 billion tCO_2eq generated via treatment processes, equivalent to 5% of overall emissions, waste production and management has a significant impact on climate change. In 2050, waste-related GHG production could amount to 2.6 billion tCO_2eq in business-as-usual scenarios (WAW 2.0, 2018).

East Asia-Pacific is currently the world's largest producer of waste (23%). All high-income countries, which represent only 16% of the world's population, generate more than a third (34%) of the world's total waste (WAW 2.0, 2018).

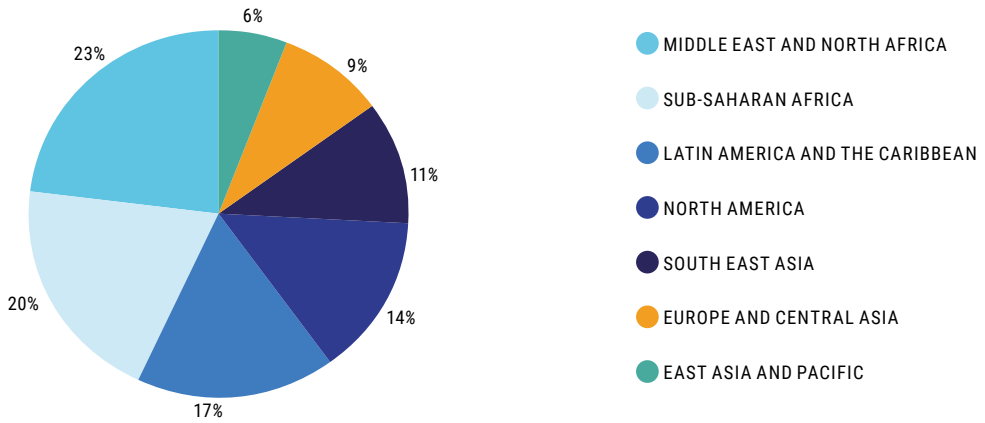
The volume of solid urban waste could increase by 70% over the next 30 years and reach 3.4 billion tonnes by 2050. The main reason behind this incline is developing countries' growth. Three effects collide: urban development, demographic growth, and economic development of middle classes.

Lower-middle income countries will witness the biggest increase in their waste volume. The WAW 2.0 report estimates that waste production will triple in Sub-Saharan Africa and double in South Asia and that these two regions will represent 35% of waste products on the Planet in 2050.

On the other hand, waste production per inhabitant in OECD countries is decreasing. Statistics gathered from this organisation[1] are showing significative drops since the year 2000 both within all OECD countries but also in some industrialised countries (fig. 3), in particular in the United States (-5% in 15 years) and above all in Japan (-21% in 16 years).

FIGURE 1

WASTE PRODUCTION BY REGION - *Source: World Bank, WAW 2.0 (2018)*



1 OECD (2019), Municipal waste (indicator). https://data.oecd.org/fr/waste/dechets-municipaux.htm (Accessed 05/08/2019)

FIGURE 2

SHARE OF WASTE GENERATED WORLDWIDE BY COUNTRY INCOME LEVEL - *Source: World Bank, WAW 2.0 (2018)*

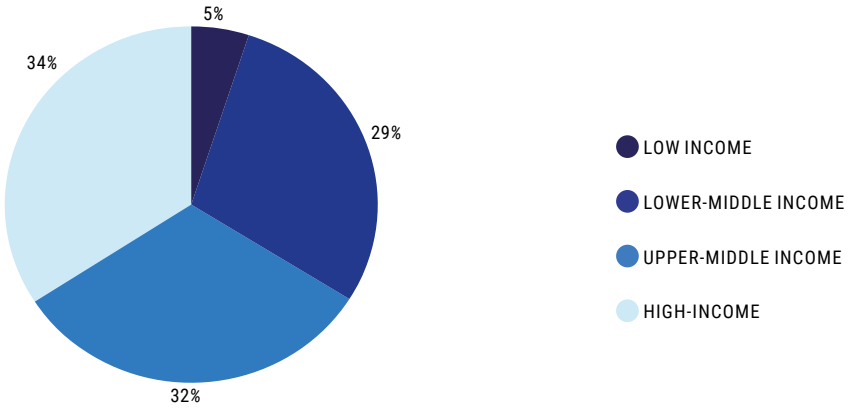
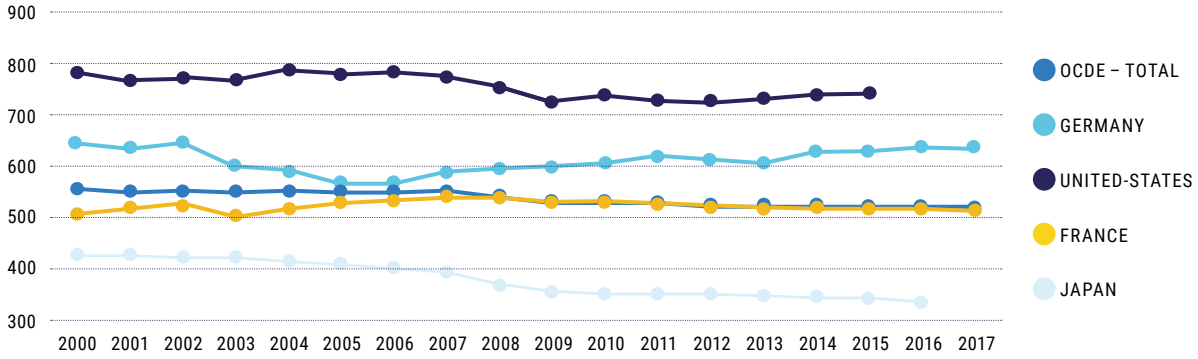


FIGURE 3

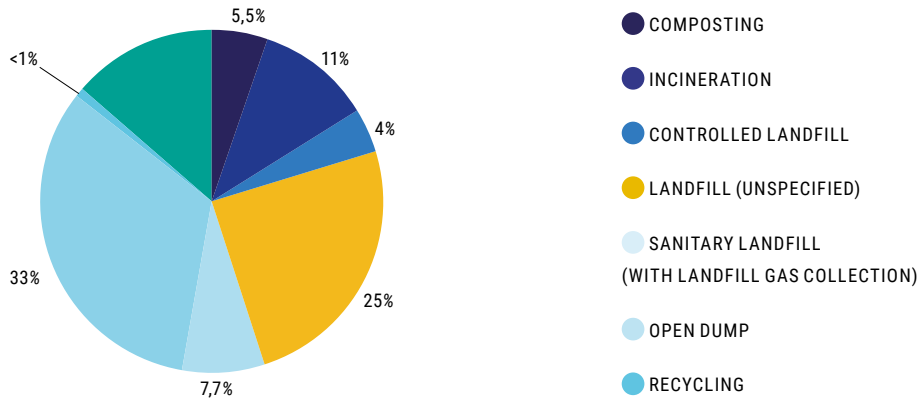
MUNICIPAL SOLID WASTE PRODUCTION PER INHABITANT AND PER YEAR IN SOME OECD COUNTRIES - *Source: ADEME graph following OECD (2019)*



• WORLDWIDE PROGRESS IN WASTE TREATMENT • **Prior to its treatment, waste must be collected – an activity that has increased in low-income countries** since the first edition of the What a Waste report (2012). With a global trend to increase recycling and composting, waste collection rose from 22% to 39%. These performances are correlated with the level of development: "*with income levels higher than $25 000/inhabitant, collection rates should be 100%*" (IEA, 2016). **In terms of treatment, however, landfilling in more or less controlled landfills (37%) and open pit deposits (33%) remain the most frequent practices (fig. 4). Globally, only 19% of the world's urban solid waste is recycled (composting + recycling).** Incineration with energy recovery increased from 0.1% to 10% over the same period in the high end of the middle-income bracket, notably because of Chinese investments. 93% of waste is deposited in ill-managed landfills located in low-income countries; the proportion decreases to 2% in high-income countries (WAW 2.0, 2018).

FIGURE 4

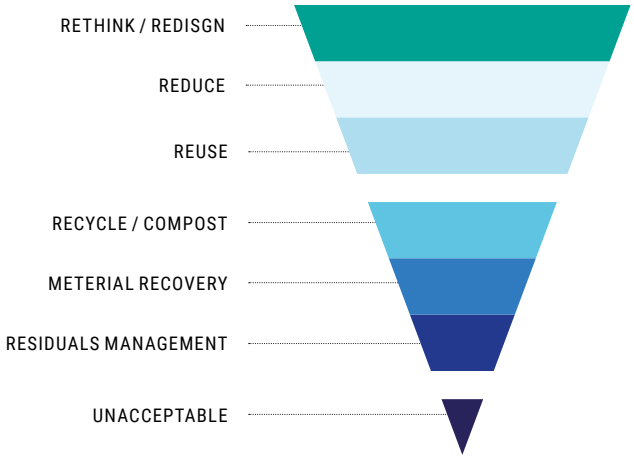
GLOBAL WASTE TREATMENT PRACTICES (IN%) – *Source: World Bank, WAW 2.0 (2018)*



Not a single report on waste highlights the best way to fight the phenomenon, which is, above all, to avoid generating waste and reduce it "at the source". The NGO *ZeroWaste* made of it its name, slogan and mission to promote the reduction of waste and wastage production at the source along the value chain. There are many debates on waste treatment methods, between zero waste supporters that exclude all energy recovery (fig. 5) and others who, like the CEO of Veolia (world leader in water and waste management), see waste as *"the raw material of the 21st century"* (La Tribune, 13/04/2016), or a way to reduce GHG emissions.

FIGURE 5

HIERARCHY OF WASTE TREATMENT METHODS – *Source: Zero Waste International Alliance*



This is why a lot of technological innovation on waste energy recovery (waste-to-energy) is attracting investors, although the World Bank recalls that "*It is a frequent misconception that technology is the solution to the problem of unmanaged and increasing waste. Technology is not a panacea and is usually only one factor to consider when managing solid waste.*" The methanisation of organic waste by anaerobic digestion (in absence of oxygen), gives an example of an alternative source of production of biogas and fertiliser for crops. Pyrolysis, gasification or heat recovery from incinerators are all opportunities to use waste as an energy source, as long as they do not hinder prevention and recycling and their environmental performance is as good as possible. Energy efficiency and the carbon footprint in these processes vary depending on the technical conditions chosen (Van Fan & al., 2018). But when, for example, they aim to capture methane emitted by landfilled waste or to recover the energy produced by incineration, these methods can help neutralise the carbon

footprint of waste treatment processes (IPCC, 2003).

The main obstacle in the way of their implementation is the average unit costs of these technologies, high and disparate. Only landfill methods with biogas recovery remain accessible (Kumar & Samadder, 2017). A recent report by France Stratégie on biogas development opportunities underlined the high fixed investment costs that the installation of methanisation of agricultural waste entails on a farmer (France Stratégie, 2018).

Another hurdle, more political this time, is the dissemination of these technologies, which means recognising the incineration of waste as a source of renewable energy. However, there is no consensus on this vision, particularly among zero-waste activists who see it as a destruction of reusable or recyclable resources, as well as a pretext for not leading the necessary efforts to reduce waste production at the source (Zero Waste, 13/12/2014). In their view, these methods can therefore only be the last option before landfilling (fig. 4). **The 2018/2001 EU Directive of 11th December 2018 on the promotion of the use of renewable energy goes in this direction, by obliging States to reduce their financial support for electricity produced by the incineration of unsorted waste**, in accordance with the collection obligations newly enacted by the "circular economy package" by the European Parliament in June 2018.

EXPERIENCE FEEDBACK

IN BURKINA FASO, TRADITION IS AN INSPIRING SOURCE OF INNOVATION FOR ORGANIC WASTE TREATMENT

In Burkina Faso, households traditionally managed waste with a practice called "tampouré" consisting in stockpiling organic waste in front of their houses during the dry season and spreading them over fields during the rainy season. Used as a layer of nutritive compost and moisture-retaining mulch, waste therefore contributes to improving agricultural production. However, cities in the country are rapidly developing with accelerating urban development in the country accompanied by an increase in waste production as well as the demand for farming products. To respond to these needs, the Ministry of Agriculture launched a manure pit operation in 2001, in many respects inspired by the traditional practice of "tampouré". The government encourages households to build pits and to compost on their own land.

Today, around 2 million tonnes of organic fertiliser are thus produced every year. A study released by the World Bank in 2016 states that 40% of waste generated by households in secondary cities and peri-urban areas in Burkina Faso were directly treated on site (WAW 2.0, 2017). This figure is remarkably high compared to other parts of the African continent. The agronomic benefits of compost have also led to increased food security and created opportunities for citizens to generate new income.

BOX 1

• METHODOLOGICAL FLAWS AND PROGRESS IN DATA COLLECTION • Although the 2006 *IPCC Guidelines for National Greenhouse Gas Inventories* classify waste as one of the five main GHG emission sectors for carbon accounting, assessing GHG emissions generated by waste production on a territorial scale is limited to the sector's specificities. Manipulating the data presented in the WAW 2.0 report therefore requires some caution: **these are rather rough and certainly minimised estimates because the quantification of global waste generation and its contribution to climate change has methodological limits, a lack of precision in the definition of "municipal solid waste[2]" and national asymmetries in data collection**.

Only European Union countries have a harmonised methodology: the Regulation (CE) n° 2150/2002 on waste statistics. The WAW 2.0 report notably points out difficulties of Sub-Saharan Africa, where

2 Defined in the report as "household, commercial and institutional waste", similar to the European definition.

only 13 countries out of 48 provided reliable data. Consequently, **few reports give an overview of the issue. Here, its scope of analysis is restricted to "municipal solid waste" only, effectively excluding wastewater or hazardous waste, which are the subject of specific measures.**

The only available data for measuring GHG emissions comes from national inventories. This waste has been collected and treated and is therefore measurable. However, the problem is other waste that needs to be taken into account, such as large quantities of waste abandoned in nature, buried under the ground or accumulating in wild dumpsites.

Other forms of waste or emissions linked to their treatment are also accounted for in other emission sectors. For example, the burning of agricultural waste is recorded in the AFOLU sector (Agriculture, Forestry, and Other Land Use), and "*emissions from biogas installation with energy production*" recorded in the Energy sector. In contrast, capturing biogas in landfills can recover between 65% and 90% of emissions depending on the technology use d, and, if it is recovered for conversion into energy, it saves fossil fuels and therefore avoids GHG

FOR A BETTER UNDERSTANDING

METHANE (CH_4) AND CARBON DIOXIDE (CO_2): THE MAIN GREENHOUSE GASES OF WASTE

The IPCC estimated in its 5th Assessment Report (2013, on 2010 data), that methane has a global warming potential 86 times higher than that of CO_2 over 20 years, and thus represents 97% of global GHG emissions of solid waste and wastewater. The reduction in methane emissions therefore represents an important driver towards action against climate change.

As a result of the degradation of organic material in the absence of oxygen (anaerobiosis), methane can be produced in a more controlled manner (in methanisation units) or uncontrolled when organic material is stockpiled in open landfills or in landfills with no methane recovery. It is then emitted directly into the atmosphere.

Agricultural and agri-food waste is mostly organic, while municipal solid waste contains an insignificant share of organic materials, between 30 and 80% depending on the country – the highest proportions being observed in developing countries. However, 33% of solid waste is deposited in uncontrolled landfills and 29% in controlled landfills without methane recovery, representing approximately 1.2 billion tonnes of waste with a direct impact on the greenhouse effect (WAW 2.0, 2018).

CH_4 is mainly produced by composting (the degradation of organic material with the presence of oxygen: aerobiosis) via the incineration and open burning (known as "flaring").

A direct consequence of these difficulties is that the GHG emissions database is weakened or even uncertain concerning the waste sector and does not provide a solid basis for commenting on global trends. No global figure exists for CH_4 – the main GHG from waste treatment – due to gaps in national reporting. While other studies have tried to establish national estimates (Ziyang & al., 2017), the figures remain uncertain and many other countries do not provide any data. Therefore, improving methodologies to assess emissions from the waste sector is a key challenge in providing decision-makers and stakeholders with a scientific basis for their actions.

BOX 2

A direct consequence of these difficulties is that the GHG emissions database is weakened or even uncertain concerning the waste sector and does not provide a solid basis for commenting on global trends. No global figure exists for CH_4 – the main GHG from waste treatment – due to gaps in national reporting. While other studies have tried to establish national estimates (Ziyang & al., 2017), the figures remain uncertain and many other countries do not provide any data. **Therefore, improving methodologies to assess emissions from the waste sector is a key challenge in providing decision-makers and stakeholders with a scientific basis for their actions.**

EXPERIENCE FEEDBACK

SCIENTIFIC LEADS FOR BETTER EMISSIONS ASSESSMENTS

In order to compensate for the lack of precise data, projects have set an objective in the past few years: to improve the reliability of measurements made in treatment installations.
Eunomia Research & Consulting Ltd, a British environmental consulting cabinet, joined with the European Environment Bureau NGO, undertook in a report that was published in December 2017 to improve comparison methods between countries presenting the highest rates of recycling. By thoroughly analysing the calculation methodologies of each country whose data was reported to Eurostat and the OECD, the study revealed that many countries overestimate their performance in this area, and identified the types of waste that, depending on whether or not they are included in the methodologies, create performance gaps (Eunomia, 2017).
In France, a consortium of university laboratories and research centres launched in 2015 **the N_2O Track project**, aiming to better assess N_2O emissions during the treatment of wastewater in water treatment plants. N_2O emissions of wastewater treatment installations are not regulated (no emission threshold or even obligation to quantify them is currently imposed), but nevertheless must be "estimated" as part of the preparation and rendering of municipal greenhouse gas summaries. Although it represents a small share of estimated waste-related emissions, the global warming power (GWP) of nitrous oxide is 265 times higher than that of CO_2 over 100 years[3]. These researchers found that the IPCC based its estimates on only one process – "activated sludge" – and on a single site in the United States in 1997. On the basis of these default factors, the IPCC estimated that wastewater treatment contributes 3.5% of N_2O emissions from human activities – this would therefore be an underestimation. By expanding the range of processes studied, *N_2O Track* has already observed N_2O measurements 60 times higher than those taken into account by the IPCC at the largest European treatment plant in Achères (France).

BOX 3

2. Waste, a globalised product under geopolitical pressure

Waste production has not only increased with the generalisation of linear take-make-use-dispose production and consumption patterns but has also risen as a result of the internationalisation of trade in consumer goods. However, waste generation can vary from 0.11 to 4.54 kg/person/day (WAW 2.0, 2018), and treatment capacities are very uneven from one country to another – to the extent that waste has itself become a commodity for international trade, causing geopolitical tensions in recent years

• PLASTIC WASTE AT THE CENTRE OF INTERNATIONAL ATTENTION • The growth of plastic products – the flagship material of post-war consumer goods – was accompanied by an acceleration in international trade throughout the second half of the 20th century. Their global circulation follows three dynamics: the exchange of goods, the exchange of plastic waste and the circulation of this same waste through atmospheric and marine flows. In 2017, a study published in Science Advances estimated the quantity of virgin plastic produced worldwide between 1959 and 2015 at around 8,300 Mt, including 8% that was recycled and 12% incinerated, the rest was deposited or buried in landfills or discharges (Geyer, R. & al, 2017). According to *Plastics Europe*, the association of European plastic producers, an extra 1,005 Mt was produced worldwide between 2016 and 2018 [4].

Due to their accumulation in ecosystems and the dangers they represent both for biodiversity and human health, plastics have been gaining in attention in the past few years. **We now know**

3 According to the last values updated by the IPCC during its 5th assessment cycle (AR5). See GHG Protocol.

4 Respectively 322, 335 et 348 Mt according to the information available here: https://www.plasticseurope.org

that plastic represents in and of itself a source of GHG emissions. A study by the University of Hawaii recently demonstrated that when plastics disintegrate, they emit traces of methane (CH_4) and ethylene (C_2H_4), two major GHGs. While testing materials used for making food products, textiles, building materials, and other diver plastic products, researchers noticed emissions generated by exposure to ambient solar radiation, with higher emission rates in the air than in water. "*Our results show that plastics represent a previously unrecognised source of trace gases with climate consequences that are expected to increase…*", concludes the study (Royer, S. J. & al., 2018).

Recent studies and explorations have demonstrated that plastic pollution, transported by winds and ocean currents in uninhabited or protected areas, exceeds the borders of human habitat. Between November 2017 and March 2018, a team of researchers observed a daily deposition of 365 micro-plastics/m² of soil surface at an altitude of 1,425 metres in the regional nature park of the Ariège Pyrénées (Allen, S. & al., 2019). On the Coco Islands (Keeling), in the middle of the Indian Ocean, at 2,100 km away from the Australian coast, an expedition led to the discovery of 414 million pieces of plastic, equivalent to 238 tonnes, including 977,000 shoes and 373,000 toothbrushes (Lavers, J.L. & al., 2019). In September 2019, the NGO *Sea Shepherd* also found 7 tonnes of plastic on an isolated Australian beach (The Guardian, 06/09/2019). Since June 2019, the British newspaper *The Guardian* launched the publication of an online series of investigations called 'United States of Plastics' in order to document on the international impact of the United States' dependence on plastic (The Guardian, 17/06/2019).

These "natural" transfers of plastic waste from one point to another around the world are met by another form of organised circulation. Plastic waste, but not only, is indeed the subject of vast movements of imports and exports from Northern countries to Southern countries. Following the refusal of several Asian countries to continue to take charge of recycling this waste, the world has been suffering since the beginning of 2018 from a "plastic crisis", forcing exporting countries to strengthen their domestic treatment capacities and recalcitrant neighbouring governments to turn away cargoes reoriented to their ports (box 4). As a result of this crisis, the 187 parties of the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, signed in 1989 without the United States, adopted almost unanimously in May 2019 an amendment reclassifying plastic waste into the hazardous waste category. Since January 2021, these transboundary movements will be submitted to the Convention's prior agreement procedure (EcoWatch, 13/05/2019). This measure is part of an increasingly frequent ban on single-use plastics (see Part 3A). In March 2019, the European Parliament voted to ban these plastics by 2021 (European Parliament, 27/03/2019)

FOR A BETTER UNDERSTANDING

CHINA, NO LONGER THE WORLD'S PLASTIC DUMP

Since the 31st December 2017 and the announcement of the "National Sword" plan, importing non-industrial plastic waste is officially banned in China. However, according to a study published in *Sciences Advances*, since 1992, 72.4% of global plastic waste destined to be recycled, equivalent to 170.5 million tonnes cumulated, was exported (Brooks, A.L. & al., 2018). Facing an increase in pollution and sanitary crises, China must also manage its own waste which continues to grow in parallel to its developing consumerist society. After years of neglecting their recycling channels by relying on those of China, exporting countries are not capable of treating waste for which they are now responsible. In 2030, if the trend continues, 111 Mt of waste could end up in escheat in developed countries, warns the same study.

Lacking the appropriate infrastructure, there is a risk that most waste will end up buried or burnt. In the United States, many States have drastically relaxed their landfill restrictions and some overburdened municipalities have indicated that they will no longer collect certain types of waste (Katz, C., 07/03/2019; CityLab, 01/04/2019). The ongoing China-U.S. trade war since

January 2018 has extended the problem well beyond plastics: China recently imposed new tariffs on imports of scrap metal, copper scrap, fibre, and paper pulp from recycled paper and cardboard from the United States (Chatham House, 20/08/2019).

Another risk is that this burden may be shifted to ill-equipped countries that, by burning or burying plastic, expose their environment and inhabitants to toxic pollutants. Malaysia saw its plastic imports triple between 2016 and 2018 (Le Monde, 29/05/2019). Thailand, Cambodia, Laos, but also Turkey and several African countries have seen their imports of all kinds of waste explode following the Chinese decision (The Guardian, 17/06/2019), forcing some, such as the Philippines, to return cargo ships filled with waste to their countries of origin (Reuters, 31/05/2019), or to impose bans similar to China's (Waste Management Review, 19/12/2018 ; Manila Times, 31/08/2019)

BOX 4

• FOOD WASTAGE AND DIGITAL WASTE • Apart from plastic, two other types of waste sparked a lot of attention over the past few years: food and digital waste.

"Zero Hunger" for 2030 is part of the 2030 Agenda and the 17 Sustainable Development Goals as well as the halving of food wastage per person which is stated as one of the SDG 12 on "Circular Economy" targets. According to the latest annual report on *Food Security and Nutrition in the World*, the FAO estimates that 820 million people across the world do not have enough to eat, an increasing trend for the first time in decades (FAO, 2019). **At the same time, a third of global agricultural production is wasted in the form of losses and waste from production to consumption, representing 1.3 billion tonnes per year and almost 65% of municipal waste production (FAO, 2015)**. The Boston Consulting Group (BCG, 2018), states that the annual quantity of food losses and wastage should increase by another 30% and therefore reach 2.1 billion tonnes by 2030. This represents not only waste in resources, but also land, water, work and energy waste, making it a large contributor to climate change: waste and losses in the food value chain represent 8% of global GHG emissions (FAO, 2013).

The distribution of losses across the value chain is geographically uneven: while in North America 58% of losses occur during the consumption phase, this proportion is just 6% in Sub-Saharan Africa where 36% of losses are recorded in the storage and handling phases (FAO, 2011).

Waste Electrical and Electronic Equipment (WEEE) has also become a growing source of concern: 50 million tonnes are generated every year, including only 20% which are recycled, according to a recent report by E-Waste Coalition of the United Nations (E-Waste Coalition, 2019). A study by the French Think-Tank known as *The Shift Project* reveals that energy intensity in the digital industry is increasing by 4% per year, while global GDP is decreasing by 1.8%. Today, the sector represents 3.5% of overall GHG emissions (The Shift Project, 2018). In 2011, the UNEP estimated that the recycling rate of none of the 14 *rare earths* of Mendeleev's table, essential components of digital technologies, exceeds 1% (UNEP, 2011).

Well upstream of the waste production chain, planned obsolescence of electrical goods whose components we do not or barely know how to recycle is particularly pointed out. In this context, the unprecedented conviction on Wednesday 24th October 2018, of Apple and Samsung for "*dishonest business practices*" has a particular significance. The Italian competition authority issued fines amounting to €10 million and €5 million respectively to the two competitors: a first for the Italian institution but also for the two companies on this ground. The cause: software on telephones that « *have caused serious malfunctions and significantly reduced services, thus accelerating the substitution of the latter.* » (Capital, 24/10/2018). Gradually, these large companies are starting to change their practices (Box 5). Marketing obsolescence and digital and electronic over-equipment are high on the Ademe's recent recommendation list, which in its study on the carbon weight of consumer products, points to high emissions from electronic devices and calls on consumers to limit their size and frequency of their renewal (Ademe, 2018).

FOR A BETTER UNDERSTANDING

TELEPHONY AND DIGITAL GIANTS REVIEW THEIR STANDARDS

Digital and telephony sectors are two big energy consumers that will generate around 4% of global GHG emissions in 2020 (The Shift Project, 2018), while companies are pushing for marketing obsolescence mainly in telephones, leading to a waste of precious materials and metals. However, giants in the sector are slowly starting to act (The Verge, 05/08/2019). Apple recovers old phones from all brands, carries out dismantling (for now only in the United States) and manufactures new devices from parts and components of old devices, therefore limiting the use of new metals. Samsung has also announced its will to only use recycled materials in all its packaging. Google is also recovering old devices – currently in the United States – and its designers are thinking about how to improve the life of their products, how to facilitate the disassembly to better recycle materials and then make the most use of them. Google's *Chromecast* device, which allows media content to be delivered from digital devices to a TV set, already uses recycled materials. The *Fairphone*, a smartphone developed by a Dutch SME, was released in September 2019 in its third version. In order to control the social and environmental *ethics* of its suppliers, the company has set up "fair trade" chains on eight materials essential for the design of a smartphone: gold, cobalt, tungsten, lithium, neodymium, copper, plastic and tin. As these materials are all energy-intensive or polluting when being extracted, the company aims to source 40% of its supplies from these fair-trade sectors by 2022.

BOX 5

3. Waste, a localised product with shared responsibilities

• MUNICIPAL WASTE MANAGEMENT FACING THE CRISIS: AN URBAN SERVICE UNDER PRESSURE • According to the WAW 2.0 report, "*around 70% of waste management services are directly supervised by a local public entity, the rest being administered through other levels of government, inter-municipal arrangements, mixed public-private entities, or private companies.*" (WAW 2.0, 2018). Private operators may also be associated with it, by means of management or concession contracts. While inter-municipal cooperation is facilitated by formal administrative framework in some countries (like Public Inter-municipality Cooperation Establishments, "EPCI" in France) and infrastructure sharing, it remains a minority practice in most countries. This responsibility is an important expense for municipalities, representing on average 20% of the municipal budget in low-income countries.

The waste management crisis, notably concerning plastics, forces local authorities to revise and develop their collection and treatment capacities. In the United States and Australia, many municipal programmes on waste management were hit hard by the Chinese decision. Some factories were obliged to shut down (Kingsport, Tennessee), and other refused all types of plastic in their treatment centres, like in Phenix City, Alabama. Still, others have found new export destinations in Asia, but were quickly frustrated by a new wave of refusals (Box 5). Paradoxically, in some US towns, the solution comes… from China. Large Chinese waste management and treatment companies have begun to invest in US plants to strengthen local treatment capacities (YaleEnvironment360, 07/03/2019).

These investments follow the "National Sword" plan: after plastic imports plummeted by 99% in 2018, and by one third for papers, Chinese treatment factories rapidly found themselves in overcapacity due to a lack of domestic collection practices and systems enabling the compensation for the lost manna from foreign waste. Chinese local governments are now also under pressure to develop mandatory local recycling plans (Box 5).

Like national governments, ever more cities and region worldwide are declaring a ban on single-use plastics, starting with Bombay who still shows very mixed results (Box 6). In the United States, over 400 cities and States have, to this day, taken important measures against plastic bags, and

even sometimes taxing paper bags, like in California. In contrast, a dozen of the most conservative States, like Oklahoma and Mississippi, have introduced laws to prevent all local measures with such purposes (Vox, 29/08/2019; National Geographic, 15/08/2019). In Nepal, a new law banning single-use plastic from 2020 in the rural municipalities of Khumbu Pasang Lhamu, where Mount Everest is located, was introduced (The Himalayan Times, 22/08/2019).

EXPERIENCE FEEDBACK

INCENTIVES AND COERCIONS: THE CASES OF BOMBAY AND SHANGHAI

An example of coercion: the case of Bombay: Since March 2018, the government of the State of Maharashtra in India has banned the manufacture, sale, possession and use of all kinds of non-reusable plastic (bags, cups, straws… and even religious holiday decorations). Any offender is liable to a fine between Rs. 5,000 and 25,000 (from €61 to €308). Worst case scenario: the penalty could be up to three months in prison. The state of 115 million inhabitants, with Bombay as its capital, uses 12.5 millions of non-recyclable plastic bottles every day and produces a total of 1,200 tonnes of plastic waste (Le Monde, 19/04/2018). However, the effective implementation of this brutal ban has been met with the discontent of plastic producers and small traders, which has forced the State to delay and stagger its implementation (YaleEnvironment360, 28/08/2018).

An example of an incentive: the case of Shanghai: Shanghai's 24 million inhabitants produce 25,280 tons of rubbish every day, a figure that has risen by 8.4% per year over the past five years, according to the Chinese Ministry of Environment. While all of China is experiencing an overproduction of waste due to the new consumption habits of an increasingly rich and urbanised population, the National Commission asked the 46 largest cities in March 2017 to set up selective waste collection.

Since June 2019, Shanghai has therefore decided to support urban citizens with the help of volunteers present at 593 stations that manage both rubbish and recyclable waste and help them deposit their waste in the correct containers. In exchange, the inhabitant must present a card with a scannable barcode to the "bin man" and is rewarded with 10 credits on their bank account, corresponding to 3 yuans (0.35€). This incentive system and network of dual-purpose stations, planned to be expanded to 8,000 units by 2021, would recycle 2.43 times more waste than Shanghai's conventional system (Le Monde, 30/08/2018; Chinadialogue, 02/07/2019)

BOX 6

Transnational networks and city cooperation networks have a role to play in encouraging the dissemination of good practices. On the Climate Initiatives Platform, 22 International Cooperation Initiatives (ICI) are listed under the category 'Waste', but only one of them is specifically dedicated to it. To date, only 9% of International Cooperation Initiatives are dedicated to mitigation include waste, while 70% concern energy (UNEP Emission Gap, 2018).

Without prejudice to their real effectiveness, some dedicated initiatives should be highlighted. For example, the C40 created the *Sustainable Solid Waste Systems* (SSWS) Network in partnership with the *Climate and Clean Air Coalition – Municipal Solid Waste Initiative* (CCAC-MSWI). Led by the cities of Delhi and Durban, the SSWS Initiative aims to strengthen the technical capacity of cities to systematise collection practices, ensure safer water treatment, and reinforce financial sustainability of infrastructure.

In May 2019, the CCAS-MSWI updated its *Solid Waste Emissions Estimation Tool (SWEET)* a tool for enabling cities to measure their methane and "black carbon" emissions as well as other pollutants emitted by the municipal solid waste sector. Developed since 2017 by the Environment Protection Agency, every update of this tool tweaks data and used variables to enable cities to build on this basis of emission scenarios and to estimate project mitigation potentials (CCAC, 2019).

Every year, the C40 underlines remarkable actions of its member in terms of waste management, by rewarding the "Cities4ZeroWaste". Two cities won the previous edition in November 2017:
• Phoenix (USA), for the *Reimagine Phoenix* initiative in support of its zero-waste objective in 2050. The initiative has notably created a circular economy hub, the *Resource Innovation Campus (RIC)*, zero waste workshops, and a recycling programme for palm leaves, (whose degradation is difficult) into feed for livestock (C40, 2017).
• Auckland (NZ), for its *Waste Management and Minimisation Plan* (2012) which achieved its target of reducing domestic waste by 30% in 2014, and ultimately aims to divert 65% of waste currently buried to appropriate treatment (C40, 2017).

• SOCIAL RESPONSIBILITY AND THE CIRCULAR ECONOMY: THE CENTRAL ROLE OF COMPANIES •

With a mounting consumption of resources and GHGs emissions "from the cradle to the grave" via disposable products and mass consumption, the need has emerged to move away from a linear economy (extract, manufacture, consume, throw away) and towards a circular economy. This new economic framework was first put on the table in 1966 by the American economist Kenneth E. Boulding in his paper *The Economics of the Coming Spaceship Earth*[5], in which he stressed the need to move from a stock-based approach to a flow-based approach. This circular economy is built, not without difficulty, on the basis of 'extended producer responsibility': this responsibility is either committed under regulatory or legal constraint, or thanks to market opportunities generated by the collection and recycling of all types of waste.

In order to accelerate the movement, concerted initiatives are emerging between companies, NGOs and governments. Since 2013, the Ellen MacArthur Foundation has been bringing together major companies around the Circular Economy 100 platform to "achieve their ambitions more quickly" in this area. In the United Kingdom, some 40 large companies – responsible for over 80% of plastic packaging sold in supermarkets across the country – signed a "pact" in April 2018 to ensure that 100% of their plastic packaging is reusable, recyclable or biodegradable by 2025. A similar agreement was signed in France in February 2018. The UK government agency in charge of waste reduction, WRAP, also signed a roadmap on the 25th September 2018 that commits all major retailers and half of the key food producers and suppliers to reducing food waste in their chains of operation by proposing individual objectives by 2025.

As a sign of the market opportunities sparked by waste recycling activities, many start-ups have recently emerged with a business model based on the circular economy and waste recycling. In the food sector, for example, they can act as intermediaries between major retail chains and charities, such as Phenix in France, or with consumers, such as TooGoodToGo. Sometimes, these young companies take advantage of the space left vacant by public authorities to ensure recycling in their place (Box 7).

5 Boulding K.E. (1966), The Economics of the Coming Spaceship Earth, in H. Jarrett (ed.) 1966. Environmental Quality in a Growing Economy, pp 3-14. Baltimore, MD: Resources for the Future / Johns Hopkins University Press.

EXPERIENCE FEEDBACK

A RECYCLING START-UP BASED IN LAGOS

Lagos (Nigeria) is a megacity with around 21 million inhabitants that struggles with the management of its 10,000 tonnes of daily waste. Only 40% of waste is collected, and 13% recycled. To resolve the problem, a start-up known as *Wecyclers*, has since 2013 made it its mission to collect waste from 15,000 inhabitants. All the residents must do is send a request for waste collection directly via text message, *Wecyclers* then sells the collected waste to the city's public waste management company for financing. Supported at its launch by the Massachusetts Institute of Technology (MIT) as well as major corporate partners, *Wecyclers*, now employs 120 people. Waste collectors get around by bicycle through narrow streets where vans cannot enter. Encouraged to get rid of their rubbish, residents receive point that they can exchange for consumer goods. Since its creation, the company has collected nearly 3,000 tonnes of waste. In the city's four treatment platforms, waste is meticulously sorted, cleaned, decontaminated, dried and finally compacted. (Jeune Afrique, 08/01/2018)

BOX 7

Making companies responsible sometimes means imposing economic or legal constraints. This tax lever, although perceived as a "punishment", Is still a very important measure used by authorities. In October 2018, the Brussels region asked the Benelux chain of the *Philip Morris* cigarette maker, and to two Belgian manufacturers' federations, *Cimabel* for cigarettes and *Fetabel* for tobacco, to regulate fees linked to the collection of littered cigarette butts (Libération, 09/10/2018). The Brussels region is claiming €200,000 for costs already incurred, as well as the financing of future actions. The idea could also make its way into other countries.

FOR A BETTER UNDERSTANDING

E-CIGARETTES, AN INDUSTRY EXPECTED AT THE TURNING POINT

Although controversy around electronic cigarettes focuses on public health, the environmental impact of e-cigarettes is another concern emerging from the electrical and electronic waste sector (WEEE) (The Guardian, 27/08/2019). Made from plastics and rare metal electronic components, e-cigarettes have the reputation of being hard to recycle. The plastic vials of liquid that fill e-cigarettes are also regularly found in rubbish bins. Although no legislation has been passed to date, actors from the sector are beginning to take up the subject. In Brest, France, two groups of shops have launched the "La Vape Zéro Déchet" initiative, aiming to collect used plastic vials and to recycle them via a local operator (vapoteurs.net, 31/07/2019). The FIVAPE (Intern-professional federation of vaping), representing professional from the e-cigarette sector in France and in Europe, signed in October 2018, a partnership with the eco-organisation *Screlec* to facilitate the collection of used batteries and accumulators from e-cigarettes (vapoteurs.net, 24/10/2018). Nevertheless, according to the group itself, no recycling programme exists as of yet at *Juul*, the world market leader (Twitter, 02/02/2018).

BOX 8

• WASTE, CITIZEN-LED MOVEMENTS AND SOCIAL PROGRESS • For waste to be seen through the climate change lens, its wording (GHG emissions) must be translated into one that differs from the one used by decision-makers in charge at local and public levels. On a daily basis, the negative effects that come from waste are most of all seen as both public health and environmental pollution issues. Waste involves the following risks:

• **To human health:** the lack of waste collection means more diseases, open burning in particular to find metals (meaning toxic emissions), water pollution carrying viruses, bacteria and metal

pollutants, recovery from illegal fills causing health and safety problems... It is estimated that there are 15 million informal recyclers worldwide (ILO/WIEGO, 2017);

• **To water quality:** the lack of waste collection leads to illegal or ill-managed landfills, untreated wastewater discharged into natural environments or plastic pollution in the ocean. Between 4.8 Mt and 12.7 Mt/year end up in the ocean (UN, 2019), the majority coming from Asia;

• **To air quality**: mainly open-air burning;

• **To biodiversity:** the local damage to the environment (soil, water);

• **To land quality:** the lack of control of discharges and open-air burning, in particular of electrical of electronic equipment causing toxic smoke that end up polluting the soil;

• **To the economy:** the cost of impacts on infrastructure and on public health or to the bad image it gives a region or country.

Since the 1970s and 1980s, it is in response to these risks that NGOs active in the field of waste and the circular economy have rapidly multiplied. The first ones were created in the form of local associations, in response to certain facility projects (most often storage centres or incinerators) or to the inaction of public authorities to respond to pollution or unsatisfactory or even non-existent services. In the field, most associations opposed to facility projects have been transformed into policy support structures. In France, for example, the CNIID (National Centre of Independent Information on Waste), created in 1997 to alert about pollution from incinerators, became *Zero Waste France* in 2014. From a purely defensive and opposition association, to a structure for proposals and partnerships, which supports local authorities and companies in their shift towards zero waste.

Some social movements have made their mark, such as *Homemakers United Foundation* (HuffPost, 27/05/2019), a women's movement against illegal landfills created in 1987. It helped transform Taiwan's rubbish island into one of the world's leading recycling centres (Eunomia, 2017). On the surrounding islands, civil society is also a driving force of change. "Plastic Free Island" is an initiative led by several organisations (Zero Waste Europe, Mother Earth Philippines, Clean Water Action, etc.) whose aim is to eliminate single-use plastics with the help of all economic actors and residents. Several islands in Greece, Indonesia and the United States have adopted the initiative to raise awareness among private actors on the ground. On the Greek island of Paros, the Clean Blue Paros initiative, launched by women residents, mobilises the municipality (raising awareness in schools, improving infrastructure, waste bins in poor condition) and most of the island's companies in search of alternatives to plastic. 50 of the 70 companies on the island have agreed to commit to waste reduction and assess their own efforts (BBC News, 19/08/2019).

Lastly, waste management is an issue that mobilised citizens during social movements in Russia. Since the start of 2018, anger has been mounting in multiple Russian cities where people are manifesting their discontentment with the increase of open-air wild landfills. The protest began Volokomansk, 130 km north-west from Moscow, where 57 children were hospitalised in March 2018 following an intoxication from sudden emissions from the nearby landfill (Courrier International, 13/04/2018). The "waste crisis" reached the point where Putin, the then presidential candidate himself, who had spoken on the subject before announced a new cleaning programme once he was re-elected, as it included levying a local tax to finance the treatment of household waste as well as setting the target of treating 60% of waste in recycling plants by 2024 (Courrier International, 08/01/2019). While 90% of waste is currently buried and only 4% recycled (compared to 46% in the European Economic Area, source: EEA, 2019), regions have had to set up sorting incentives and waste management programmes in 2018. But the new programme and the opaque management of local stakeholders are met with opposition. The population of the Arkhangelsk region, more than 1,000 km from Moscow, has been rallying since December 2018 to prevent the construction of a 300 ha landfill to receive 6% of the capital's household waste, which represents 500,000 t/year (Reporterre, 13/06/2019).

In developing countries, authorities are also supported by associations in order to develop sorting and recovery systems, as these will both unite inhabitants and structure the informal collectors'

activities who roam the streets, in order to ultimately agree on better working conditions and salary. In the absence of social policy, waste collection is a survival for poor workers or the unemployed in Africa, Asia, and Latin America. These "rag-and-bone men" – it should be noted that women also play an important role (Box 8) – complete or replace public services for waste management, but with no formal recognition and in awful hygiene conditions. A joint report with the World Labour Organisation and the WIEGO[6] network reveals that for example in Mexico, life expectancy of these unrecognised workers is 39 years old against 67 for the rest of the population. In Port-Saïd (Egypt), the rate of child mortality in these workers' communities was 33%, several times higher than the rate of the overall region. In Cairo, a quarter of new-born babies in these workers' communities die before the age of 1 (ILO, WIEGO, 2017).

Often under pressure of local NGOs or self-formed groups, local or national policies were implemented to formalise and integrate the work of these "informal collectors". In Bogotá, 100 informal collector organisations were made official in April 2018 enabling them to receive salaries from the municipality (Rateau, M. & Tovar, L., 2019). In South Africa, around 200 informal collectors of the *African Reclaimner Organisation (ARO)* protested in the streets of Johannesburg to demand a regularisation at Pikitup, a local waste management agency (Times, 02/05/2019). There are no results to date. In late August 2019, the department of Guaymallén in the province of Mendoza (Argentina), unveiled its *Centro Verde par el reciclaje de basura*, a new waste sorting and treatment area in the framework of the alliance between Danone and the Regional Initiative for Inclusive Recycling, a platform that was designed by the Inter-American Development Bank and big companies. The *Centre Verde* employs 47 former informal collectors to date and aims to see this figure reach 300 (La Nación, 10/09/2019).

FOR A BETTER UNDERSTANDING

THE IMPORTANCE OF WOMEN IN WASTE MANAGEMENT IN DEVELOPING COUNTRIES

As mentioned earlier, women are often at the forefront of waste-related subjects, an over-representation at the origin of the creation of an international association: WIEGO for *Women in Informal Employment: Globalizing & Organising*. WIEGO was created in 1997 in Italy by 10 researchers and development practitioners concerned about the poor conditions of the informal economy, and in particular the position of women, that were not understood, valued nor supported, may it be in politics or in the international development community. WIEGO is a worldwide network aiming to secure decent means of subsistence of poor workers, mostly women, in the informal economy, by strengthening workers' organisations' capacities and by broadening background knowledge on the subject. The organisation also aims to influence local, national, and international policies (wiego.org).

The *Global Alliance of Informal Collectors*, created 10 years earlier, is part of the WIEGO network but does not work purely on women's conditions. It contributes to a better understanding of the issue and initiatives while giving support at local, national and international levels to improve the overall situation of informal collectors worldwide (globalrec.org).

BOX 9

In the richest countries, there's a popular trend amongst some citizens who, while gaining awareness on their "waste-footprint", have decided to change their individual consumption habits, or are getting involved with collective activist actions. Born in the small town of Keynsham near Bristol, the British movement "Plastic Attack" has started to spread to France, Belgium and Canada since 2018: when going to the supermarket, once they arrive at the cashier, citizens replace plastic

6 ILO/WIEGO (2017). Cooperation among workers in the informal economy: A focus on home-based workers and waste pickers

packaging with reusable packaging. Waste collection is gradually becoming more fun: for instance, "zero waste families", or local plogging groups, a concept imported from Sweden consisting in the collection of waste while jogging, etc. – all of which received extensive media coverage last year. Finally, spectacular voluntary beach clean-up operations continue. Celebrated since its launch in 2015 as the largest operation of its kind in the world, the voluntary clean-up of Versova Beach in Mumbai has collected 20 million kilogrammes of waste in three years (HindustanTime, 14/11/2018), and for the first time in ten years, new turtle eggs have been spotted (The Guardian, 30/03/2018)

CONCLUSION

Although progress has been made in treatment capacity, the quantity of waste generated by the global economy is expected to continue growing due to the development of new mass consumption markets. Improvements in measurement methodologies will therefore be sought to refine estimates of the environmental and climate impacts of these deposits. Even though the greenhouse gas emissions approach is not the most prevalent among waste sector actors, improving its management and reducing its production has real climate and environmental co-benefits. Non-state actors have an essential role to play, before (with companies and the global economic system) and after (with consumers, distributors, local authorities...) the chain – not only to improve the overall efficiency of treatment, but also to spark political momentum for state actors or supra-state actors who are generally unaware of the issue. This year, the subject has also taken a geo-political dimension since China chose to stop importing waste from Western states, and has also moved up the national political agenda in some countries; such as Russia, where it was included in the agenda for the 2018 presidential elections and mobilised European legislators as part of the new Circular Economy Package.

Please do not hesitate to share with us any additional information, reports of data via the following email address: contribution@climate-chance.org

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LAND USE

With rising pressure on forests, the mobilisation of stakeholders intensifies

With rising pressure on forests, the mobilisation of stakeholders intensifies

Author • **Aude Valade** • *Researcher for The Centre for Research on Ecology and Forestry Applications (CREAF)*

The main factor of emissions linked to land use is the rate of deforestation that shows no real sign of change: although the number of hectares lost has decreased, 2018 is still the 4th most devastating year for the world's forests, and it is possible that in this El Niño year, the 2019 toll will be even higher. The fires in the Amazon, the Congo basin, California and Siberia, particularly shocked the global community and even became a part of the G7's agenda in August. By summarising existing science, the IPCC's special report on land use was a reminder on how land damage and climate change are mutually reinforcing. However, forests and soils play a vital role as carbon sinks, absorbing the equivalent of the United States' overall emissions every year. They are also crucial for keeping the balance between all natural resources and therefore enhance the achievement of the SDGs. Some weak signals, at the crossroads of state policies and non-state initiatives, seem to indicate encouraging trends in many parts of the world.

Key takeaways

A total of 12 million hectares of tropical forests perished in 2018, a smaller number than record years 2017 and 2016 that were marked by unprecedented fires (Global Forest Watch). The signatories of the New York Declaration will not be able to achieve their 2020 target for reducing by half the rate of deforestation. Although Bonn aims to restore 150 million hectares of degraded land, it also generated many commitments from governments and companies, only less than one fifth of them are being implemented on the ground.

The IPCC's special report on land use was a flagship report in the sector's scientific news in 2019, and established some key facts: while ¾ of the land surface is exploited by humans, soils currently absorb 29% of anthropogenic CO_2 emissions, notably via forests, peat bogs and mangroves, whose destruction generated 10 to 15% of CO_2 emissions per year.

The upsurge of forest fires this year, in Brazil, Bolivia, the Democratic Republic of the Congo and in California has continued to alert public opinion. After having reduced logging to its lowest level since 2003, the effectiveness of Indonesia's measures against deforestation is being undermined by the major fires in 2019.

More than one in four voluntary carbon offset projects focus on land use. However, monoculture plantations, afforestation and low attention to biodiversity raise questions about their effectiveness. None of the world's 350 largest companies will be able to achieve the target of eliminating deforestation from production chains by 2020, to which 57% of them have committed themselves (Forest 500). The labelling and monitoring of projects is therefore essential to avoid the "malformations" against which NGOs and citizens are fighting, like in China and Ireland.

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5 **CHANGES IN AGRICULTURAL PRACTICES**

1. 2019, a pivotal year for the scientific assessment of the climate impact of land use

Worldwide, forest cover represents around 92% of terrestrial biomass and stocks about 400 $GtCO_2$ in their biomass (Pan et al., 2013) and nearly 1,000 $GtCO_2$ in their soils. In comparison, in 2018, the atmosphere had about 860 $GtCO_2$ (Le Quéré et al., 2018). These stocks, which have been built up since life on Earth began, constantly exchange carbon with the atmosphere through natural processes of photosynthesis and respiration and are therefore sensitive to climate change and human activities.

The IPCC's special report on climate change and land use synthesises scientific knowledge related to these issues (IPCC, 2019). This new synthesis written by international experts on the climate explores in detail, how climate change is a threat to ecosystem services, including carbon sequestration, and how human activities on ecosystems are destabilising the global climate.

On a global scale, the report reminds us that 60 to 85% of forest land and 73 to 89% of non-forestry ecosystems (particularly grasslands and savannahs) are now used by humans at different levels of intensity. The last primary forests (untouched by humans) are now found only in tropical and boreal regions. The IPCC report highlights the difficulty of separating the direct effects of human activities on ecosystems, through land use management change (mainly deforestation), from the indirect effects of climate change. **This being said, the IPCC teams estimate that from 2006 to 2017, land sequestered an average of 11.2 $GtCO_2$ per year, while emitting 5.2 Gt: the land remains for the moment a net carbon sink, at about 6 $GtCO_2$/year**.

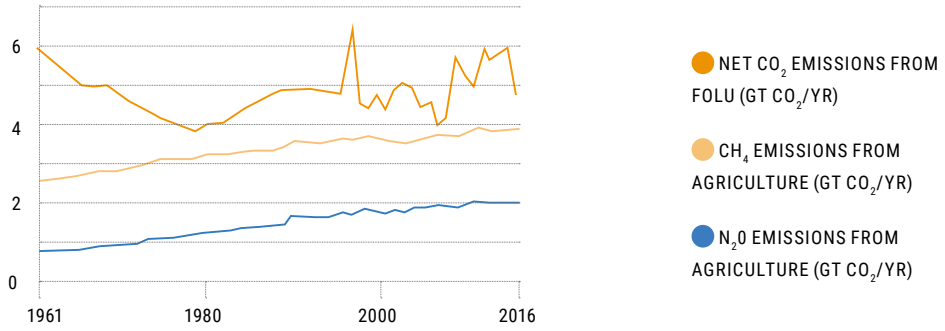
Deforestation, most often taking place to convert forests into agricultural land, is the primary source of greenhouse gas (GHG) emissions from the land sector. **In 2017, emissions resulting from a land change were estimated at 1.4 $GtCO_2$, a stable figure compared to a decade average of 1.5 $GtCO_2$/year** (Le Quéré et al., 2018). But this apparent stability masks different trends depending on the type of forest. Trends over the past few decades indicate a steady loss of forest cover in the tropics that is not slowing down and a forest gain in the boreal and temperate regions. In late October 2019, a new study led by a University of Queensland researcher and published in *Science Advances* claims that GHG emissions from tropical forest losses would be six times higher than previously estimated, due to the release of carbon absorbed by trees in the past (Maxwell & al., 2019).

Forests are not the only lands whose human use is likely to exacerbate climate change. Methane emissions (CH_4), (with its 28 times higher warming power than CO_2, are mainly due to cattle breeding for meat and milk, and to rice fields and were approaching 4 $GtCO_2$eq./year in 2016. Nitrous oxide emissions (N_2O), 265 times warmer than CO_2 are the consequence of agricultural application of nitrogen fertilisers, of which on average of only about 50% are captured by crops while the rest gets released into the soil and atmosphere. It adds about 2 $GtCO_2$eq into the atmosphere every year.

Forests' effect on the climate does not only include GHGs. Changes in land cover and management also change the interception and reflection of solar radiation and water exchange between soil, vegetation and atmosphere and are therefore likely to significantly change the regional climate. A 2017 publication (Perugini et al., 2017) quantifies the decrease in rainfall due to tropical deforestation according to the type of conversion, whether to bare ground, (470mm/year reduction) or grasslands (220mm/year reduction in rainfall). The IPCC report helps to review the biophysical effects of forests on the climate, that have yet to be considered by managers and decision-makers. In tropical regions, deforestation causes a biophysical warming effect and reforestation, on the other hand, it also causes a cooling effect. In temperate zones, the effects of deforestation and afforestation vary with the seasons and the rotation between day and night: forest loss increases temperature variations by warming the climate during the summer and the day, and cooling down the climate over the winter and during the night, because of forests' ability to intercept and store energy.

FIGURE 1

EVOLUTION OF CO_2, CH_4 AND N_2O EMISSIONS SINCE 1961 ($GTCO_2EQ./YEAR$) - *Source: IPCC, 2019*



The IPCC's special report on land use identifies 3 main challenges related to land use and climate change, which are all interlocked: soil degradation, desertification and food security.

Soil degradation can be defined by the loss of biological productivity, ecological integrity or human ecosystem value (IPCC, 2019). The main cause is human activities, either directly, by agricultural or forestry practices, or indirectly, through climate change. The United Nations Convention to Combat Desertification estimates in its latest report that approximately 24% of land mass is currently affected with a stable upward trend of 12 million degraded hectares per year. Moreover, between 1.3 and 3.2 billion people are affected (UNCCD, 2019).

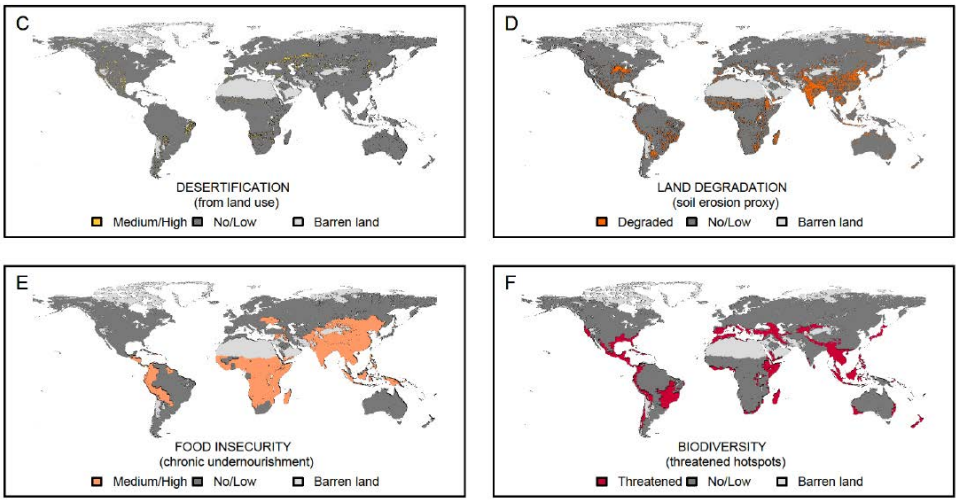
In arid regions, soil degradation takes a different form. In these ecosystems, the combination of the extension of agricultural areas with the rise in temperatures and the decrease in rainfall leads to desertification. This entails many consequences for local populations, from falling agricultural yields to biodiversity loss, depletion of groundwater reserves and increasing sand and dust storms. In addition, loss of plant productivity reduces the potential for carbon sinks, resulting in a "positive feedback loop" that further amplifies climate change. The IPCC report estimates that in 2015, desertification affected about 9.2% of arid zones, affecting about 500 million people, mainly in Southeast Asia, North Africa and the Middle East (IPCC, 2019).

Agriculture and the food system are key for answering to climate change. Since 1961, food production per inhabitant has risen by 30%, while the use of nitrogen fertilisers jumped by an astonishing 800% and 100% for irrigation. Yet, the IPCC report points out that 25-30% of food production is lost or wasted, representing about 8-10% of anthropogenic GHG emissions. In 2017, 821 million people were malnourished, a figure that has been rising since 2015 after 30 years of decline according to the United Nations Food and Agriculture Agency (FAO). Conflicts combined with droughts and floods are the primary factors explaining these trends.

Challenges related to land use are often interlocked, and sometimes share the same causes and solutions, which cover both mitigation and adaptation to climate change.

FIGURE 2

GLOBAL DISTRIBUTION OF LAND AND CLIMATE-RELATED CHALLENGES - *Source: IPCC, 2019*



FOR A BETTER UNDERSTANDING

FORESTS' CONTRIBUTION TO THE SUSTAINABLE DEVELOPMENT GOALS

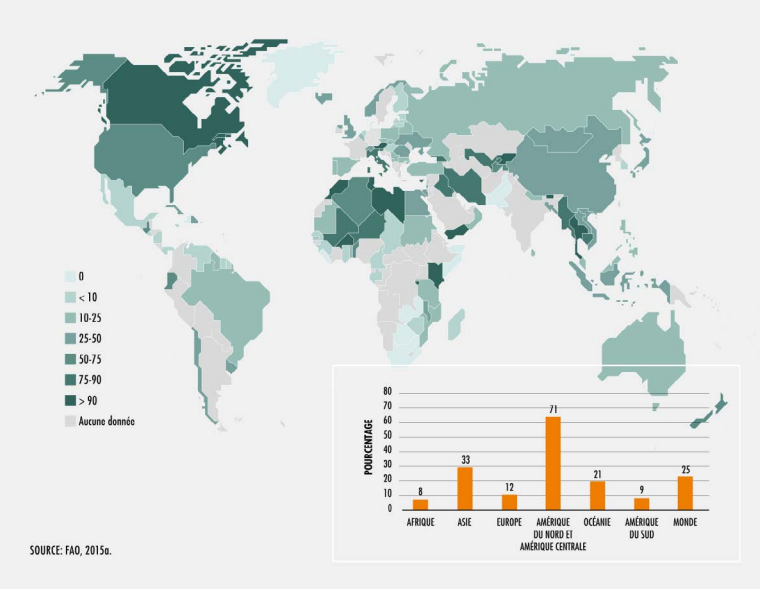
The IPCC report provides a list of available and integrated solutions for facing the challenges highlighted within the report. These solutions fall into 3 categories: land, sector and risk management, and some 40 of them are systematically explored by quantifying their co-benefits for both adaptation and mitigation of climate change. For example, agroforestry, several examples of which are detailed in section 5.2, has co-benefits on all dimensions studied, both by improving crop resilience and by limiting their negative effects on climate change. On the other hand, the protection of peatlands and grasslands can have antagonistic effects with beneficial effects for soil carbon storage and the prevention of desertification. It can also pose risks to food security by removing cropland. The development of bioenergy is another example that requires many compromises. The expected benefits in terms of GHG emissions are in balance with the risks to food security, biodiversity and land degradation. The FAO report titled "The state of the world's forests 2018" focuses on the role of forests for achieving the 17 sustainable development goals set by the UN Programme 2030 in 2015 (United Nations, 2015), including their effects on water and soil protection. On a global scale, forest management for water and soil protection covers around 25% of the world's forest area. But this average does not reflect the large spatial variability of this indicator, driven upwards by the United States and Canada, where rates are currently at 68 and 91% respectively. For example, the US National Forest Service estimates that 180 million Americans depend on forests for their drinking water.

Source: FAO, 2018

BOX 1

FIGURE 3

SHARE OF FOREST AREAS MANAGED FOR WATER AND SOIL PROTECTION (%) - *Source: FAO, 2018*



2. 2020 targets out of reach, despite increasing commitments

• PROGRESS REPORT ON THE NEW YORK DECLARATION • According to Global Forest Watch, **12 million hectares of tropical forests were lost in 2018, equivalent to the area of Belgium, including 3.6 million hectares of primary forest** (Global Forest Watch, 2019). 2018 was therefore the 4th most devasting year for the past 20 years for tropical primary forests, following records that were reached in 2016 and 2017, two years that were particularly marked by intense forest fires. Although we are getting closer to 2010s' averages, this figure remains alarming because the huge amounts of carbon contained in tropical forests and the biodiversity they shelter, are irreplaceable. The Global Forest Watch report also states that the countries having lost the most primary forest in 2018 are: Brazil, the Democratic Republic of the Congo and Indonesia. The latter was the only country where governmental measures seemed to present results with a downward trend, with the rate of deforestation in 2018 remaining close to the 2017 level, about 40% lower than the average for the 2002-2016 period. Ghana on the other hand, shows a worrying trend with a 60% increase between 2017 and 2018.

Across the globe, despite the major differences, what is driving the tropical deforestation is always similar: extraction of wood, agricultural development and the construction of infrastructure. For example, although in Bolivia, intensive farming is the biggest driver, in Ghana and in Ivory Coast, forest loss is highly linked to the expansion of cocoa plantations, including 70% that are located in protected zones (see "Case study on Ivory Coast – LULUCF" – 2018 Climate Chance Report).

FIGURE 4

CHANGE IN AVERAGE ANNUAL CO_2 EMISSION FROM GROSS TREE COVER LOSS IN TROPICAL COUNTRIES BETWEEN 2002-2013 - *Source: NYD Assessment Partners, 2019*

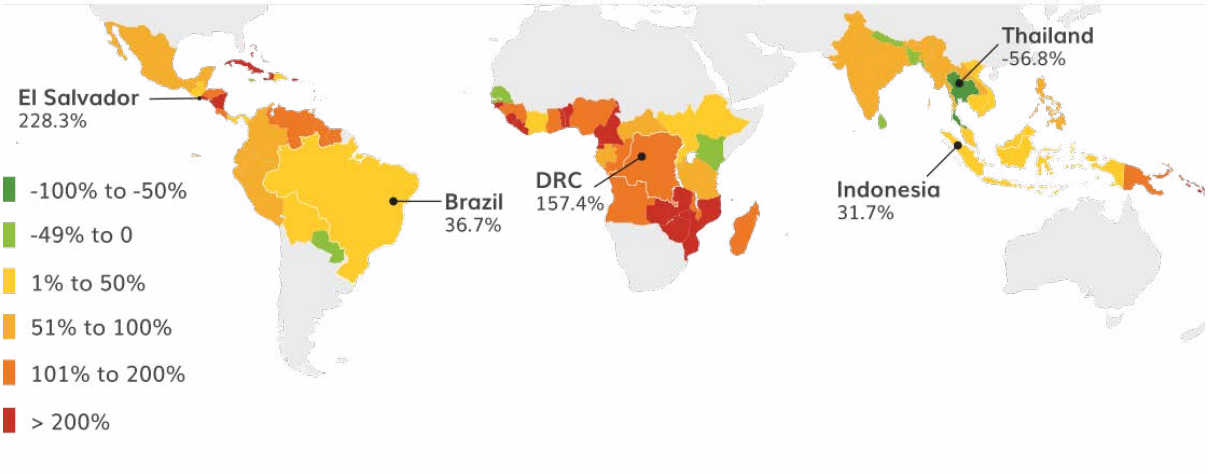
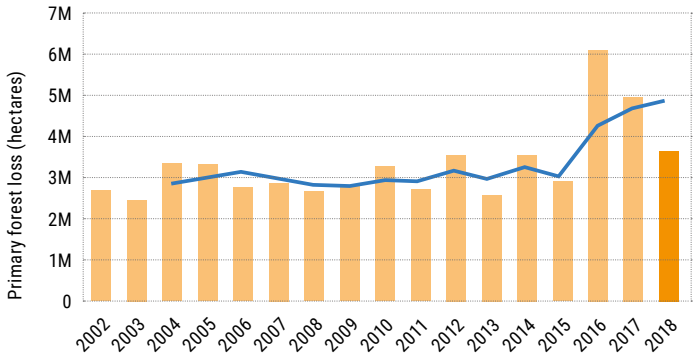


FIGURE 5

GLOBAL LOSS OF TROPICAL PRIMARY FOREST PER YEAR IN HECTARES

Source: Global Forest Watch

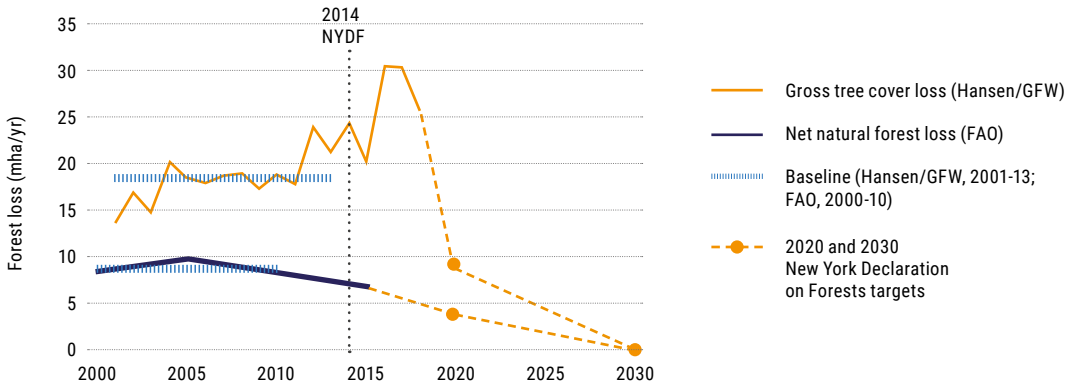


The New York Declaration on Forests is a voluntary and non-binding declaration aiming to stop the global loss of forests. Signed during the United Nations Climate Summit in September 2014, today, the Declaration brings together over 200 signatories including 41 national governments, 21 sub-national governments, 60 multinational companies, 22 indigenous peoples' groups and 65 non-governmental organisations. With its ambition, the Declaration calls to stop all deforestation by 2030 with an intermediary objective of halving deforestation by in 2020. In September 2019, 5 years after the signing of the NYDF, and just before 2020, a report that measures the progress achieved and what is left to be done, is published. The report highlights the gap between the goals that were set at the time of the signing process, and the slow progress that will probably prevent the objectives from being reached by 2020. In addition, if Norway, Germany and the United Kingdom seem close to meeting their financial commitments that they defined as part of the Declaration, other countries and the private sector still must work on providing funding (NYD Assessment Partners, 2019).

FIGURE 6

CHANGES IN GROSS AND NET FOREST LOSS COMPARED TO THE OBJECTIVES OF THE NEW YORK DECLARATION ON FORESTS, FOR 2020 AND 2030 (MILLIONS OF HECTARES)

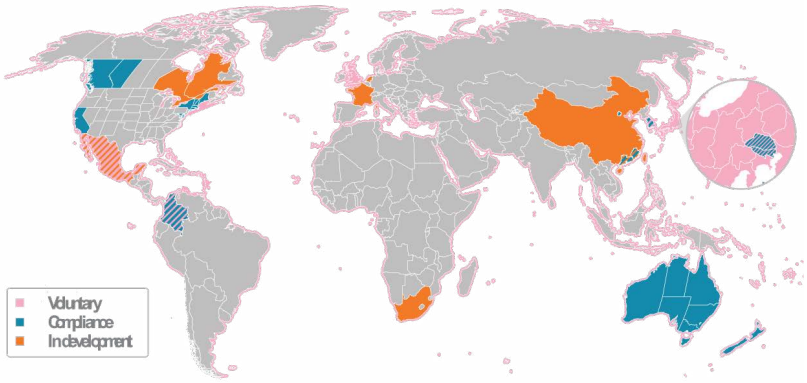
Source: NYD Assessment Partners, 2019



• A MULTITUDE OF CARBON FINANCE INITIATIVES • Voluntary carbon offset markets that emerged following the Kyoto Protocol intend to spark the creation of initiatives to reduce GHG emissions. To this end, once the "carbon projects" have been accredited, emission reduction certificates can be sold to other actors that wish to offset their emissions. The transaction money is therefore supposed to fund real mitigation projects. And what could be better than reforestation to offset its emissions? During the first quarter of 2018, **land sector carbon projects represented 27% of all carbon projects traded on voluntary markets with 5 $MtCO_2eq$**, in the second category behind renewable energy projects (Hamrick and Gallant, 2018). These projects can be different types: in 2016, 77% of forest carbon projects were avoided deforestation, 12% for afforestation or reforestation activities, 8% for improved management and 2% for agroforestry development (Hamrick and Gallant, 2017).

FIGURE 7

MAP OF POLICY PROGRAMS THAT INCLUDE FORESTRY AND/OR LAND-USE OFFSETS, EITHER VOLUNTARY, FOR COMPLIANCE OR IN DEVELOPMENT - *Source: Hamrick and Gallant, 2017*



Notes: Programs marked "In development" may either be countries/provinces/states with carbon pricing schemes in development that have indicated a plan to include forest carbon OR those with active carbon pricing schemes that are developing ways to include forest carbon.

To guarantee the effectiveness of these offsetting projects, carbon certification labels and standards were created around methodologies for validating the quality of carbon reduction projects. New certificates are often created and in 2018 with some new elements. In Holland, the government opened in May 2017, the national carbon market GreenDeal. The national market's objective is to cover the sectors of the economy that are not included in the European allowance

market in a domestic voluntary offset market. One of the issues for the land sector in Holland is the sustainable management of peatlands that cover 8% of the national territory. The scheme should enable to generate 0.5Mt CO_2eq of reduced emission per year (I4CE, 2018). In France, the release of the low-carbon label in April 2019, should encourage the development of forestry and agricultural projects for the climate. The pilot project of the French low-carbon label, led by the free trade union association for forests of the Terre de Peyre with the support of the La Poste group, consists, for example, in reforesting 36 hectares of pine forests in Lozère with a mixture of species to promote carbon sequestration, biodiversity and outlets for local sectors (MTES, 08/11/2019). In Spain, the first national voluntary carbon market called ValVolCar was launched in June 2019 under the supervision of the Polytechnique University of Valence and funded par the Climate-KIC. In northern Spain, Finnish companies have launched a new online platform for voluntary offsetting PURO offers auctions for the sale or purchase of carbon certificates. Carbon certificates come from three different sources, two of which are linked to the land sector, biochar, an extremely stable form of carbon that can be stocked in soils, and the construction the incentive to use timber.

Europe is not the only region where carbon credit exchanges are being developed. In Taiwan for example, in 2017, the environmental protection agency launched its national action programme against climate change that includes the setting up of an exchange system for emission quotas, which is still being developed. The Canadian state of Ontario has also launched an emissions cap and trade programme in 2017. The programme is still under development, but project evaluation methodologies should be applied to afforestation urban forest and conservation agriculture projects.

• EUROPE, IMPORTED DEFORESTATION AND FAILURE OF PRIVATE COMPANIES' COMMITMENTS •

For many civil society actors, the fight against deforestation is not played out in the forest but with the consumer by revealing imported deforestation of consumer products. A 2013 study led by the European Commission calculated that about 30% of global deforestation is linked to commodities consumed in Europe, whether it is beef, soya, palm oil or cocoa. The declarations of intent follow one another on this subject. In 2017, Denmark, France, Germany, the Netherlands, Norway and the United Kingdom signed the Amsterdam declaration that supported the intention of the private sector, to eliminate deforestation from its supply chains by 2020. These objective align with the declared intentions of the EU, whether it is through support for the New York Declaration on Forests that was signed in 2014, which also calls for a halt to deforestation in 2030, or the European Commission's Communication on intensifying EU actions to protect and restore the world's forests, published in July 2019. This document states the importance of the fight against imported deforestation and proposes actions to be implemented at the level of the European Commission or the Member States. Yet, it does not currently provide for any financial or regulatory means to implement them. In 2018, France adopted a national strategy that fights against imported deforestation and aims to put an end to it by 2030. Planned measures include a zero-deforestation public procurement policy by 2022, corporate social responsibility policies such as developing a platform for sharing data on imports at risk, and the creation of a zero-deforestation label to guide private consumers.

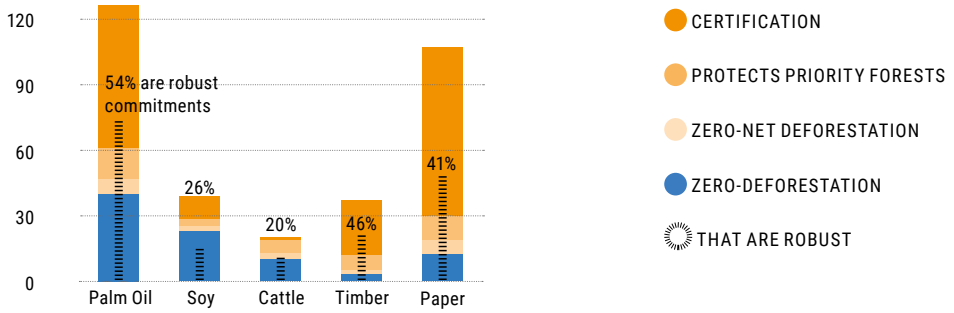
State declarations on the fight against imported deforestation give pride and place to corporate responsibility, as does the New York Declaration of which 60 signatories are multinational companies.

According to the Forest 500 (Rogerson et al., 2019) report that was published in 2018 and that assesses the 350 largest global companies whose activities involve a risk of deforestation, 57% of them were planning in 2018 to eliminate deforestation from their supply chain by 2020 at the latest. On the contrary, 29% of these companies failed to take any action in this direction. As 2020 approaches, the authors of the report show that none of the companies that have made commitments will stick to them. This is the case although some have made good progress, especially in the supply of palm oil, the raw material that has sparked the creation of the largest number of commitments. Among the 31 companies analysed, that signed the New York Declaration on Forests,

the trend is not much better: 45% of these companies have not made a commitment to deforestation-free supply chain, 19% have implemented concrete actions and only 6% report their progress on each of their raw materials.

FIGURE 8

COMPANY COMMITMENTS BY COMMODITY AND CONTENT, AND SHARE OF COMPANY COMMITMENTS THAT ARE ROBUST, IN PERCENT (%) - *Source: NYD Assessment Partners, 2019*



FEEDBACK EXPERIENCE

NESTLÉ, A TREE HIDING A FOREST OF MULTINATIONAL COMPANIES

In its 2019 report known as "The Money Trees", CDP analyses the progress made by 306 companies with a high impact of forest risks in their efforts to eliminate deforestation in four markets: livestock, soya, palm oil and timber or timber products. Based on the data reported by these companies in a questionnaire, CDP offers a rather pessimistic analysis of the situation. One third of companies do not yet include problems related to forests within their risk assessments, while almost all of those that do, identify very significant risks. Three-quarters did not report an assessment of the financial impact these risks represent for their activities. While 90% of product manufacturers and retails report that they have started to implement actions, over a quarter of suppliers have still not implemented anything (CDP, 2019a). A few heavy goods vehicles in the consumer product market, such as Avon (cosmetics), The Kraft Heinz Company or Associated British Food (Primark, Twinnngs…) do not declare any income related to these activities. RBI (Burger King), Kraft Heinz and Tyson Foods (food industry in the USA), are the companies furthest from their 2030 targets, according to another CDP analysis (CDP, 2019b).

BOX 2

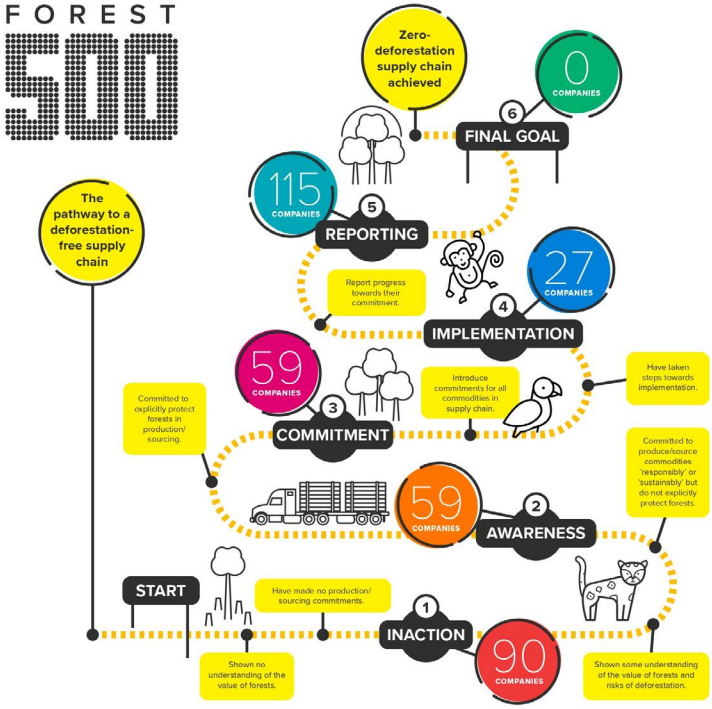
Conversely, the agri-food giant Nestlé, which is regularly targeted by environmental activists, is referred o as an example in both the CDP and Forest 500 reports. In 2018, Nestlé set up a satellite detection system to monitor its palm oil supply chain in collaboration with Airbus, which developed the system. Yet, these satellite monitoring systems have limited potential, especially for cocoa cultivation – which is mostly grown on small plots and under forest cover) – making it more difficult to detect plants from the air. A new platform launched in 2018 and developed by the Global Forest Watch team from the World Resource Institute, should improve the reliability of the monitoring. This platform, that entailed collaboration between NGO, private companies and high-tech companies, aims to enable all actors in the supply chain, from a small local producer to banks or distributors, to enter data on the location of farms or processing units and to compare these data with maps

of risks of deforestation, fires and protected areas. Transparency and traceability are not the only means available to companies: CDP notes that 70% of food companies invest in vegetarian alternatives to meat, and many of them move their supply chains closer to local producers. This is a good way to reduce the impact of crop concentration and soil pressure in the few countries most affected by deforestation.

FIGURE 9

PROGRESS OF COMPANIES IN THEIR EFFORTS TO ADDRESS DEFORESTATION IN THEIR SUPPLY CHAINS

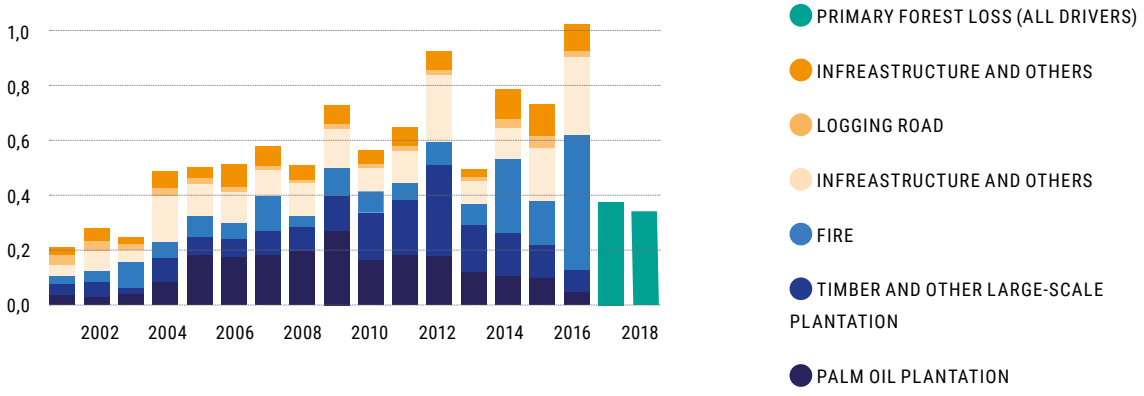
Source: Rogerson et al., 2019



Financial institutions are the least active category in the fight against deforestation. Out of the 150 companies evaluated, only 53 had a plan to combat deforestation and the means implemented are very limited. For example, financial institutions require guarantees from the companies in which they invest for their impact on the natural environment. To do this, they use certificates, or labels, that relieve themselves of the responsibility of verification and exclude a large part of the sector since only 1% of soya production is certified, for example. One exception is BNDES, a Brazilian development bank, which is the only bank that requests insurance on the supply of beef for which no certificate exists, using an animal traceability system from birth to slaughter.

FIGURE 10

PRIMARY FOREST LOSS IN INDONESIA DEPENDING ON THE CAUSE, BETWEEN 2001 AND 2018 (MILLIONS OF HECTARES) - *Source: Enerdata, 2019*



• ASIA, INDONESIA›S PROGRESS REWARDED BUT THREANTENED BY FIRES • In line with measures taken after the large-scale fires of 2015, Indonesia was cited as an example for its achievements in combating deforestation (see. Climate Chance, Case Study LULUCF, 2018). The decline in deforestation that was measured in 2017 was reaffirmed once again in 2018. It sparked Norway's first performance payment as part of a REDD+ agreement, signed between the two countries in 2010. This payment should add up to 24 million dollars in order to prevent 4.8 tonnes of emissions at $5 per tonne (WRI, 21/02/2019). However, while previous years were relatively wet, 2019 was marked by many fires favoured by a moderate El Niño event that brings hot and dry conditions. Between June and October, around 70,000 fires were reported to Global Forest Watch. This significantly intense fire season raises doubts about the origin of the recent decrease in deforestation, depending on whether it is due to the humid climate, the low price of palm oil or government policies to protect forests implemented in 2015. Fires are most often started to clear land, whether by small farmers or large plantation owners (New York Times, 11/10/2019).

Lastly, there is still a gap between corporate ambitions and reality in Indonesia: this is the conclusion of the recent CDP Palm Book, which examines disclosures from 96 reporting companies whose activities are related to palm oil in Indonesia. Most of them are North American or European manufacturers and retailers: few suppliers at the beginning of the chain report their action. Only 20% of companies declare that they are on the right track to meet their 2020 targets, whether it is certification or traceability commitments. However, the CDP reveals a positive point: 91% of reporting companies have a supervisory board on forest-related issues, compared to 69% in 2017 (CDP, 2019).

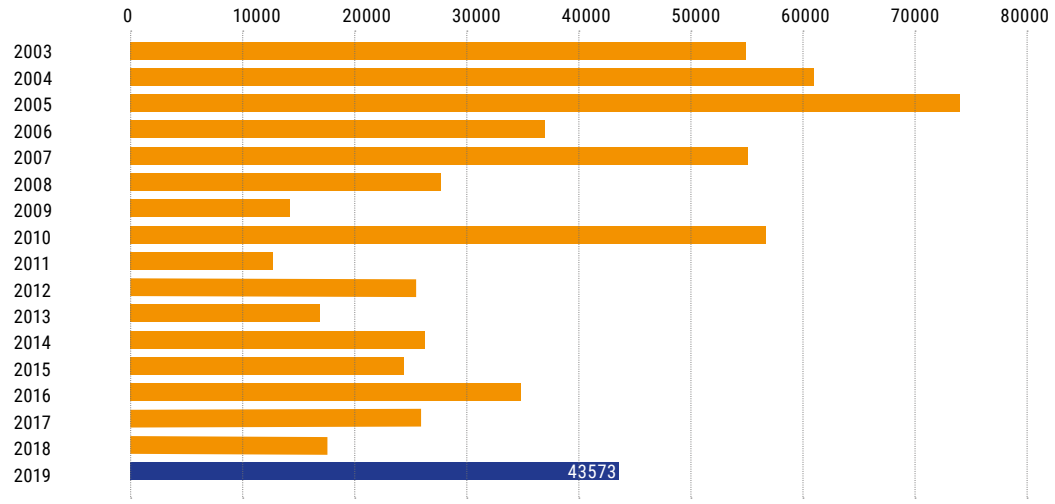
• LATIN AMERICA AND THE CARIBBEAN, INSTITUTIONS UNDER PRESSURE OF CIVIL SOCIETY •
In 2018, in a landmark court decision, the Colombian Supreme Court declared the Amazonian forest a "subject of law" and required the Colombian State to implement concrete measures for its protection, including the creation of an "Intergenerational Pact for the Life of the Colombian Amazon" (*Pacto Intergeneracional por la Vida del Amazonas Colombiano–PIVAC*). This decision was in response to a lawsuit brought by a group of 25 young people and children supported by the NGO DeJusticia (Climate Chance, 2018). On year later, the NGO notes that deforestation in the Colombian Amazon is still out of control and that the measures ordered by the court decision have not been implemented (El Espectador, 02/04/2019). In particular, the action plan against deforestation transferred to the court was carried out without consulting the Amazonian communities and remains in draft form, subject to change according to government priorities and the budget. Recent fires in the Amazon have led Colombia, whose canopy covers 35% of the country but lost nearly 5000,000 ha between 2016 and 2018, to take the initiative again on the international scene. First, by signing on

the 6th September, the "Leticia Pact" with six other neighbouring states of the Amazon to commit for Amazonian to commit to take effective action for protecting the forest (Mongabay, 09/09/2019); then, on the 23rd of September, during the Tropical Forests Summit, co-organised by Colombia as part of the United Nations Climate Summit, during which the President Duque called for 180 million trees to be planted within four years, sustainable livestock farming to reach 100 million hectares of sylvopastoral land and the advancement of the circular economy in Latin America (Semana, 28/09/2019). On this occasion, more than $300 million was pledged for the Amazon forest by Germany, Norway, the United Kingdom, France and the NGO Conservation International.

FIGURE 11

CUMULATIVE AREA BURNED IN THE BRAZILIAN AMAZON THROUGH AUGUST

Source: Mongabay, 2019



FEEDBACK EXPERIENCE

AMAZONIAN FOREST FIRES SHINE A LIGHT ON BRAZILIAN DEFORESTATION

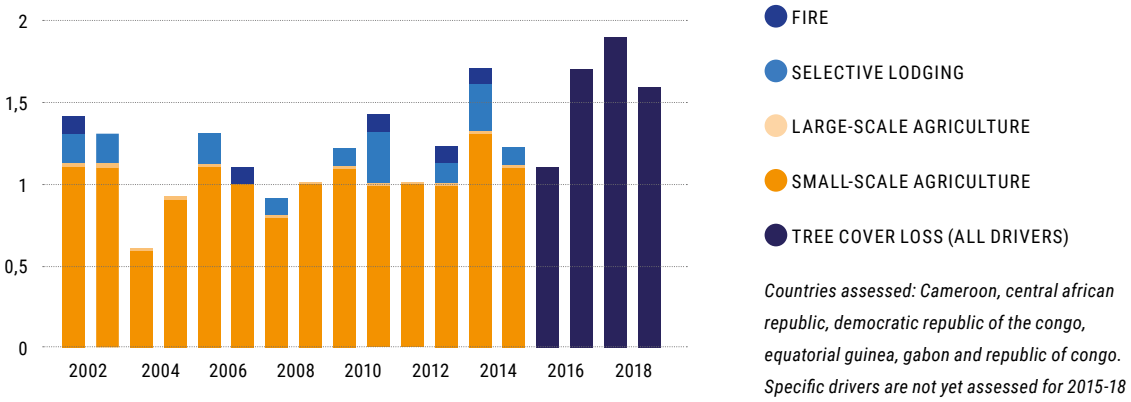
In August 2019, tropical deforestation took centre stage on the international media scene as the burning Brazilian Amazonian forest. After a month of July that was considered the hottest month on record, August 2019 was indeed marked by the fires that ravaged the Amazon in alarming proportions. Brazil alone witnessed its burned areas increased by an estimated 85% compared to 2018. With deforestation leaping by 88% and 68% respectively between June-July 2018 and 2019 according to the Brazilian National Institute of Space Research (INPE), and being main cause of fires according to experts, a wave of protests emerged in Brazil and around the world against the President Jair Bolsonaro. The political consequences were not long coming, with the suspension of the ratification of the trade agreement between the EU and Mercosur (see section 2.3 on imported deforestation), and the suspension by Norwegian and Finnish governments of their subsidies to the Amazon fund supposed to finance the preservation of the Amazon forest. The consequences on the climate and atmosphere are more difficult to estimate. To track the amounts of carbon dioxide released by forest fires, space agencies use satellite images and atmospheric models. For example, the European satellite observation service Copernicus calculated that in Amazonas state, August fires emitted around 25 megatons of carbon dioxide, the highest level measured since 2003 for the state. For the Amazon as a whole, this figure is estimated at 228 megatons (ESA, 2019).

BOX 3

• AFRICA, CAFI STRUGGLES TO REVERSE A WORRYING SIUTATION IN THE CONGO BASIN •
In Gabon, the partnership established with Norway as part of the CAFI (Central African Forest Initiative) is strengthening. A new agreement, this time amounting to 150 million USD over 10 years was signed in September 2019, for which Norway commits to paying $10 per tonne of non-emitted carbon by Gabon compared to its emissions from 2005-2014 (Gabon Review, 23/09/2019) after verification. This is the second agreement between the two countries after the $18 million agreement that was signed in 2017, but whose funds have not yet been disbursed pending certification of results. However, this second agreement comes in a context of tension around the Gabonese forestry sector following the "Kévazingogate" scandal. 353 containers loaded with kevazingo, a rare tropical tree whose exploitation is prohibited in Gabon, were seized with falsified documents involving members of the Ministry of Water and Forests before disappearing for more than 150 of them blaming Ministry officials (France Info, 25/05/2019).

In the Democratic Republic of the Congo (DRC), the situation is also tense after the suspension of €65 million from the CAFI (Climate Chance, 2018) following the granting of illegal forest concessions. In December 2019, the ex-president Kabila granted oil exploration permits, some of which were granted in the Salonga and Virunga national parks, listed as UNESCO World Heritage Sites (Bloomberg, 26/02/2019) raising concerns for environmental protection agencies.

FIGURE 12
PRIMARY FOREST LOSS IN THE CONGO BASIN DEPENDING ON CAUSES BETWEEN 2001 AND 2018 (MILLIONS OF HECTARES) - *Source: NYDF Assessment partners, 2019*



Countries assessed: Cameroon, central african republic, democratic republic of the congo, equatorial guinea, gabon and republic of congo. Specific drivers are not yet assessed for 2015-18

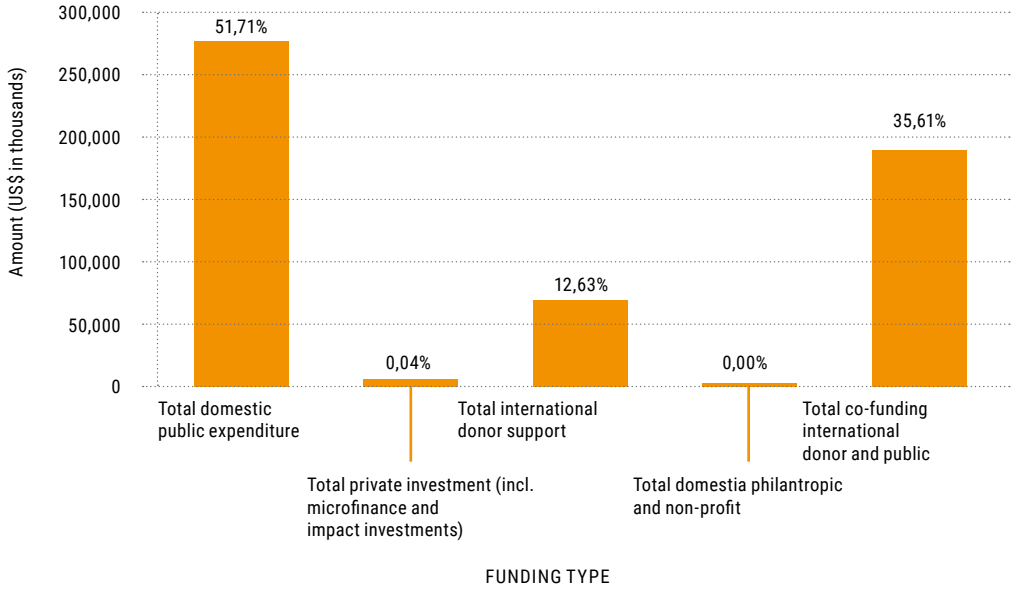
3. The proliferation of tropical reforestation projects

• THE BONN CHALLENGE GENERATES MANY COMMITMENTS • The Bonn Challenge, which served as a starting point to the New York Declaration on forests, aims at stimulating ecosystems restoration initiatives. Launched in 2011 by the German government and the International Union for the Conservation of Nature (IUCN), it pushed 43 countries towards committing to the reforestation or restoration of 350 million hectares by 2030, including 83% of tropical and subtropical zones. A second tracking report of the Bonn Challenge published by the IUCN in 2019, based on the in-depth study of reforestation projects in 5 countries (Brazil, Rwanda, El Salvador, Mexico, United States), estimates that about 44 million hectares were restored in 2018, i.e. 29% of the intermediary target for 2020 (Dave et al., 2019). This year**, IUCN also published online the "Bonn Challenge barometer of progress", making it possible to track progress of these same countries towards their objectives** (Bonn challenge barometer web tool). One of the achievements, also appearing in the assessment report of the New York Declaration on Forests, is the importance of political commitments regarding the ecosystem restoration, reaching 170 Mha. However, only 18% of these commitments led to effective land restoration, most of the projects being held outside of forests. IUCN barometers note

several positive signals for the achievements of Bonn challenge's objectives, starting with the large use made of the Restoration Opportunities Assessment Methodology (ROAM), designed by IUCN and WRI. It helped 36 jurisdictions to identify where and how restoration actions were operated. Restoration plans were therefore put in place in 25 jurisdictions: in Brazil, Mexico, Uganda, Malawi, Rwanda and 6 Central American States. Moreover, financing was allocated to restorations: $150 million from the World Bank to Burundi and Mozambique, $210 million to the Guatemalan program dubbed PROBOSQUES, and $5.37 billion for rural development as part of the Bonn Challenge in India (Dave et al., 2017).

FIGURE 13

FUNDING STREAMS BY TYPE IN SUPPORT OF ACTIONS TO RESTORE FORESTS IN RWANDA (THOUSANDS OF US DOLLARS) - *Source: Dave et al., 2019*



One of the effects stemming from the Bonn Challenge is to favour the development of huge reforestation programmes yet questioning their real benefits. Indeed, most of the objectives are vague about the essences of planted trees and where they are located. They also rarely mention the impact of these trees on biodiversity. On the matter, IPBES' "Global assessment report on biodiversity and ecosystem services", written by an international panel of scientists, warns against the risks reforestation projects carry for biodiversity and ecosystem management (IPBES, 2018). A study published in *Nature* in April 2019 (Lewis et al., 2019) assessed the gap in carbon sequestrations between scenarios reforesting natural forests or plantations. It showed that **achieving the Bonn Challenge with current countries commitments, where plantations account for nearly half of restoration efforts, would only stock 16 $GtCO_2$ against 42 $GtCO_2$ if restoration were in favour of natural regeneration**.

• AFRICA, THE MANY FACES OF THE FIGHT AGAINST DESERTIFICATION • Rwanda is one of the countries the IUCN takes a close look at the efforts of restoration for its Bonn Challenge barometer 2019. The analysis highlights the country's progress in providing an institutional framework capable of stimulating the restoration of ecosystems to reach its 2030 target of 2 million restored hectares. IUCN report identifies 27 strategies or plans (including 8 promulgated in 2018) and 44 tangible projects targeting land restoration. **In 2019 the country would have accomplished 35% of its objective, thereby sequestrating 27 million tCO_2 according to UICN calculations, mainly through initiatives developing agroforestry.** The implementation of policies is sometimes well advanced,

but largely hampered by short financing. More than 51% of financing so far has come from public spending, 36% co-financed by public funds and international grants, while private sector investments are below 1%.

A little more north, the Great Green Wall for Sahara and Sahel aspire to make for the greatest living structure on Earth, with an 8,000km long per 15km large of vegetation stretching from the East to the West of the continent to fend off desertification. This multilateral project launched by the African Bank of Development, UNCCD, the World Bank, the European Union and the FAO is estimated at about US$ 8 billion and claims important progress in most of the 21 affected countries. Ethiopia for instance, whose forest cover plummeted from 35% in 1900 to only 4% today has signed the Bonn Challenge with a commitment of 15 million hectares to be restored from 2014 to 2020. To that purpose, since 10 years, it invested over US$ 1.2 billion per year for restoration projects (Abera et al., 2019). On July 30th, 2019, with its "Green Legacy" programme launched by the Prime Minister, Ethiopia smashed the former record of 66.7 million trees planted in 12 hours in India. On the opening day, citizens planted 350 million seedlings over 1,000 sites across the country; it aims at reaching 4 billion indigenous trees planted by the end of the year.

Also partner of the Great Green Wall, Senegal has reportedly seeded 18 million trees since 2008 according to project coordinators. But planting trees is sometimes criticized as not being cost-effective enough because of the weak survival rates of plants (Time, 12/09/2019). Other projects are ongoing. For instance, the NGO Oceanium leads the world's biggest mangrove restoration project since 2011, under the leadership of Haïdar El Ali, former Environment minister of Senegal and activist. These forests developing in tidal swamps, and with their roots bathed in saltwater, protect the costs from flooding, shelter birds, fish and amphibious animals protect agricultural soils from salt-water infiltration, and stock carbon. According to the NGO, Senegal has lost 25% of its mangroves since the 1970s, i.e. 45,000 ha, due to droughts, unsustainable agricultural practices, deforestation and infrastructure construction. To this day, Oceanium enabled the restoration of about 15,000ha of mangroves by planting 152 million trees in 10 years (Le Quotidien, 16/10/2019).

• ASIA, THE LESSONS OF 20 YEARS OF RESTORATION • In China, ahead of gigantic programmes of reforestation and afforestation, critics are vocal against the discrepancy between quantity and quality of ambitions of plantation campaigns. "Grain-for-green" programme, started in 1999 and for which China invested US$100 billion in one decade has for instance lately been harshly evaluated regarding its destructive effects on biodiversity. Just like numerous reforestation programmes, new forests are monodominant plantations. In this case, a team of scientists demonstrated, by quantifying bee populations and bird life, that tree plantations were less welcoming to the fauna than agricultural equivalents (Wang et al., 2018). This same biodiversity issue is even more blatant when native forests are logged and superseded by commercial-purpose essences of trees (Hua et al., 2018). Another analysis put in the light by these long-standing programmes is the effect on the water cycle. Scientific studies all point out that tree plantations, often non-native, tend to absorb more water than their natural equivalent and thus diminish water transfer to drainage basins. A study showed that semi-arid areas have raised by 33% between the 1950s and the 2000s, and another that arid areas spread by 1.6 million km^2 since 1980. Local governments seem to take account this feedback and increasingly turn towards planting more water-efficient shrubs (Zastrow, 2019).

• LATIN AMERICA, THE WORLD'S LARGEST REFORESTATION PROJECT WAS INSPIRED BY NATURE BUT IS UNDER THREAT • In Latin America too, massive reforestation projects through planting are gradually clearing the way to new technics that are more respectful of ecosystems. Most often, these projects are the result of NGOs' initiatives. For instance, the *muvuca* technique, born in Brazil, consists in seeding, on every square meter, grains of more than 200 different species in order to allow a natural selection of the species most likely to adapt to local conditions. Another benefit of this approach is that while minimizing natural regeneration allows densities to

reach up to 2,500 trees per hectare against 160 for traditional plantation technics, which require more and more workforce. This technique should be used for the biggest reforestation project ever initiated, carried by the NGO Conservancy International since 2017 in Amazonia. The target is ambitious: 73 million trees planted over 30,000 hectares in 6 years, relying on the collaboration of the NGO with the Brazilian Ministry of Environment, the Global Environment Fund (GEF), the World Bank, the Brazilian Fund for Biodiversity and the music festival Rock in Rio (BBC, 01/11/2017). With Jair Bolsonaro taking presidency in January 2019, the evolution of this project, like any other else in Brazil, still remains uncertain (Lifegate, 06/11/2018).

4. Temperate forests: between biomass energy production, improved management and response to climate risks

In temperate zones, despite weaker carbon storage capacity than in tropical forests, and a more ambiguous effect over climate because of the reflection of solar radiation by the leaves and their role in water cycle, forests are also at the heart of strategies to fight climate change.

FEEDBACK EXPERIENCE

THE IRISH PARADOX: PLANTING TREES… TO MAINTAIN AN EMITTING AGRICULTURE

Ireland's climate objectives aim to cut emissions by 20% in 2020 compared to 2005 levels. Current trends point out that by 2020 they will only be reduced 1%, exposing the country to financial sanctions from the EU. Because of a high-emitting dairy industry, Irish agriculture amounts to 33% of national emissions, while the EU-28's average is 10%.

In its Climate Action Plan issued in June 2019, Ireland considers forest planting as a means to achieve carbon neutrality in the land-use sector by 2050. Expanding forest-covered surfaces would indeed offset the high emissions of the milk industry, which are hard to reduce. The Plan therefore organises the increase of forest cover from 11 to 18% by 2046 through the plantation of 22 million trees per year during the next two decades, i.e. 440 million trees in total (DCCAE, 2019). Critics of this massive afforestation plan see two important barriers. The first is the lack of credibility due to the difficulty to convince farmers to turn their lands into forest plantations. To answer this limit, in addition to financial support, the government set up an action to raise awareness among the actors about the importance of forest and ecosystem services (The Irish Times, 31/01/2019). The second critic faced by the Irish afforestation plan is the failure to take account of biodiversity. In Ireland, subsidised plantations so far have been monodominant plantations, most often Sitka spruce, a fast-growing non-native conifer which provides little shelter for birds, insects and mammals (The Guardian, 07/07/2019).

BOX 4

• **EUROPE** • December 2018 revised directive of the EU on renewable energies includes forest biomass energy in the production objectives, arguing biomass is carbon neutral. Scientists have yet already largely refuted this argument, owing to the fossil emissions necessary to forest management, the gap between the decade's trees require to absorb carbon in comparison to the few months after which biomass is burnt and loss of carbon sequestrated by logged trees. A citizen movement covering 6 countries (Estonia, France, Ireland, Romania, Slovakia and the USA), supported by the Romanian NGO 2Celsius, the Slovakian WOLF and the French Association "Lutte Contre les Nuisances et la Pollution" has brought the question to the EU court of justice in March 2019. They are pressing charges against the inclusion of forest biomass as a renewable energy in the REDII European directive adopted in June 2018, and thus hope to hamper the increase of wood collection for energy purposes. Indeed, the use of biomass-energy – 60% from wood – has leaped from 5.9%

in 2005 to 10.3% in 2017 of the total gross energy consumptions in Europe.

Aside from the controversial increase in wood harvesting to produce energy, some initiatives for enhanced management of European forests have sprang up, stimulated by the voluntary carbon market and the development of certification frameworks

• UNITED STATES • Destructive and fatal fires from 2017 to 2018 seem to be in line with a long-term trend with an fivefold increase in burnt surface between 1972 and 2018 (Williams et al., 2019). Facing these risks, different actors get involved in the fight against forest fires in California, starting with power companies whose equipment are responsible for a large share of fire. When vegetation blown by strong winds breaks power lines, that spark in dry conditions. In 2018 the biggest power supplier in California, PG&E, was charged with failure in maintenance of their transmission lines. This entailed numerous fires, including one in particular that started under a high-voltage line, led to the "first climate-change bankruptcy" (Wall Street Journal, 18/01/2019). The Camp Fire resulted in 85 people dead. Still currently in operation and undergoing a process of restructuration, the company has, this year, set up a strategy of large-scale preventive power outage, leaving nearly a million customers with no electricity when wind increases the fire risk (Los Angeles Times, 18/11/2019).

In addition to the droughts and strong wind, a third condition favouring wildfires observed in California these last years is the lack of preventive management, with the accumulation of undergrowth and vegetation favouring spreading of fires. Indeed, forest services have had to rise spending allocated to fighting fires at the expense of preventive actions. To tackle this cause, the Blue Forest start-up, whose headquarters are in San Francisco, developed finance instruments to fund cleaning and maintenance of forest parcels. By selling bonds to investors, they finance thinning operations in over-stocked forests. These operations follow the objective to reduce the risk of wildfires by minimizing the amounts of flammable matter; but also, to free space for water to flow freely to reservoirs.

5. Changes in agricultural practices

Agricultural practices contribute significantly to land degradation and GHG emissions mainly through the use of chemical inputs and cattle breeding. In turn, climate chance has an impact on yields through a combination of temperature increases and increased or reduced drought frequencies, depending on the region of the world. The IPCC Special Report assesses the potential emission reductions that would result from changes in agricultural producers' and consumers' practices. By modifying emissions from crops and livestock, for example by sequestering carbon in the soil, reducing the use of nitrogen fertilisers and reducing methane emissions from rice fields, overall agricultural emissions could be reduced by 1.5 to 4 $GtCO_2$eq./year by 2030. This figure is of the same order of magnitude as the reduction potential of 1.8 to 3.4 $GtCO_2$eq/year that could be achieved by changing diets, in particular through reduced consumption of animal meats.

In response to these findings, over 30 countries, as part of the Paris Agreement, committed to convert their agriculture to more virtuous and resilient practices.

FEEDBACK EXPERIENCE

SCHOOLCHILDREN: PIONEERS OF THE CHANGE IN THE FOOD SYSTEM

Often seen as an individual action, dietary change to reduce the proportion of animal products is now being implemented on a collective scale, with schools and universities leading the way. However, from the start of the school year, in 2019, Goldsmith University in London banned the sale of beef on its campus, with the aim to achieve carbon neutrality by 2025. In New York City, for the year 2019-2020, the city has joined the "Meatless Monday". There are 1.1 million students in addition to this movement, which began in 2003 in the United States, and is now

happening in 40 countries. Schools, campuses, collective restaurants and hospitals are all getting involved. In Brazil, 4 cities are going further than the initial programme, they are now aiming for 100% vegetarian meals by the end of 2019 in all schools. The programme is focuses on vegetable cooking training for school cooks and monitoring the health of students to assess the programme's effects on their health, in particular on their vitamin B12, cholesterol and iron levels. In France, the initiative took the form of an online challenge "*le lundi vert*" (Green Monday) by which scientists monitor the ability of online registered volunteers to change their regime. This unique study, the preliminary results of which were published in the journal *Nutrients* showed that "Green Monday" actions mainly concerned young and urban women with a high level of education, underlining the importance of setting up means of communication for other audiences.

BOX 5

• THE 4 PER 1000 INITIATIVE • Various changes in practice are encouraged by the "4 per 1000" initiative launched in 2015, with the priority of increasing carbon storage in the first soil layers by 0.4% per year. There are two side to the target: to absorb the equivalent of annual anthropogenic GHG emissions, or about 6 billion tonnes of CO_2 per year, and to restore degraded agricultural soils to their fertility while protecting them from erosion. This initiative brings together actors from the worlds of forestry and agriculture, scientific experts and public decision makers and promote a range of complementary methods like the use of intermediary crops to avoid leaving the soil bare, the installation of hedges, the development of agroforestry or the use of compost. In June 2019, the INRA's first study quantifies the carbon storage potential in different soils in France and assess the best way to do it (INRA, 2019). One of the conclusions of the study was the high capacity of increasing carbon storage in intensively cultivated soils where stock is currently very low, while for forest soils already rich in carbon, the challenge is to protect the carbon already stored by limiting their disruption. To reach the objective of +0.4% carbon storage per year, researchers found that an increase in stocks via adapted agricultural techniques (like those listed above), but also stopping the artificialisation of soils and preserving important stocks in forests and permanent grasslands, are both necessary.

• AGROFORESTRY RAISES HOPE • The solutions to be implemented to achieve climate-friendly agriculture differ from region to region and depend on their climate and socio-cultural characteristics. In tropical areas, agroforestry, which consists of combining crops, trees and sometimes livestock in the same area, is a method with great potential. A 2018 meta-analysis of 54 scientific studies shows that carbon storage is indeed more important in agroforestry plots than in conventional agriculture plots, in addition to providing significant benefits for biodiversity (De Stefano & Jacobson, 2018).

With climate change, the design of agroforestry systems that have auxiliary tree species resilient to future climatic conditions is a crucial issue for drought-resistant crops and the maintenance of yields. To this end, a new initiative coordinated by a coalition of NGOs called the Global EverGreening Alliance is behind the "Grand savannah green up program". In September 2019, the involved NGOs including World Vision, Catholic Relief Services, World Agroforestry, CARE International, Justdiggit, World Resources Institute, The Nature Conservancy, and Concern Worldwide announced that that secured $85 million for the first phase of their programme taking place in Ethiopia, Uganda, Kenya, Zambia, Tanzania and Malawi (Mongabay, 24/10/2019). The goal of the programme is to restore 2 million hectares over 5 years by supporting the change in agricultural practices of over 2 million households on the ground and therefore to sequester 20 billion tonnes of CO_2 every year by 2050. Actions that take place in the field include increasing tree cover on agricultural land, planting leguminous shrubs in fields to increase their fertility and carbon storage, increasing energy production from biomass and regenerating grasslands. The NGO, alliance Global Evergreen Alliance, obtained

the first funding for this programme through the G9 Ark Foundation, which announced for January 2020 the launch of a global social network, which will allow its members to engage in and monitor ecosystem restoration projects. The cocoa sector is also trying to take over agroforestry. The Cocoa & Forest initiative, which has united them with the main cocoa-producing countries since 2017, places the development of agroforestry at the forefront of action to be taken for a sustainable cocoa cultivation that respects the environment and the climate. The initiative has taken a different dimension this year, **notably with the approval in March 2019 of the Ghana and Ivory Coast action plans (nearly 60% of world cocoa production)** to stop deforestation in the cocoa sector. These plans bring together governments from the countries as well as 33 private companies representing 85% of the world's cocoa consumption (World Cocoa Foundation, 2019). The national plans are mainly based on the national forest preservation, rehabilitation and extension policies for Ivory Coast, and on the Ghanaian REDD+ programme, by which states undertake to provide stakeholders with updated maps on forest cover and land use, socio-economic data on cocoa producers, and detailed operational guidelines. For their part, each company prepared an initial individual action plan detailing the actions it will undertake from 2018 and 2022. Again, the mapping of growing areas is at the centre of the strategy to eliminate crops from classified areas. In addition, companies are committed to promoting agroforestry systems by supporting the distribution and planting of multipurpose trees on farms. Indeed, one of the main lines of the companies' action plans is to promote the involvement of local communities in protection and restoration activities.

FOR A BETTER UNDERSTANDING

AGROFORESTRY IN THE SPOTLIGHT AT THE UNITED NATIONS

The young Philippine cook chef Louise Mabulo was awarded the prestigious title of Young Champion of the Earth from the UNEP for its Cacao Project. As a chef, her concern for agriculture resilience in her country aggravated in 2016 after a typhoon devastated 80% of cultivated surfaces of the San Fernando region. Louise Mabulo then seized the opportunity to change farmers' practices from rice, coconuts and corn monocultures to cacao agroforestry, cacao trees being more resistant to climate changes and able to provide for sustainable incomes to farmers. She developed a training programme from farmers, teaching them how to cultivate cacao in a sustainable way and providing them with cacao seeds. By training nearly 200 farmers, her programme allowed to seed more than 70,000 cacao trees.

Source: UN Environment, 2019

BOX 6

In Ireland too, agroforestry is all the rage but with a radically different face. With the aim to reduce GHG agriculture emissions originating from agriculture from 10 to 15%, in a growing dairy sector, the government needs the collaboration of farmers and industrials. It launched for that purpose, in November 2019, a consultation for the agriculture sector, "*Ag-Climatise*", expecting feedbacks from economic actors upon a proposed draft of roadmap. From 2017, agroforestry is included as an option in the Environmental Farming Scheme (EFS), which remunerates farmers for actions in biodiversity or fighting climate change. In the preliminary roadmap submitted for consultation, it is suggested to revise the national forest programme with a target of 8,000 ha of newly planted forests every year, i.e. about 18.6 million trees.

CONCLUSION

Quantifying the global impact of land use on GHG emissions is a tricky task, as so ambivalent is the influence of the sector over CO_2 streams. In this way, the IPCC's Special Report on the topic has presented a synthesis both precious as alarming: in view of the results, none of the objectives set by the international community will be achieved in 2020. The multiplication of carbon neutrality strategies observed in 2019 from States, cities and companies, and the large place conservation, reforestation and afforestation projects hold within them, open new financing opportunities to protect biodiversity and lower pressure on soils. However, a twisted execution of field projects risks causing additional damage to ecosystems. Lastly, the success of international and multi-actor cooperation in Gabon and Indonesia prove that proactive policies can quickly lead to tangible results.

Please do not hesitate to share with us any additional information, reports of data via the following email address: contribution@climate-chance.org

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