Sustainability News – 17th November, 2016.

Climate Change

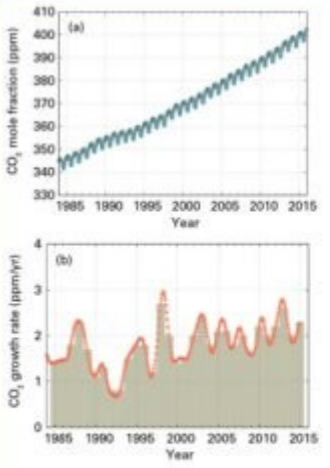


Figure 3. Globally averaged CO_2 mole fraction (a) and its growth rate (b) from 1984 to 2015. Increases in successive annual means are shown as columns in (b).

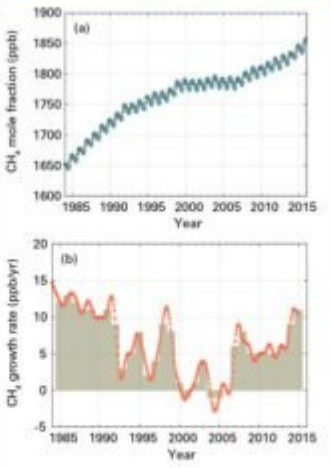


Figure 4. Globally averaged CH_4 mole fraction (a) and its growth rate (b) from 1984 to 2015. Increases in successive annual means are shown as columns in (b).

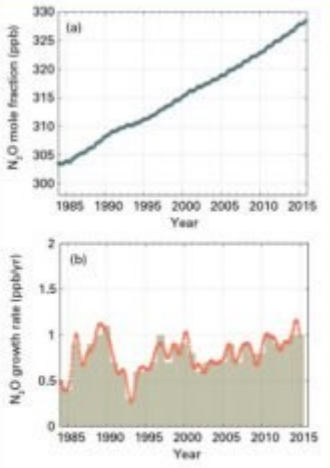
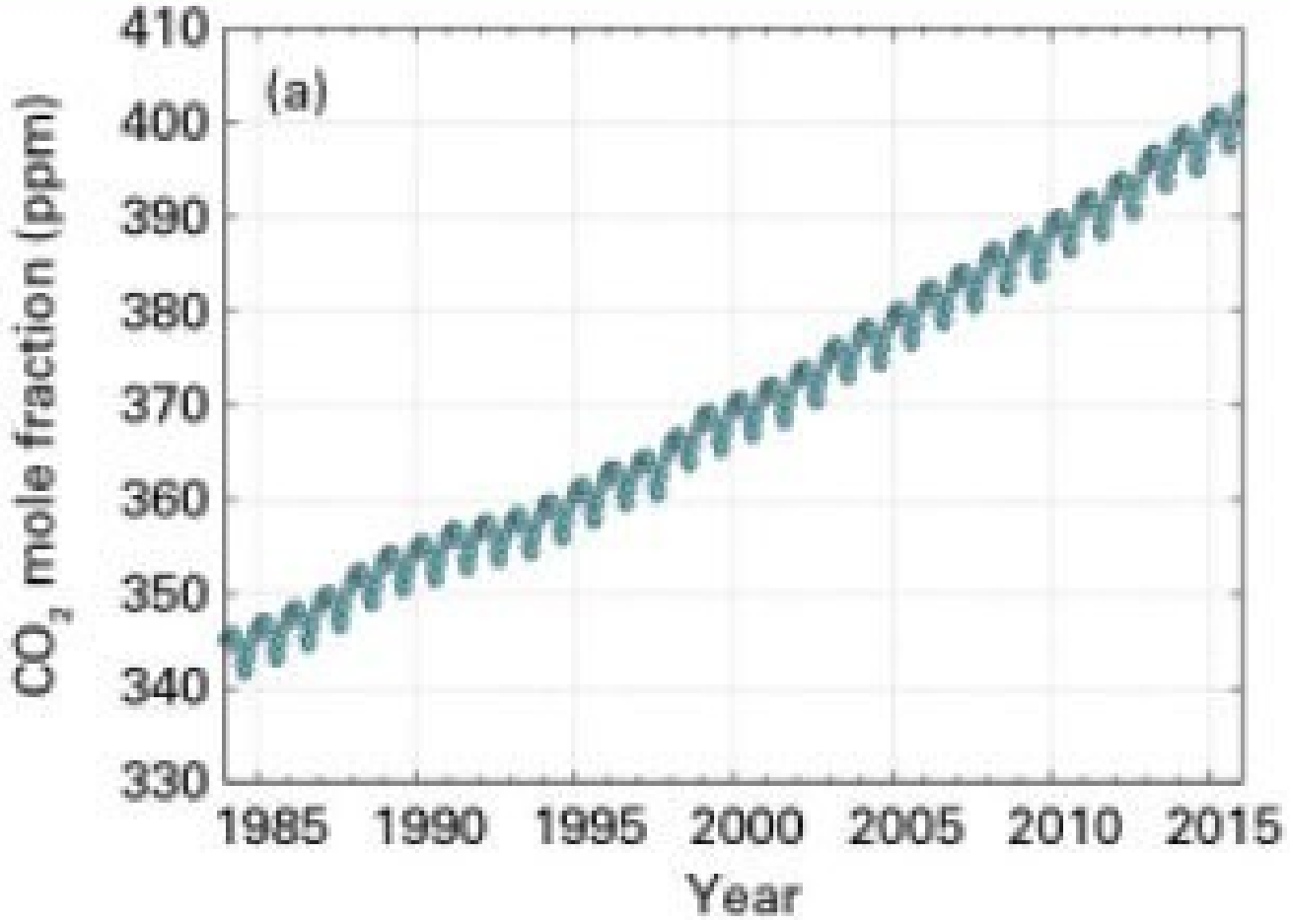
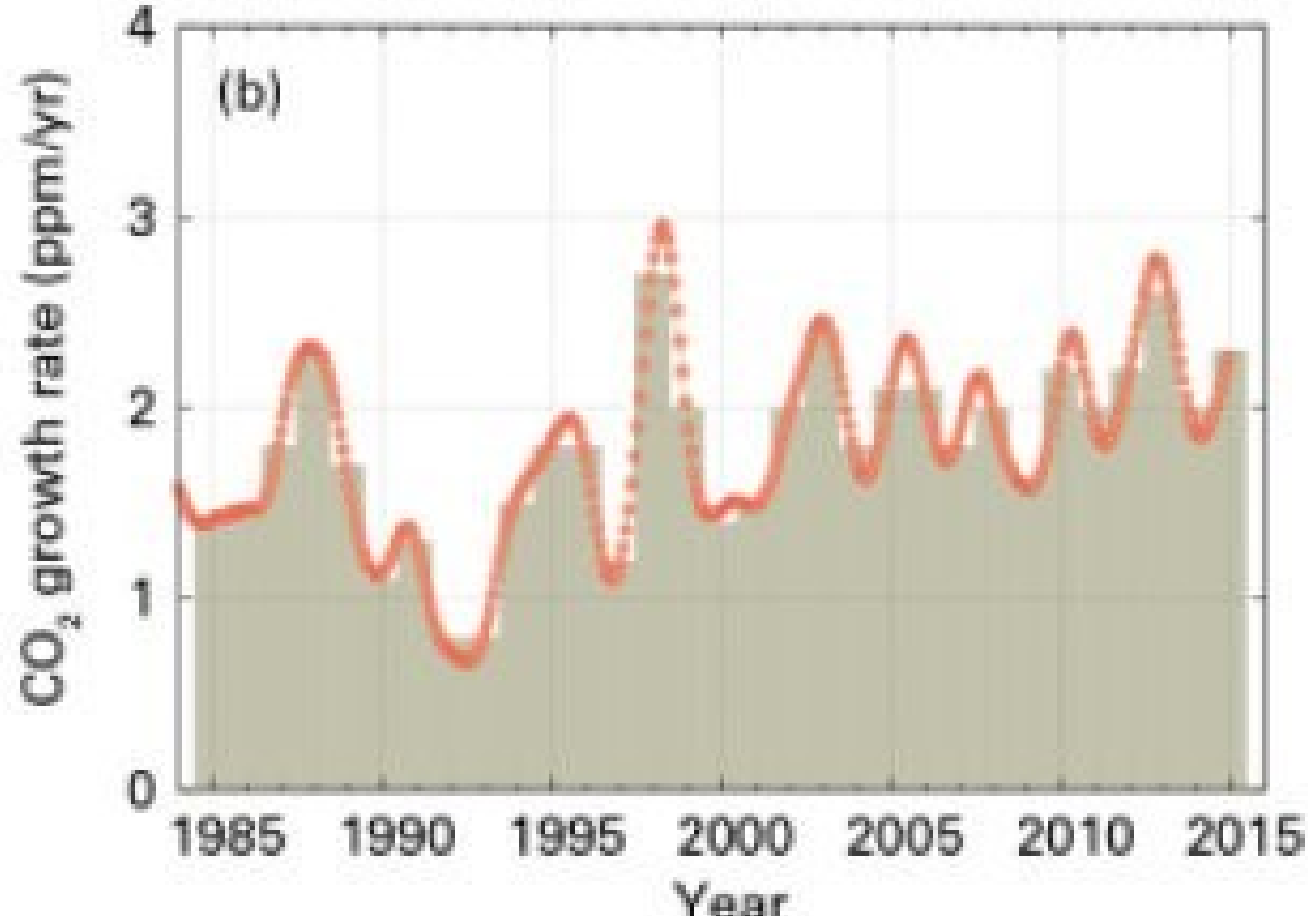


Figure 5. Globally averaged N_2O mole fraction (a) and its growth rate (b) from 1984 to 2015. Increases in successive annual means are shown as columns in (b).

Greenhouse gas emissions by year. The WMO Global Atmosphere Watch Programme coordinates systematic observations and analysis of greenhouse gases and other trace species. Fifty one countries contributed data for the Greenhouse Gas Bulletin.


(a)
410
400
390
380
370
360
350
340
330
CO_2 mole fraction (ppm)
1985
1990
1995
2000
2005
2010
2015
Year


(b)
4
3
2
1
0
CO_2 growth rate (ppm/yr)
1985
1990
1995
2000
2005
2010
2015
Year

Globally averaged concentration of carbon dioxide in the atmosphere reached the symbolic and significant milestone of 400 parts per million for the first time in 2015 and surged again to new records in 2016 on the back of the very powerful El Niño event, according to the World Meteorological Organization's annual Greenhouse Gas Bulletin.

CO_2 levels had previously reached the 400 ppm barrier for certain months of the year and in certain locations but never before on a global average basis for the entire year. The longest-established greenhouse gas monitoring station at Mauna Loa, Hawaii, predicts that CO_2 concentrations will stay above 400 ppm for the whole of 2016 and not dip below that level for many generations.

The growth spurt in CO_2 was fueled by the El Niño event, which started in 2015 and had a strong impact well into 2016. This triggered droughts in tropical regions and reduced the capacity of "sinks" like forests, vegetation and the oceans to absorb CO_2. These sinks currently absorb about half of CO_2 emissions but there is a risk that they may become saturated, which would increase the fraction of emitted carbon dioxide which stays in the atmosphere, according to the Greenhouse Gas Bulletin.

Between 1990 and 2015 there was a 37% increase in radiative forcing -- the warming effect on our climate -- because of long-lived greenhouse gases such as carbon dioxide, methane and nitrous oxide (N_2O) from industrial, agricultural and domestic activities.

"The year 2015 ushered in a new era of optimism and climate action with the Paris climate change agreement. But it will also make history as marking a new era of climate change reality with record high greenhouse gas concentrations," said WMO Secretary-General Petteri Taalas. "The El Niño event has disappeared. Climate change has not."

"The recent agreement in Kigali to amend the so-called Montreal Protocol and phase out hydrofluorocarbons, which act as strong greenhouse gases, is good news. WMO salutes the commitment of the international community to meaningful climate action," said Mr Taalas.

"But the real elephant in the room is carbon dioxide, which remains in the atmosphere for thousands of years and in the oceans for even longer. Without tackling CO_2 emissions, we cannot tackle climate change and keep temperature increases to below 2°C above the pre-industrial era. It is therefore of the utmost importance that the Paris Agreement does indeed enter into force well ahead of schedule on 4 November and that we fast-track its implementation." he said.

WMO and partners are working towards an Integrated Global Greenhouse Gas Information System to provide information that can help nations to track the progress toward implementation of their national emission pledges, improve national emission reporting and inform additional mitigation actions. This system builds on the long-term experience of WMO in greenhouse gas observations and atmospheric modelling.

WMO is also striving to improve weather and climate services for the renewable energy sector and to support the Green Economy and sustainable development. To optimize the use of solar, wind and hydropower production, new types of weather services are needed.

Highlights of Greenhouse Gas Bulletin

The WMO Greenhouse Gas Bulletin reports on atmospheric concentrations of greenhouse gases. Emissions represent what goes into the atmosphere. Concentrations represent what remains in the atmosphere after the complex system of interactions between the atmosphere, biosphere, cryosphere and the oceans. About a quarter of the total emissions is taken up by the oceans and another quarter by the biosphere, reducing in this way the amount of CO_2 in the atmosphere.

The Greenhouse Gas Bulletin provides a scientific base for decision-making. WMO released it ahead of the U.N. climate change negotiations in Marrakech, Morocco, to be held from 7 -- 18 November 2016.

Carbon dioxide (CO_2) accounted for about 65% of radiative forcing by long-lived greenhouse gases. The pre-industrial level of about 278 ppm represented a balance between the atmosphere, the oceans and the biosphere. Human activities such as the burning of fossil fuels has altered the natural balance and in 2015,

globally averaged levels were 144% of pre-industrial levels. In 2015, global annual average concentration of CO_2 concentrations reached 400.0 ppm. The increase of CO_2 from 2014 to 2015 was larger than the previous year and the average over the previous 10 years.

In addition to reducing the capacity of vegetation to absorb CO_2 the powerful El Niño also led to an increase in CO_2 emissions from forest fires. According to the Global Fire Emission Database, CO_2 emissions in Equatorial Asia -- where there were serious forest fires in Indonesia in August-September 2015 -- were more than twice as high as the 1997-2015 average.

Methane (CH_4) is the second most important long-lived greenhouse gas and contributes to about 17% of radiative forcing. Approximately 40% of methane is emitted into the atmosphere by natural sources (e.g., wetlands and termites), and about 60% comes from human activities like cattle breeding, rice agriculture, fossil fuel exploitation, landfills and biomass burning. Atmospheric methane reached a new high of about 1845 parts per billion (ppb) in 2015 and is now 256% of the pre-industrial level.

Nitrous oxide (N_2O) is emitted into the atmosphere from both natural (about 60%) and anthropogenic sources (approximately 40%), including oceans, soil, biomass burning, fertilizer use, and various industrial processes. Its atmospheric concentration in 2015 was about 328 parts per billion. This is 121% of pre-industrial levels. It also plays an important role in the destruction of the stratospheric ozone layer which protects us from the harmful ultraviolet rays of the sun. It accounts for about 6% of radiative forcing by long-lived greenhouse gases.

Other long-lived greenhouse gases

Sulphur hexafluoride is a potent long-lived greenhouse gas. It is produced by the chemical industry, mainly as an electrical insulator in power distribution equipment. Atmospheric levels are about twice the level observed in the mid-1990s. Ozone-depleting chlorofluorocarbons (CFCs), together with minor halogenated gases, contribute about 12% to radiative forcing by long-lived greenhouse gases. While CFCs and most halons are decreasing, some hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), which are also potent greenhouse gases, are increasing at relatively rapid rates, although they are still low in abundance.

Morocco and climate change

As the host of this year's COP22 climate change conference in Marrakech, Morocco has been keen to demonstrate its green credentials and make this COP the "African COP".

In the past year, Morocco has banned the use of plastic bags, launched new plans for extending the urban tram networks in Casablanca and Rabat, started the process of replacing its dirty old fleet of buses and taxis, launched Africa's first city bicycle hire scheme, and launched a new initiative – the "Adaptation of African Agriculture" – to help the continent's farmers adjust to climate change.

As UN climate talks start in Marrakech, Morocco calls on world leaders to put the focus on concrete plans for helping Africa's small-scale farmers
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But by far the most attention has been on the development of "mega" infrastructure projects in an ambitious plan to transform the country's energy mix.

Morocco has no fossil fuel reserves so is almost entirely reliant on imports. In 2015 King Mohammed VI committed the country to increasing its share of renewable electricity generation to 52% by 2030, aiming for the installation of around 10 gigawatts (GW). Of that, 14% is expected to come from solar, with plans to install 2GW of new capacity by 2020, as well as increases in wind power and hydraulic dams. Morocco has even opened the door to exchanging electricity produced from renewable sources with Europe.

Morocco's INDC (Intended Nationally Determined Contribution) plan submitted to the UNFCCC is equally ambitious and commits the country to cutting greenhouse gas emissions – particularly in agriculture – by 32% by 2030, compared to business as usual. Morocco has also committed to planting 200,000 hectares of forest (pdf) and greatly increasing in irrigation. The commitment is dependent on accessing climate financing, but translates to a cumulative reduction of 401 megatonnes of C02 over the period 2020-30. In 2015 Morocco completely removed subsidies on petroleum products.

The first phase of the giant Noor solar complex near Morocco's southern desert town of Ouarzazate is the 160MW Noor One plant, which was opened by the king in February. Instead of PV (photovoltaic) solar panels, Noor uses CSP (concentrated solar power) technology – giant mirrors to reflect the sun's rays on to tubes containing liquid which is super-heated to drive turbines. CSP offers storage of electricity for up to three hours after the sun has set, which covers peak demand times.

Renewables sites in Morocco

Close to the site of Noor One, Noor two, currently under construction, will use the same CSP technology, but on a bigger scale with the hope of storing electricity for seven hours. Noor Three however will use a new variant on CSP technology – the solar tower, where the mirrors are directed at a central point.

Between them they will add another 350MW to the national grid, and are expected to be completed by 2017/18. Noor Four will be constructed near the High Atlas town of Midelt and Morocco's renewables agency, Masen, announced this week at COP22 that it would open the bidding for two 400MW combined PV and CSP plants in early 2017.

Morocco is also investing in wind. A consortium of Enel Green Power, Nareva (owned by King Mohammed VI's investment company) and Siemens won a bid in March to build five new wind farms at different sites across Morocco – Midelt, Tangier, Jbel Lahdid, and Tiskrid and Boujdour in the disputed Western Sahara territory. Their combined capacity will be 850MW, a huge increase taking Morocco closer to its aim of producing 14% of electricity from wind by 2020. The unit cost in the tender documents was one of the lowest in the world, at just $0.03 per kWh.

But while developing renewable power sounds good on paper, cost will be a big factor. The launch of the Noor CSP project has helped the price of electricity produced by CSP to come down to around $0.16 per kWh, but that looks expensive compared to solar PV which has fallen as low as $0.03 per kWh.

It remains to be seen whether the costs of CSP will fall low enough to be globally commercially competitive, and deliver cost-effective renewable power for Moroccan consumers. CSP also uses large amounts of water to keep the mirrors clean – a real problem in water-stressed Morocco. At the same time, Morocco has not totally kicked the fossil fuel habit – coal still makes up the biggest part of energy production today (35%) and is set to be expanded over the next five years. The new energy mix will include at least 3,900MW of energy from natural gas, and the search for hydrocarbon deposits on Moroccan soil continues.

John

17th November, 2016.