

Climate Change Update for the Energy Management Task Force

**Presented by Peter Prebble, BBA, Med, MSEM, Board Member
Saskatchewan Environmental Society**

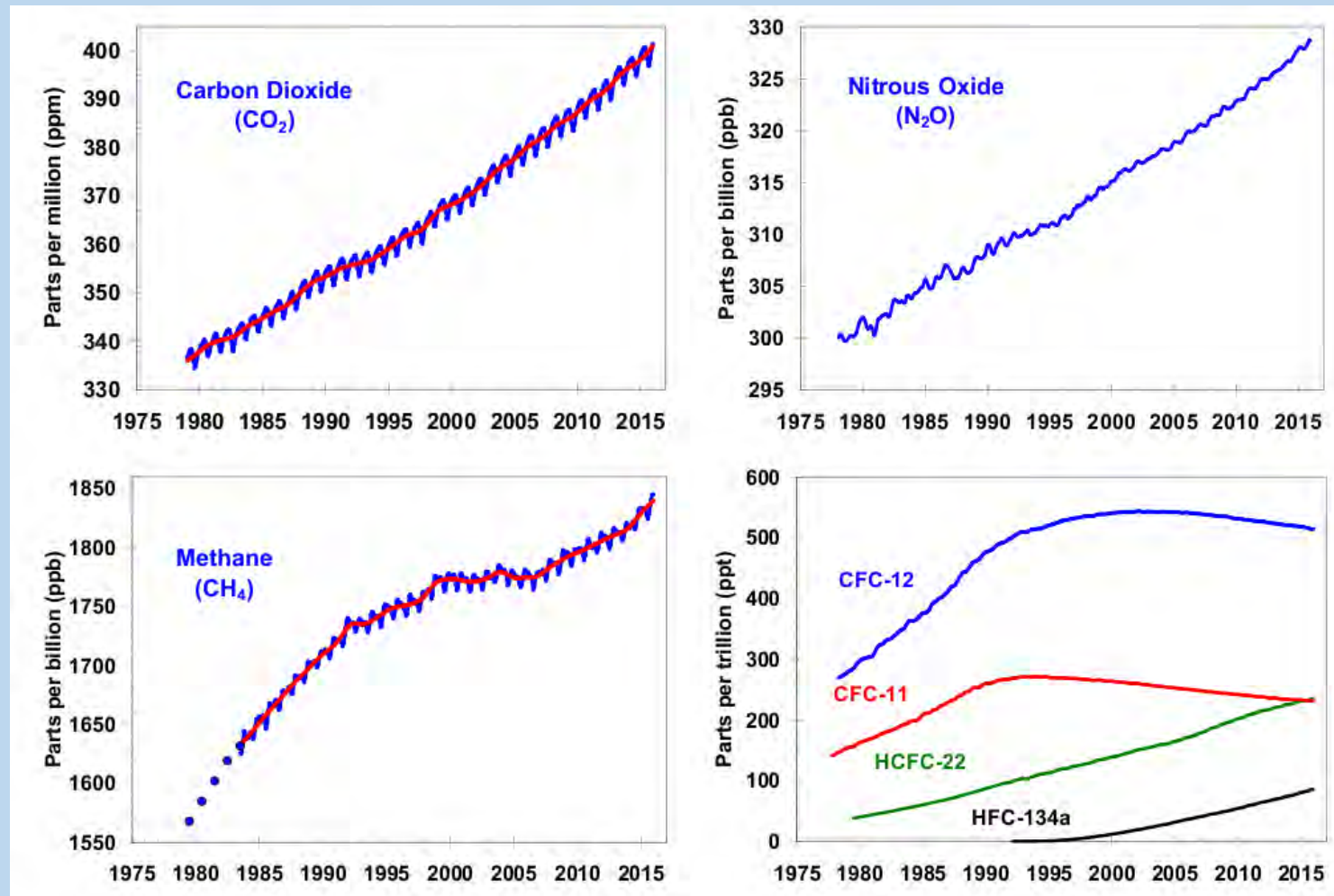
September 2016

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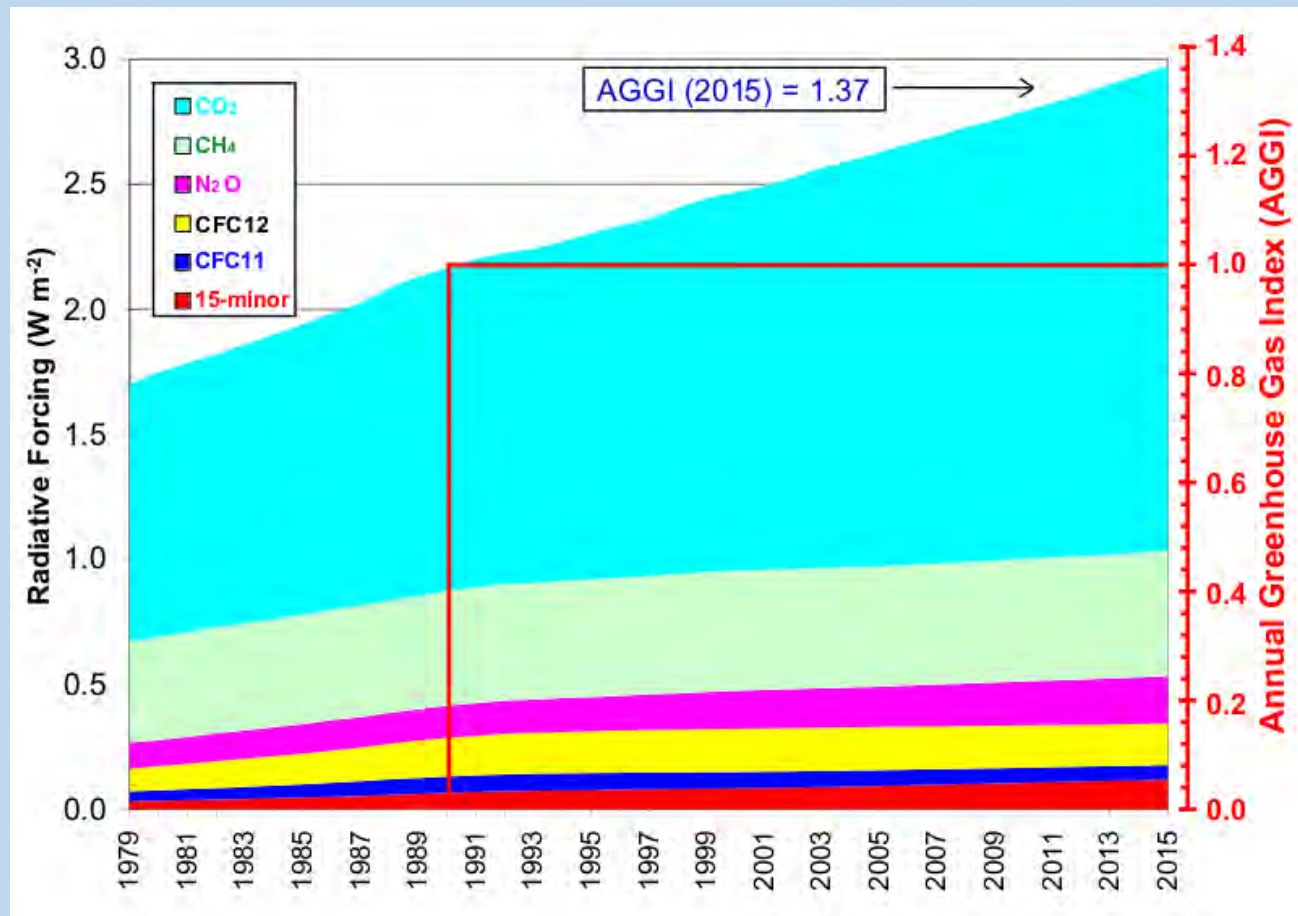
Global average abundances in the atmosphere of the major, well-mixed, long-lived greenhouse gases. The steady rise in their concentration is related primarily to human activity and is the primary cause of climate change.

Source: NOAA Research Laboratory <http://esrl.noaa.gov/gmd/aggi/aggi.fig2.png> Updated: Spring 2016



The radiative forcing of the long-lived, well mixed greenhouse gases has increased 37% from 1990 to 2015. About 4/5 of this increase is due to the rise in carbon dioxide.

Source: <http://esrl.noaa.gov/gmd/aggi/aggi.fig4.png>

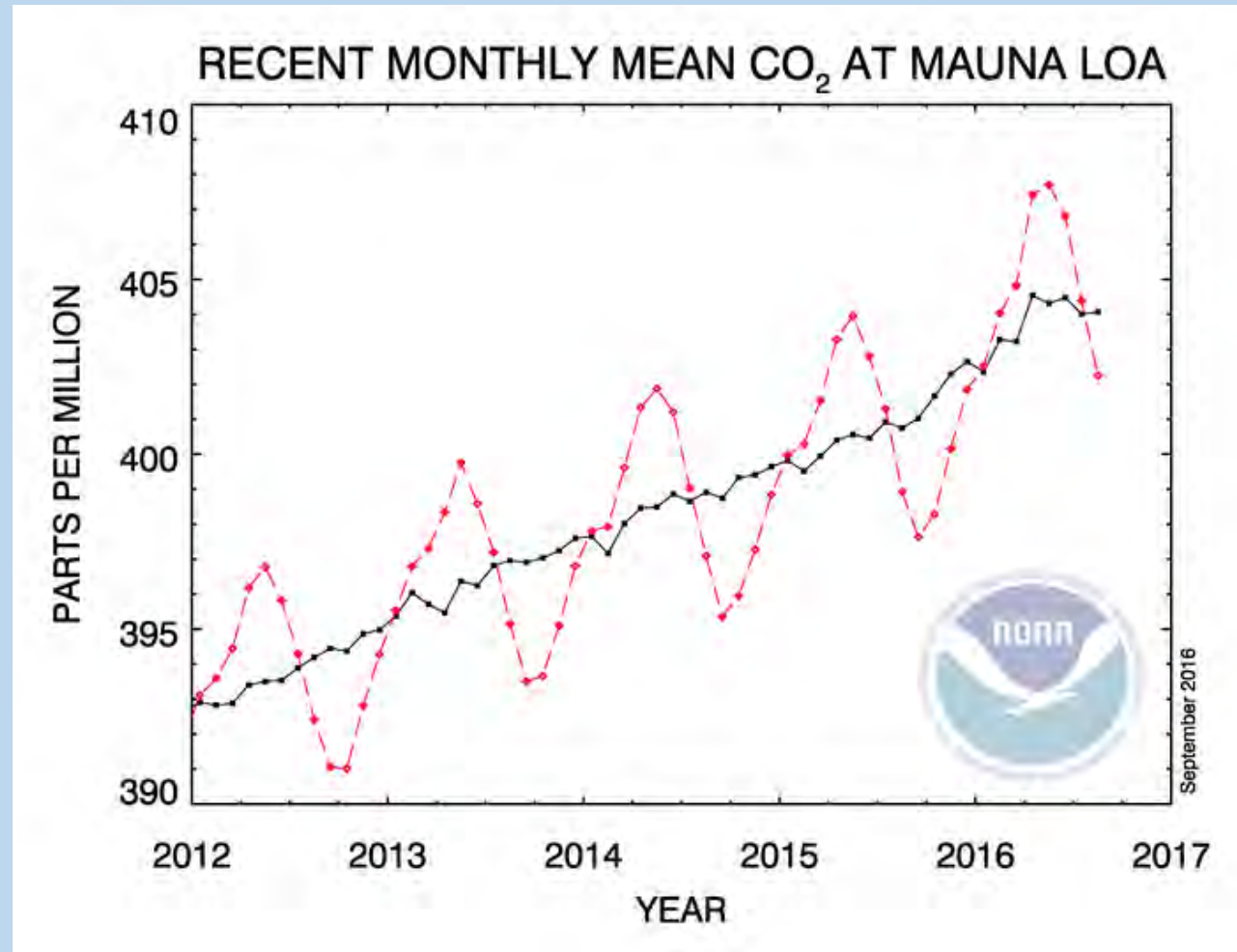


Latest monthly carbon dioxide concentration in the atmosphere:

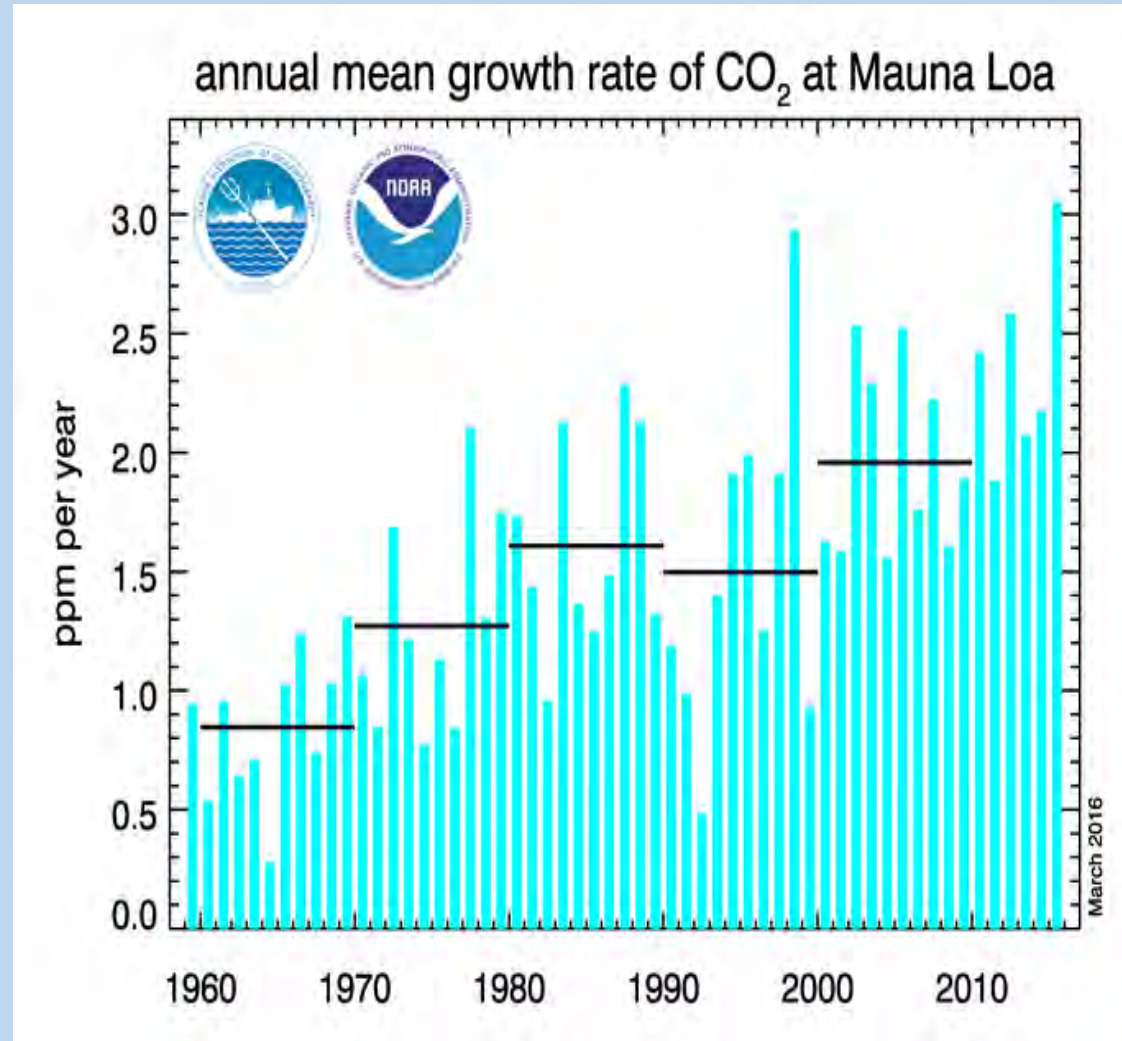
August 2016: 402.25ppm

August 2015: 398.93ppm

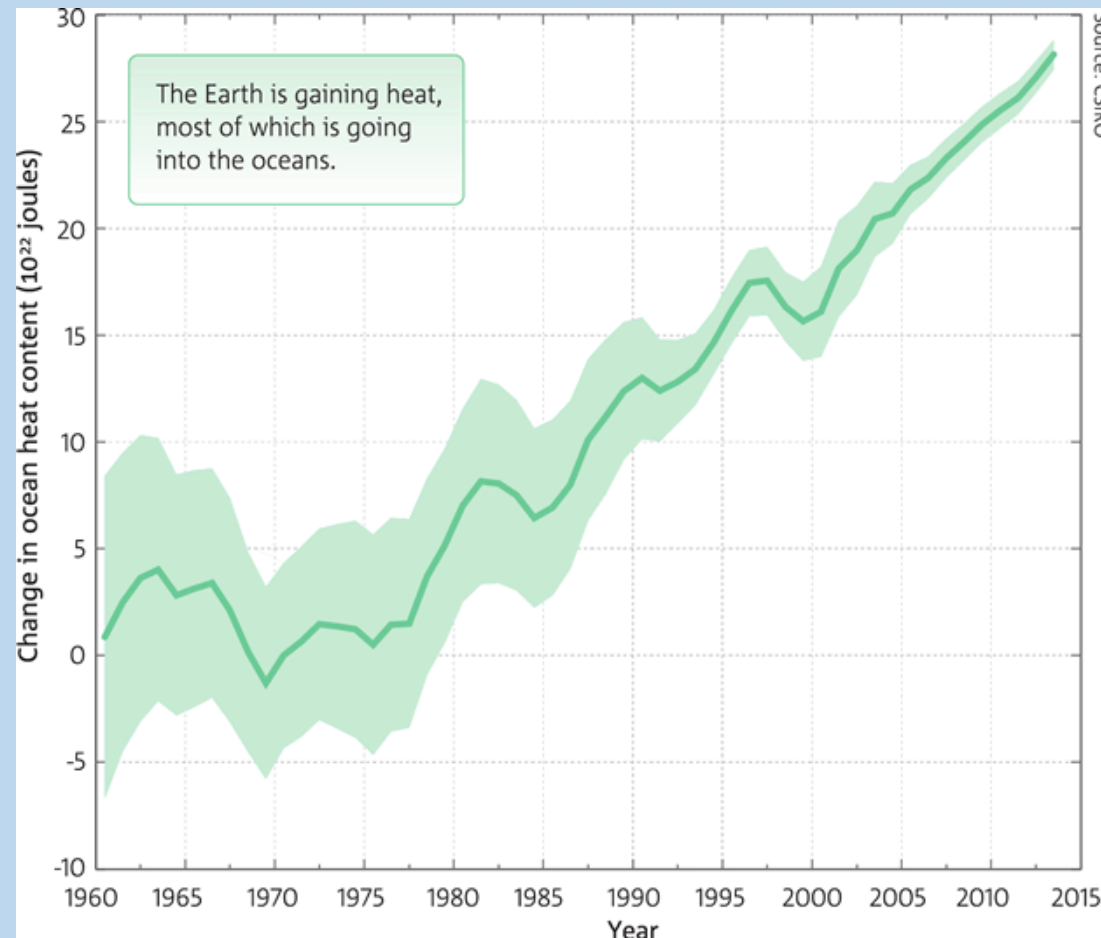
Source: <http://www.esrl.noaa.gov/gmd/ccgg/trends/>



Carbon dioxide concentrations in the atmosphere are increasing every year. The rate of increase is explosive compared to natural processes. We are now in completely uncharted territory due mostly to the burning of fossil fuels.



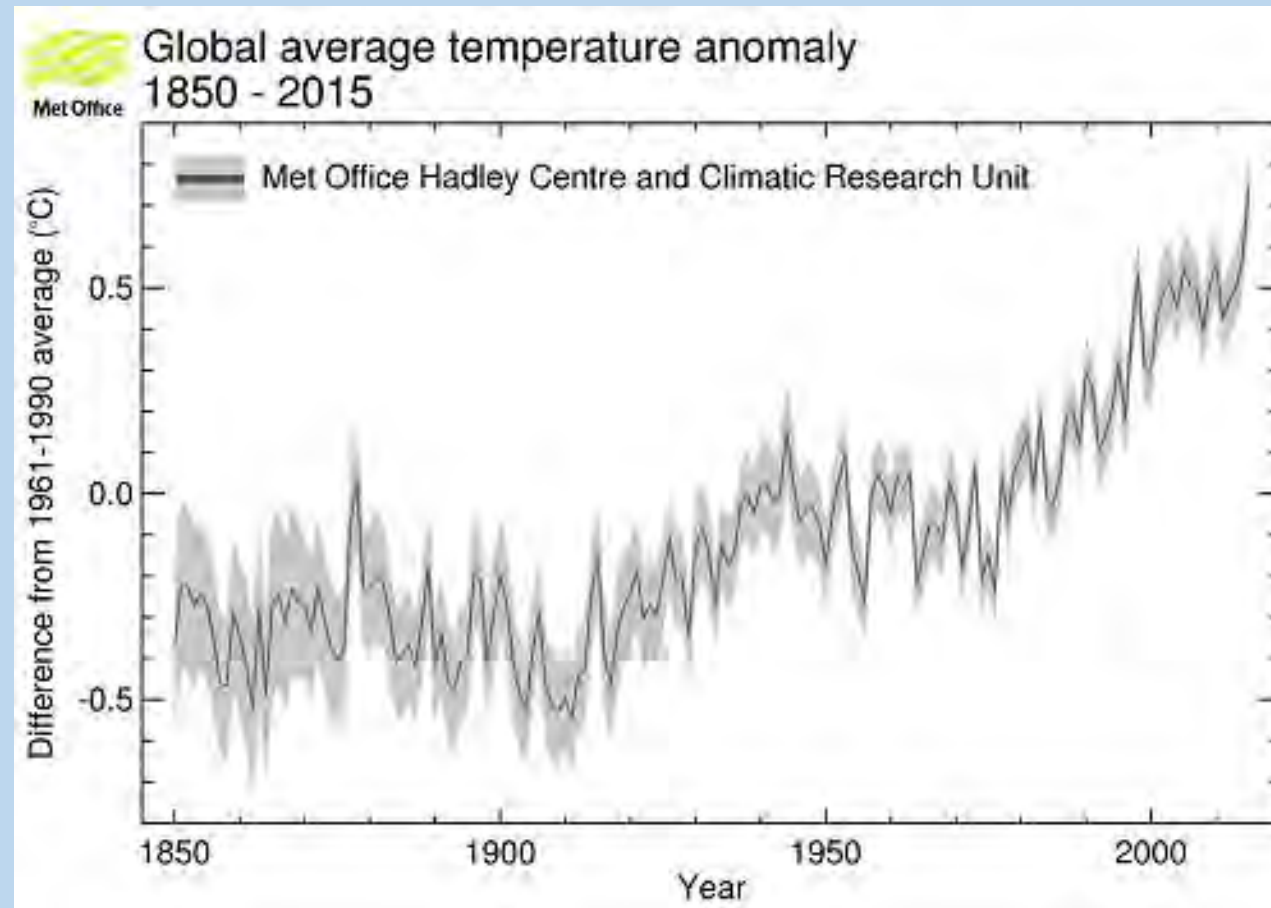
Change in ocean heat content (in joules) from the full ocean depth, from 1960 to present. Shading provides an indication of the confidence range of the estimate.



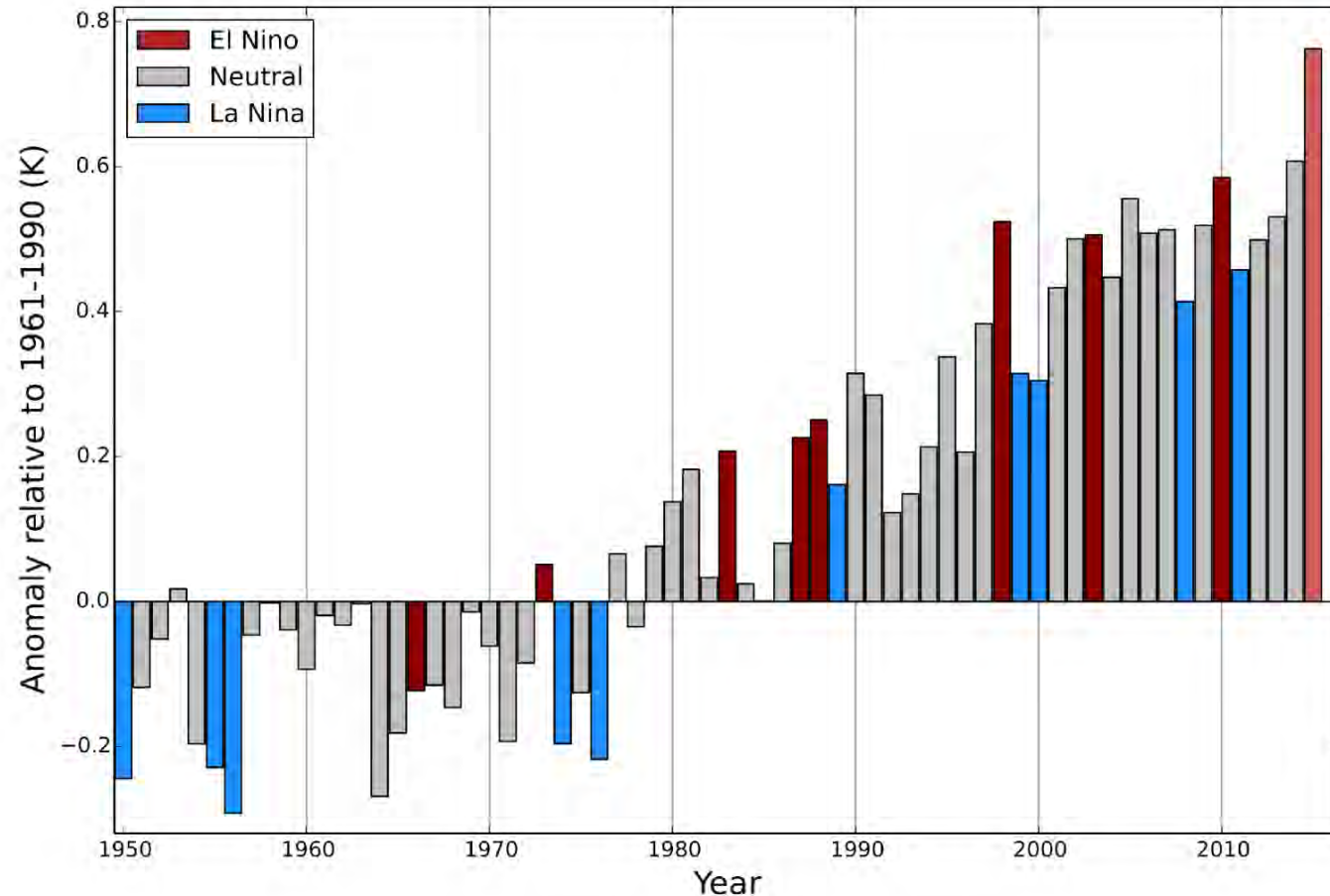
<http://www.bom.gov.au/state-of-the-climate/>

2015 had the highest global average temperature since reliable worldwide records began to be kept in the mid 1800s. The global average temperature has now risen one full degree Celsius above pre-industrial levels. 15 of the 16 warmest years on record have occurred in the 21st century.

Graph Source: <http://www.metoffice.gov.uk/news/releases/archive/2016/2015-global-temperature>

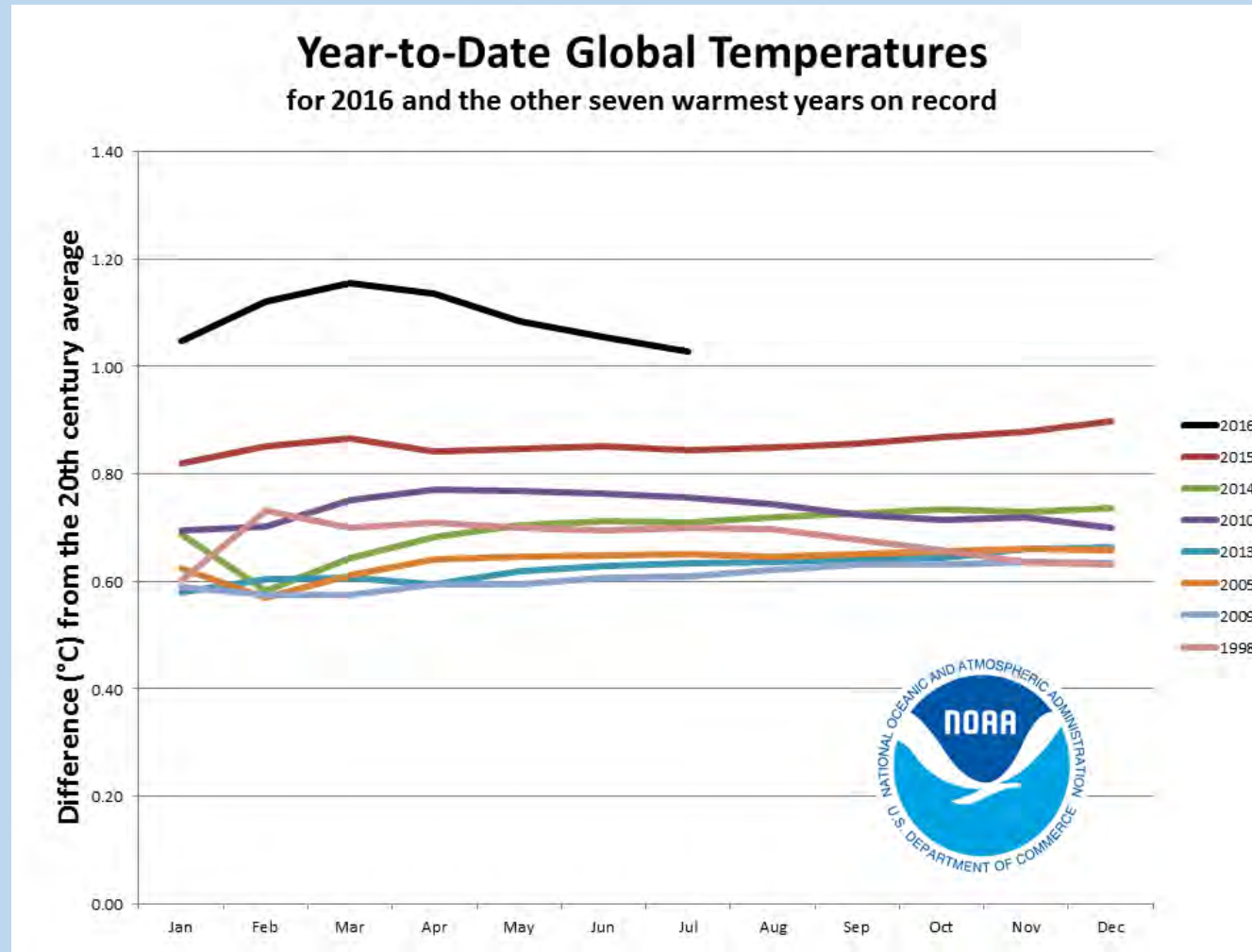


El Nino years and La Nina years have both been getting steadily warmer, particularly since 1980. 2015 was an El Nino year – the warmest on record.



The average global land and ocean surface temperature for January–July 2016 was 1.03°C (1.85°F) above the 20th century average of 13.8°C (56.9°F)—the highest global land and ocean temperature for January–July in the 1880–2016 record, surpassing the previous record set in 2015 by 0.19°C (0.34°F).

Source: <http://www.ncdc.noaa.gov/sotc/global/2016/7/supplemental/page-2>



Update on Examples of Climate Change Impacts:

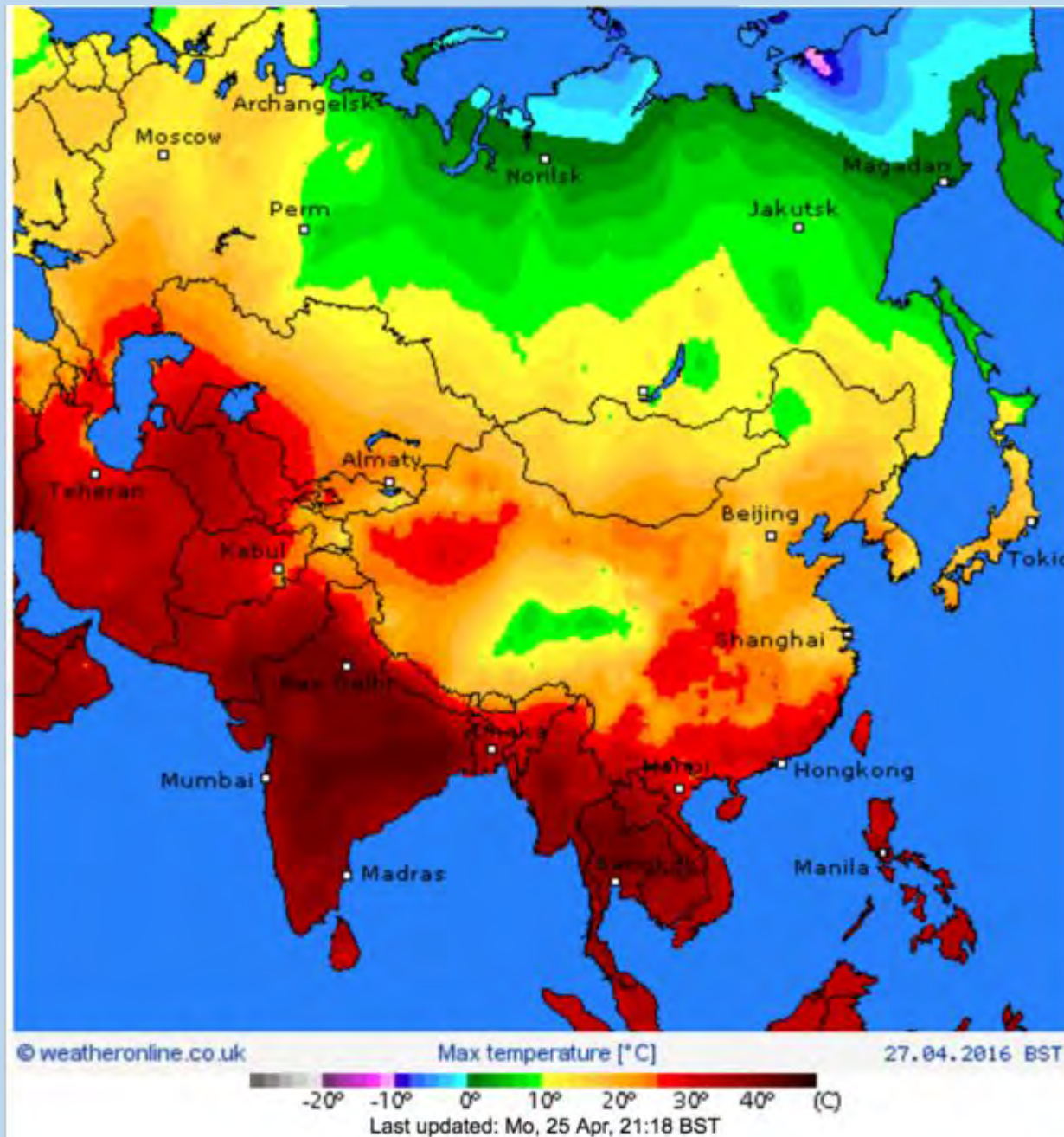
#1 Melting on Greenland

Almost 12% of Greenland's ice sheet was melting on April 11, 2016 exceeding the previous record for a melt of more than 10% in extent by over three weeks. The previous record was set on May 5, 2010.

Sources: Danish Meteorological Institute and the Guardian, April 13, 2016 Also see:

<http://www.theweathernetwork.com/news/articles/six-metre-sea-level-rise-ahead-as-world-warms-study/54062>





#2 Extreme Heat

Temperatures across Asia in the last week of April 2016 were consistent with the influence of climate change combined with El Nino.

Temperatures Updated
as of April 25, 2016
Source: Voice of America
News, April 27, 2016

India set a new high temperature record in May 2016

- India recorded its highest-ever temperature on May 19, 2016 when the heat in the town of Phalodi, in the western state of Rajasthan, shot up to a burning 51 degrees Celsius.
- In New Delhi, the capital, the temperature reached nearly 47 degrees Celsius on May 18th.
- [Source: http://www.cnn.com/2016/05/20/asia/india-record-temperature/](http://www.cnn.com/2016/05/20/asia/india-record-temperature/) May 23, 2016

New high temperature records were set for the eastern hemisphere in July 2016 in the Middle East

Source: <http://public.wmo.int/en/media/news/wmo-examines-reported-record-temperature-of-54%C2%B0c-kuwait> July 26, 2016 World Meteorological Organization News Release

- Mitrabah, Kuwait, set a new highest temperature record for the Eastern hemisphere and Asia, with a reported temperature of 54.0°C (129.2°F) on 21 July 2016.
- The city of Basra in Iraq recorded a temperature of 53.9°C (128°C) on Friday 22 July 2016.

Update on Examples of Climate Change Impacts Continued

3 Hunger in Africa:

- IPCC confirms big impacts in Africa have already occurred, with a decline in fruit bearing trees in the Sahel and reduced fisheries productivity in the Great Lakes and Lake Kariba.
- In 2014 IPCC forecast major climate change driven food security issues for Africa as early as the 2020's.
- **Now in 2016 a combination of El Nino and climate change is already putting many African countries at high risk of widespread hunger: Ethiopia, Lesotho, Malawi, Mozambique, South Africa, Swaziland, Zambia and Zimbabwe are all at risk. More than 36 million people face hunger on the southern and eastern parts of the continent.**
- Sources: Intergovernmental Panel on Climate Change (Impacts, Adaptation and Vulnerability, 2014) and The Guardian, March 21, 2016 ('Current record-shattering temperatures are shocking even to climate scientists')



4 Intense rainfall events are becoming more frequent as the atmosphere warms. This photo shows flooding in Sudan on August 6, 2016, with 13 of 18 provinces affected. Within a day of these floods major flooding was also occurring in Macedonia, in western Gujarat state of India and in Karachi, Pakistan. Later in August, close to 2 feet of rain fell in a 48 hour period in parts of southern Louisiana.

Source: <https://www.theweathernetwork.com/news/articles/four-deadly-floods-taking-place-right-this-second/70911/> August 7, 2016



5 Climate change is increasing the power of hurricanes/typhoons. This photo shows the aftermath of Typhoon Haiyan which battered the Philippines in November 2013. Sustained wind speed: 315km/hr Gusts of up to 378km/hr Over 6,000 people died.



Pope Francis: The poor “ have no other financial activities or resources which can enable them to adapt to climate change or to face natural disasters”.

In 2015 the World Meteorological Organization reported on another example of record high hurricane speeds:

- Tropical cyclone Patricia hit Mexico on October 20, 2015 as the strongest hurricane on record in either the Atlantic or eastern north Pacific, with sustained wind speeds of 325km/h and gusts much higher.
- Fortunately, it hit a relatively unpopulated part of Mexico, but brought home the reality that storm systems in the Americas are becoming more and more dangerous.

Source: World Meteorological Organization: <http://public.wmo.int/en/media/news/hurricane-patricia-strongest-recorded-eastern-north-pacific>

The UN reports the decade 2005-2015 saw almost twice as many weather disasters as in 1985-94. (The photo illustrates Hurricane Nargis bringing torrential rain to Myanmar in 2008. That hurricane ultimately killed 138,000 people.)

Source: <http://www.theguardian.com/environment/2015/nov/23/weather-disasters-occurred-almost-daily-over-last-decade-un-says>



#6 Sea level rise: In this slide the sea washes through downtown Majuro, the capital of the Marshall Islands. Globally, sea levels are rising at an average of 3.2 mm per year. In the Marshall Islands, scientists have found that every 3cm of sea-level rise causes an inundation to reach 30 metres further inland.

Sources: IPCC 2013 (The Physical Science Basis) and the Guardian



Photograph: The Marshall Island Journal

7 Pollinators are being negatively impacted

For instance, the journal *Science* reported on July 10, 2015 that the geographical range of bumblebees is shrinking due to climate change. In both North America and Europe, the southern historical range of bumblebees has shrunk by about 300 kilometres. At the same time, the bees northern range has not expanded.

Bumblebees are a keystone species and help pollinate many crops such as blueberries, cherries, tomatoes & clover.



Study Title: *Climate change impacts on bumblebees converge across continents*

Photo credit: <http://www.trinitynewsdaily.com/wp-content/uploads/2015/07/>

Bumblebee-Populations-Shrinking-at-Alarming-Rate-due-to-Global-Warming.jpg

#8 Coastal Fisheries Decline Near The World's Small Islands

- In 2014 IPCC concluded that climate change is causing increased degradation of coastal fisheries on the world's small islands, especially due to coral reef bleaching.
- WWF estimates 850 million people depend on coral reefs for food security.



Source: Intergovernmental Panel on Climate Change Working Group 2, 2014 Summary for Policy Makers

#9 Coral Reef Die-Off and Severe Bleaching Events Due To Rising Ocean Temperatures

Major coral reef sites are seen as red dots on this world map. Most of the reefs, with a few exceptions are found in tropical and semitropical waters, between 30° north and 30° south latitudes.



Source: http://www.coris.noaa.gov/about/what_are/ Value: Biodiversity, Fisheries, Coastal protection, Tourism

In 2016 many coral reefs were hit by extremely serious bleaching and die-off events caused by record warming of the oceans. The photo below shows dead coral in shallow waters at Cygnet Bay in Western Australia.

Source: Photograph: STR/AFP/Getty Images <https://www.theguardian.com/environment/2016/aug/17/the-coral-die-off-crisis>



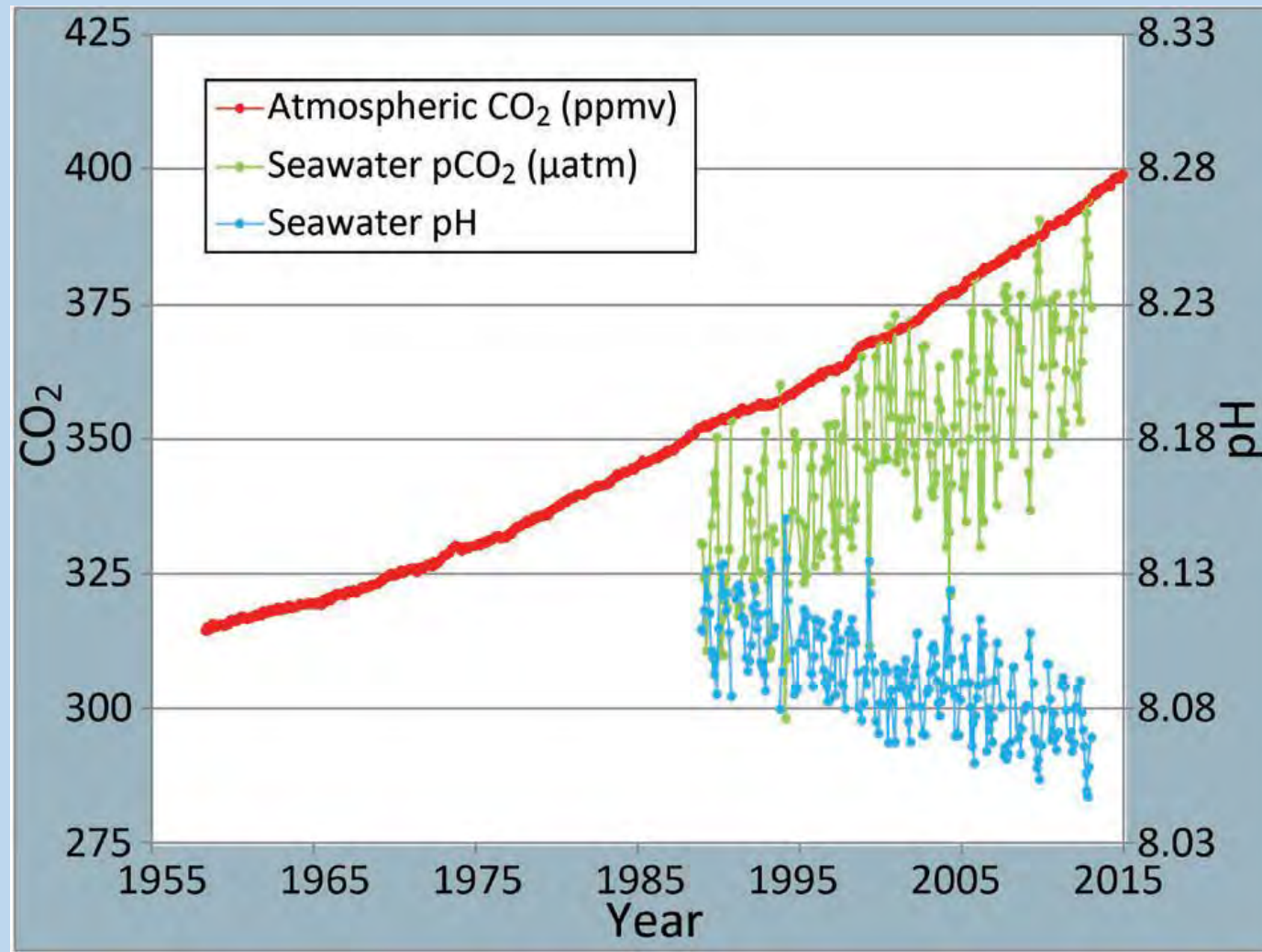
In another example, coral reef bleaching hit more than 60% of the coral reefs in the Maldives Photo: August 8, 2016 Hudhuranfushi Island, North Male atoll

Source: <https://www.theguardian.com/environment/2016/aug/08/more-than-60-of-maldives-coral-reefs-hit-by-bleaching#img-1>



10 Rising concentrations of carbon dioxide in the atmosphere and in seawater are leading to increased acidity of the oceans (declining pH) Everyone will be affected by the declining ability of the oceans to support shell forming life.

Source: <http://westcoastoah.org/wp-content/uploads/2016/04/OAH-Panel-Key-Findings-Recommendations-and-Actions-4.4.16-FINAL.pdf>



11 Negative Health Impacts

Title of a recent study: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment April 15, 2016

Quote from the study:

- **“ The health threats from climate change are expected to worsen. These include increases in exposure to excessive heat, more frequent, severe, or longer-lasting extreme weather events, degraded air quality, diseases transmitted through food, water, and vectors (such as ticks and mosquitoes), and even stresses to mental health”.**

Linking Events In Saskatchewan To Climate Change

- Part of our challenge in making climate change issues a high priority in Saskatchewan is that our own province is feeling the effects of climate change less than many other parts of the world.
- However, some climate change effects are beginning to be felt here. Heavy precipitation events, rising Provincial Disaster Assistance expenditures, and an unprecedented 2015 forest fire season are three examples. Here is a quick update on each.



A Saskatchewan example of flooding events where climate change likely had a role: In June 2011 southwest Saskatchewan was hit by a 1 in 100 year rainfall event. This photo shows much of Roche Percee, a village of 147 people in southeast Saskatchewan, under water. The flooding followed a June 2011 weekend of extremely heavy rains and the unavoidable release of water from major dams in the area.
(continued on next 2 slides)



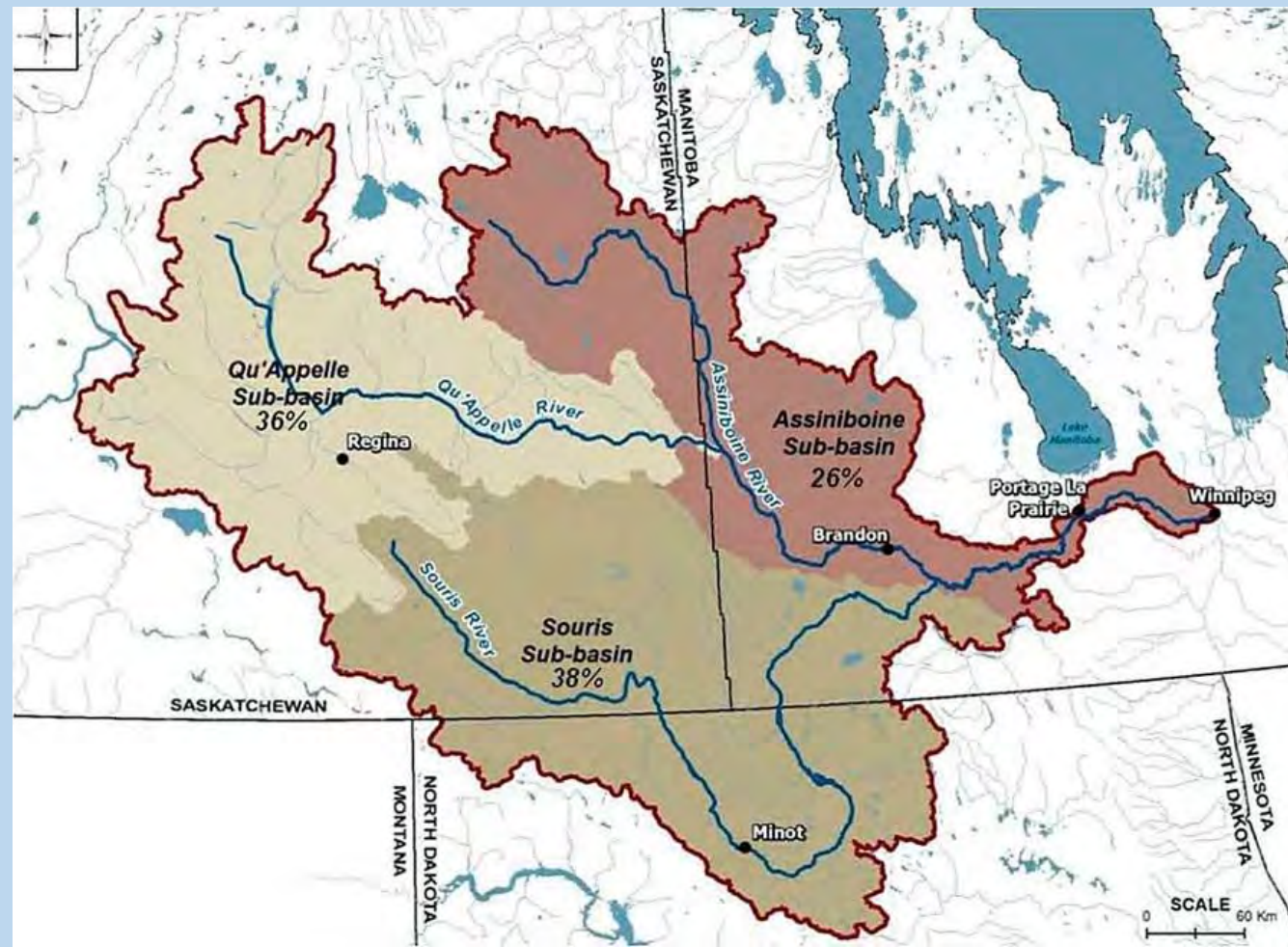
Source: CBC Saskatchewan, June 20, 2011 'Tiny town submerged by Saskatchewan flood'

Southeast Saskatchewan was hit again in June 2014, as was southwest Manitoba. In Saskatchewan thousands of basements flooded, crops were lost, and there was extensive damage to critical infrastructure. Over 160 communities were approved for Provincial Disaster Assistance. At the time, the Saskatchewan Environmental Society pointed out that these events were very consistent with the impacts that can be expected from climate change.



Photograph by: Don Healy, Regina Leader-Post on June 30, 2014 The washout of Highway 13 just west of Redvers in southeast Saskatchewan

A formal publication looking at worldwide climate events, including the June 2014 flooding in Saskatchewan, has been published by the American Meteorological Society. This November 2015 report is entitled “Explaining Extreme Events of 2014”. It finds significant signs that there may be a link between climate change and the June 2014 floods in southeast Saskatchewan. Moreover, extensive drainage of wetlands in the Assiniboia River Basin further amplified flooding impacts.



**Bulletin of the American
Meteorological Society
2015**

THE RISE IN SASKATCHEWAN'S PROVINCIAL DISASTER ASSISTANCE PROGRAM SPENDING

Fiscal Year Ending March 31st	Total Spending
2002	\$1,500,000
2003	\$1,675,000
2004	\$ 618,000
2005	\$ 276,000
2006	\$15,154,000
2007	\$ 9,866,000
2008	\$31,378,000
2009	\$14,486,000
2010	\$10,440,000
2011	\$48,150,000
2012	\$157,115,000
2013	\$72,597,000
2014	\$46,816,000
2015	\$110,443,000

Source: Annual data was compiled using Volume 2 of the Saskatchewan Government Public Accounts for each of the fiscal years 2001-2002 through to 2013-15 Compiled by Peter Prebble, Director of Environmental Policy, Saskatchewan Environmental Society

One of the results of a warmer than average summer in western Canada in 2015 was a very difficult wild fire season. The impacts on northern Saskatchewan were unprecedented. By July 7, 2015 13,000 northerners in 51 communities had been forced to leave their homes. In total 1.7 million hectares of forest in northern Saskatchewan burned over the course of 2015.

Sources: Canadian Press, June 30, 2015 "Saskatchewan out of firefighting funds as more than 3,000 evacuated from north"

"Some remain in La Loche as nearest fire comes within five kilometres" Star Phoenix, June 30, 2015

"Thousands evacuated as Western Canada burns" <http://www.theweathernetwork.com/news/articles/thousands-evacuated-as-western-canada-burns/53793/> July 6, 2015

<http://www.theweathernetwork.com/news/articles/thousands-evacuated-as-western-canada-burns/53793/> July 7, 2015

<http://www.theweathernetwork.com/news/articles/alberta-gets-an-early-start-to-wildfire-season/63804> This article contains the reference to 1.7 million hectares burning in Saskatchewan in 2015.



It is not just western North America suffering these forest fire impacts. In many parts of the world, the wildfire season is becoming longer and more intense due to climate change. Unprecedented blazes are occurring. One recent example is the fires that broke out in January 2016 in Tasmania's World Heritage Site wilderness area. They burned trees over 1,000 years old, including in alpine areas never before touched.

Photo source: <http://www.smh.com.au/environment/pr-war-over-fires-in-tasmanias-world-heritage-area-takes-to-the-air-20160212-gmstxz.html>



Tasmania World Heritage Wilderness Area



Lightning strikes start unprecedented fires in Tasmania's wilderness area. January 2016.



- In 2015 Pope Francis released *Laudato Si'*: “The natural environment is a collective good, the patrimony of all humanity and the responsibility of everyone.”
- “Our goal... is to dare to turn what is happening to the world into our own personal suffering and thus to discover what each of us can do about it.”
- “There is an urgent need to develop policies so that, in the next few years, the emission of carbon dioxide and other highly polluting gases can be drastically reduced, for example, substituting for fossil fuels and developing sources of renewable energy.”

On December 12, 2015 an international climate change accord was reached in Paris, France bringing to fruition years of challenging UN negotiations. A central part of the accord is a target on limiting global average temperature rise.

Photo Source: World Meteorological Organization, December 14, 2015 news release 'Historic Paris Agreement on Climate Change'



New Temperature Objective Set in the Paris Agreement

- Representatives of the 195 countries gathered in Paris agreed to strengthen the global response to the threat of climate change by ***“holding the increase in the global average temperature to well below 2 degrees C above pre-industrial levels”*** and by pursuing efforts ***“to limit the temperature increase to 1.5 degrees C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.”*** This target implies a much more rapid phase-out of fossil fuels than observers had been expecting.

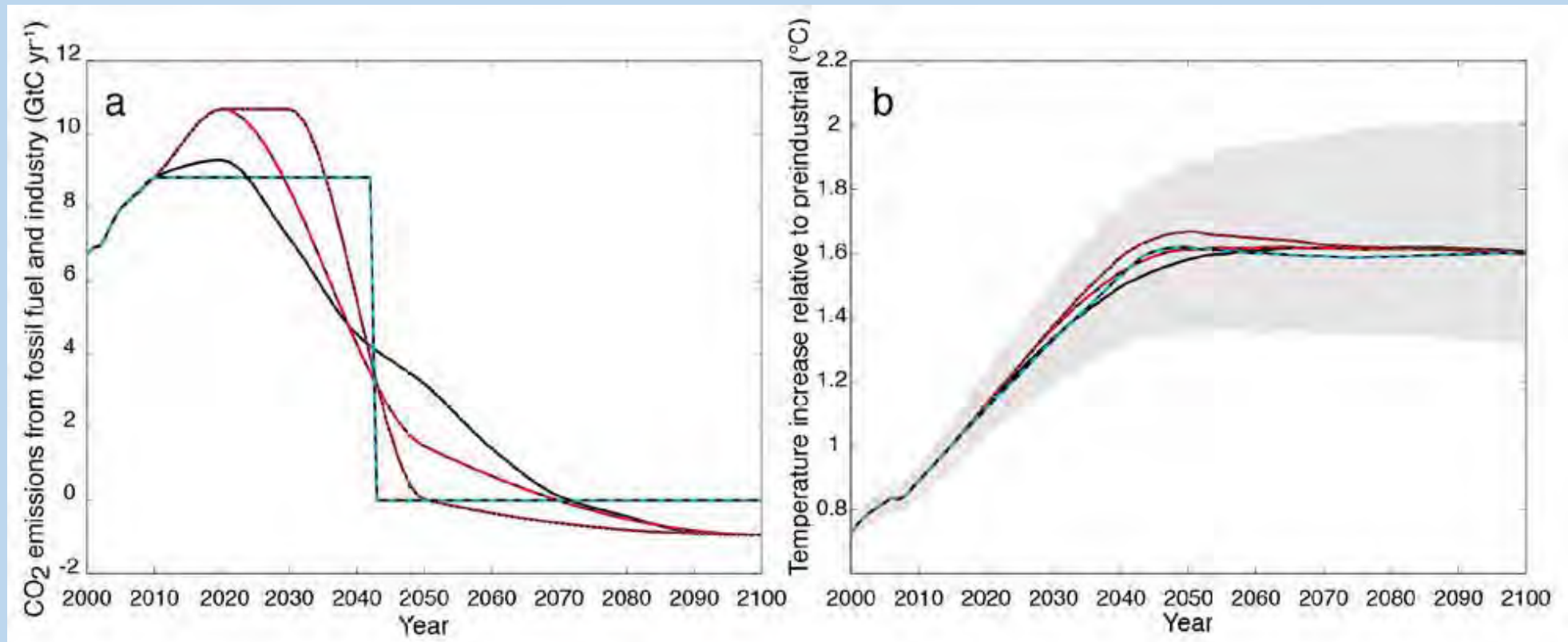
Moving to net zero emissions

The Paris agreement also aims to reach global peaking of greenhouse gas emissions *“as soon as possible”* and commits countries to take emission reductions thereafter *“so as to achieve*

a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.” In practical terms this means getting to net zero emissions, a measure that can only be achieved by phasing out fossil fuels.



The pace of greenhouse gas emission reduction required to achieve the Paris 'temperature targets' corresponds closely to this chart in the Intergovernmental Panel for Climate Change 2013 Report.



Weaknesses of the Paris Agreement

- In my view, one missing element in the agreement is its failure to specify limits on the actual production and extraction of fossil fuels worldwide.
- A second weakness is that the national pledges for emission reduction and the commitments for financial support for developing countries are not legally binding. In part, this is an attempt by UN negotiators to craft an agreement that President Obama can commit the United States to, without the President having to take it to the US Congress and Senate for approval.

Gap between UN temperature target and planned national actions

- 188 countries have now filed pledges with the United Nations outlining actions they will take to limit greenhouse gas emissions. If all pledges are acted upon, global average temperature would rise to between 2.7 and 3.0 degrees Celsius above pre-industrial
- Canada's current pledge is a 30% reduction below 2005 greenhouse gas emission levels by 2030. The new federal government has indicated it is seeking to make that pledge more ambitious, but the outcome of negotiations with the provinces is still uncertain.

Advice on the world's remaining carbon budget from the IPCC

To have a 66% chance of staying below an average global temperature increase of 2 degrees C (the United Nations official objective), the Intergovernmental Panel on Climate Change recommends humanity's total global carbon release should not exceed 790 billion tonnes. As of 2011 it was 515 billion tonnes, and rising at 10.4 billion tonnes per year.

Source: IPCC 2013: Physical Science Basis

On February 15, 2016 Fiji became the 1st country in the world to ratify the Paris climate agreement – by a unanimous resolution in Parliament.

Sources: <http://www.theweathernetwork.com/news/articles/tropical-cyclone-winston-intensifies-as-it-approaches-fiji-/63931/>
<http://www.theguardian.com/environment/2016/feb/15/fiji-becomes-first-country-in-the-world-to-ratify-paris-agreement>



Fiji's capital city of Suva.

On August 5, 2016 the United States and China both agreed to ratify the international climate change treaty. This will bring the number of countries to have ratified to 26. Together they will account for over 38% of global emissions.



Hopeful Sign: Renewable power installations are outpacing new fossil fuel installations for electricity generation worldwide, although not yet in Saskatchewan

- Worldwide in 2015 new installations of renewable power outpaced new installations of fossil fuel – generated electricity by a wide margin.
- Wind and solar accounted for 2/3 of new capacity on the US grid in 2015.
- In early 2016, for the first time, solar power outpaced coal in electricity production in the United Kingdom.
- In contrast, only 3% of Saskatchewan's electricity comes from wind power and only a very tiny portion from solar. Coal provides 46% of Saskatchewan's electricity.

Sources: The Guardian, March 31, 2016 and Annual Reports of SaskPower



An Estimate of the Economic Costs of Saskatchewan GHG Emissions by Peter Prebble

- The US government estimates that a tonne of carbon dioxide – when released into the atmosphere – causes \$37 of harm in today's dollars
- Applying this value to Saskatchewan's 75 million tonnes of emissions annually nets a figure of over \$2.7 billion per year in damage we cause to the rest of the world.

Source for value of carbon dioxide per tonne: "Improve economic models of climate change", *Nature*, Richards L, Revesz et al. Volume 508, April 10, 2014 The authors refer to the Interagency Working Group on Social Cost of Carbon. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis, US Government, 2013.

Saskatchewan Environmental Society recommendations to Saskatoon City Council

- Detailed assessment of current community wide GHG emissions – now committed to by Council
- Net metering – now committed to by Council
- Community-wide GHG reduction target
- Progressive energy efficiency provision in Saskatoon's building code
- Net zero energy construction to be standard practice within 10 years.
- Each new neighbourhood design should fully utilize solar energy.
- Develop a model 'low GHG emission neighbourhood' – every house is super-insulated and uses solar energy.

SES Recommendations to Saskatoon City Council continued: electricity policy

- City is asked by SES to facilitate payment of capital costs for solar power installations
- City asked to seek SaskPower co-operation to build a wind farm outside Saskatoon
- City Council asked to encourage Saskatoon Light and Power to do large scale direct installation of electricity efficient technologies
- LED street lighting in every Saskatoon neighbourhood, not just new neighbourhoods
- Adopt a bylaw to regulate over-lighting on signs

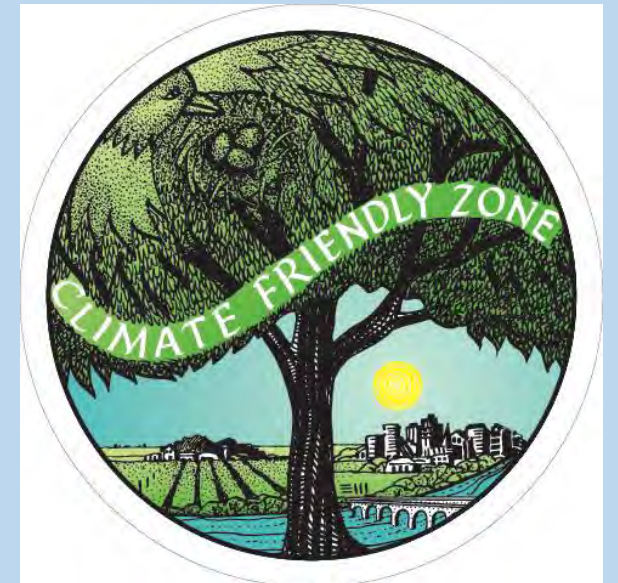
Saskatchewan Environmental Society transport recommendations to Saskatoon City Council

- City of Saskatoon is asked to establish incentives for ultra-low emission vehicles
- City is asked to adopt an idle-free bylaw: no idling for more than 3 minutes in the spring, summer and autumn/ exemptions for police, fire and other emergency service vehicles
- Comprehensive system of bicycle paths
- Higher targets for transit ridership; lower bus fares; better maintenance of snow around bus shelters



For more information:

- Contact Peter Prebble at 306-665-0085 or at prebble@sasktel.net
- Check out the SES Solar Co-op web site at: www.sessolarcoop.ca
- Check out Angie Bugg's extensive work on energy conservation including Building Operator Training, 25 Acts of Energy Conservation, and Student Action for a Sustainable Future
- Check out the SES Climate Friendly Zone Campaign Hayley Carlson cfz@environmentalsociety.ca
- Check out the Guardian which has an outstanding set of environmental web pages.



Building An Environmentally Sustainable Future for Saskatchewan: Saskatchewan's
Role in Global Climate Change and the Path to Sustainability
March 2015 Canadian Centre for Policy Alternatives



By Peter Prebble, David Henry, Murray Hidlebaugh & Bill Wardell

https://www.policyalternatives.ca/sites/default/files/uploads/publications/Saskatchewan%20Office/2015/03/Sustainable_Future_for_SK.pdf