

We are in big trouble

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By Justin Gillis

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Global warming is daunting. So here's a place to start: Often-asked questions with some straightforward answers.

WHAT IS HAPPENING?

Climate change or global warming? Both are accurate, but they mean different things. You can think of global warming as one type of climate change. The broader term covers changes beyond warmer temperatures, such as shifting rainfall patterns. Scientists have used both terms for decades.

HOW MUCH IS THE EARTH HEATING UP?

Two degrees is more significant than it sounds. As of early this year, the Earth had warmed by roughly 2°F (more than 1°C) since 1880, when records began at a global scale.

The number may sound low, but as an average over the surface of an entire planet, it is actually high, which explains why much of the world's land ice is starting to melt and the oceans are rising at an accelerating pace. If greenhouse gas emissions continue unchecked, scientists say, the global warming could ultimately exceed 8°F, which would undermine the planet's capacity to support a large human population.

WHAT IS THE GREENHOUSE EFFECT, AND HOW DOES IT CAUSE GLOBAL WARMING?

We've known about it for more than a century. Really.

In the 19th century, scientists discovered that certain gases in the air trap and slow down heat that would otherwise escape to space. Carbon dioxide is a major player; without any of it in the air, the Earth would be a frozen wasteland. The first prediction that the planet would warm as humans released more of the gas was made in 1896. The gas has increased 43 per cent above the pre-industrial level, and the Earth has warmed by roughly the amount scientists predicted it would.

HOW DO WE KNOW HUMANS ARE RESPONSIBLE FOR THE INCREASE IN CARBON DIOXIDE?

This one is nailed down. Hard evidence, including studies that use radioactivity to distinguish industrial emissions from natural emissions, shows that the extra gas is coming from human activity. Carbon dioxide levels rose and fell naturally in the long-ago past, but those changes took thousands of years. Geologists say humans are pumping the gas into the air much faster than nature has ever done.

COULD NATURAL FACTORS BE THE CAUSE OF THE WARMING?

No. In theory, they could be. If the sun were to start putting out more radiation, for instance, that would definitely warm the Earth. But, scientists have looked carefully at the natural factors known to influence planetary temperature and found that they are not changing nearly enough.

The warming is extremely rapid on the geologic timescale, and no other factor can explain it as well as human emissions of greenhouse gases.

HOW MUCH TROUBLE ARE WE IN?

Big trouble. Over the coming 25 or 30 years, scientists say, the climate is likely to gradually warm, with more extreme weather. Coral reefs and other sensitive habitats are starting to die. In the long-term, if emissions rise unchecked, scientists fear climate effects so severe that they might destabilise governments, produce waves of refugees, precipitate the sixth mass extinction of plants and animals in the Earth's history, and melt the polar ice caps, causing the seas to rise high enough to flood most of the world's coastal cities.

The emissions that create those risks are happening, raising deep moral questions for our generation.

HOW MUCH WILL THE SEAS RISE?

The real question is how fast.

The ocean has accelerated and is rising at a rate of about one foot (0.3m) per century, forcing governments and property owners to spend tens of billions of dollars fighting coastal erosion. But, if that rate continued, it would probably be manageable, experts say.

The risk is that the rate will increase.

Scientists who study the Earth's history say waters could rise by one foot per decade in a worst-case scenario, though that looks unlikely.

Many experts believe that even if emissions stopped tomorrow, 15 or 20 feet of sea level rise is inevitable, enough to flood many cities unless trillions of dollars are spent protecting them.

How long it will take is unclear.

But, if emissions continue apace, the ultimate rise could be 80 or 100 feet.

IS RECENT CRAZY WEATHER TIED TO CLIMATE CHANGE?

Some of it is. Scientists have published strong evidence that the warming climate is making heat waves more frequent and intense. It is also causing heavier rainstorms, and coastal flooding is getting worse as the oceans rise because of human

emissions. Global warming has intensified droughts in regions like the Middle East, and it may have strengthened a recent drought in California.

In many other cases, though — hurricanes, for example — the linkage to global warming for particular trends is uncertain or disputed. Scientists are gradually improving their understanding as computer analyses of the climate grow more powerful.

ARE THERE ANY REALISTIC SOLUTIONS TO THE PROBLEM?

Yes, but change is happening too slowly. Society has put off action for so long that the risks are now severe, scientists say.

But, as long as there are still unburnt fossil fuels in the ground, it is not too late to act.

The warming will slow to a potentially manageable pace only when human emissions are reduced to zero. The good news is that they are falling in many countries as a result of programmes like fuel-economy standards for cars, stricter building codes and emissions limits for power plants. But, experts say the energy transition needs to speed up to head off the worst effects of climate change. NYT