The heat in 2016 broke the historic record set in 2015, which broke the one from 2014. Last year’s average global surface temperature, compiled from measurements made by thousands of weather stations, buoys, and ships, was 1.69 degrees Fahrenheit warmer than the 20th-century average. Satellites probing the atmosphere also have documented a clear warming trend.
7 THINGS YOU NEED TO KNOW

Change

We need energy—food, fuel, electricity—to lead modern lives. Billions of people need more of it. But how we get energy is changing the Earth in ways that threaten us all. Can we find a better way? Climate change isn’t a hoax or a scientific conspiracy, it’s a grand challenge. Here are the facts.

2 IT’S BECAUSE OF US.

El Niño added to last year’s record by temporarily releasing heat from the Pacific. But no natural cause explains the half-century warming trend. The sun’s output cycles up and down every 11 years; volcanic eruptions sporadically cool the planet. Meanwhile human-emitted greenhouse gases form a steadily thickening blanket that traps heat at Earth’s surface.

3 WE’RE SURE.

More than nine out of 10 climate scientists agree: Carbon emissions cause global warming. We’ve known about the greenhouse effect since the 1800s. Swedish physicist Svante Arrhenius even predicted in 1896 that carbon dioxide from coal burning would warm the planet. He saw it as a good thing—and just how bad it will be is debatable. But it’s real, and it’s dangerous.
LAST SUMMER the Crystal Serenity, a large cruise ship, sailed through the ice-free Northwest Passage. Days after it passed, researchers off King William Island found the long-lost wreck of H.M.S. Terror, of Britain’s Franklin expedition—which had gotten trapped in the ice in 1846 while searching for the passage. The Arctic has warmed dramatically, and its ice cover has thinned and shrunk (graph, below). That loss speeds the warming, as sunlight is absorbed by dark ocean instead of reflected into space by ice.

Melting sea ice doesn’t raise sea level—it’s already in the water—but melting land ice does. Mountain glaciers are in global retreat. The total sea level rise of eight or nine inches since 1900 has contributed to a sharp increase in flooding along coasts. During Superstorm Sandy, for example, floods and winds caused $68 billion in damage on the U.S. East Coast.

The big threat is the ice sheets covering Greenland and Antarctica. They hold enough ice to raise seas more than 200 feet—and they’re losing it. When Earth was just a bit warmer, 125,000 years ago, they seem to have lost a lot: Sea levels were 20 to 30 feet higher. Such a rise today would swamp coastal cities.

DWINDLING ARCTIC ICE
The Arctic sea surface freezes each winter, but an increasing part of it melts again in the summer. The area that’s still ice-covered in September has declined sharply.

HOW FAST CAN ICE SHEETS FAIL?
A red-suited researcher explores blue pools of meltwater on the Greenland ice sheet (above); since 2002 it has lost an average of 287 billion metric tons of ice a year, according to NASA satellites. Antarctica is losing less, but it’s vulnerable: Much of the West Antarctic ice sheet sits on the seabed, and the floating ice shelves that buttress it are eroding in a warmer ocean—as the calving of a 44-square-mile iceberg into Pine Island Bay illustrates (right). A glacial collapse that would raise sea level several feet could take centuries. Or maybe just decades.
Weather Is Getting Intense.

IN THE CRAPSHOOT that is our weather, climate change loads the dice. It doesn’t cause a particular drought or storm, but it makes such events more or less likely—and in the case of heat waves, a lot more likely. The extraordinary heat wave that killed some 70,000 people in Europe in 2003 should have been a once-in-500-years event; at the current level of global warming, it has become a once-in-40-years event, according to a study published last year. In Paris alone, that analysis found, climate change caused 506 excess deaths in 2003. If it continues unchecked, another recent study said, by late this century people living along the Persian Gulf may face many days so hot that it will be unsafe to go outside.

It’s not just the heat: Global warming adds moisture to the air, removing it from land and ocean. Where rain is lacking, it makes the drought worse. When rain or snow falls, it’s more likely to be extreme; think of the 2016 floods in Paris or Houston. How climate change affects hurricanes and other tropical cyclones is less certain. But by heating the ocean—the storms’ energy source—it’s likely to make them more intense, if less frequent.

UNNATURAL DISASTERS
Globally, numbers of geologic disasters such as earthquakes are holding steady, while disasters involving parts of the Earth affected by climate change are on the rise.

THE CHANGES MATTER

The Syrian civil war—which has forced millions from the country and killed hundreds of thousands, including the boy above—was ignited in part by a historic drought that drove farmers into cities. Climate change more than doubled the odds of such a drought, a 2015 study says. It also helped temporarily dry up Lake Poopó (far right), Bolivia’s second largest lake until sapped by drought and water diversion. In other spots, like New York City, more water vapor in the air causes heavier snowfalls—but snow also is melting sooner in spring.
Wildlife Is Already Hurting.

CLIMATE CHANGE SPELLS TROUBLE for far more than just the Arctic’s iconic predator, the polar bear. In 2016 scientists announced that the last Bramble Cay melomys, a ratlike rodent found on one low-lying island in Australia’s Torres Strait, had vanished, the victim of forces including rising seas. It’s being called the first documented case of a mammal being driven to extinction by climate change. More will surely follow (figures, below).

Rising temperatures are depressing some plant and animal populations, driving species toward the poles, shifting migrations and behavior. Populations of Adélie penguins on the Antarctic Peninsula have plummeted. An Arctic shorebird called the red knot is getting smaller. Ice loss is forcing walruses by the thousands onto land in Alaska. Entire regions are being transformed: Alpine ecosystems from the Rockies to the Swiss Alps are being squeezed off mountaintops. The exceptional ocean warmth of the past few years has triggered coral bleaching and die-offs at reefs around the world.

There will be winners. For now, humpback whales are thriving in newly ice-free waters off Antarctica. Sea urchins too are proving to be resilient. But climate change isn’t the only threat that spreading human populations impose on other species; we’re also fragmenting and destroying natural habitats. Some species will adapt to the jarring changes in their world—but how many, and for how long?

47% of 976 species surveyed in a 2016 study had vanished from areas they’d previously occupied on the warm edge of their range. This was true across a variety of habitats and suggests they’d been unable to adapt to the changes in climate. Animals were somewhat more likely than plants to have suffered “local extinction.”

1 in 6 species risks global extinction if the climate warms by nearly 8°F. That could happen by 2100 if we don’t cut emissions, according to a 2015 study. Biologically rich regions such as South America and New Zealand would be hardest hit, as land features would block species from moving to keep pace with changing climates.

Sources: John Wiens, Mark Urban

A polar bear swims past melting sea ice outside Naujaat, an Inuit hunting village in Nunavut Territory, Canada. A 2017 U.S. government report says greenhouse gas emissions are the top reason polar bears will likely be gone from much of their range by 2050. Meanwhile, the Great Barrier Reef experienced its largest recorded coral die-off in 2016. Prolonged bleaching killed about 67 percent of corals in one 430-mile stretch. Between March 21 (right) and May 15 (farright), warm water decimated coral colonies off Lizard Island.
We Can Do Something About It.

FREE MARKETS are often lauded for their efficient results. In this connected age, there’s something like a free market of ideas. So ask yourself: If climate change weren’t a serious danger, would 195 countries have signed the Paris Agreement, pledging to try to keep the warming below 2°C (3.6°F)?

Though shadowed by the new U.S. administration’s threat to withdraw from it, the agreement stands as one hopeful sign. The graph below shows another: The cost of solar energy is plummeting. Even without a carbon tax—the most efficient way to wean an economy off fossil fuels—renewables soon may be cheaper sources of electricity. Worldwide they accounted for more than half the new generating capacity in 2015. In the U.S., solar now employs more people than coal, oil, and gas combined.

The switch from fossil fuels is still just beginning. Every little bit matters: Every ton of CO₂ we emit melts 32 square feet of Arctic ice, according to a 2016 study, which means the average American melts 525 square feet a year. Every energy-saving building, retired gas-guzzler, and acre of preserved forest helps. But none of it will help much if the world doesn’t switch to a carbon-free energy supply soon.

CLEAN ENERGY, EVER CHEAPER
As sales of solar panels have exploded, the cost has plummeted faster than experts predicted—a result of technological progress as well as economies of scale.

The 300-megawatt wind farm near Tarfaya, Morocco (above), is one of the largest in Africa—which has a chance to leapfrog part of the carbon era. Wind and solar use a lot of land, though, so Japan is putting solar panels on ponds (right) as well as rooftops. Nuclear power uses less land and runs 24/7, but has safety and waste concerns. Two new reactors being built at the Vogtle plant in Georgia (far right) are among the first in the U.S. since the 1979 Three Mile Island accident. The photo shows the containment structure for one reactor.
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