

THE FRAGILE FRAMEWORK

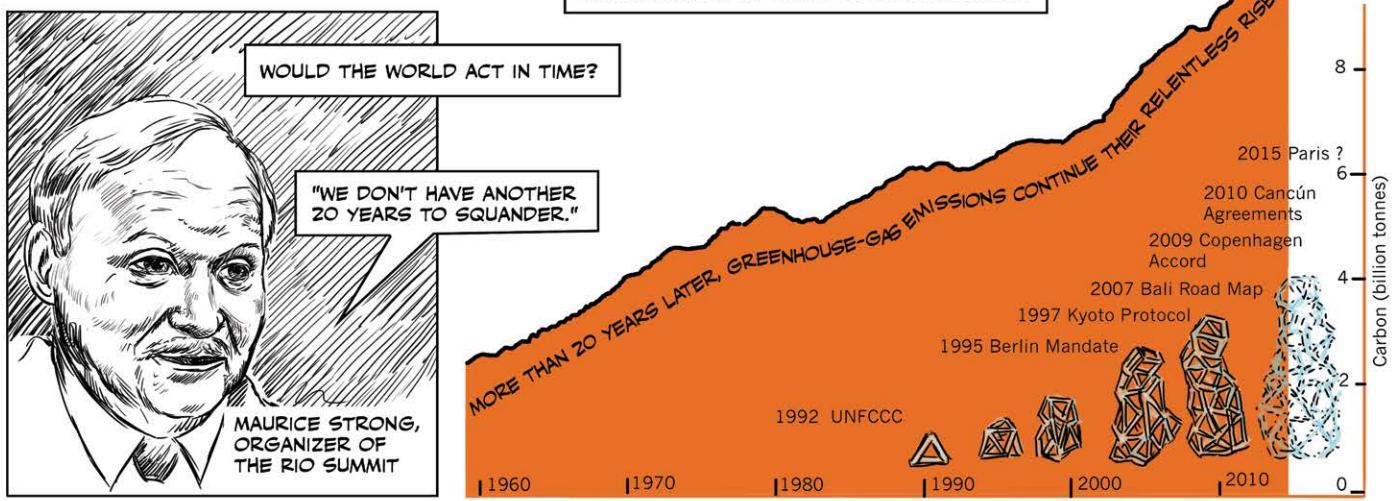
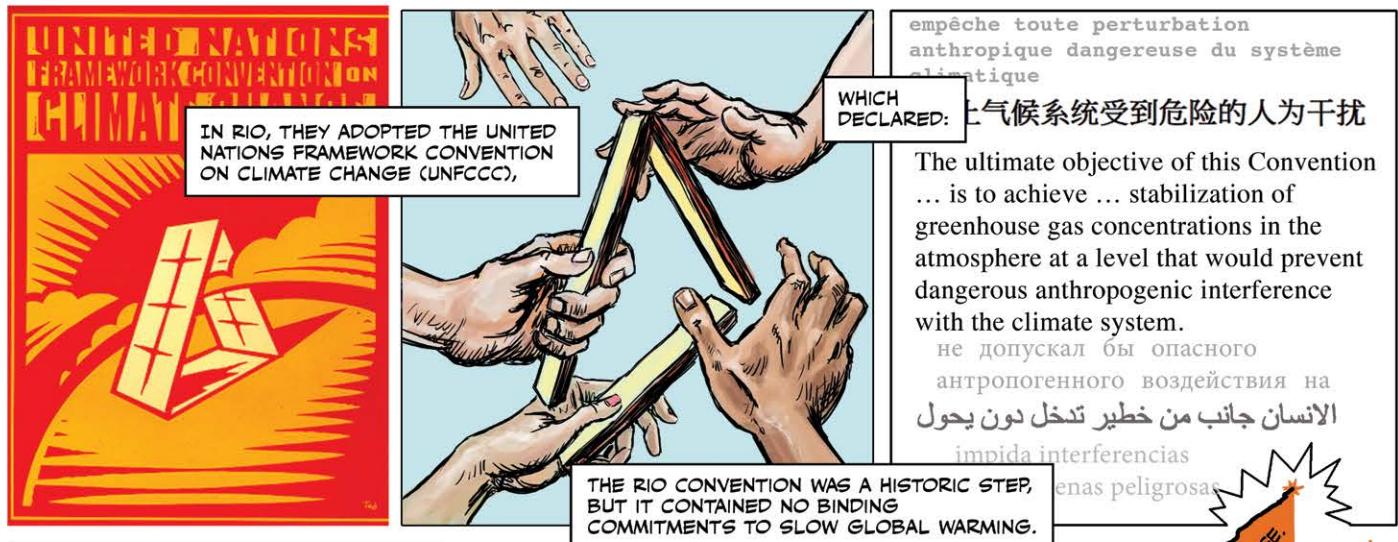
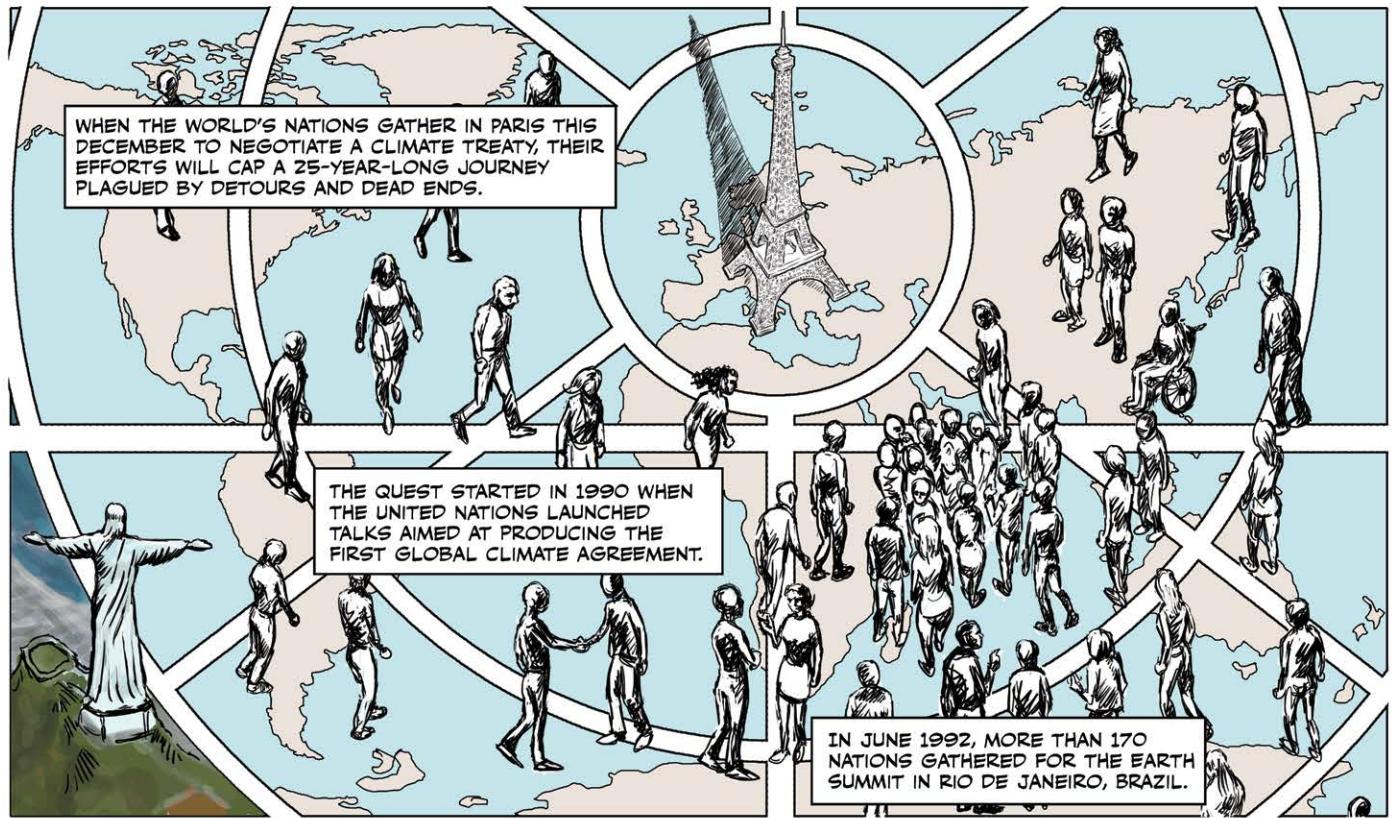
*Can nations unite to save
Earth's climate?*

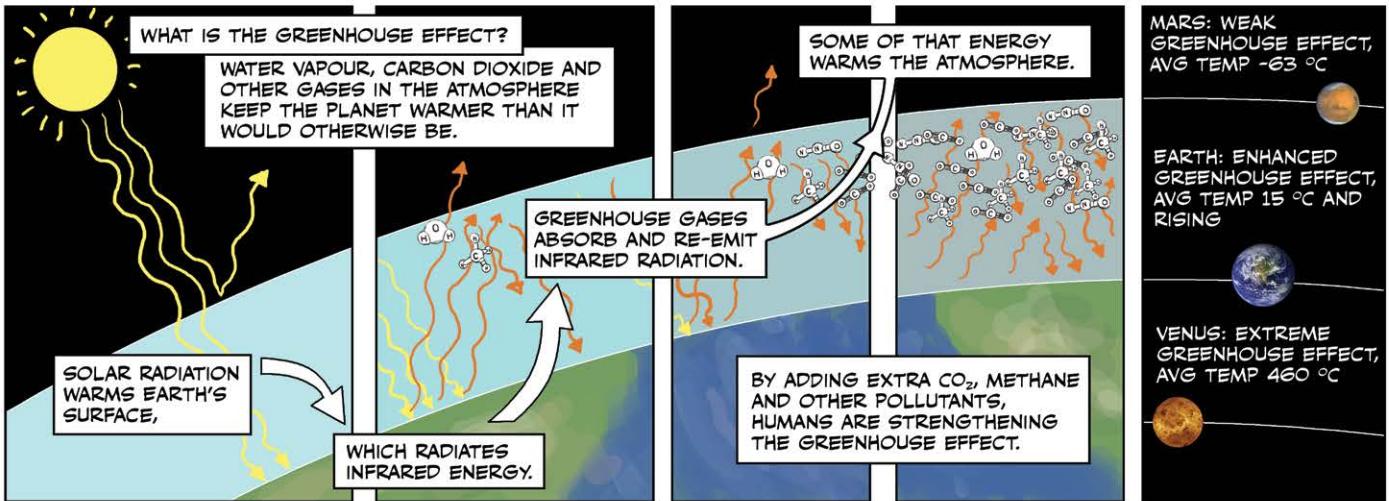


A COMIC BY
RICHARD MONASTERSKY
AND **NICK SOUSANIS**



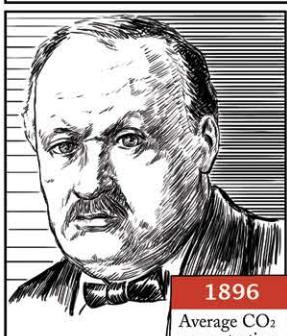
PARIS CLIMATE TALKS
A *Nature* special issue
nature.com/parisclimate





IN 1896, THE SWEDISH SCIENTIST SVANTE ARRHENIUS CALCULATED HOW CHANGES IN THE AMOUNT OF CO₂ IN THE ATMOSPHERE COULD WARM OR COOL EARTH.

THE
LONDON, EDINBURGH, AND DUBLIN
PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE.
APRIL 1896.



1896

Average CO₂ concentration 295 parts per million (p.p.m.)

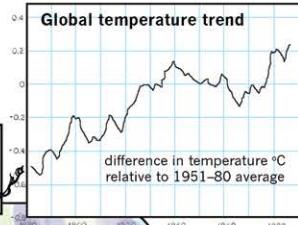
XXXI. On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground. By Prof. SVA

HE LATER SUGGESTED HUMANS WERE RAISING THE PLANET'S TEMPERATURE AND IT WOULD BECOME NOTICEABLE IN A FEW CENTURIES.

Table VII.—Variation of Temperature caused by a given Variation of Carbonic Acid.

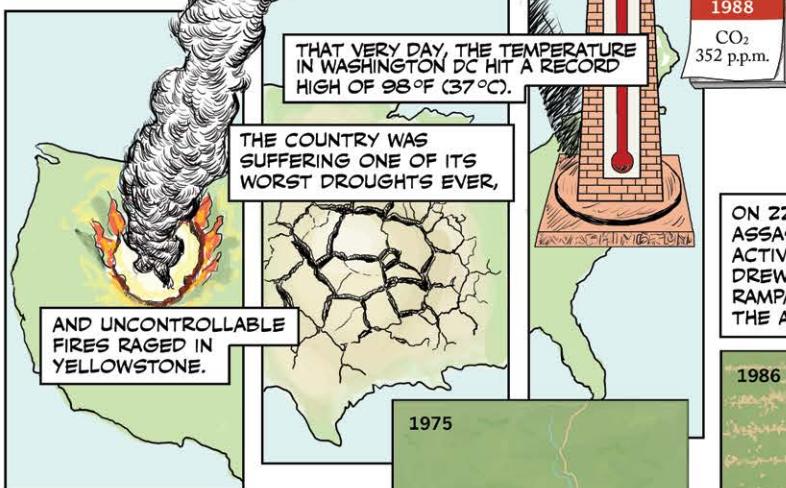
Latitude.	Carbonic Acid +0.01%												Carbonic Acid -0.01%											
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
30°	-25	-20	-18	-21	-31	-21	20	29	37	26	20	10	01	01	01	01	01	01	01	01	01	01	01	01
25°	-22	-18	-16	-19	-28	-18	18	27	35	26	20	11	01	01	01	01	01	01	01	01	01	01	01	01
20°	-20	-16	-14	-17	-26	-16	16	25	33	24	18	9	01	01	01	01	01	01	01	01	01	01	01	01
15°	-18	-14	-12	-15	-24	-14	14	23	31	22	16	7	01	01	01	01	01	01	01	01	01	01	01	01
10°	-16	-12	-10	-13	-22	-12	12	21	29	20	14	5	01	01	01	01	01	01	01	01	01	01	01	01
5°	-14	-10	-8	-11	-20	-10	10	19	27	18	12	3	01	01	01	01	01	01	01	01	01	01	01	01
0°	-12	-8	-6	-9	-18	-8	8	17	25	16	10	1	01	01	01	01	01	01	01	01	01	01	01	01

THE CHANGES CAME MUCH FASTER THAN ARRHENIUS ANTICIPATED.



ON 23 JUNE 1988, NASA SCIENTIST JAMES HANSEN TOLD A US SENATE HEARING THAT HUMANS WERE HAVING A CLEAR IMPACT BY BURNING FOSSIL FUELS SUCH AS COAL, OIL AND NATURAL GAS.

"THE GREENHOUSE EFFECT HAS BEEN DETECTED, AND IT IS CHANGING OUR CLIMATE NOW."



THE COUNTRY WAS SUFFERING ONE OF ITS WORST DROUGHTS EVER,

AND UNCONTROLLABLE FIRES RAGED IN YELLOWSTONE.

THAT VERY DAY, THE TEMPERATURE IN WASHINGTON DC HIT A RECORD HIGH OF 98°F (37°C).

1975

FOSIL FUELS ARE NOT THE ONLY CAUSE OF WARMING. DEFORESTATION ALSO CONTRIBUTES BY RELEASING THE CO₂ STORED IN TREES.

ON 22 DECEMBER 1988, THE ASSASSINATION OF BRAZILIAN ACTIVIST CHICO MENDES DREW ATTENTION TO THE RAMPANT DESTRUCTION OF THE AMAZON FOREST.

1986

Landsat satellite images show forest loss in Rondônia, Brazil.



ALARMED BY THE GROWING PROBLEM, THE UNITED NATIONS CREATED THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) IN 1988 TO ASSESS THE ISSUE.

ipcc



AT THE IPCC'S FIRST MEETING, THE DIRECTOR OF THE UNITED NATIONS ENVIRONMENT PROGRAMME, MOSTAFA TOLBA, IMPLORIED SCIENTISTS TO USE THE TIME LEFT IN THE CENTURY – JUST 4,000 DAYS – TO DEAL WITH CLIMATE CHANGE.

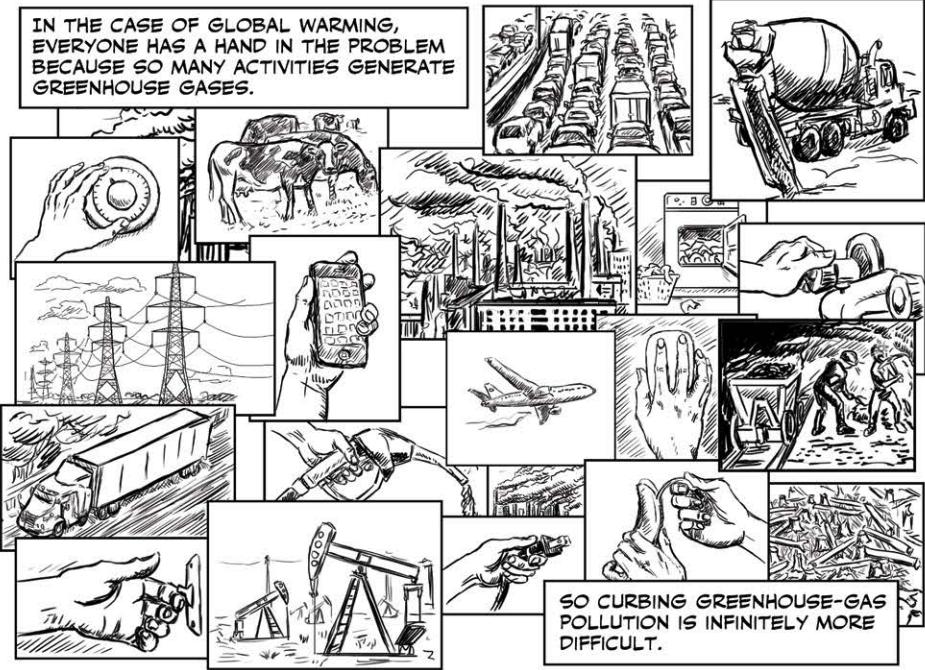
HOPES WERE HIGH BECAUSE THE WORLD HAD ALREADY TAKEN STEPS TO SOLVE ONE ENVIRONMENTAL DISASTER.



IN 1987, NATIONS ADOPTED A TREATY TO PROTECT THE OZONE LAYER.

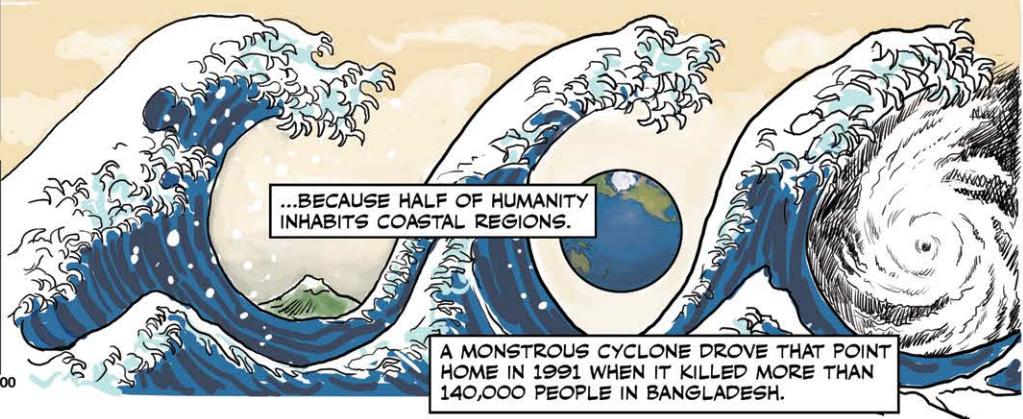
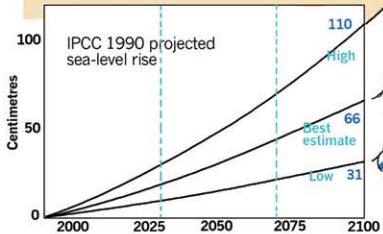
BUT REACHING THAT AGREEMENT WAS RELATIVELY EASY BECAUSE ONLY A HANDFUL OF COMPANIES IN A FEW COUNTRIES PRODUCED OZONE-DESTROYING COMPOUNDS.

IN THE CASE OF GLOBAL WARMING, EVERYONE HAS A HAND IN THE PROBLEM BECAUSE SO MANY ACTIVITIES GENERATE GREENHOUSE GASES.



SO CURBING GREENHOUSE-GAS POLLUTION IS INFINITELY MORE DIFFICULT.

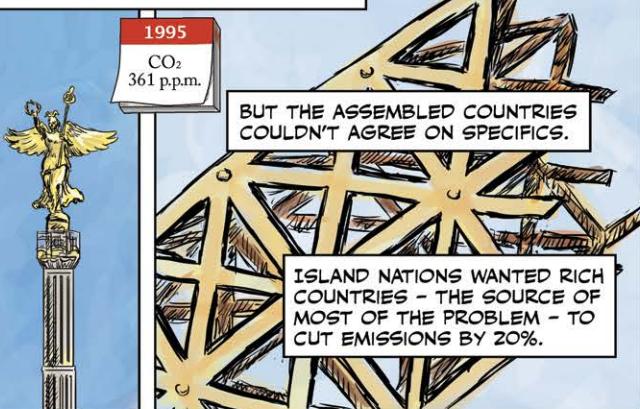
IN ITS FIRST REPORT, THE IPCC FORECASTED THAT IF CURRENT TRENDS CONTINUE UNTIL 2100, THE WORLD WOULD BE 4°C WARMER THAN IT WAS IN 1850. SWELLING OCEANS WOULD BE A MAJOR PROBLEM ...



...BECAUSE HALF OF HUMANITY INHABITS COASTAL REGIONS.

A MONSTROUS CYCLONE DROVE THAT POINT HOME IN 1991 WHEN IT KILLED MORE THAN 140,000 PEOPLE IN BANGLADESH.

THE RIO TREATY WAS CLEARLY NOT ENOUGH, SO NATIONS GATHERED IN 1995 IN BERLIN TO NEGOTIATE A STRONGER ACCORD.



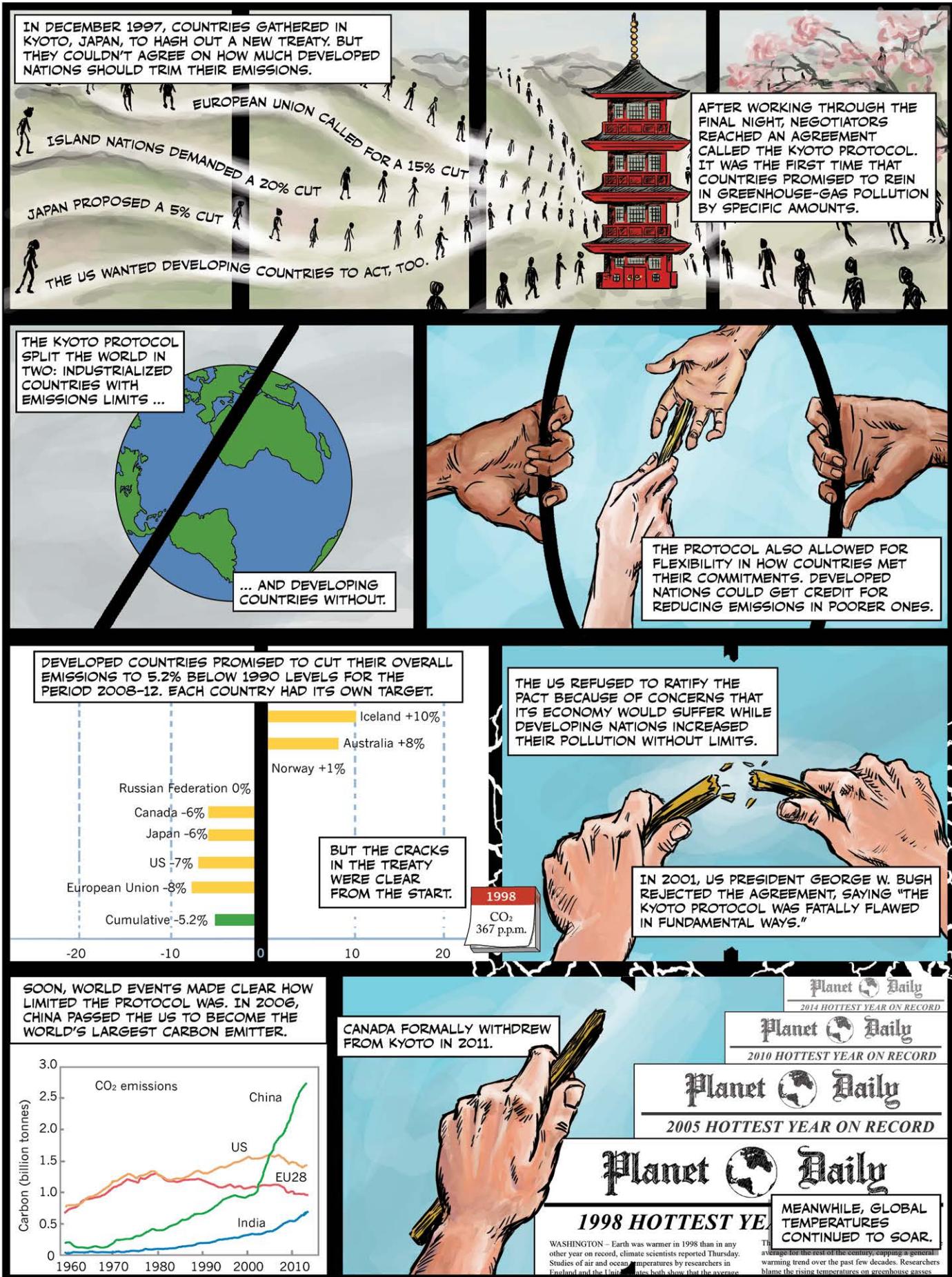
BUT THE ASSEMBLED COUNTRIES COULDN'T AGREE ON SPECIFICS.

ISLAND NATIONS WANTED RICH COUNTRIES – THE SOURCE OF MOST OF THE PROBLEM – TO CUT EMISSIONS BY 20%.

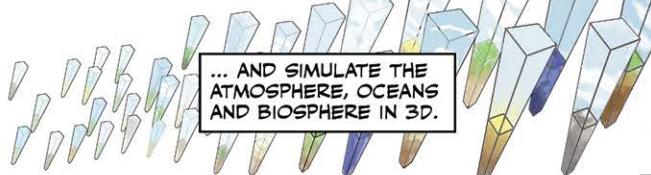
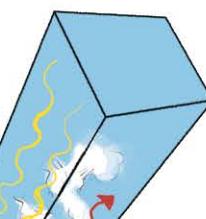
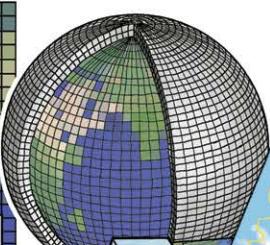
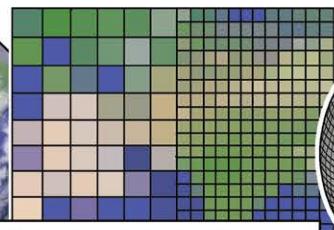
THE US DEMANDED THAT DEVELOPING NATIONS AGREE TO FUTURE COMMITMENTS.

CHINA SAID DEVELOPED NATIONS HAD TO ACT FIRST BECAUSE THEY HAD CAUSED THE PROBLEM.

DURING ALL-NIGHT NEGOTIATIONS, GERMANY'S ENVIRONMENT MINISTER, ANGELA MERKEL, BROKERED A DEAL. COUNTRIES WOULD HAVE TWO YEARS TO AGREE ON EMISSIONS LIMITS FOR DEVELOPED NATIONS.



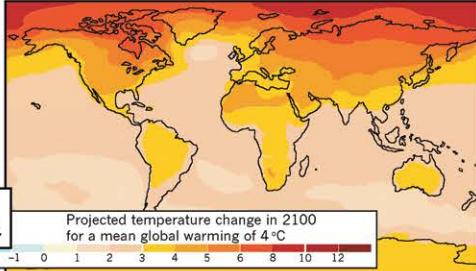
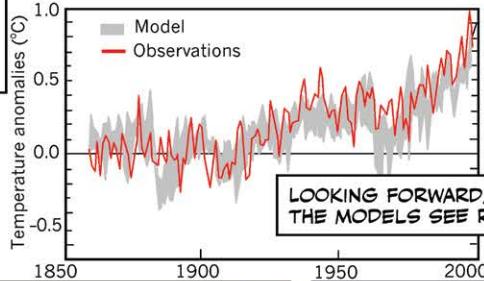
THROUGHOUT THE CLIMATE NEGOTIATIONS, SCIENTISTS HAVE TRIED TO SHOW WHAT KIND OF WORLD AWAITS FUTURE GENERATIONS IF GLOBAL WARMING CONTINUES.



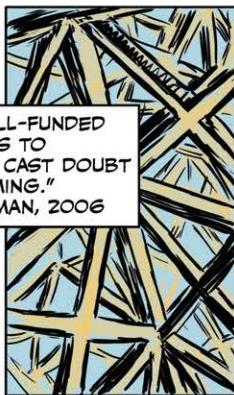
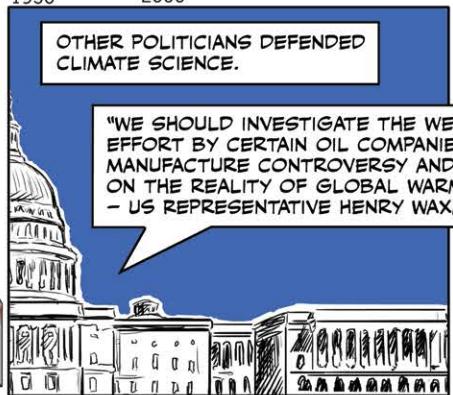
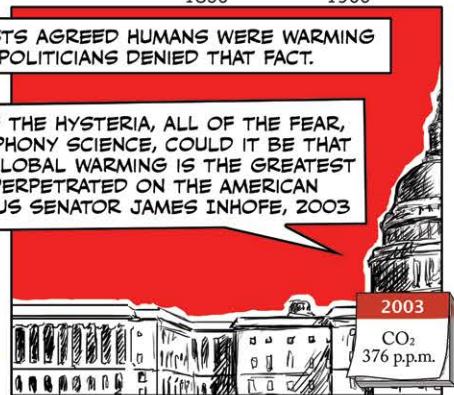
SUCH FORECASTS COME FROM COMPLEX CLIMATE SYSTEM MODELS, WHICH DIVIDE THE GLOBE INTO MILLIONS OF CELLS ...

... AND SIMULATE THE ATMOSPHERE, OCEANS AND BIOSPHERE IN 3D.

RESEARCHERS HAVE CONFIDENCE IN THEIR MODELS BECAUSE THEY CAN REPRODUCE FEATURES OF PAST AND CURRENT CLIMATES.



LOOKING FORWARD, THE MODELS SEE RED.



ALTHOUGH SCIENTISTS AGREED HUMANS WERE WARMING THE PLANET, SOME POLITICIANS DENIED THAT FACT.

"WITH ALL OF THE HYSTERIA, ALL OF THE FEAR, ALL OF THE PHONY SCIENCE, COULD IT BE THAT MAN-MADE GLOBAL WARMING IS THE GREATEST HOAX EVER PERPETRATED ON THE AMERICAN PEOPLE?" – US SENATOR JAMES INHOFE, 2003

2003
CO₂
376 p.p.m.

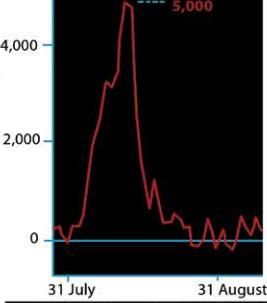
OTHER POLITICIANS DEFENDED CLIMATE SCIENCE.

"WE SHOULD INVESTIGATE THE WELL-FUNDED EFFORT BY CERTAIN OIL COMPANIES TO MANUFACTURE CONTROVERSY AND CAST DOUBT ON THE REALITY OF GLOBAL WARMING."

– US REPRESENTATIVE HENRY WAXMAN, 2006

IN 2003, EUROPE SUFFERED A PROLONGED HEAT WAVE THAT KILLED AN ESTIMATED 70,000 PEOPLE.

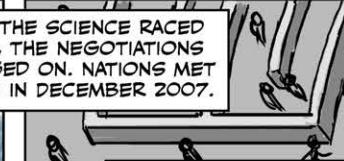
Excess deaths per day



THE IMPACTS WERE GETTING CLEARER. THE IPCC DECLARED IN 2007: "WARMING OF THE CLIMATE SYSTEM IS UNEQUIVOCAL."



LATER THAT YEAR, THE IPCC WAS AWARDED THE NOBEL PEACE PRIZE FOR ITS EFFORTS.

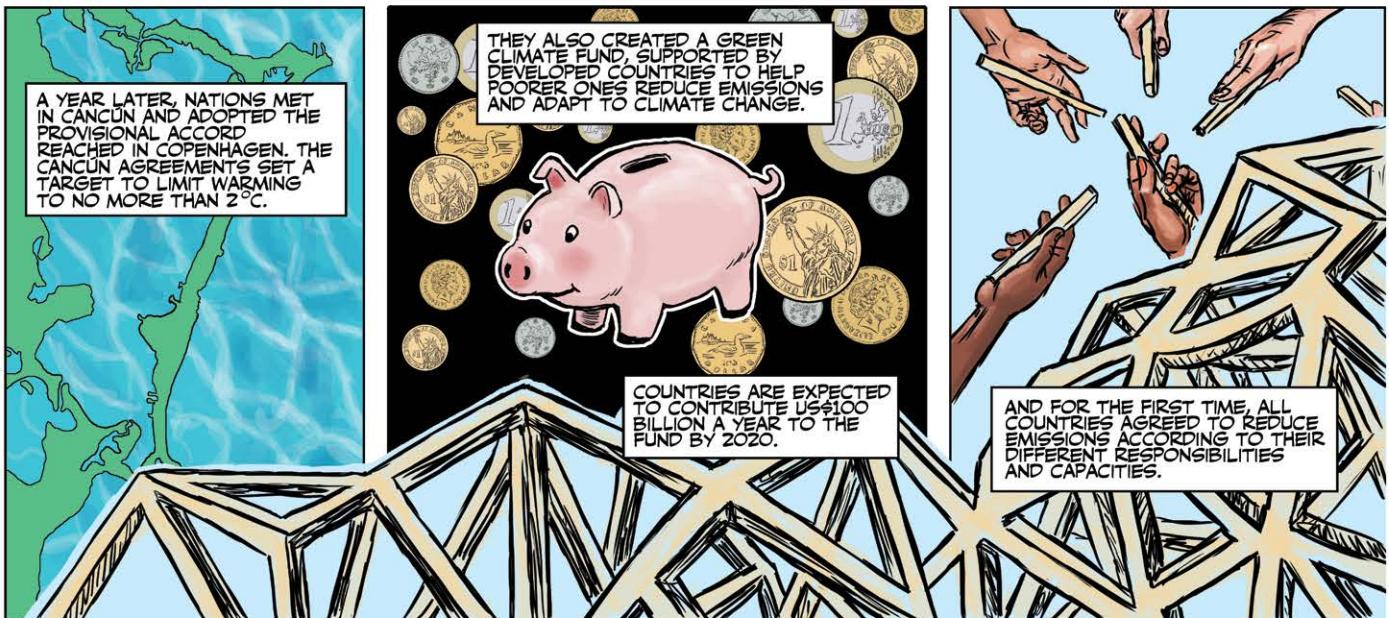
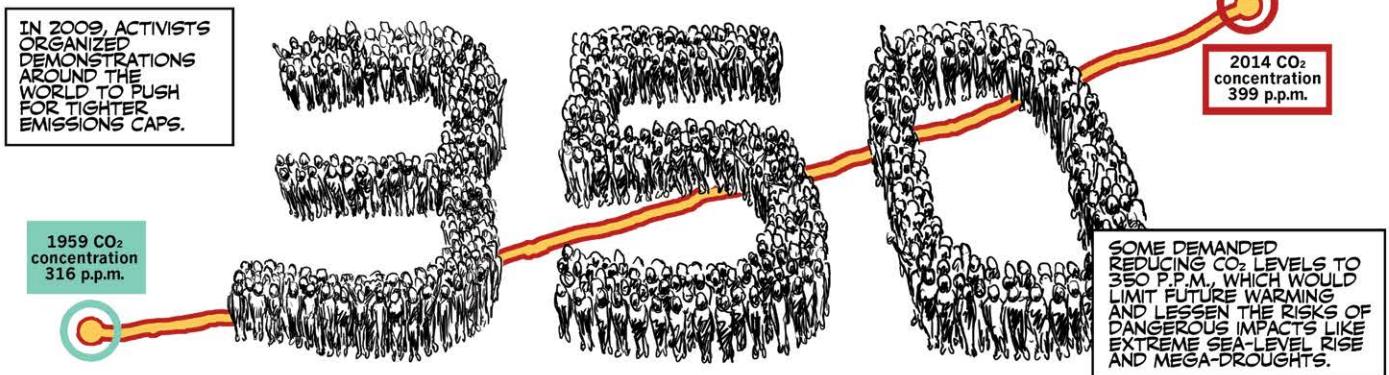


WHILE THE SCIENCE RACED AHEAD, THE NEGOTIATIONS DRAGGED ON. NATIONS MET IN BALI IN DECEMBER 2007.

FOR THE FIRST TIME, DEVELOPING NATIONS AGREED TO "MITIGATION ACTIONS" OF THEIR OWN CHOOSING TO LIMIT CLIMATE CHANGE.

THE TALKS WERE SO FRACTIOUS THAT AT ONE POINT, THE CHAIRMAN BROKE DOWN IN TEARS. BUT A DEADLINE WAS SET FOR A TREATY IN 2009 THAT WOULD INCLUDE NEW COMMITMENTS BY DEVELOPED COUNTRIES.

AND PARTICIPANTS DECIDED THE NEXT TREATY WOULD ADDRESS DEFORESTATION.



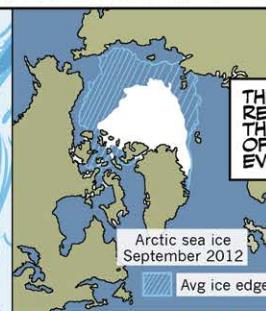
AS THE NEGOTIATIONS HAVE CRAWLED ALONG, THE WORLD HAS HURLED THROUGH CHANGES.

IN OCTOBER 2011, THE GLOBAL POPULATION TOPPED 7 BILLION PEOPLE.

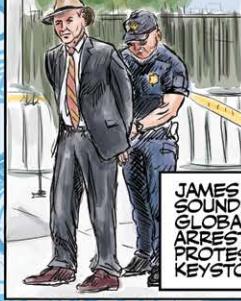
IN 2012, 97% OF THE GREENLAND ICE SHEET SHOWED SIGNS OF MELTING – THE FIRST TIME SUCH AN EXTENSIVE AREA HAD THAWED.

NOVEMBER 2013: SUPERSTORM HAIYAN BECAME THE STRONGEST ON RECORD TO MAKE LANDFALL WHEN IT SLAMMED INTO THE PHILIPPINES WITH WINDS OF 315 KILOMETRES PER HOUR.

THE ARCTIC SEA SET A RECORD IN 2012 FOR THE LEAST AMOUNT OF ICE COVERAGE EVER DOCUMENTED.



9 MAY 2013: DAILY ATMOSPHERIC MEASUREMENTS OF CO₂ AT A STATION IN HAWAII TOPPED 400 P.P.M. FOR THE FIRST TIME IN, PERHAPS, MILLIONS OF YEARS.



JAMES HANSEN, WHO HAD SOUNDED THE ALARM OVER GLOBAL WARMING, WAS ARRESTED SEVERAL TIMES FOR PROTESTS OVER THE PROPOSED KEYSTONE XL PIPELINE.

A HEAT WAVE IN RUSSIA IN 2010 KILLED ROUGHLY 55,000 PEOPLE AND STOKED WILDFIRES ACROSS THE COUNTRY.



AT CLIMATE TALKS IN 2013, PHILIPPINE DELEGATE NADEREV SANO BROKE DOWN OVER HIS COUNTRY'S DEVASTATION AND THE LACK OF PROGRESS IN NEGOTIATIONS.

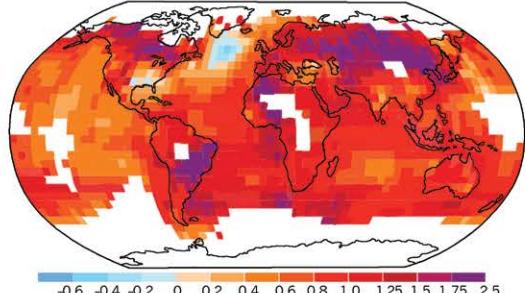
"BY FAILING TO MEET THE OBJECTIVE OF THE CONVENTION, WE MAY HAVE RATIFIED THE DOOM OF VULNERABLE COUNTRIES."

2014: CHINA OVERTOOK THE EUROPEAN UNION IN PER CAPITA EMISSIONS OF CO₂.

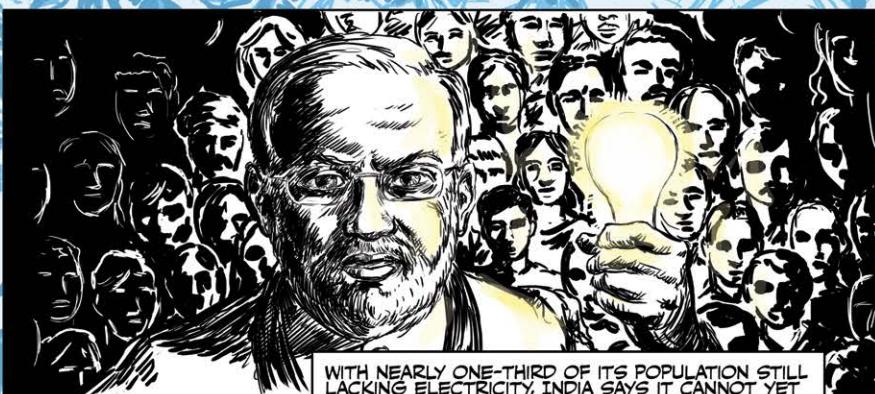


THE US AND CHINA BROKERED A HISTORIC CLIMATE DEAL IN NOVEMBER 2014. THE US PLEDGED TO CUT GREENHOUSE-GAS EMISSIONS 26–28% BELOW 2005 LEVELS BY 2025. CHINA SAID ITS EMISSIONS WOULD PEAK AROUND 2030.

Observed change in surface temperature 1901–2012



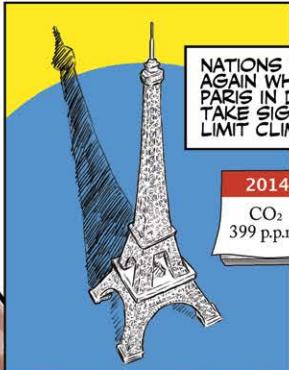
IN SEPTEMBER 2013, THE IPCC REPORTED THAT "HUMAN INFLUENCE ON THE CLIMATE SYSTEM IS CLEAR."



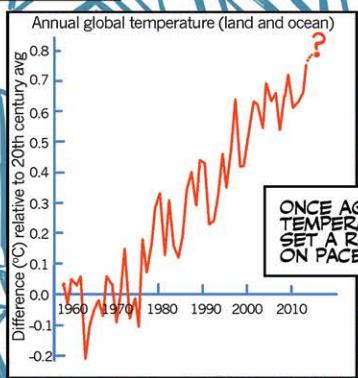
WITH NEARLY ONE-THIRD OF ITS POPULATION STILL LACKING ELECTRICITY, INDIA SAYS IT CANNOT YET CUT ITS CO₂ EMISSIONS. PRIME MINISTER NARENDRA MODI'S GOVERNMENT PLEDGED TO SUBSTANTIALLY INCREASE ENERGY EFFICIENCY.

THESE BECAME THE BASIS FOR WHAT THE TWO COUNTRIES SUBMITTED TO THE UNFCCC AS THEIR PROPOSED EMISSIONS TARGETS IN ADVANCE OF THE PARIS SUMMIT. SO FAR, MORE THAN 160 COUNTRIES HAVE SUBMITTED THEIR PLEDGES.

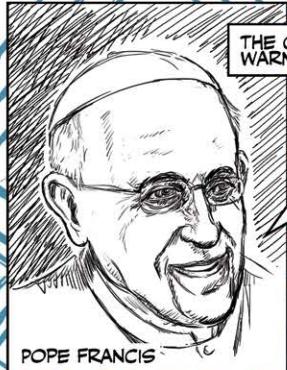
2014 SET THE RECORD AS THE HOTTEST YEAR EVER RECORDED FOR GLOBAL LAND AND SEA SURFACE TEMPERATURES.



2014
CO₂
399 p.p.m.



ONCE AGAIN, GLOBAL TEMPERATURES WILL SET A RECORD. 2015 IS ON PACE TO TOP 2014.



THE CALLS FOR ACTION – AND THE WARNING SIGNS – GROW STRONGER.

"CLIMATE CHANGE IS A GLOBAL PROBLEM WITH GRAVE IMPLICATIONS IT REPRESENTS ONE OF THE PRINCIPAL CHALLENGES FACING HUMANITY IN OUR DAY."



"ALTHOUGH WE'RE MOVING IN THE RIGHT DIRECTION, IT IS CLEARLY NOT ENOUGH."

FIRE IN INDONESIA RAVAGED THE COUNTRY AND PUMPED HALF A BILLION TONNES OF CARBON INTO THE AIR, MORE THAN JAPAN PRODUCES IN A YEAR.



THE PARIS PLEDGES WILL PROBABLY LIMIT WARMING TO BELOW 3°C, BUT MUCH STRONGER ACTION IS NEEDED TO STAY UNDER 2°C. COUNTRIES WILL PROBABLY BLOW THROUGH THE TRILLION-TONNE CARBON BUDGET BEFORE 2040.



CO₂ CONTINUES TO THICKEN THE SKIES. CONCENTRATIONS MAY NEVER AGAIN DROP BELOW 400 P.P.M.



THE WORLD HAS COME A LONG WAY SINCE KYOTO. THIS YEAR, ALL COUNTRIES ARE SETTING THEIR OWN GOALS, WHICH MAY MAKE THE TARGETS MORE REALISTIC, AND NATIONS MAY AGREE TO STEP UP THEIR COMMITMENTS PERIODICALLY.



THE FRAMEWORK TO FIX THE PLANET IS COMING TOGETHER, BUT IT IS FRAGILE AND FAR TOO SMALL. THE JOB OF FINISHING THE TASK WILL FALL TO FUTURE GENERATIONS.

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For more on the Paris climate talks,
see: nature.com/parisclimate