

EARTH 2100—ACT SEVEN

BOB WOODRUFF

It's a new world, and not a better one, as we catch up with Lucy, our fictional storyteller. The year is 2060, past mid-century and into middle age for Lucy. At 51, she has grown up in a world of soaring population, dwindling resources and intense climate change. The worst case scenario imagined by some experts is playing out. But there are signs of hope – a growing global movement led by cities like New York.

EUGENE LINDEN

Author, *The Winds of Change*

New York is probably the most geographically favored city in America — a great port, rich fisheries around it, this wonderful river that allows transport and access to great farmland and things like that. It's a center of the arts; it's been a center of finance. I think it'll continue to be so.

LUCY

After what I had been through, New York was a new beginning—the city was full of energy and hope and promise. You'd walk down the streets and meet each other's eyes and see the sense of purpose—it was some great place to be part of back then.

NEW YORK CITY—2061

GRAPHIC NOVEL ELEMENT:

LUCY

The first years we were there were the best of our lives. Josh was working as an engineer on the Great Barrier project, I was at Bellevue Hospital, a venerable institution already more than 300 years old.¹ The building we lived in was green in every sense of the word— and Molly worked in the gardens that grew our food. They were part of the building itself.

VAN JONES

Founder, Green for All

You're gonna see greenhouses that are multi-story greenhouses, and each floor will be growing carrots and potatoes, et cetera, and that'll be just considered normal.²

LUCY

The building generated not just our food, but most of our own energy.

FRED KRUPP

President, Environmental Defense Fund

Instead of having solar panels, big, heavy, bulky things, we can just put this thin film on rooftops, on window panes, and generate electricity that way.

LUCY

I rode my bike to work every day, a mere thirty blocks. We had designated bicycle lanes,³ the traffic was manageable and you could breathe the air—all the vehicles were electric.

DAN ESTY

Professor, Environmental Law and Policy, Yale University

There will probably be lots of places where you hook your car up to a mega-transport system that will move you a good bit of the distance to your final destination—kind of a train of cars—and then you get disconnected from the mass combination transit and drive the last little bit yourself.

GRAPHIC NOVEL ELEMENT:

LUCY

Molly fell in love as quickly as her parents had. She married George, who was studying to become a botanist. A year later my grandson Daniel was born, and a lovelier child I had never seen. It was a happy time and when Molly told me they were moving upstate to work on a real farm Josh and I understood – it had always been their dream.

LUCY

The city was getting a lot of attention, and money flowed in both private and public. The biggest and maybe important project was my husband Josh's, since without the barriers, the city was at risk.

MALCOLM BOWMAN

Professor of Oceanography, Stony Brook University

It would be the best civil-engineering project in US history. Be comparable to putting a man on the moon when you think of what's involved.

LUCY

The project had been under way for years and those working on them had a tremendous sense of pride.

MALCOLM BOWMAN

It'd be like in Medieval times, people building a beautiful huge cathedral. In Europe. You know, and it took generations to build, and there was a great sense of purpose and it gave purpose and meaning to life

LUCY

Sea level was rising and without the barriers big storms would flood the city.⁴ There were three barriers going up—one at the Verrazano Narrows Bridge, one at the top of the East River, and one in Staten Island at Batten Hills. You could see them rising a little every day.

The project drew thousands of people into the city every day looking for work. New York City was then, as it had always been, a beacon of hope.

EUGENE LINDEN

New York, it'll be a magnet, as any viable city will be a magnet. And these great, these cities where people come to flee instability become Petri dishes for diseases, new diseases and resistant forms of disease.

LUCY

Keeping New York safe from disease was crucial, and Bellevue was busy. I didn't feel as tired at the end of the day as I might have—we were doing important work, keeping a close eye on any new infectious diseases.

LUCY

I remember the night I was called to the worker's camps in Flushing. A young Ecuadorian family had just arrived in New York and they all had high fevers and blisters on their hands and feet. We sprung into action immediately – we closed off the neighborhood and called in the CDC. They knew right away they were looking at a new virus. We set up a mobile clinic at the camp where we treated dozens of workers and their families. Everyone recovered, and the disease was contained.

¹ George Washington was only four years old in 1736 when Bellevue, America's oldest public hospital, was founded. Then an almshouse for the poor, Bellevue supported 6 beds; today, the hospital accommodates nearly 800. While the sheer number of patients Bellevue treats each year is staggering, the quality and breadth of its services, as well as its distinguished staff, are widely recognized. (Source: New York City Health and Hospitals Corporation, <http://www.nyc.gov/html/hhc/html/facilities/bellevue.shtml>)

² The concept of indoor farming is not new, since hothouse production of tomatoes, a wide variety of herbs, and other produce has been in vogue for some time. What is new is the urgent need to scale up this technology to accommodate another 3 billion people. An entirely new approach to indoor farming must be invented, employing cutting edge technologies. The Vertical Farm must be efficient (cheap to construct and safe to operate). Vertical farms, many stories high, will be situated in the heart of the world's urban centers. If successfully implemented, they offer the promise of urban renewal, sustainable production of a safe and varied food supply (year-round crop production), and the eventual repair of ecosystems that have been sacrificed for horizontal farming. (Source: The Vertical Farm Project, <http://www.verticalfarm.com/>)

Dickson Despommier became the guru of vertical farming because his students were bummed out. A professor of environmental health at Columbia University in New York City, Despommier teaches about parasitism, environmental disruption and other assorted happy topics. Eventually his students complained; they wanted to work on something optimistic. So the class began studying the idea of rooftop gardening for cities. They quickly discarded that approach—too small-scale—in favor of something more ambitious: a 30-story urban farm with a greenhouse on every floor. "I think vertical farming is an idea that can work in a big way," says Despommier.

Why would we want to build skyscrapers filled with lettuce when we've been farming on the ground for 10,000 years? Because as the world's population grows—from 6.8 billion now to as much as 9 billion by 2050—we could run out of productive soil and water. Most of the population growth will occur in cities that can't easily feed

themselves. Add the fact that modern agriculture and everything associated with it--deforestation, chemical-laden fertilizers and carbon-emitting transportation--is a significant contributor to climate change, and suddenly vertical farming doesn't seem so magic beanstalk in the sky.

"Vertical farming could allow food to be grown locally and sustainably," says Glen Kertz, CEO of Valcent, a tech company based in El Paso, Texas, that's trying out the process. His firm uses hydroponic greenhouse methods to grow upward rather than out. The result saves space—vital in urban areas—and allows farmers to irrigate and fertilize with far less waste. (Source: Time Magazine, "Vertical Farming," December 11, 2008)

³ The goal of the Department of City Planning, New York City Department of Transportation, and the Department of Parks and Recreation Bicycle Network Development program is to reduce congestion by promoting cycling in New York City. The central objectives of the program are to implement and maintain New York City's on- and off-street bicycle network; improve cycling safety; improve bicycle access on bridges and mass transit; and institutionalize cycling in public and private organizations.

The program continues to implement a city-wide network of bicycle lanes and paths that would result in an increase in bicycling in all five boroughs. This program also involves the collection of annual bicycle ridership data and taking part in the "NYC Bike Month" events which takes place in the month of May. (Source: New York City Department of City Planning, <http://www.nyc.gov/html/dcp/html/bike/home.shtml>)

⁴ "New York has built its storm surge capacity based on a hundred-year flood level from the 20th century. But with a one-meter sea level rise, that storm surge will happen every five years, not every 100 years. So, again, the capacity of the systems we built and the investments we've made will come under tremendous pressure. " (John Podesta, President, Center for American Progress, in conversation with Linda Hirsch for ABC News)

EARTH 2100—ACT EIGHT

BOB WOODRUFF

Imagine now the year 2070, and things are in danger of unraveling. Sea levels have risen nearly three feet,⁵ redrawing the map of the world.⁶ Island nations have disappeared. Much of Bangladesh, reclaimed by the sea.⁷ Some of California's famous beaches, gone.⁸ The Florida Everglades, underwater.⁹ Now, the richest countries are being forced to come up with innovative and expensive solutions. Lucy's husband, Josh, is one of the leaders.

GRAPHIC NOVEL ELEMENT:

LUCY

Josh was an engineer on the Great Barrier project. After 30 years in the making it was nearing completion. Within a few months they would be testing the massive gates.

MALCOLM BOWMAN

If I was the engineer in charge I would be very nervous, but you would have practice runs, and during nice weather you would say, all right, let's close the gates today, and make sure everything's working right, it's not gonna jam up.

LUCY

Josh was worried about something else too. New York City's barriers, like others around the world, had been built on the assumption that sea level rise would be gradual. But it was becoming clear – that might not be the case.

JAY GULLEDGE

Senior Scientist, Pew Center on Global Climate Change

You know, climate in general, especially in a given region, doesn't change smoothly the way we're used to seeing projections from climate models.

PETER DeMENOCA

Professor of Environmental Sciences, Columbia University

We find out the transitions from cold to warm, some of those transitions can be really, really abrupt. Abrupt meaning within the time scale of a decade, or sometimes even less than a decade

LUCY

Josh knew there were certain things that could rapidly turn up the heat, but we didn't know what that tipping point would be until it happened.

NEWS BULLETIN

Our top story tonight, scientists say they are detecting a massive spike in the level of methane in the atmosphere...

JOHN HOLDREN

Professor, Harvard University

Maybe the tipping point is you heat up the tundra and the permafrost so much that there's a huge burp of methane and carbon dioxide out of those northern soils.

MALCOLM BOWMAN

Methane is a very—a big worry in my mind because it's some 23 to 30 times more potent than CO²

BOB WOODRUFF

An enormous reservoir of methane, produced by decomposing plants and animals, lies buried beneath the frozen Arctic tundra.¹⁰ It has been there since the Ice Age. If the tundra melts and the gas is released, global temperatures would soar.¹¹

THOMAS HOMER-DIXON

Professor, Centre for Environment and Business, University of Waterloo

This is a bit like a light switch. You push the light switch a little bit and nothing happens. You push a little bit more and nothing happens. And then you push it a little bit more and it flips completely to a new state.

NEWSCAST

This amount of methane has the potential to drastically raise global temperatures.

NEWSCAST

A panel of experts is convening to recalculate how warm the planet could get.

THOMAS HOMER-DIXON

This is what specialists call a non-linear flip or a non-linear change. And when that happens, we don't know what the consequences will be.

NEWSCAST

Spiking global temperatures are wreaking havoc with the Greenland ice sheet.

NEWSCAST

Scientists have observed more rapid melting, and some fear that the colossal sheet is on the verge of collapse...

NEWSCAST

Unless drastic measures are taken, low lying coastal cities around the world can expect to see disastrous flooding.

NEWSCAST

Citizens are demanding their government respond to the impending temp...

NEWSCAST

The pentagon today held closed door meetings to discuss climate change.

NEWSCAST

Our top story tonight. The President is announcing the Cosmic Shield Project which aims to...

DAN SCHRAG

Professor of Environmental Science & Engineering, Harvard University

Imagine now that you're the President of the United States. And you have word that Greenland is going to collapse in the next ten years, adding seven meters of sea level. I'm not saying that's happening today. I'm saying imagine that were to happen. And you were told that technology exists to stop it. Wouldn't you be tempted to use it?

LUCY

It didn't take long for the world to agree: a technology existed that could stop the ice sheets from melting¹² – it should be used.¹³

Hundreds of jets from all around the world spraying a mist of sulfur dioxide into the atmosphere.¹⁴ The gas would form particles which would shade the earth and temporarily cool it.

HEIDI CULLEN

Climatologist, Climate Central

This is your solution of last resort. You say, all bets are off—we are just going to intervene in this system with reckless abandon.

LUCY

For a year, it seemed like it was working – and there were spectacular sunsets.¹⁵

PETER GLEICK

President, Pacific Institute

But what are the other consequences of those things? Maybe it would cool the earth; maybe it would cool it too much. That might be a disaster in the opposite direction. Maybe it would cause some other environmental problem that we don't foresee today.

LUCY

The earth cooled, but that was the least of it.

NEWSCAST

Tonight in Washington, there is debate on whether to follow China and Great Britain and cease flying Cosmic Shield Missions.

HEIDI CULLEN

That's the thing. We've learned that in all aspects of engineering, there are unintended consequences

NEWSCAST

The Surgeon General testified before Congress today on the health effects of further depleting....

LUCY

The cloud was burning off the ozone layer.¹⁶ Once that was gone, every living creature would be exposed to a massive dose of radiation. The experiment was halted.

Once they stopped spraying the gas, the ice sheets started melting at a quicker pace.¹⁷ Sea level rise would soon be measured in feet, not inches.¹⁸

R. JAMES WOOLSEY

Former Director, CIA

If you end up with several meters of sea level rise, you change life as we know it.

NEWSCAST

New York watchdog groups are now suggesting the storm surge barriers may be too low.

LUCY

Josh and the other engineers were working around the clock to try to build the barriers even higher but we all knew we were in a race against time.

PETER GLEICK

Society is not set up to deal with rapid sea level rise. It would be a catastrophe of a magnitude we've never experienced.

JAMES HOWARD KUNSTLER

Author, *The Long Emergency*

One of our political leaders said, not too long ago, that the American way of life is non-negotiable. And we're gonna discover the hard way that, when you don't negotiate the circumstances that are sent to you by the universe, you automatically get assigned a new negotiating partner. Named reality. And then it will negotiate for you. You don't even have to be in the room.

CLOCK MOVES FORWARD TO 2075

GRAPHIC NOVEL ELEMENT:

NEWSCAST

A vicious nor'easter is headed up the east coast and is expected to hit New York on the high tide this afternoon. Storm surge is expected to be over twenty feet.¹⁹

LUCY

As the storm approached, the engineers started closing the entire bay wall. It absolutely had to work or the city would be devastated. It was terrifying. Then the winds picked up, and a gate got stuck.

MALCOLM BOWMAN

That's a nightmare scenario, getting stuck halfway shut. Because the water will pour in and flood the city, and as time goes by, the floods are going to get worse and worse.

LUCY

A team was assembled to manually close the gate. They would have to go out into the harbor by boat. I asked Joshua not go, I begged him to stay safe with me, but this was his project—he had to see it through.

⁵ This number is based on conversations with several scientists who foresee a worst-case sea level rise of several meters by 2100, as well as recent studies that confirm that outcome is possible.

“You know, it's, it's very hard to say when an ice sheet will start really disintegrating, causing the largest changes. But I can't imagine that that would not happen before 2100 if we stay on, business as usual. And that means we're going to get at least a few meters of sea level rise. Now, most of the reports are not talking about numbers that high, but if you talk to the scientists in the back room, there are many of them who are in fact worried about that and they can see what's already happening on west Antarctica and Greenland.” (James Hansen, Director, NASA Goddard Institute for Space Studies, in conversation with Michael Bicks for ABC News)

“What we can say is, this has happened before, it's within the same context of the climate that we're producing today. The risk is very high that, that we could see a meter of sea level rise by 2050, possibly two or three by the end of the century.” (Jay Gullledge, Senior Scientist, Pew Center on Global Climate Change, in conversation with Michael Bicks for ABC News)

“On the basis of calculations presented here, we suggest that an improved estimate of the range of SLR to 2100 including increased ice dynamics lies between 0.8 and 2.0 m.” (Source: Pfeffer et al, Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise, *Science* 321, 1340, 2008)

⁶ “Well, there have been times in the Earth's history when sea level went up as much as five meters per century. That's one meter every 20 years, and obviously one meter itself would be disastrous to places like Florida, Bangladesh. Many places would be severely impacted by just one meter.” (James Hansen, Director, NASA Goddard Institute for Space Studies, in conversation with Michael Bicks for ABC News)

“A one meter sea level rise, is going to have, all by itself—which is a relatively conservative estimate—is going to have enormous implications...In Manhattan and San Francisco, we'll build sea walls, we'll spend the money to protect really high value property and infrastructure. In the poorer countries of the world, they're in big trouble. It's going to mean huge population disruptions. Either in advance, if we're smart enough, we'll move people out of harm's way, or in hindsight, when big storms come, with a one meter sea level rise, and thousands or hundreds of thousands of people die in monsoons, in flooding disasters, because we haven't had the foresight to move them out...” (Peter Gleick, President, Pacific Institute, in conversation with Michael Bicks for ABC News)

⁷

Table-2: Sea level rise (SLR) in Bangladesh and its possible impacts Year	2020	2050	2100

Sea level rise	10cm	25cm	1 m (high end estimate)
Land below SLR	2 % of land (2,500 km ²)	4 % of land (6,300 km ²)	17.5 % of land (25,000 km ²). Patuakhali, Khulna and Barisal regions will be most affected

(Source: The World Bank, “Bangladesh - Climate Change and Sustainable Development” December 19, 2000)



(Source: University of Arizona, Department of Geosciences, Environmental Studies Laboratory
http://www.geo.arizona.edu/dges/research/other/climate_change_and_sea_level/sea_level_rise/sea_level_rise.htm)

¹⁰http://www.unep.org/geo/yearbook/yb2008/report/UNEP_YearBook2008_Full_EN.pdf

“A potentially very large arctic source of methane to the atmosphere is the decay of organic matter in the form of dead plant, animal, and microbial remains that have been frozen in shallow permafrost (1-25 metres below the surface) for tens of thousands of years. This important source of atmospheric methane is not currently considered in modeled projections of future warming. The amount of carbon stored in the organic matter of arctic permafrost is staggering. It is estimated to be around 750 to 950 billion metric tons—equal to or larger than the nearly 800 billion metric tons of carbon currently in the atmosphere in the form of carbon dioxide.” (Source: UNEP Yearbook 2008, Page 40)

¹¹“Methane release due to thawing permafrost in the Arctic is a global warming wildcard. The balance of evidence suggests that Arctic feedbacks that amplify warming, globally and regionally, will dominate during the next 50 to 100 years. As warming continues, these feedbacks will likely intensify. We may be approaching thresholds that are difficult to predict precisely, but crossing such thresholds could have serious global consequences...It is already

clear that the global climate is vulnerable to Arctic feedbacks and that the consequences of those feedbacks could be disastrous. The only way to reduce the magnitude of these consequences is to dramatically reduce and stabilize concentrations of GHGs in the atmosphere...The potential consequences of large amounts of methane entering the atmosphere, from thawing permafrost or destabilized ocean hydrates, would lead to abrupt changes in the climate.” (Source: UNEP Yearbook 2008, Page 46)

¹² http://www.cogci.dk/news/Crutzen_albedo%20enhancement_sulfur%20injections.pdf “Although by far not the best solution, the usefulness of artificially enhancing earth’s albedo and thereby cooling climate by adding sunlight reflecting aerosol in the stratosphere (Budyko, 1977; NAS, 1992) might again be explored and debated as a way to...counteract the climate forcing of growing CO2 emissions.” (P. Crutzen, “Albedo Enhancement By Stratospheric Sulfur Injections: A Contribution To Resolve A Policy Dilemma?” *Climatic Change* 77 (3-4): 211–220)

¹³ “One framing is a kind of emergency response system where you find Greenland is sliding into the sea, we need to do something now. In that kind of emergency situation...if we thought that was going to happen we could start out with airplanes distributing sulfur. Any kind of small particle would do the job, but sulfur you can put up as a gas and it will form small particles.” (Ken Caldeira, Department of Global Ecology, Carnegie Institution of Washington, in conversation with Lynn Levy for ABC News, May 7 2009)

“If all the big cities in the world are about to go underwater because Greenland’s about to break up, you might want to do this. It might be worth it. If we thought it was going to melt catastrophically”. (Source: Alan Robock Professor, Department of Environmental Sciences, Rutgers University, in conversation with Lynn Levy for ABC News, May 6 2009)

¹⁴ “The cheapest way to do it would be to use airplanes. The US military has planes that can get up in the stratosphere in the tropics.” (Source: Alan Robock, Professor, Department of Environmental Sciences, Rutgers University, in conversation with Lynn Levy for ABC News, May 6 2009)

Table 1. Costs for different methods of injecting 1 Tg H2S per year to the stratosphere.

Method	Payload (tons)	Ceiling (km)	# of Units	Purchase Price (2007 dollars)	Annual Cost
F-15C Eagle	8	20	167 with 3 flights/day	\$6,363,000,000	\$4,175,000,000

(Source: Robock et al. “The Practicality Of Geoengineering” January 2009)

¹⁵ “Immediately after the particles went into the atmosphere, it would take a little while for them to spread out to the point where they covered a significant amount of the globe. Once that happens you would expect to see bright pink sunrises and sunsets.” (Source: Phil Rasch, Pacific Northwest National Laboratory, in conversation with Lynn Levy for ABC News, May 7 2009)

“Atmospheric aerosols close to the size of the wavelength of light produce a white, cloudy appearance to the sky. They also contribute to colorful sunsets, similar to those that occur after volcanic eruptions. The red and yellow sky in *The Scream* by Edvard Munch was inspired by the brilliant sunsets he witnessed over Oslo in 1883, following the eruption of Krakatau in Indonesia.” (Source: Alan Robock, 2008: “20 Reasons Why Geoengineering May Be a Bad Idea.” *Bulletin of the Atomic Scientists*, 64, No. 2, 14-18.)

¹⁶ “Aerosol particles in the stratosphere serve as surfaces for chemical reactions that destroy ozone in the same way that water and nitric acid aerosols in polar stratospheric clouds produce the seasonal Antarctic ozone holes ...additional aerosols from geoengineering would destroy even more ozone and increase damaging ultraviolet flux to Earth’s surface.” (Alan Robock, 2008: “20 Reasons Why Geoengineering May Be a Bad Idea.” *Bulletin of the Atomic Scientists*, 64, No. 2, 14-18.)

¹⁷ “If we stopped doing this, warming would be rapid after we stopped. When you stop blocking out the sun and the greenhouse gasses are still there, as soon as you stop blocking out the sun you are going to get a much steeper increase in warming, and often the steep rate of warming is the real problem.” (Alan Robock, Professor, Dept. of Environmental Sciences, Rutgers University, in conversation with Lynn Levy for ABC News, May 6 2009)

¹⁸ “If we look at the Earth's history, we see how sea level has responded to changes in atmospheric composition and changes in global temperature. And what we find is that it's very sensitive. What we don't know is exactly how long it will take for that to occur. And some modelers were thinking it may take a millennium for the ice sheets to respond. Well, we now know that's not the case because we have better information on the paleodata, the history of the Earth, and we see that there are times when the ice sheets melted quite rapidly. And also, we just look at the ice sheets now and they're beginning to respond to just the small amount of warming that has occurred so far. So there — as I say, there's no way that I can believe that we could go through the century without having sea level rise, measured in meters, not centimeters.” (James Hansen, Director, NASA Goddard Institute for Space Studies, in conversation with Michael Bicks)

“You know, it's, it's very hard to say when an ice sheet will start really disintegrating, causing the largest changes. But I can't imagine that that would not happen before 2100 if we stay on, business as usual. And that means we're going to get at least a few meters of sea level rise. Now, most of the reports are not talking about numbers that high, but if you talk to the scientists in the back room, there are many of them who are in fact worried about that and they can see what's already happening on west Antarctica and Greenland.” (James Hansen, Director, NASA Goddard Institute for Space Studies, in conversation with Michael Bicks)

¹⁹ “So, within the next 50 years, it's very likely that we would see a hurricane hit the Northeast. So, worst-case scenario would be a Category 3 hurricane coming up the Eastern Seaboard. If it wedges itself to the south of Manhattan, you have massive storm surge. We're talkin' 20 to 40 foot storm surge. Now, that obviously would have enormous impacts on a city like Manhattan, which, the greater metropolitan area is, we're talking 17 million people.” (Heidi Cullen, Climatologist, Climate Central, in conversation with Linda Hirsch for ABC News)

EARTH 2100—ACT NINE

NEWSCAST

...preliminary reports that one of the gates in the Great Barrier has failed to close. We are awaiting confirmation from the mayor's office...

LUCY

It was high tide when the storm hit.

NEWSCAST

...flooding of subway tunnels throughout the city. A spokesman for the MTA said that the 4, 5 and 6 trains as well as the ACE...

LUCY

The streets were filling with water.²⁰

NEWSCAST

...the mayor has made the decision to evacuate City Hall and move to higher ground...

LUCY

Something had gone terribly wrong.

NEWSCAST

...truly catastrophic flooding...

MALCOLM BOWMAN

The tide comes in, and on top of that...surge.

NEWSCAST

Both the Lincoln and Holland tunnels are filling with seawater, blocking access to the city.

STANLEY FEDER

Former CIA Scenario Designer

When New York begins to flood, it would be total chaos.

NEWSCAST

There is an evacuation order in effect for all...

MALCOLM BOWMAN

The Office of Emergency Management says, we have to evacuate. But we've got a problem: the subway's full of sea water and has shut down. What do people do?

NEWSCAST

Authorities are now telling anyone still in the city to remain calm and stay inside.

LUCY

Outside the storm raged, and all I could do was wait for Josh to come home. When I heard the knock on my door, I knew. He died a hero, they said, but that was no comfort.

I called Molly and she wept. She wanted me to come live with her. But I couldn't leave. I just couldn't leave.

NEWSCAST

...four or five feet of water. We could see the worst of this storm by 3 am. New Yorkers are going to wake up in a different city tomorrow.

LUCY

As the sun rose the next day it was clear that both my city and my life had been destroyed.

MALCOLM BOWMAN

Battery Park fills up with water. Lower West Side, Lower East Side. Coney Island, southern Brooklyn, Queens is flooded. Kennedy Airport's flooded. Newark Airport's flooded. LaGuardia, it's all gonna be under water.

LUCY

In the coming days, when the waters receded, the city was filthy and everything that could rot was rotting. People wanted to leave but for many of them there was nowhere to go.

MICHAEL KLARE

Professor of Peace & World Security Studies, Hampshire College

How welcoming will people be when New York or Boston sink under water and all those people bedraggled in their millions, come to New England, to higher ground or to Pennsylvania. How welcoming will people be?

EARTH 2080

LUCY

I packed my things and set them at the door, but I didn't leave. Why didn't I leave? I suppose you could say I was stubborn and I was needed at Bellevue more than ever. There were millions who needed someone to care for them.

EARTH 2082 - SEA LEVEL + 6 feet ²¹

LUCY

As the seas rose the wealthy moved uptown to higher ground and hired private companies to pick up the trash. But in the low-lying slums tap water was contaminated and people were only eating once a day, if they ate at all.

ANTHONY FAUCI

Director, National Institute of Allergy and Infectious Diseases

When people are hungry and malnourished, they are clearly more susceptible to infections. As you continue to have displacement with floods, there's no doubt that's a perfect setup for certain types of infections.

LUCY

I was working the late shift when the first case came in.²² A young man with a cough and a high fever and then I noticed the blisters all over his body. Was this the virus I had seen years ago?

NEWSCAST

...another case of Caspian Fever. Public health officials have issued a statement asking residents to avoid public meeting places. All New York City schools have been shut down. The CDC confirms that this virus is cause for concern.

LUCY

Within a week over 20 were dead. People on the streets wore masks, avoided each other. The air was ripe with panic.

NEWSCAST

...another advisory reminding citizens to wash their hands and cover their mouths.

IAN LIPKIN

Director, Center for Infection & Immunity, Columbia University

It would shut down factories, it would shut down trade. You should shut down commerce. Everything would shut down

NEWSCAST

The death toll from the Caspian Fever has reached one hundred and seven.

LUCY

The virus continued to mutate and spread.

EUGENE LINDEN

So, some long-incubating virus that kills very fast. That's the kind of thing that's gonna get us in the end, I think. We won't really know it until it's too late.

LUCY

It only took a few people on a few planes to spread it around the world.²³

NEWSCAST

Cases of the Caspian Fever have been confirmed in over a hundred countries. It is now estimated that ten thousand have died in Mexico City, temporary morgues are in the streets of Shanghai...the Vatican conducted a nationwide funeral mass today.²⁴

LUCY

From Singapore to Sydney the globe shut down. Farmers wouldn't bring food into cities; cargo ships wouldn't dock let alone unload. Billions were on the verge of starvation.²⁵

EARTH 2084 – POPULATION 4 Billion²⁶

LUCY

I saw hundreds of people die every day. I was immune, one of the lucky ones. It was hard to feel anything, there was too much to feel.

STANLEY FEDER

You think about the effect that this kind of disaster would everybody's depressed. What do you do with all the bodies. Are people just gonna take their loved ones to the local park, and leave them there?

EUGENE LINDEN

At that point cities would be unbearable.

LUCY

You could see it on people's faces on the street. They had given up. As more and more people died, all services broke down. There were frequent blackouts. Connections to the internet were intermittent at best.

NEWSCAST

Around the world, Caspian fever shows no sign of *(picture cuts out abruptly)*

LUCY

And then one day the power just went out. The phones, the internet, the whole data network went dead. Some said it was a terrorist, others thought it was the flooding, suddenly no one knew anything for sure.

EUGENE LINDEN

So, if communication breaks down in New York, rumor becomes the communication system. Then a mob psychology takes over.

THOMAS HOMER DIXON

Collapse is not something that actually happens overnight. It's the result of an accumulation of stresses, an erosion of the internal strength of society, so that it just becomes like an eggshell. And one last shock breaks it.

LUCY

Looting was rampant. Most of the police force had deserted. The mayor was nowhere to be found.

We waited for the president or the National Guard to appear, but no one came. That's when it dawned on us that the government, like everything else, was gone.

JOHN PODESTA

President, Center for American Progress

If the world breaks down, if globalization breaks down, then even the capacity of the United State to manage a degraded global environment, I think, will come into question.

JAMES HOWARD KUNSTLER

What we'll see is the federal government and being viewed as something not to be taken seriously anymore.

LUCY:

Reports were sketchy, but here's what I know for sure. The virus continued to spread. India and China had gone to war over water and who knew what else, millions were dying from famine. The human race was collapsing under its own weight.²⁷

ROBERT HEINBERG

Senior Fellow, Post Carbon Institute

By that time most of civil society will have degenerated and we will be seeing a substantial die off of the human population.

EARTH 2085

LUCY

I was 75 when I walked across the George Washington Bridge. There were no checkpoints anymore. I left with a couple of friends, and a dog who had adopted me. Rosie I called her. She never left my side.

But where was I going? I didn't know if Molly was still alive, let alone still on the farm up north. I didn't know if I had a grandson anymore. But that was my hope, that I could somehow find them, or they me.

²⁰ These flood scenarios are based in part on information from a presentation titled "Vulnerability and Potential Losses in NYC from Coastal Flooding," by Joshua Friedman, a Hazard Impact Modeler from the New York City Office of Emergency Management, New York, NY. The paper was presented at a conference of the American Society of Civil Engineers called *Against the Deluge: Storm Surge Barriers to Protect New York City*. This paper and other papers relating to the possibility of building storm surge barriers in New York can be found here: <http://www.ascemetsection.org/content/view/274/725/#2009>

²¹ This number is based on conversations with several scientists who foresee a worst-case sea level rise of several meters by 2100, as well as recent studies that conclude that outcome is possible.

“You know, it's, it's very hard to say when an ice sheet will start really disintegrating, causing the largest changes. But I can't imagine that that would not happen before 2100 if we stay on, business as usual. And that means we're going to get at least a few meters of sea level rise. Now, most of the reports are not talking about numbers that high, but if you talk to the scientists in the back room, there are many of them who are in fact worried about that and they can see what's already happening on west Antarctica and Greenland.” (James Hansen, Director, NASA Goddard Institute for Space Studies, in conversation with Michael Bicks for ABC News)

“What we can say is, this has happened before, it's within the same context of the climate that we're producing today. The risk is very high that, that we could see a meter of sea level rise by 2050, possibly two or three by the end of the century.” (Jay Gullledge, Senior Scientist, Pew Center on Global Climate Change, in conversation with Michael Bicks for ABC News)

“On the basis of calculations presented here, we suggest that an improved estimate of the range of SLR to 2100 including increased ice dynamics lies between 0.8 and 2.0 m.” (Source: Pfeffer et al, Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise, *Science* 321, 1340, 2008)

²² “Major climate events or earthquakes can also result in outbreaks of infectious disease. So pollution of groundwater can result in cholera. Lack of access to clean water or to clean food can result in distribution of a wide variety of infectious agents. Chiefly, the first ones that we're concerned about are those that are spread by food and by water, chiefly by water. But as people become overcrowded, you may see spread of respiratory pathogens as well.” (Ian Lipkin, Director, Center for Infection & Immunity, Columbia University, in conversation with Linda Hirsch for ABC News)

Climate change may have serious impacts on disease vectors. Under conditions of extreme climate change the risk of pandemic explosions of disease increase. (CNAS, *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*, November 2007, Page 77)

²³ “The more people you have, the more of them that are malnourished, the more susceptible we are to having transfers of dangerous microorganisms, viruses, from animal populations which we're pushing larger and larger groups of people into contact with. Then we have rapid transport systems. So, you know, in 1600 if a plague ship left Japan to go to India nobody in India got the plague because everybody on the ship either died or got, become immune during the trip...You can move things around very fast today. You haven't heard any planning about quarantines, have you? Or closing the borders or really putting in huge stock piles of anti viral drugs and so on? I would think that the biggest chance of most of the people listening to this show, of them dying from something other than natural causes, you know, a large scale disaster, it would be a large scale super-flu of one kind or another, or some related disease.” (Paul Ehrlich, Author, *The Population Bomb*, in conversation with Michael Bicks for ABC News)

²⁴ “One of the real challenges we may face in the future is—the possibility of some kind of global pandemic— a disease that sort of sweeps across, a new disease that sweeps across the planet—because we're all so tightly connected together. Now, humankind represents one of the largest total masses of similar organic material on the planet. In other words, we're a bit like a-- a mono-crop, like a—a field of corn or wheat that is all the same genetically. And we know that when you have a mono-crop—that's all the same genetically, that if a—a disease affects one plant, it tends to sweep across everything in the field because—because every plant stalk is equally vulnerable. And in some sense, humankind is the same. We're genetically very similar. And we're all packed together now, especially in our large cities. And in the developing world in poor countries where those cities are often under supplied with healthcare and with public health—these are breeding grounds for the emergence of new diseases that then can spread around the planet through—our global air traffic system and our transportation

networks.” (Thomas Homer Dixon, Professor of Global Systems, University of Waterloo, in conversation with Linda Hirsch for ABC News)

²⁵ “The impact of a major outbreak or an epidemic of infectious disease in a major city anywhere in the world would be catastrophic. We are completely dependent upon foods coming in on a regular basis, a daily basis, sometimes even more than daily. We're dependent on water coming in and so forth. If we were unable to maintain those distribution networks so we could handle movement of garbage out, movement of food in— there would be— it would be catastrophic. We'd have political instability, we would have people starving.” (Ian Lipkin, Director, Center for Infection & Immunity, Columbia University, in conversation with Linda Hirsch for ABC News)

²⁶ “What does it look like when a society collapses, and how does a society unravel? We're very fortunate in that we haven't seen this on the Earth in recent centuries. So we have to look at the historical collapses. And we have a fair number of those, and we know what the aftermath was. The Dark Ages were called the Dark Ages for a reason. What happens after a collapse is, generally, population is much smaller than it was before. For example, in the collapse of Maya civilization, a very large part of the population seems to have died, perhaps as much as 80 percent of the population in some areas. Because they depended on a complex society for their survival. Without the complex society, people don't survive. In our case, we depend on industrial medicine and industrial agriculture. Without those, or with less of those available, population will decline.” (Joseph Tainter, Author, *The Collapse of Complex Societies*, in conversation with Michael Bicks for ABC News)

²⁷ War and disease can be the means to achieve a grim kind of environmentally sustainable relationship between humankind and nature. Hundreds of millions of people already survive on a hand-to-mouth basis, living essentially on the leavings and limited charity of those who are better off. As climate change deepens, even the “donor” portion of society will feel the effects, and those below will be much worse off than before. Severe climate change will put additional stress on all systems of social support. Already tenuous health care systems may collapse. Vulnerability to new forms of disease will increase. In some regions the process may resemble the abrupt dieoffs that are thought to have occurred on a smaller scale among ancient peoples. Instead of focusing on ways to save modern civilization, social efforts may increasingly focus on sheer survival. Preemptive desertion of urban civilization will occur. Attention to the long-term requirements of society will attrite, in view of a public conviction that nothing can be done to alter the downward course of events. (CNAS, *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*, November 2007, Page 77)

EARTH 2100—ACT TEN

E.O. WILSON

Biologist & Entomologist, Harvard University

A few hundred years down the line, they'll look back and say, the dark ages began with the twenty-first century.

LUCY

Our city, our beautiful city was abandoned. And like cities of past civilizations, it didn't take long for nature to take over.

ALAN WEISMAN

Author, *The World Without Us*

The subway tunnels would flood and they would stay flooded. And the columns that hold up the streets, they will rust. They will corrode. And as they collapse the streets above them start caving in, and low and behold we have surface rivers once again in Manhattan. You know, the four, five, six line becomes the Lexington River.

JAMEEL AHMAD

Professor and Head of Civil Engineering, The Cooper Union

Nature has a certain dynamics in it. I mean it wants to go back to where the natural situation is. It won't be the asphalt jungle; it will be the real jungle.

ALAN WEISMAN

Big skyscrapers weren't designed to be water-logged. Think of what happens when a big tree falls in a forest. It brings down a lot of other trees. Well, buildings are gonna start to get taken out.

LUCY

It wasn't just the city. Our whole way of life had crumbled.²⁸

But I found my daughter Molly, and Daniel, my grandson. He was a young man now. Molly's husband, George, had been killed. Both of us were widows now.

It is a hard life. The United States has fragmented into a million shards. We're all cut off from each other, each protecting what little we have.²⁹

JOSEPH TAINTER

Author, *The Collapse of Complex Societies*

It would be a wrenching transition. It would be a catastrophic transition. It's something we don't want to experience. The Dark Ages were called the Dark Ages for a reason.

MICHAEL KLARE

I fear that we'll see a world like medieval Europe where you have feudal states fighting amongst themselves for what remains of a source of water, a source of energy.

LUCY

We manage to produce our own power, and communicate over radio waves.

The cities that have endured are now walled fortresses, jealously guarding whatever remains of the computer age.

MICHAEL KLARE

I'm picturing enclaves of affluence and wealth, but surrounded by vast masses of people who will be barely surviving.

E.O. WILSON

Humanity could very well be in hell, where hell is defined as truth realized too late

LUCY

We have had to relearn what we had unlearned centuries before – how to live off the land, how to make do.³⁰

MICHAEL KLARE

I fear that we'll see a world in which a lot of the great things — literature, the arts, democracy, music – will disappear, largely disappear.

EUGENE LINDEN

How much of the wonderful scientific breakthroughs of the 20th and 21st century will still be retained? If it's some electronic-based thing, it could all be lost.

LUCY

My grandson Daniel might never hear a symphony, go to college, or read the books I read. He will never marvel at a Right Whale,³¹ the beauty of a coral reef³² or a spotted owl.

PETER DeMENOCA

Professor of Environmental Sciences, Columbia University

If you actually ever get outside, and just kind of, look at the wonder of the world, it takes your breath away. And I think to think of a world where somehow that's not available to us, or somehow that is taken away, is really sad.

STUART PIMM

Professor of Conservation Ecology, Duke University

We're going to leave a planet that is so desperately beaten up that it will probably take hundreds of thousands of years to get it back, to restore it. We will have lost so much of our natural heritage.

LUCY

I can teach Daniel poems and songs. I can tell him what I saw and what I learned along the way. I can try to tell him what is precious.

LUCY

What is precious? I ought to know that. They say I am the oldest woman on earth. With age is supposed to come wisdom. What is precious? This earth of ours. This garden we must tend. These people we love.

BOB WOODRUFF

The future is not yet written. The ending to our story can still be changed. That, when we come back.

²⁸ “What does a collapse look like? How does a society unravel? Technology will simplify. We will no longer have access to the very intense, high technology that we enjoy today. We will no longer have access to the medical care that we are accustomed to. People's lives will simplify. People's lives will become more localized. People will have to become more self-sufficient and provide for themselves. There will be less education. There will be less literacy and less numeracy. Life expectancy will probably decline. People will simply have less knowledge about the rest of the world.” (Joseph Tainter, Author, *The Collapse of Complex Societies*, in conversation with Michael Bicks for ABC News)

The scale of the potential consequences associated with climate change — particularly in more dire and distant scenarios — made it difficult to grasp the extent and magnitude of the possible changes ahead. Even among our creative and determined group of seasoned observers, it was extraordinarily challenging to contemplate revolutionary global change of this magnitude. Global temperature increases of more than 3°C and sea level rises measured in meters (a potential future examined in scenario three) pose such a dramatically new global paradigm that it is virtually impossible to contemplate all the aspects of national and international life that would be inevitably affected. As one participant noted, “unchecked climate change equals the world depicted by Mad Max, only hotter, with no beaches, and perhaps with even more chaos.” While such a characterization may seem extreme, a careful and thorough examination of all the many potential consequences associated with global climate change is profoundly disquieting. The collapse and chaos associated with extreme climate change futures would destabilize virtually every aspect of modern life. (CNAS, *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*, November 2007)

²⁹ “As I look into the future, I fear that resources will become increasingly scarce and precious. Water, energy, land for growing food, essential minerals. So I, I fear in my worst nightmares, and I wish I didn't have to say this, but this is what I see, that we'll see a world of — like medieval Europe where — where you have feudal states fighting amongst themselves for what remains of a source of water, a source of energy, other means of survival, maybe bartering with each other for what's left, because I think there won't be enough to provide for the kind of population that we have today.” (Source: Michael Klare, Professor of Peace & World Security Studies, Hampshire College, in conversation with Michael Bicks for ABC News)

³⁰ “Our lives will be radically simplified if we have major breakdowns of our technological systems, our infrastructure, because we will be focused on doing the very basic things to survive. We'll be focused on getting food, on energy, on making sure our children are safe. They'll be much harder lives. But, at the same time, they'll be much simpler.” (Source: Thomas Homer Dixon, Professor, Centre for Environment and Business, University of Waterloo, in conversation with Linda Hirsch for ABC News)

³¹ “We may have lost polar bears because they, you know, they need the ice to perch when they're trying to catch their food. Lions are really in trouble in India, may go extinct in Africa, too. Tigers are threatened across their entire range in Africa. Right Whales may no longer survive twenty or thirty years, let alone a hundred. So we could be losing some really charismatic, big species. The things that really sort of part of our culture. The sort of things that our kids love to see. We will be leaving them a massively depleted, depopulate planet if we don't

change what we're doing." (Stuart Pimm, Professor of Conservation Ecology, Duke University, in conversation with Michael Bicks for ABC News)

³² "We're pickling the oceans. And the way this happens is that some of the carbon dioxide we add to the atmosphere dissolves in the ocean, and it makes carbonic acid, which lowers the pH of the ocean. That is, it makes it more acidic...and ultimately, if you look at the data, you discover that we are quite likely, by the middle of this century, to have made most of the world's oceans inhospitable to coral reefs. The organisms that form coral reefs won't be able to do it anymore." (John Holdren, Director, Professor, Harvard University, in conversation with Michael Bicks for ABC News)

It now appears that corals are threatened by global climate change...We may already be seeing the negative impact of increased sea surface temperatures on the health of corals. The most visible symptom of declining coral health is coral bleaching. Because many corals live in water which is already near their upper temperature limit, a water temperature increase of only a few degrees can be deadly. As water temperatures rise, corals become increasingly stressed. When stress levels get too high, corals expel the symbiotic algae, or zooxanthellae (tiny one-celled plants) which live within the thin layer of live coral tissue. Zooxanthellae are important because they turn sunlight into food for their coral hosts. They also facilitate the formation of the coral skeleton – the main structural component of coral reefs. Because zooxanthellae give corals their various rich colors, a coral without zooxanthellae appears bleached. Corals cannot thrive without zooxanthellae. For coral reefs that are already stressed due to poor water quality, destructive fishing, or frequent interactions with irresponsible divers and snorkellers, increased water temperatures could become the proverbial straw that breaks the camel's back. (Source: NOAA, <http://www.ncdc.noaa.gov/paleo/outreach/coral/coralchange.html>)

EARTH 2100—ACT 11

BOB WOODRUFF

Lucy's story is a worst case scenario of what could happen if we continue on our current path. It's a wake-up call, a challenge for us to plan a different course. But, our experts say, we must act immediately.

Where did Lucy's world go wrong? What can we learn from their mistakes? We turn back the clock now... to show you a vision of a future we can still create.

VAN JONES

There's a future out there that's a much better future than the present that we're living in right now, to be sure.

E.O. WILSON

If we took the measures we should take, 2100 would be at the beginning of an era that we today would regard as paradise.

PETER GLEICK

We have a chance to get it right, to move from a disconnected, inefficient world of fighting populations to a sustainable planet. The problem we face today, is how do we get from here to there?

CALENDAR RESET TO 2009

BOB WOODRUFF

The world that Lucy was born into is our world of 2009. There are plenty of signs that the world is in trouble. But there are hopeful signs as well.

JARED DIAMOND

the problems that we face, problems of water, soil, climate change and so on, they're all problems caused by humans, so we're capable of solving those problems.

THOMAS FRIEDMAN

Foreign Affairs Columnist, *The New York Times*

I just try to take it one brick, one chunk at a time. I think that's how you have to deal with it.

BOB WOODRUFF

So what should we do right now to chart another course? How do we avoid ending up in Lucy's world?

Many experts say the first step should be transforming how we use energy. Much of what we need to do, we already know.

ERIC SCHMIDT

Use compact fluorescent bulbs.

MICHAEL POLLAN

Plant a garden.

PETER SCHWARTZ

More mass transit.

VAN JONES

Better windows.

ERIC SCHMIDT

Insulate your homes.

PETER SCHWARTZ

Smaller cars.

DAN GILBERT

There is no simple solution. But a hundred percent of the Earth's population doing a very small thing makes a very big difference.

BOB WOODRUFF

But individuals alone won't be able to turn things around. Governments and industries are going to have to change on a massive scale.

FRED KRUPP

We're gonna have to come up with more solar, more wave power, more geothermal energy.

VAN JONES

We can't drill and burn our way out of our problems. But we can invent and invest our way out.

BOB WOODRUFF

Beyond the familiar technologies, amazing new ones are already in the works. Fields of solar balloons³³ that could power thousands of homes a day...a nuclear fusion facility³⁴ that could produce the energy of a tiny manmade star...

Getting enough of these projects up and running will take people. That means jobs.

CALENDAR RESETS TO 2015

BOB WOODRUFF

And if we can put more people back to work, then by 2015, instead of

communities disintegrating, they could start to rebound.

VAN JONES

You can fight pollution and poverty at the same time. You can beat global warming and the economic downturn with the same dollar bill, if you invest it in green jobs, green industries, green technologies.

BOB WOODRUFF

If we start those investments today, there wouldn't be gas lines and fights as in Lucy's world. Instead, there would be electric cars that could run 300 miles per charge.³⁵

But completely redesigning our energy system would require rapid change. It would mean both sacrifice and hard work for the whole country. But we have done it before.

THOMAS FRIEDMAN

*But the thing I would compare it to is World War II. After Pearl Harbor, FDR turned to Detroit, the automakers, and said you will now make tanks. You will now make Jeeps. Just like that, that was like overnight almost.*³⁶ *And they did it.*

BOB WOODRUFF

And we won that war. It's going to take that same level of commitment.

DAN GILBERT

Imagine that all of us did enough things that it made a real difference in our country. What effect does that have on China, on India? On other nations?

ERIC SCHMIDT

Chairman & CEO, Google

Well, if we don't set an example as the strongest and most important country in the world, what do we expect them to do? They're not gonna follow if we don't lead.

BOB WOODRUFF

A turning point in Lucy's world was the global summit of 2015. When the world leaders failed to agree on actions to slow climate change, they set in motion all the disasters that would follow.

But what if they had agreed?

NEWSCAST

"For the first time ever, China, India, the US and Europe have reached an agreement that could avert catastrophic climate change."

JOHN PODESTA

You could change this vicious cycle I think into a virtuous cycle

ALEX STEFFEN

Author, *Worldchanging: A User's Guide for the Twenty-First Century*

Then what we could see is actually billions of people coming in to far more stable, sustainable, prosperous, you know, economies.

BOB WOODRUFF

As we move forward in the century, we will see the investments and hard choices we made early on, begin to pay off.

PETER GLEICK

The positive scenario is, we've restored ecosystems, we've integrated climate change into our thinking. Fossil fuels will be disappearing. We're growing more food with less water.

CALENDAR RESETS TO 2050

BOB WOODRUFF

By the middle of the century, we would be using water and other resources much more carefully. Farmers would be planting drought-resistant crops.³⁷ Water would be recycled.³⁸ And there would be enough to support the US – Southwest. In 2050, places like Las Vegas could survive.

The hope is that once we figure out how to solve these problems, we'll be in a much better position to help the rest of the world.

ALEX STEFFEN

If we can actually raise the prospects of the bottom few billion people, we actually make the stability, the global stability, possible.

JEFF SACHS

Director, Earth Institute

We reduce mass migration, refugee movements, desperation. And if we do all those things we bring a sustainable world prosperity closer to hand.

ALEX STEFFEN

There's a very good chance that we could see, by about 2050, the worst part of the crisis having passed. It doesn't mean that there aren't gonna be big problems still to face. But it means that we will have avoided sailing right off the cliff.

WOODRUFF

When we come back, a different vision of the year 2100.

³³ Solar cells are expensive, so it makes sense to use them efficiently. One way to do so is to concentrate sunlight onto them. That means a smaller area of cell can be used to convert a given amount of light into electricity. This, though, imposes another cost—that of the mirrors needed to do the concentrating. Traditionally these are large pieces of polished metal, steered by electric motors to keep the sun's rays focused on the cell. But now Cool Earth Solar of Livermore, California, has come up with what it hopes will be a better, cheaper alternative: balloons.

Anyone who has children will be familiar with aluminised party balloons. Such balloons are made from metal-coated plastic. Cool Earth's insight was that if you coat only one half of a balloon, leaving the other transparent, the inner surface of the coated half will act as a concave mirror. Put a solar cell at the focus of that mirror and you have an inexpensive solar-energy collector. (Source: "Solar Energy: Party Time!" The Economist, March 5th 2009)

³⁴ The world's largest and highest-energy laser was certified to operate by the U.S. Department of Energy on March 27, 2009. In 2010, NIF will focus the intense energy of 192 giant laser beams on a BB-sized target filled with hydrogen fuel — fusing, or igniting, the hydrogen atoms' nuclei in the world's first controlled thermonuclear reaction. This is the same fusion energy process that makes stars shine and provides the life-giving energy of the sun. (Source: NIF, <https://lasers.llnl.gov/>)

³⁵ EVs with a 150-mile range could be built and sold in quantity at a profit today for \$25,000. Ranges exceeding 300 miles on a charge exist today, but with the cost of batteries as high as they are, it is impractical for most cars at this point. (Plug-In America, <http://www.pluginamerica.org/learn-about-plug-ins/frequently-asked-questions.html>)

³⁶ "Let no man say it cannot be done. It must be done—and we have undertaken to do it. I have just sent a letter of directive to the appropriate departments and agencies of our Government, ordering that immediate steps be taken:

First, to increase our production rate of airplanes so rapidly that in this year, 1942, we shall produce 60,000 planes, 10,000 more than the goal that we set a year and a half ago. This includes 45,000 combat planes- bombers, dive bombers, pursuit planes. The rate of increase will be maintained and continued so that next year, 1943, we shall produce 125,000 airplanes, including 100,000 combat planes.

Second, to increase our production rate of tanks so rapidly that in this year, 1942, we shall produce 45,000 tanks; and to continue that increase so that next year, 1943, we shall produce 75,000 tanks.

Third, to increase our production rate of anti-aircraft guns so rapidly that in this year, 1942, we shall produce 20,000 of them; and to continue that increase so that next year, 1943, we shall produce 35,000 anti-aircraft guns. And fourth, to increase our production rate of merchant ships so rapidly that in this year, 1942, we shall build 6,000,000 deadweight tons as compared with a 1941 completed production of 1,100,000...

War costs money. So far, we have hardly even begun to pay for it. We have devoted only 15 percent of our national income to national defense. As will appear in my Budget Message tomorrow, our war program for the coming fiscal year will cost 56 billion dollars or, in other words, more than half of the estimated annual national income. That means taxes and bonds and bonds and taxes. It means cutting luxuries and other non-essentials. In a word, it means an "all-out" war by individual effort and family effort in a united country.

Only this all-out scale of production will hasten the ultimate all-out victory. Speed will count. Lost ground can always be regained- lost time never. Speed will save lives; speed will save this Nation which is in peril; speed will save our freedom and our civilization—and slowness has never been an American characteristic." (Excerpted from Franklin Delano Roosevelt's State of the Union Address, January 6, 1942)

³⁷ Genetically modified crops that are drought resistant will be grown by farmers within four to five years, according to scientists developing the technology. Dr David Dennis, the chief executive of Performance Plants Incorporated in Kingston, Ontario, said varieties of drought-tolerant oilseed rape and maize were already being tested in field trials in the US. He claimed the new varieties can increase yield by 40% when the plants are most water-stressed. (Source: "Drought Resistant GM Crops Ready in Four Years" The Guardian, October 8, 2008)

³⁸ **What Is Water Recycling?** While recycling is a term generally applied to aluminum cans, glass bottles, and newspapers, water can be recycled as well. Water recycling is reusing treated wastewater for beneficial purposes

such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a ground water basin (referred to as ground water recharge).

Water is sometimes recycled and reused onsite; for example, when an industrial facility recycles water used for cooling processes. A common type of recycled water is water that has been reclaimed from municipal wastewater, or sewage. The term water recycling is generally used synonymously with water reclamation and water reuse.

What Is The Future Of Water Recycling? Water recycling has proven to be effective and successful in creating a new and reliable water supply, while not compromising public health. Non-potable reuse is a widely accepted practice that will continue to grow. However, in many parts of the United States, the uses of recycled water are expanding in order to accommodate the needs of the environment and growing water supply demands. Advances in wastewater treatment technology and health studies of indirect potable reuse have led many to predict that planned indirect potable reuse will soon become more common. (Source: U.S. Environmental Protection Agency, <http://www.epa.gov/region/water/recycling/>)

EARTH 2100—ACT TWELVE

BOB WOODRUFF

By 2100, our world could be transformed.

HEIDI CULLEN

Just, imagine a city that's not polluted, that has a great transportation infrastructure...

MITCHELL JOACHIM

Architect And Urban Designer

Stackable cars, and they would charge, and be a shared ownership model, and you would just pull out the one that's available that's fully charged. Everything happens inside the city itself. That means our food production, our waste and recycling, our energy.³⁹

PETER GLEICK

We're going to have joint management of water resources, of energy resources, uh, of disaster management. We're going to be living on a planet where we don't see things at a national level, but we see things at a global level.

VAN JONES

By the time we get to 2100, the challenge of building a global, green economy where we're sharing technologies and where we're not fighting wars over water and oil... That's going to bring out the best in the human family.

E.O. WILSON

Humanity will be relatively, um, disease-free. Children will be treated as rare treasures.

PETER DeMENOCA

What most people don't realize is that not only can we change, we must change. And I think that's how you own the future. That's how you take control of your destiny,

STUART PIMM

I have huge faith in humanity.

THOMAS FRIEDMAN

And we will be able to create a world that will be a livable planet for our kids and their kids. That is our opportunity. That is our obligation.

ALEX STEFFEN

Kids born today will see us navigate past the first greatest test of humanity, which is: can we actually be smart enough to live on a planet without destroying it?

BOB WOODRUFF

In December of this year, nearly 200 countries plan to meet in Copenhagen, Denmark.⁴⁰ Their mission: to draw up a strategy, a way to pool their best minds and their money to safeguard the planet.

If you'd like to learn more about earth 2100 or if you want to get involved in the solutions, go to our webpage at ABCnews.com.

I'm Bob Woodruff. For all of us at ABC News, goodnight.

³⁹ Designed for mobility in urban cores, the stackable car is for two passengers. New transport stacks are placed throughout the downtown to create a linked transportation system that works within existing infrastructure. By locating stacks in urban areas and vital junction zones, the car allows the populace a certain flexibility to merge mass transit effectively with personal mobility. This is an exceedingly resourceful parking scheme, as the stack accepts inward bound vehicles and recharges their power supply. Similar to baggage pushcarts at airports, users basically take the first completely charged automobile at the face of the stack. These urban vehicles are not a substitute for individual cars, taxis, buses, or trains, but rather a new archetype that endorses a communally accountable and more potent means of urban mobility. (Source: Terreform ONE, Stackable Cars, Urban Solar Recharge Port in the City, http://www.terreform.org/projects_mobility_stackable.html)

⁴⁰ In 1990, the United Nations General Assembly decided to start work on a climate change convention. The endeavors led to 154 countries signing the United Nations Framework Climate Change Convention (UNFCCC) at the UN Summit in Rio de Janeiro in 1992. Since then, 192 countries including the USA have ratified the convention. The goals of the climate change convention are to stabilize the amount of greenhouse gases in the atmosphere at a level that prevents dangerous man-made climate changes. According to the objective paragraph, this stabilization must occur in such a way as to give ecosystems the opportunity to adapt naturally. This means that food safety must not be compromised, and that the potential to create sustainable social and economic development must not be endangered. Each year, a Conference of the Parties is held, where the countries which have ratified the convention meet and discuss how the convention's goals can be implemented in practice. (Source: United Nations Climate Change Conference website, <http://en.cop15.dk/about+cop15>)