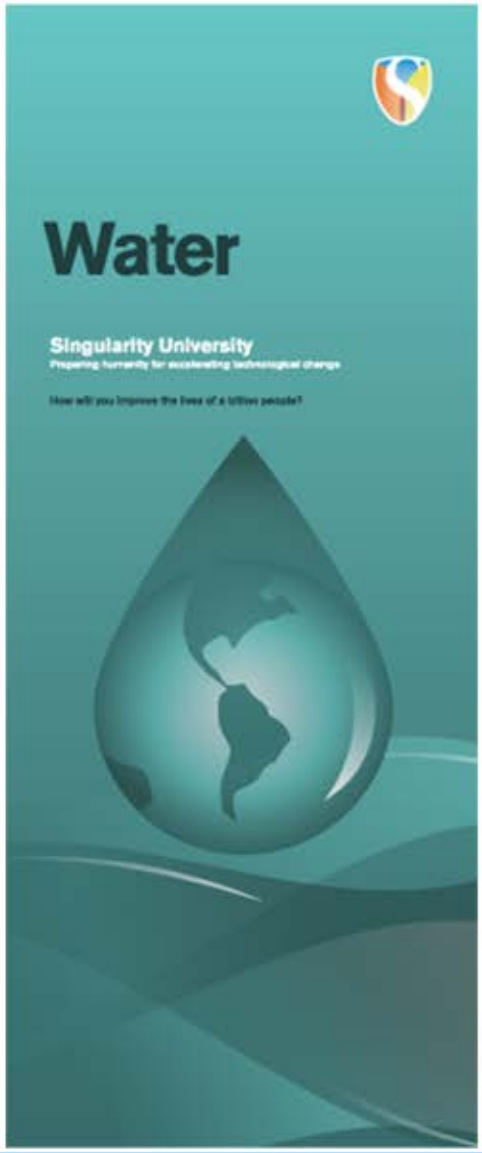
A BRIGHTER TOMORROW

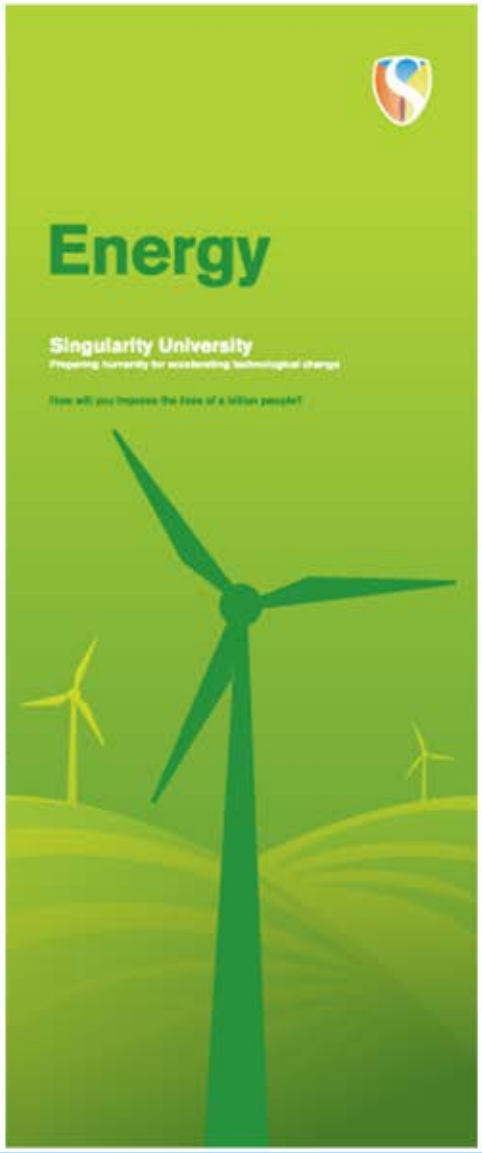
Ramez Naam

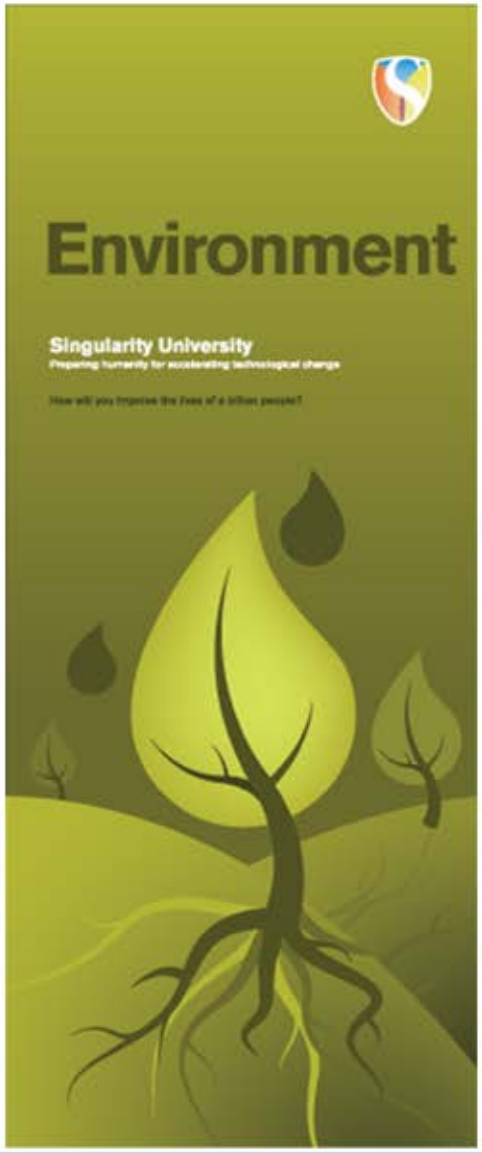
@ramez

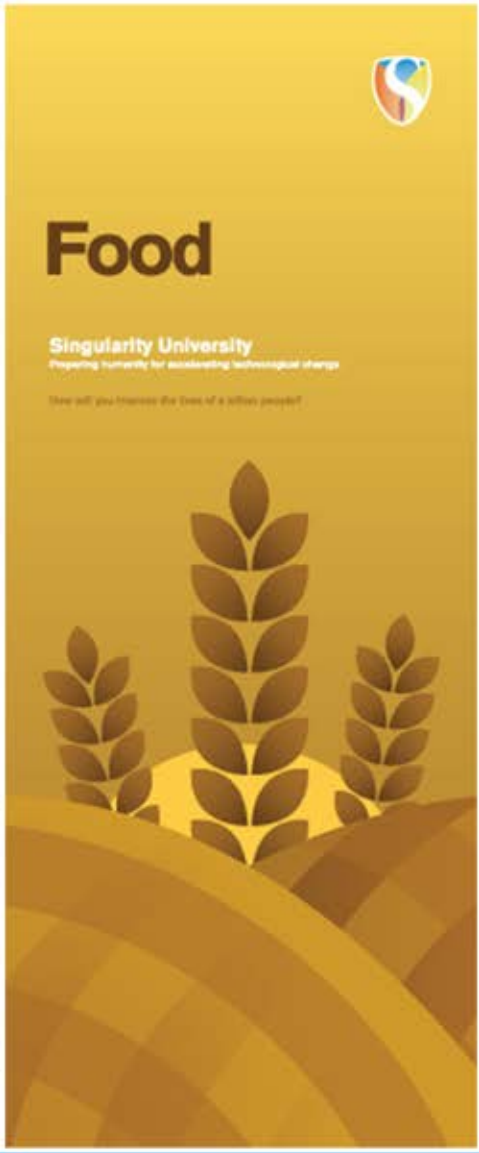
14 YEARS IN TECH

Ramez Naam @ramez









the infinite resource

the power of ideas on a finite planet

RAMEZ NAAM


It was the **best of times**,
It was the **worst of times**
NASA

BEST OF TIMES

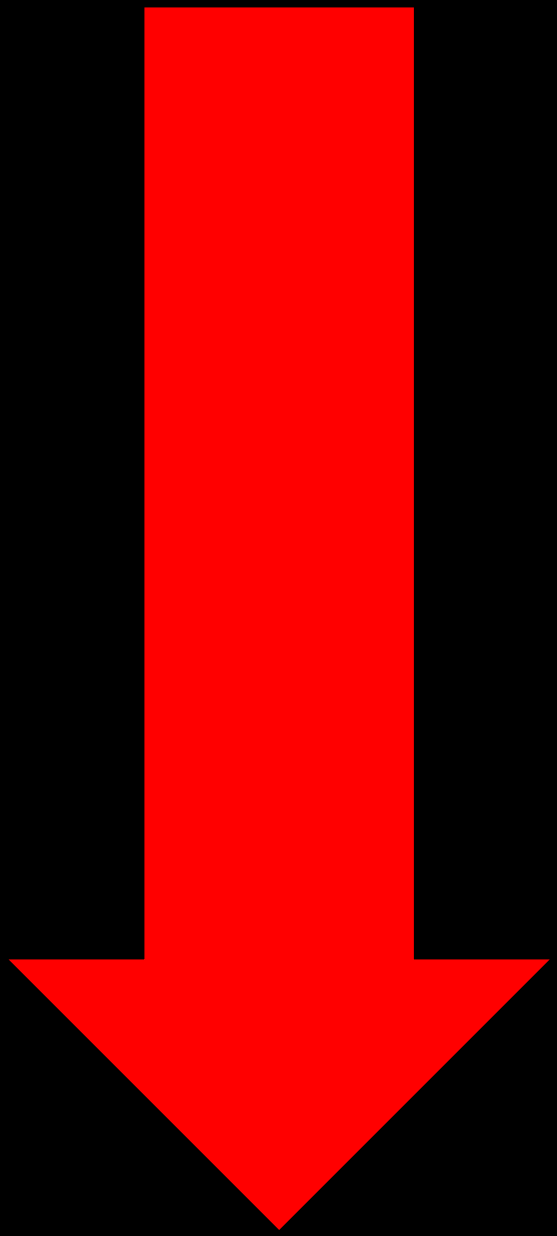
Poverty

Hunger

Infant Mortality

Warfare

Disease



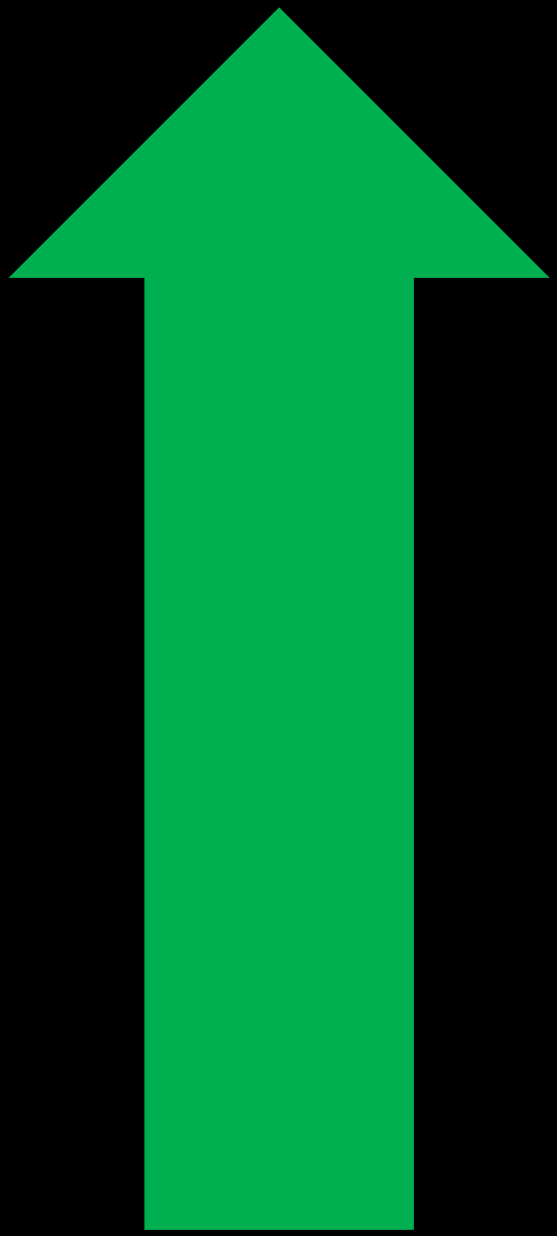
Longevity

Education

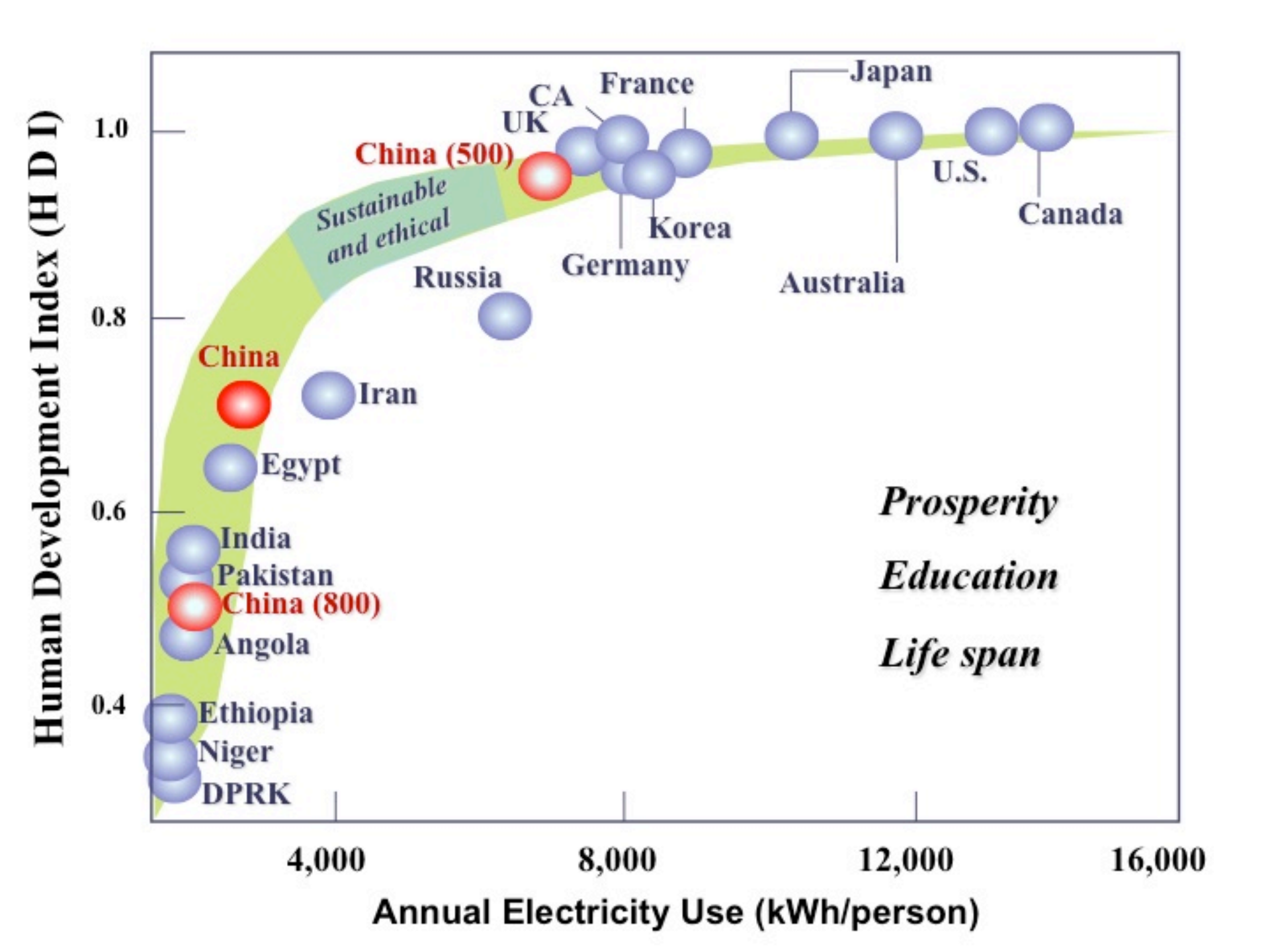
Communication

Access to Knowledge

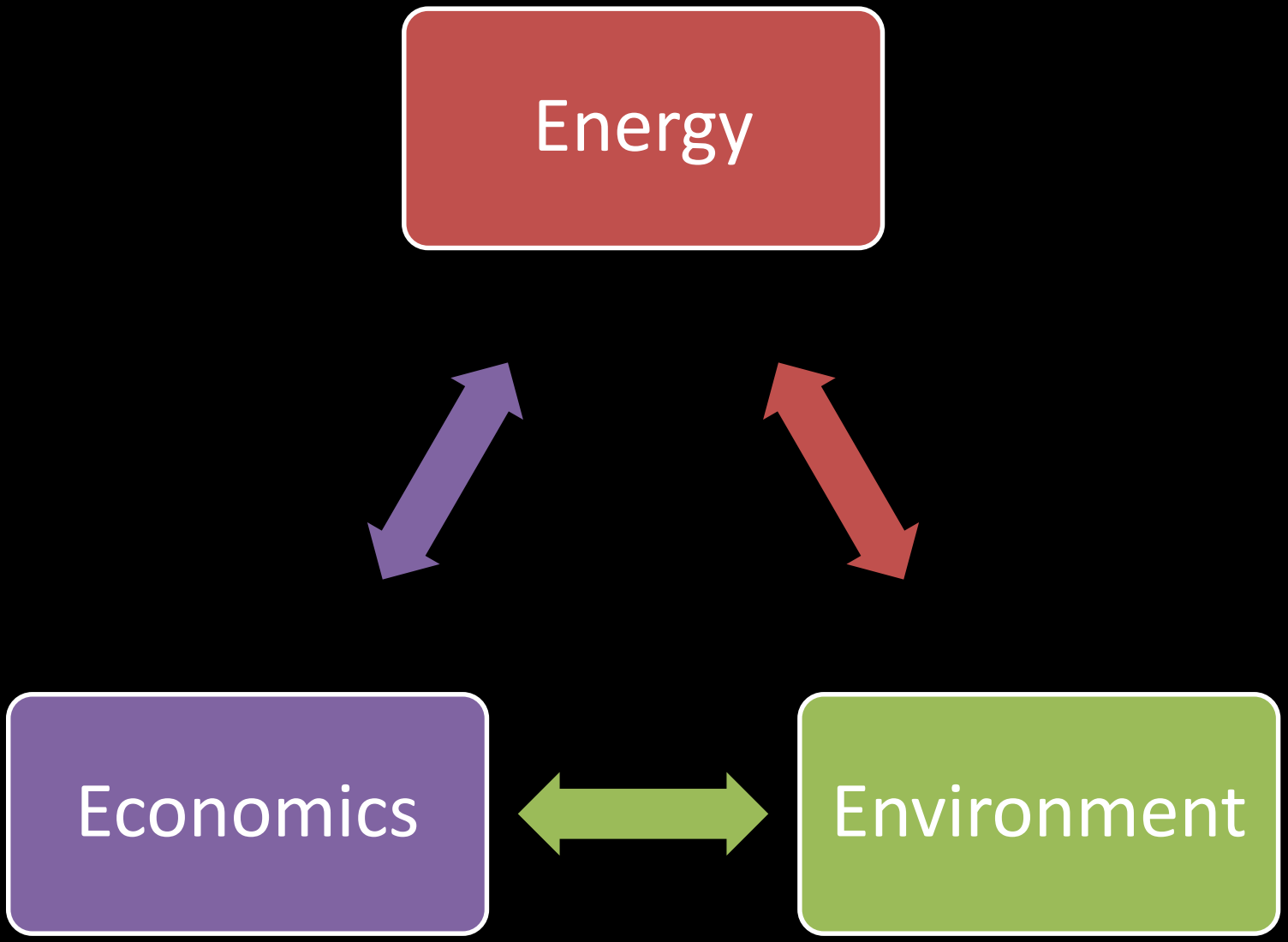
Freedom



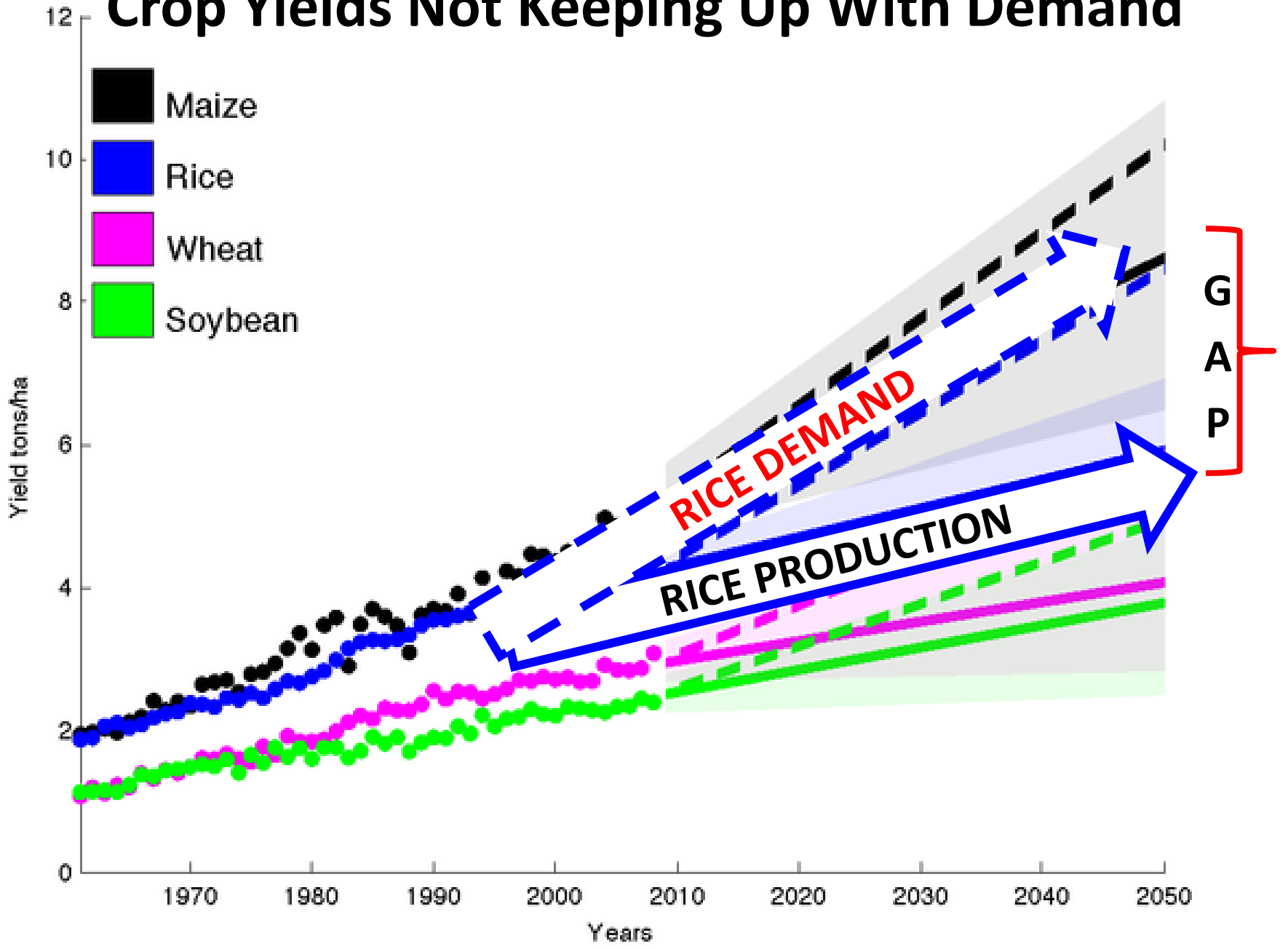

Aivaris Zukis


Human Development Index (H D I)
1.0
0.8
0.6
0.4
Sustainable and ethical
CA
France
Japan
UK
China (500)
U.S.
Canada
Korea
Germany
Russia
Australia
China
Iran
Egypt
India
Pakistan
China (800)
Angola
Ethiopia
Niger
DPRK
Prosperity
Education
Life span
4,000
8,000
12,000
16,000
Annual Electricity Use (kWh/person)

WORST OF TIMES


Energy
Economics
Environment

Crop Yields Not Keeping Up With Demand



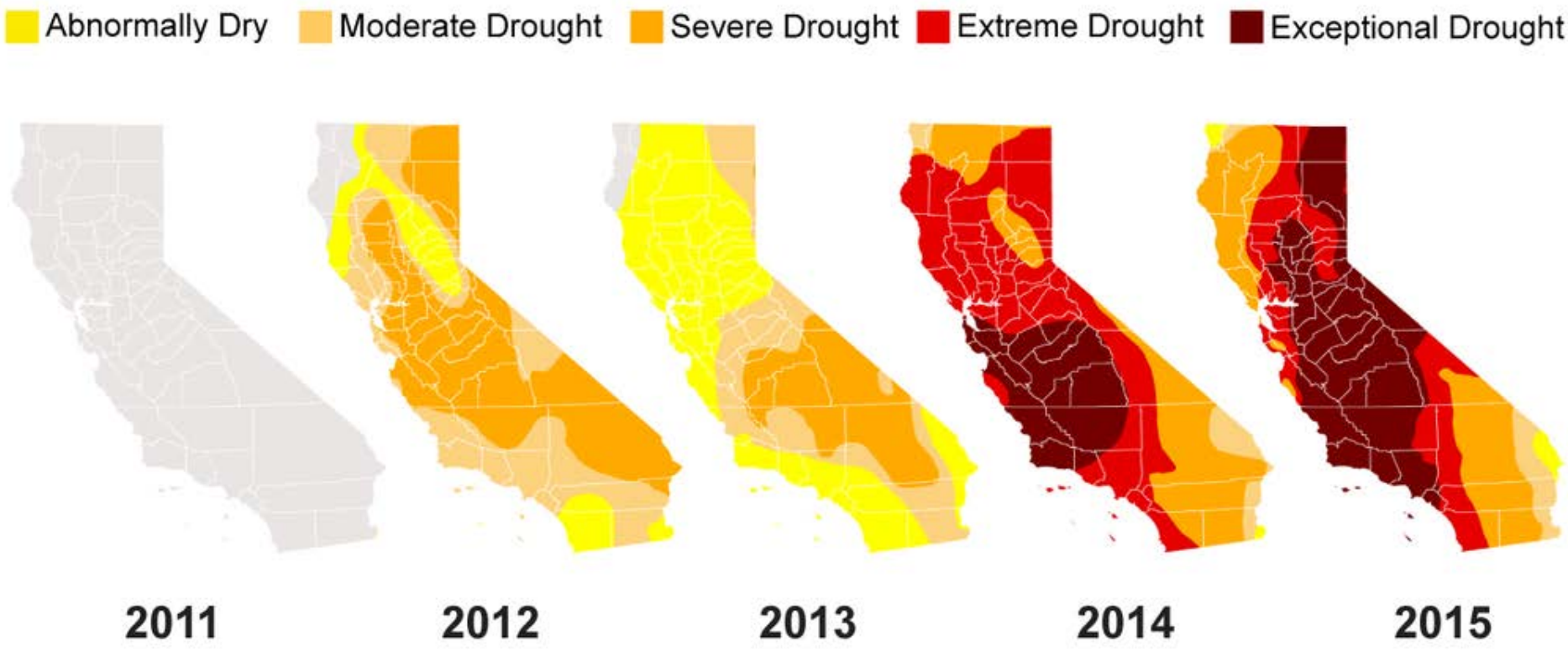

Dhy

July - September, 1989

NASA

NASA

California's drought level at second week of April

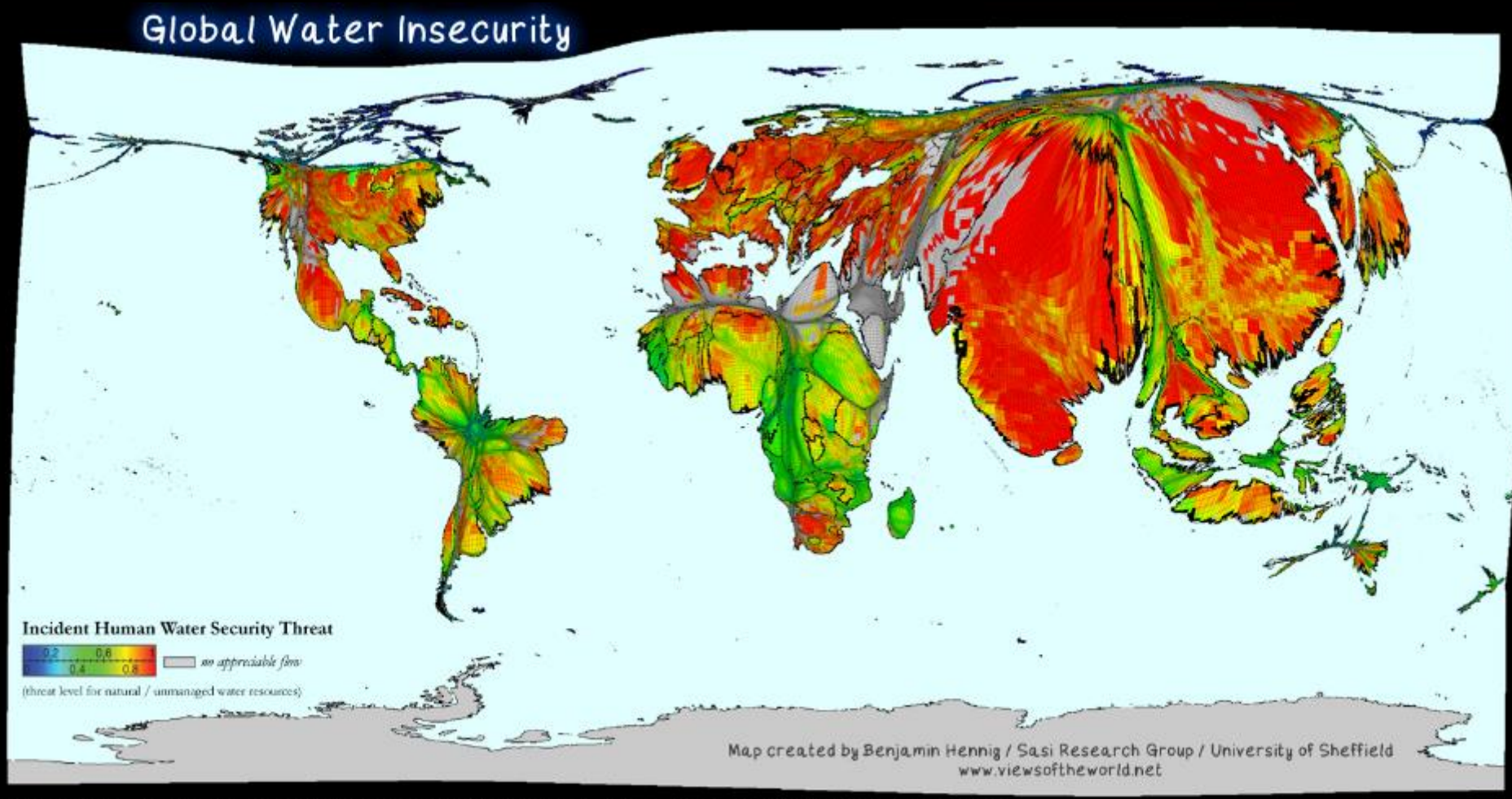


Source: U.S. Drought Monitor

@latimesgraphics


© Getty Images

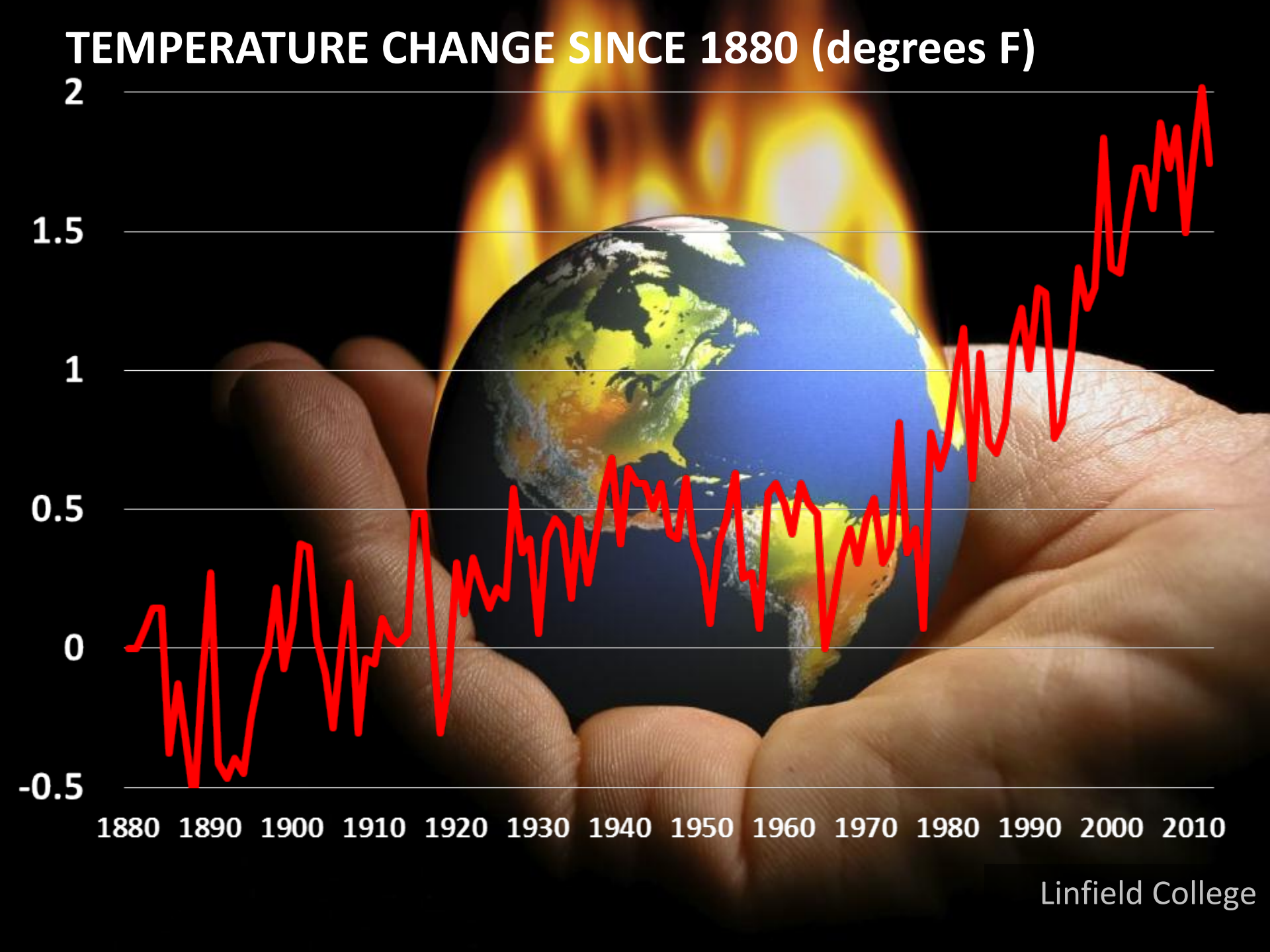

© Getty Images



Data Source: http://www.riverthreat.net/data.html - based on CJ Vörösmarty et al. Nature 467, 555-561 (2010) doi:10.1038/nature09440

CLIMATE CHANGE

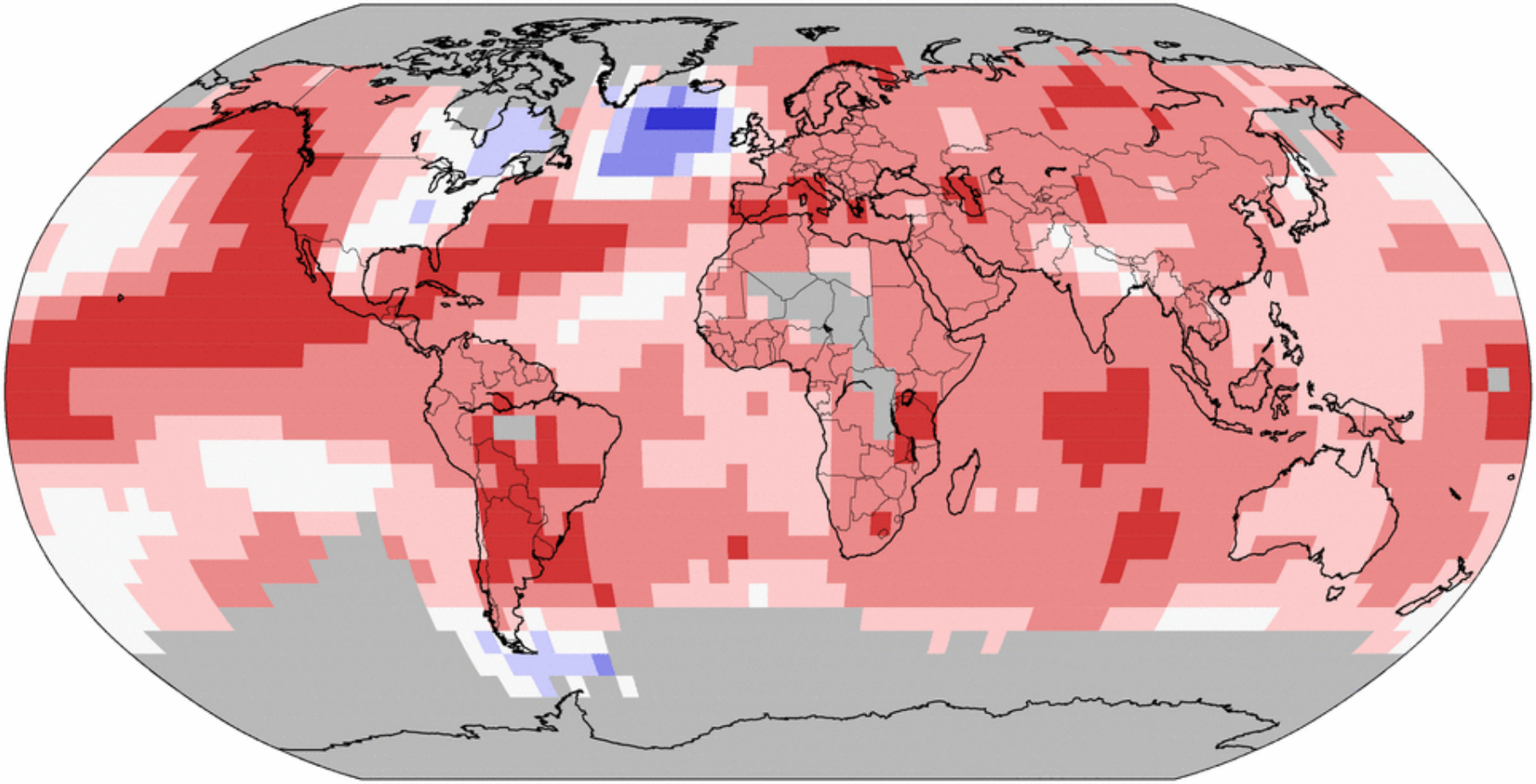
Linfield College


TEMPERATURE CHANGE SINCE 1880 (degrees F)
2
1.5
1
0.5
0
-0.5
1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
Linfield College

Land & Ocean Temperature Percentiles Jan–Aug 2015

NOAA's National Centers for Environmental Information

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0



Record Coldest | Much Cooler than Average | Cooler than Average | Near Average | Warmer than Average | Much Warmer than Average | Record Warmest

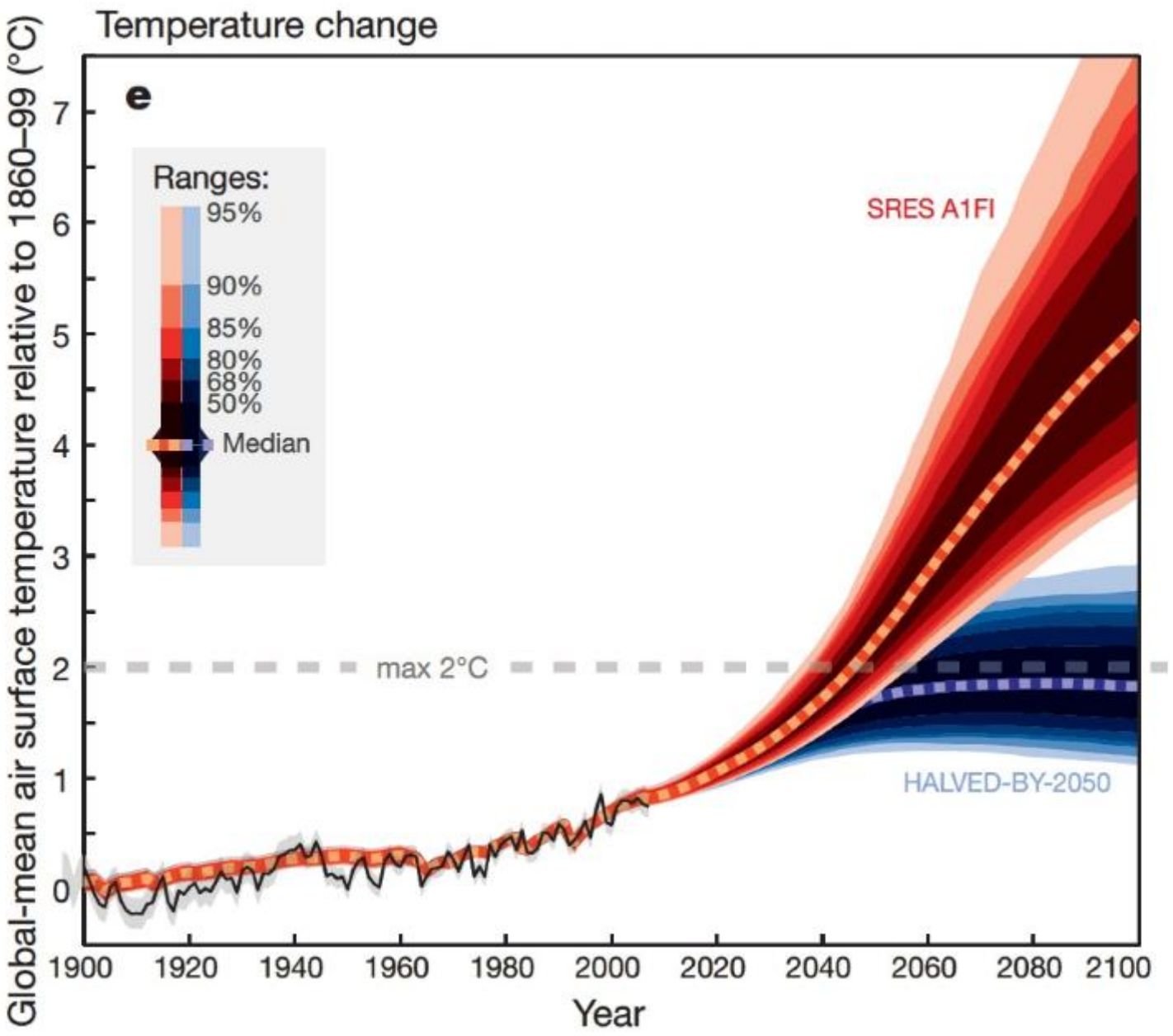
Mon Sep 14 06:43:31 EDT 2015

GlobalWarmingArt.com


European PressPhoto Agency

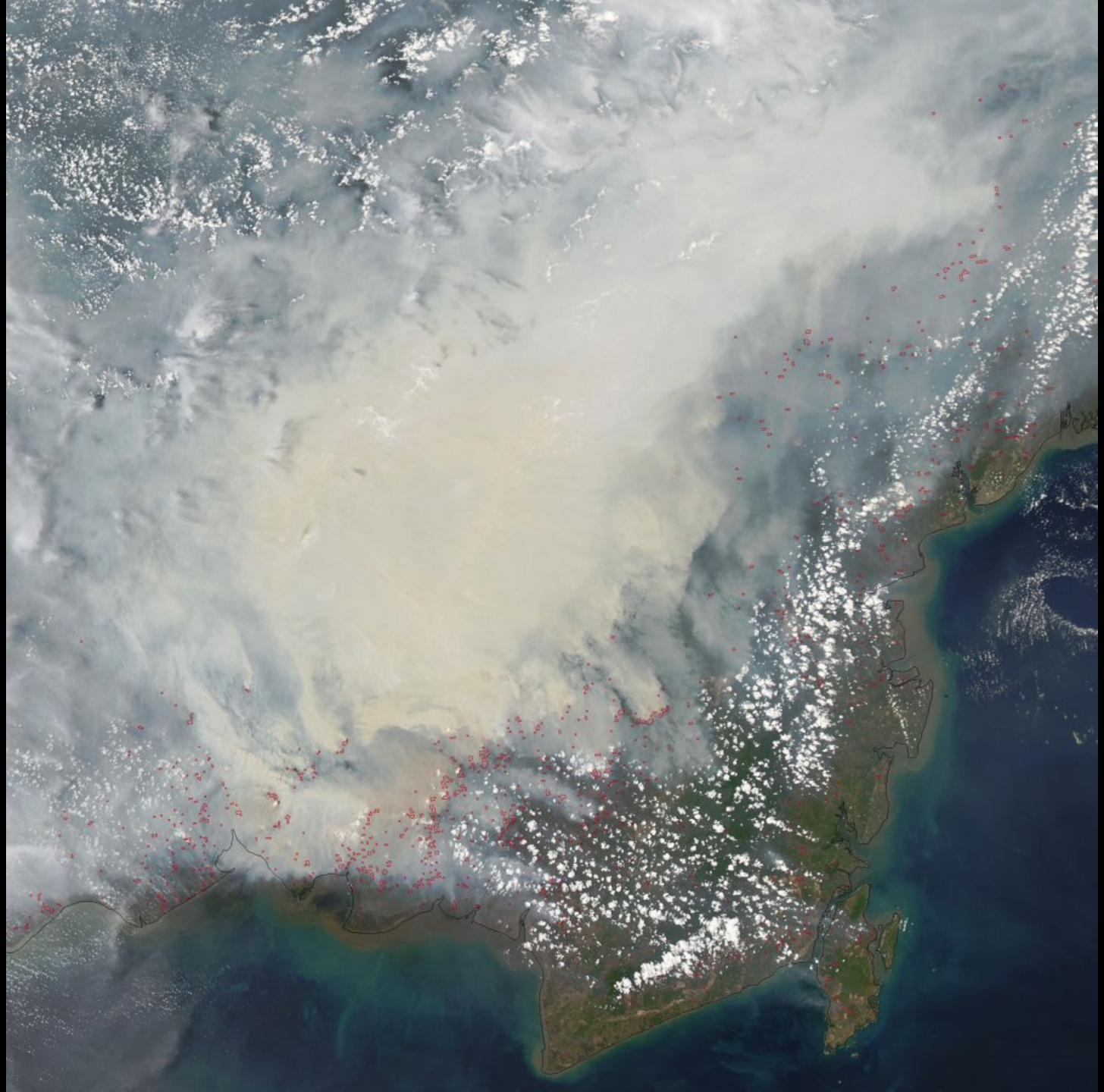

Andrey Smirnov


Xinhua


Temperature change
e
Ranges:
95%
90%
85%
80%
68%
50%
Median
SRES A1FI
max 2°C
HALVED-BY-2050
Global-mean air surface temperature relative to 1860–99 (°C)
0
1
2
3
4
5
6
7
1900
1920
1940
1960
1980
2000
2020
2040
2060
2080
2100
Year

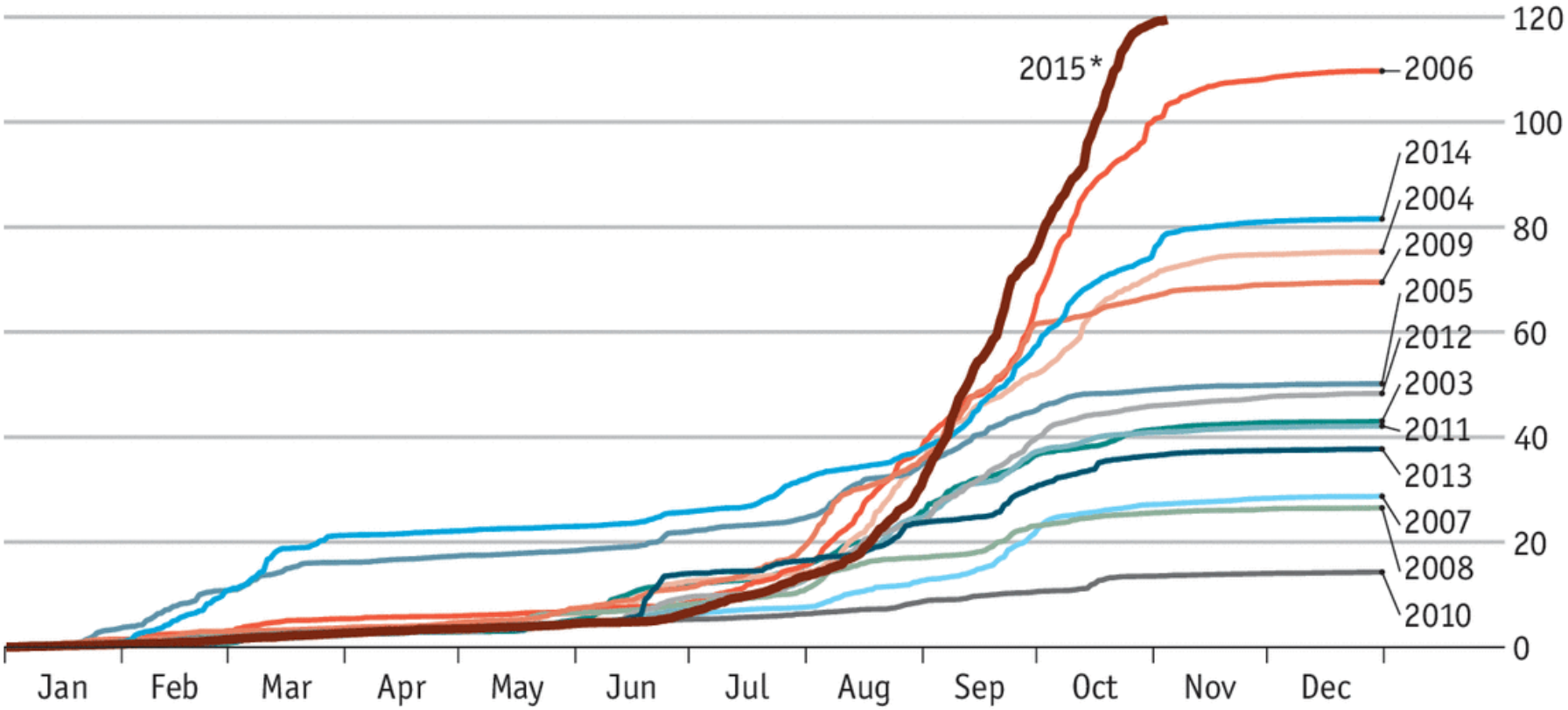

Laitche


Geraldine Garcon Juncas



Flaming October

Indonesia, cumulative number of active fire detections per year, ’000

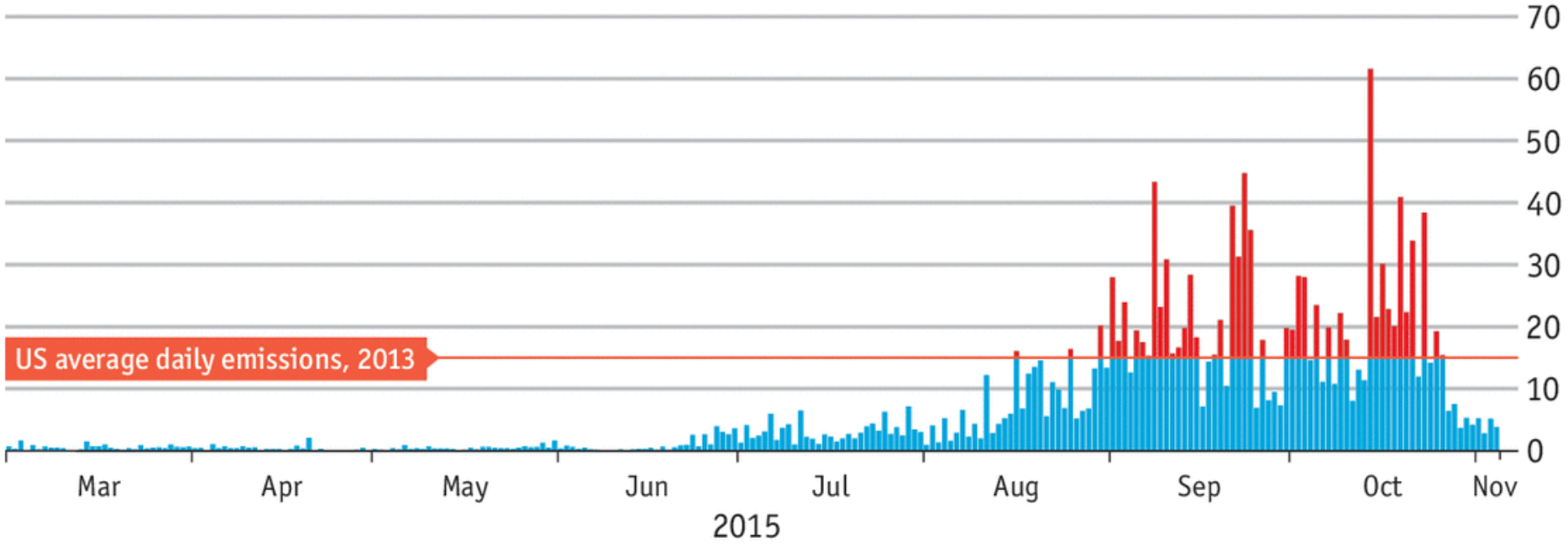


Source: Guido Van der Werf, NASA

*To November 4th

Up in smoke

Daily emissions from Indonesian fires, m tonnes CO_2 equivalent

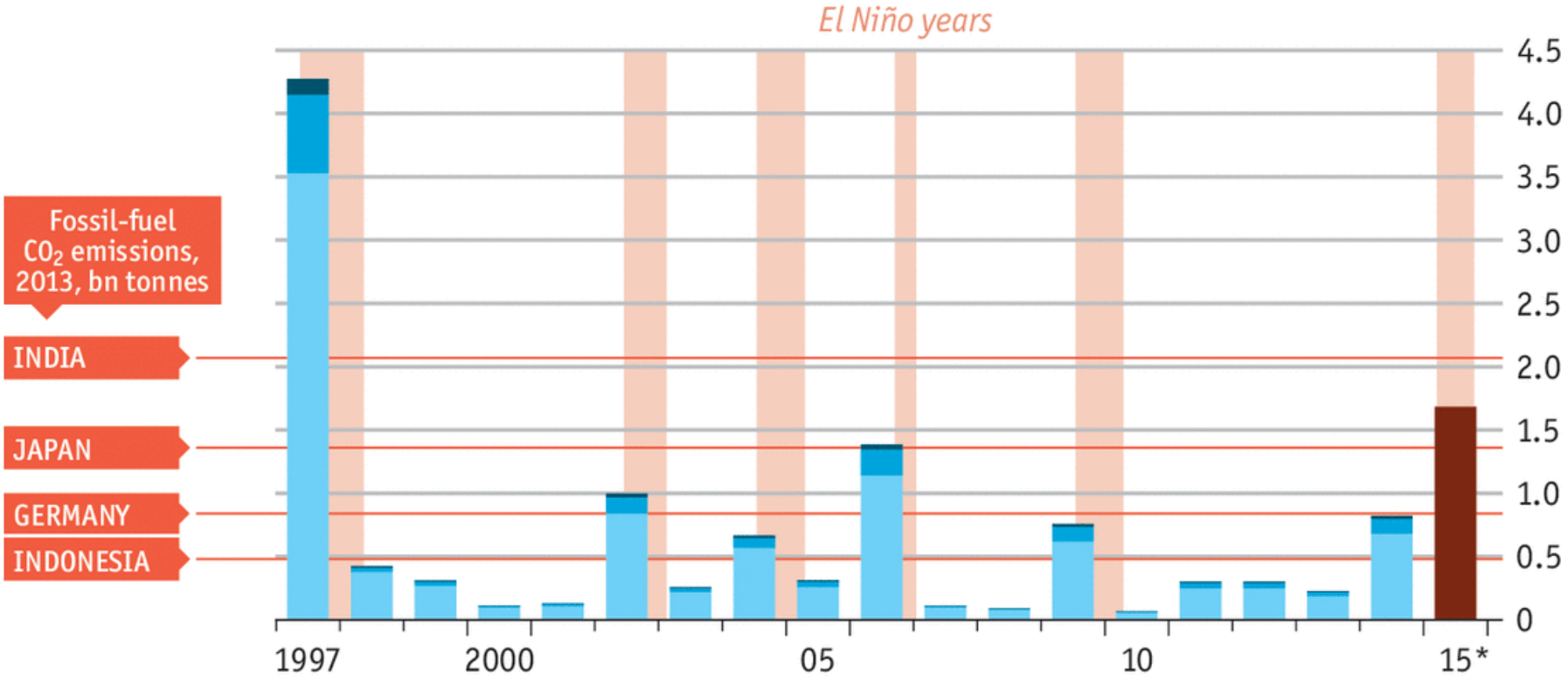


Sources: Guido van der Werf; WRI

Fetch the engines

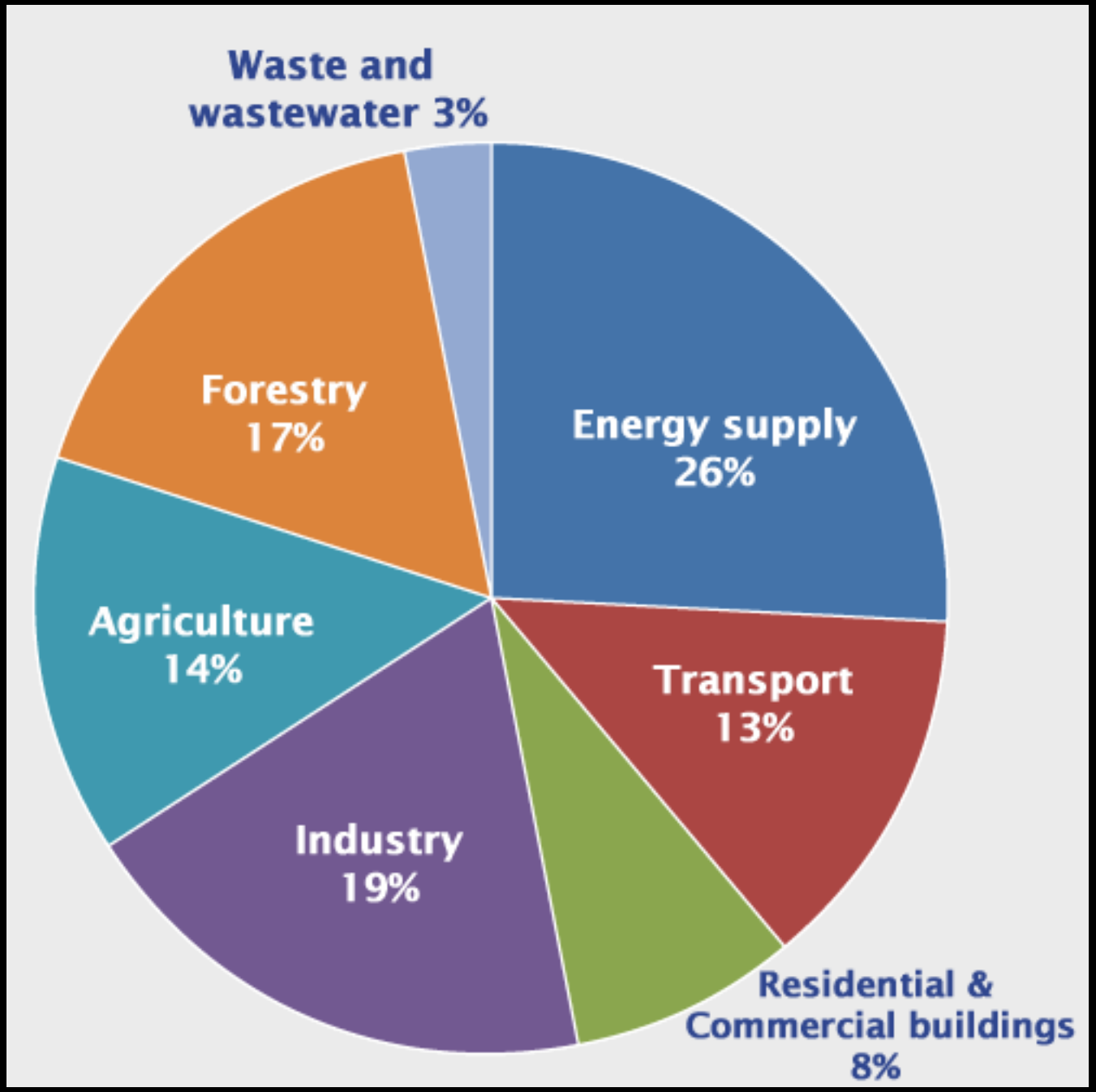
Emissions from Indonesian fires

Bn tonnes CO_2 equivalent from: CO_2 CH_4 N_2O



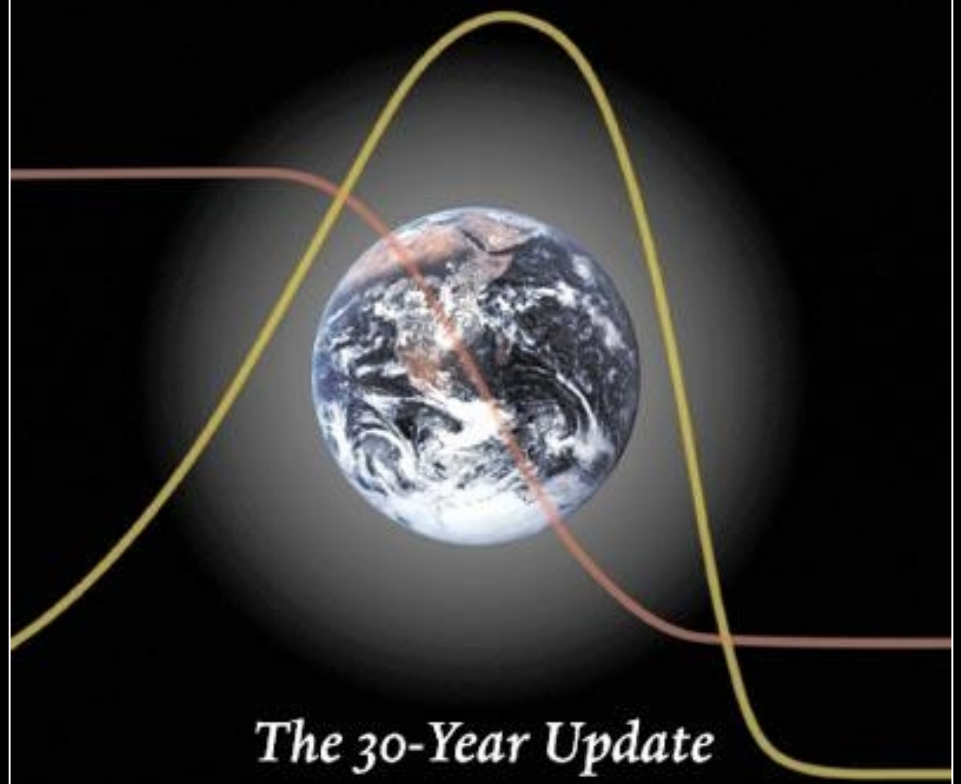
Sources: Guido van der Werf; WRI; EDGAR

*To Nov 4th, total emissions


Waste and wastewater 3%
Forestry 17%
Energy supply 26%
Agriculture 14%
Transport 13%
Industry 19%
Residential & Commercial buildings 8%


Rock
Hard Place

LIMITS TO GROWTH



The 30-Year Update

DONELLA MEADOWS | JORGEN RANDERS | DENNIS MEADOWS

AUTHOR OF NO LOGO AND THE SHOCK DOCTRINE

NAOMI KLEIN

THIS CHANGES EVERYTHING

CAPITALISM VS THE CLIMATE

ISBN 978-1-846-14505-6


Terry Luns

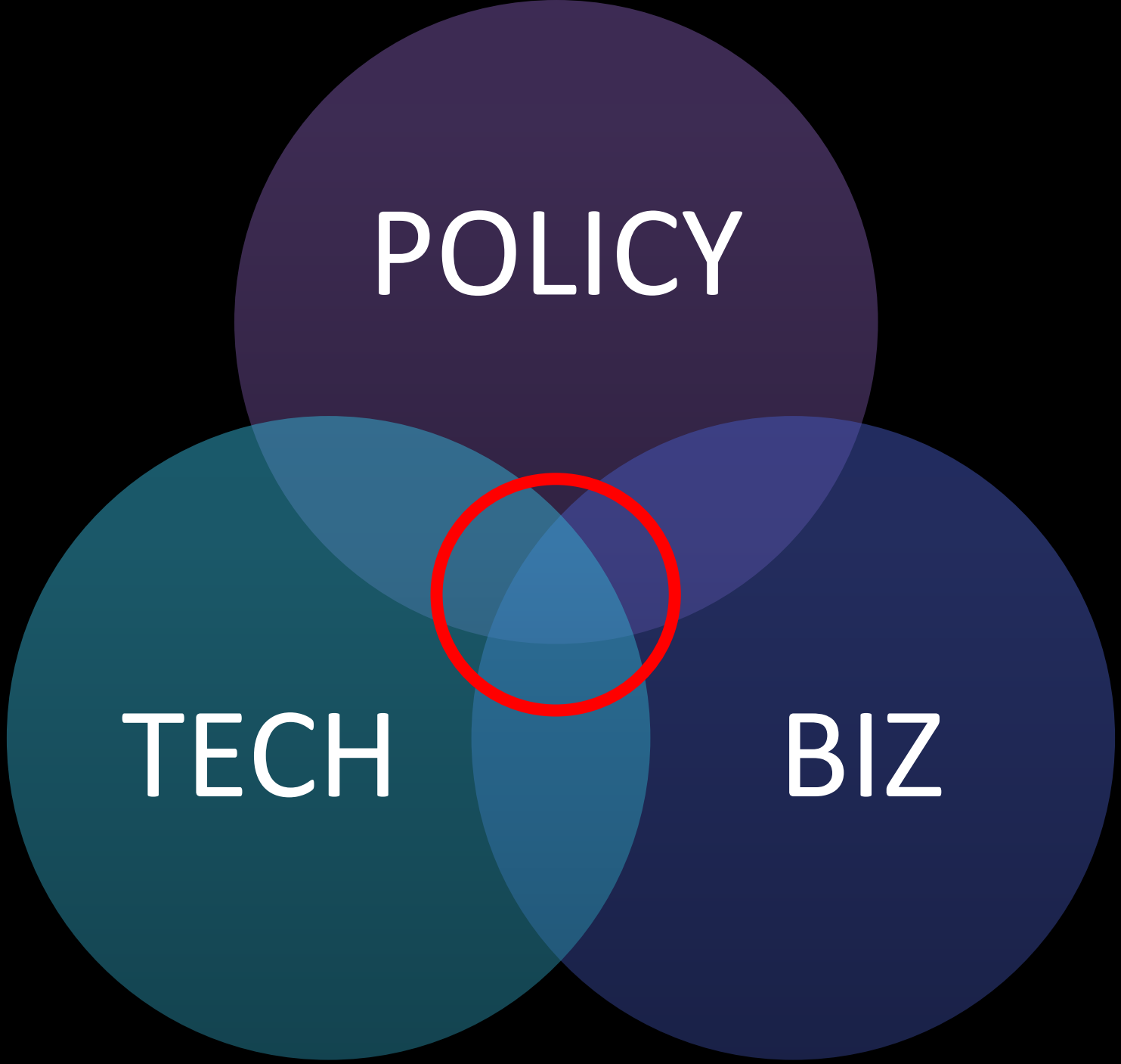
Marvin Greene


Cleveland State University

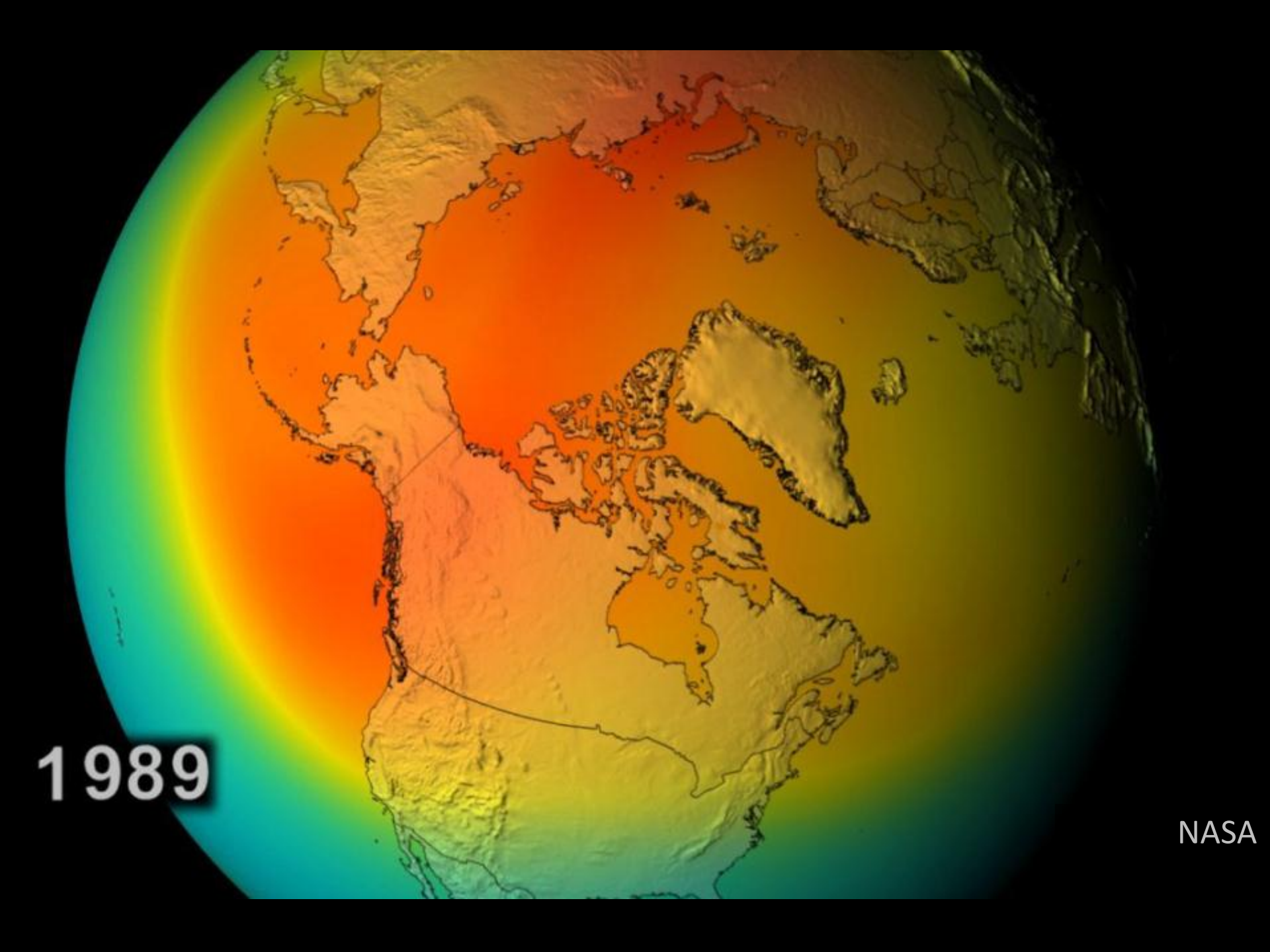

Brent Durken

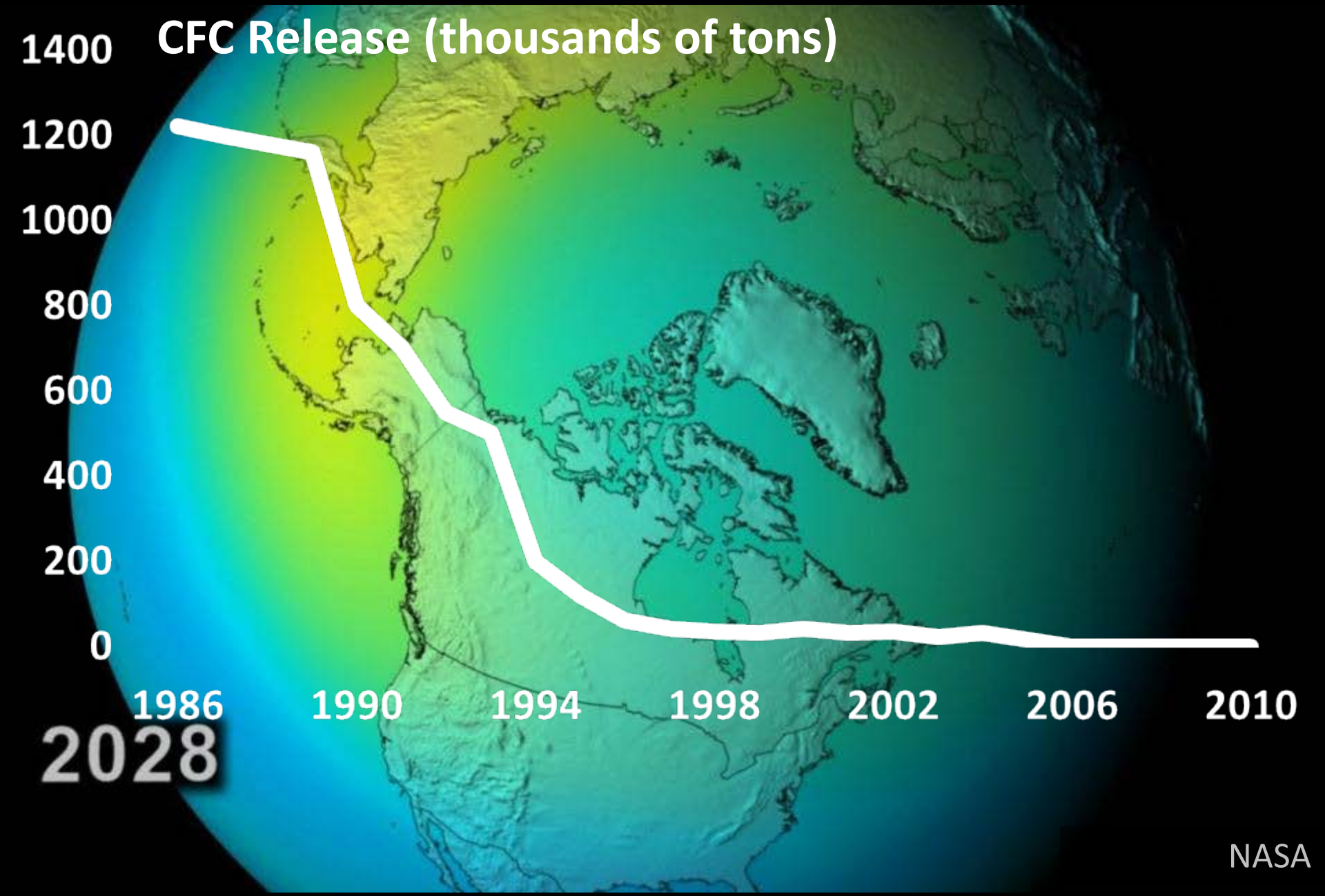
OVERCOME CHALLENGES BEFORE

INNOVATING

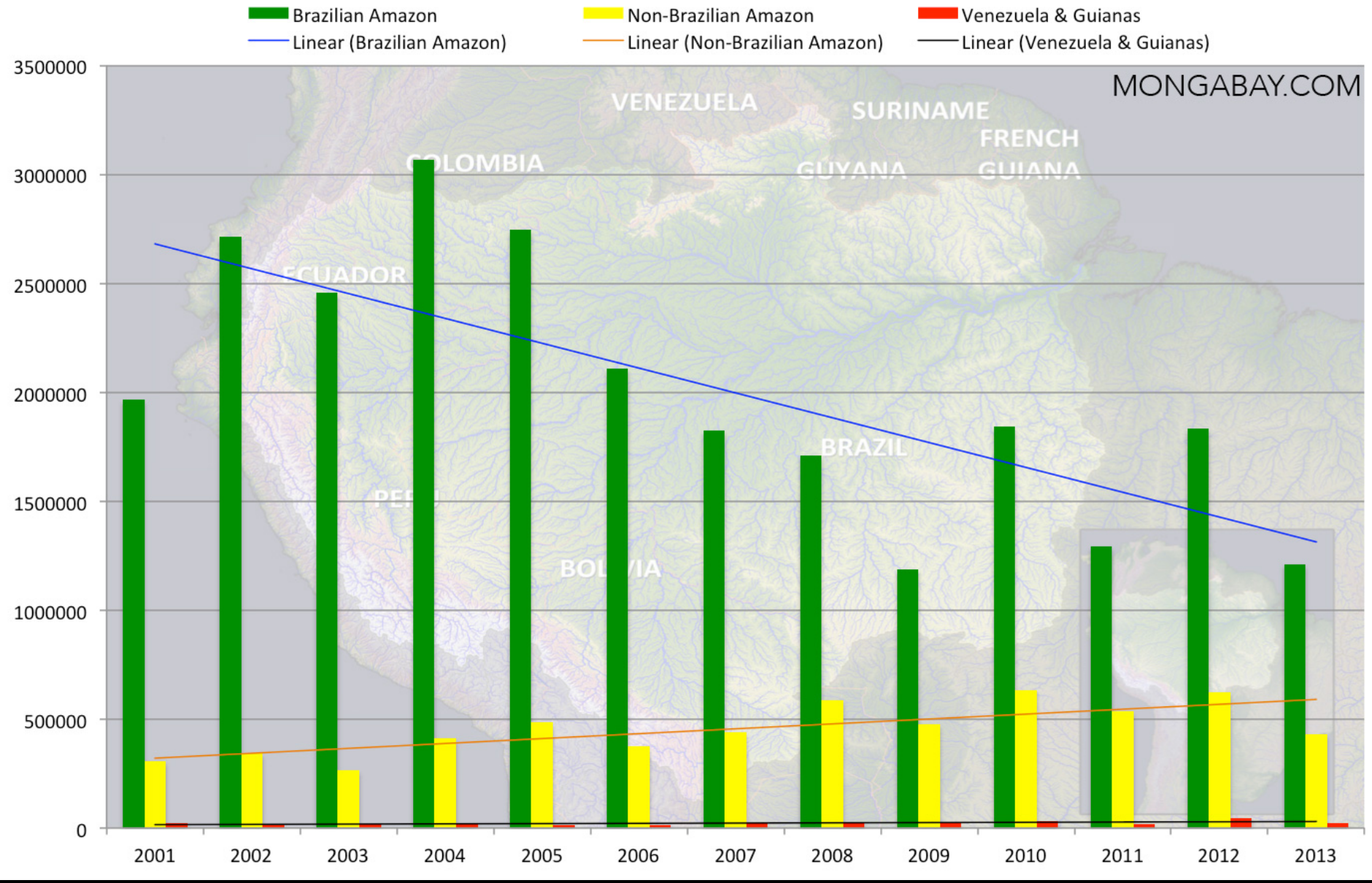

POLICY
TECH
BIZ

SMOG IN NEW YORK CITY, 1966

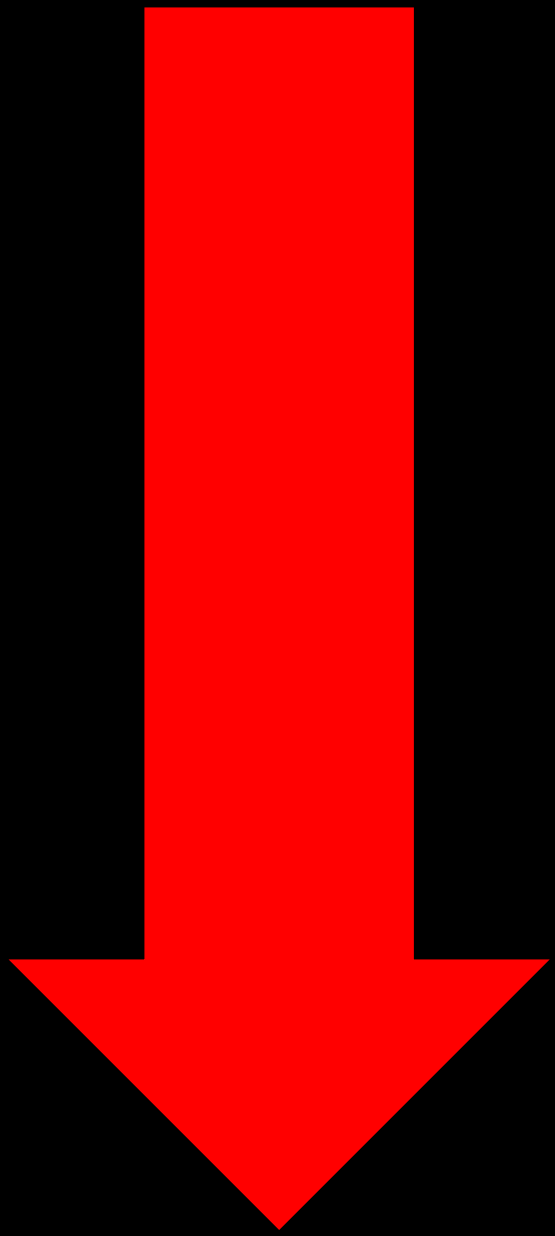

1989
NASA


CFC Release (thousands of tons)
1400
1200
1000
800
600
400
200
0
1986
1990
1994
1998
2002
2006
2010
2028
NASA

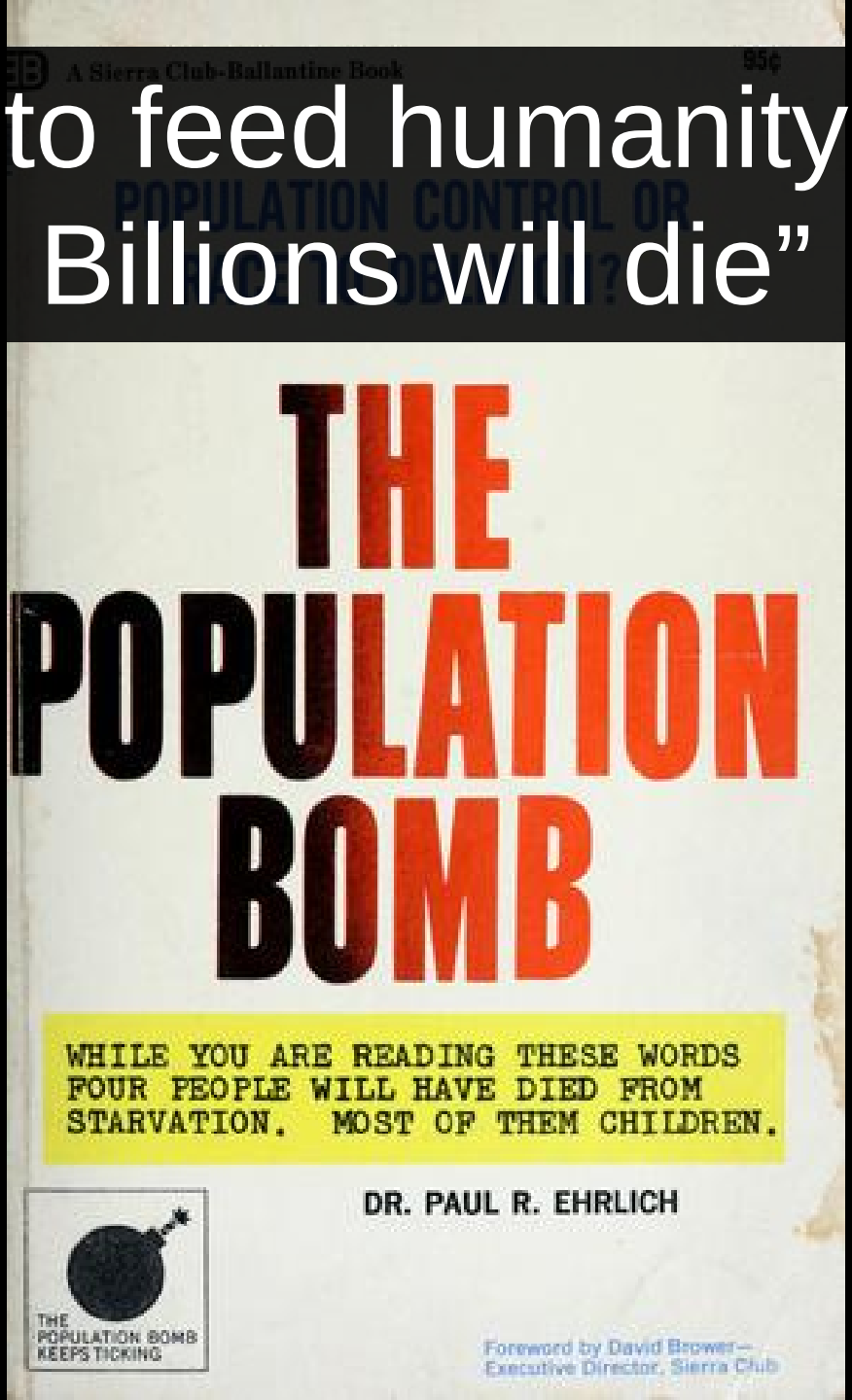
Forest loss in the Amazon region, 2001-2013 (ha)

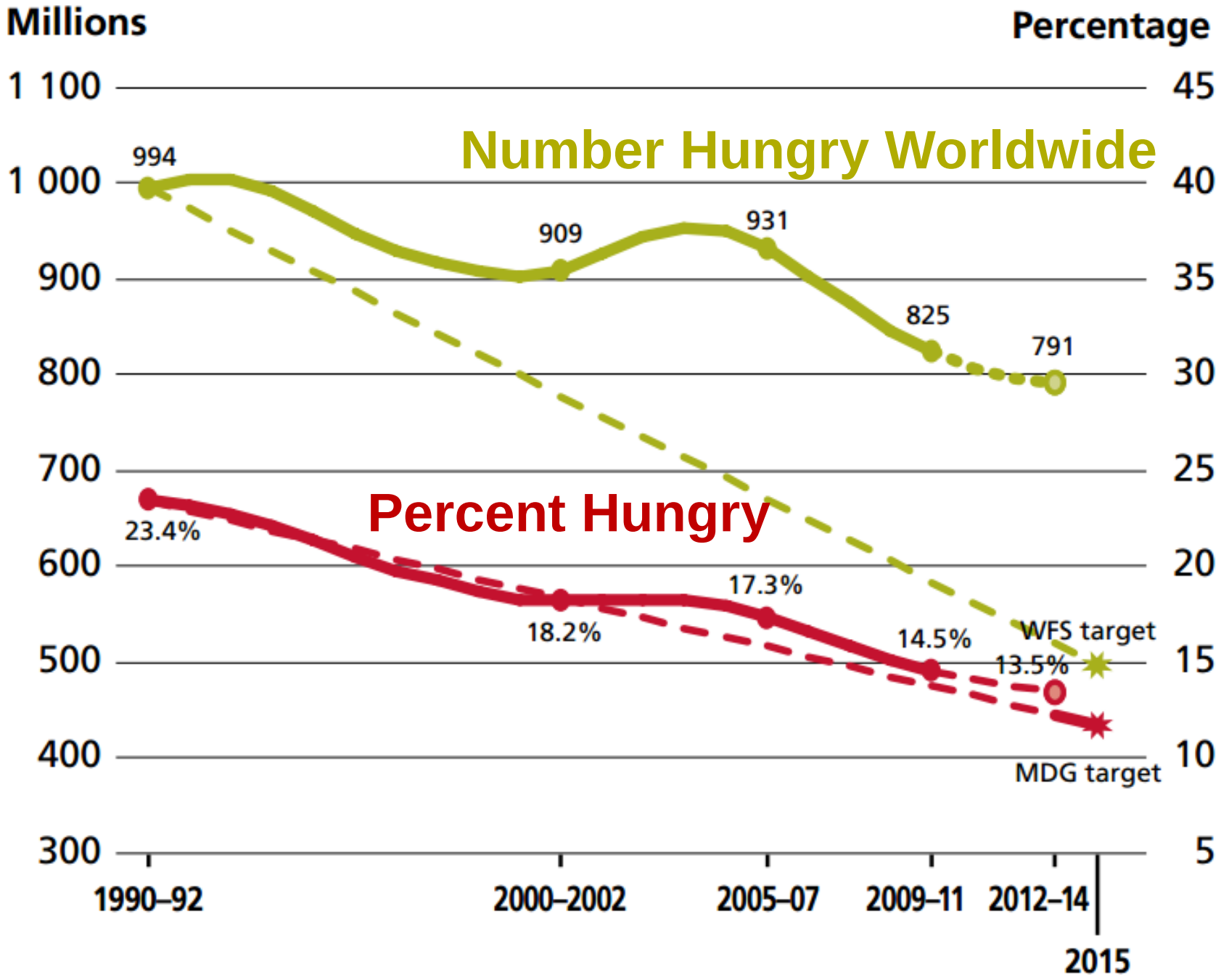


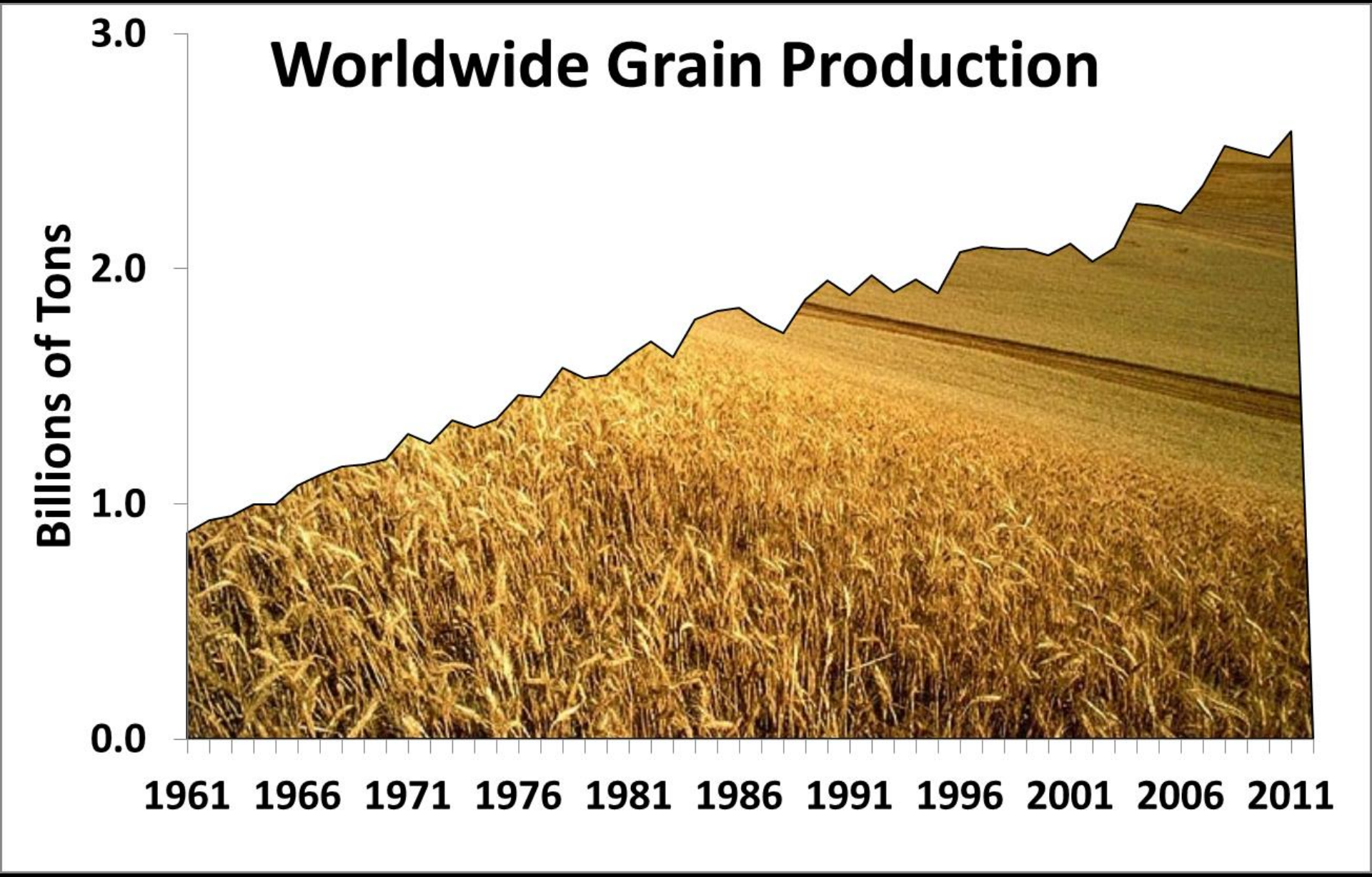
Lead
Benzene
Sulfur Dioxide
Acid Rain
Water Pollution
Smog
Particulates
Asbestos
CFCs
…



“The war to feed humanity is over… Billions will die”




Millions
Percentage
1 100
1 000
900
800
700
600
500
400
300
45
40
35
30
25
20
15
10
5
Number Hungry Worldwide
994
909
931
825
791
Percent Hungry
23.4%
18.2%
17.3%
14.5%
13.5%
WFS target
MDG target
1990–92
2000–2002
2005–07
2009–11
2012–14
2015


Worldwide Grain Production
Billions of Tons
3.0
2.0
1.0
0.0
1961
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011


LIFETIME CHILDREN PER WOMAN
5.5
5
4.5
4
3.5
3
2.5
2
1950
1960
1970
1980
1990
2000
2010


POPULATION (millions)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
1950 1970 1990 2010 2030 2050 2070 2090 2110 2130 2150

ON THE HORIZON

WORLD CLIMATE SUMMIT

PARIS, FRANCE, 2015

Obama Outlines Ambitious Plan to Cut Greenhouse Gases

Christopher Gregory/The New York Times

Obama Unveils Climate Change Plan: At Georgetown University on Tuesday, the president outlined steps to reduce greenhouse gas emissions and combat global warming through a series of executive actions.

By MARK LANDLER and JOHN M. BRODER

Published: June 25, 2013 | 586 Comments

U.S. and China Reach Climate Accord

China to cut coal use, shut polluters, in bid to clear the air

BY DAVID STANWAY

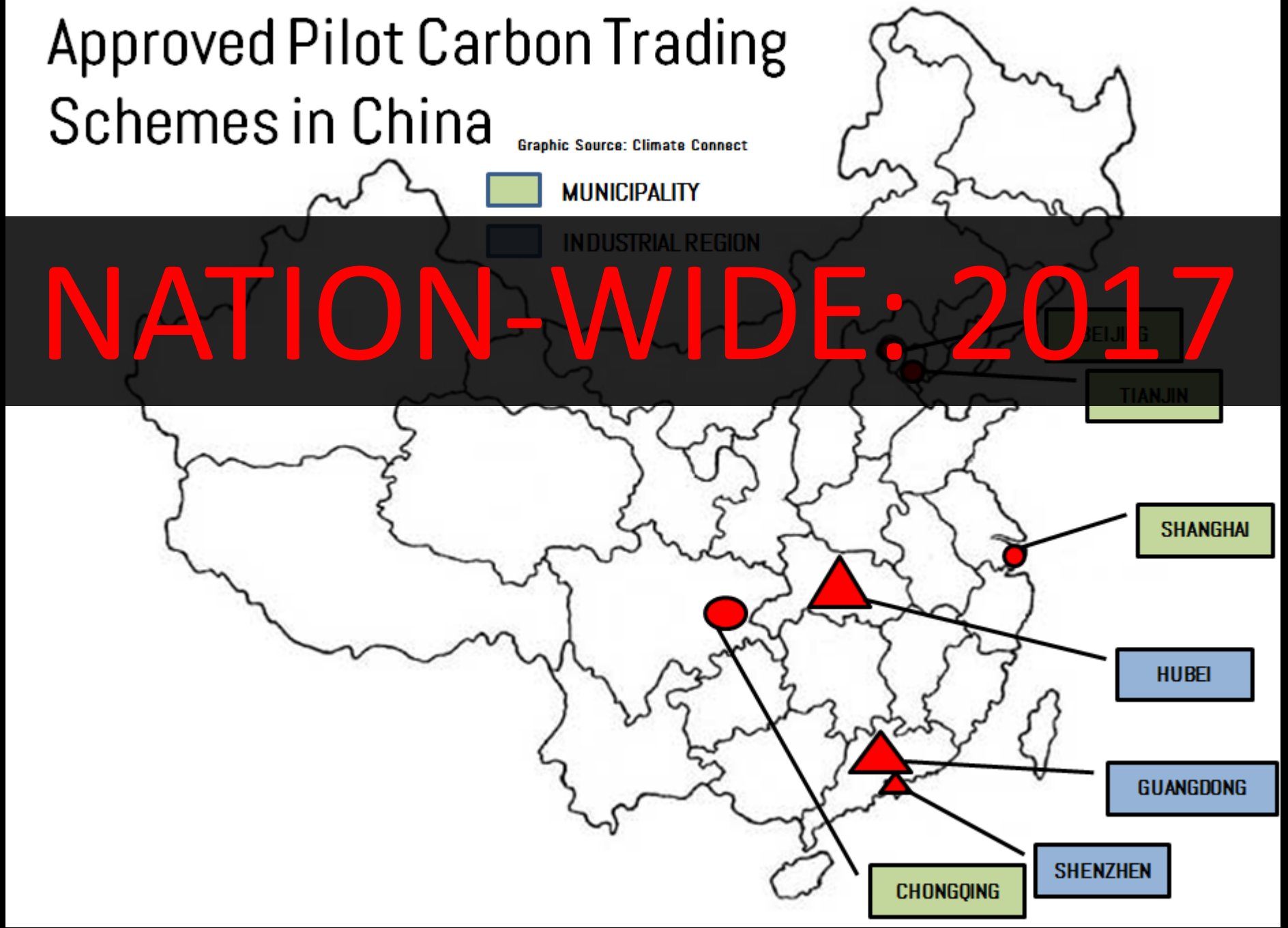
BEIJING Thu Sep 12, 2013 2:26am EDT

Vehicles past apartment blocks during rush hour in Beijing July 11, 2013.

CREDIT: REUTERS/JASON LEE

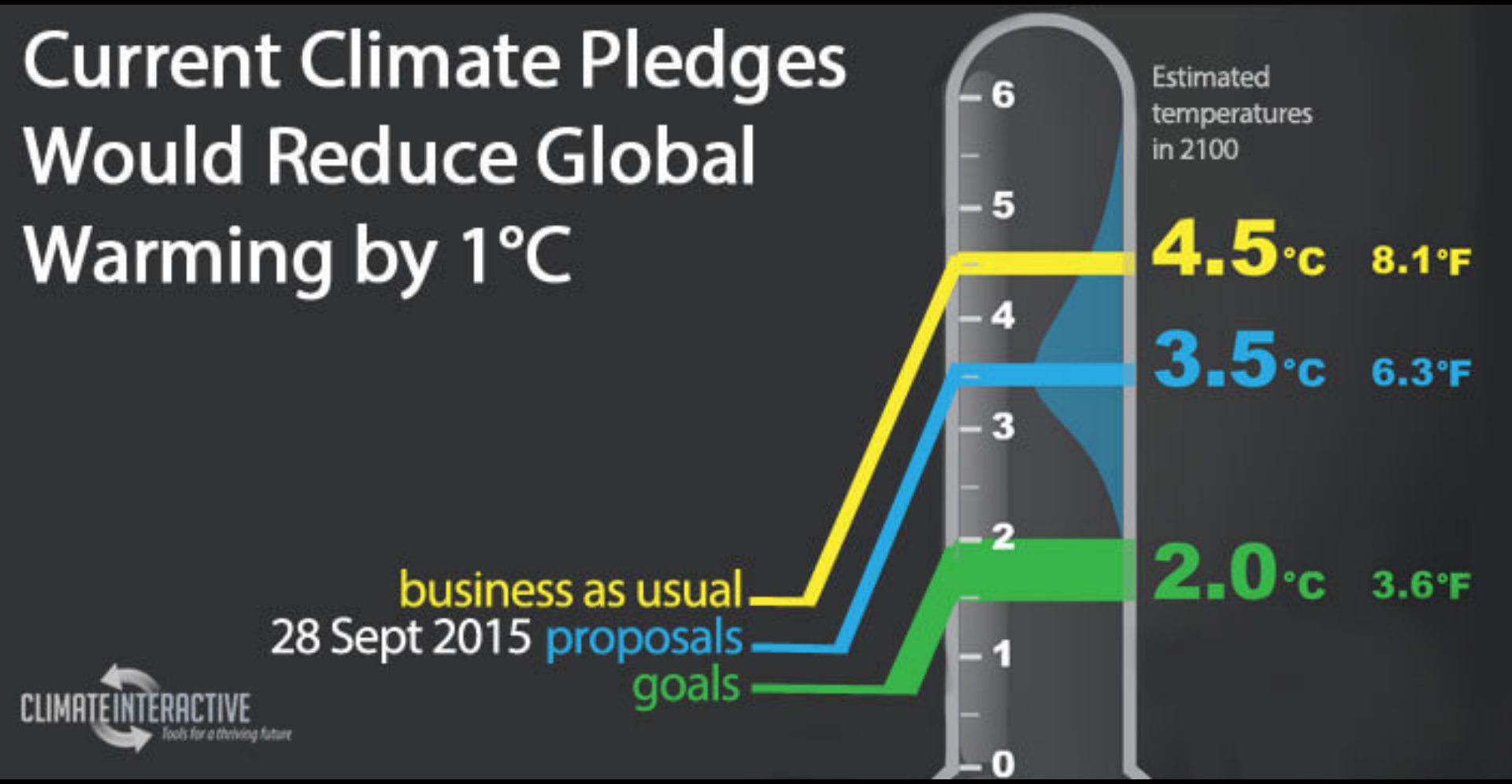
Approved Pilot Carbon Trading Schemes in China

Graphic Source: Climate Connect

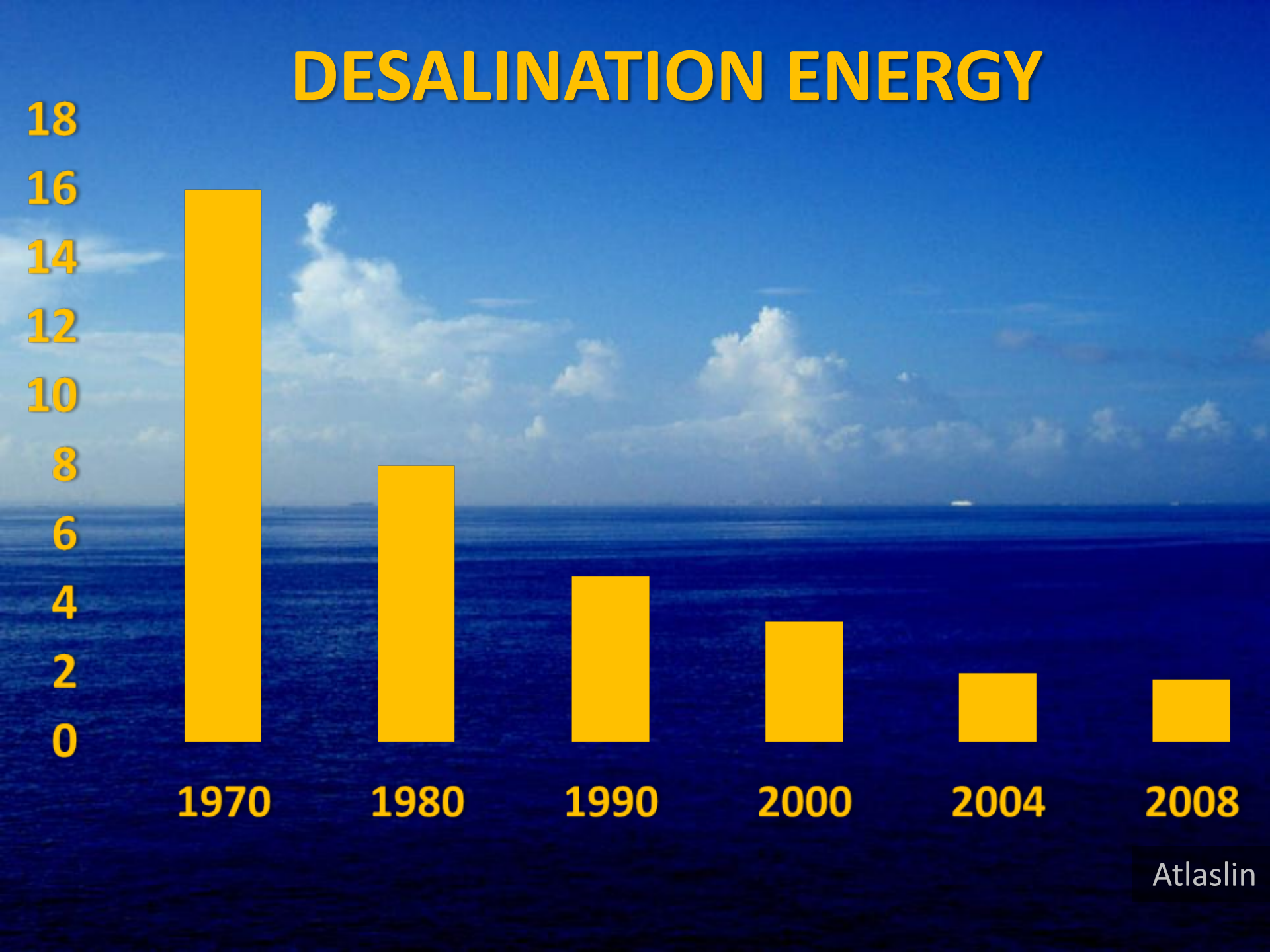


UN-REDD

PROGRAMME


Current Climate Pledges Would Reduce Global Warming by 1°C
Estimated temperatures in 2100
6
5
4
3
2
1
0
4.5°C 8.1°F
3.5°C 6.3°F
2.0°C 3.6°F
business as usual
28 Sept 2015 proposals
goals
CLIMATE INTERACTIVE
Tools for a thriving future

DESALINATION ENERGY

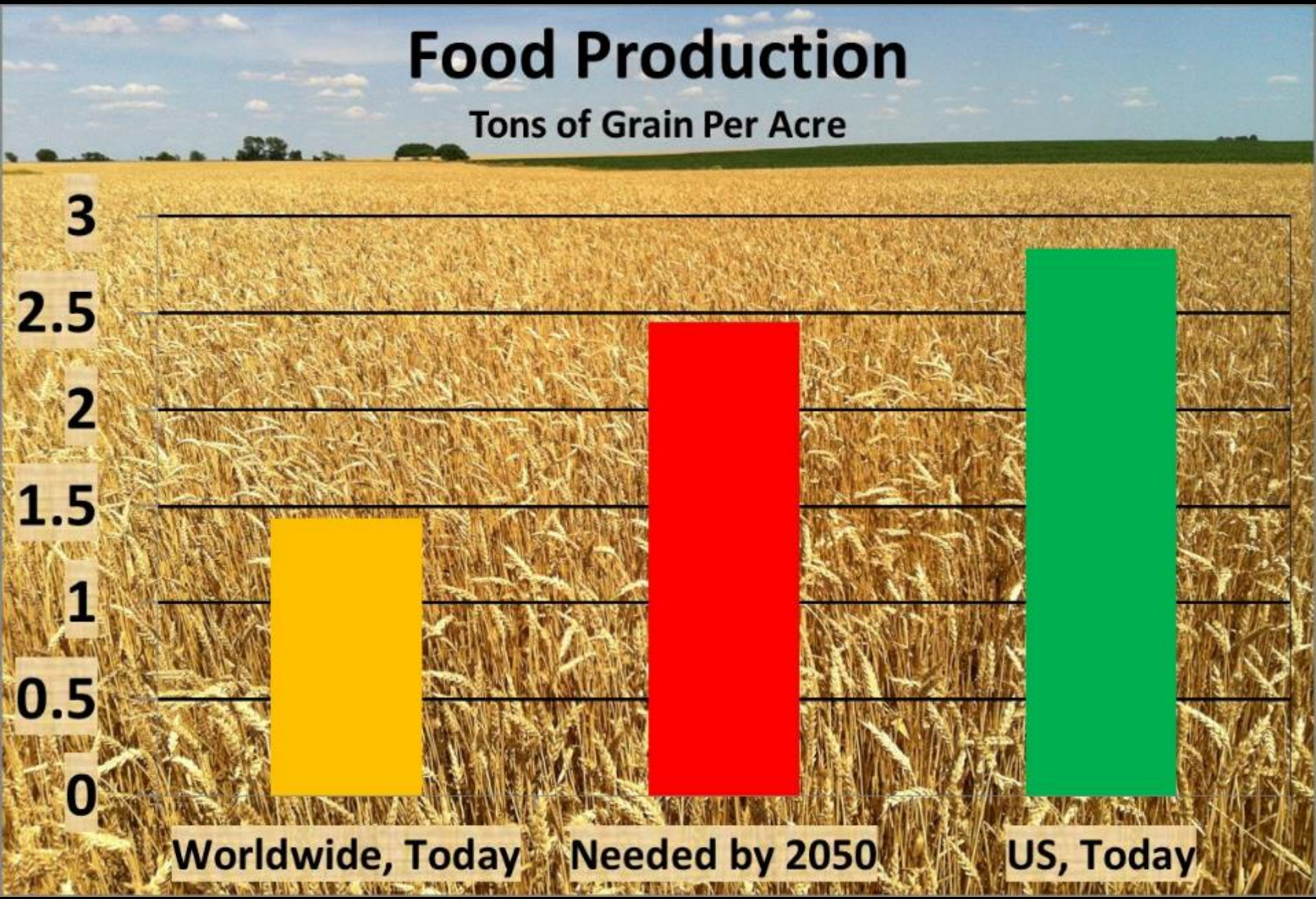


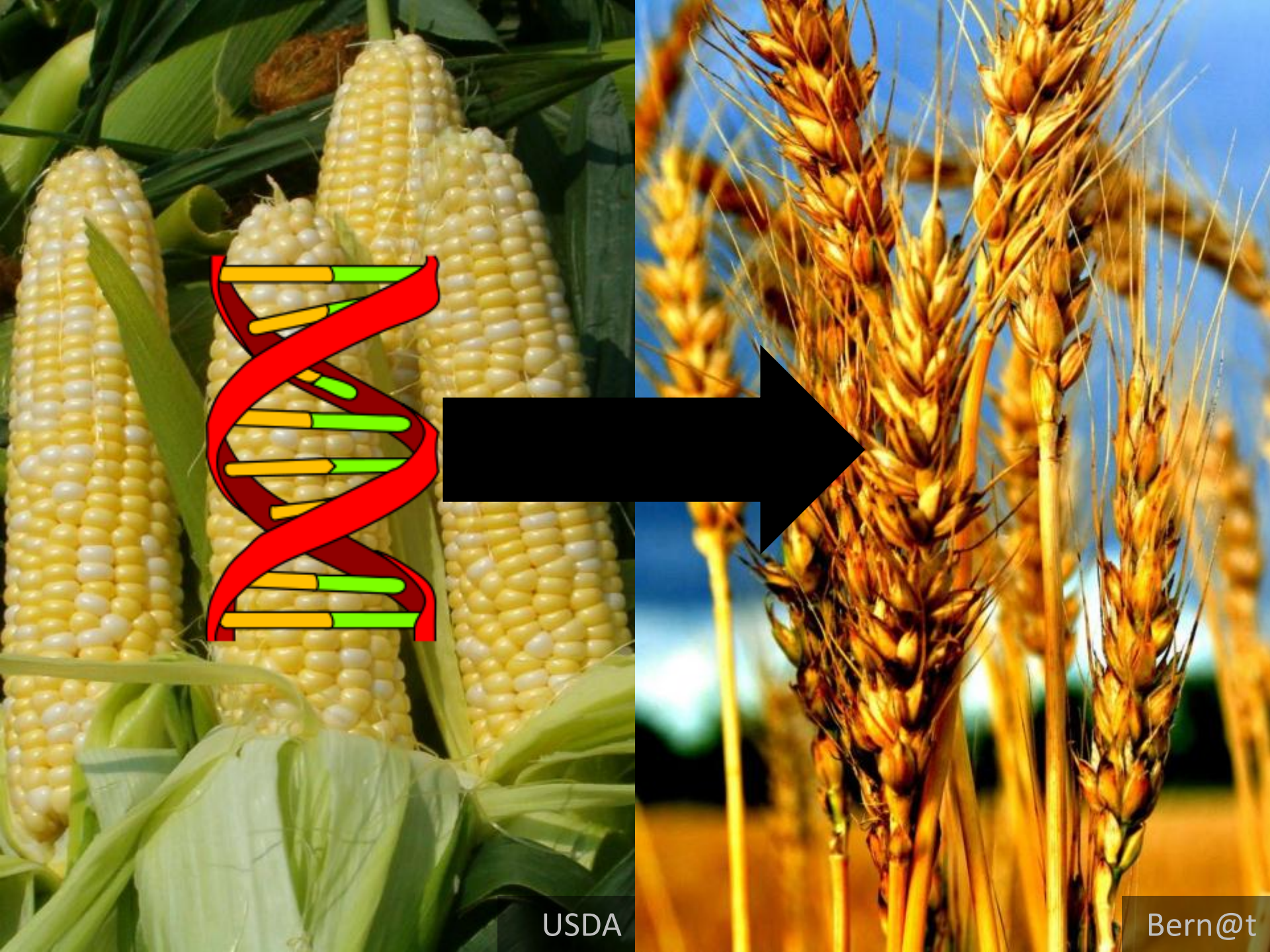
Atlaslin

Global Food Production - Today vs Possible

(billions of tons of grain)

Source: International Food Policy Research Institute


Food Production
Tons of Grain Per Acre
3
2.5
2
1.5
1
0.5
0
Worldwide, Today
Needed by 2050
US, Today


USDA
Bern@t


USDA
Bern@t

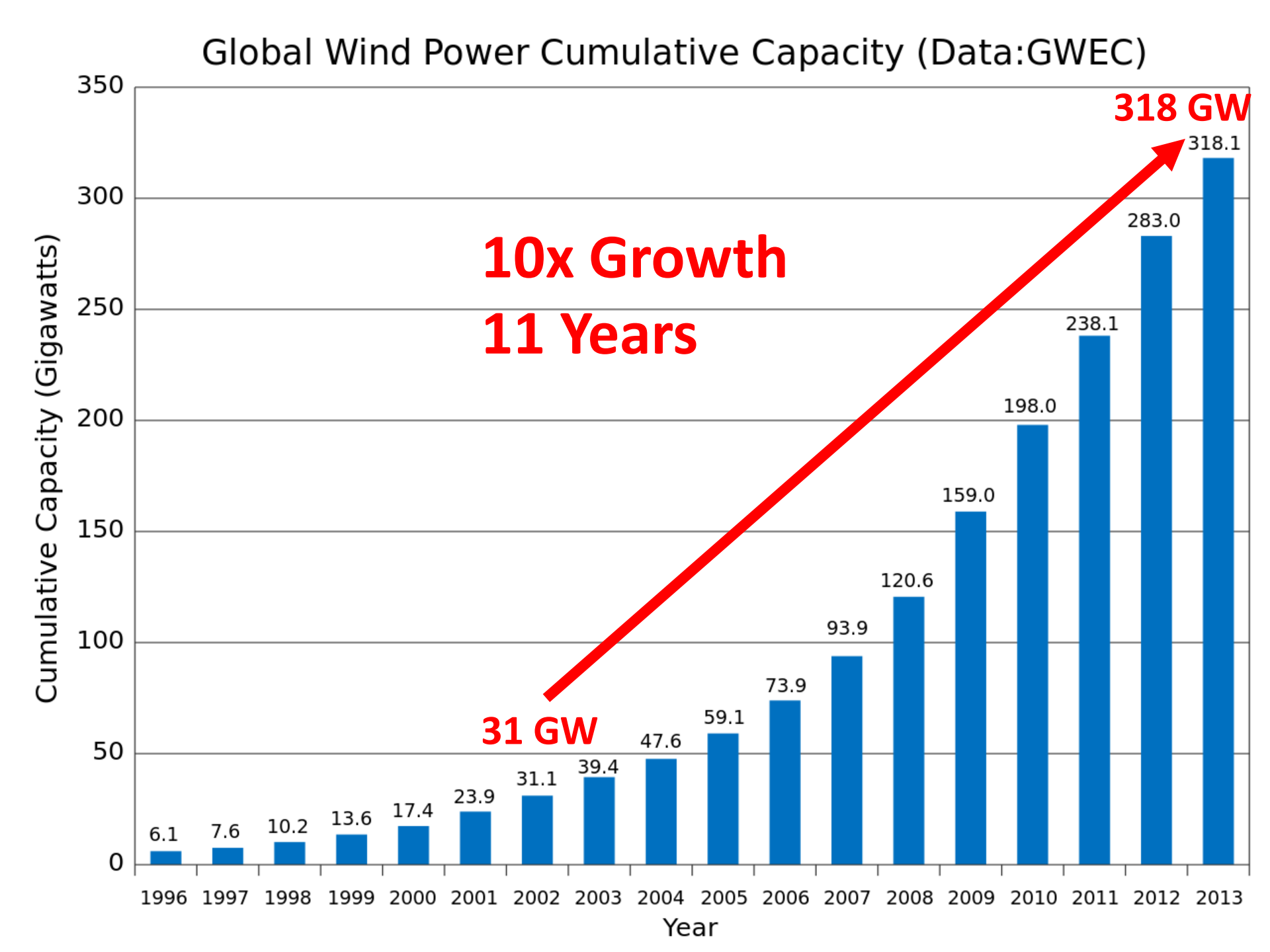
10,000 x

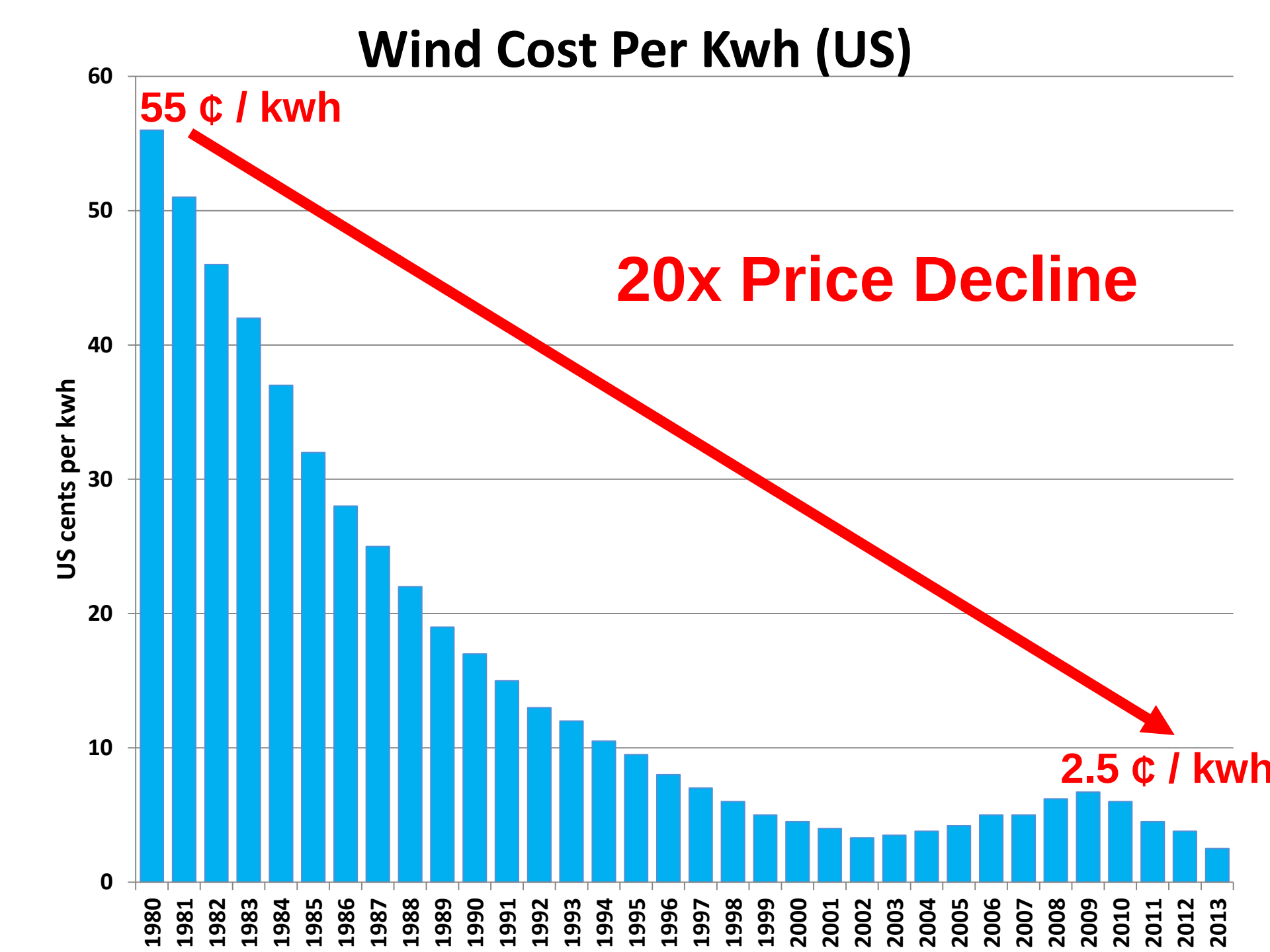
1 Day of Humanity’s Energy Use =

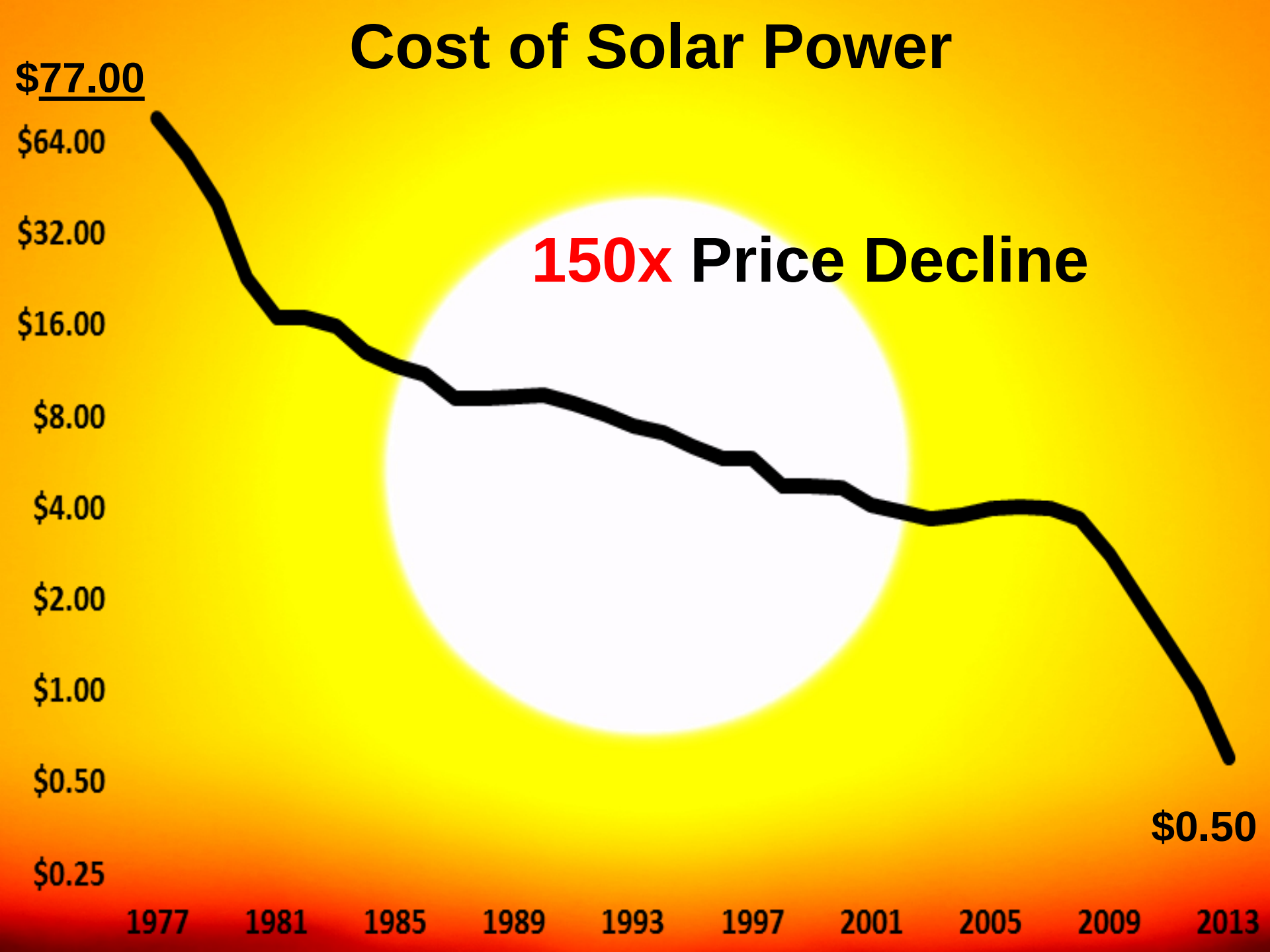
10 Seconds of Sunlight

1 Year of Humanity’s Energy Use =

1 Hour of Sunlight

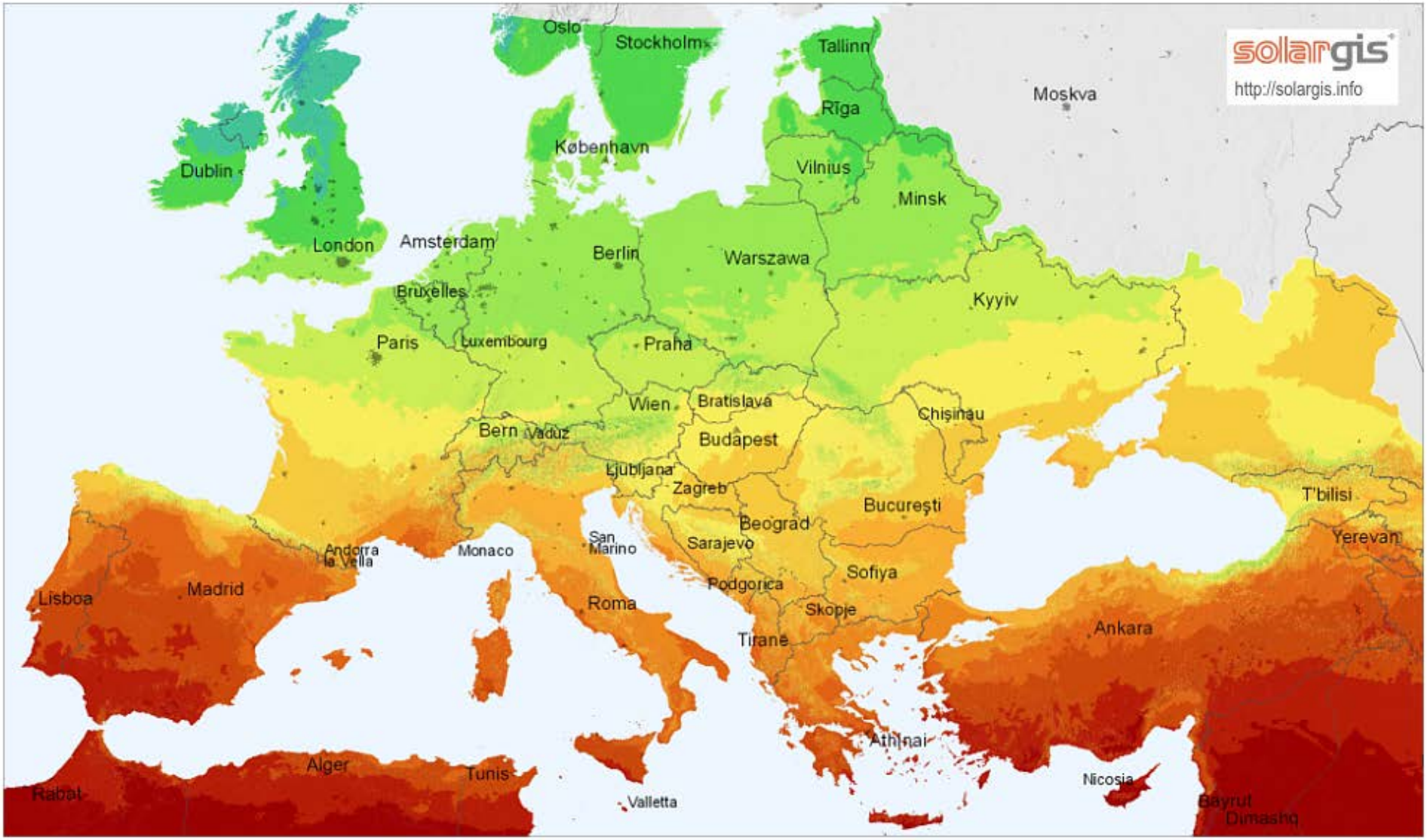

Global Wind Power Cumulative Capacity (Data:GWEC)
Cumulative Capacity (Gigawatts)
Year
0
50
100
150
200
250
300
350
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
6.1
7.6
10.2
13.6
17.4
23.9
31.1
39.4
47.6
59.1
73.9
93.9
120.6
159.0
198.0
238.1
283.0
318.1
10x Growth
11 Years
31 GW
318 GW


Wind Cost Per Kwh (US)
55 ¢ / kwh
20x Price Decline
2.5 ¢ / kwh
US cents per kwh
60
50
40
30
20
10
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013


Cost of Solar Power
$77.00
$64.00
$32.00
$16.00
$8.00
$4.00
$2.00
$1.00
$0.50
$0.25
150x Price Decline
$0.50
1977
1981
1985
1989
1993
1997
2001
2005
2009
2013

Global horizontal irradiation

Europe



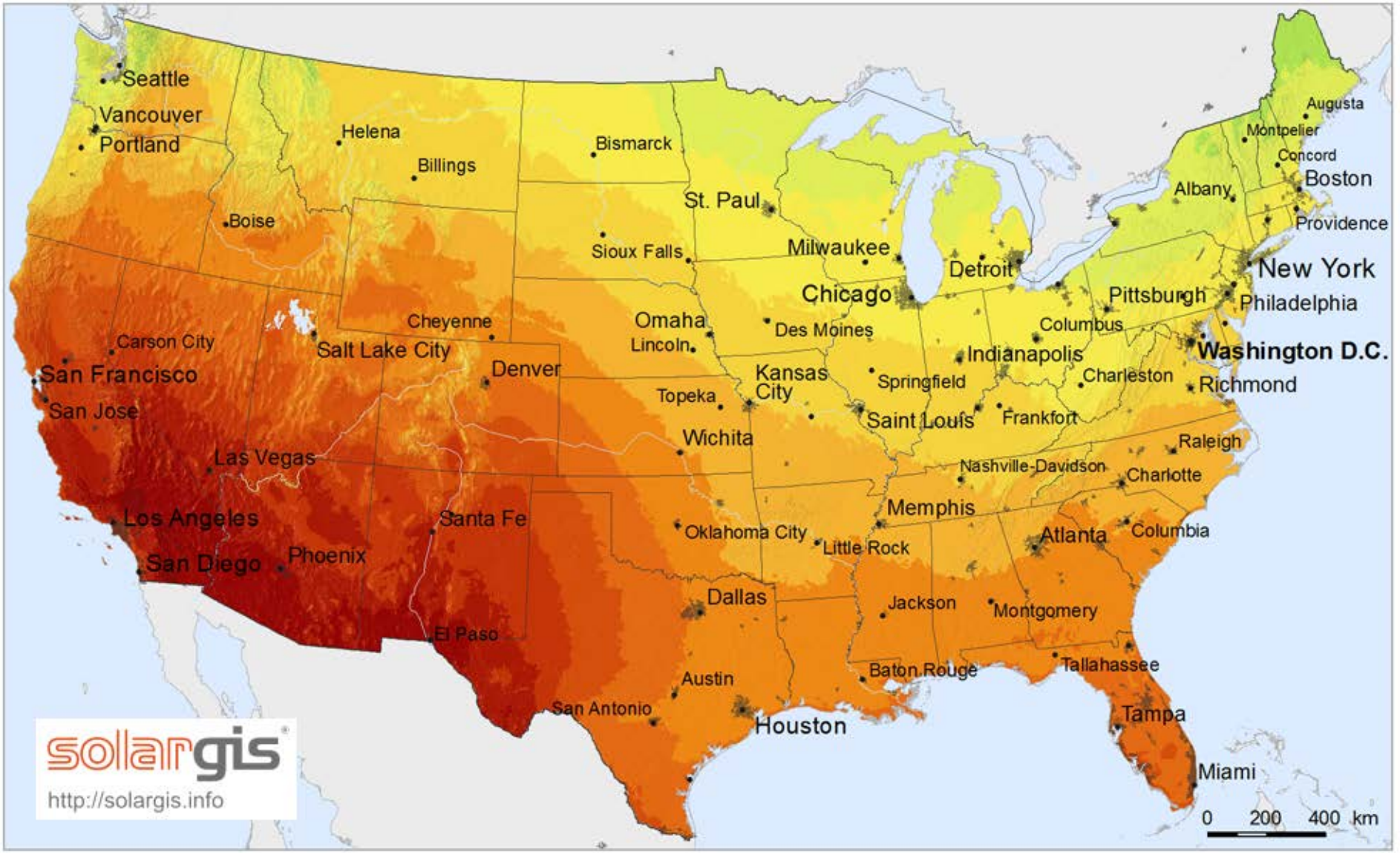
Average annual sum (4/2004 - 3/2010)

< 700 900 1100 1300 1500 1700 1900 > kWh/m^2

0 250 500 km

Global Horizontal Irradiation

USA Mainlands



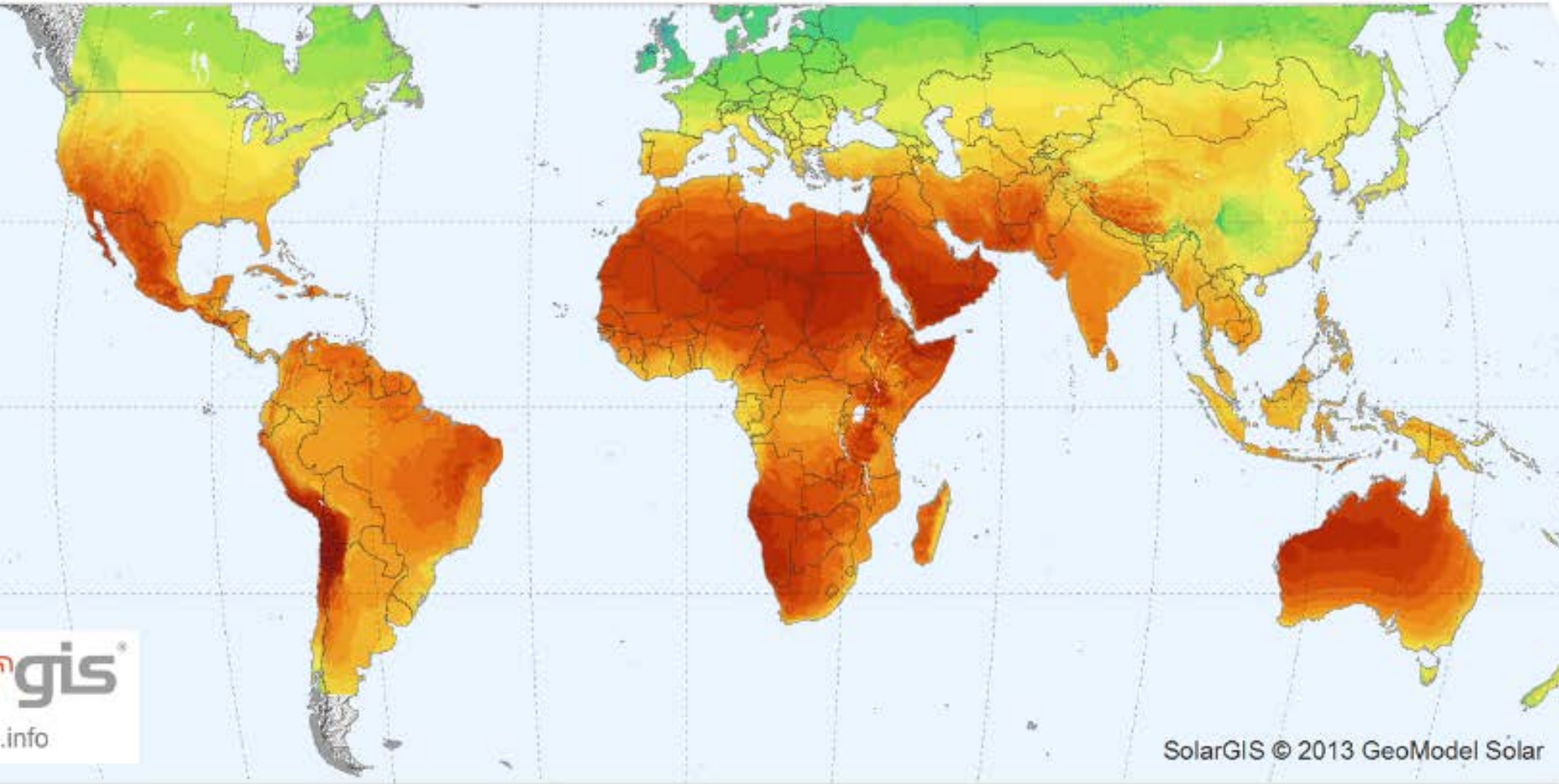
solargis
http://solargis.info

Average annual sum, period 1999-2011

< 1100 1300 1500 1700 1900 2100 2300 > kWh/m^2

MAP OF GLOBAL HORIZONTAL IRRADIATION

GeoModel SOLAR



.info

verage of: Annual sum < 700 900 1100 1300 1500 1700 1900 2100 2300 2500 2700 > kWh/m²

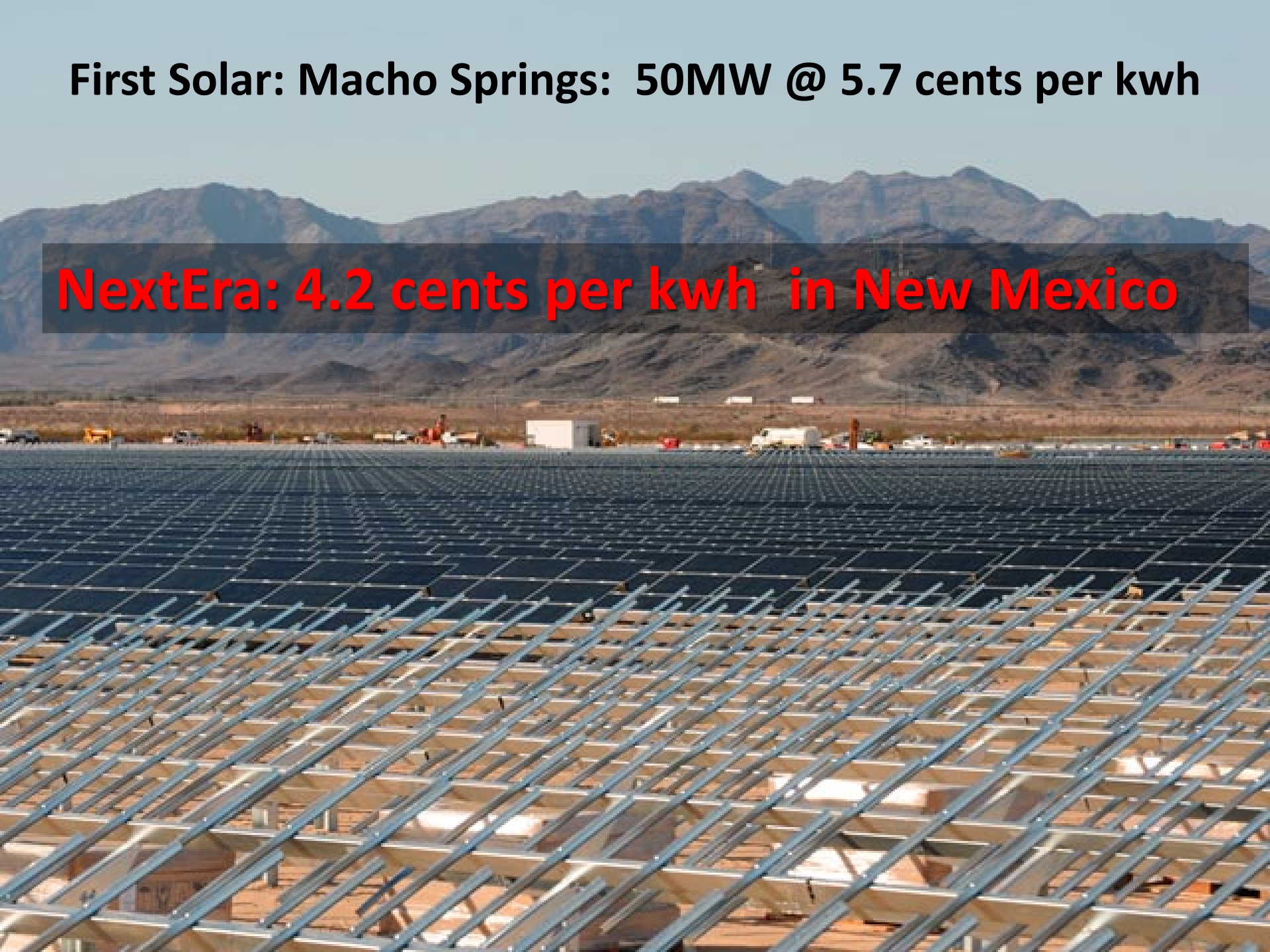
Daily sum < 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 >

First Solar: Luz del Norte, Chile: 162MW, Unsubsidized

XINJIANG – TURPAN PREFECTURE
1,000 MW SOLAR PROJECT

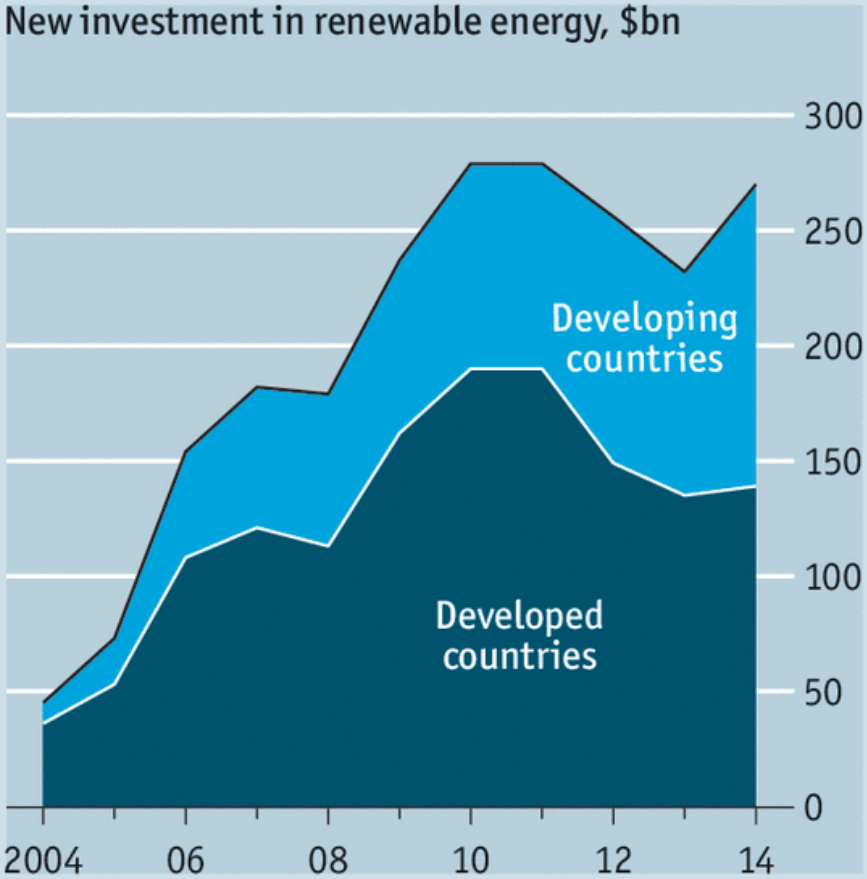
Sambhar Ultra: Rajasthan India: 4 GW, Unsubsidized

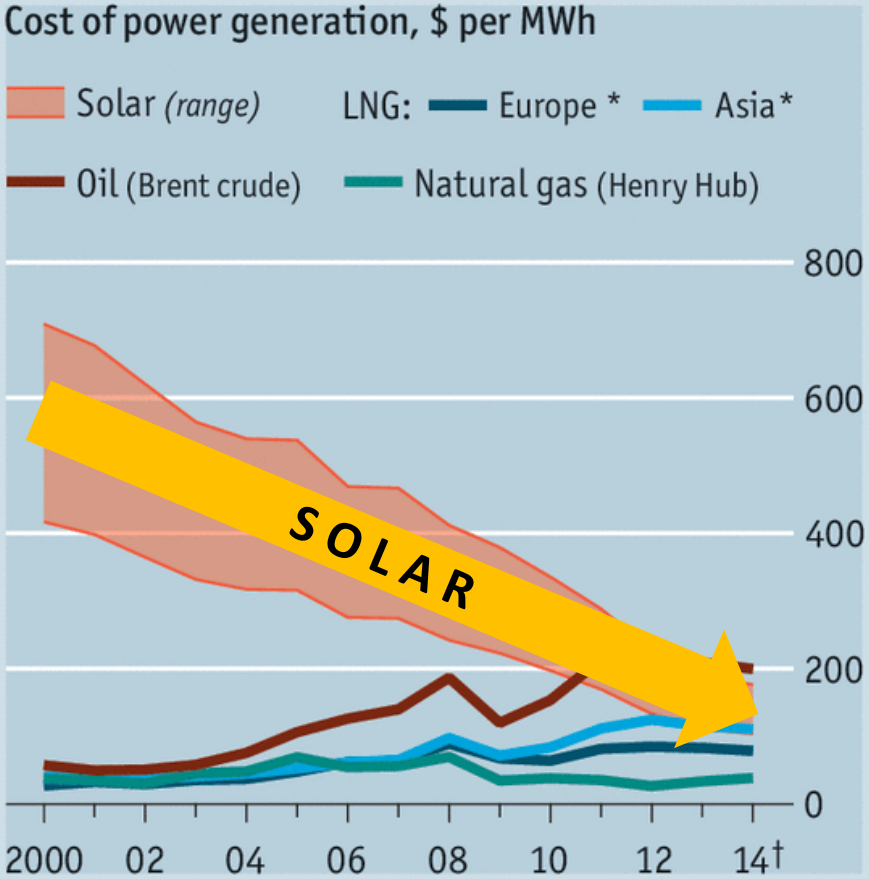
First Solar: Macho Springs: 50MW @ 5.7 cents per kwh



NextEra: 4.2 cents per kwh in New Mexico

Sunny outlook

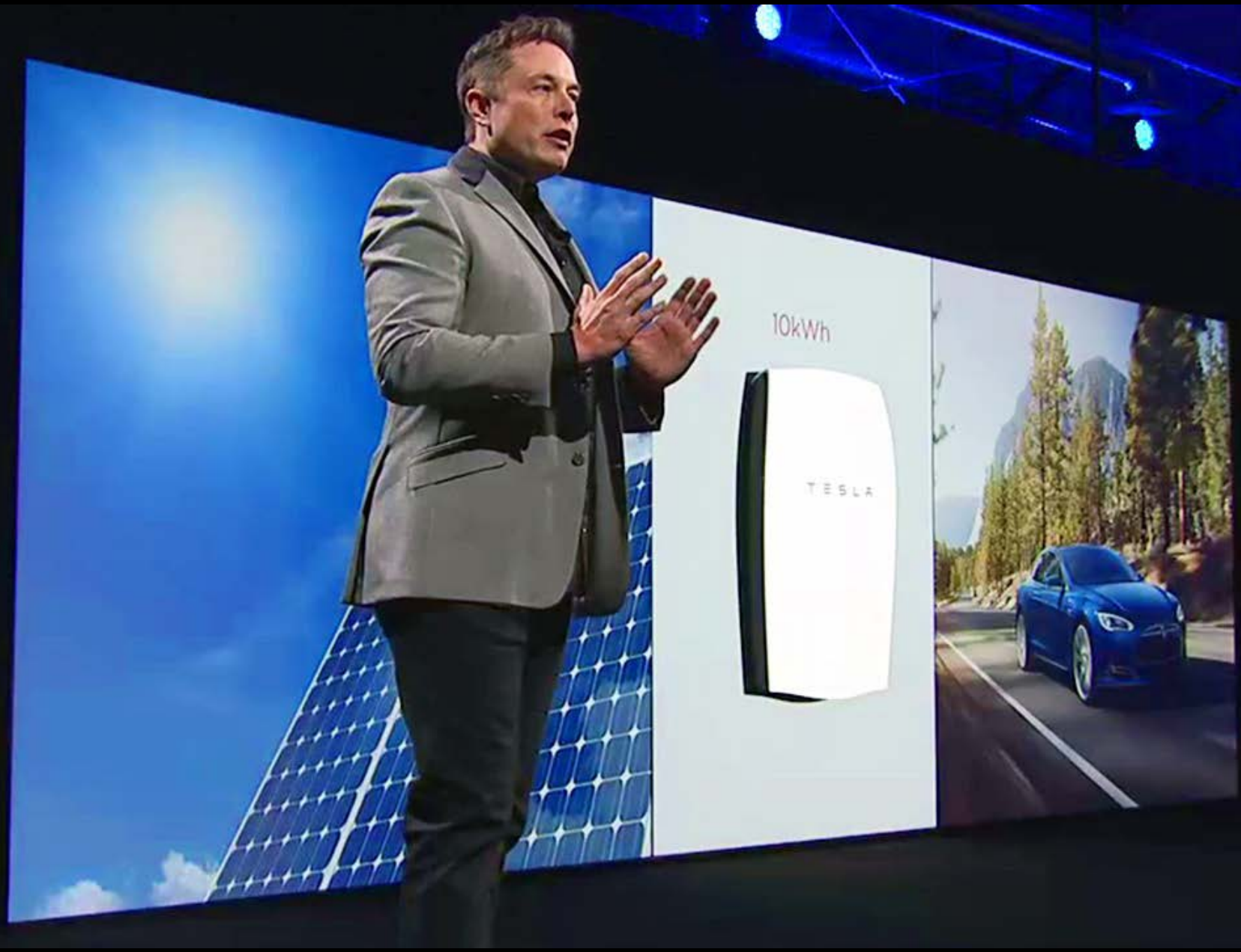




Sources: UNEP, Bloomberg New Energy Finance; IHS Energy

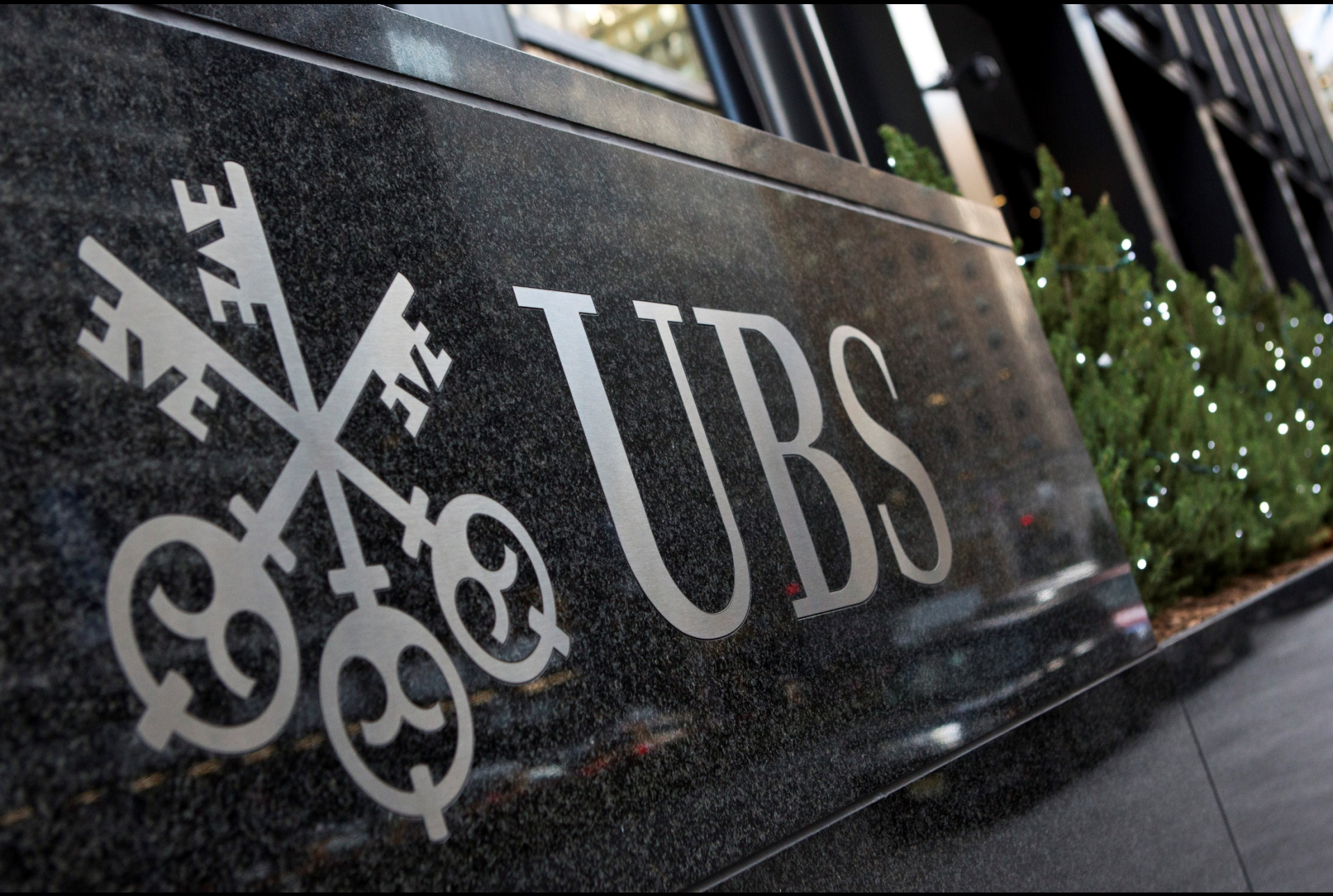
*Long-term contract price †To November

ENERGY STORAGE


10kWh
TESLA


LOWER COST
HIGHER DENSITY
240
120
60
4
2
1
0.5
0.25
Price: US $ per Watt Hour
BATTERY
PRICE (10x decline)
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
Energy Density
US$ / Wh

CHEAPER ENERGY

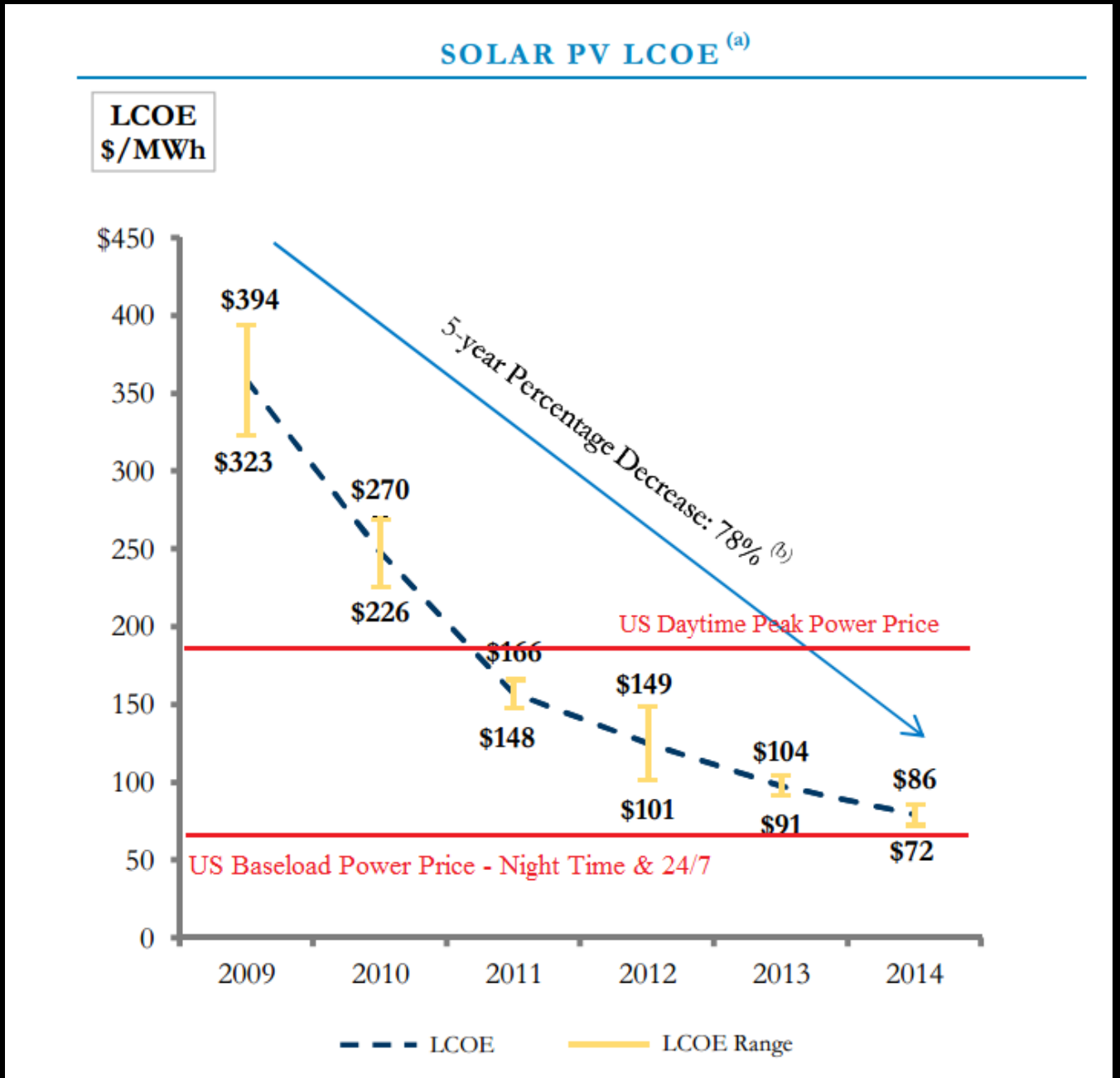

UBS

“Renewables are now **deflationary** to energy prices.” - UBS

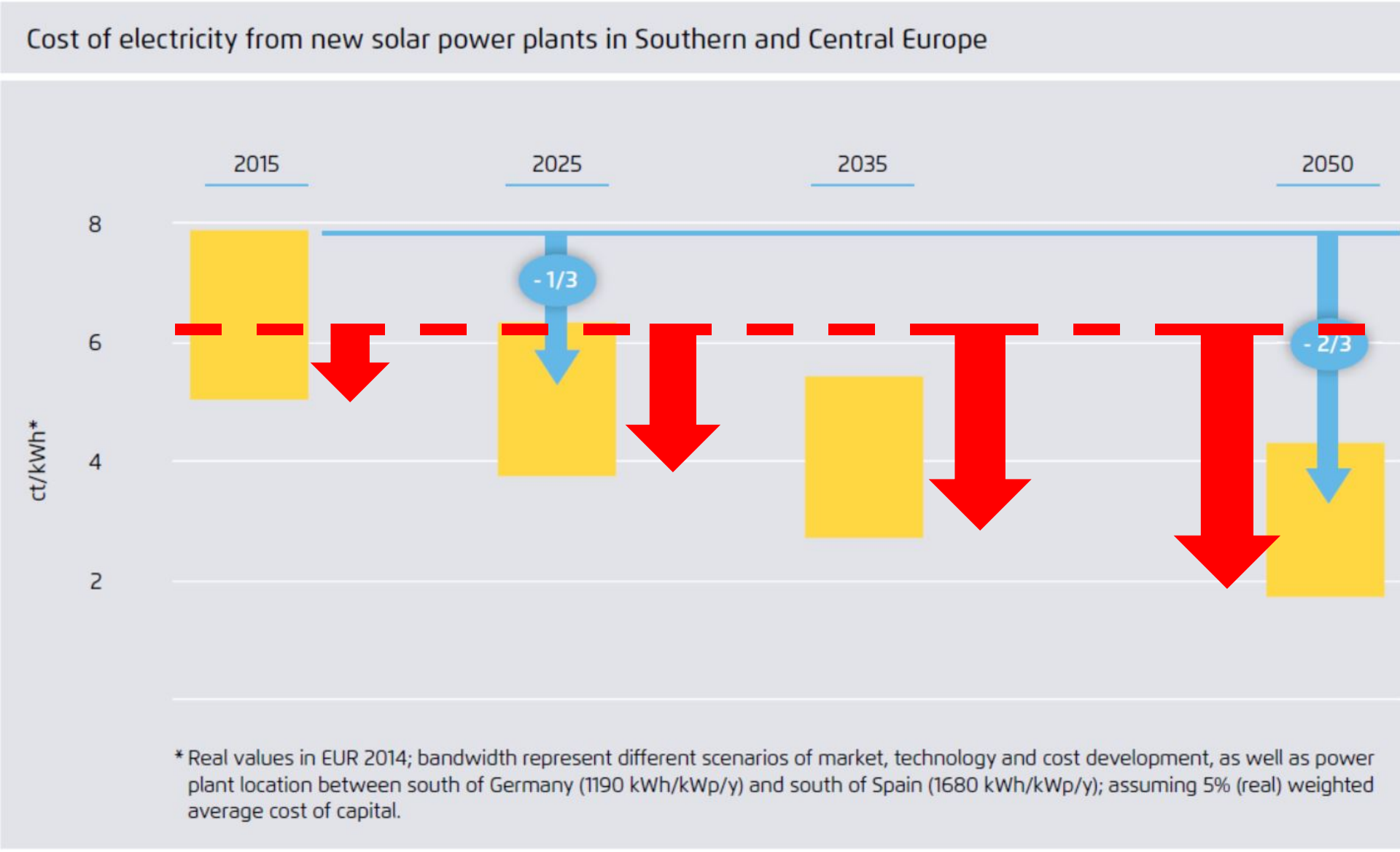
LAZARD

ASSET MANAGEMENT

SOLAR DROPPING BELOW GRID PRICES

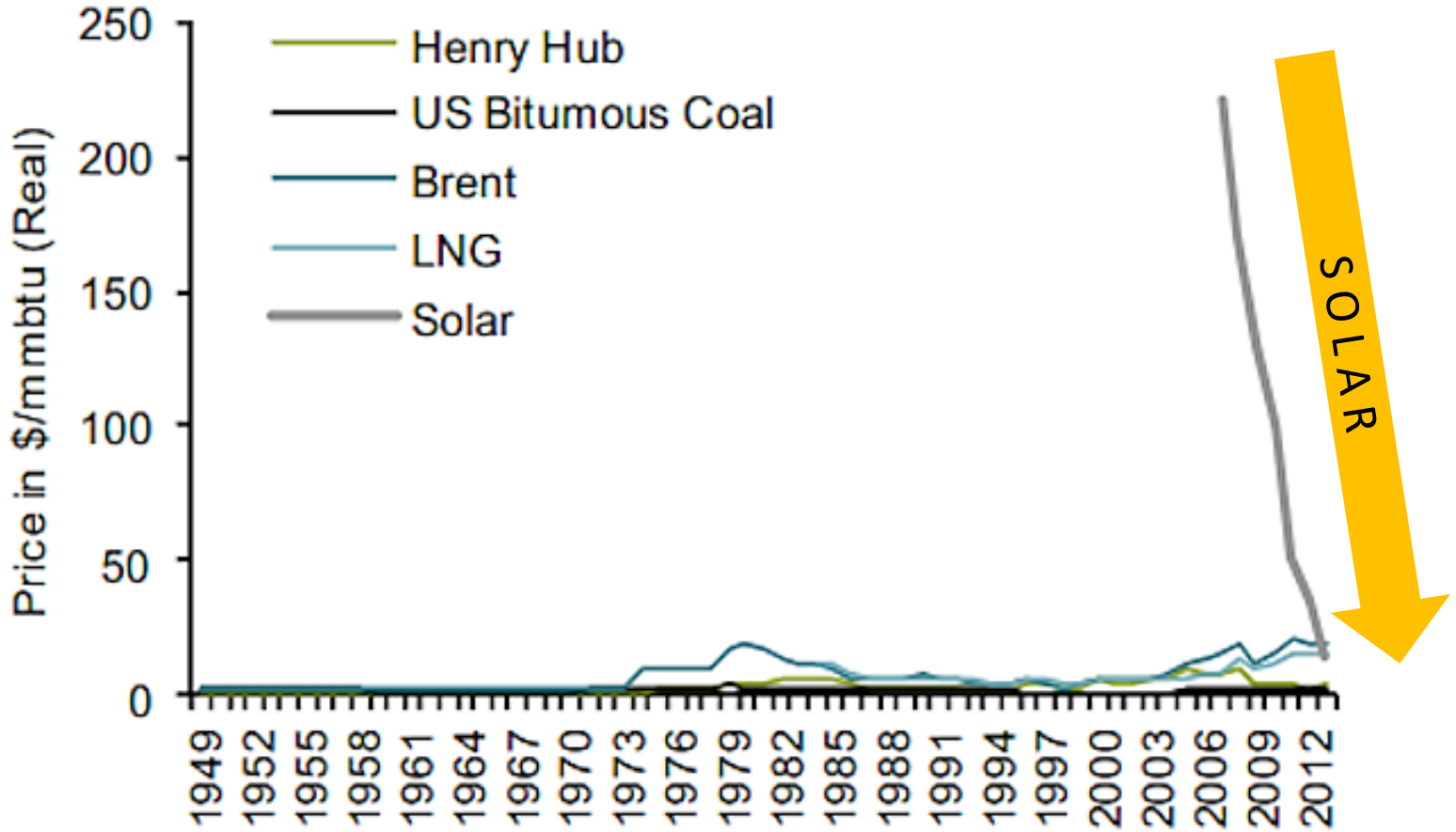


Fraunhofer ISE Projection




AB ALLIANCEBERNSTEIN
1345

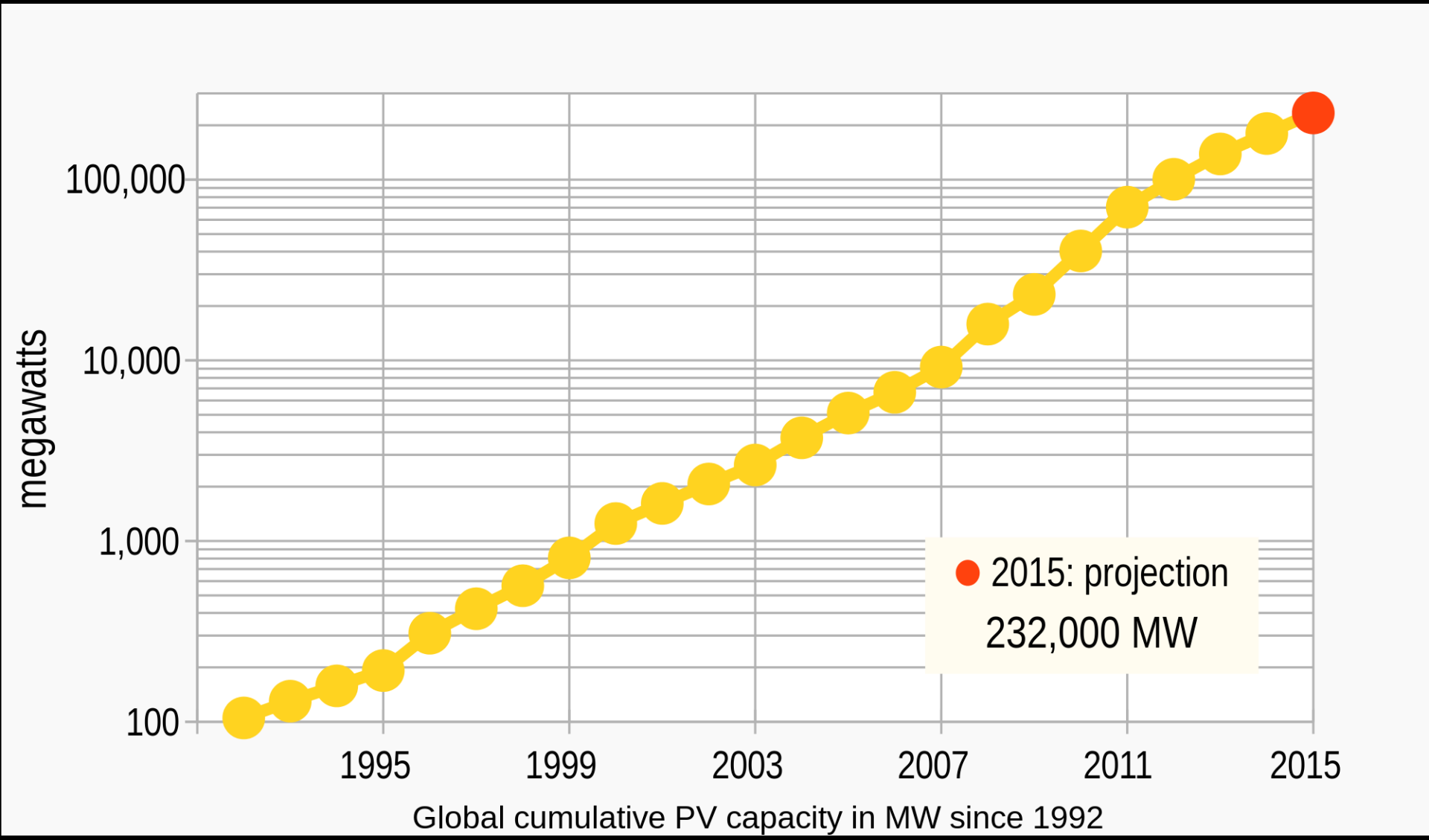
Welcome to the Terrordome… $/MMBTU by Energy Type



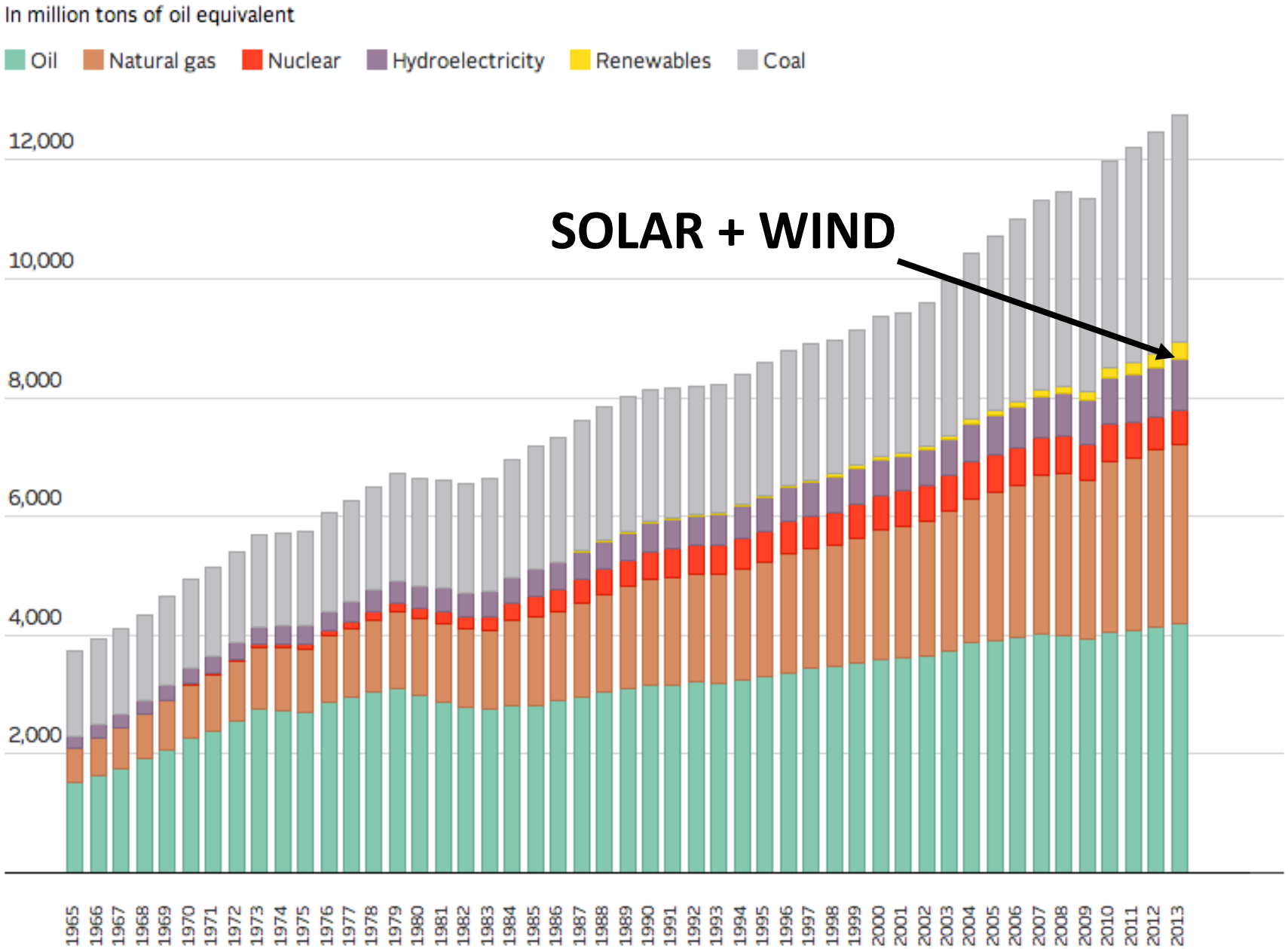
Source: EIA, CIA, World Bank, Bernstein analysis

MAJOR CHALLENGES

SOLAR GROWTH

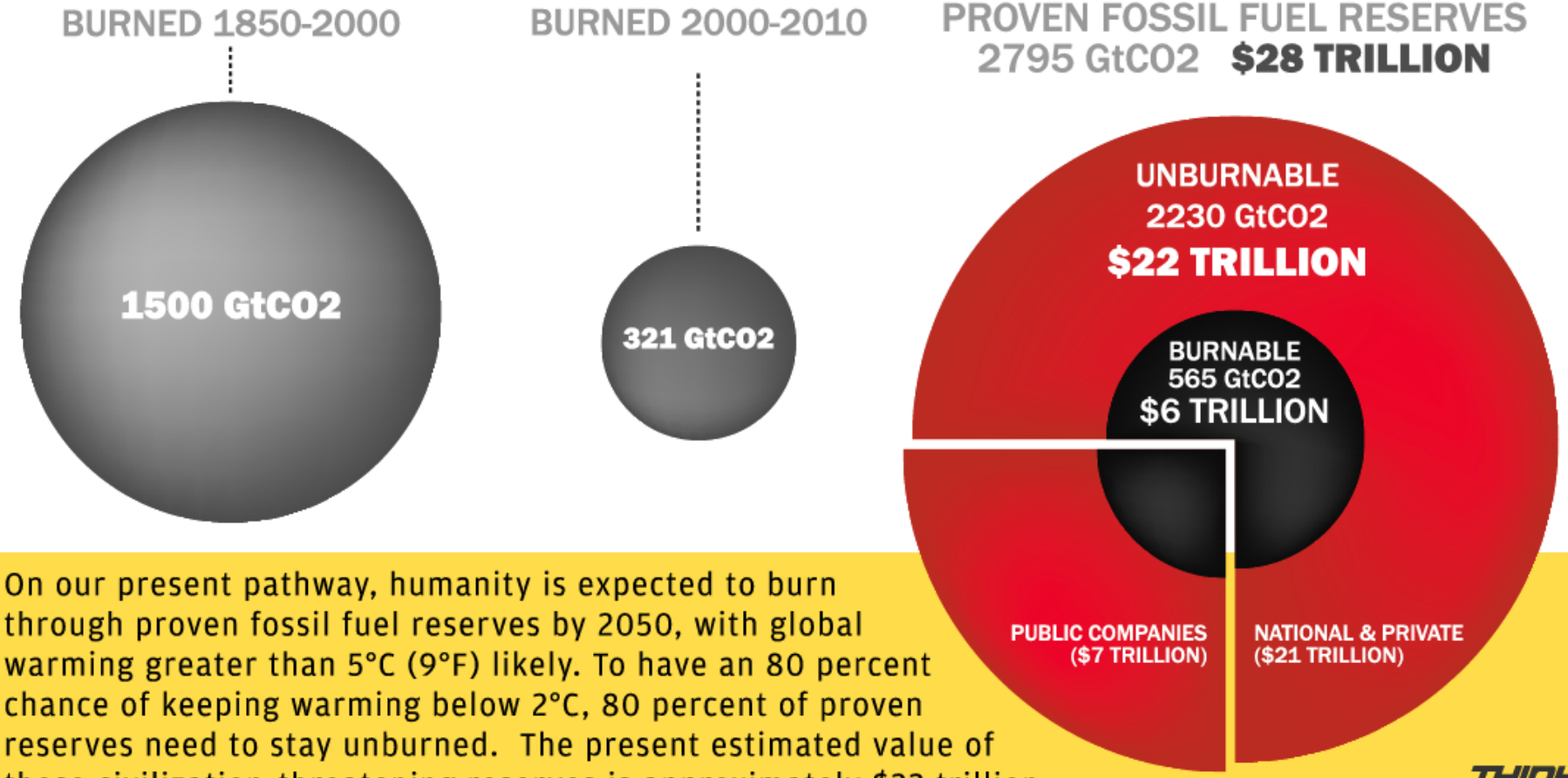


Global energy use by source



Source: BP Statistical Review of Energy 2014

THE $22 TRILLION CARBON BUBBLE

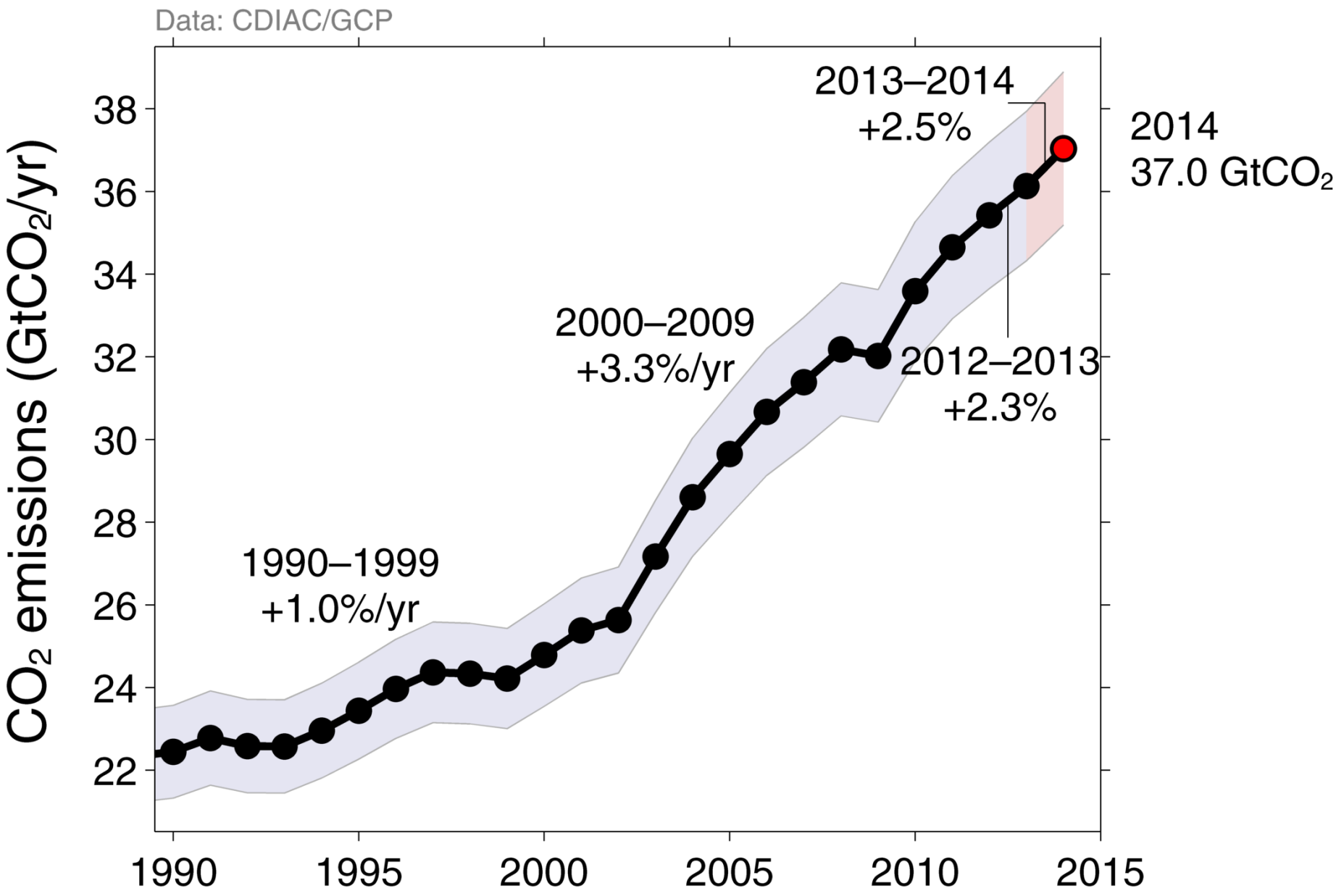


On our present pathway, humanity is expected to burn through proven fossil fuel reserves by 2050, with global warming greater than 5°C (9°F) likely. To have an 80 percent chance of keeping warming below 2°C, 80 percent of proven reserves need to stay unburned. The present estimated value of these civilization-threatening reserves is approximately $22 trillion.

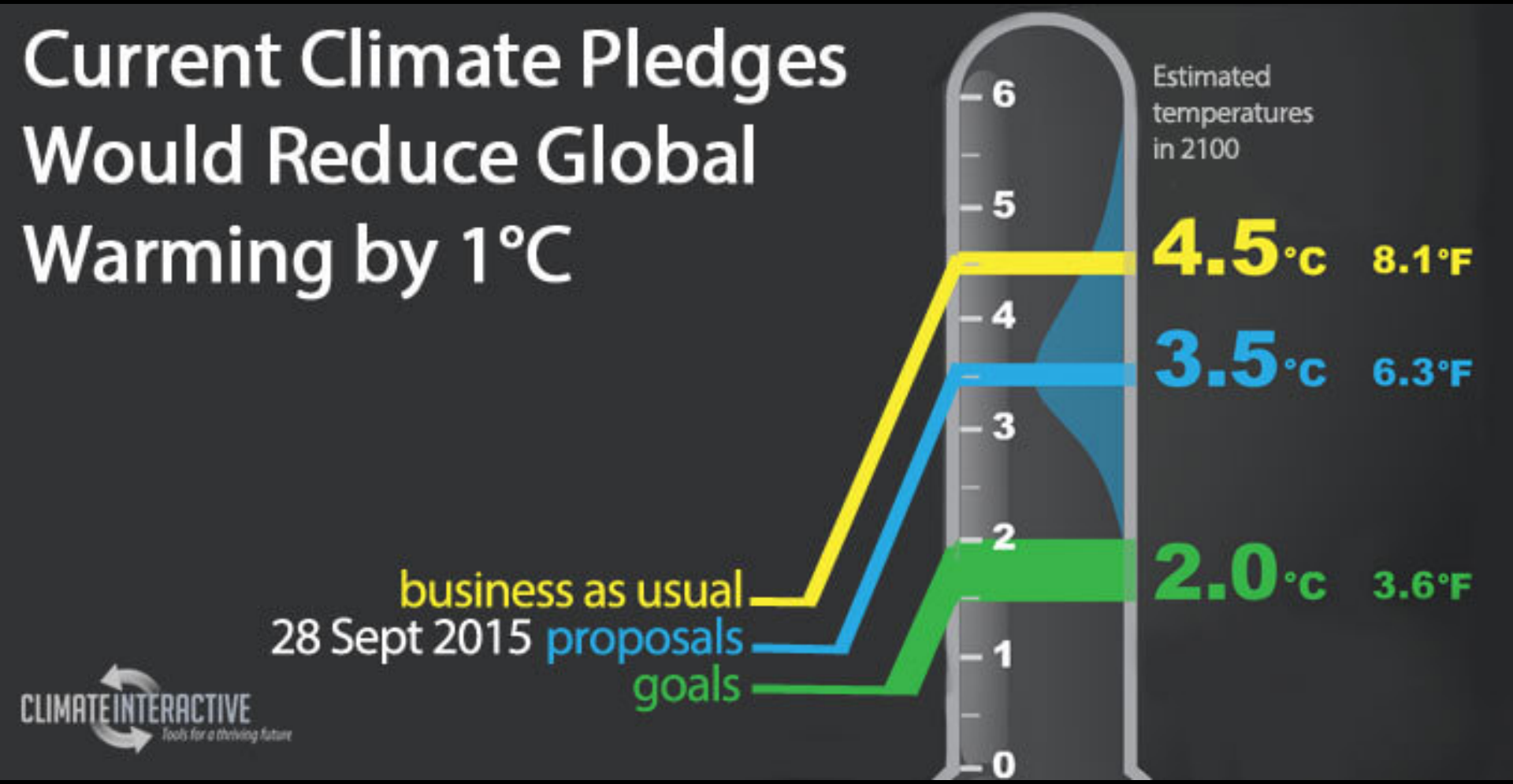
THINK PROGRESS

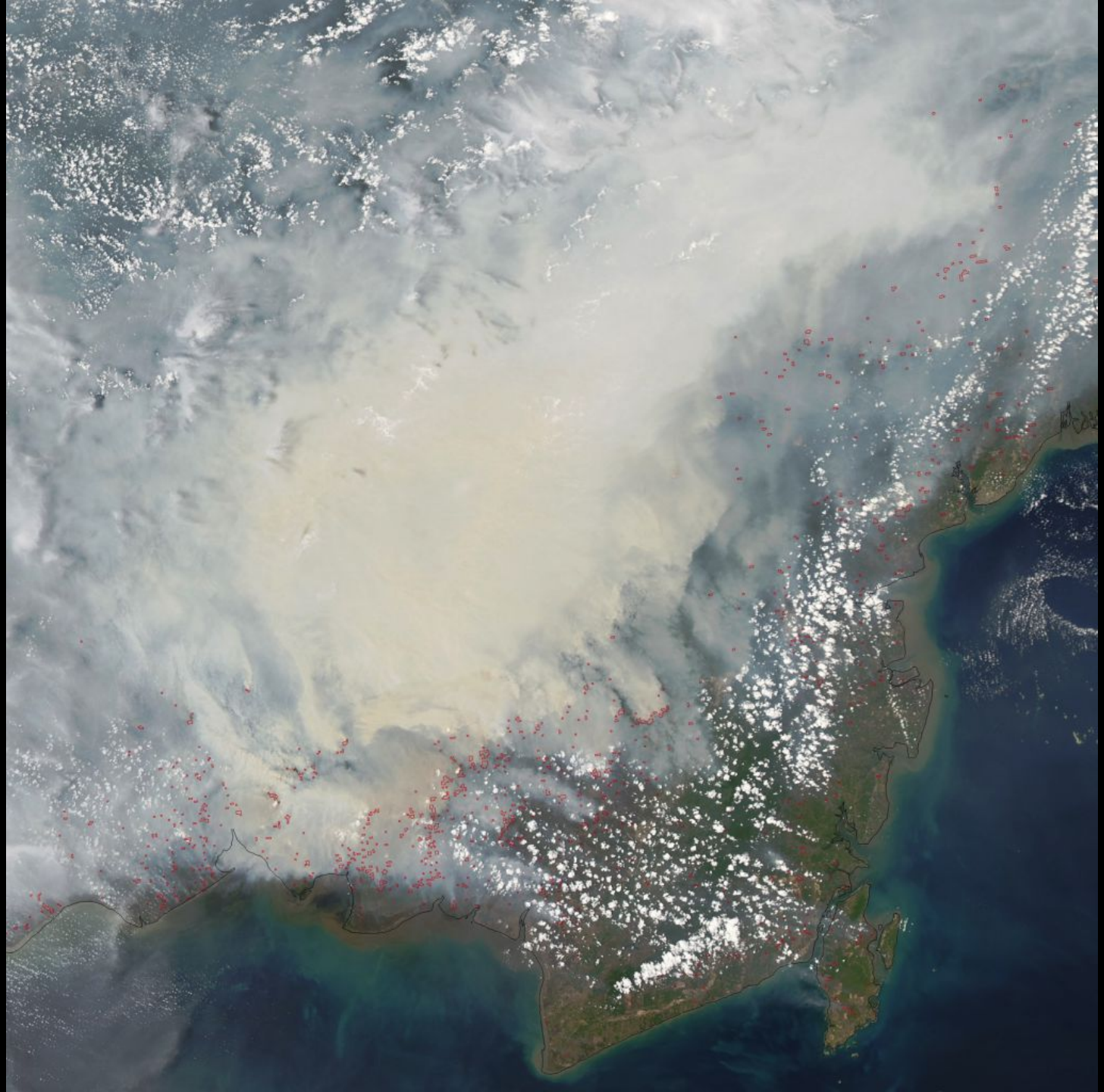
Sources: Meinshausen et al. 2009; Allen et al. 2009; Sokolov et al. 2009; Carbon Tracker Initiative 2011. Carbon reserves as of the start of 2011; since then approximately 50 gigatons of carbon dioxide have been burned. Total fossil reserves are projected to be four times larger than proven reserves, and exploration for new reserves continues.

CARBON EMISSIONS STILL RISING



SUNK COST

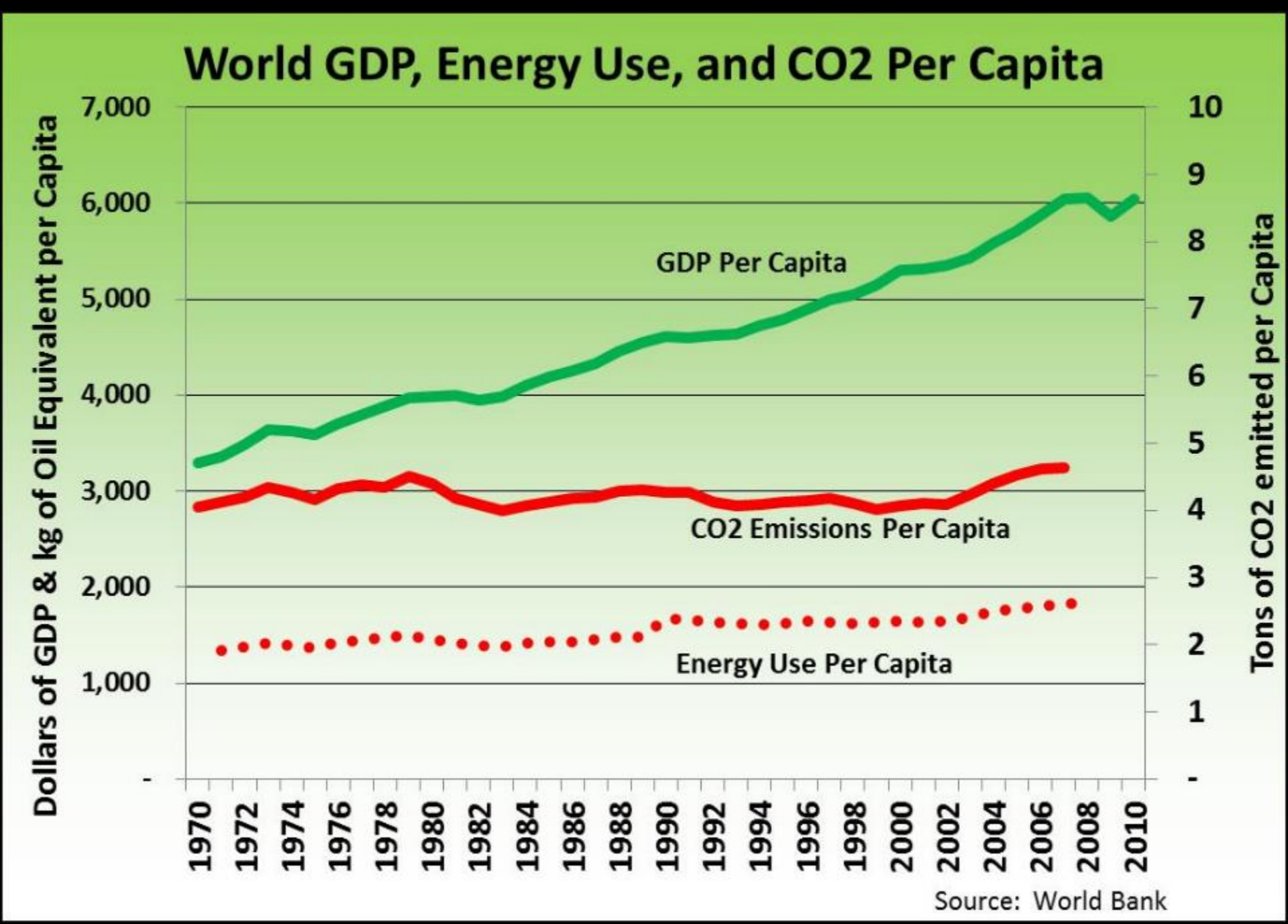

Current Climate Pledges Would Reduce Global Warming by 1°C
Estimated temperatures in 2100
6
5
4
3
2
1
0
4.5°C 8.1°F
3.5°C 6.3°F
2.0°C 3.6°F
business as usual
28 Sept 2015 proposals
goals
CLIMATE INTERACTIVE
Tools for a thriving future



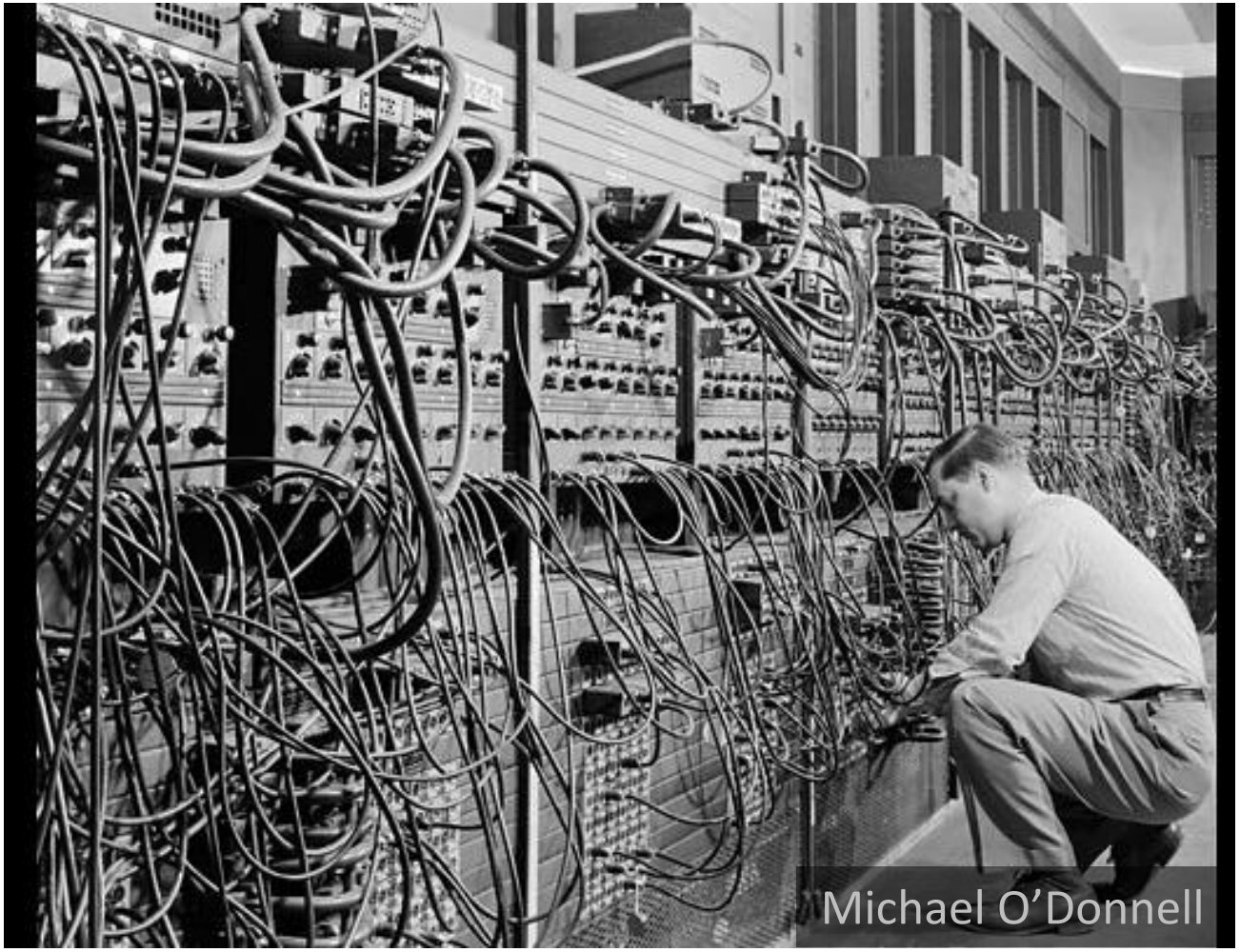
PROBLEMS NOT SOLVED

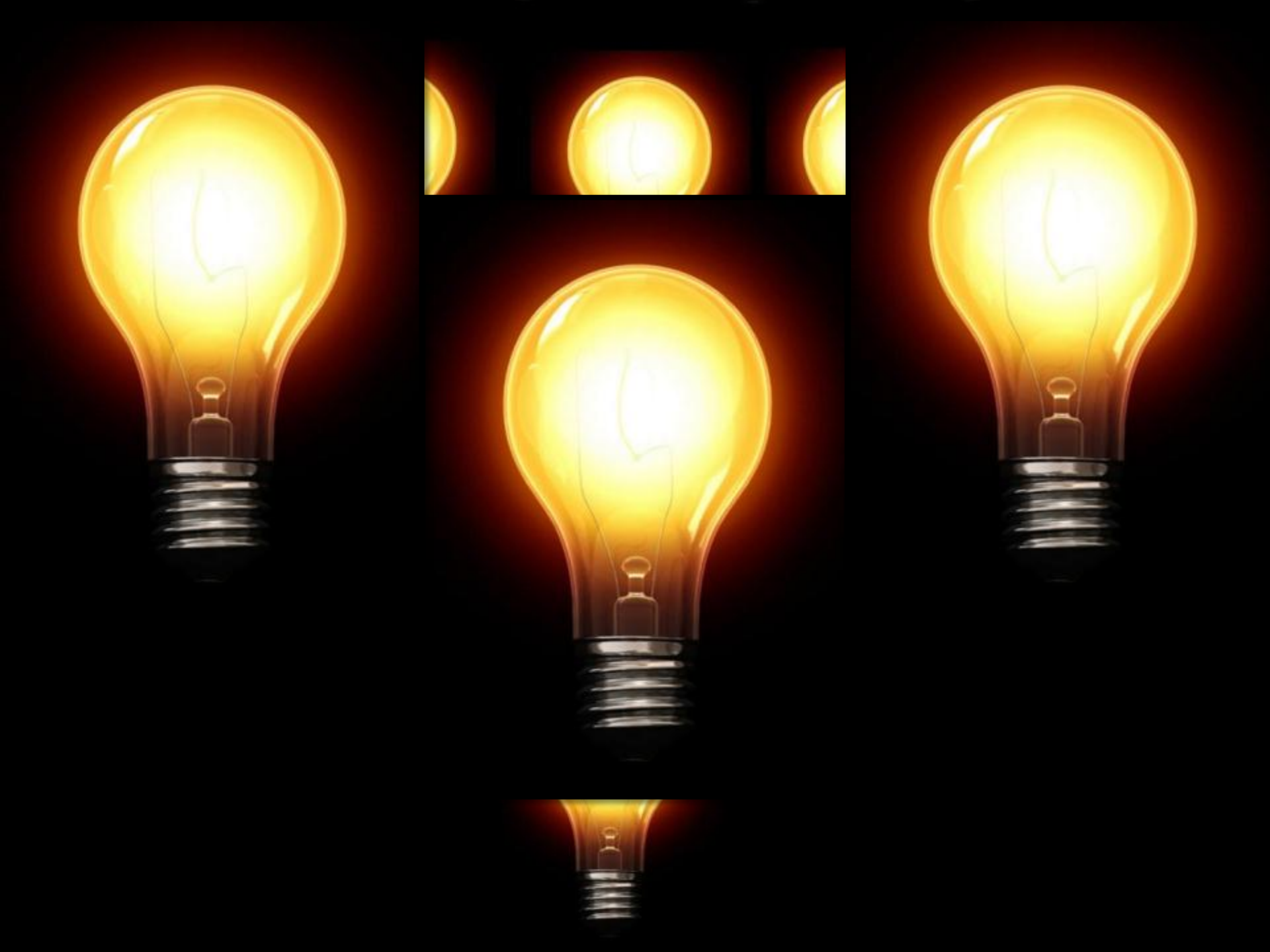
BUT THEY'RE SOLVABLE

ONE KEY RESOURCE


World GDP, Energy Use, and CO2 Per Capita
Dollars of GDP & kg of Oil Equivalent per Capita
Tons of CO2 emitted per Capita
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
10
9
8
7
6
5
4
3
2
1
-
GDP Per Capita
CO2 Emissions Per Capita
Energy Use Per Capita
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Source: World Bank


9:41 AM
100%
Tuesday
9
Messages
Calendar
Photos
Camera
Weather
Clock
Maps
Videos
Notes
Reminders
Stocks
Game Center
Newsstand
iTunes Store
App Store
iBooks
Health
Passbook
Settings
Phone
Mail
Safari
Music


Michael O’Donnell



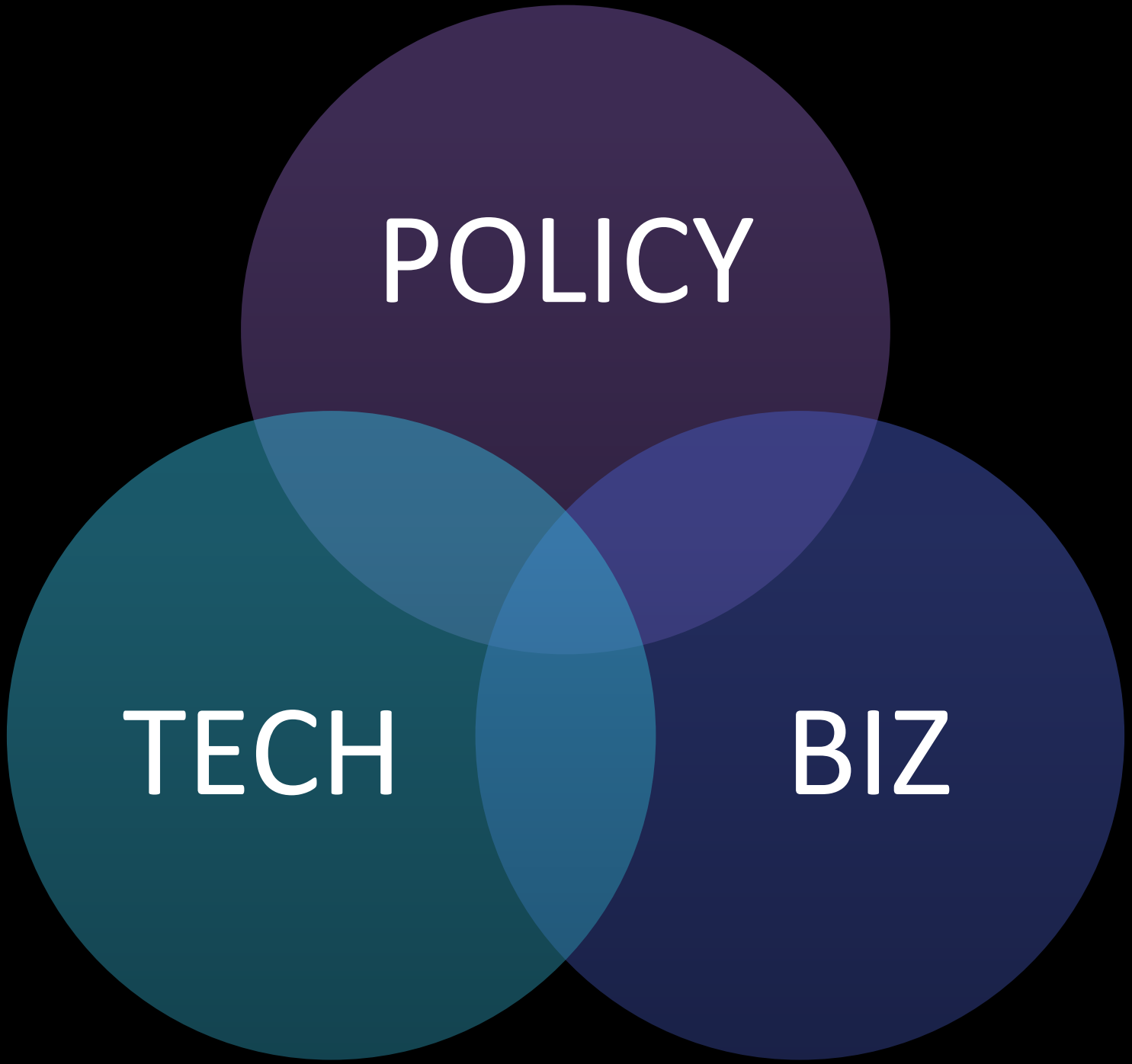
WE'RE IN A RACE

DESTRUCTION

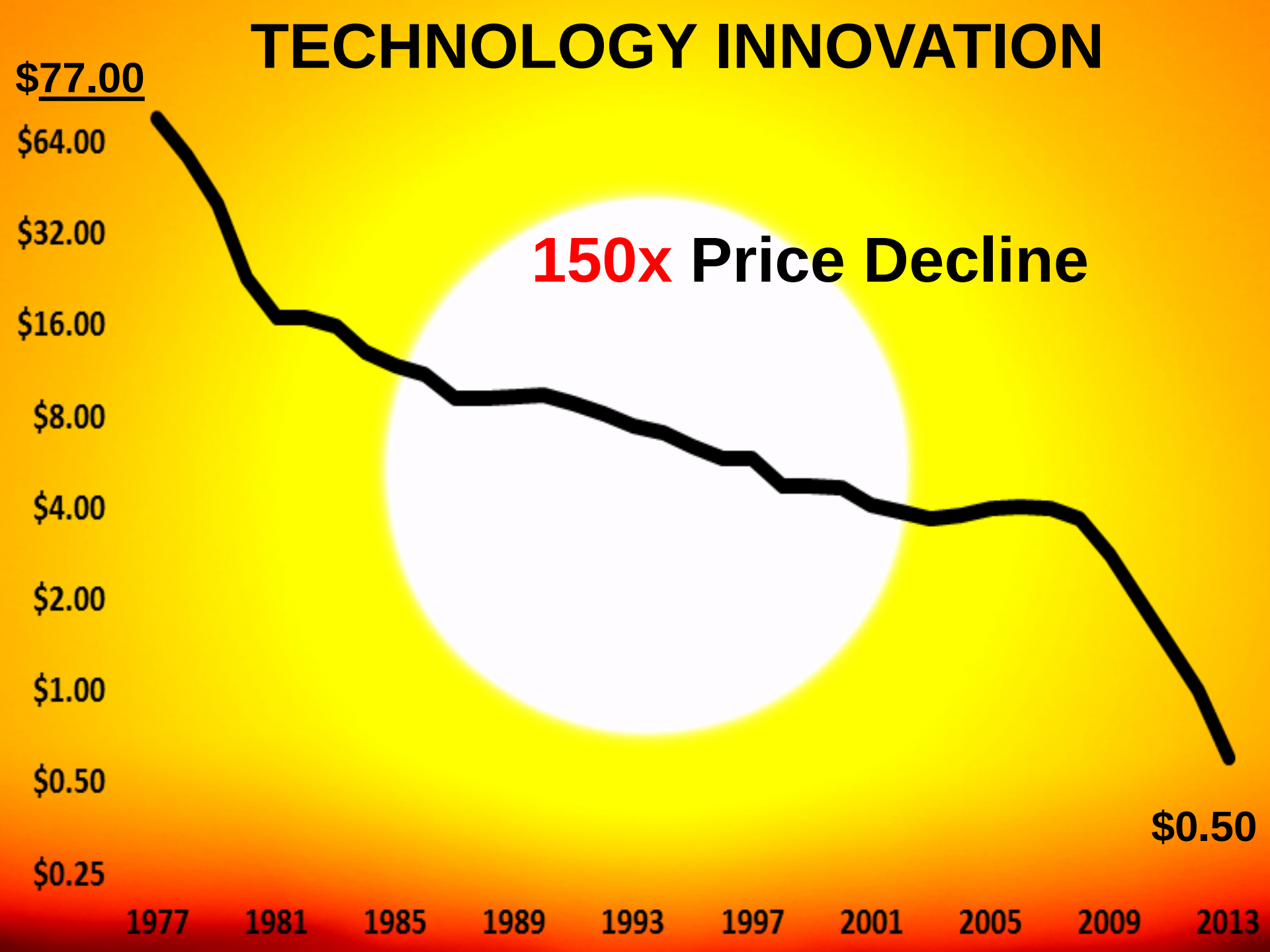
VS

INNOVATION

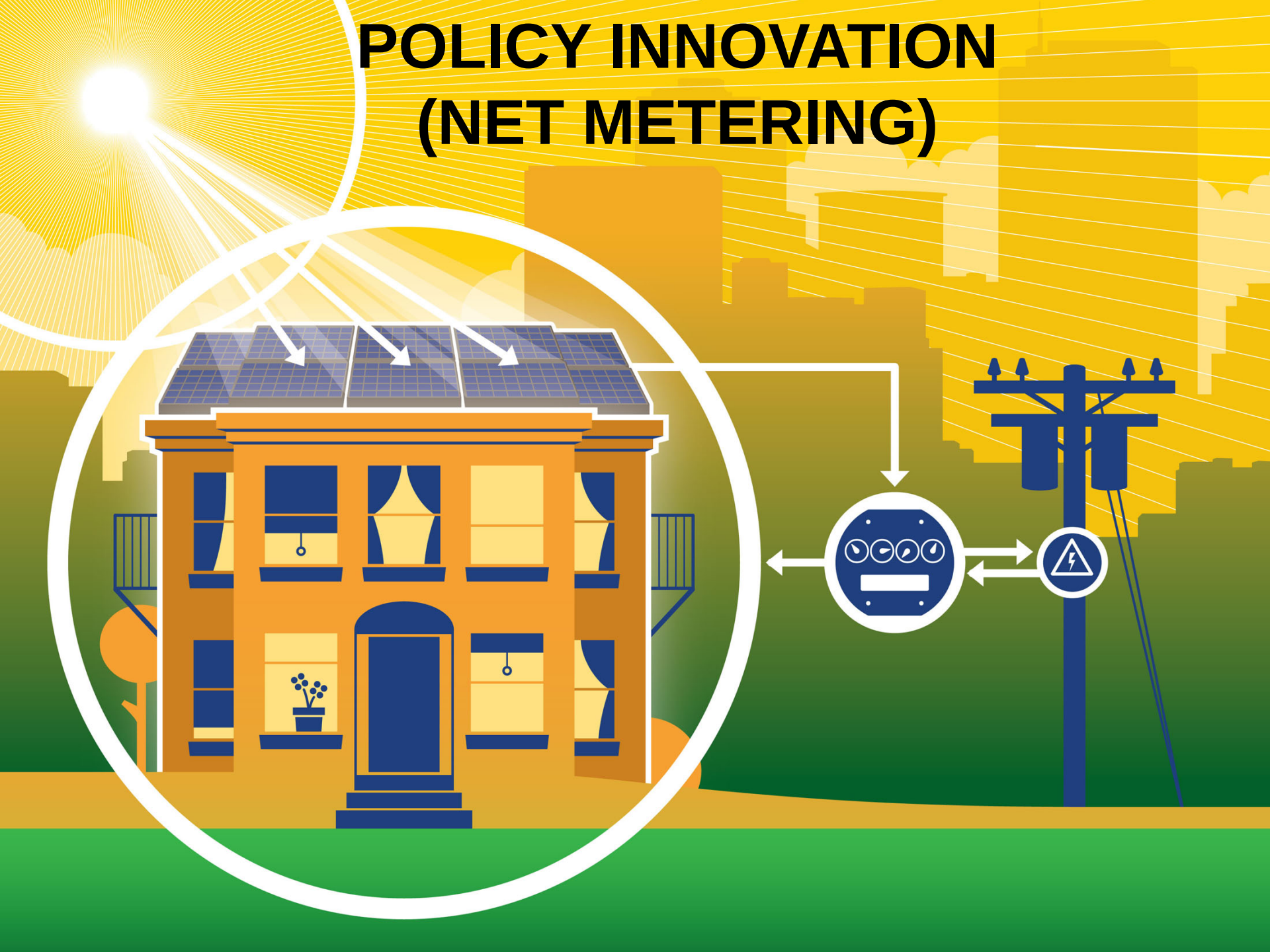
WHAT CAN WE DO?


POLICY
TECH
BIZ

TECHNOLOGY INNOVATION

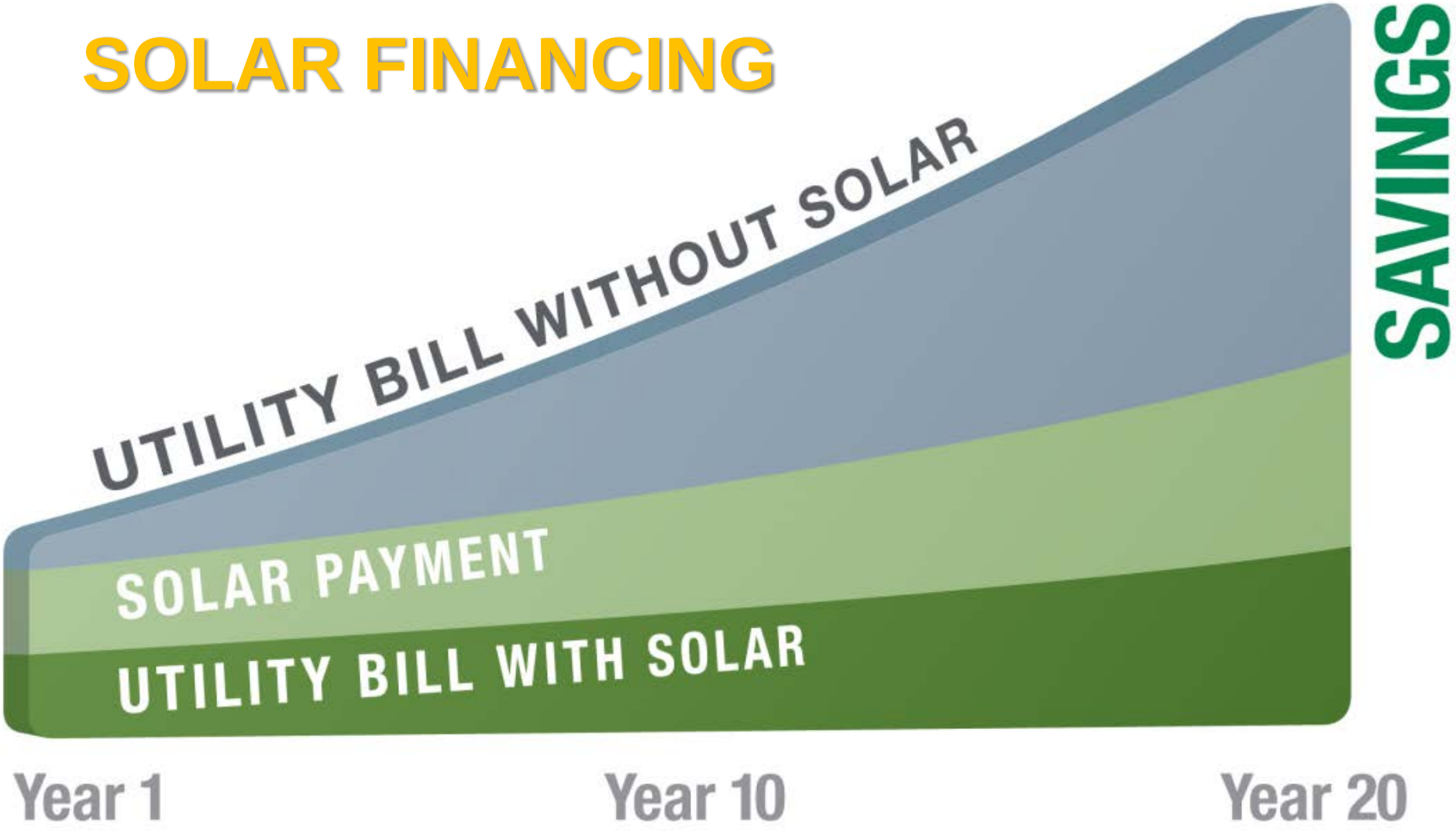


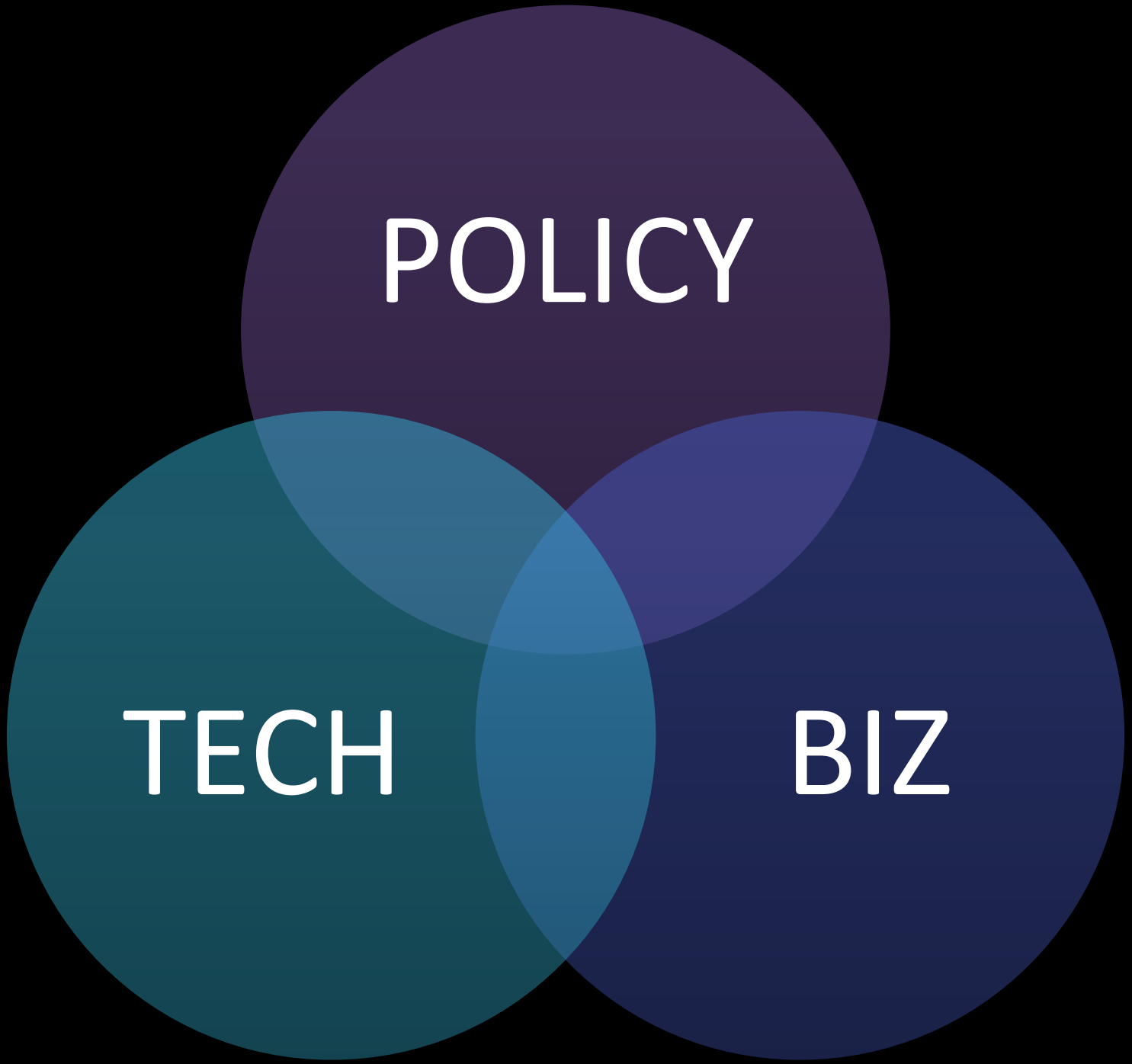
POLICY INNOVATION (NET METERING)

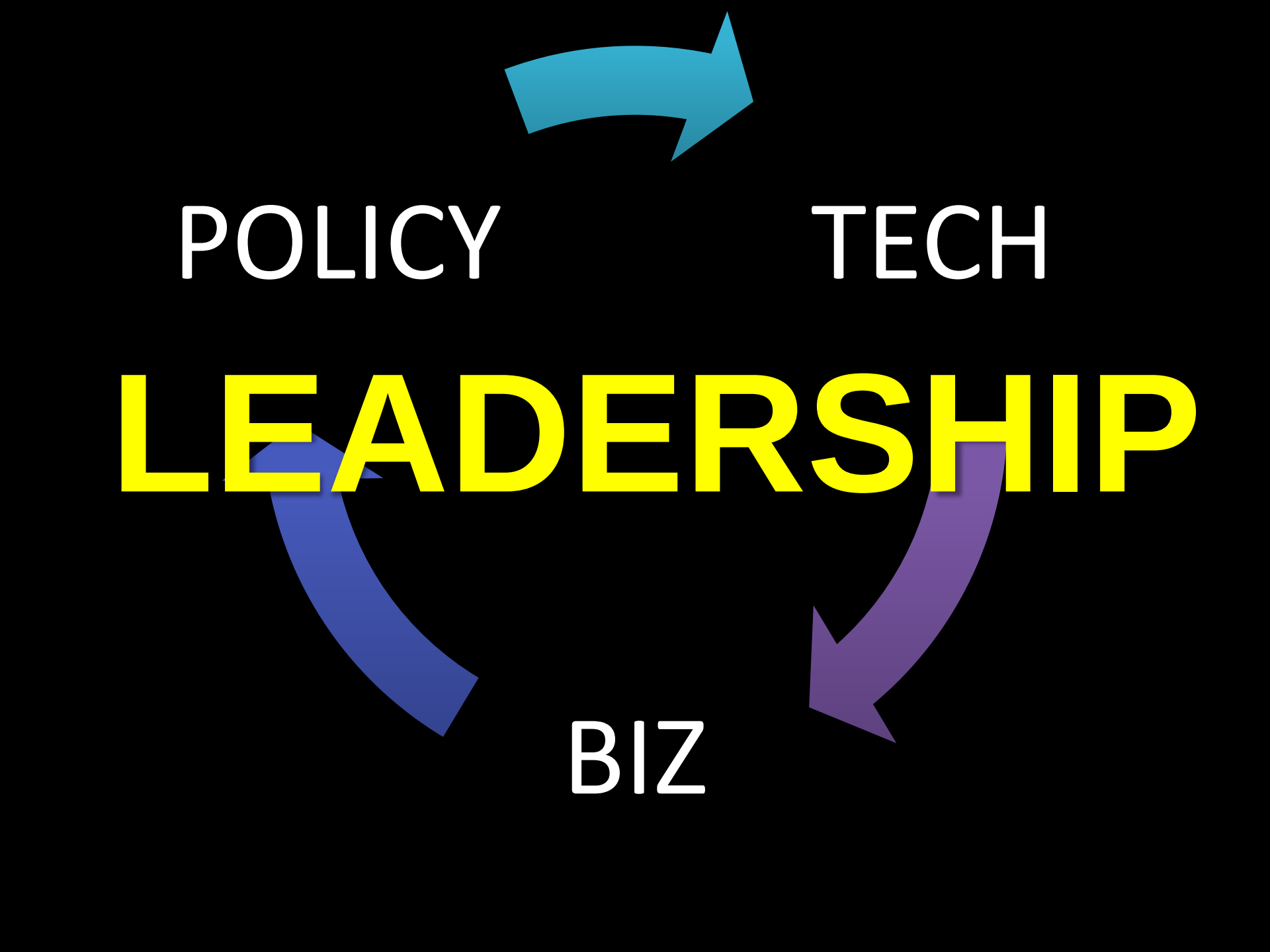


BUSINESS MODEL INNOVATION

SOLAR FINANCING




POLICY
TECH
BIZ


POLICY
TECH
LEADERSHIP
BIZ


KEEP HOPE

Crisis


Cleveland State University


Brent Durken

mez@morethanhuman.org @ramez

the infinite resource

the power of ideas on a finite planet

RAMEZ NAAM