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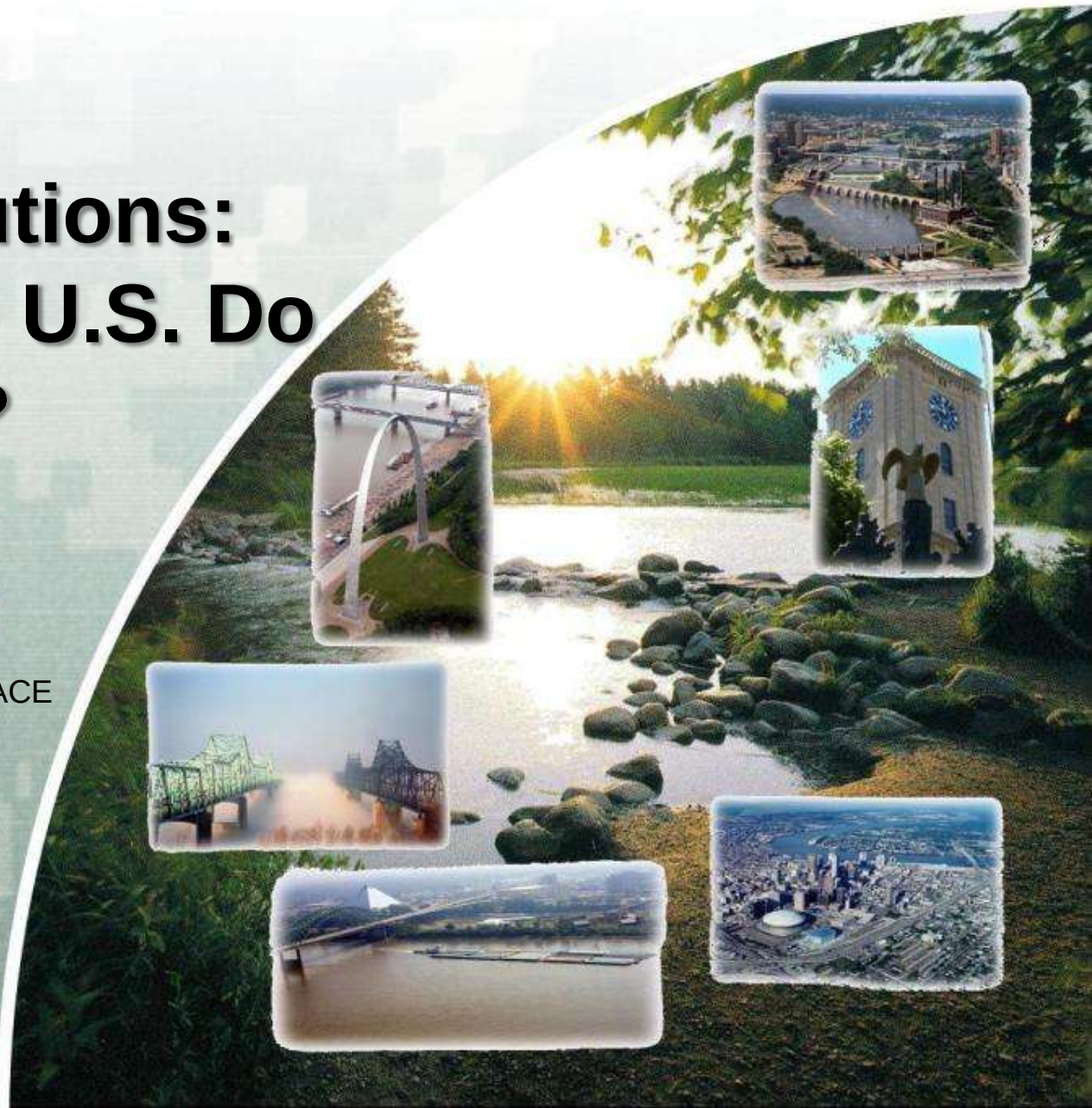
FOUR Revolutions: What Will the U.S. Do About Them?



Brig. Gen. Duke DeLuca

President, Miss River Commission

Cmdg Gen, Miss Valley Division USACE

14 May 2014

US Army Corps of Engineers
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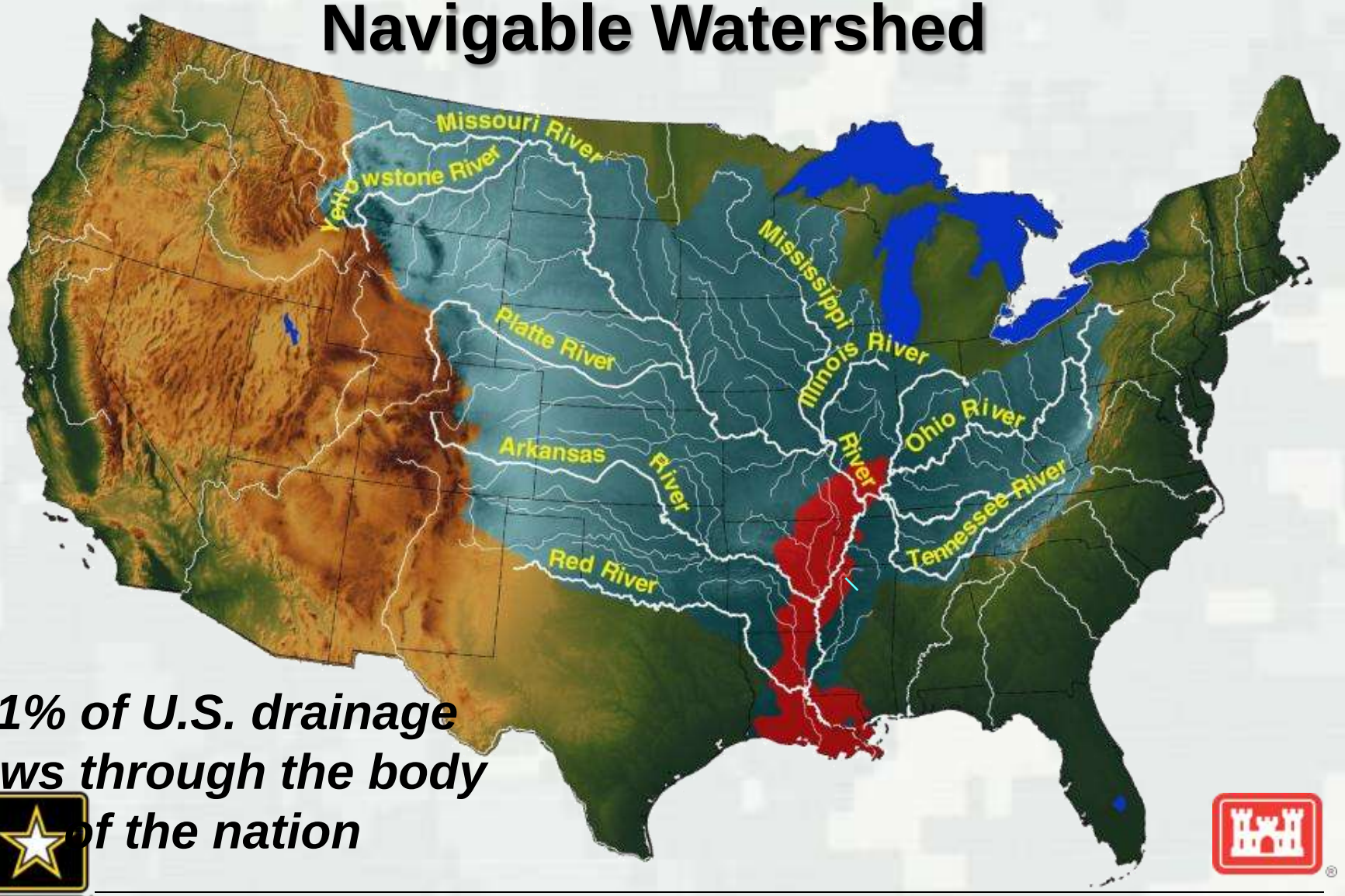
U.S. Army Corps of Engineers

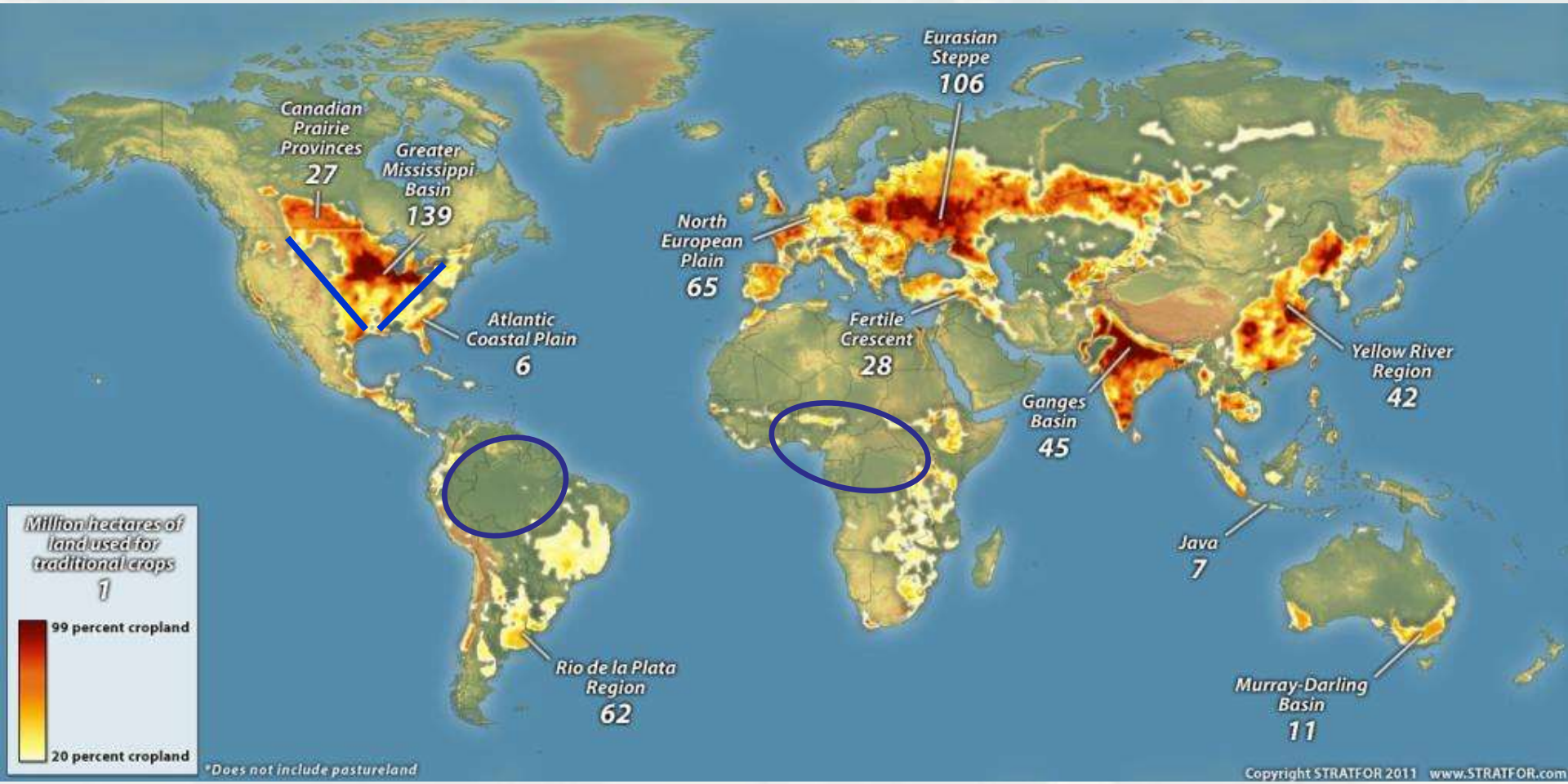
Civil Works Funding Supports our Diverse Missions/Workforce

World's Largest Naturally Navigable Watershed



41% of U.S. drainage flows through the body of the nation

Revolution #1: Explosive Growth in US Agricultural Productivity



Revolution #2: Hydrocarbon Production Revolution

- Unconventional Oil and Gas Production Methods
  - Horizontal Drilling, Hydraulic Fracturing of Shale

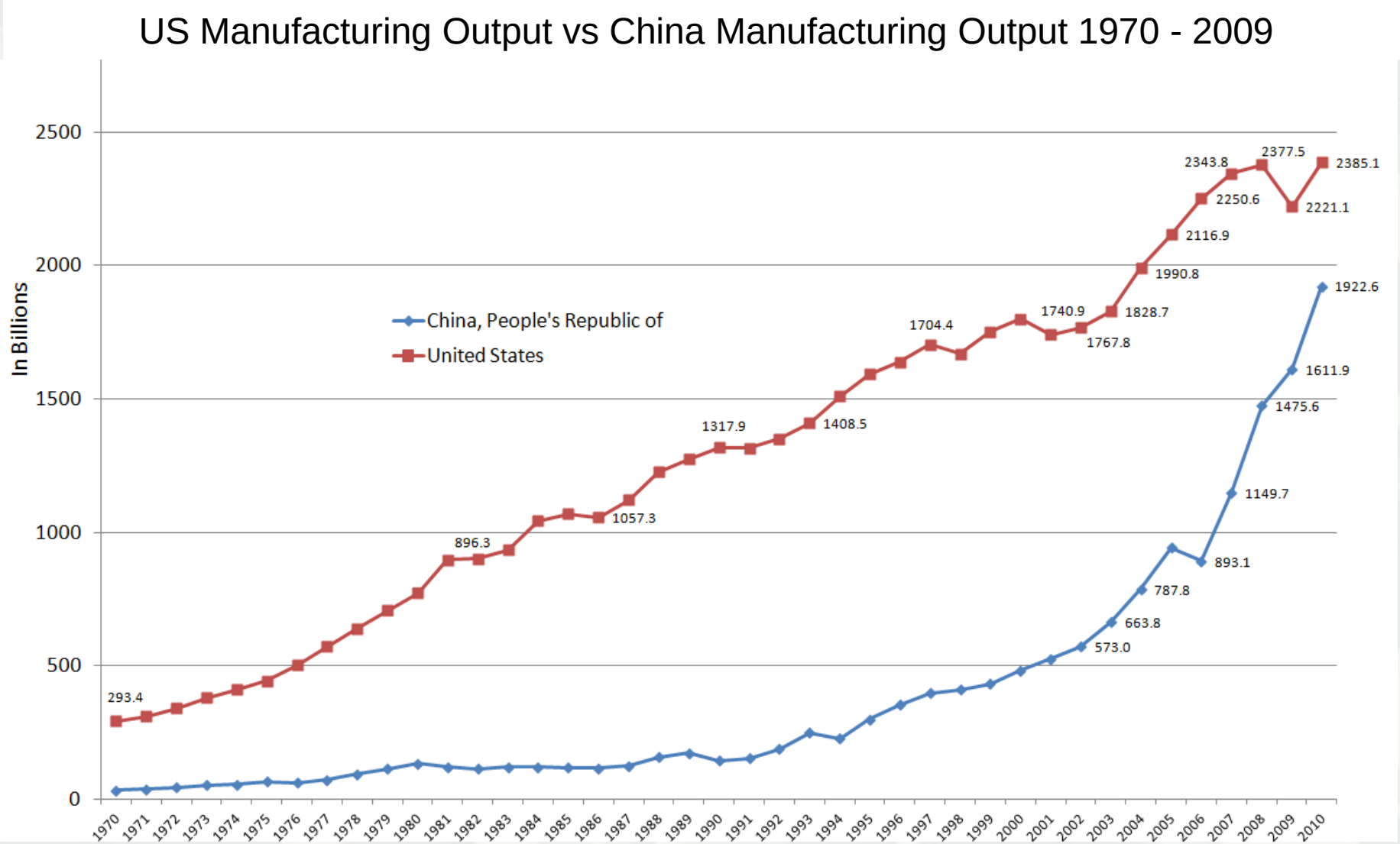
- US Oil Production:
  - Grew 18% in last year alone
  - US will be World #1 producer in 2015 (more than KSA)

- US Natural Gas Production:
  - US is World #1 producer as of 2013 (more than Russia)

- Affects Many Other Industries including Chemical, Plastics, and all Manufacturing

*In China and India, equivalent degree compared to USA accredited institutions

Revolution #3: Return of Manufacturing to the US and The Mississippi Valley



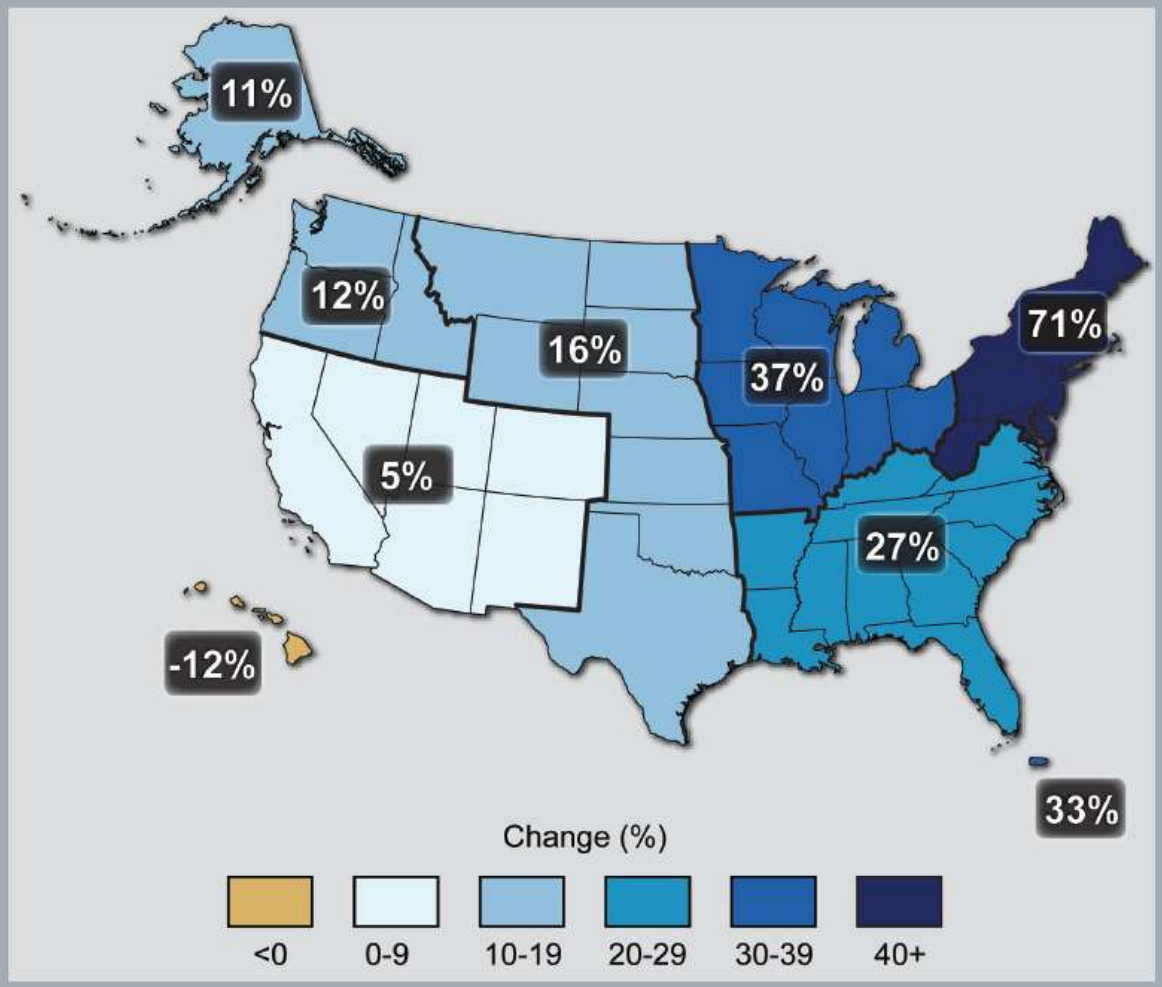
Revolution #4: Accelerating Impacts of Climate Change

- Changes to Weather
  - Precipitation more Intense – More Volume in Less Time
  - Increased Runoff from this and development
  - Significant Storm events of high intensity
    - Record number of >$1B events in 2013 (41 - 7 in US)
    - Increasing High Damage weather events 151 since 1980

- Changes to Watershed Functioning – part climate chg
  - Higher Stages with same or less flow as in the past (need new flow line for Mississippi River – underway)
  - Bottom Changes (Geomorphology study underway)
    - Accelerating Sea Level Rise
    - Louisiana Coastal land Loss is Relative SLR

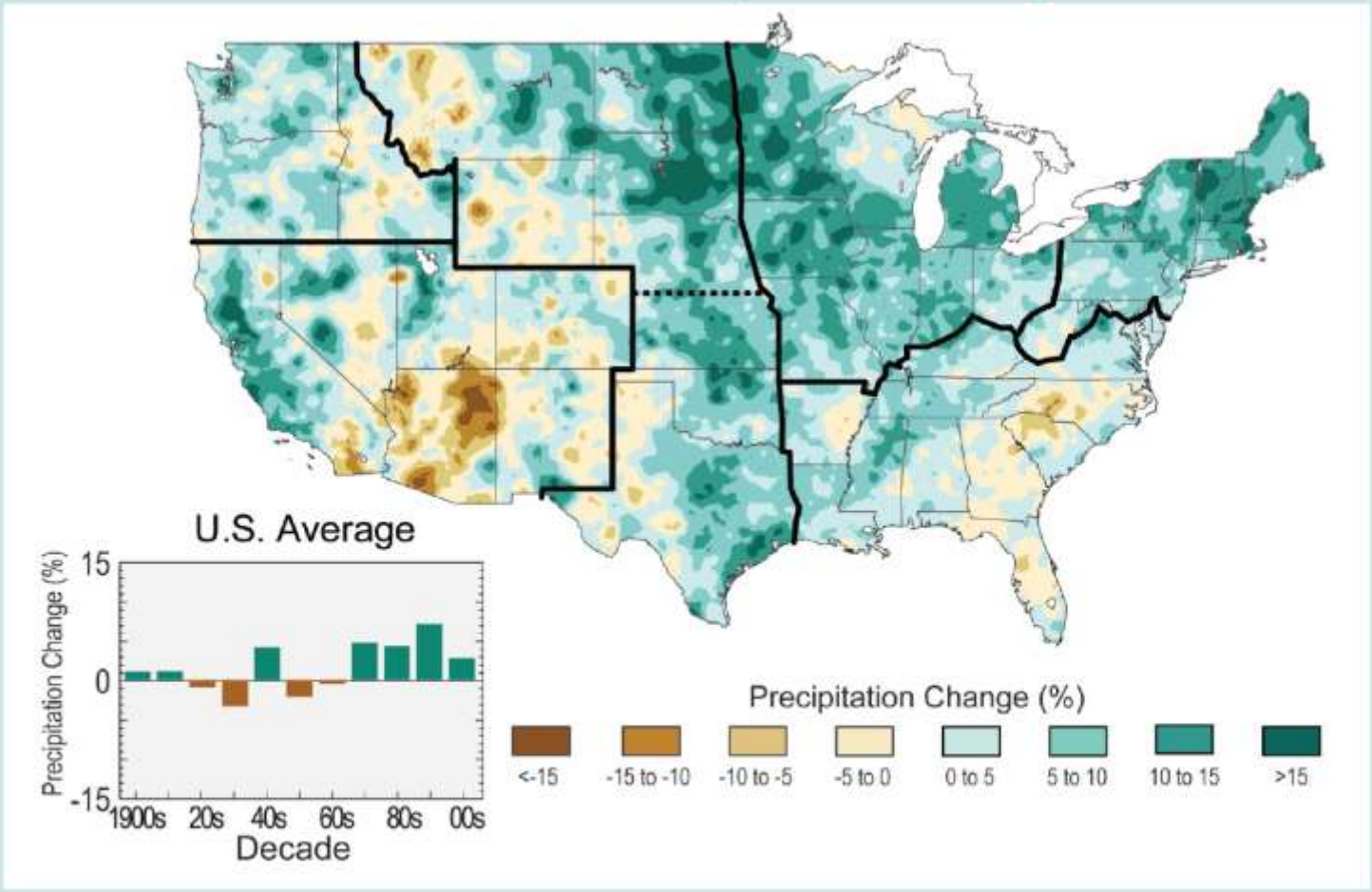
*In China and India, equivalent degree compared to USA accredited institutions

Observed Change in Very Heavy Precipitation

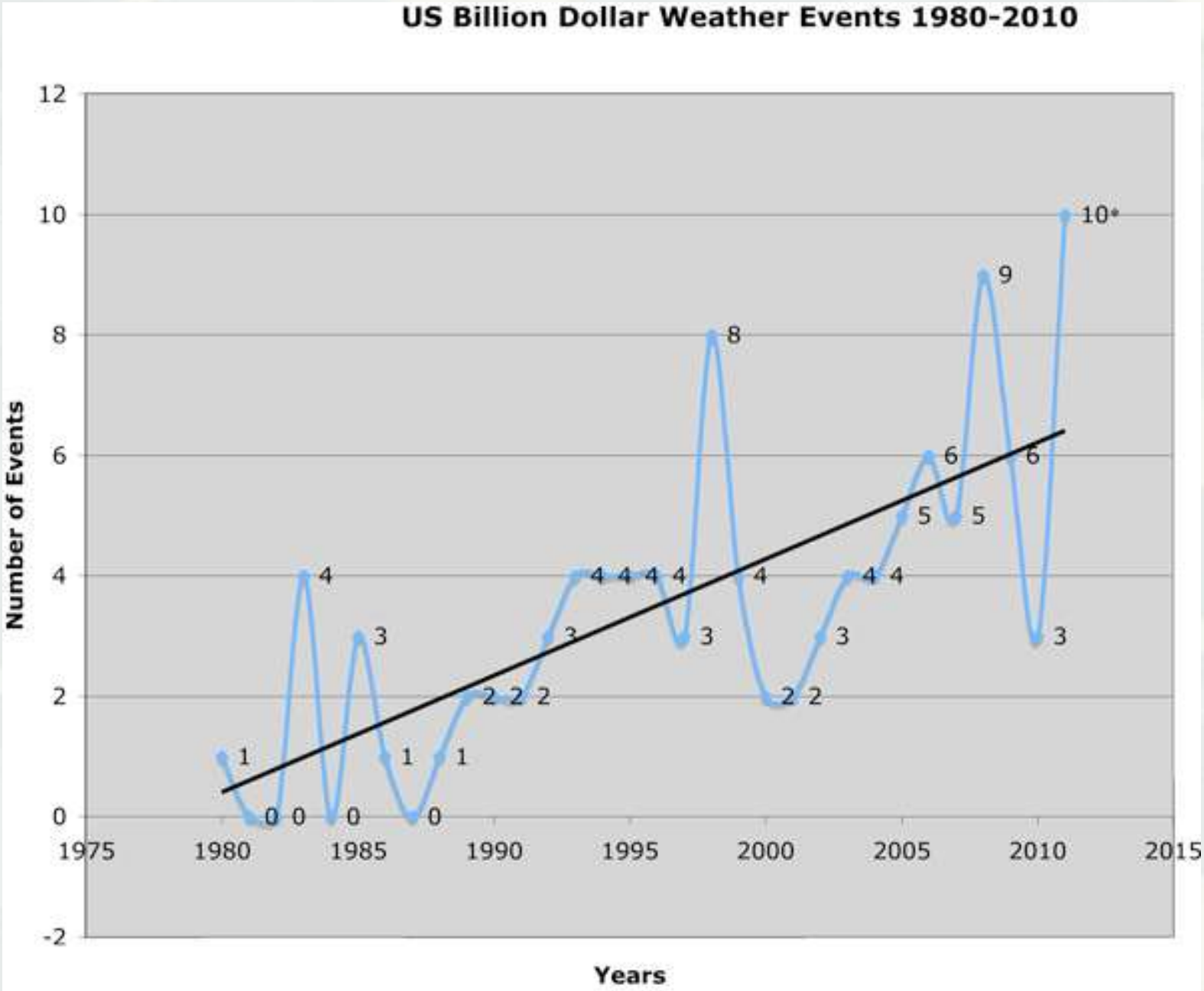


Percent changes in the amount of precipitation falling in very heavy events (the heaviest 1%) from 1958 to 2012 for each region. There is a clear national trend toward a greater amount of precipitation being concentrated in very heavy events, particularly in the Northeast and Midwest. (Figure source: updated from Karl et al. 2009[c]).

Observed U.S. Precipitation Change



The colors on the map show annual total precipitation changes for 1991-2012 compared to the 1901-1960 average, and show wetter conditions in most areas. The bars on the graph show average precipitation differences by decade for 1901-2012 (relative to the 1901-1960 average). The far right bar is for 2001-2012. (Figure source: NOAA NCDC / CICS-NC).



* Including Hurricane Irene, the US has experienced 10 billion-dollar weather events in 2011, as of September 1

Data Source: NOAA's National Climatic Data Center http://www.ncdc.noaa.gov/img/reports/billion/disasters2010.pdf

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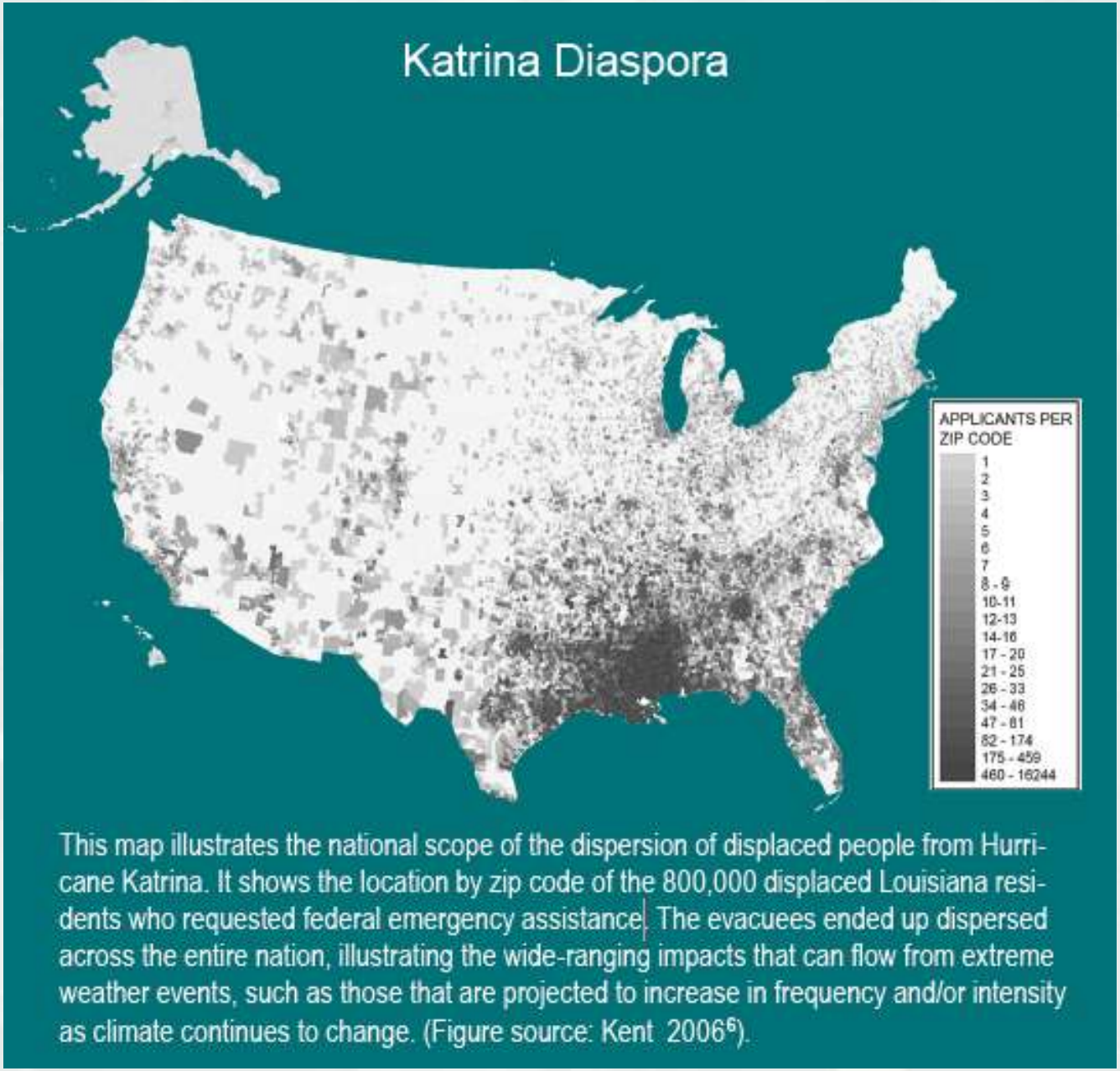
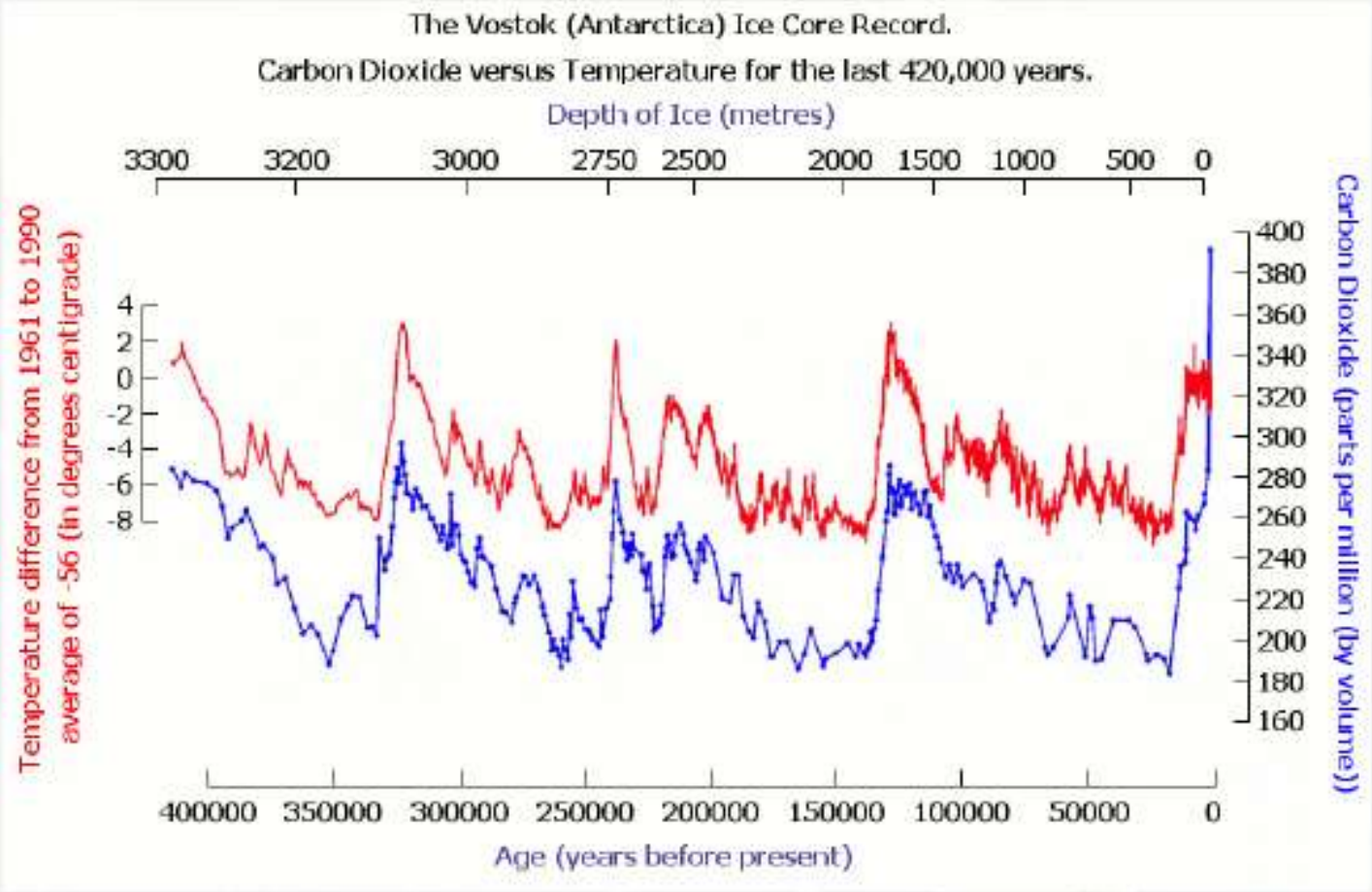
Katrina Diaspora



This map illustrates the national scope of the dispersion of displaced people from Hurricane Katrina. It shows the location by zip code of the 800,000 displaced Louisiana residents who requested federal emergency assistance. The evacuees ended up dispersed across the entire nation, illustrating the wide-ranging impacts that can flow from extreme weather events, such as those that are projected to increase in frequency and/or intensity as climate continues to change. (Figure source: Kent 2006[6]).

CO_2 Concentrations and Proxy Temperatures from the 400,000+ Vostok Ice Core Data Set



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*Graphic courtesy of NOAA Paleoclimatology, National Climatic Data Center. (http://www.ncdc.noaa.gov/paleo/icecore/antarctica/vostok/vostok_data.html)

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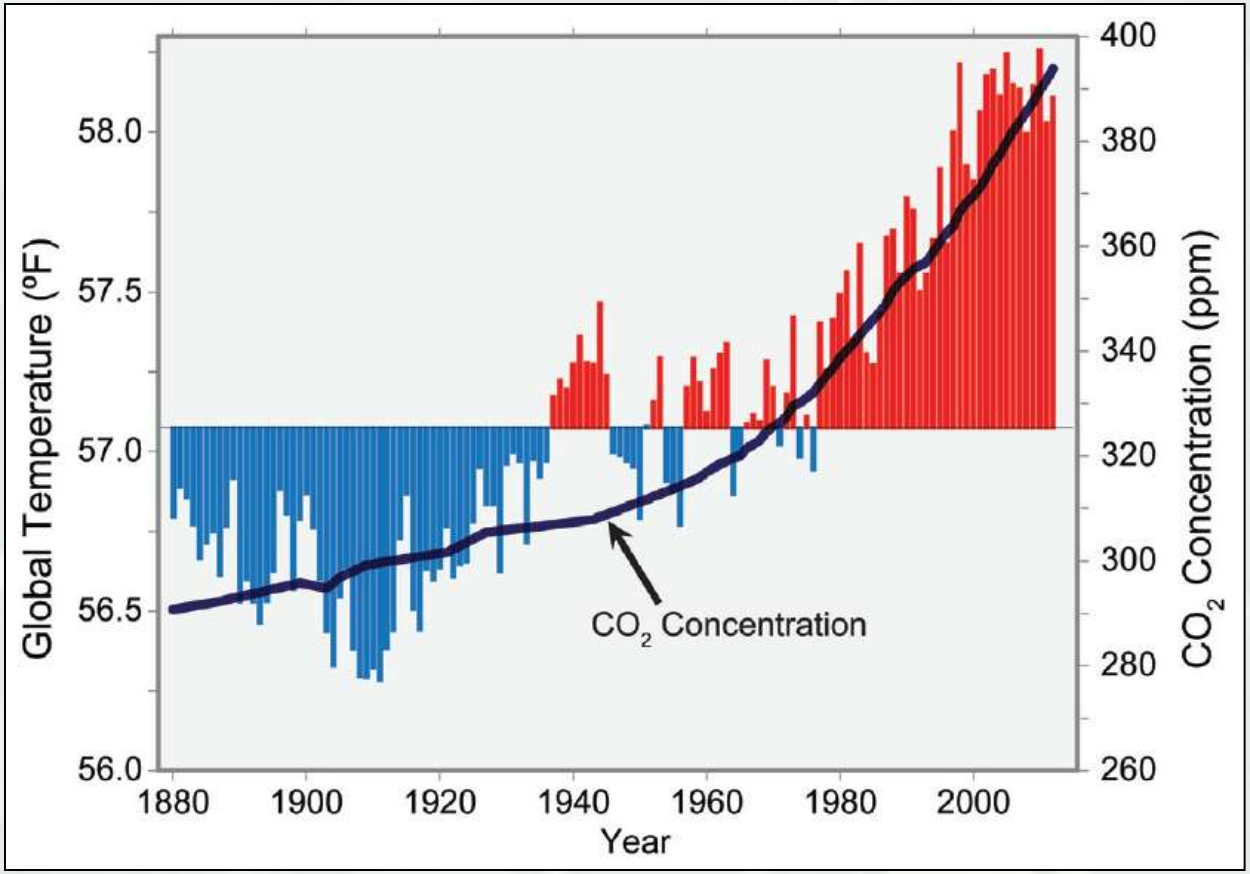
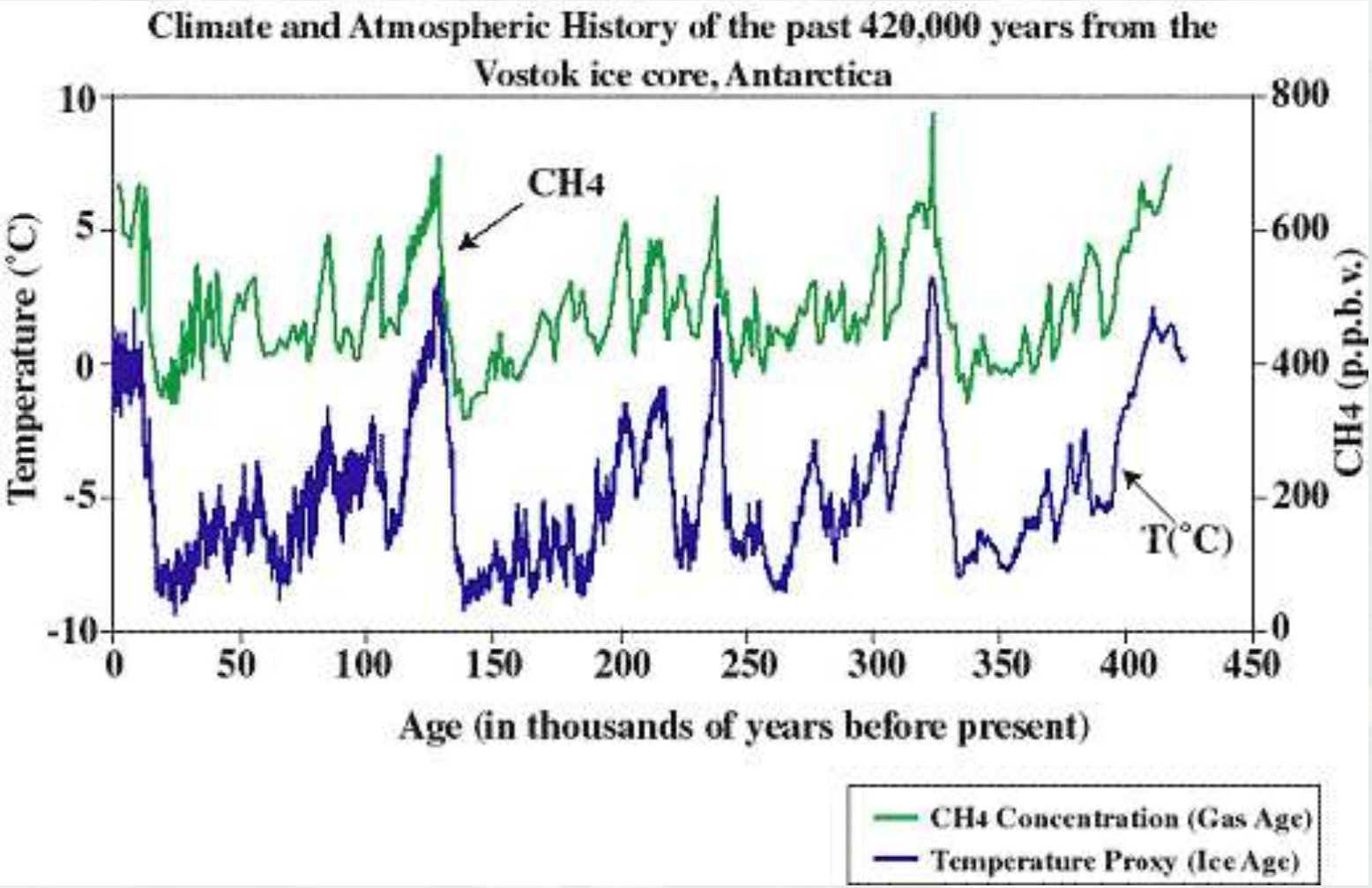
Global Temperature and Carbon Dioxide



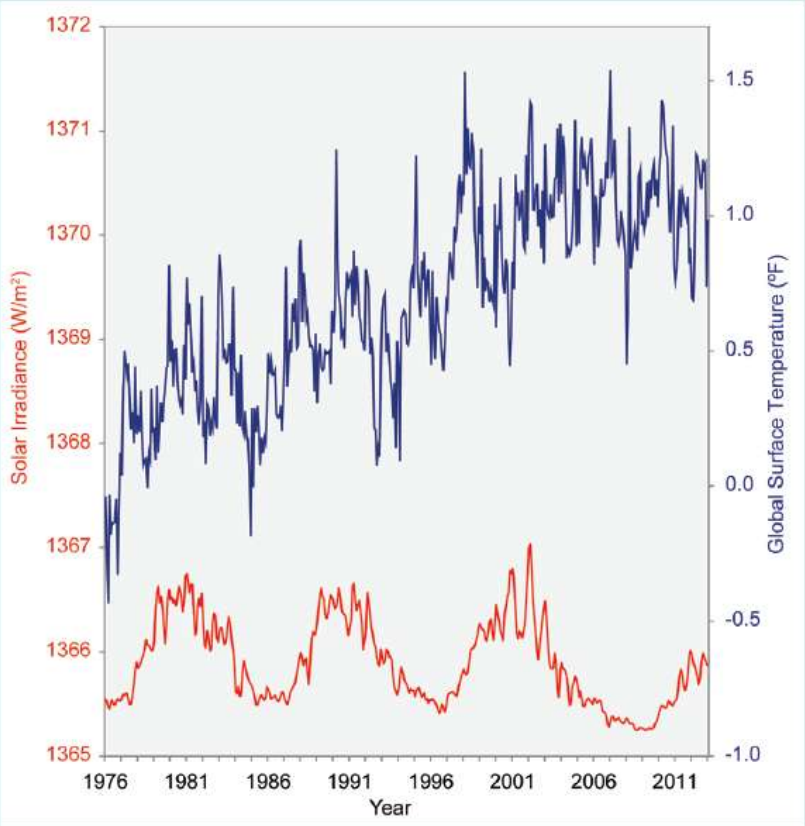
Climate Change Impacts in the United States: Highlights, U.S. Global Change Research Program, p. 18, http://nca2014.globalchange.gov/highlights

Vostok Ice Core Data Temp v. CH_4



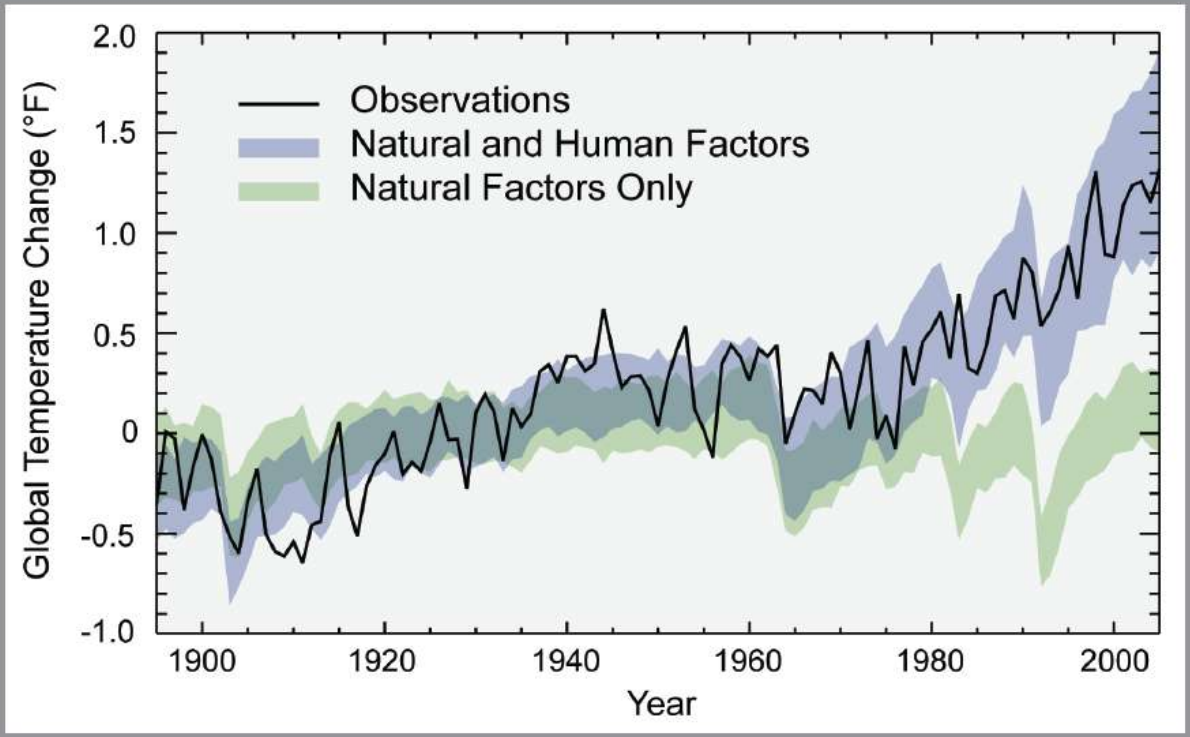
*Graphic courtesy of NASA, Goddard Institute for Space Studies. (http://www.giss.nasa.gov/research/features/200409_methane/)
**pg. 26

Measurements of Surface Temperature and Sun's Energy



The full record of satellite measurements of the sun's energy received at the top of the Earth's atmosphere is shown in red, following its natural 11-year cycle of small ups and downs, without any net increase. Over the same period, global temperature relative to 1961-1990 average (shown in blue) has risen markedly. This is a clear indication that changes in the sun are not responsible for the observed warming over recent decades. (Figure source: NOAA NCDC / CICS-NC).

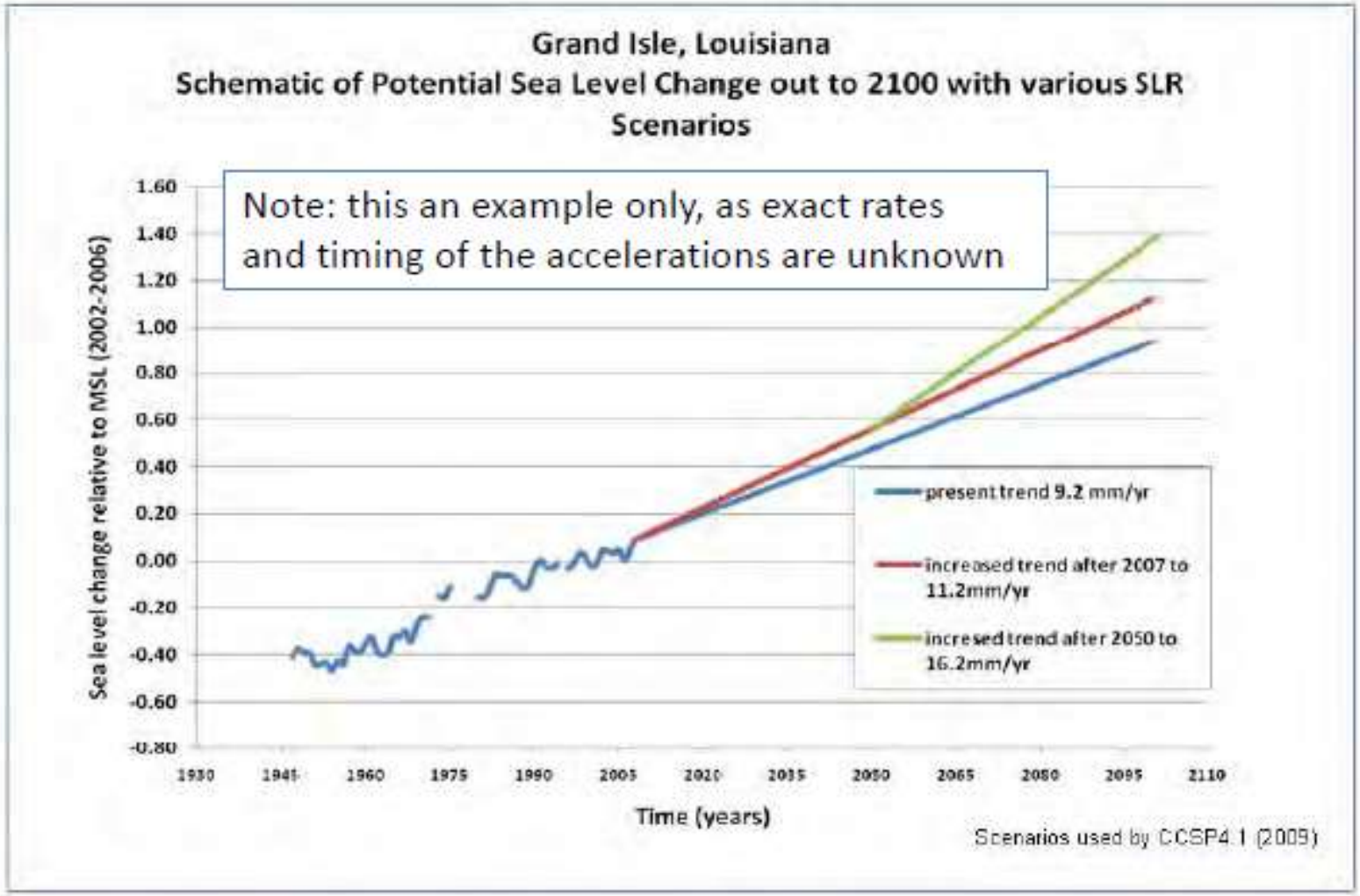
Separating Human and Natural Influences on Climate

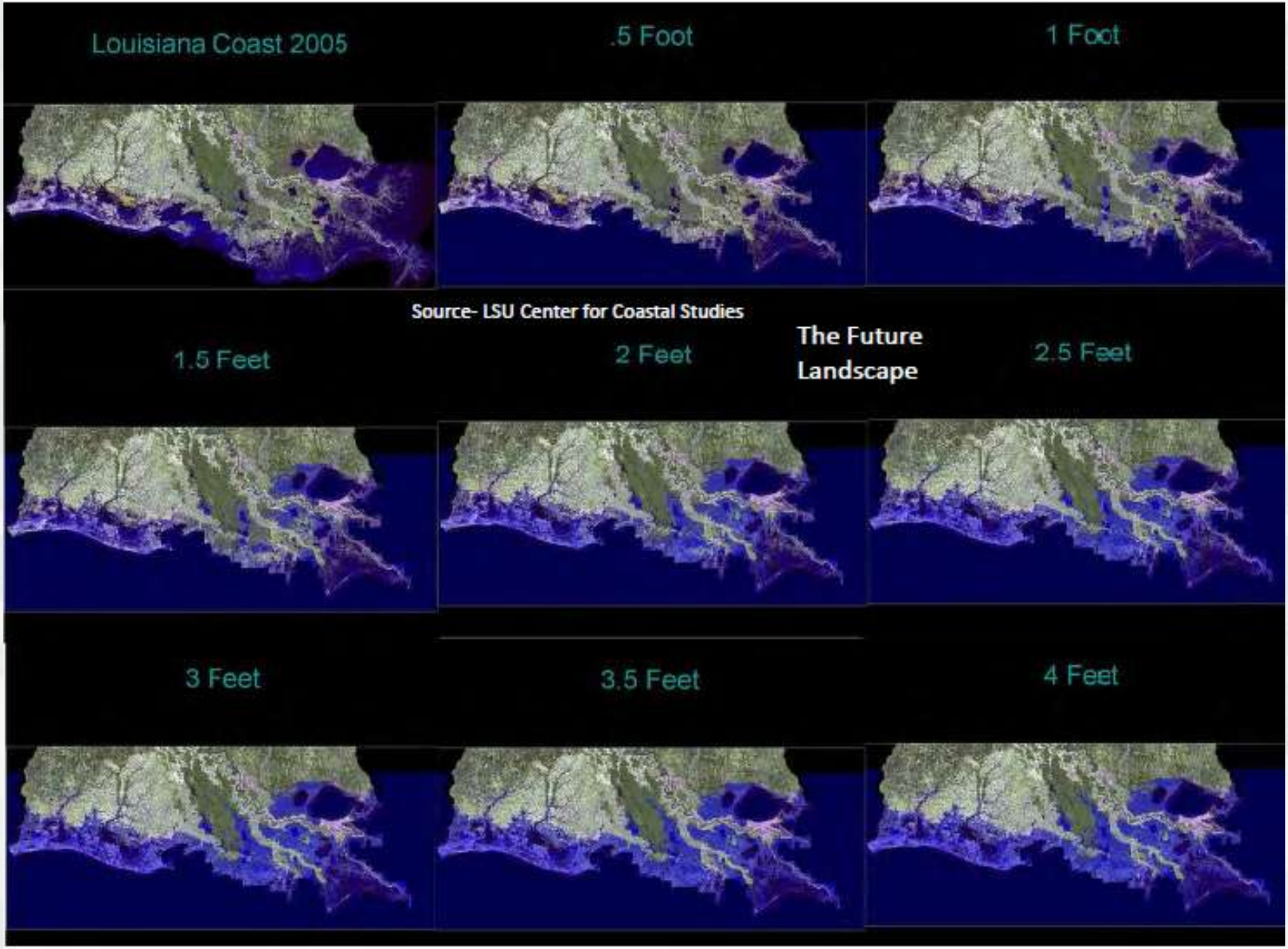


The green band shows how global average temperature would have changed over the last century due to natural forces alone, as simulated by climate models. The blue band shows model simulations of the effects of human and natural forces (including solar and volcanic activity) combined. The black line shows the actual observed global average temperatures. Only with the inclusion of human influences can models reproduce the observed temperature changes. (Figure source: adapted from Huber and Knutti 2012[b]).

Climate Change Impacts in the United States: Highlights, U.S. Global Change Research Program, p. 5, http://nca2014.globalchange.gov/highlights

Climate models project acceleration in Sea Level Rise starting before 2100 due to climate change- Many Areas through SE Coastal Louisiana See High Rates Now In Excess of 10mm

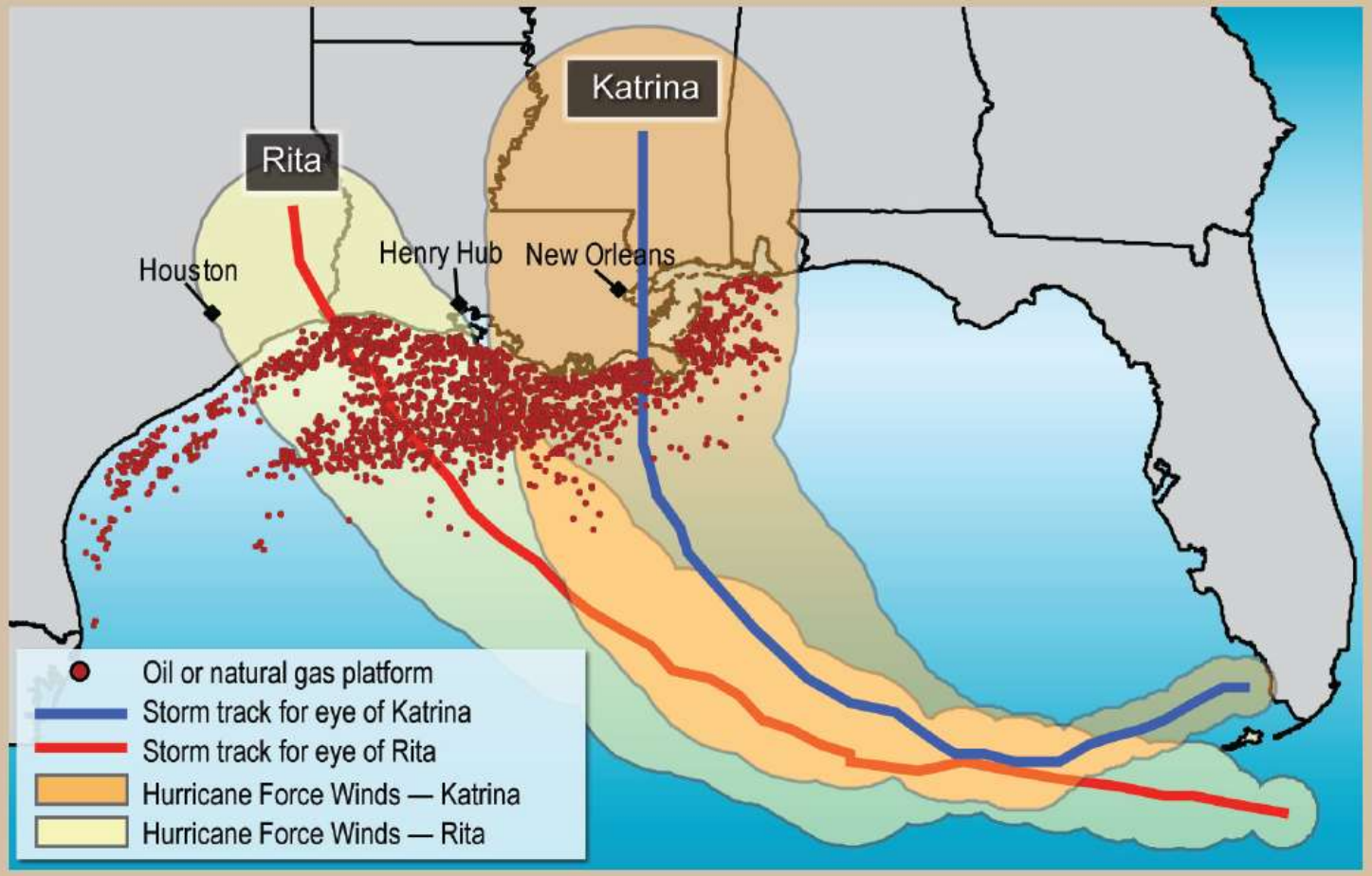



Louisiana Coast 2005
.5 Foot
1 Foot
Source- LSU Center for Coastal Studies
The Future Landscape
1.5 Feet
2 Feet
2.5 Feet
3 Feet
3.5 Feet
4 Feet

Gulf Coast Transportation Hubs at Risk

Within this century, 2,400 miles of major roadway are projected to be inundated by sea level rise in the Gulf Coast region. The map shows roadways at risk in the event of a sea level rise of about 4 feet, which is within the range of projections for this region in this century. In total, 24% of interstate highway miles and 28% of secondary road miles in the Gulf Coast region are at elevations below 4 feet. (Figure source: Kafalenos et al. 2008[6]).

Paths of Hurricanes Katrina and Rita Relative to Oil and Gas Production Facilities

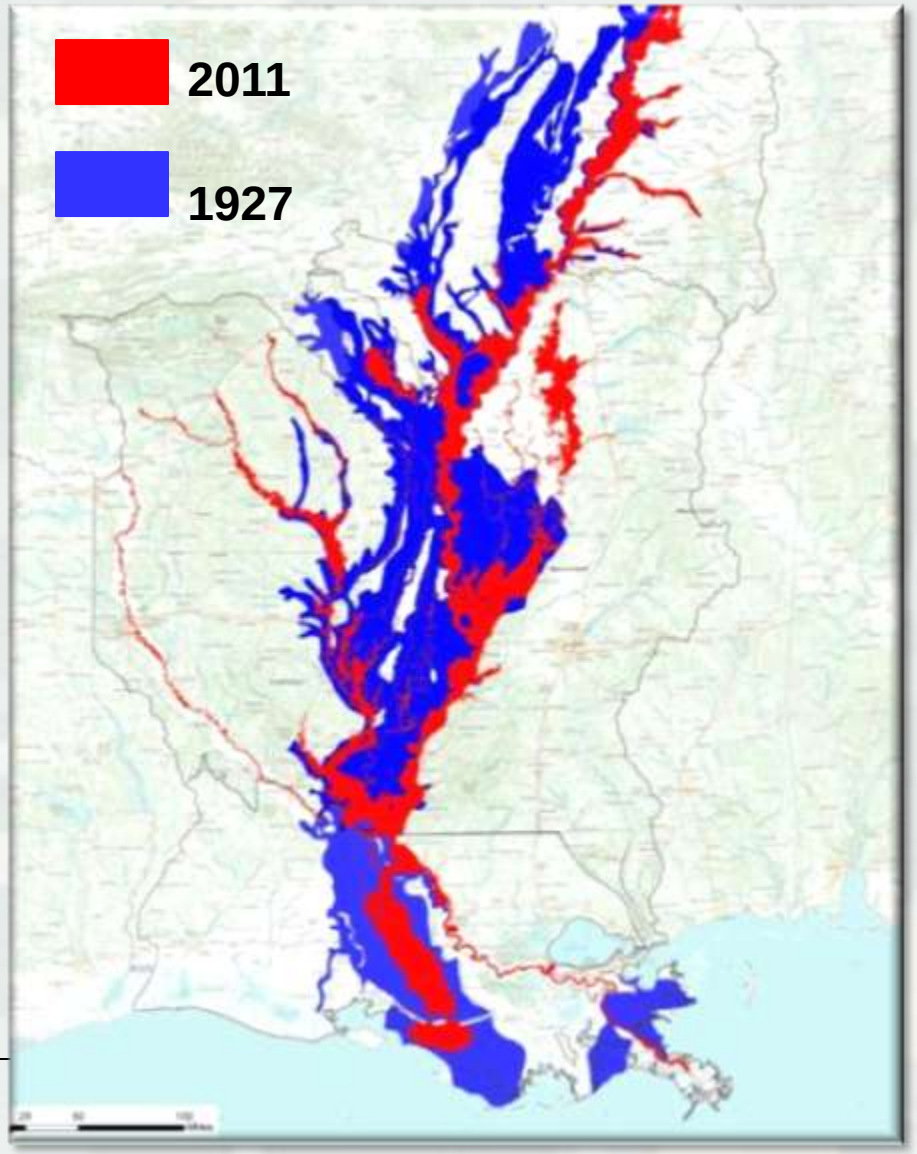


A substantial portion of U.S. energy facilities are located on the Gulf Coast as well as offshore in the Gulf of Mexico, where they are particularly vulnerable to hurricanes and other storms and sea level rise. (Figure source: U.S. Government Accountability Office 2006[4]).

Climate Change Impacts in the United States: Highlights, U.S. Global Change Research Program, p. 89, http://nca2014.globalchange.gov/highlights

1927 vs. 2011 Mississippi River Record Flood:
From "Levees Only" to "Room for the River"

- 1927 Flood = 16.8 million acres
- 2011 Flood = 6.4 million acres
- $14 billion Investment since 1928
- $234 billion damages prevented (2011)
  - ✓ $612 billion since 1928
  - ✓ 44 to 1 return on investment
- Over 4 million people protected
- $3 billion annual transportation rate savings
- Untold economic productivity enabled for farms, towns, factories



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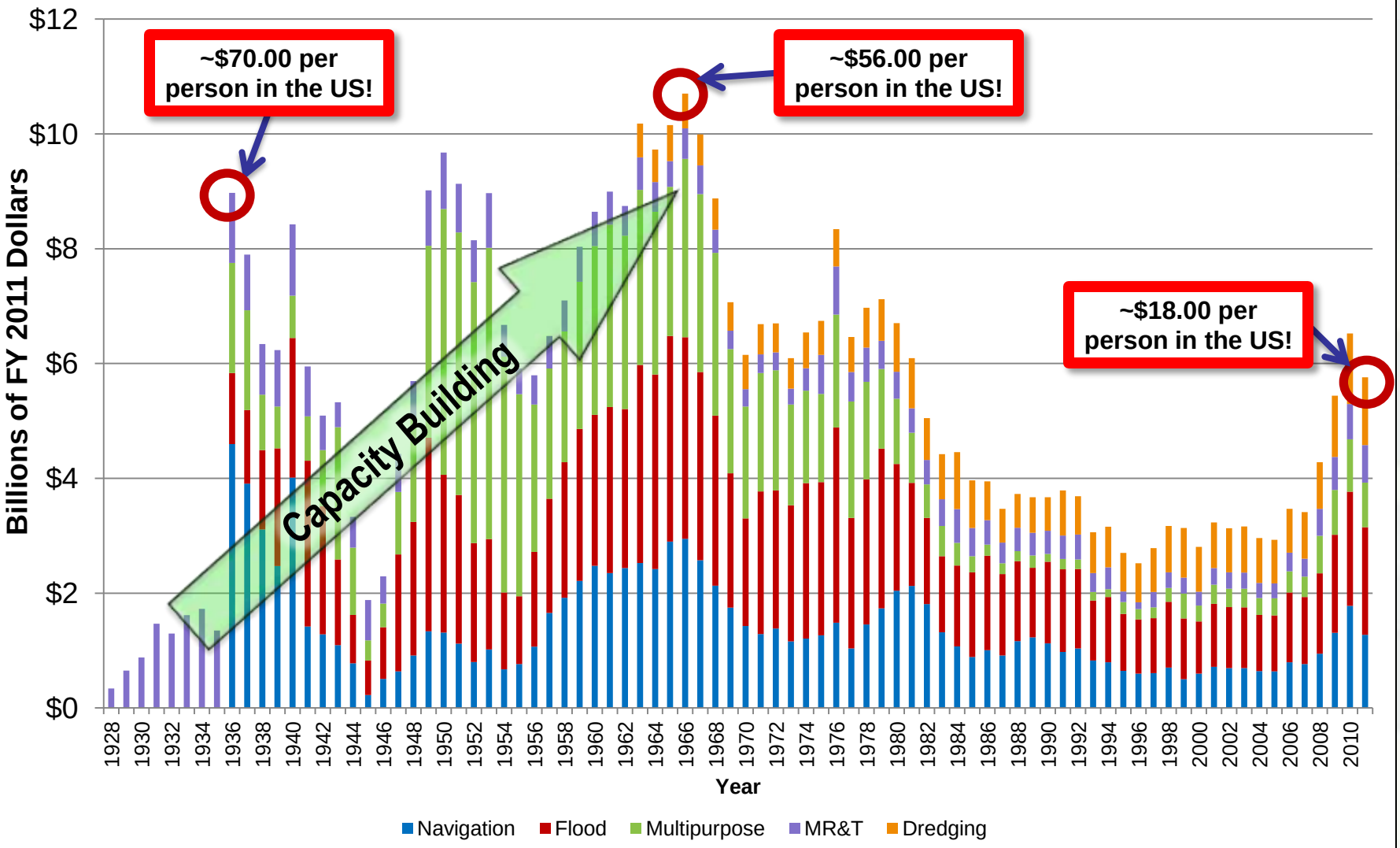
The Bottom Line:

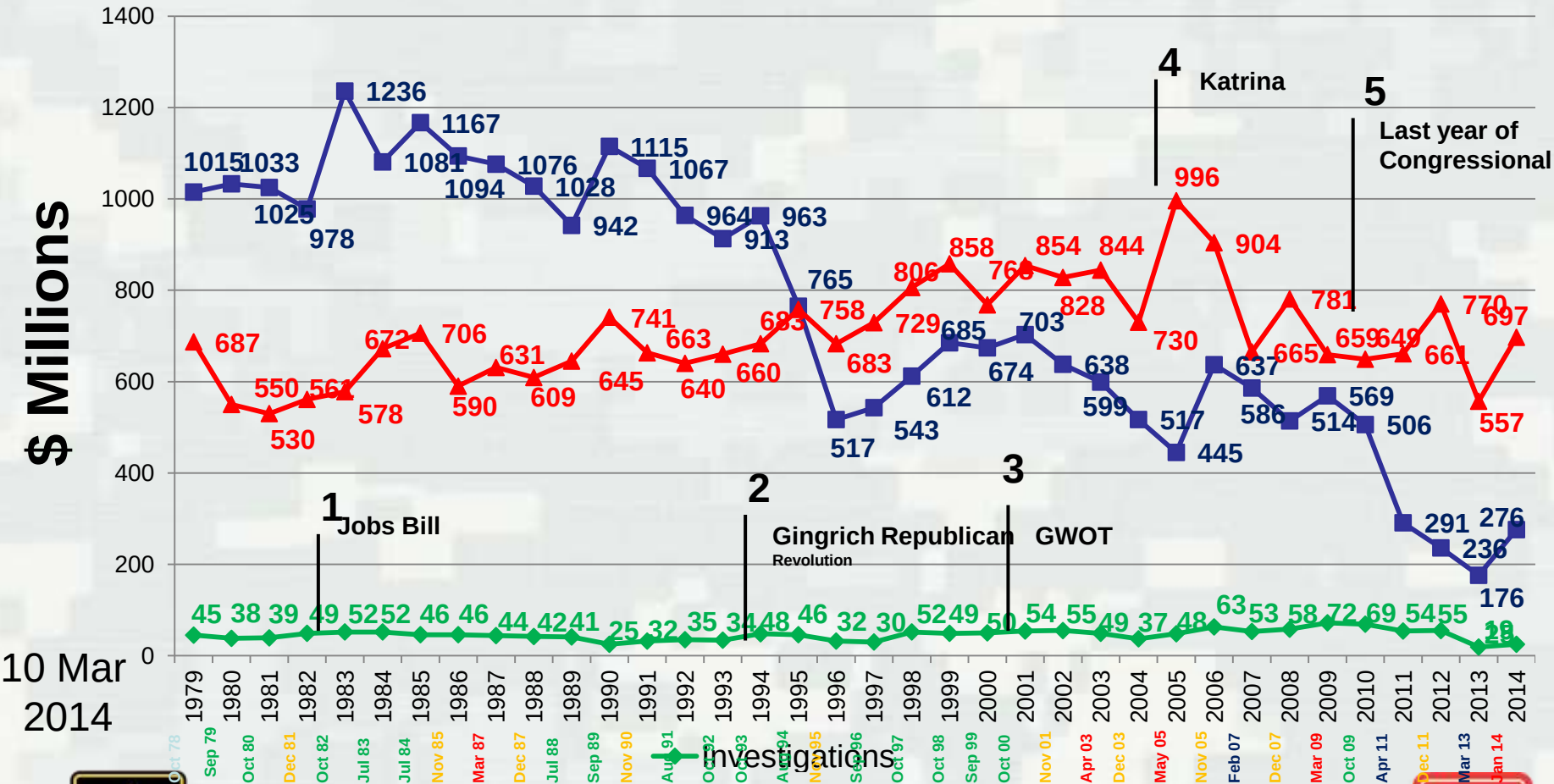
- **Our infrastructure makes delivery of domestic stability and security possible!**
- Our infrastructure is degrading
- Our infrastructure is underperforming
- The US is under-investing in its infrastructure
- The US significantly lags other developed nations in its maintenance of prior investments.
- We stand to lose hard-fought ground earned by prior generations through their financial and personal sacrifices.
- Our economic prosperity, standard of living, and environmental quality are at risk.
- Our infrastructure is NOT disposable and should not be treated as such

<u>The United States is on an unsustainable glide-path!</u>

Historical Investments by USACE Functional Category 1928 to 2011



MVD Civil Works Funding Trend Comparison
Investigations, Construction and O&M
(Constant 2013 $'s)



10 Mar 2014

Appropriation Bills

Green = Oct or before

Amber = Nov-Dec

Red = Jan or after

Blue = Year-long CR

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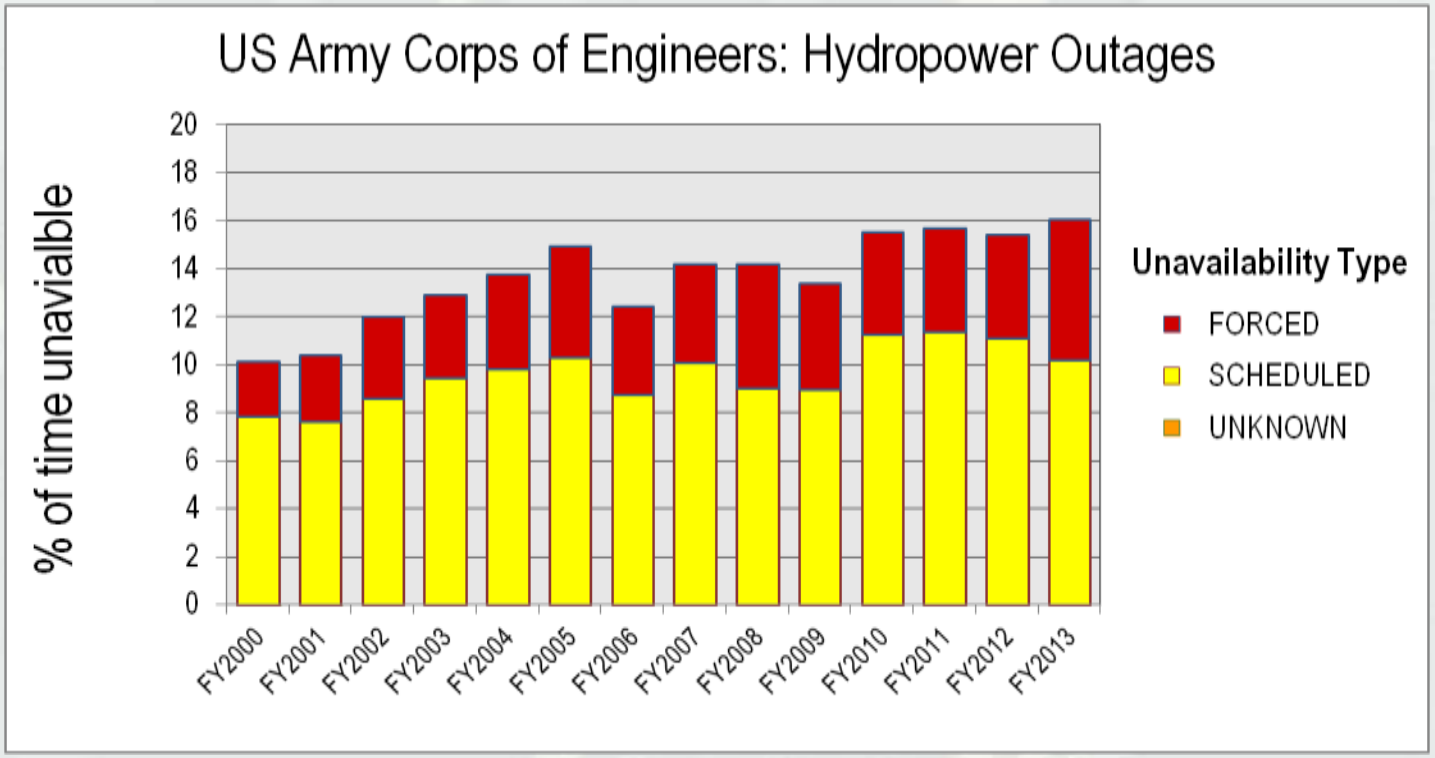
< Markland main chamber gate collapsed into river

Greenup main chamber gate dropped when anchor point failed >

< Monitoring of decaying sidewalls of John Day lock

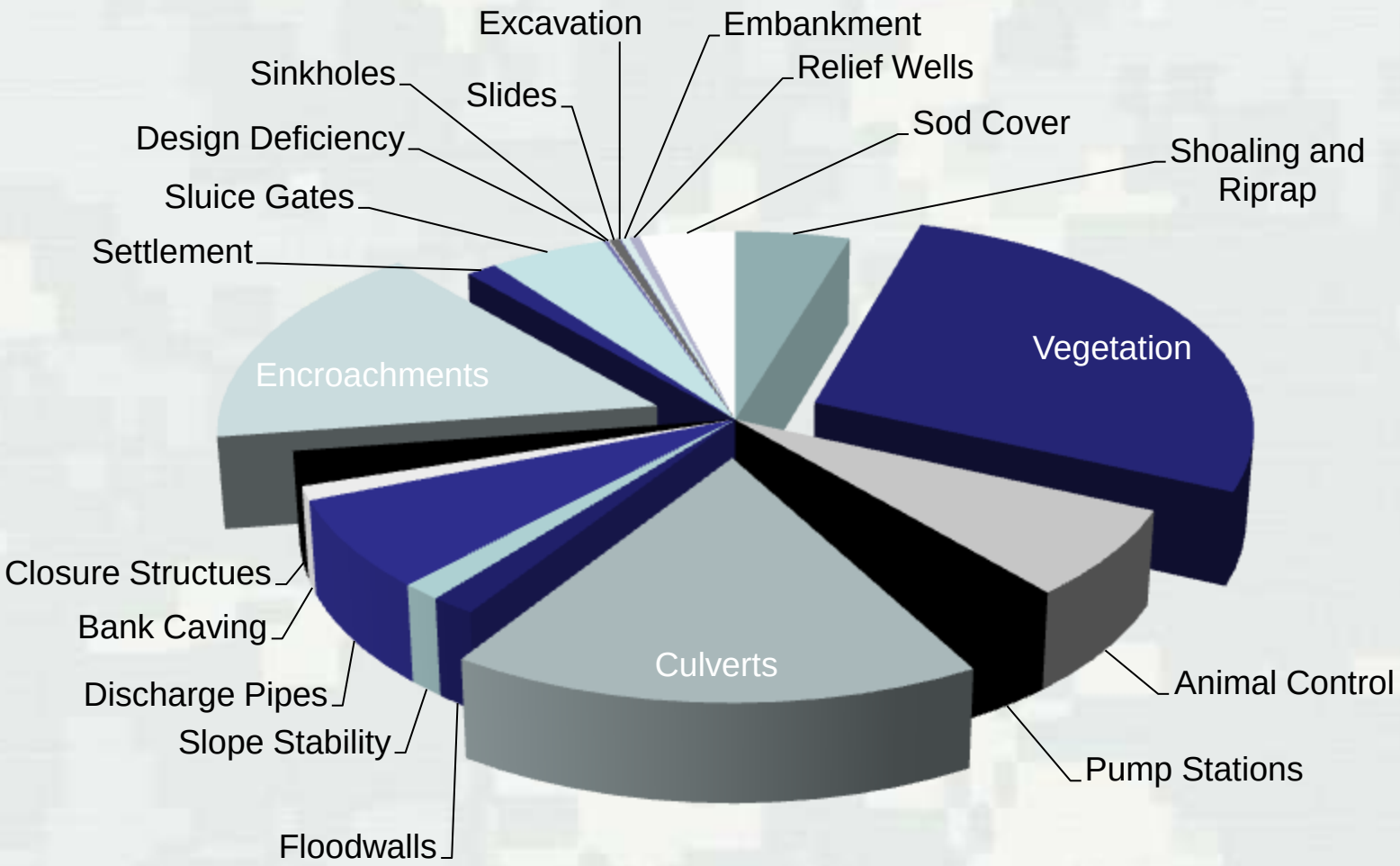
Effects of Decreased Investment



Since 2000:

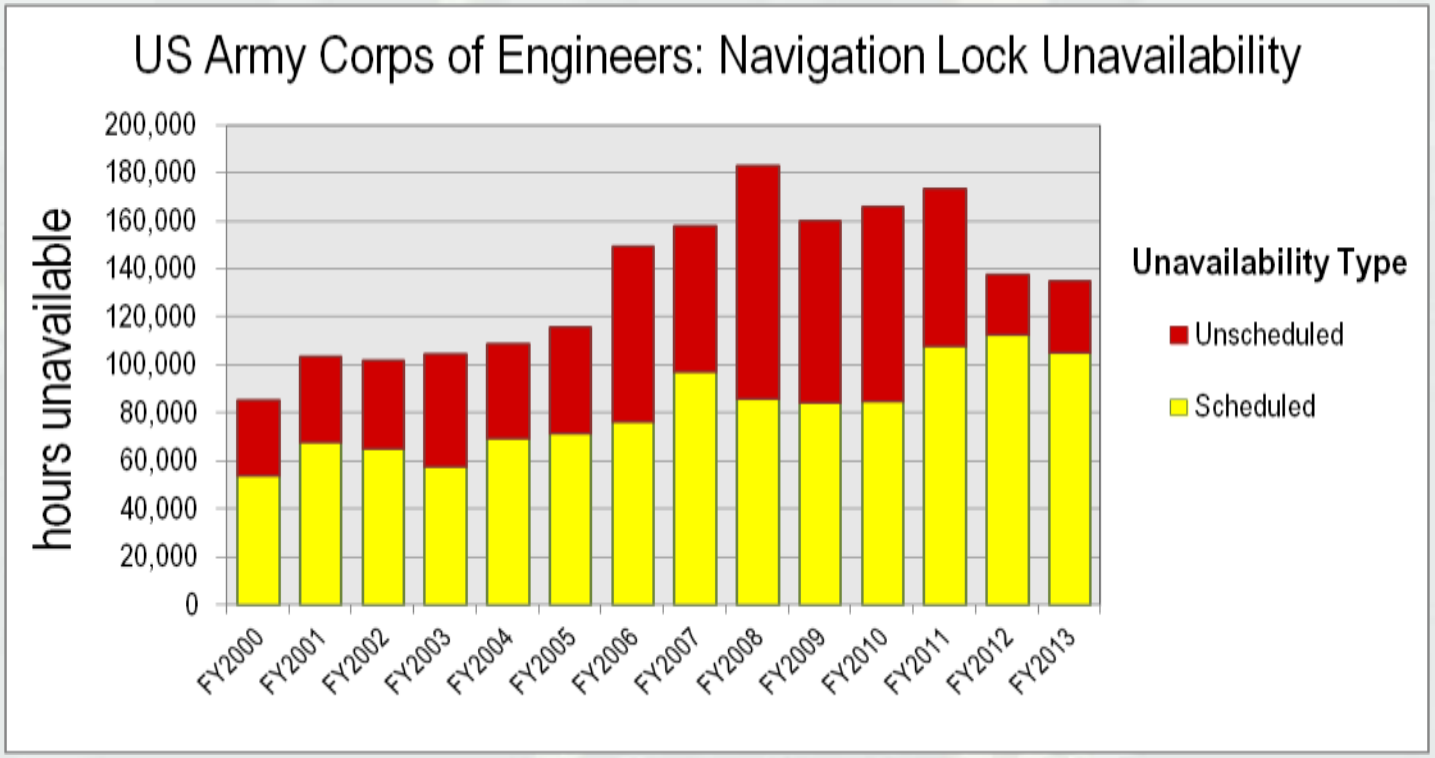
- **~50% increase in down time**
- **<u>Threefold</u> increase in forced outages!**

Effects of Decreased Investment



Issues facing levee systems across the nation.

Effects of Decreased Investment



Since 2000:

- **~50% decrease in availability**
- **Twofold increase in scheduled outages!**

Recent Major Lock Outages

Marseilles Miter Gate
Mar 2013
Closed 7 Days

Marseilles Miter Gate Machinery
Closed - Feb 8-10 2014

Lockport Wall Collapse
Oct 2011
Closed 4 days

Mel Price Main Chamber
Liftgate Cables
Closed - 28 Dec 2013

Marseilles
April 2013
Dam Allision

La Grange
Closed
10 - 16 Jan 2014
Gate Allision

Locks 27 Protection Cell
Sep 2012
Closed 6 days
$16m in Transportation impacts

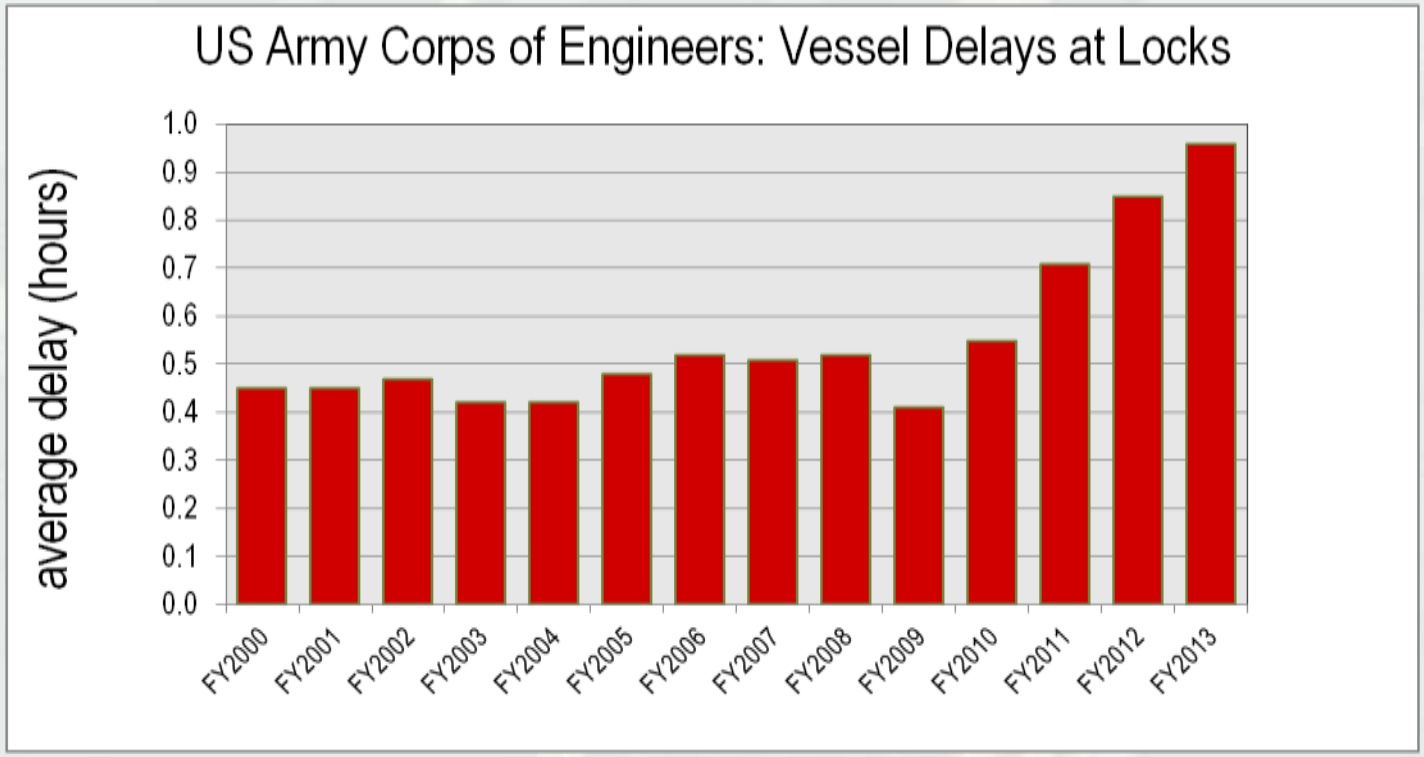
IHNC
Closed
4 - 14 Jan 2014
Queue 86+

Red River - Lock 2
Strut Arm Bushing Failure
April 2012
Closed 15 days

Harvey
Gate Machinery
Closed- 15 -18 Feb 2013

Algiers
27 Mar – 18Jul 2013
Closed 112 Days
$146m in transportation impacts

Effects of Decreased Investment

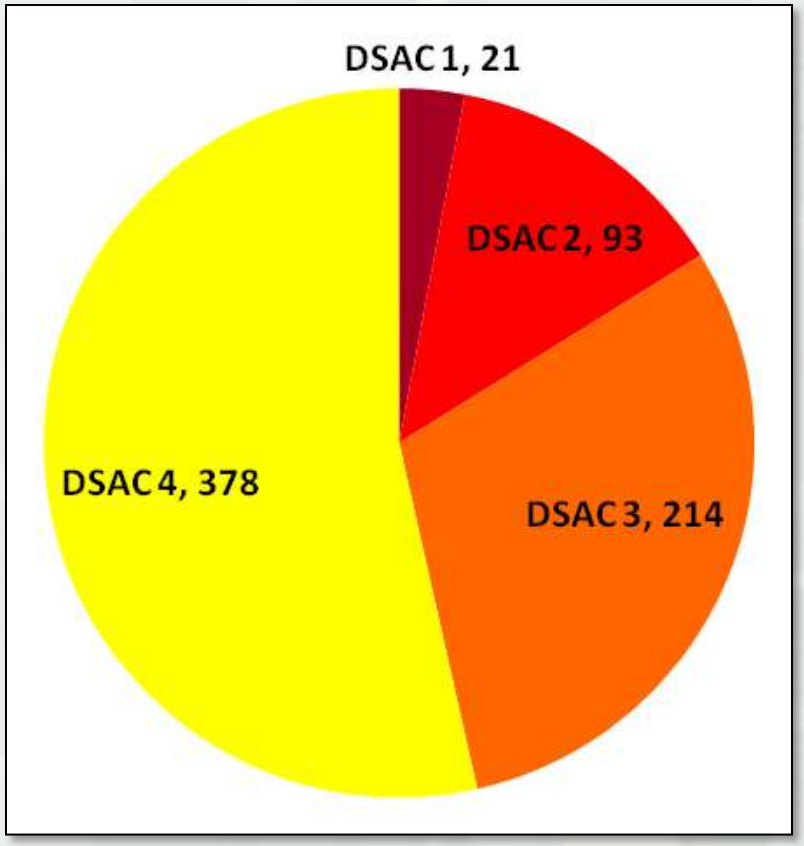


Since 2000:

- **more than a <u>doubling</u> in delays!**

These are actual delays experienced by vessels!

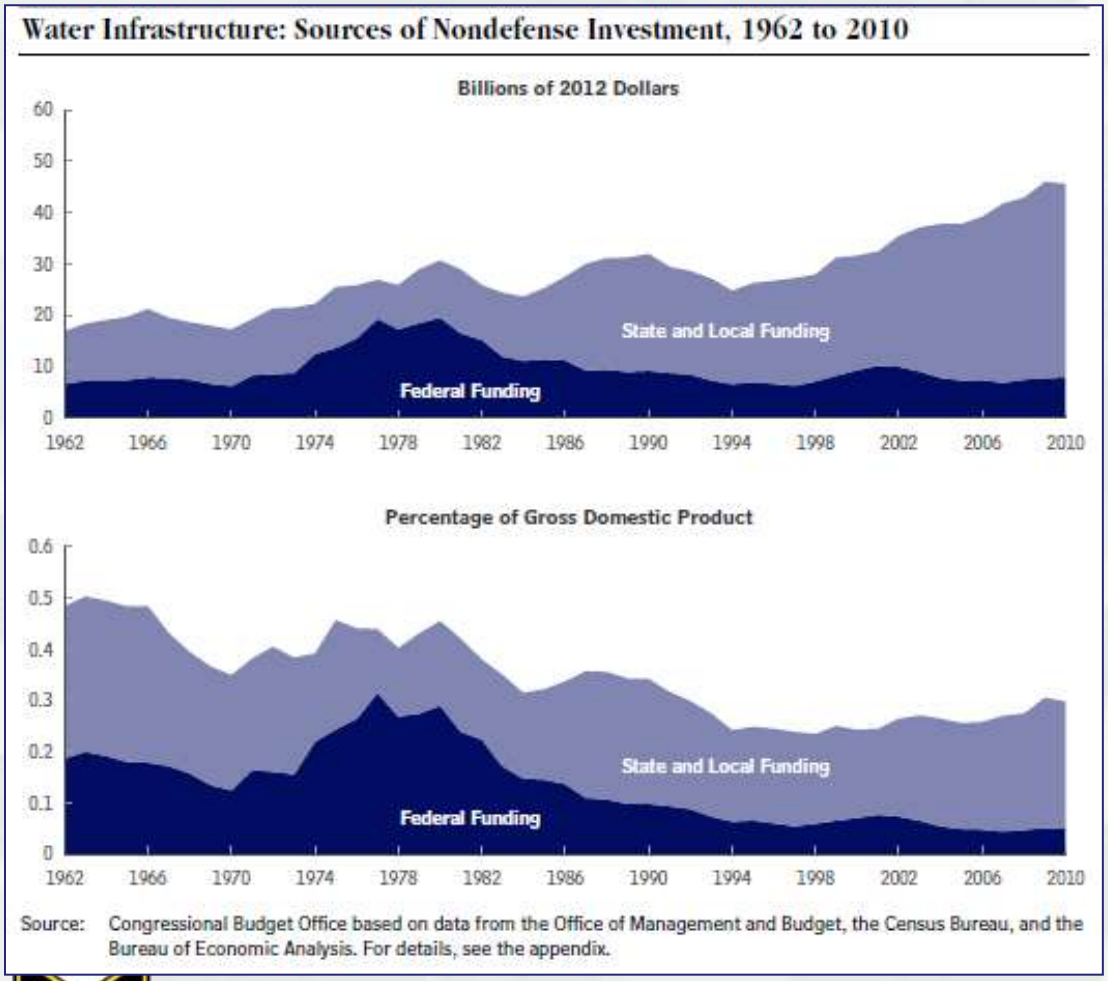
Effects of Decreased Investment



- 707 dams at 557 projects
- DSAC chart includes all USACE dams except one newly constructed dam that has not been assigned a DSAC value.
- Data source: DSPMT, 16 Oct 2013

USACE Dam Safety Action Classifications

Water Infrastructure Spending

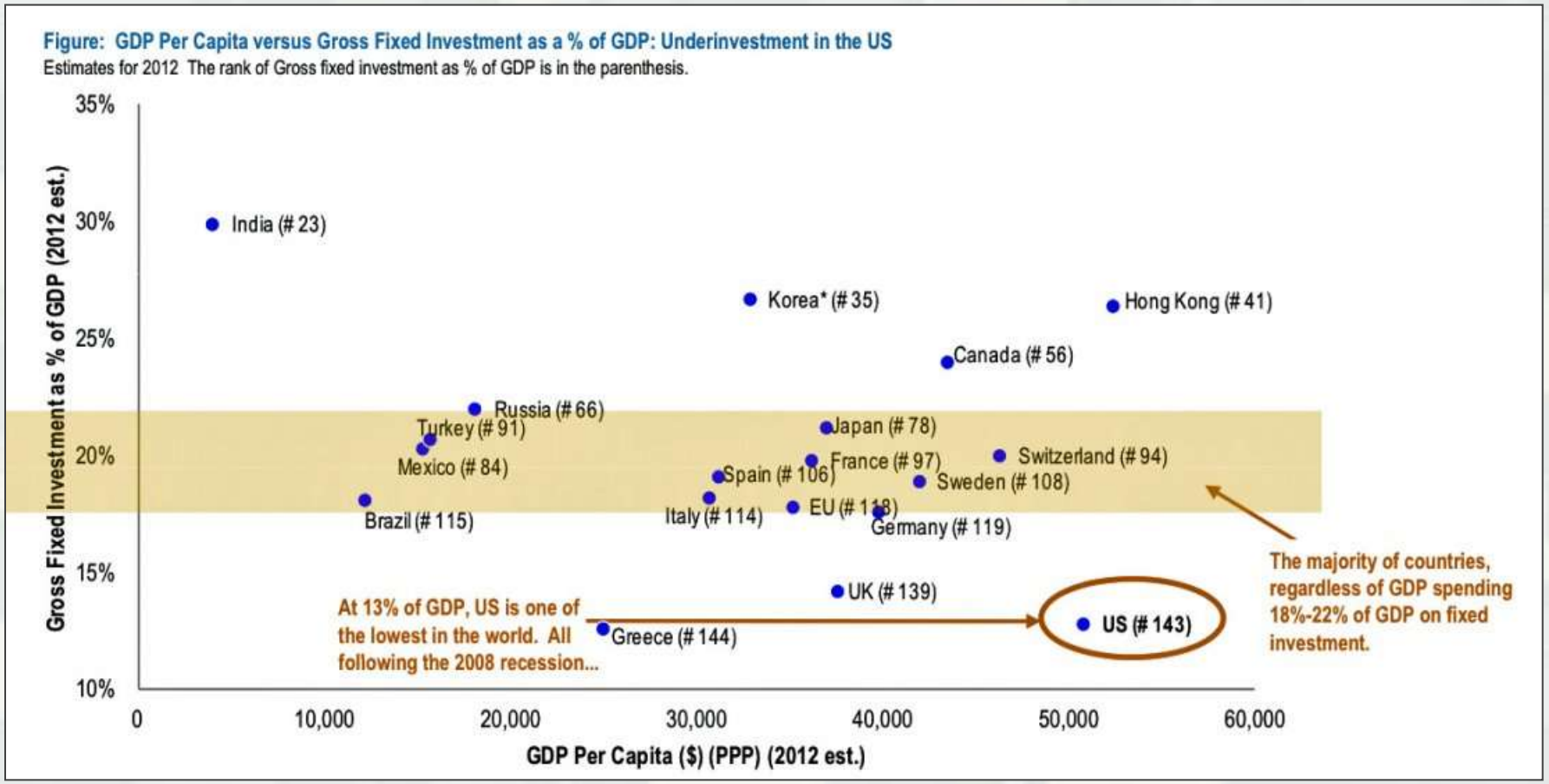


Between 1962 to 2010…

Total funding increased
% GDP decreased

Greater burden on state and local funding sources as infrastructure ages.

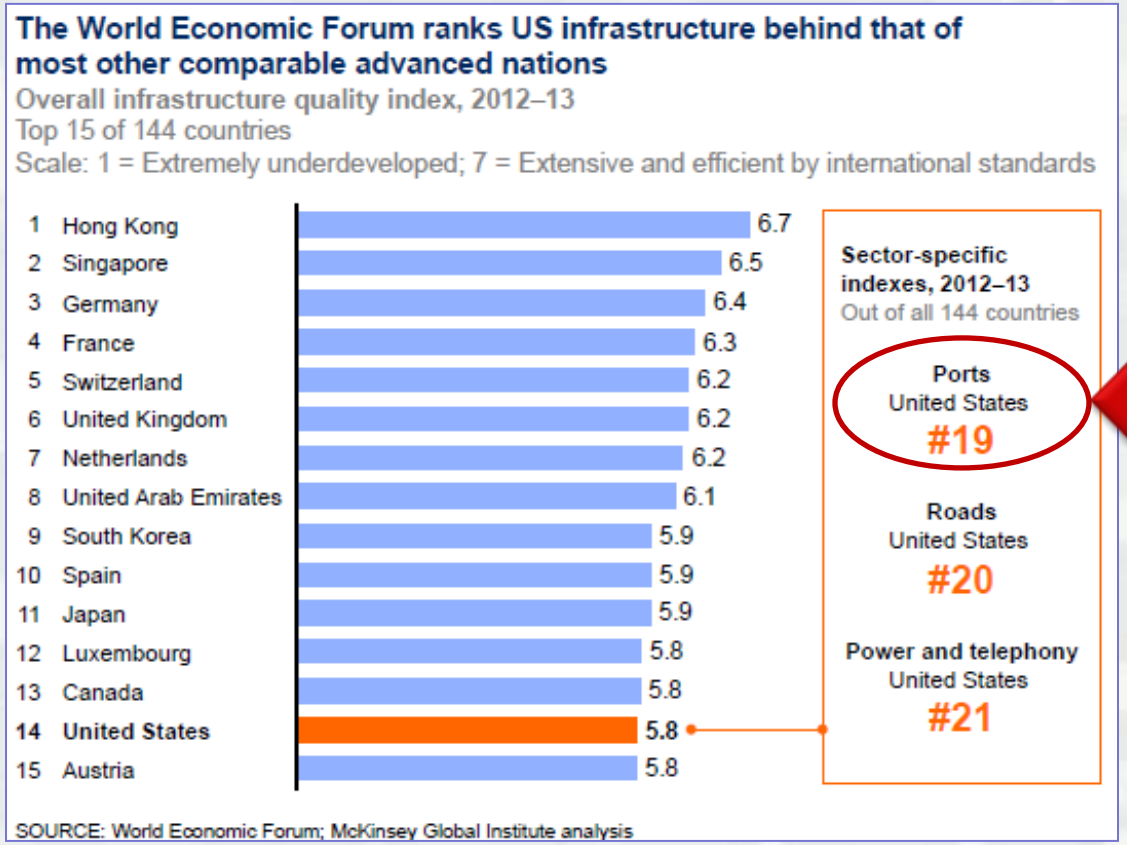
United States Relative to Other Nations



Low investment in infrastructure!

(equivalent to Greece)

Relative Quality of US Infrastructure



Not even among the top 15!

2013 Report Card for America's Infrastructure

by the American Society of Civil Engineers

D+

America's Cumulative G.P.A.

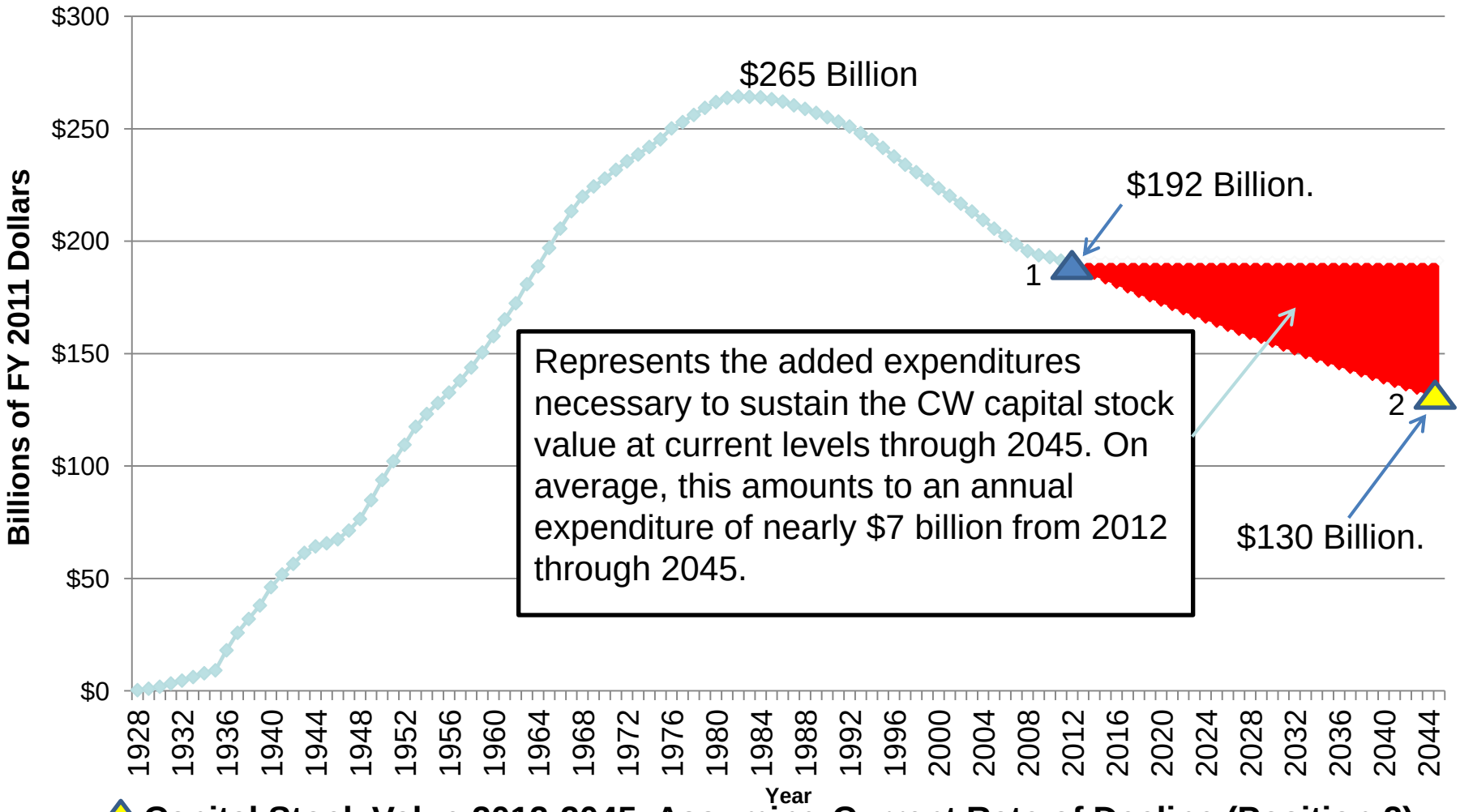
Aviation	**D**	**Ports**	**C**
Bridges	**C+**	**Public Parks & Recreation**	**C-**
Dams	**D**	**Rail**	**C+**
Drinking Water	**D**	**Roads**	**D**
Energy	**D+**	**Schools**	**D**
Hazardous Waste	**D**	**Solid Waste**	**B-**
Inland Waterways	**D-**	**Transit**	**D**
Levees	**D-**	**Wastewater**	**D**

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

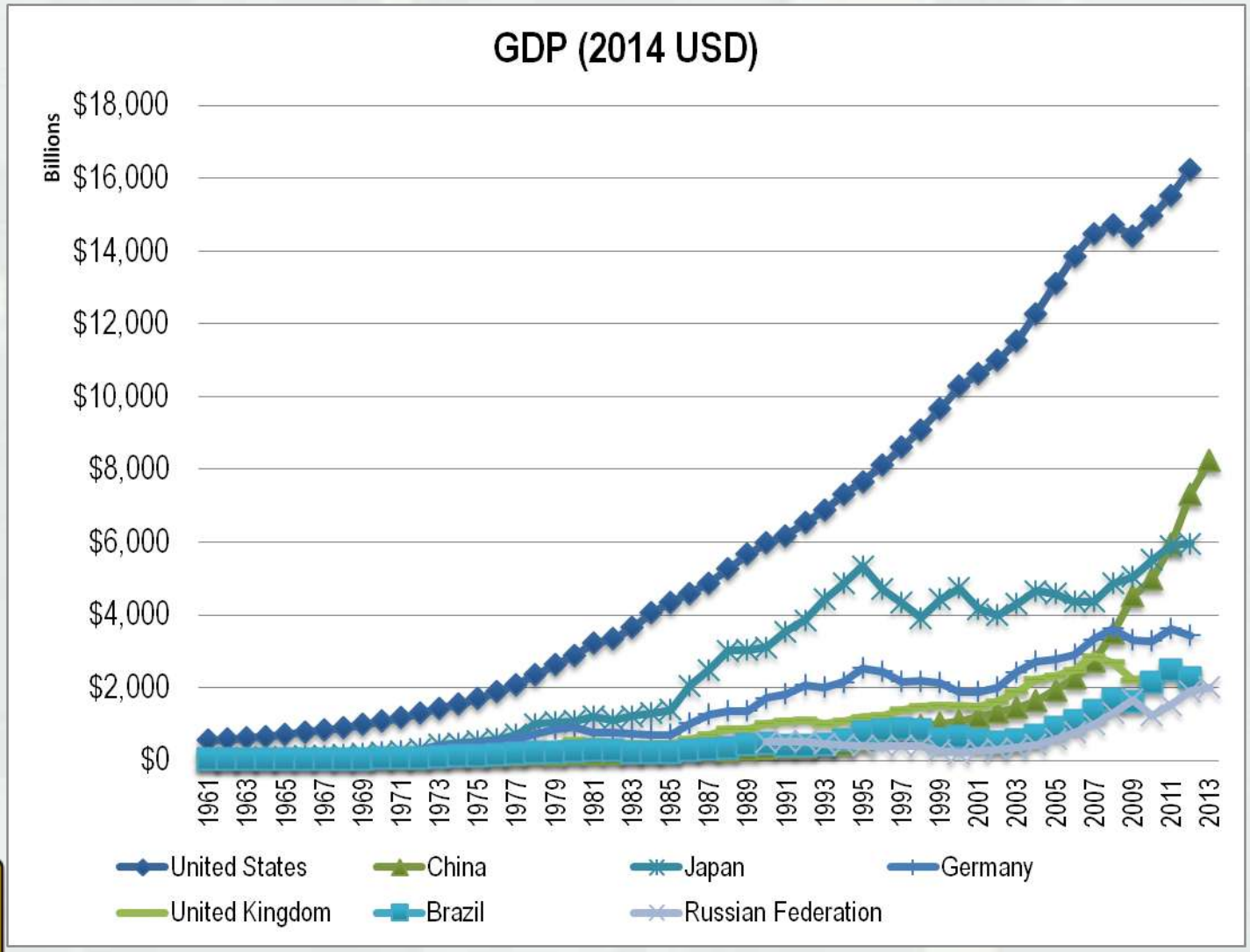
Estimated investment needed by 2020 =

$3.6 trillion

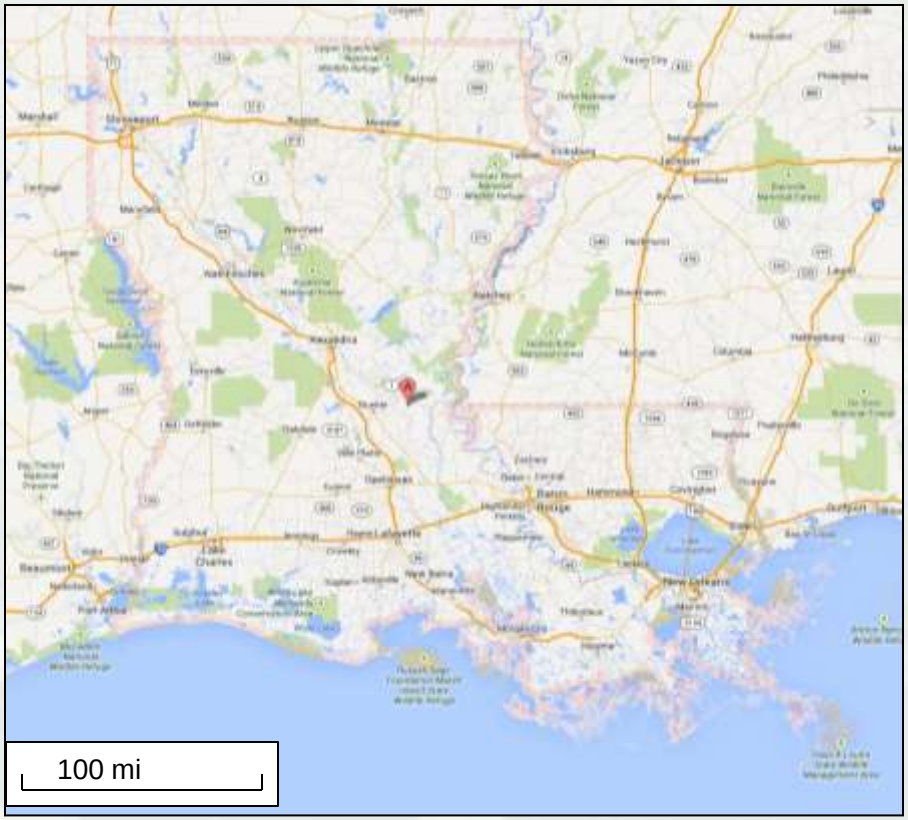
USACE Capital Stock Value, 1928 to 2011 & Trends Based on Investment Levels Reflecting a Continuation of the 1982-2011 Decline versus Sustainment of 2011 Capital Stock Value



Comparison of Gross Domestic Product

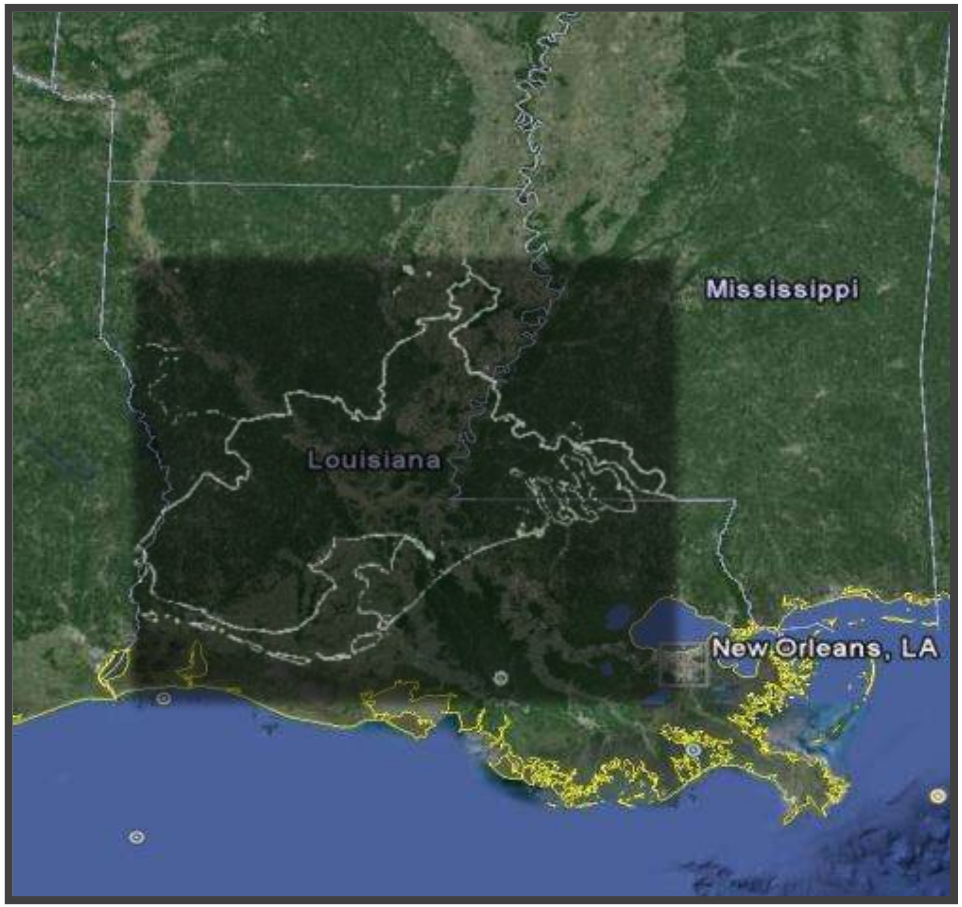


Louisiana vs. The Netherlands



	United States	Louisiana	The Netherlands
Coastline:	5,525 miles	397 miles	280 miles
Land Mass:	3,531,905 sq miles	43,203 sq. miles	13,086 sq. miles
GDP (2012):	13,430B	$198.5B	$772.2B
Population:	313.9M	4.6M	16.8M

Louisiana v. Netherlands



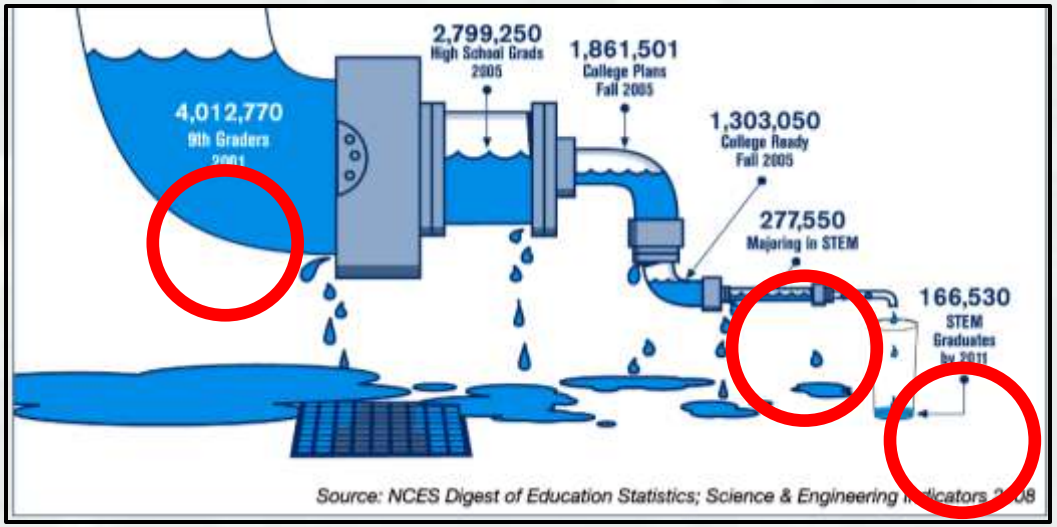
	United States	Louisiana	The Netherlands
Coastline:	5,525 miles[1]	397 miles[1]	280 miles[2]
Land Mass:	3,531,905 sq miles[3]	43,203 sq. miles[3]	13,086 sq. miles[4]
GDP (2012):	13,430B[5]	$198.5B[5]	$772.2B[6]
Population:	313.9M[3]	4.6M[3]	16.8M[7]

Conclusion

- Our infrastructure makes delivery of domestic stability and security possible.
- We are losing hard-fought ground earned by prior generations through their financial and personal sacrifices.
- Our economic prosperity, standard of living, and environmental quality are increasingly vulnerable to threats posed by aging infrastructure and increase potential for failure.
- We have benefitted from the investments of our forefathers but have done little to assure this heritage will be passed on to future generations.
- Our sense of resolve to secure a sound economic and environmental footing for future generations should be no less than that of those who sacrificed to provide us with the same.
- **Our glide path is unconscionable.**

10:1 return on investment… we should aim to do better.

USACE – A Leader in STEM



4,012,770 9th Graders in 2001 in the USA

70% graduated high school in 2005

32.4% college ready in 2005

6% choose a STEM Major

4% earn STEM Degree (166,530 grads)

China: **1.9M** "Engineer" graduates
763K received an **equivalent*** degree
10% globally employable
= **76,400 globally employable grads**

India: **793K** "Engineer" graduates
497K received an **equivalent*** degree
25% globally employable
= **124,400 globally employable grads**

USA: **166K** STEM graduates
166K received an **accredited** degree
81% globally employable
= **134,460 globally employable grads**

- **China and India have no standard definition of the word "Engineer" (includes auto mechanics, IT Specialists, varies based on needs of the government)**
- **"Quantity instead of Quality" Program Goals in both India and China**
- **In China and India, if you've taken ONE STEM related class, you're counted as an 'Engineer' in education**
- **The Chinese Government is notorious for inflating statistics to compete with global leaders (i.e. manufacturing, GDP) The Indian Government is more realistic, but not by much**

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*In China and India, equivalent degree compared to USA accredited institutions

Nothing is As Easy As It Looks or Sounds

Questions

BACKGROUND

Tonnage on Domestic Waterway Network

Compare...

Iowa Department of Transportation

Source: Iowa Department of Transportation · 800 Lincoln Way · Ames, IA 50010 · 515-239-1520

Cargo Capacity

ONE BARGE
1,500 TON
52,500 BUSHELS
453,600 GALLONS

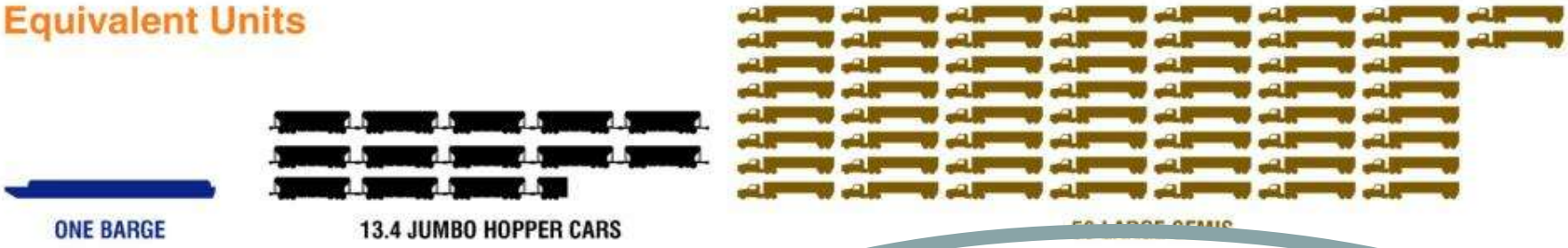
ONE 15 BARGE TOW
22,500 TON
787,500 BUSHELS
6,804,000 GALLONS

ONE JUMBO HOPPER CAR
112 TON
4,000 BUSHELS
33,870 GALLONS

ONE 100 CAR TRAIN
11,200 TON
400,000 BUSHELS
3,387,000 GALLONS

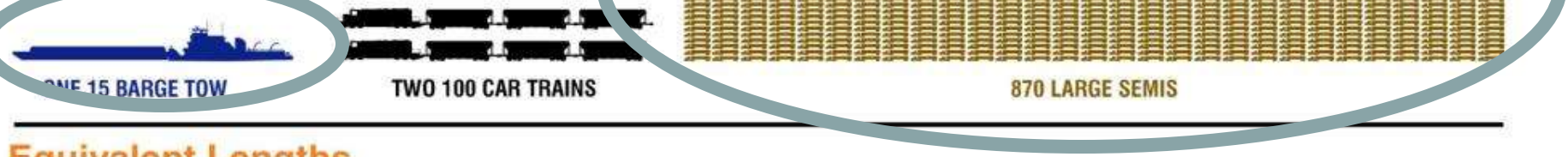
ONE LARGE SEMI
26 TON
910 BUSHELS
7,865 GALLONS

Equivalent Units



ONE BARGE

13.4 JUMBO HOPPER CARS



ONE 15 BARGE TOW

TWO 100 CAR TRAINS

870 LARGE SEMIS

Equivalent Lengths

ONE 15 BARGE TOW
.25 MILE

TWO 100 CAR TRAINS
2.4 MILES

870 LARGE SEMIS
11.5 MILES
(BUMPER TO BUMPER)

One 15 barge tow takes 870 large semi truck off of our highways!

PM 444 3-6-08

America's Watershed: a 200-year working vision

An Intergenerational Commitment

The Mississippi watershed is 41% of the US, 31 States, 1.25 million square miles, over 250 tributaries

Our people enjoy a quality of life unmatched in the world. We ...

- Lead secure lives along the river or tributary.
- Enjoy fresh air and the surrounding fauna, flora and forests while hunting, fishing and recreating.
- Travel easily, safely and affordably.
- Drink from and use the abundant waters of any river, stream or aquifer.
- Choose from an abundance of affordable basic goods and essential supplies that are grown, manufactured and transported along and by the river to local and world markets.

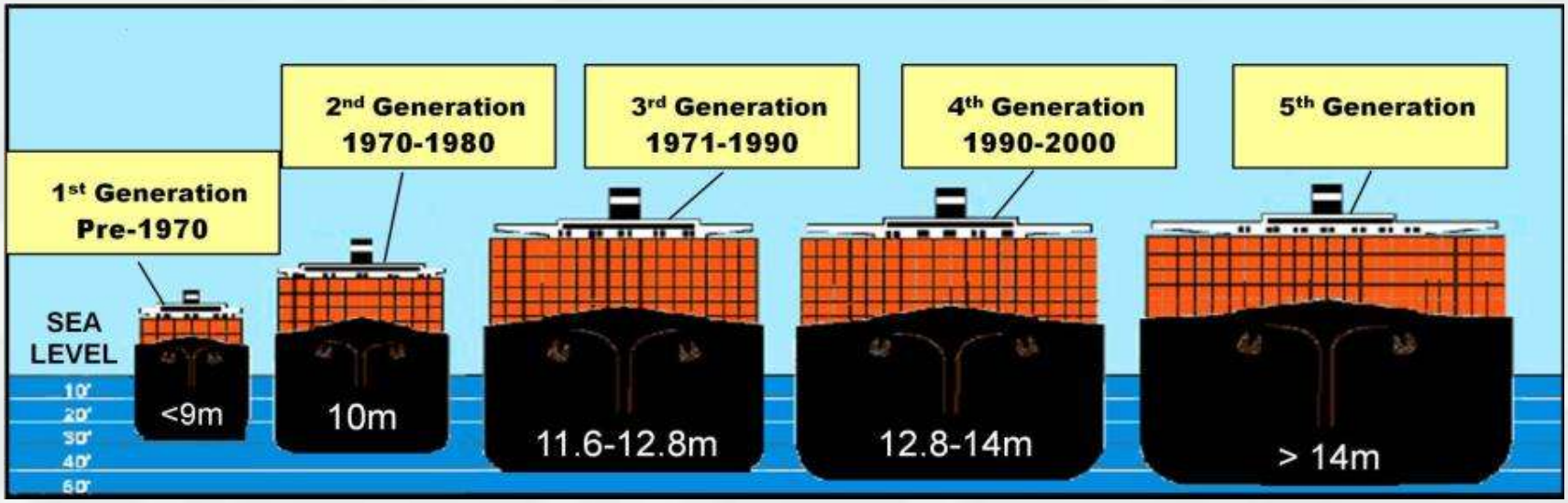
Balancing the nation's needs for:

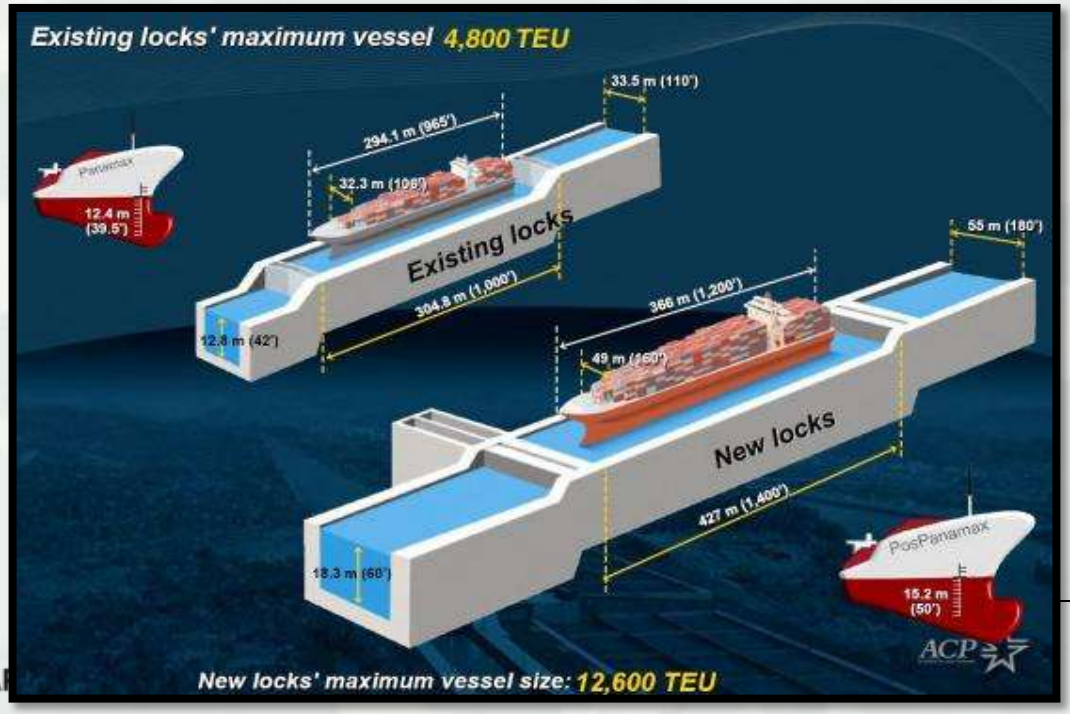
- National security & flood protection &management
- Environmental sustainability & recreation
- Infrastructure & energy
- Water supply & water quality
- Movement of goods; agriculture & manufacturing

join the dialogue ...
visit *www.mvd.usace.army.mil/mrc*
or email ***cemvd-ex@usace.army.mil***

Leveraging local citizens' input, international dialogue, science, engineering, technology and public policy

We Can't Wait

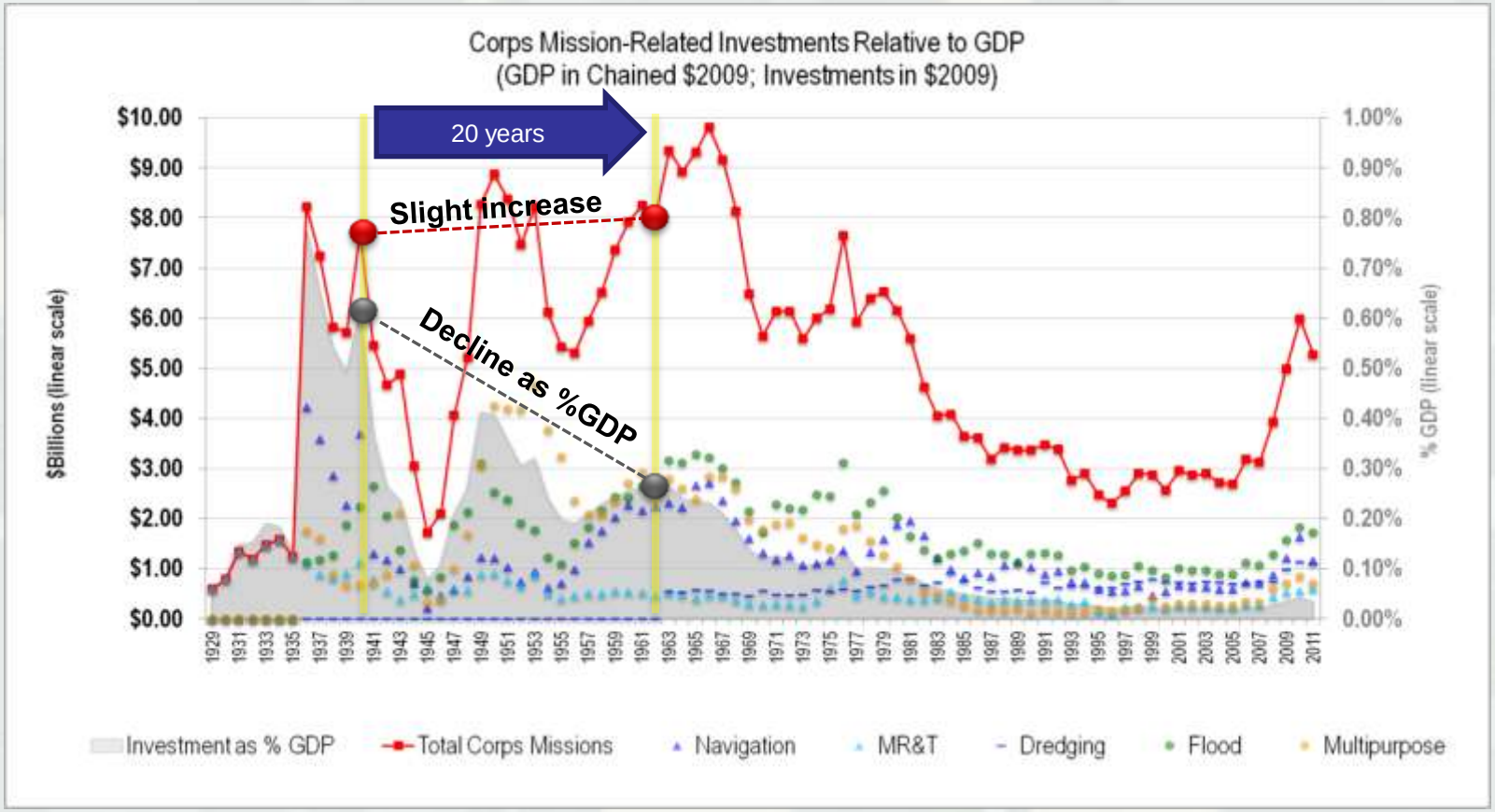




Advancing 7 key infrastructure projects at 5 East Coast ports:

- NY / NJ
- Charleston
- Savannah
- Jacksonville
- Miami

Corps Mission-Related Investments

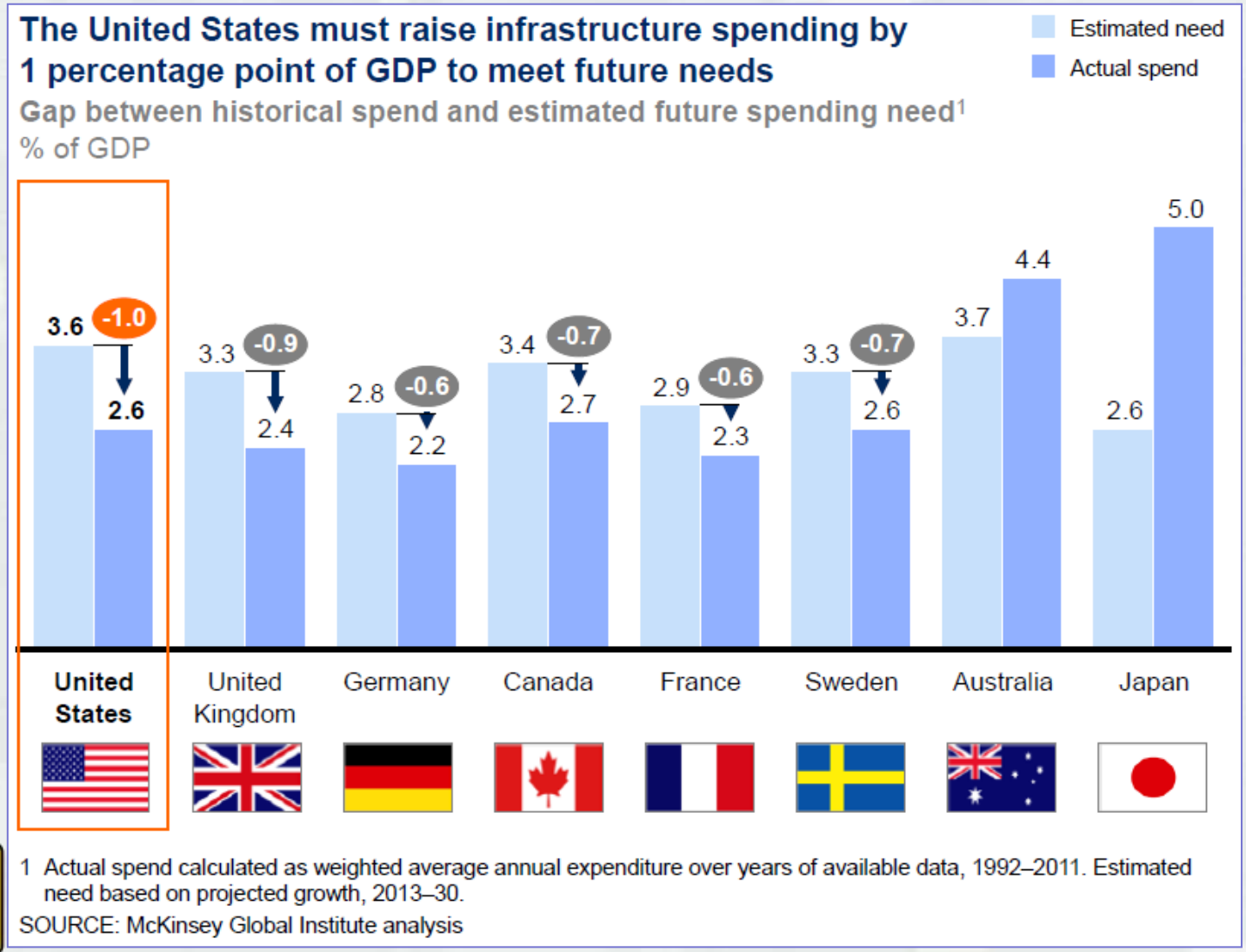


More than a tenfold increase in GDP since 1928!

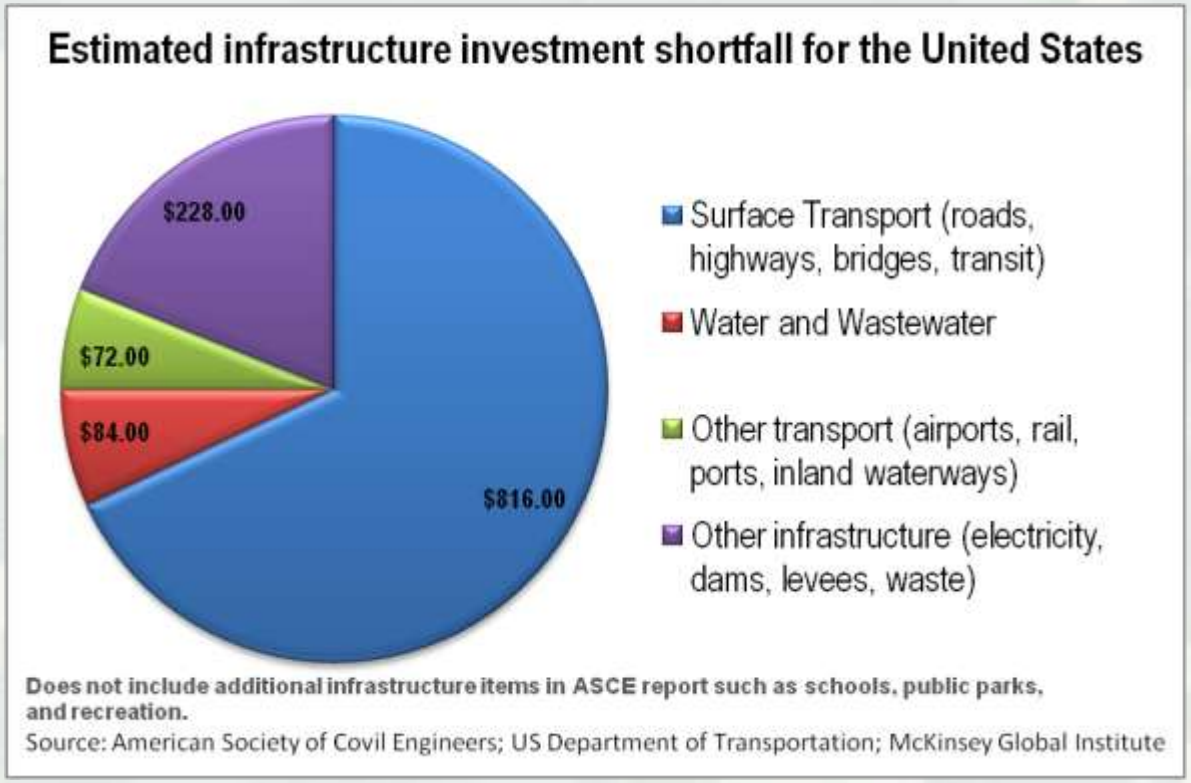
Similar level of investment will not keep pace with GDP.

Decreasing levels of investment magnify the effect.

Patterns in Global Spending in Infrastructure



Distribution of US Infrastructure Investment Shortfall by 2020



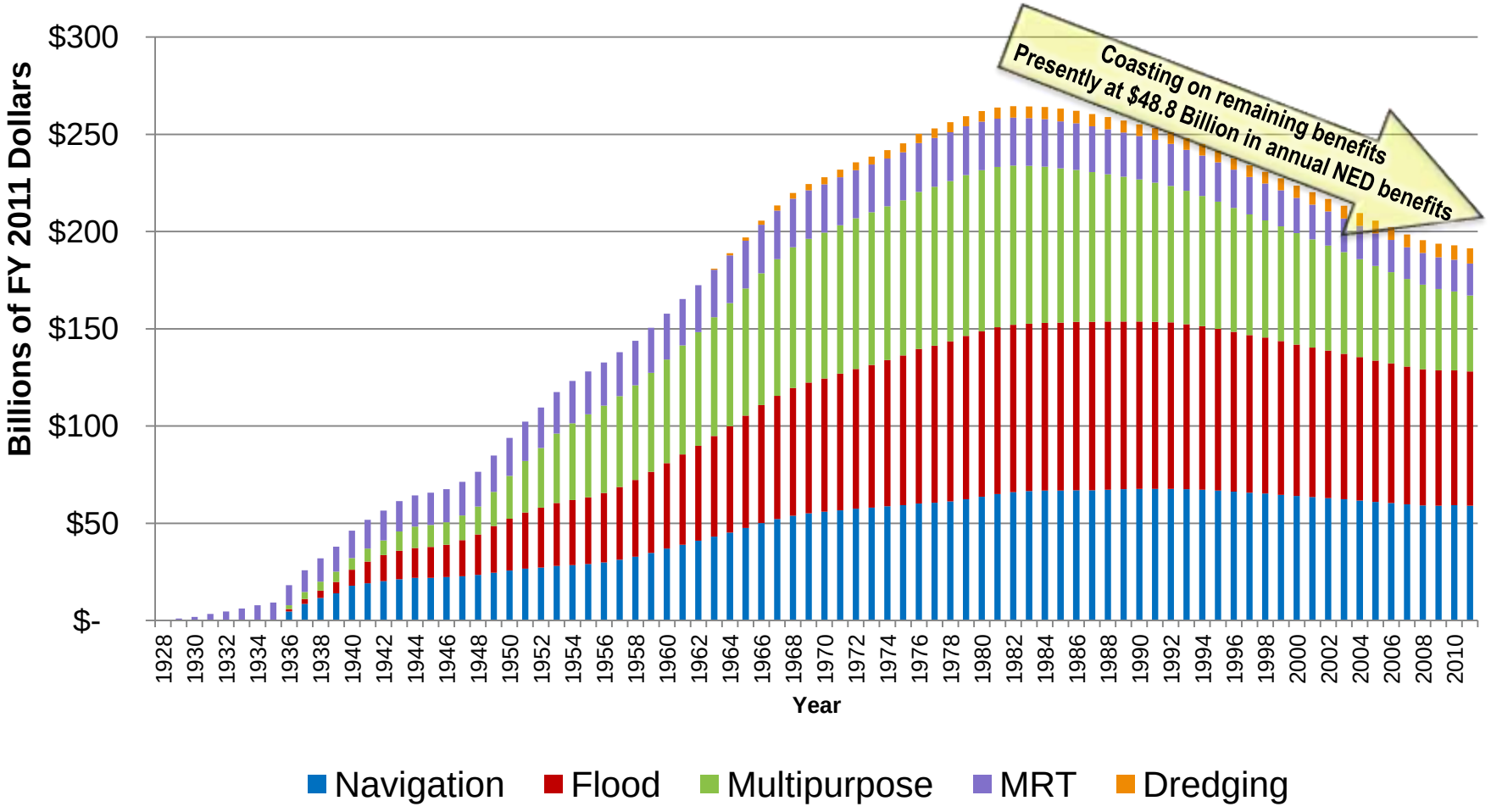
32% of the shortfall ($372B) involves infrastructure associated with Corps authorities!

- Water
- Ports
- Waterways
- Levees
- Dams
- Power generation

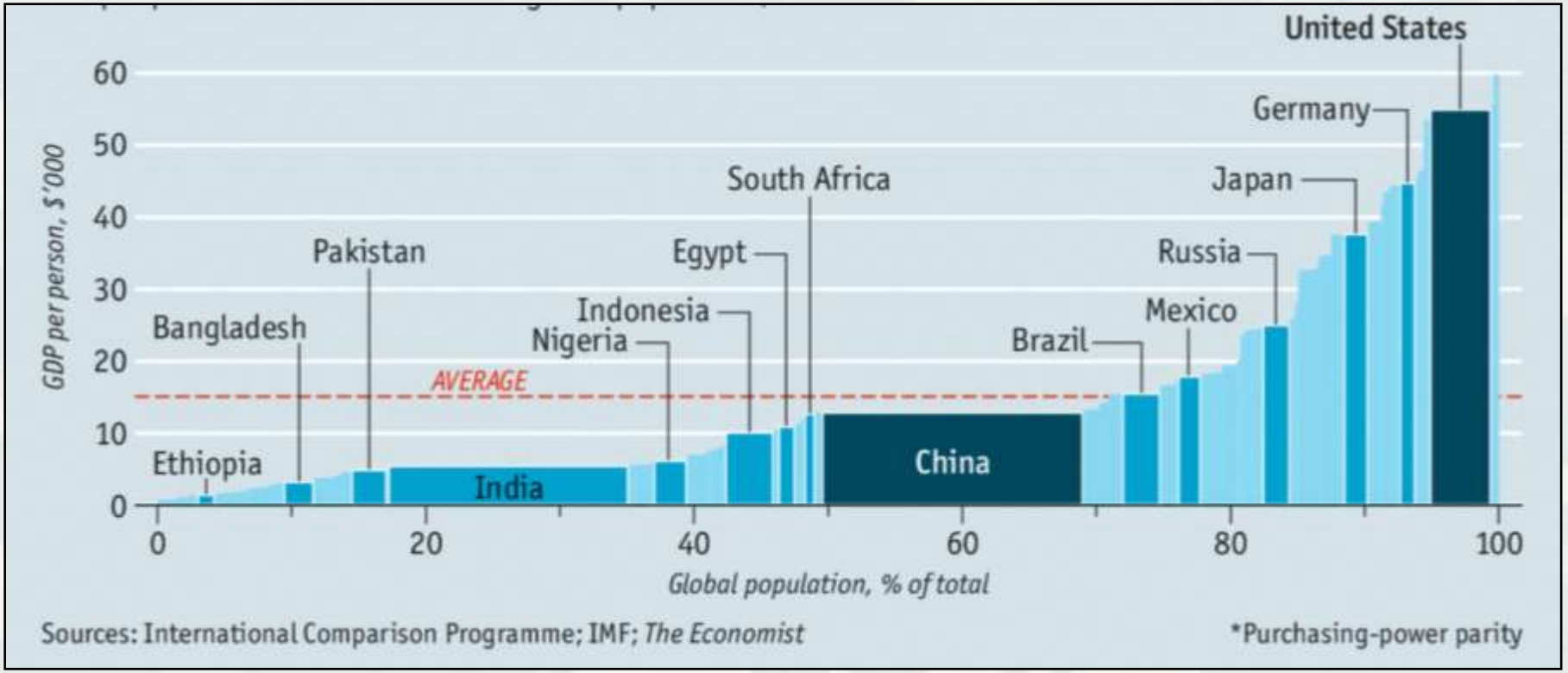
Approximately $200.00 per person per year

(the equivalent of one latte per week)

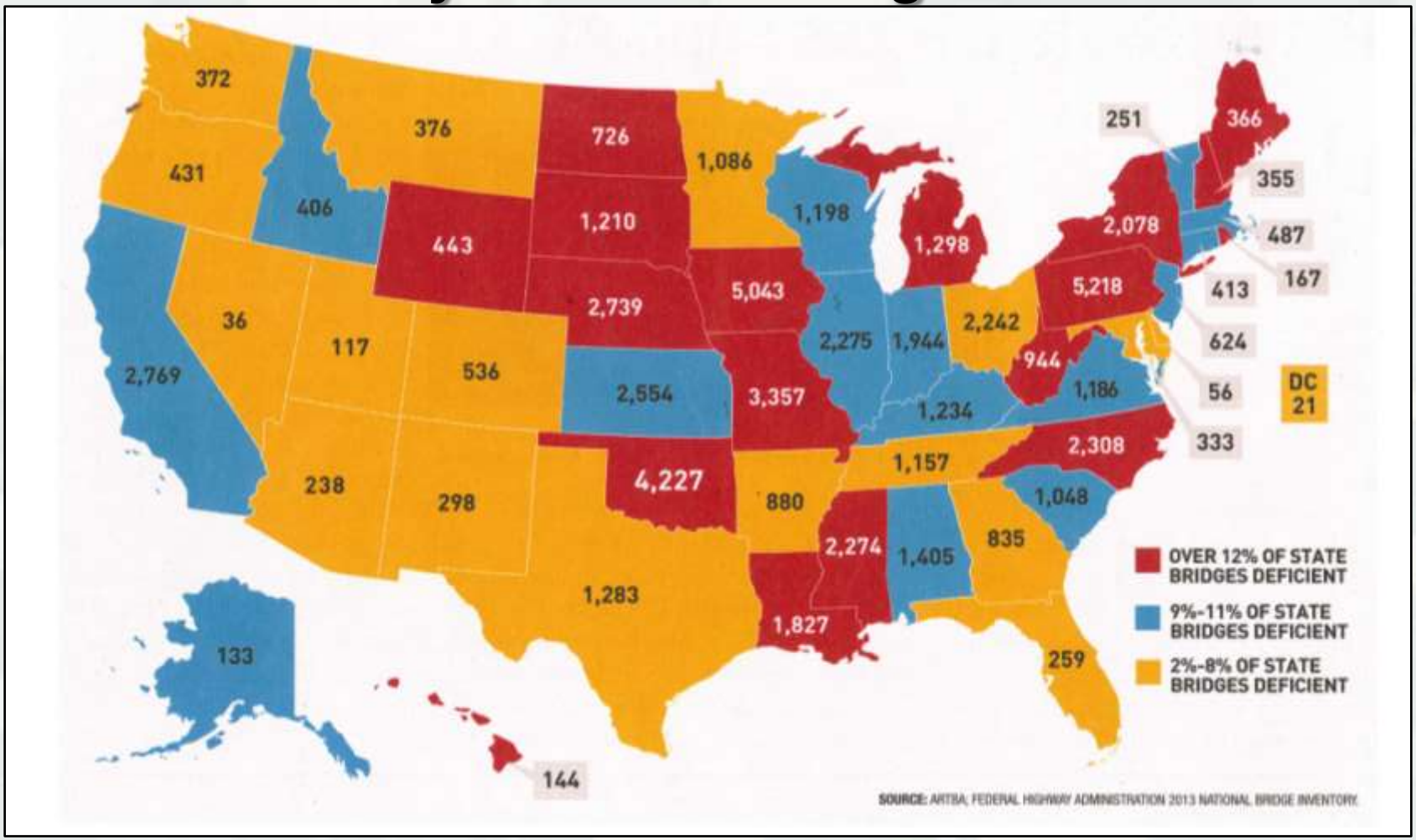
USACE Capital Stock Value by Functional Category 1928 to 2011



GDP per person at Purchasing Power Parity and share of global population, 2014 forecast



Structurally Deficient Bridges in the U.S.



63,000 Structurally Deficient (SD) Bridges in the U.S.

250 million crossings in 2013 on SD Bridges

U.S. ARMY
ARMY STRONG.™

As published in Engineering News-Record (ENR), "U.S. DOT, Industry Renew Call to Bolster Federal Trust Fund Before it Goes Bankrupt", May 5th 2014, p. 15.

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