

Session 2: Why and How?



Presented by:
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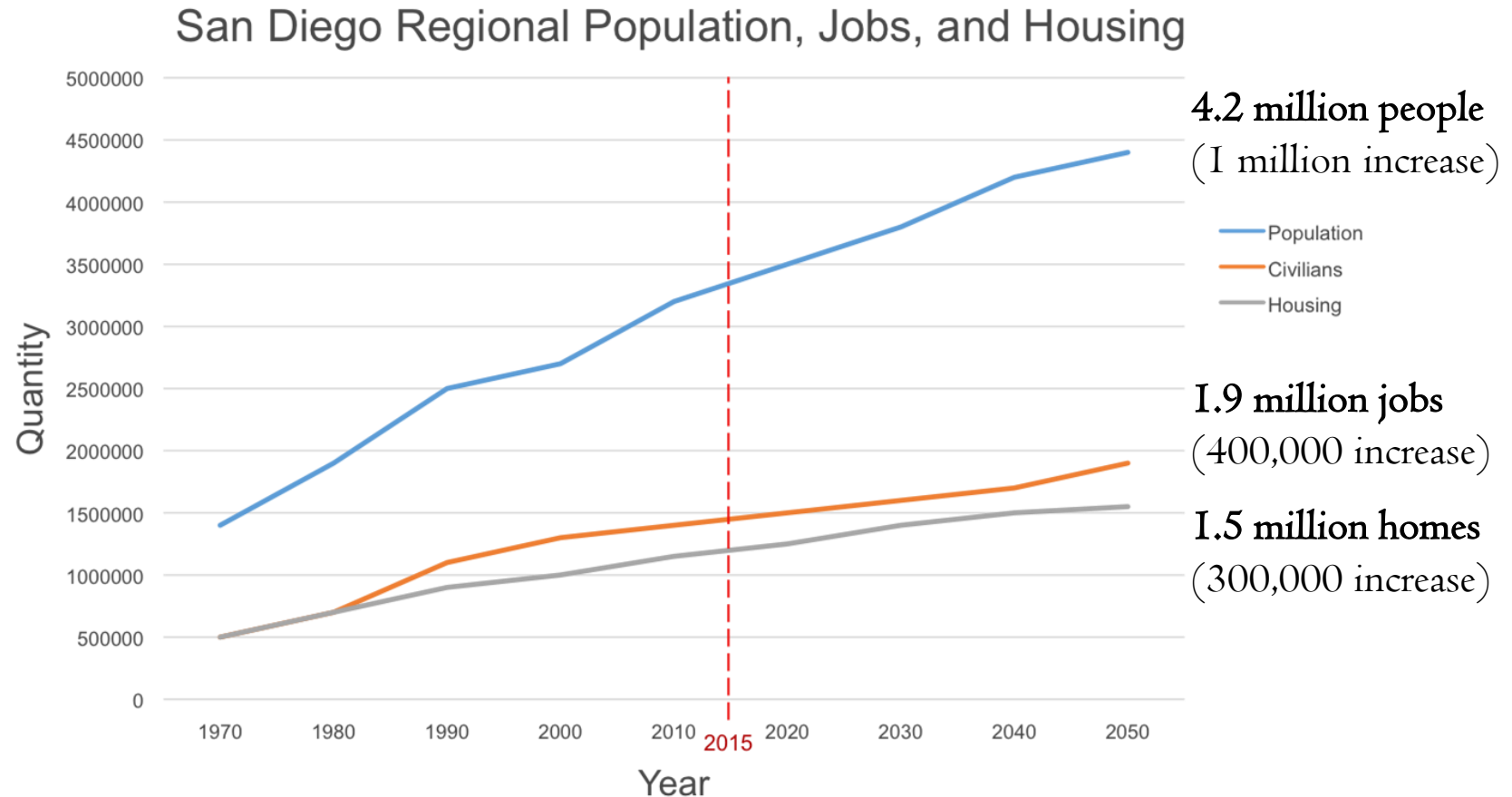
What we will talk about:

- Recap of last Geodesign presentation
- Planet
 - Background of climate change
 - How climate change has impacted our environment?
 - How climate change will impact our environment in the future?
- People
 - Who will it effect?
 - Health and Hunger
- Profit
 - How do we measure wealth?
 - Effects of land desertification

Recap

- **Geodesign** – a methodology that promotes designing with geography instead of designing around geography.
- **Design Science** – application of the principles of science to help the Earth's finite resources meet the needs of all humanity without without disrupting the ecological processes of the planet.
- Engineer the transition to sustainable water and energy management for:
 - San Diego
 - Baja
 - Brazil

Recap San Diego



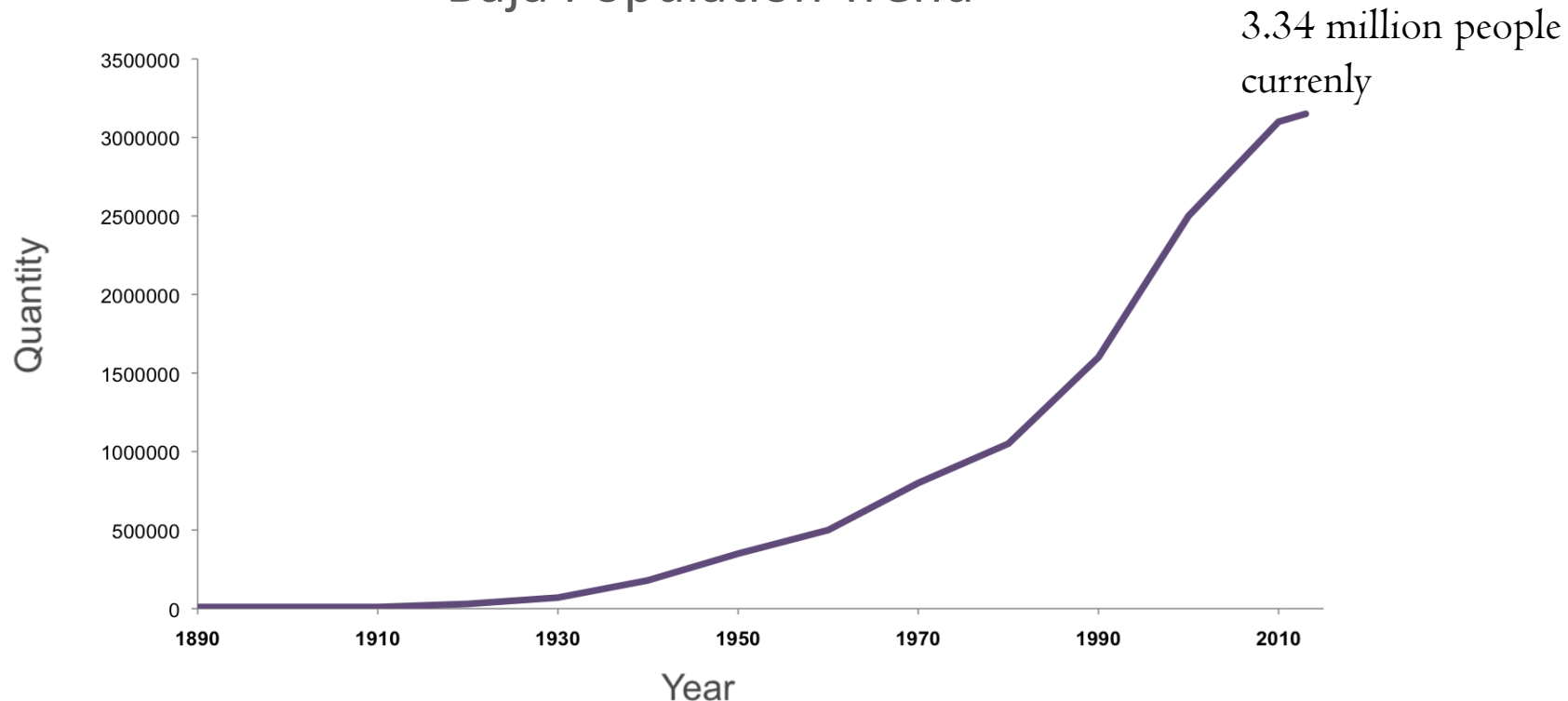
Population, Job and Housing increase leads to:

- Excessive Consumption of energy and water

Source: SANDAG Regional Growth Forecast

Recap Baja

Baja Population Trend



- Baja's GPD is US\$ 29,021 compared to California's GDP of \$2.2 trillion
- Population and consumption increase leads to:
 - Impoverished people turn to cheapest way to produce energy

Source: Panorama Social Demographics of Baja California

Climate Change

Planet. People. Profit.

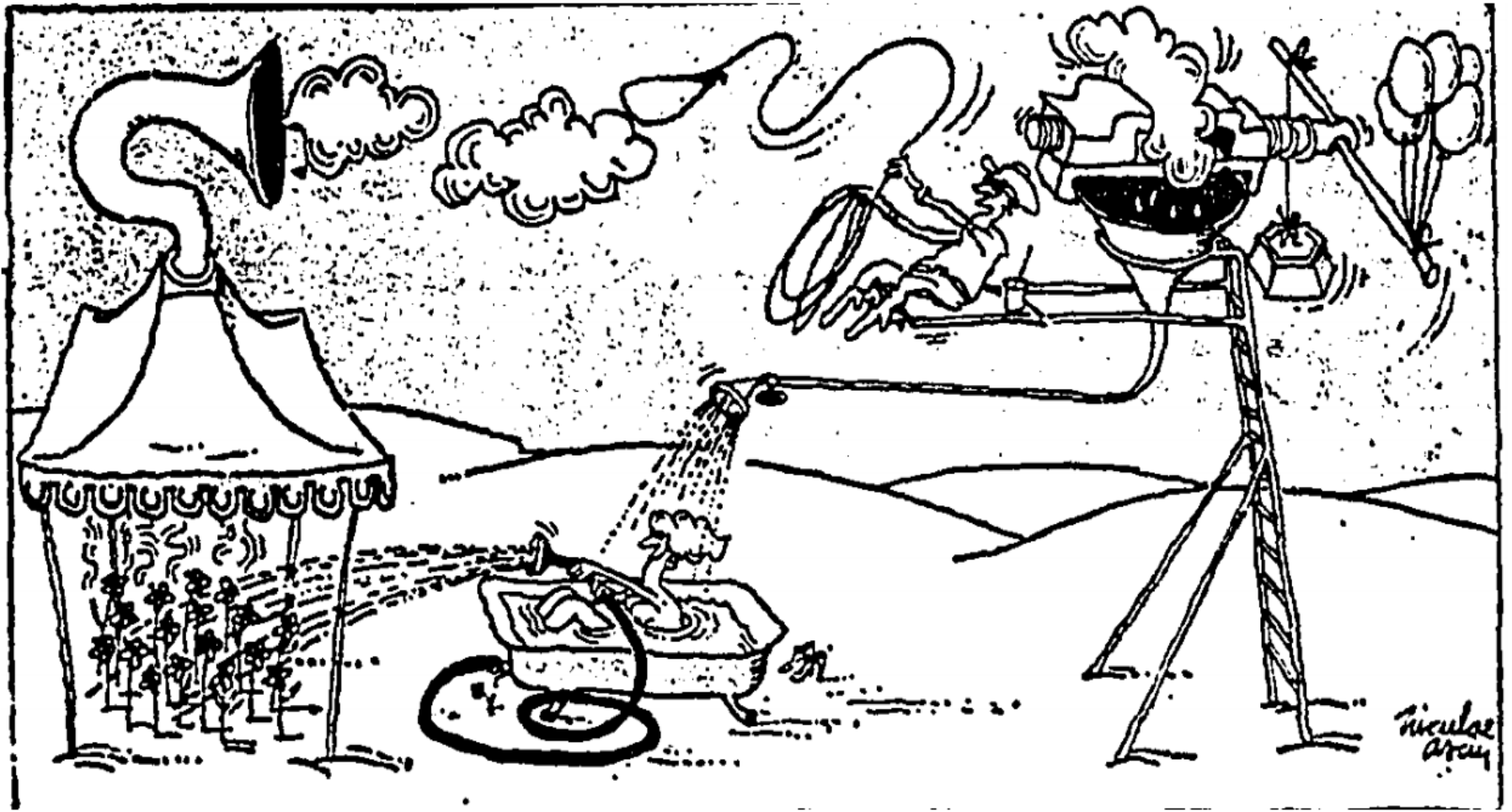


Illustration by Niculae Asciu

Planet

Anthropogenic Climate Change

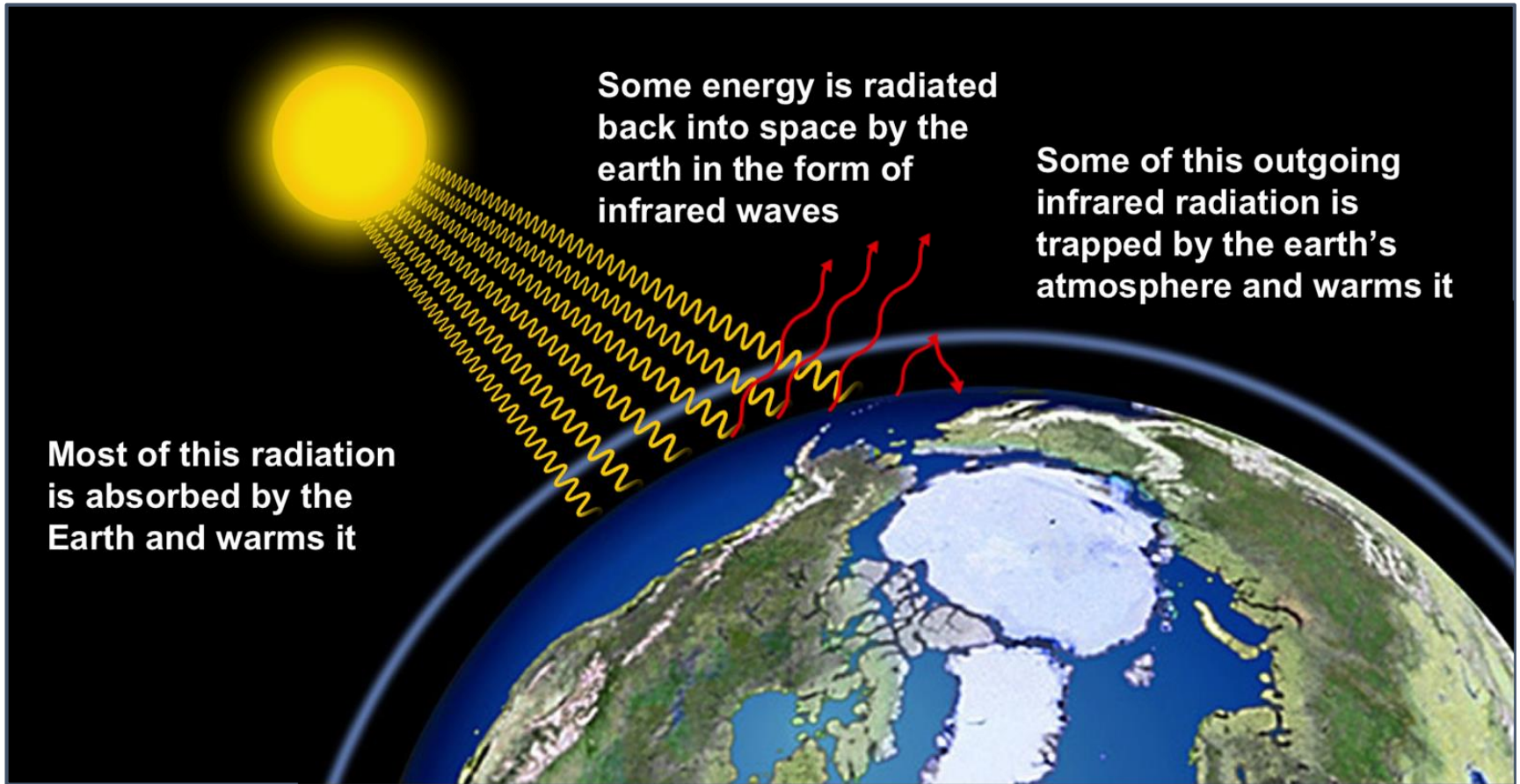
Fact not Belief



“I’m often asked whether I believe in global warming. I now reply with the question: Do you believe in gravity?”

- Neil de Grasse Tyson,
Astrophysicist, Cosmologist.

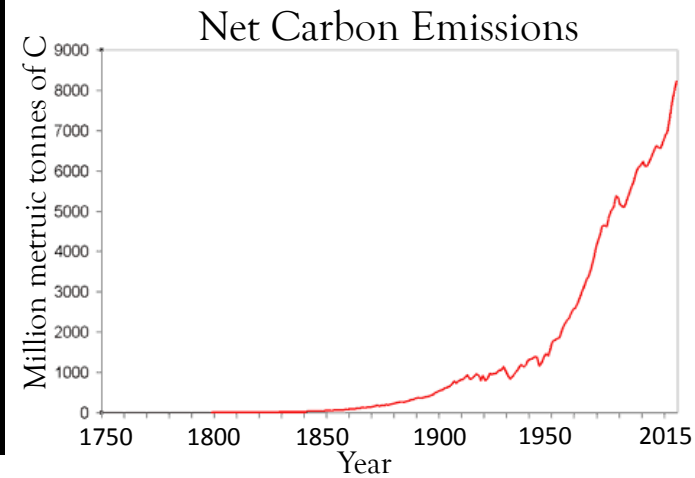
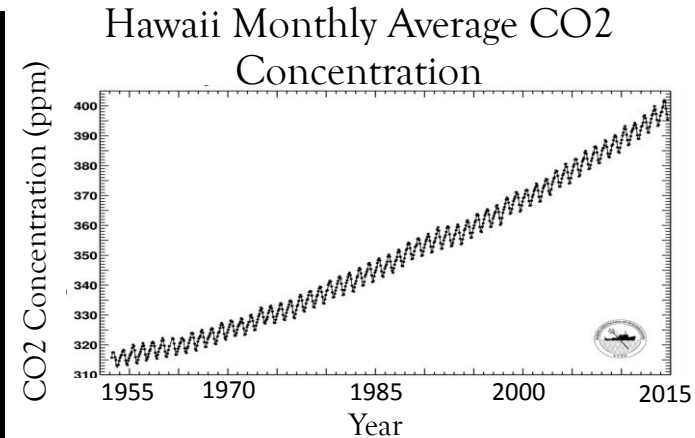
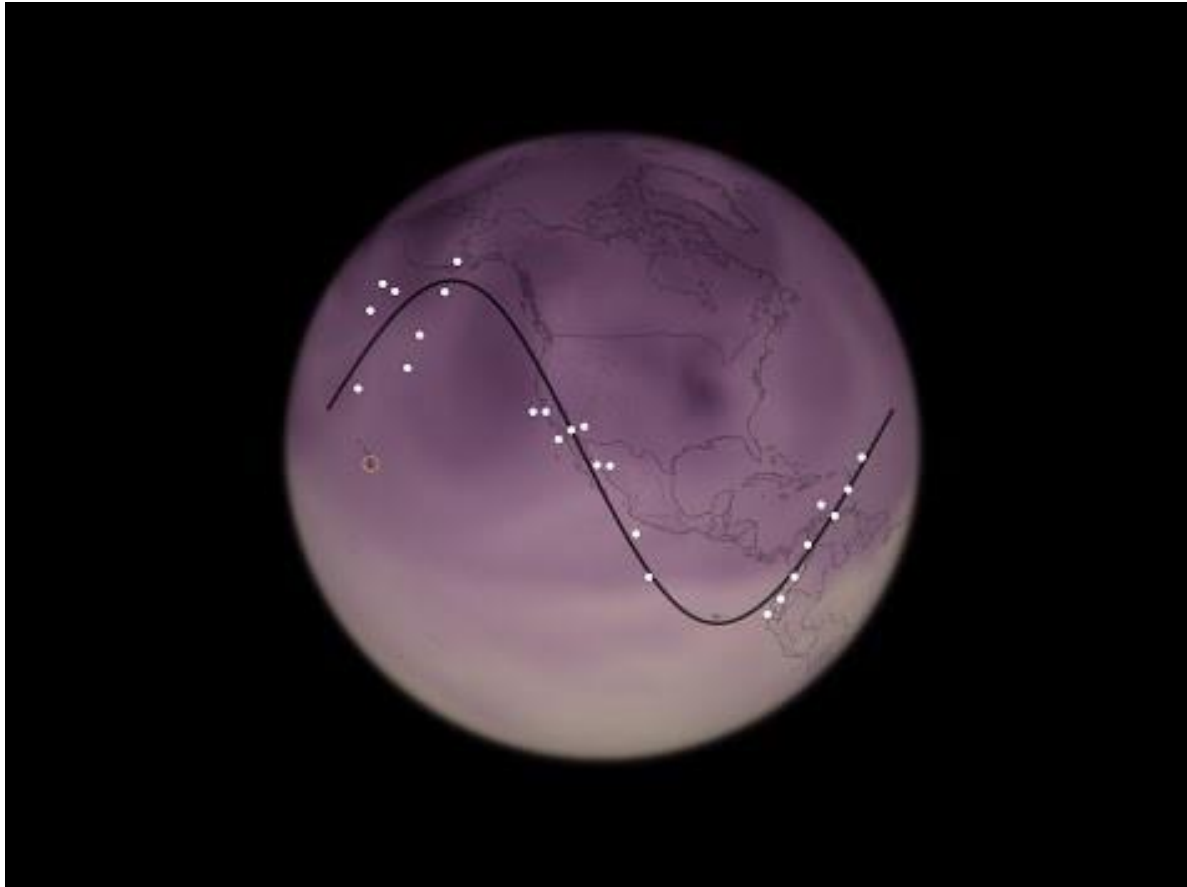
Greenhouse Effect



Source: The Climate Reality Project

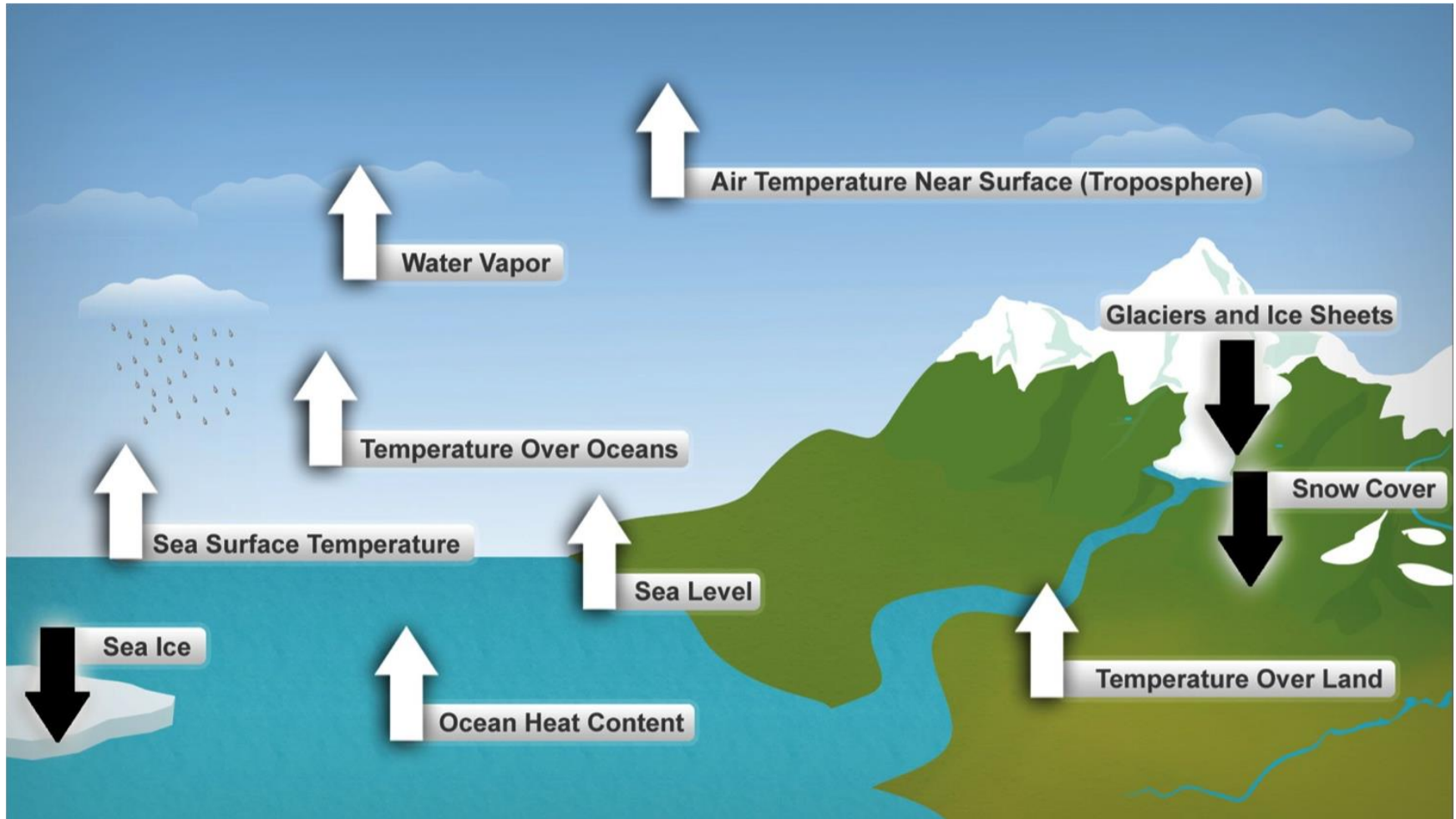
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The Keeling Curve



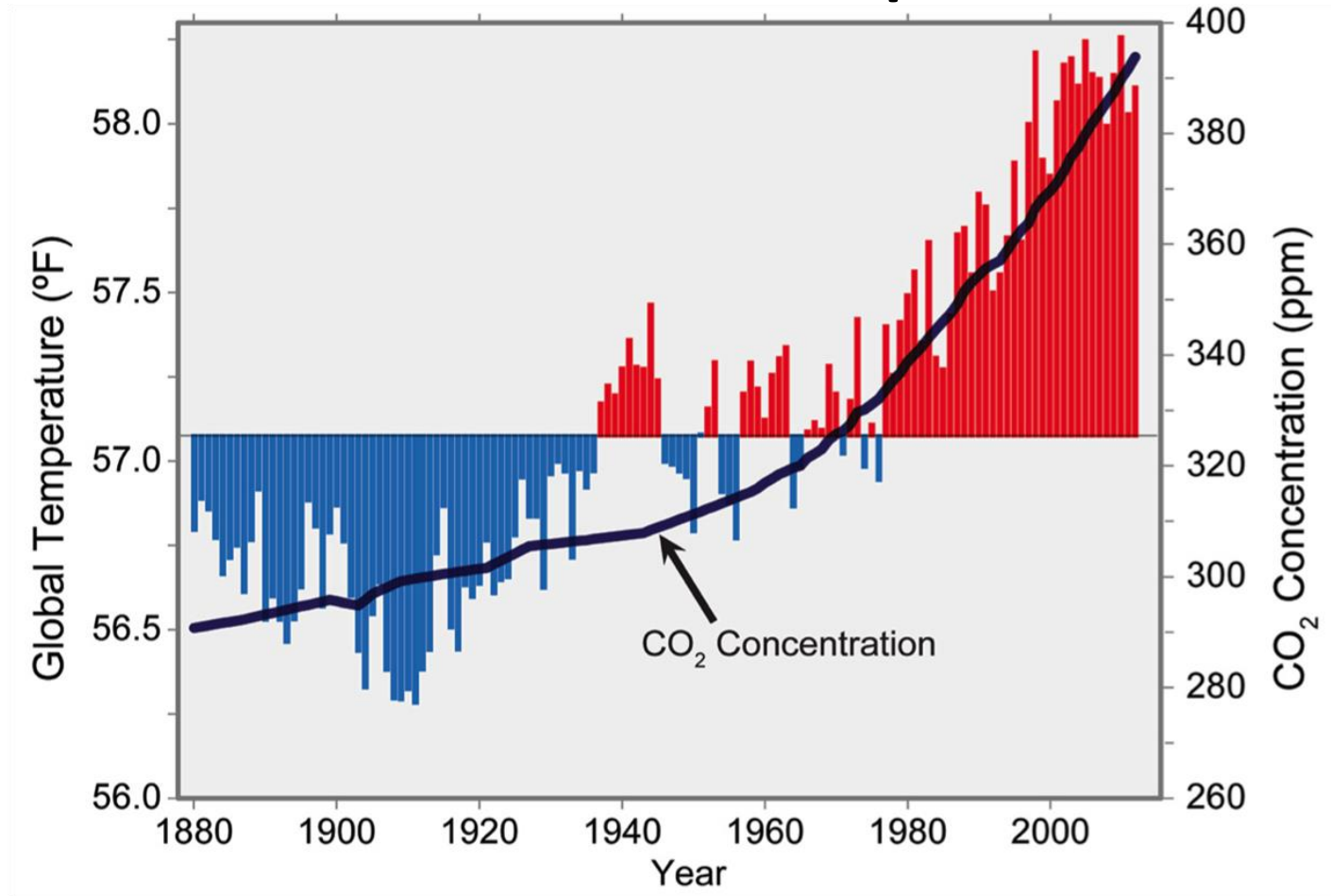
Source: The Climate Reality Project

Evidence of Warming



Source: Climate Refugee (2010)

CO₂ vs Global Temperature

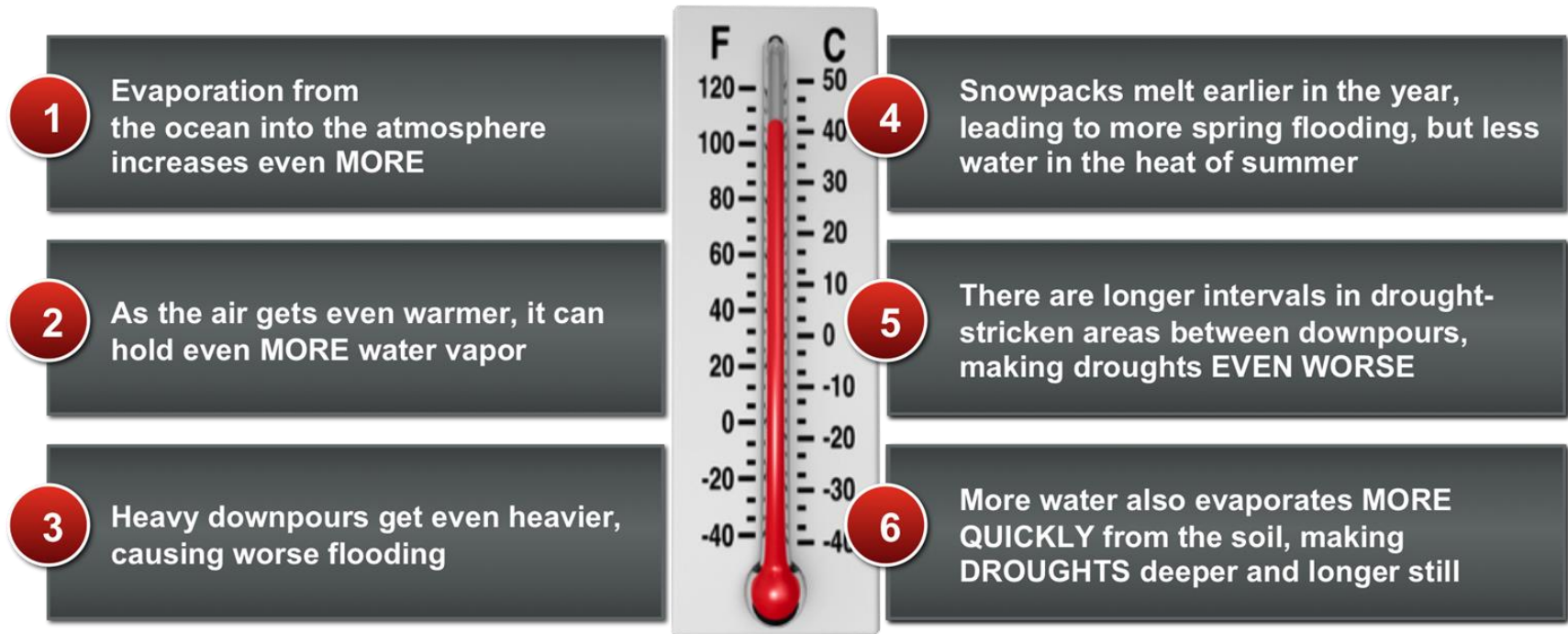


Increased levels of greenhouse gasses are strongly correlated with increased average global temperatures

Source: 3rd National Climate Assessment

Climate Change Impact

Intense downpours lasting less time - Longer and deeper DROUGHT



Source: Climate Refugee (2010)

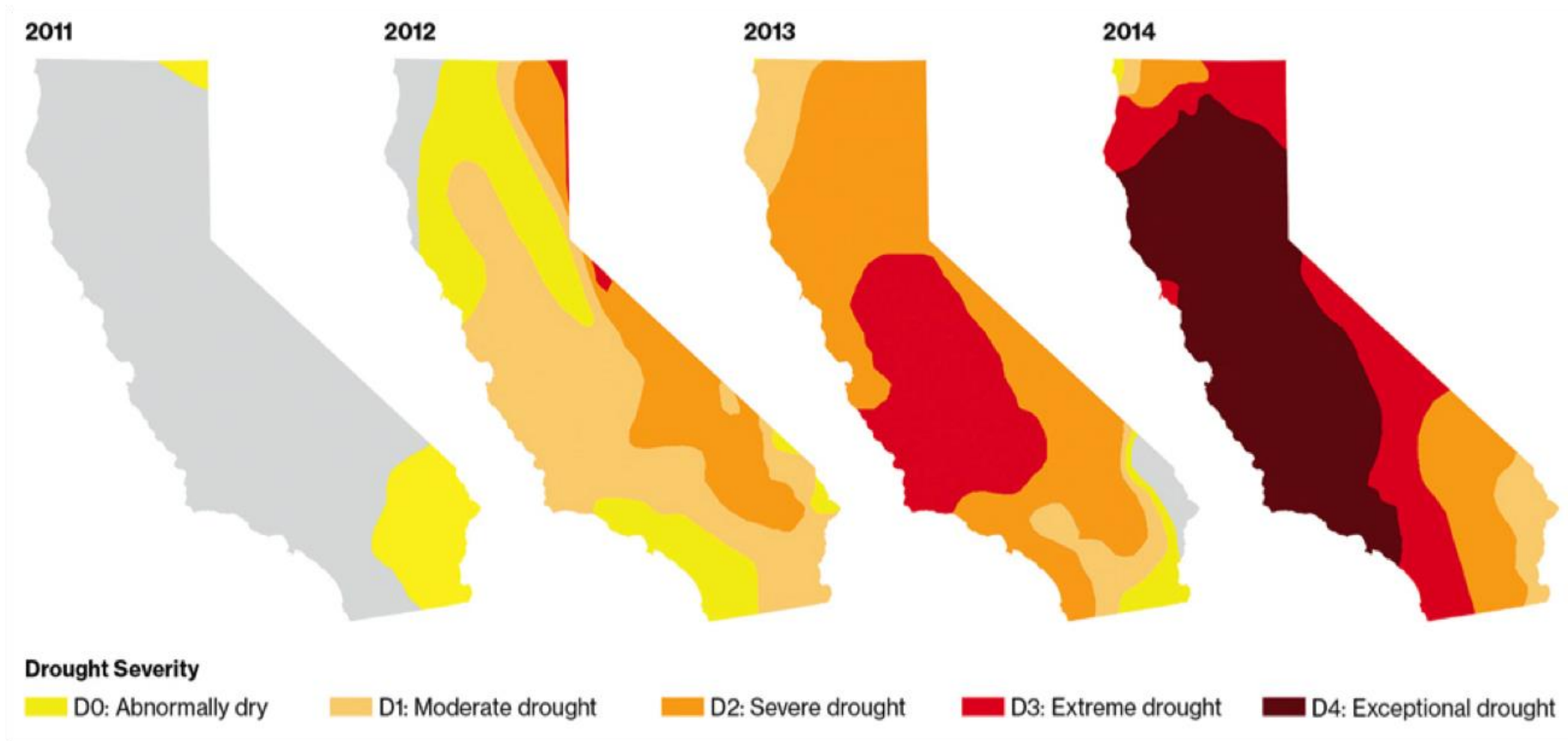
Our Regions

Closing in on Sustainability

San Diego and Baja

Current Drought Situation

The 2012-2014 drought is the worst in 1200 years

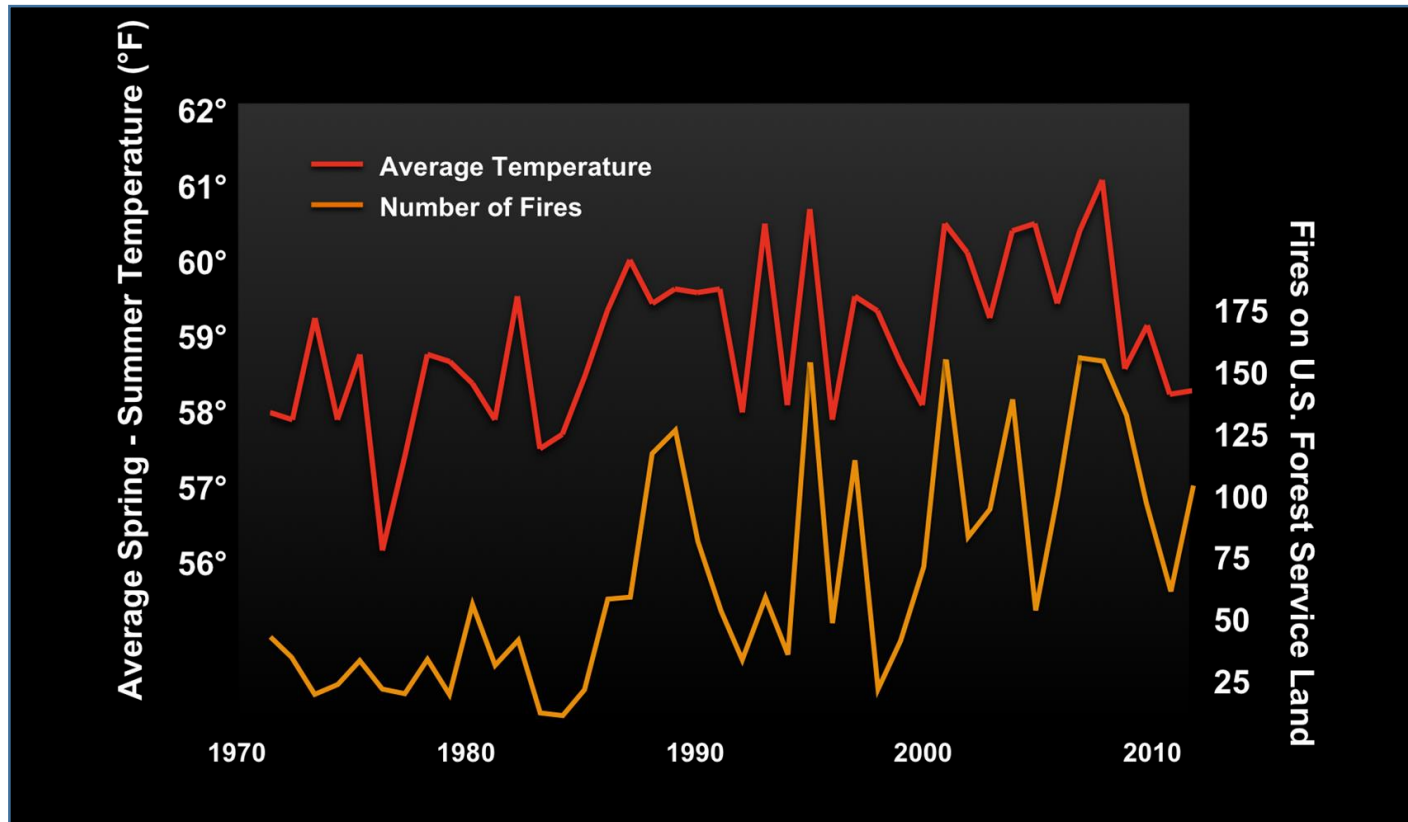


Source: U.S. Drought Monitor.

Current Fire Situation

California

Hotter Temperature = More Fires



Source: Westerling

Current Fire Situation

Southern California Fires

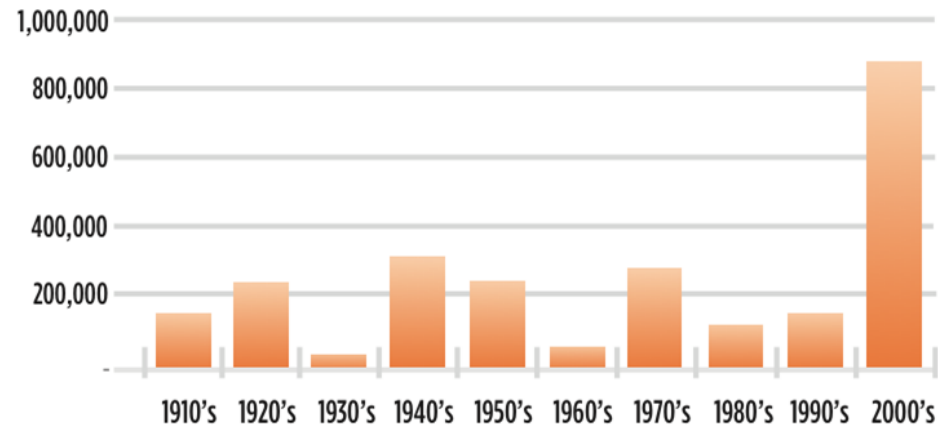
- Of the 20 largest fires in CA since 1932, 19 occurred after 1970.
- In 2003 and 2007, wildfires burned nearly 740,000 acres.



Picture taken October 27, 2003 during ten large fires

Source: NASA

Total Acres Burned by Wildfires in San Diego County by Decade



Current Environmental Degradation

Mexico



97% affected

60% of the 97%
is severe

Annual environmental degradation

- 70% of environmental degradation of Mexico is affected by drought

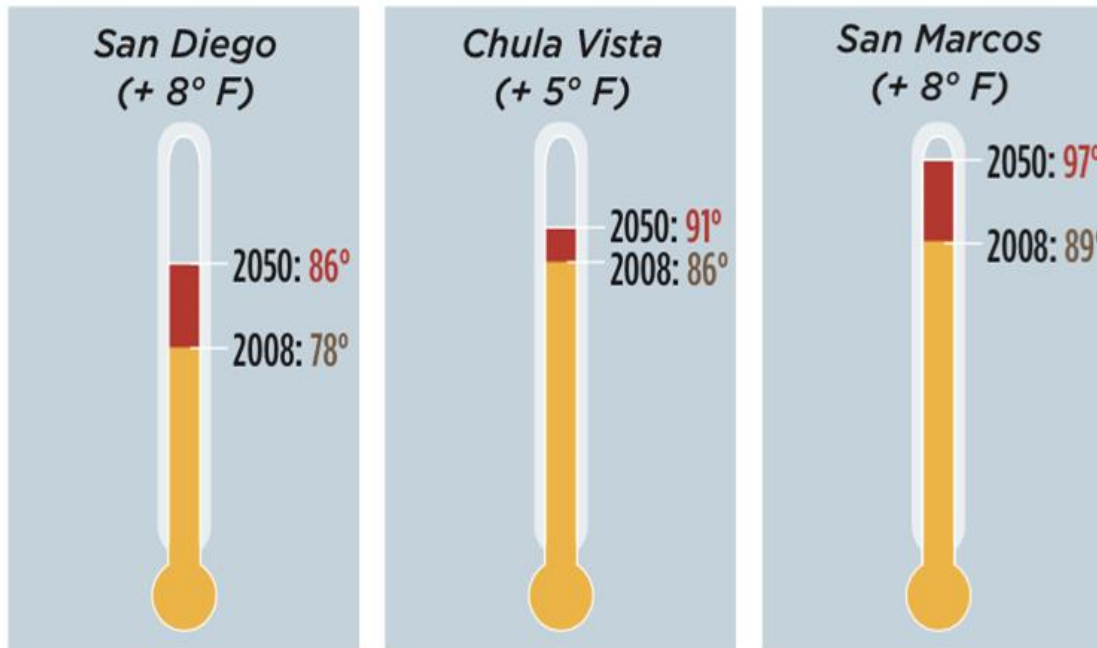
Source: U.S Commission on Immigration Reform

Projections

Looking at Future Impacts of Climate Change

Temperature

Expected difference in August average temperature
by 2050



- Average annual temperatures will rise **between 1.5°F and 4.5°F**, with **higher increases** summer.
- **Heat waves** will increase in **frequency and intensity**
- Our region will become **even more vulnerable to drought**

Source: The San Diego Foundation

Fires

San Diego County



- *Wildfires will become more frequent and intense*
- 58-128% increase in fire frequency by 2085 in California
- Warmer spring temperatures will make the fire season longer
- Droughts will make vegetation drier and further increase fire risk.
- The number of days each year with ideal conditions for large-scale fires will

Source: The San Diego Foundation

Oceans



- Our region's sea level will increase by 12 in to 18 in
- Cliffs will collapse
- Storms will become much more damaging
- Properties will be more frequently flooded
- Coastal wetlands will no longer be able to filter polluted runoff and keep beaches clean

Source: The San Diego Foundation

Water

San Diego County



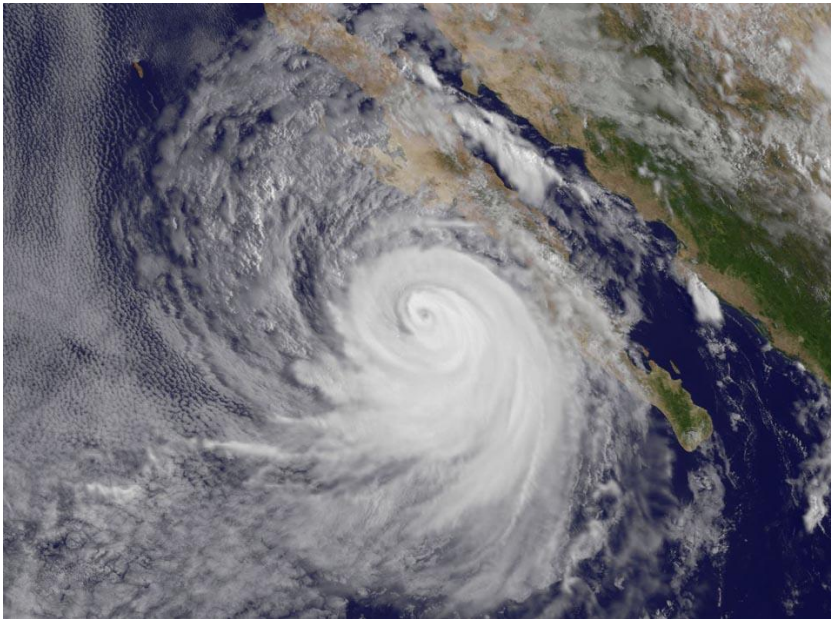
Depleted Irrigation to the Rice Farms of Richvale, CA

In 2050

- Demand will increase by 37%
- Major sources of water — the Colorado River and the rivers of Northern California — could **shrink** by 20% or more.

Hurricanes

Baja California



Hurricane Norbert - 2014

“Among the predictions are stronger hurricanes, changes in arroyo flows, loss of vegetation and soils, accelerated desertification, and negative impacts on fisheries and biodiversity.”

-Gladys Rodriguez, University of New Mexico

Climate Change

It's warming.

It's us.

It hasn't stopped.

The heat is mainly in the sea.

Sea level is rising.

Ice is shrinking.

CO₂ makes the sea more acidic.

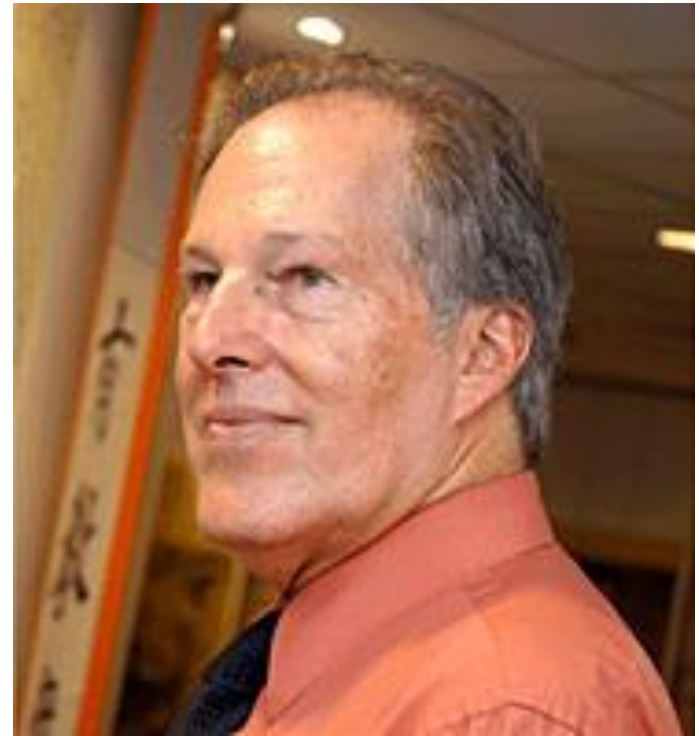
CO₂ in the air is up 40% since the 1800s.

It's now the highest in 800,000 years.

Cumulative emissions **set** the warming.

Reducing emissions **limits** the warming.

Climate change will last for centuries.



Dr. Richard Somerville – Scripps
Institution of Oceanography

Source: Richard C. J. Somerville. Scripps Institution of Oceanography

People

How we are affected by Climate Change

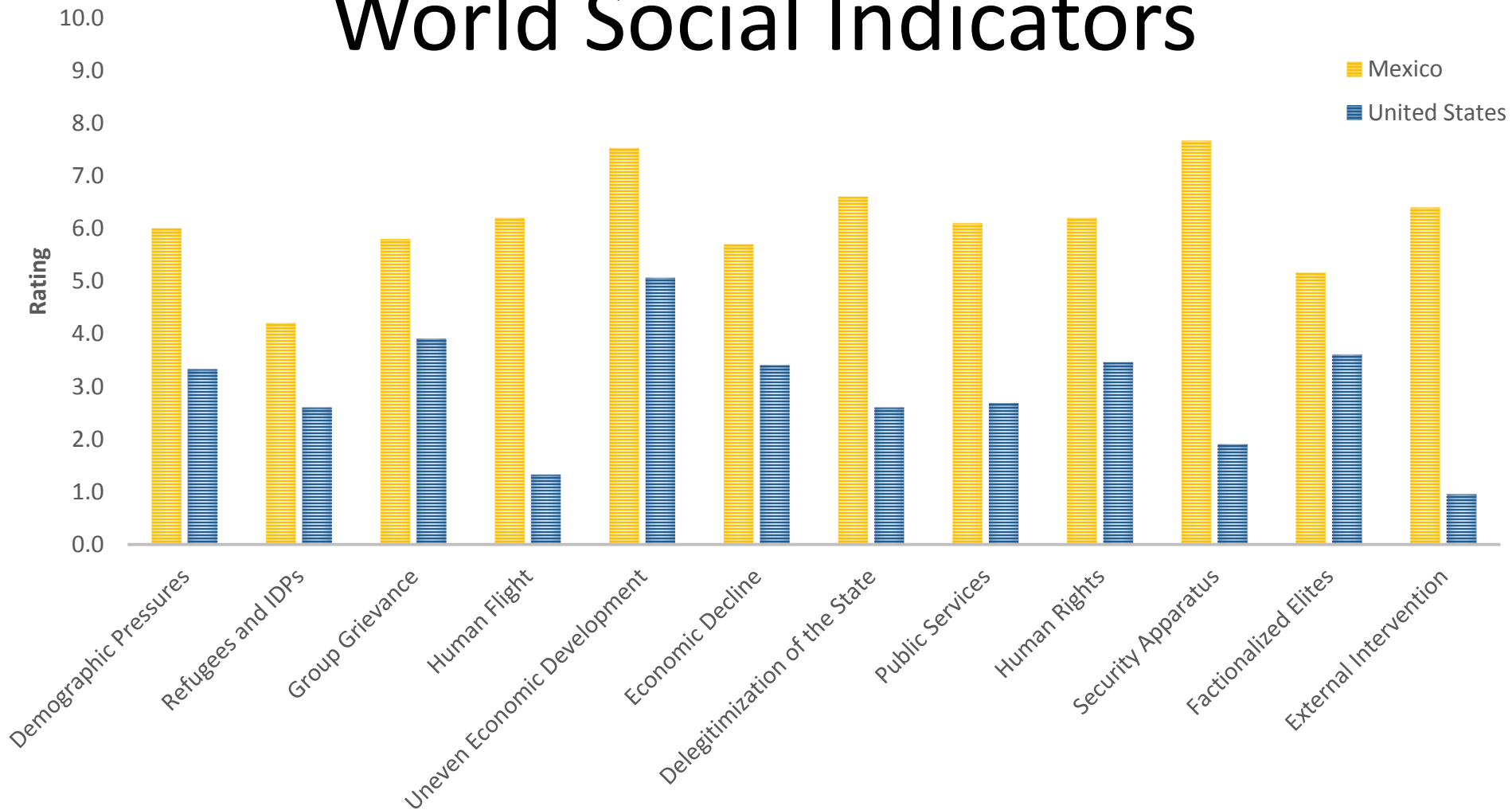
People



“Addressing the changes in the Earth’s Climate is not simply about saving Polar bears and preserving the beauty of mountain glaciers. *Climate change is a threat to our national security*”

- Navy Vice Adm. Lee F. Gunn.

World Social Indicators

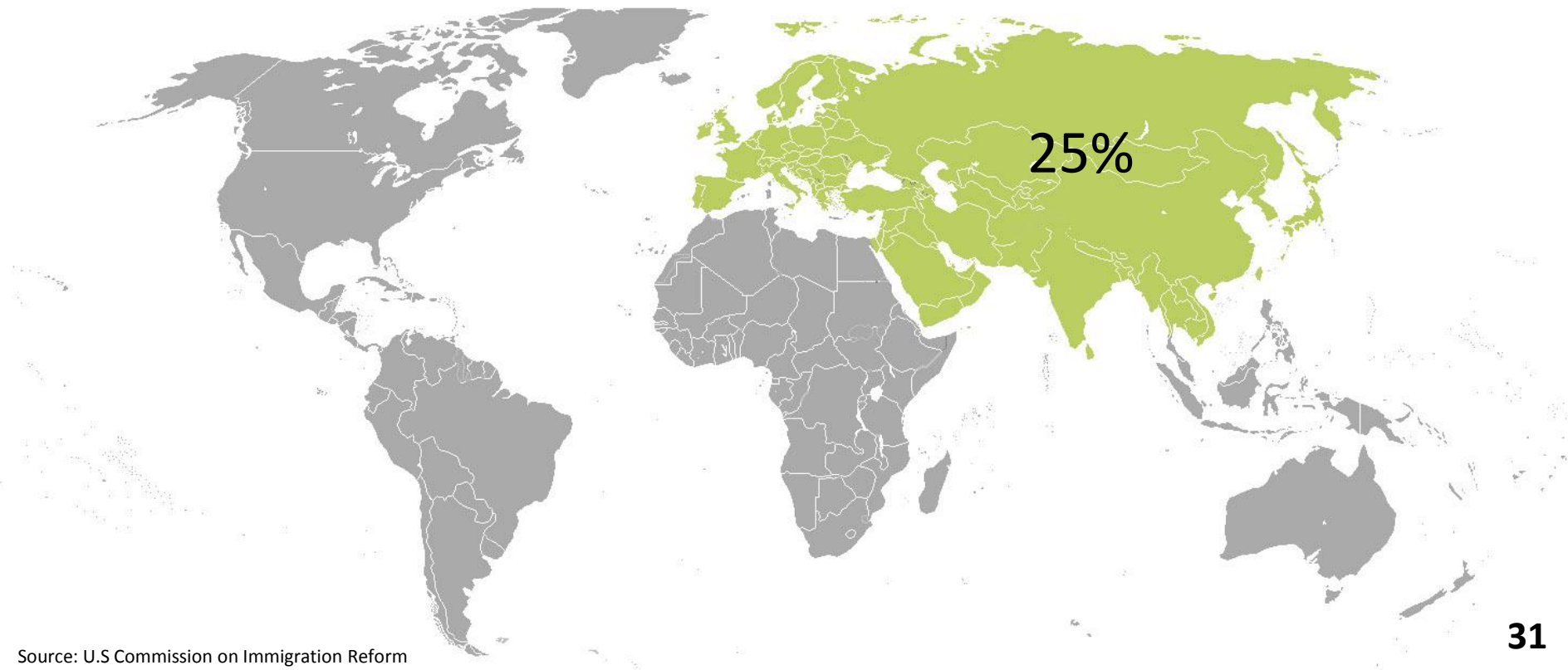


With comparative effects of climate change on the planet, the U.S still maintains considerably higher living conditions compared to Mexico.

Source: Earth Policy Institute

Agriculture

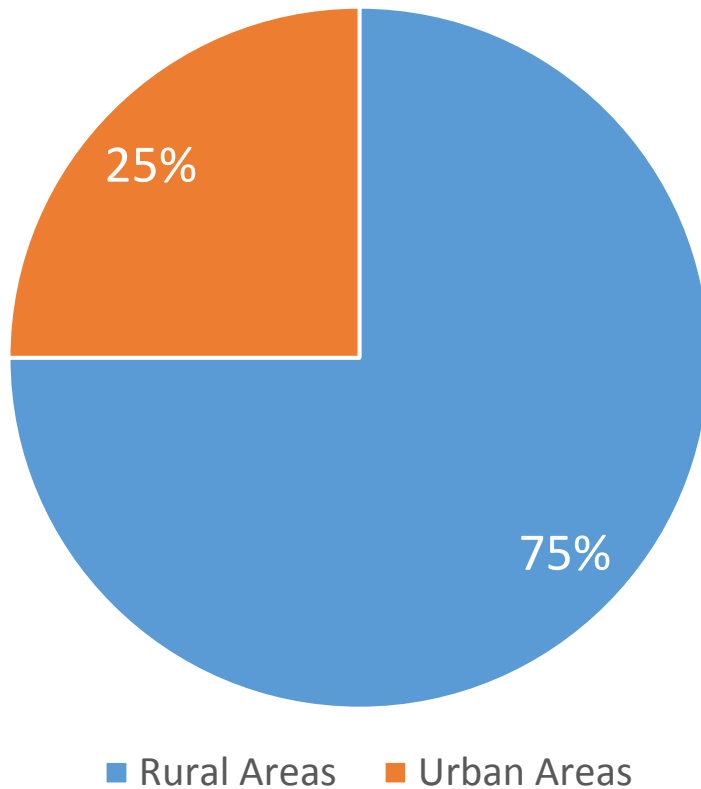
- Desertification currently affects **3.6 billion hectares**
- Many people in developing lands depend on farming for their livelihood



Source: U.S Commission on Immigration Reform

Agriculture - Mexico

Poverty Distribution

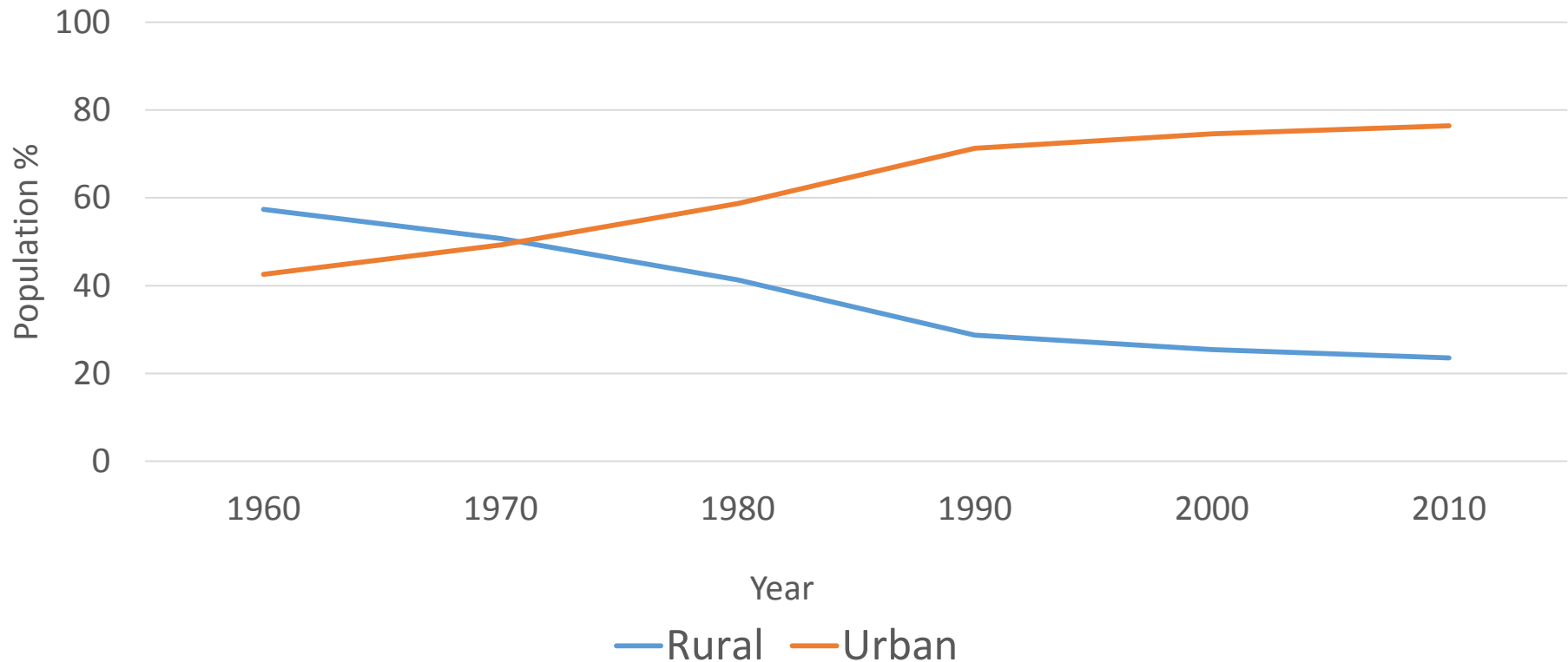


- Approximately 1,400 square miles of potentially productive farmland are taken out of production or abandoned each year.
- 900,000 people migrate annually from arid and semiarid rural regions.
 - Require new infrastructure

Source: U.S Commission on Immigration Reform

Population Redistribution - Mexico

Rural and Urban Population in Mexico



Environmental deterioration due to climate change forces farmers off their farms and into urban centers to find a means of livelihood.

Source: National Statistics and Geography Institute (INEGI)

Climate Refugee



- Globally, the international Red Cross estimates that there are **more environmental refugees than political refugees** fleeing from wars and other conflicts.
- **36 million people** were displaced by natural disasters in 2009
- Scientists predict this number to rise to at least **50 million by 2050**
 - Could be as high as 200 million

Source: National Geographic's

Climate Refugee- USA

*In addition to hundreds of thousands of post-Katrina and Rita refugees, many of whom are expected never to return, **there have been thousands of environmental refugees in the US** in recent years.*

- 2007 Fires in California forcing **many people to move temporary**
- **200 Alaskan Villages** are being forced move because of encroaching waves.
- 1993 Flooding in the Missouri and Mississippi River basins drove many people from their homes and encouraged **many towns and cities to relocate.**

Climate Refugee- Mexico

One of the driving forces behind the hotly debated immigration of Mexican residents into the US is the dearth of natural resources in much of Mexico, with problems exacerbated by a sustained drought.

- 700 000 homes in Tabasco and Chiapas in Mexico effected by flooding by heavy heavy rains and large Waves. Similar to Katrina.
- The 2,000 mile border had given way to to more than **17 million illegal Latin-American** immigrants in the last 30 years.
- 150,000 to 600,000 persons per year move to the U.S.

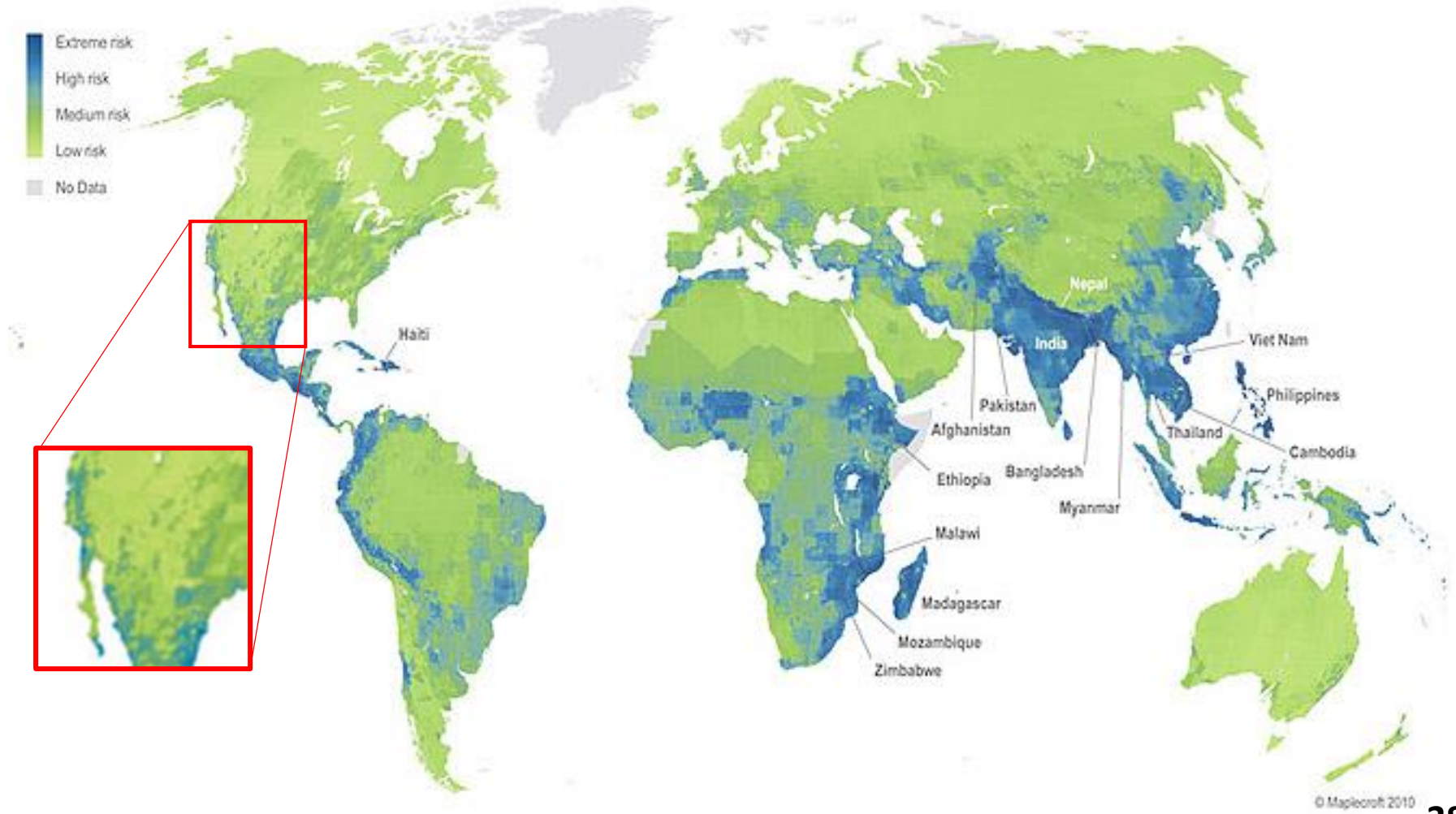
People



“Climate Change is a *threat multiplier*, it pressures areas that are already stressed over the tipping point of social unrest.”

-Stephen Schneider. Climatologists, Stanford University.

Climate Change Vulnerability Index



Source: Healthy Planet UK (2011)

Health



Source: World Health Organization

- The direct damage costs to health are estimated between US \$2-4 billion/year by 2030.
- Driving up particle pollution and Ground-Level Ozone
- Extreme-Heat Events
 - 7800 deaths between 1999 – 2009.
 - In 2006 140 Californians died, 12000 hospitalized. \$133 million Health Costs.
- Increasing Infectious Diseases
- Increasing the frequency of Heavy Rainfall and Flooding
 - 98 deaths per year

Hunger

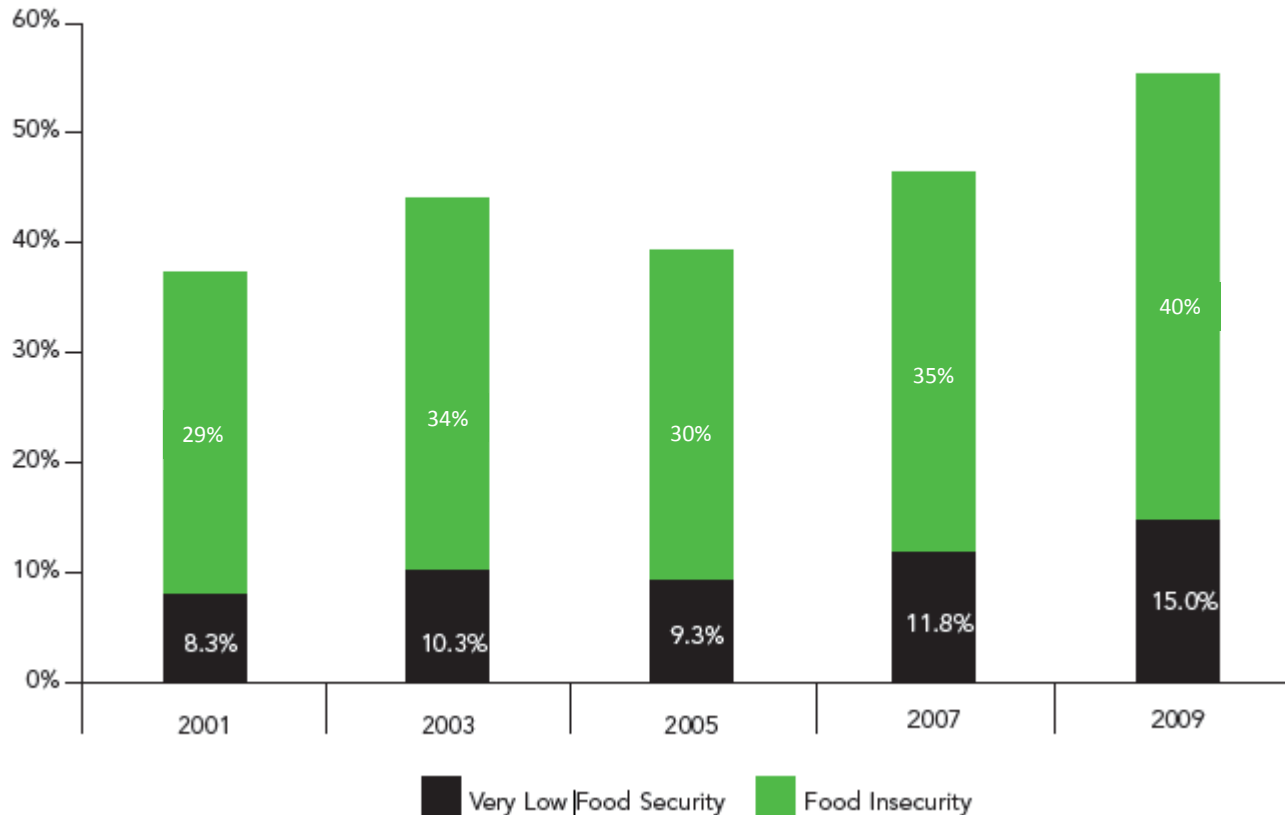


- Currently 750 million people lack access to improved water source and 2.5 billion lack access to basic sanitation.
- Worldwide 2.7 billion do not have a safe way to cook food
- Globally 842 million people are chronically hungry. **Climate change will make meeting the food and nutrition needs of a growing population even more challenging.**
- The resulting malnutrition can translate to a loss of as much as 8% of a countries GDP.

Source: World Health Organization

Hunger - California

Prevalence of Food Insecurity and Very Low Food Security Among Low-Income Households, California, 2001-2009



- 40% of the population of San Diego have food insecurity.
- California Health Interview Survey (CHIS) suggest 3.8 million Californians in 2009 could not afford food.

Source: World Health Organization

Profit

Closing in on Sustainability

Measure of 'Wealth'

How do we measure change and development?

- There is a clear relationship between access to electricity and quality of life.
- Quality of life is often measured in the form of an index which is usually determined by a combination of social and economic factors.



Human Development Index (HDI)

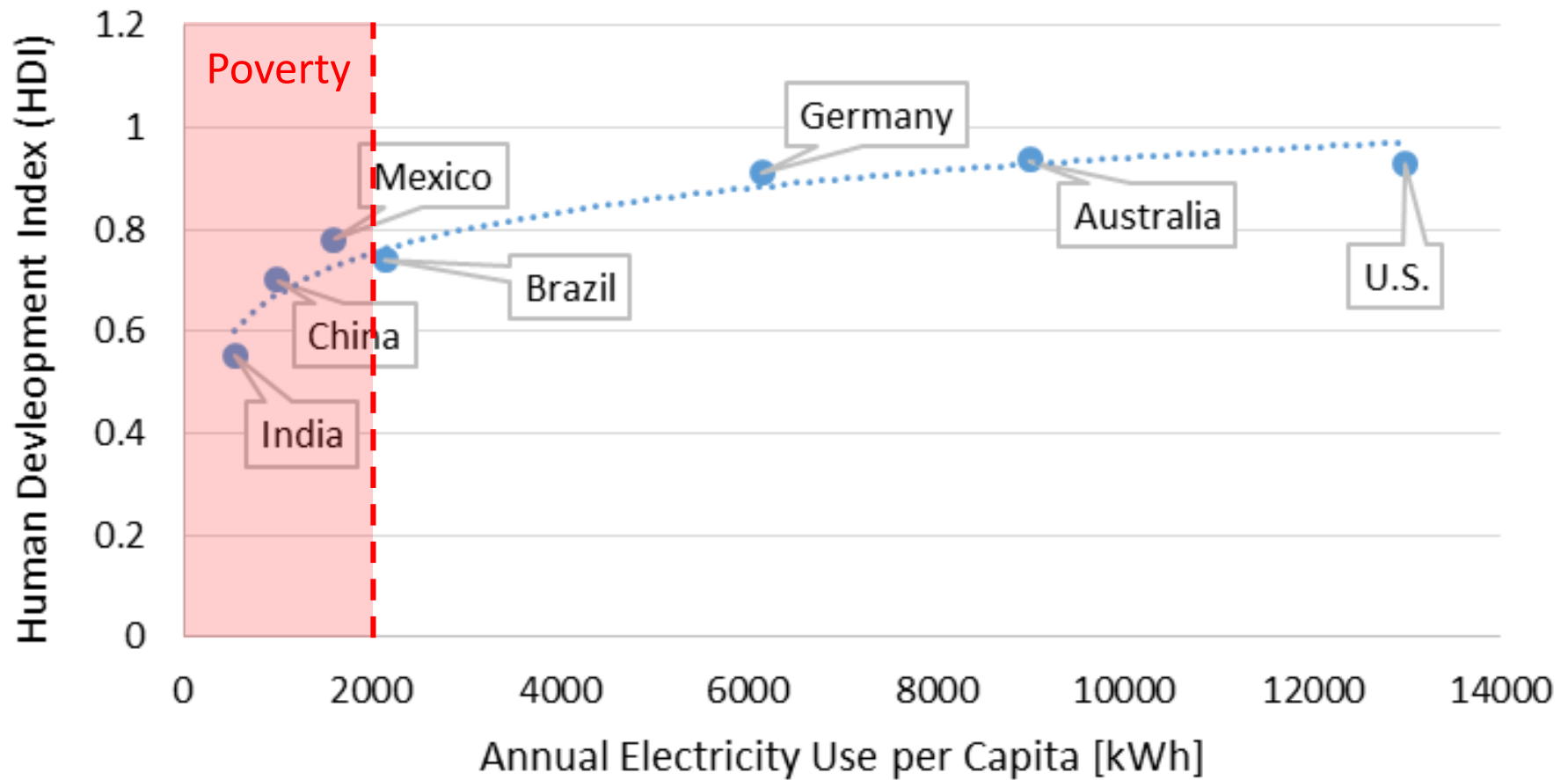
1. Life Expectancy
2. Education
3. GDP per capita

Physical Quality of Life Index (PQLI)

1. Literacy Rate
2. Infant Mortality Rate
3. Life Expectancy

Electricity

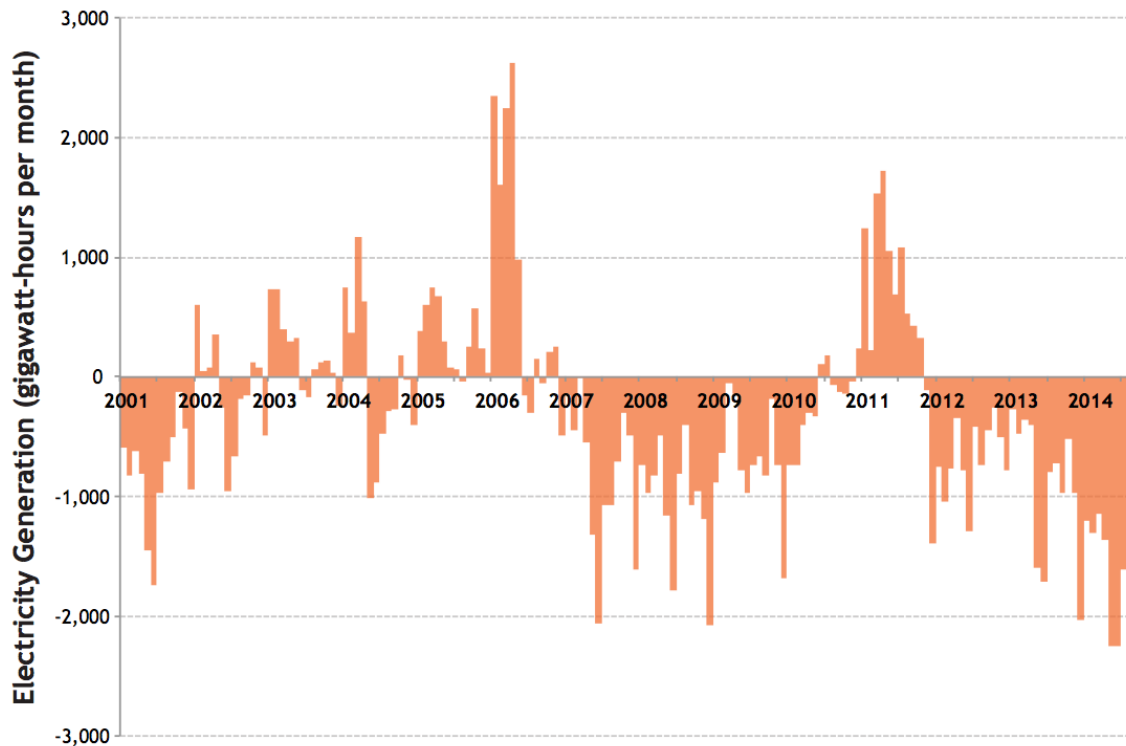
Electricity use and HDI



Source: HDI Provided by United Nations

Current Drought Situation

California Hydroelectric Energy Generation



Effects of drought

- Energy mix went from 18% to 13% between 2011 and 2014
- Reductions in hydro are **made up by increased use of fossil fuel** and other renewables
- Reduced production increases marginal cost
 - Cost of hydropower between 2012-2014 increased statewide energy cost by 1.4 billion

Source: CEC 2015.

Current Drought Situation

Effects of drought

- Senior Water Districts face restrictions for the first time since the 70s
- In 2014 growers lost about 6.6 million acre-feet of surface water
 - Increased pumping of ground water accounted for 75% of that loss



San Joaquin Valley



Source: CEC 2015.

Agriculture

California Crop Production

	Loss Quantity	Average Year	Percent Loss
Water Use (Million Acre Feet)	6.6 MAF	26 MAF	25%
Net shortage after increased groundwater pumping	1.5 MAF	26 MAF	6%
Fallowed irrigated land	428,000 acres		n/a
Crop revenue loss	\$810 million	\$35 billion	2.30%
Revenue lost plus additional pumping cost (\$454 million)	\$1.26 billion	n/a	n/a
Economic loss	\$1.75	n/a	n/a

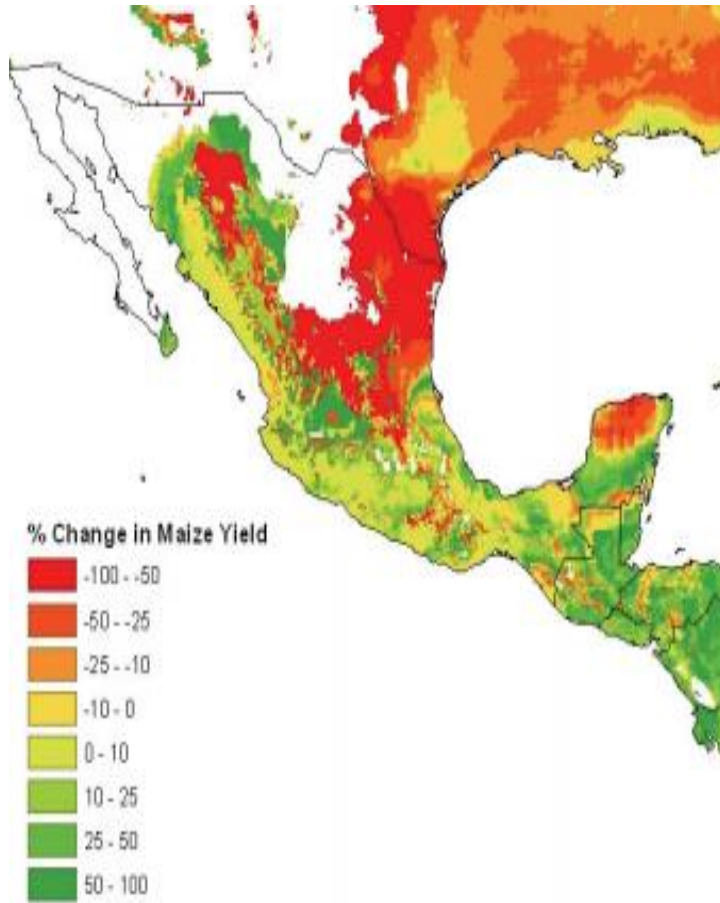
Climate change increases pressures of water availability, making it difficult for crops to grow. This leads to a decrease of crop production and consequently profits.

Source: UC Davis 2014

Agriculture

Baja Corn Production

IIASA Maize 2055 vs. 1961-1990



- FACT: Corn makes up 50% of Baja's agricultural production.
- There will be a 4.2% decrease of suitable land cultivation for Maize by 2055.

Source: World Bank


Agriculture

Baja Fishing

- Baja's major revenue and food security comes from the fishing industry. It is also within the top 15 fishing nations.
- Shrimp production will **decrease by 1.1% for every 1% of temperature increase**
- The worst-case scenario for the shrimp fishery losses of **US\$1 billion** in NPV (net present value) by 2030.

KEY FACT: Poverty levels will increase from 15.3% (without climate change) to 17.7% percent (with climate change) by 2030

Baja Economy



By 2100, the total **economic costs of climate change**, according to their calculations, would be equivalent to an **accumulated loss of between 6% and 30% of Mexico's GDP** and this affect the rural communities the most.

- UC Davis 2014

Resilient Cities

To achieve beyond sustainability

Pressing Forward

Global climate change is no longer an event to plan for; it affects us today.



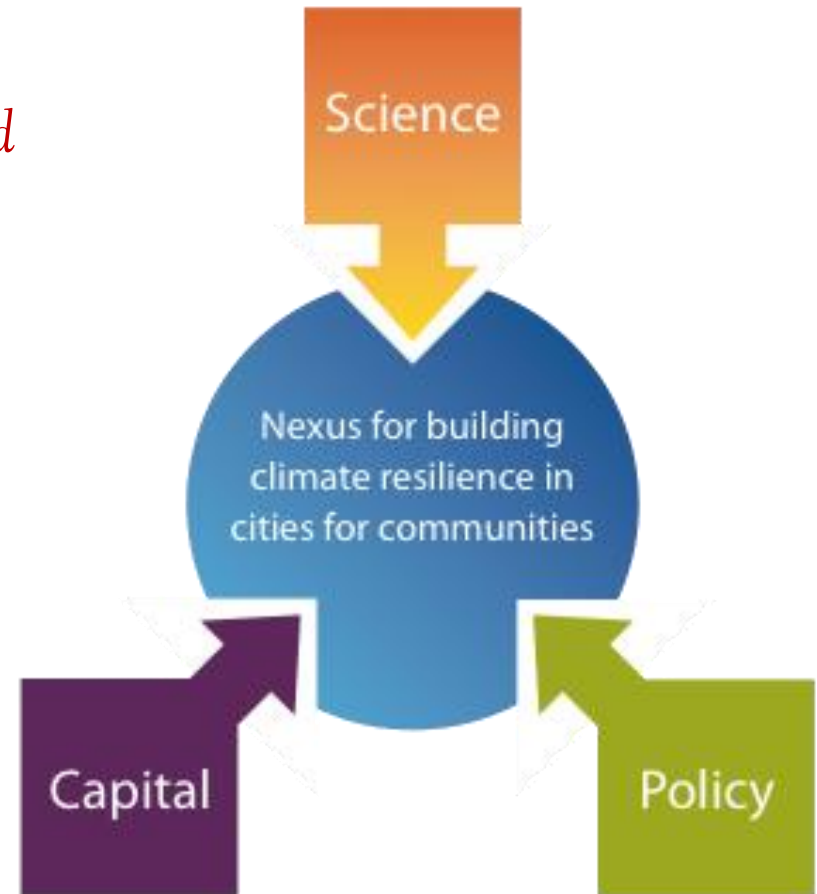
Source: World Resources Sim Center, GENI

Resilient Cities

The new approach for San Diego and Baja's

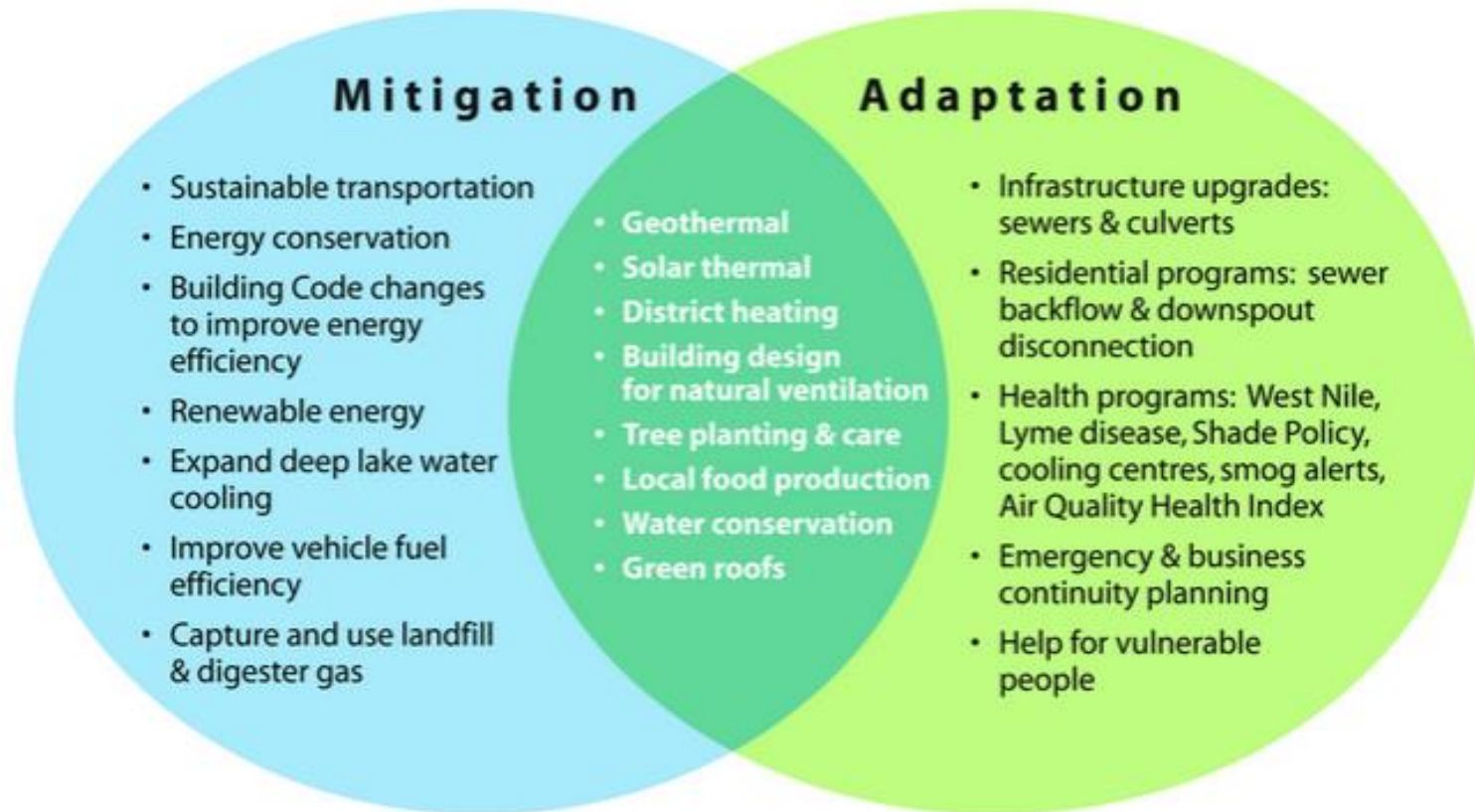
“The ability to become strong, healthy or successful again after something bad happens”

- A resourceful community
- Take the opportunity to strength health, environmental, social and economic systems.
- Learn about past emergencies to better prepare.



Source: CERES: Mobilizing Business Leadership for a Sustainable World

Resilient Cities



Mitigation: the globally responsible thing to do

Actions that reduce the emissions that contribute to climate change.

Adaptation: the locally responsible thing to do

Actions that minimize or prevent the negative impacts of climate change.

Source: Center for Clean Air Policy CCAP