



# Biofuels, bioenergy and bioproducts: Critical for health and the economy

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Todd Pray, PhD, MBA  
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Advanced Biofuels (and  
Bioproducts) Process  
Demonstration Unit

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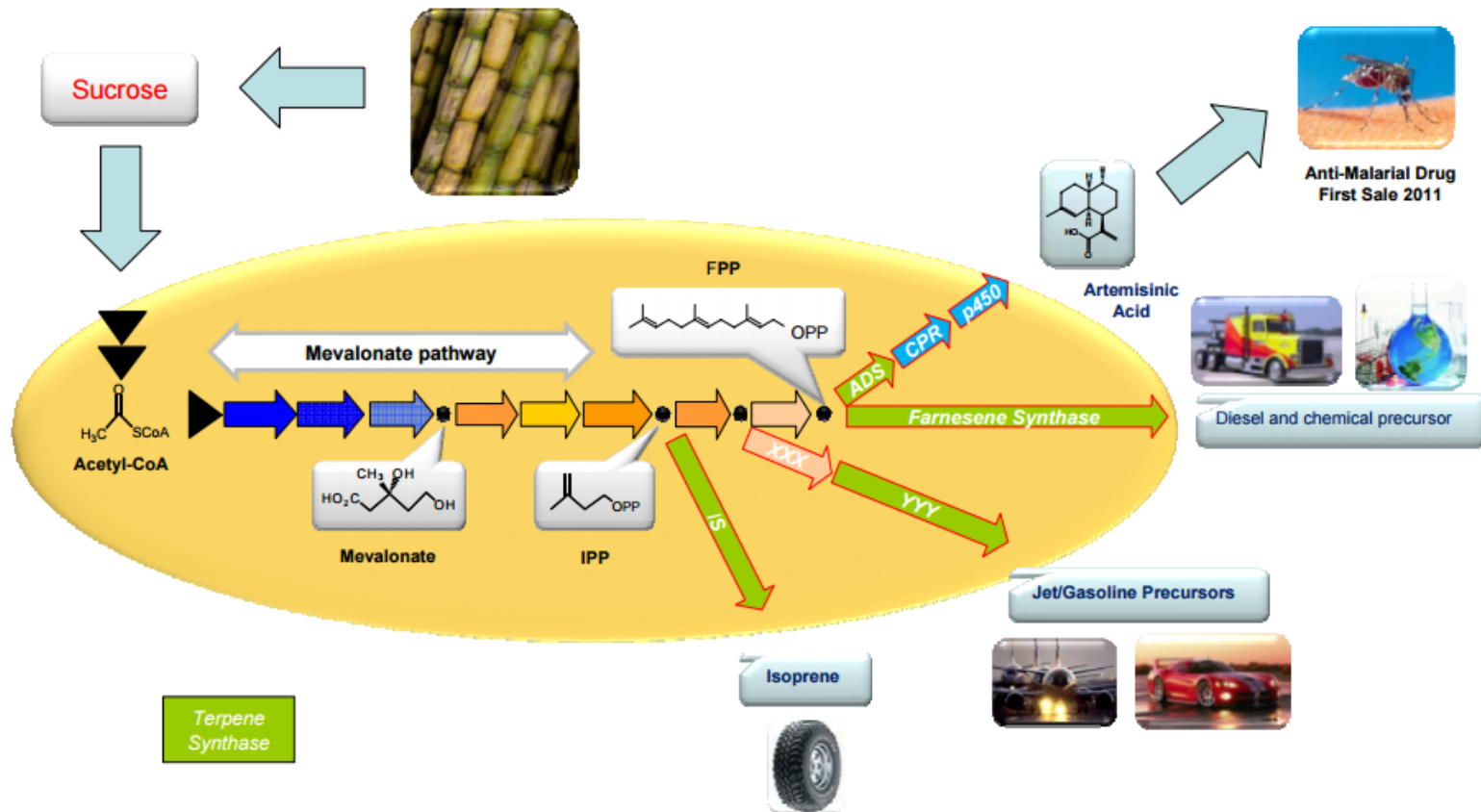
# Bio-based products – a focal point for health and sustainability

Food or Fuel?

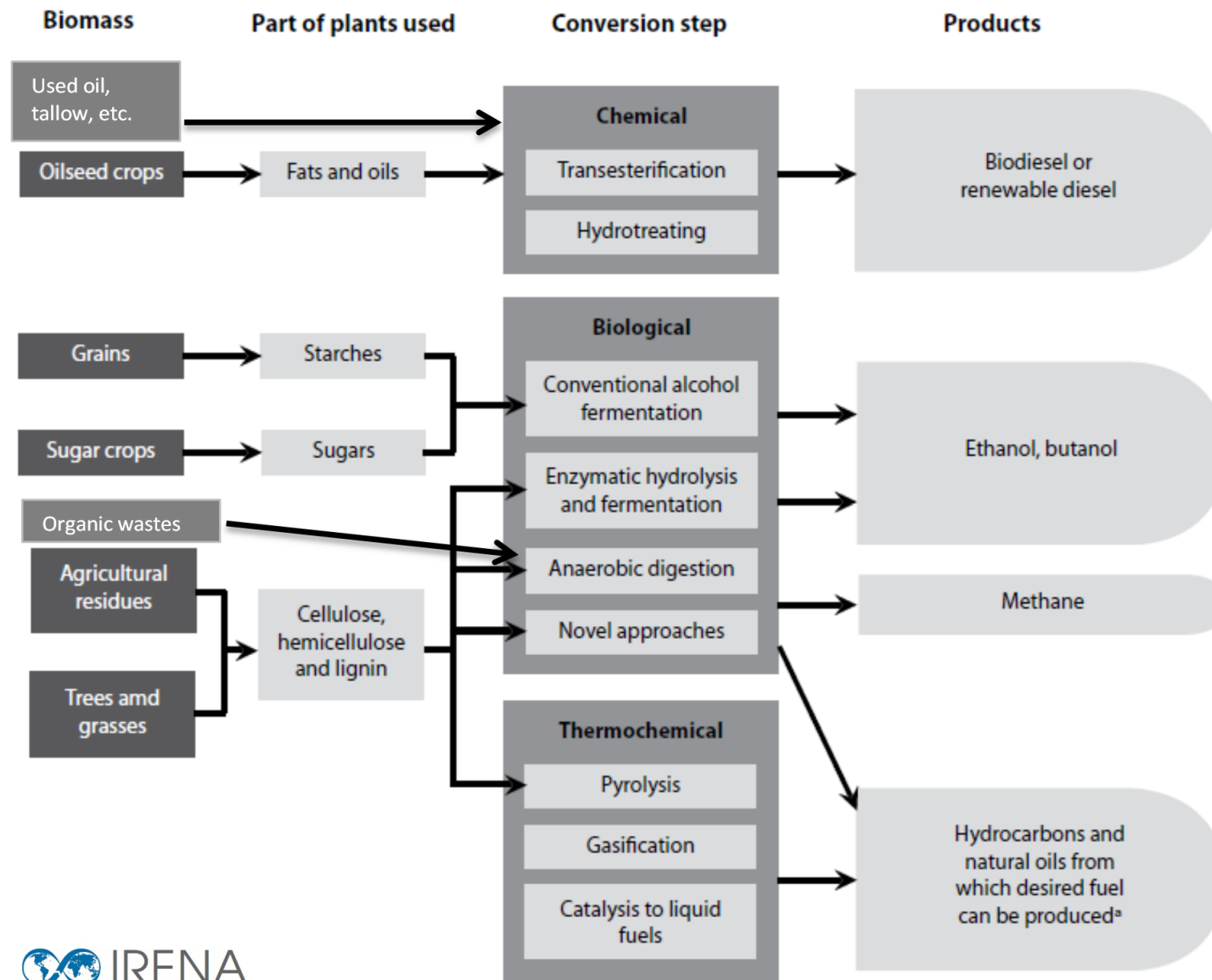


# Commonality in pharma and fuel production

A platform technology  
for production of multiple products

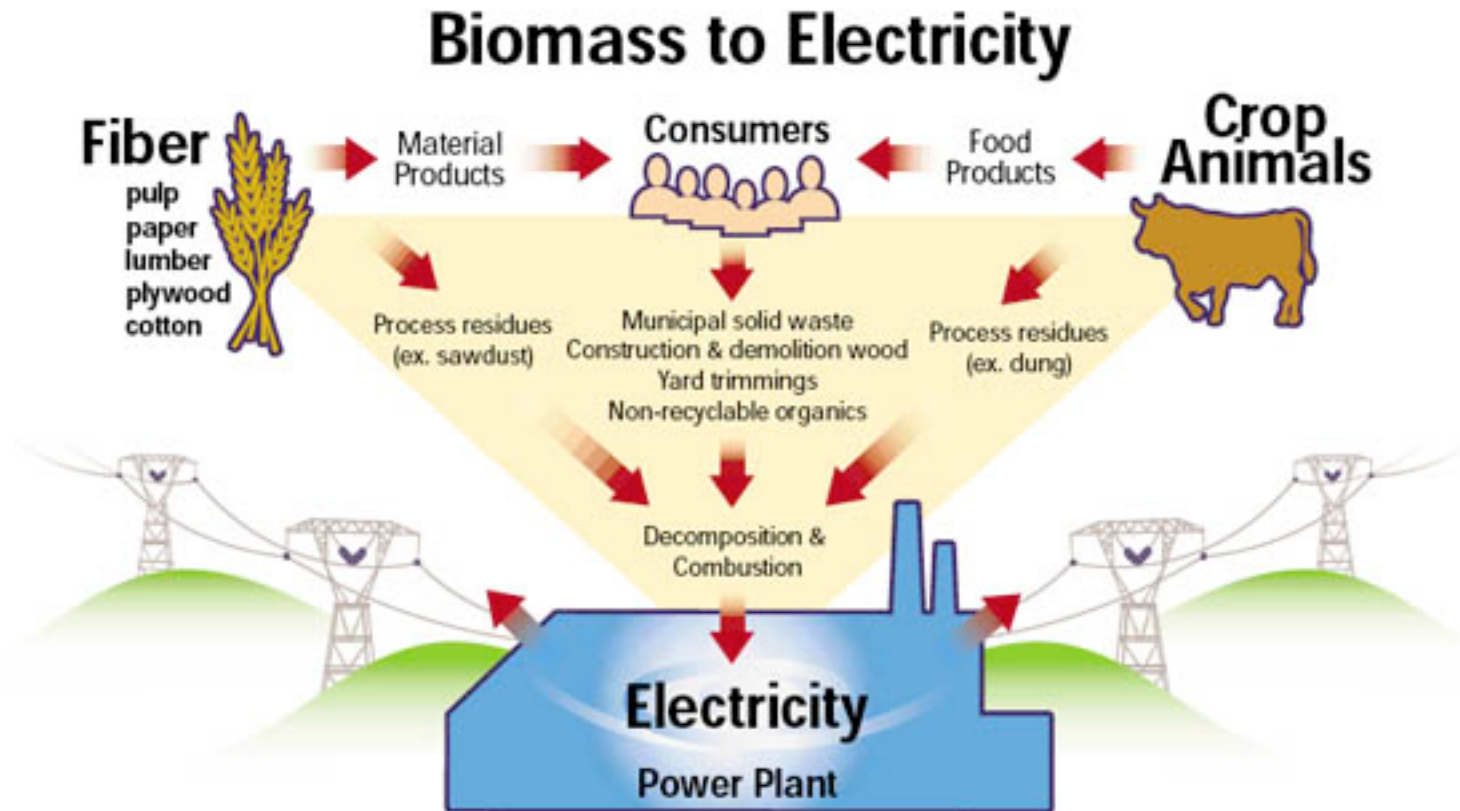


# Biofuel technology “pathways”





# California Energy Commission – vision for bioenergy



# Key products & players in the bioeconomy

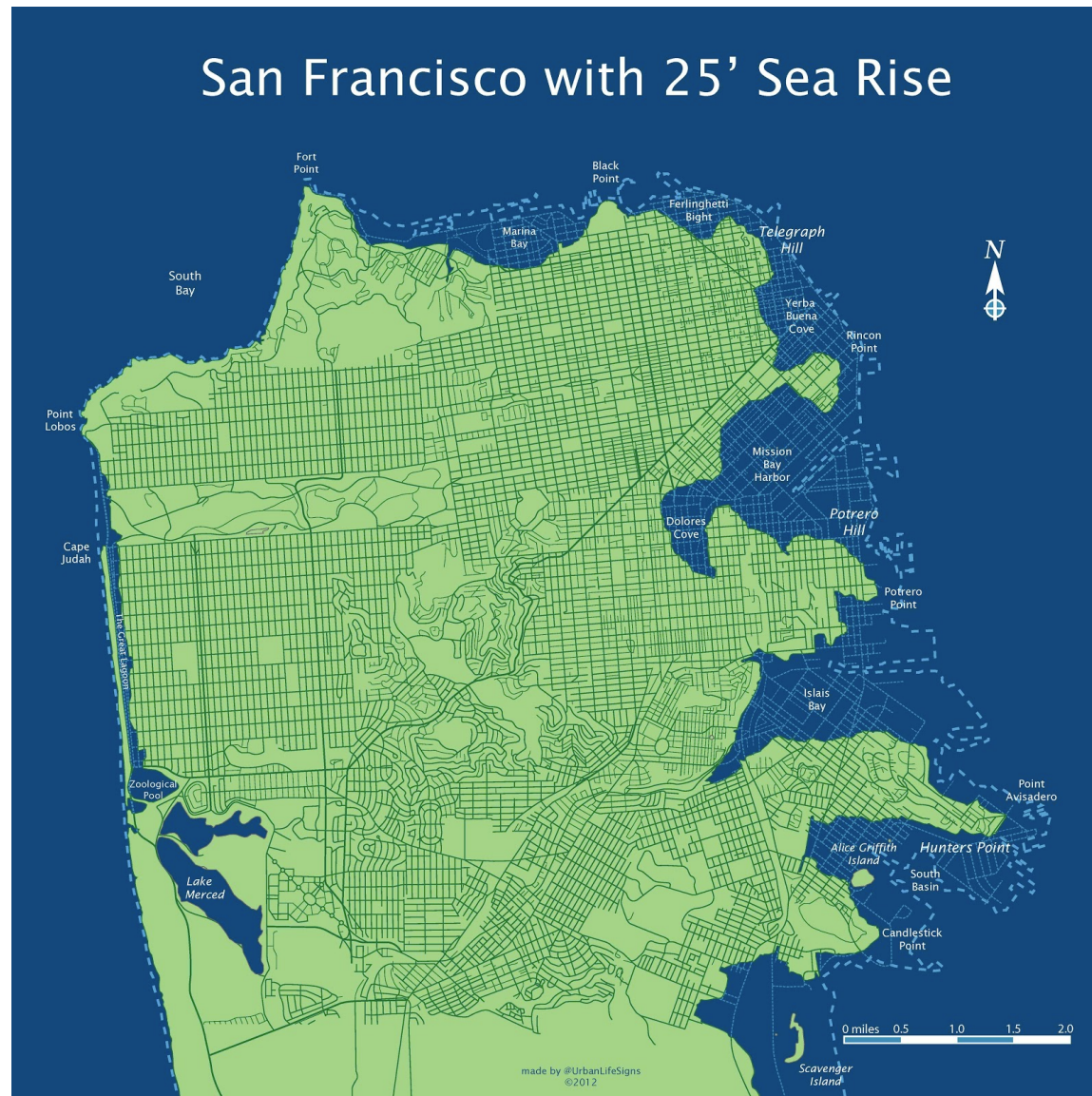
- Alcohols
  - Ethanol (cellulosic)
  - PDO & BDO
  - (iso-)butanol
- Acids
  - Aminos
  - Lactic & Succinic
- Hydrocarbons
  - Farnesene
  - Isoprene & butadiene
- Oils & derivatives
  - Algal



# But, climate change is still happening: what if...

- **Sea levels rise by 20-30 feet due to melting ice** – mass population displacement (500+ million affected) and even more densely populated coastal regions with associated poverty and disease increase
- **Food and water supply chains are disrupted** – terrestrial and aquatic food production / harvesting becomes more costly and fresh water availability shifts at the regional and continental scale due to altered atmospheric and oceanic currents
- **More storms develop each year, and with greater severity** – higher incidence of storm-related damage, less predictable growing season duration
- **Air and water quality continue deteriorating** – ocean chemical composition changes (dissolved CO<sub>2</sub>) disrupt food chain, and particulate emissions from fossil carbon utilization create health risk at a global scale

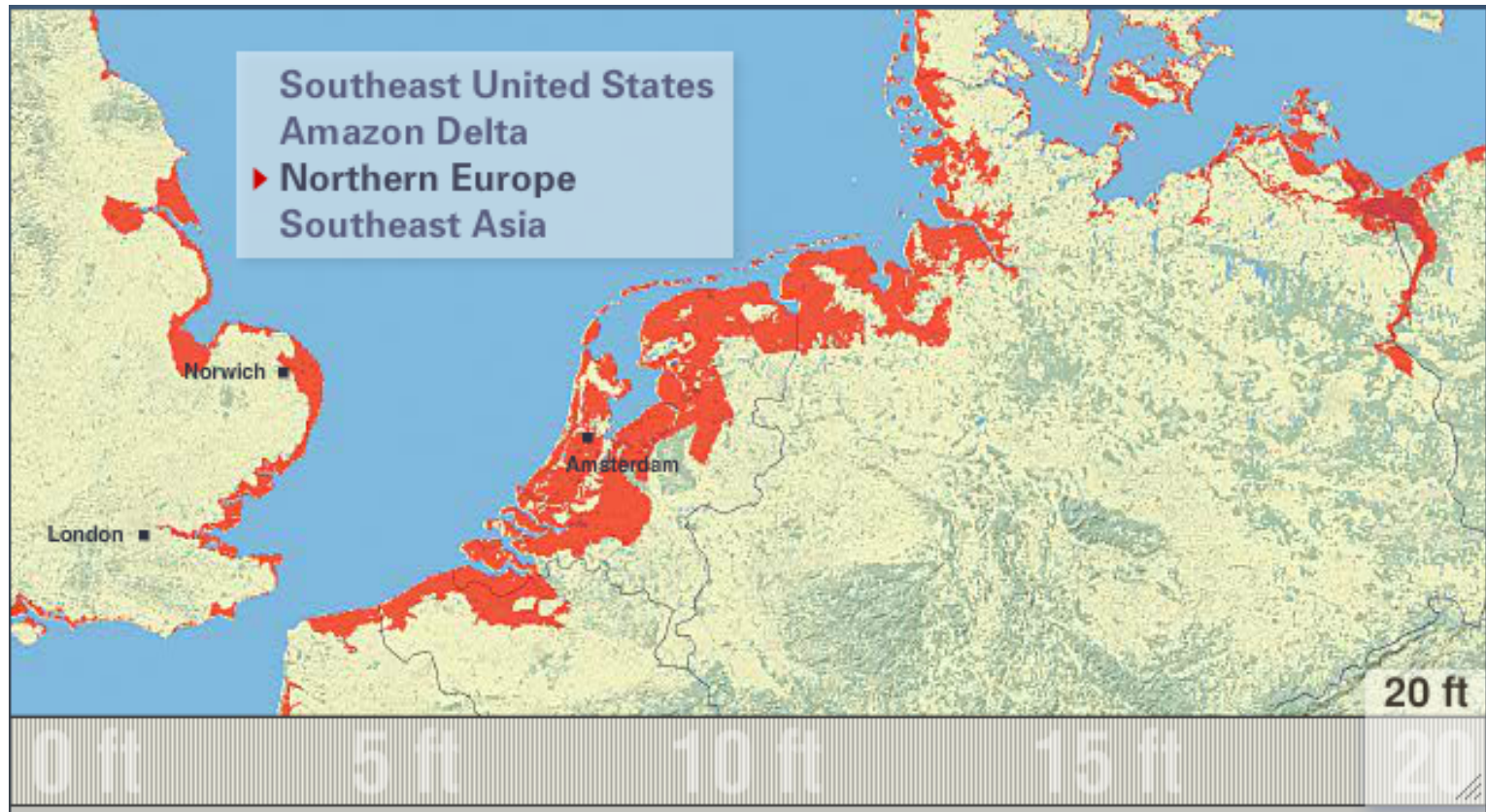
# A shift in beach-front real estate values



<http://urbanlifesigns.blogspot.com/2012/12/the-streets-of-flooded-san-francisco.html>



# Holland, Holland everywhere...

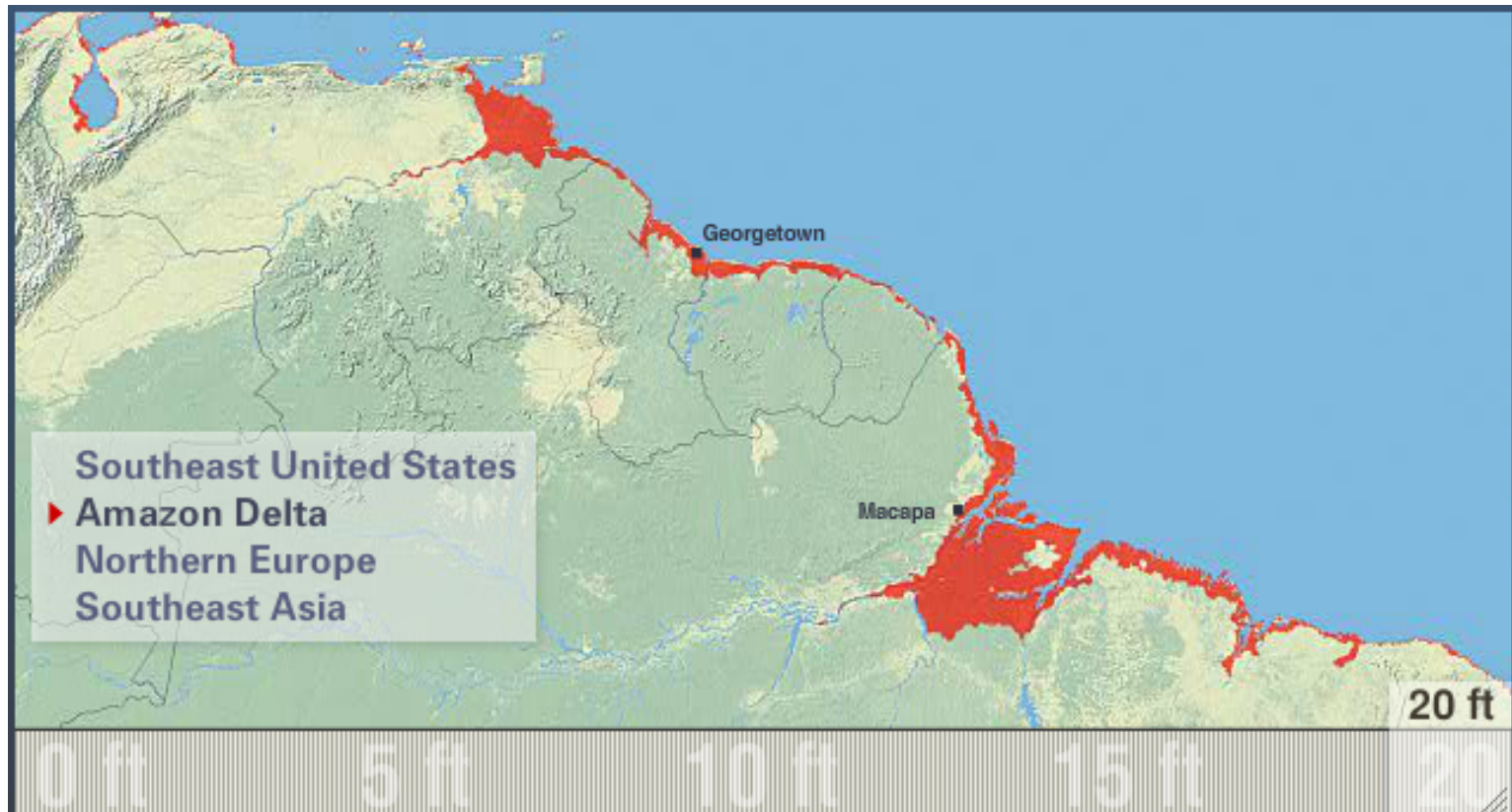




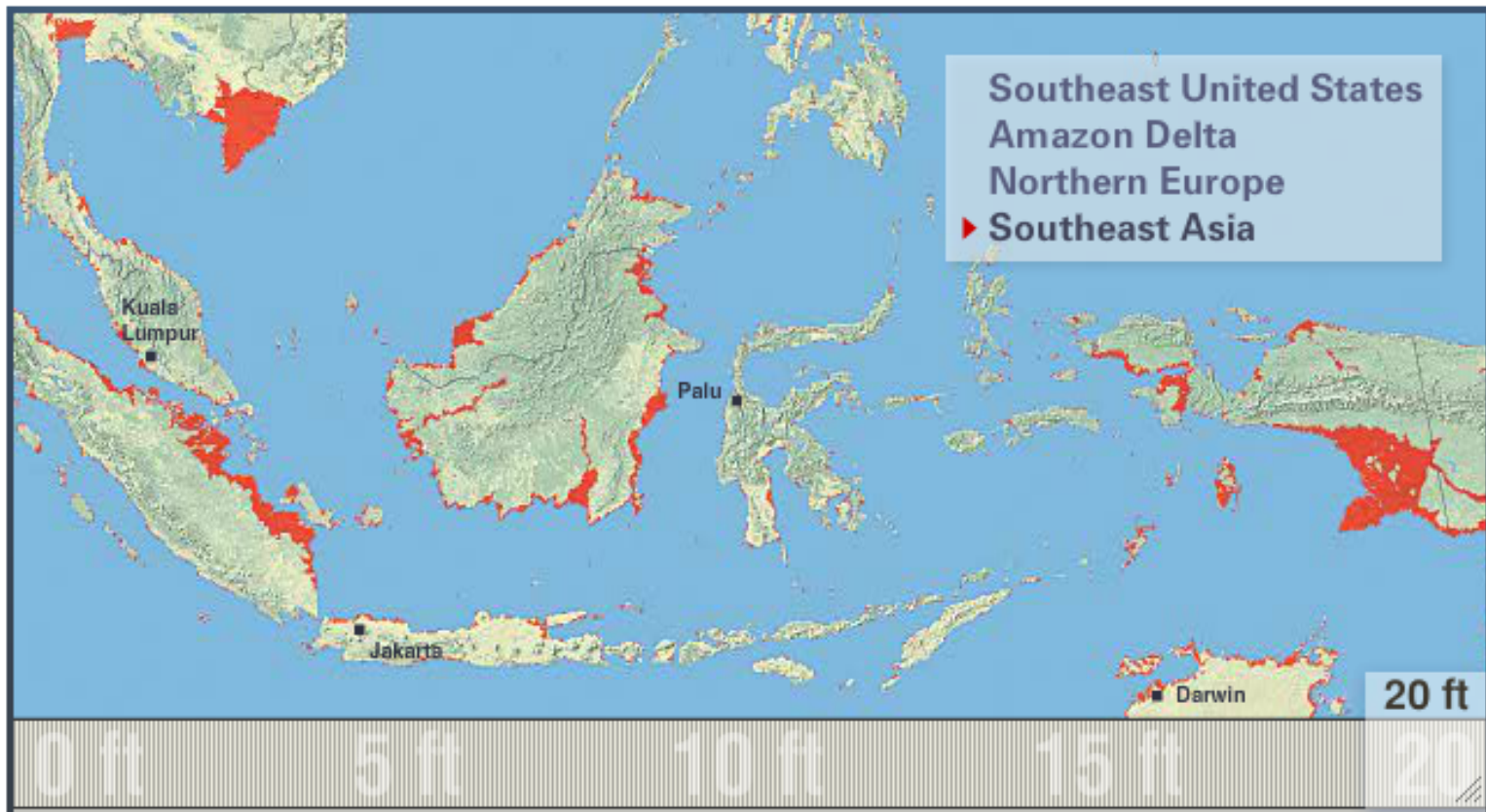
# As if it wasn't humid enough already...



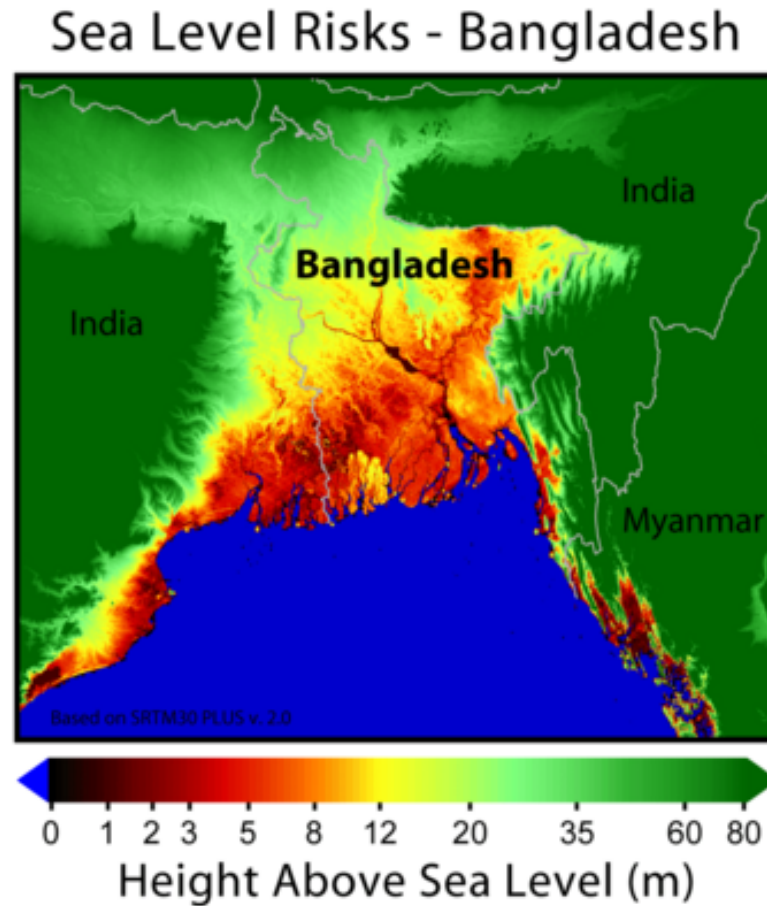
# No longer a delta...



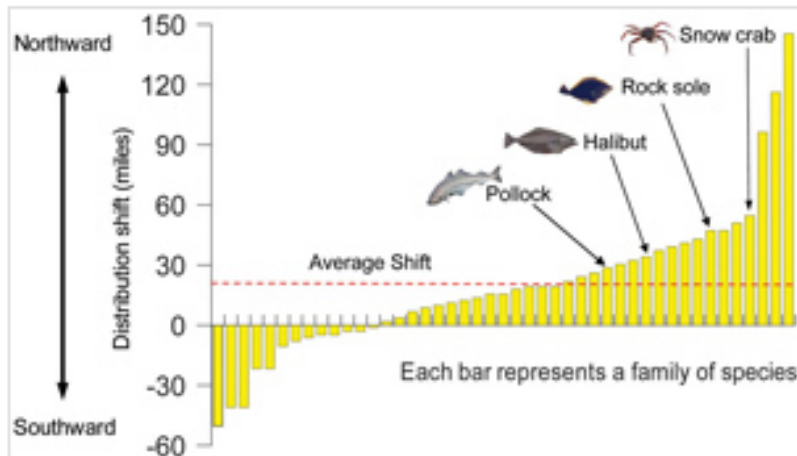
# Not so funny anymore



Really not funny



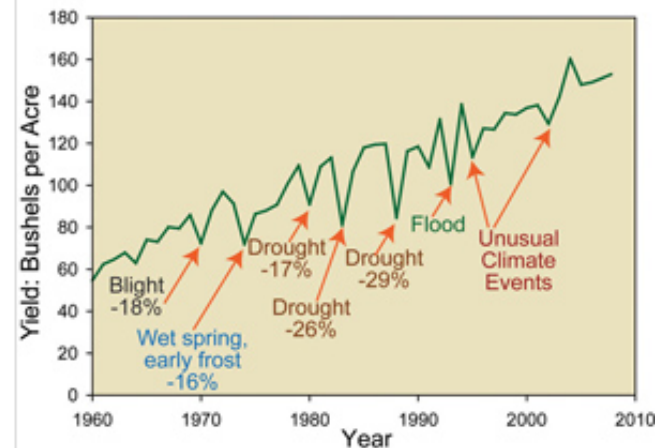
# Shifting and more volatile food supplies



[View enlarged image](#)

The ranges of marine species have shifted northward as waters have warmed.

Source: USGCRP (2009)



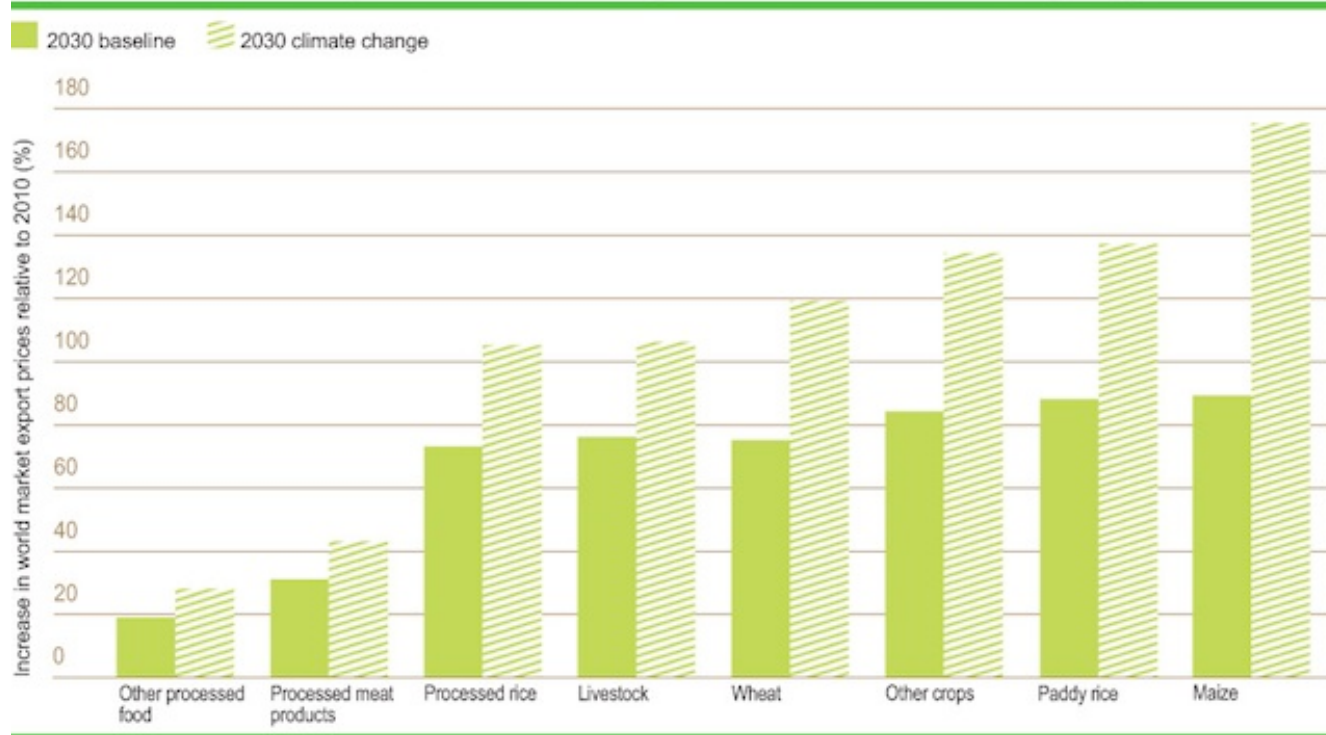
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Despite technological improvements that increase corn yields, extreme weather events have caused significant yield reductions in some years. Source: USGCRP (2009)



# More expensive food, globally

**Figure 10: Predicted impact of climate change on world market food export prices to 2030**



# Unexpected, and really dangerous...

## Lightning Expected to Increase by 50 Percent with Global Warming

News Release [Robert Sanders](#) (510) 643-6998 • **NOVEMBER 13, 2014**

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Today's climate models predict a 50 percent increase in lightning strikes across the United States during this century as a result of warming temperatures associated with climate change.

Reporting in the [Nov. 14 issue](#) of the journal *Science*, climate scientist David Roms of Lawrence Berkeley National Laboratory and the University of California, Berkeley, and his colleagues look at predictions of precipitation and cloud buoyancy in 11 different climate models and conclude that their combined effect will generate more frequent electrical discharges to the ground.

<http://newscenter.lbl.gov/2014/11/13/lightning-expected-to-increase-by-50-percent-with-global-warming/>

# It's not just about climate change...

## New Research Quantifies Health Benefits of Reducing Greenhouse Gas Emissions

News Release [Allan Chen](#) 510-486-4210 • **NOVEMBER 18, 2014**

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Reducing greenhouse gas (GHG) emissions, which result from the burning of fossil fuels, also reduces the incidence of health problems from particulate matter (PM) in these emissions.

A team of scientists at the Lawrence Berkeley National Laboratory (Berkeley Lab), the National Institute of Environmental Health Sciences (NIEHS), RAND Corp., and the University of Washington, has calculated that the economic benefit of reduced health impacts from GHG reduction strategies in the U.S. range between \$6 and \$14 billion annually in 2020, depending on how the reductions are accomplished. This equates to a health benefit of between \$40 and \$93 per metric ton of carbon dioxide reduction.

# So what are we doing about it...

- Roll movie...
  - <https://www.youtube.com/watch?v=GU0Cu45cLT4>
- Bioenergy: America's Energy Future
- **U.S. Department of Energy**
- **Published on Aug 19, 2014**
- Bioenergy: America's Energy Future is a short documentary film showcasing examples of bioenergy innovations across the biomass supply chain and the United States. The film highlights a few stories of individuals and companies who are passionate about achieving the promise of biofuels and addressing the challenges of developing a thriving bioeconomy. This outreach product supports media initiatives to expand the public's understanding of the bioenergy industry and sustainable transportation and was developed by the U.S. Department of Energy Bioenergy Technologies Office (BETO), Oak Ridge National Laboratory, Green Focus Films, and BCS, Incorporated.

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# Other bio-products at forefront of commercial scale-up



Hydrocarbon production (farnesene) using yeast fermentation in Brazil



Succinic acid production using bacterial fermentation in Louisiana



Fatty acid, lipid and protein production using algae fermentation in Brazil



# Multinationals making a difference

## Bayer MaterialScience launches the first bio-based polyurethanes for textile coating

📅 23 April 2015 👤 II Bioeconomista

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# Small companies at the cutting edge

## China Steel green-lights commercial-scale LanzaTech advanced biofuels project

April 22, 2015 | Jim Lane

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Phase 1 will



30

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produce 17M gallons/year of gasoline blendstock and ethanol; in Phase 2, a 34M gallon facility.

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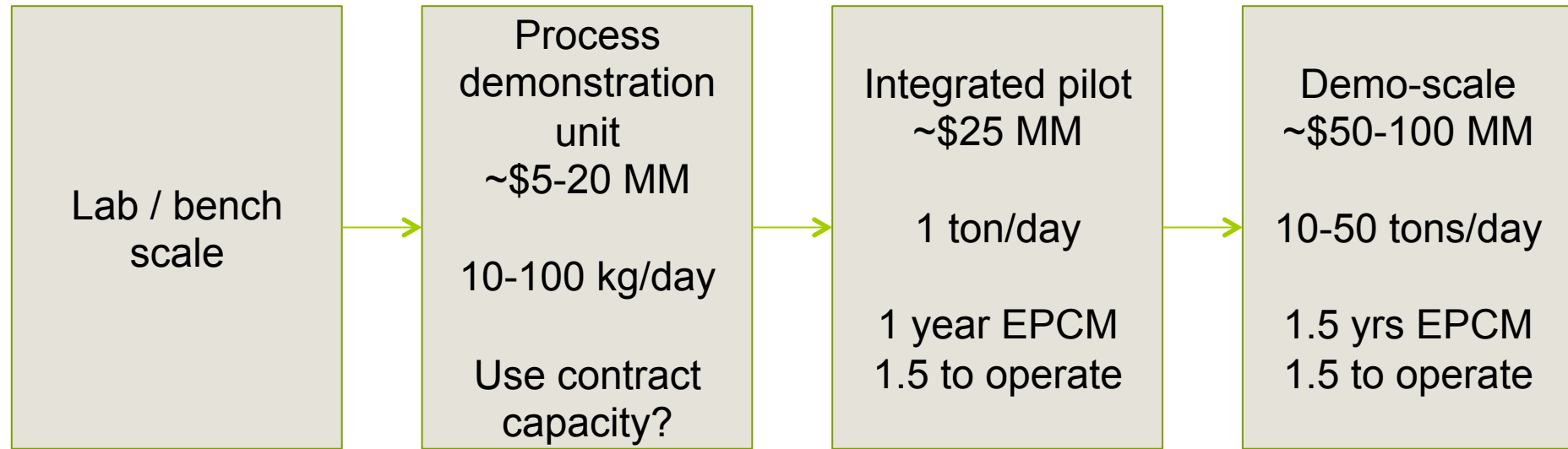
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**In Taiwan,** China Steel Corporation announced formal Board approval of a \$46M capital investment in a LanzaTech commercial ethanol facility. This follows the successful demonstration of the revolutionary carbon recycling platform at the White Biotech

Demonstration Plant in Kaohsiung using steel mill off gases for ethanol production.

# The pathway to commercialization for new bio-products



Critical to success: Robust front-end process development, realistic planning (cost, schedule, technical and commercial objectives), and a clear stage-gate process for investing in scale-up and product launches.

# The challenge

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- The technologies exist for more sustainable products – but volumes and production cost are still too small and too large, respectively, relative to fossil-derived fuels, energy and materials
- Scaling up the entire supply and value chain, from feedstock to products, is an immense undertaking, especially with perceived risk in the market.
- What price makes sense, if any, to account for environmental impact or benefit of specific products?

# A rising tide of public opinion...

## Industry poll: Majority supports ethanol mandate

 10   26  4 

COMMENTS 13



By Timothy Cama - 04/27/15 10:46 AM EDT

Thinkstock

More than six in 10 voters support the law that requires that ethanol and biodiesel are blended into traditional fossil fuels, according to a poll commissioned by a biofuel industry group.

The **survey**, conducted by Morning Consult, found majority support for the renewable fuel standard among Democrats, Republicans and independent voters. Only 18 percent of respondents opposed it, according to the findings released Monday.

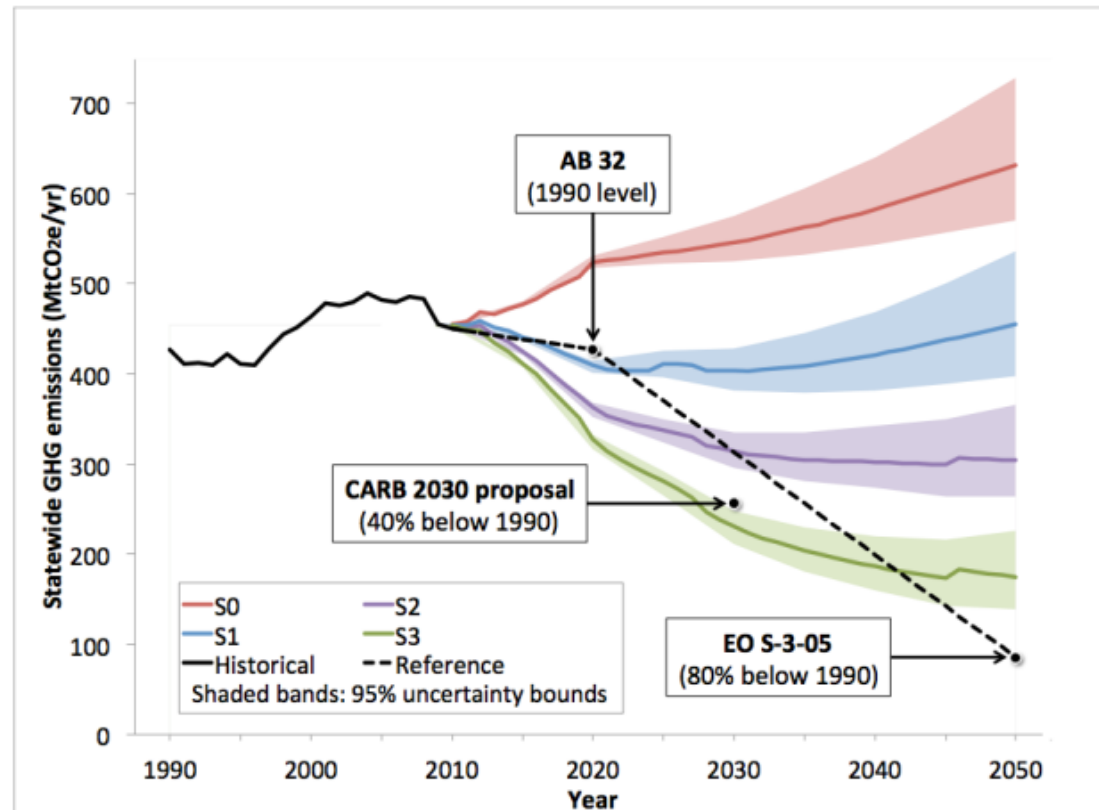


And progress...

## California's Policies Can Significantly Cut Greenhouse Gas Emissions through 2030

New Berkeley Lab model finds state will meet 2020 reduction goals.

News Release [Julie Chao](#) (510) 486-6491 • JANUARY 22, 2015



The CALGAPS model shows greenhouse gas emissions through 2050 under four different scenarios.

<http://newscenter.lbl.gov/2015/01/22/californias-policies-can-significantly-cut-greenhouse-gas-emissions/>

# What should we do

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- **Educate** – to better enable technology and workforce development
- **Advocate** – to support policies and incentives for increased biofuel/energy/product commercialization
- **Integrate** – so we can improve food, fuel and other product processes in parallel and make the system more efficient
- **Invest** – in companies and products that best meet your ideas for sustainability in the global challenge we ALL face

# Thank you!

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510-486-6053