Austin Energy Generation Task Force

Wind/Compressed Air Energy Storage

WindSoHy
Joe Spease, CEO
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The WindSoHy Difference Wind/CAES/H2

- Unique technologies
- Plant is energy efficient and reliable
- Major cost advantages
- Cost benefits from clean, renewable energy; no fossil fuels used in our process
- Lower cost of energy for customers
- Supported by DOE

Technological Advantage

- Wind power at night is the key element (renewable and inexpensive)
- Compressed air is heated before hitting the turbine blades
- Traditional CAES plants use NG combustion
- WindSoHy uses H2/Oxy
- Efficient and Reliable

Depleted Gas Wells for Storage

- Existing CAES projects use caverns mined from salt domes
- WSH prefers depleted gas wells
- Lower cost to develop and maintain
- Large size allows for bulk scale

WindSoHy Cost Advantages

- Wind, waste water and H2 are a fraction of the fuel cost of NG (10-20%)
- Electricity from fracked gas cannot compete with Wind/CAES
- NG price volatility is avoided
- 1 cent per kWh for compression/H2 charge

WSH Project Suggestions

- Bulk scale creates a price advantage for customer
- Oversize to produce energy for Ancillary Services (2000-3000 MW)
- Sell excess energy on wholesale market
- Produce H2 to lower fuel costs for city vehicles

Project Funding

- DOE funding for energy storage
- Bond project financing support
- DOE funding to lower project costs
- DOE funding for vehicle conversion

WindSoHy CAES/H2 Best Choice for Austin Energy

- Lowest priced baseload power
- Avoids climate damage; no GHG emissions
- Eliminates future price increases/volatility of fossil fuel cost
- Greater efficiency and reliability than gas, coal and nuclear
- Opportunities for project finance help from DOE are greater than for NGCC

NG Problems Going Forward

- Breakeven price for fracked gas $7-8/mmBtu

  Arthur Berman, Petroleum Engineer

- Fugitive methane at NGCC plants produces 2-5 times more GHG emissions than coal

  Cornell study

- Casing failures at frack wells start at 5-10% in the first year and increase annually
- Carbon taxes and future cost to reduce methane emissions will increase NG prices

Growing Body of Evidence on Methane Gas Emissions

- Methane emissions from wells in Denver Julesberg Basin average 19 metric tons per hour (75% of total methane emissions from all sources); and were3 times more than previously estimated

"G. Petron et al, Journal of Geophysical Research—Atmospheres, 2014
National Oceanic and Atmospheric Administration (NOAA)
Cooperative Inst. Research in Environmental Sciences (CIRES)

- Methane emissions during drilling phase of southwestern PA wells were 100-1000 times greater rate and 2-3 times more than previously estimated by EPA

D R Caulton et al, Proceedings of National Academy of Sciences, 2014

Leaks in U.S. Natural Gas System

- Review of more than 200 studies confirms that U.S. emissions of methane are considerably higher than official estimates

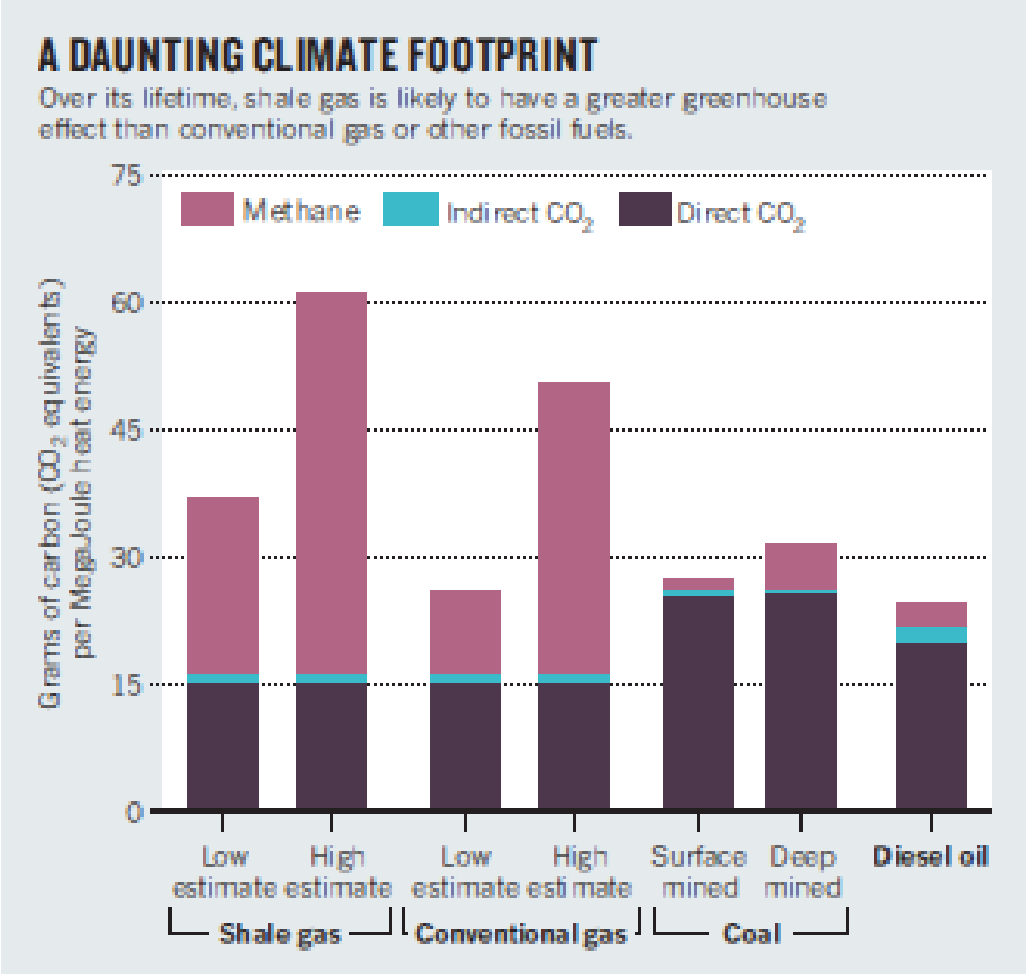
Adam Brandt et al, Feb. 2014, Science Journal
American Assoc. Advancement of Science (AAAS)

- If methane leakage rate is only 1.2 percent, it wipes out the entire climate benefit from increasing natural gas use in the utility sector

- Every ton of methane in the atmosphere has a global warming effect that is more than 20 times greater than a ton of carbon dioxide

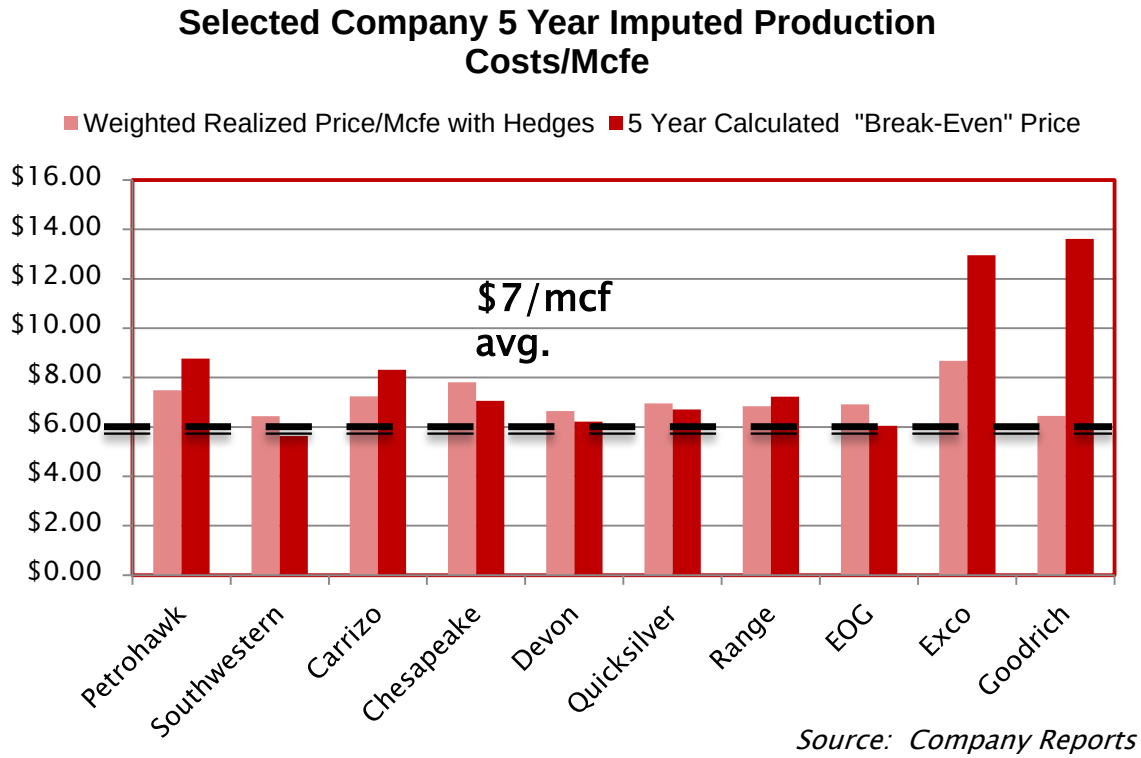
Shale gas vs Conventional or Coal

Global warming potential of methane



Howarth & Ingraffea, *Nature*, Sept., 2011

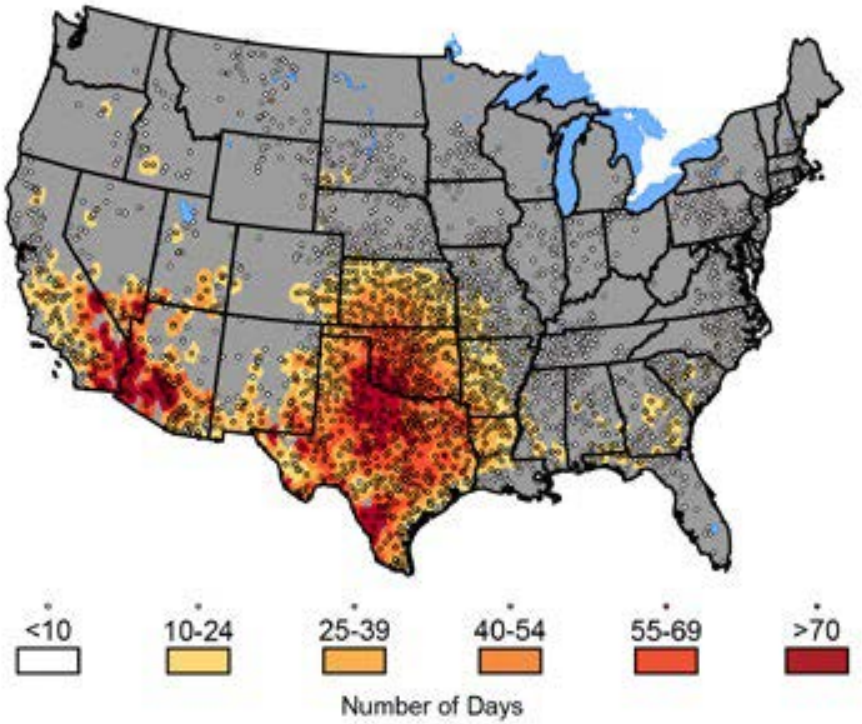
Natural Gas Cost Understated: True Break-Even Price is $7.00/mcf



- Claims of profitability at less than $5.00/mscf are based largely on point-forward economics at odds with costs reported to SEC in 10-K filings—all sunk costs written off.
- Price must rise to meet the true break-even cost.
- Several executives recently said 6/mcf is a minimum threshold to justify more drilling.

Arthur Berman, Labyrinth Consulting Services, Inc.
Duke University Nicholas School of the Environment

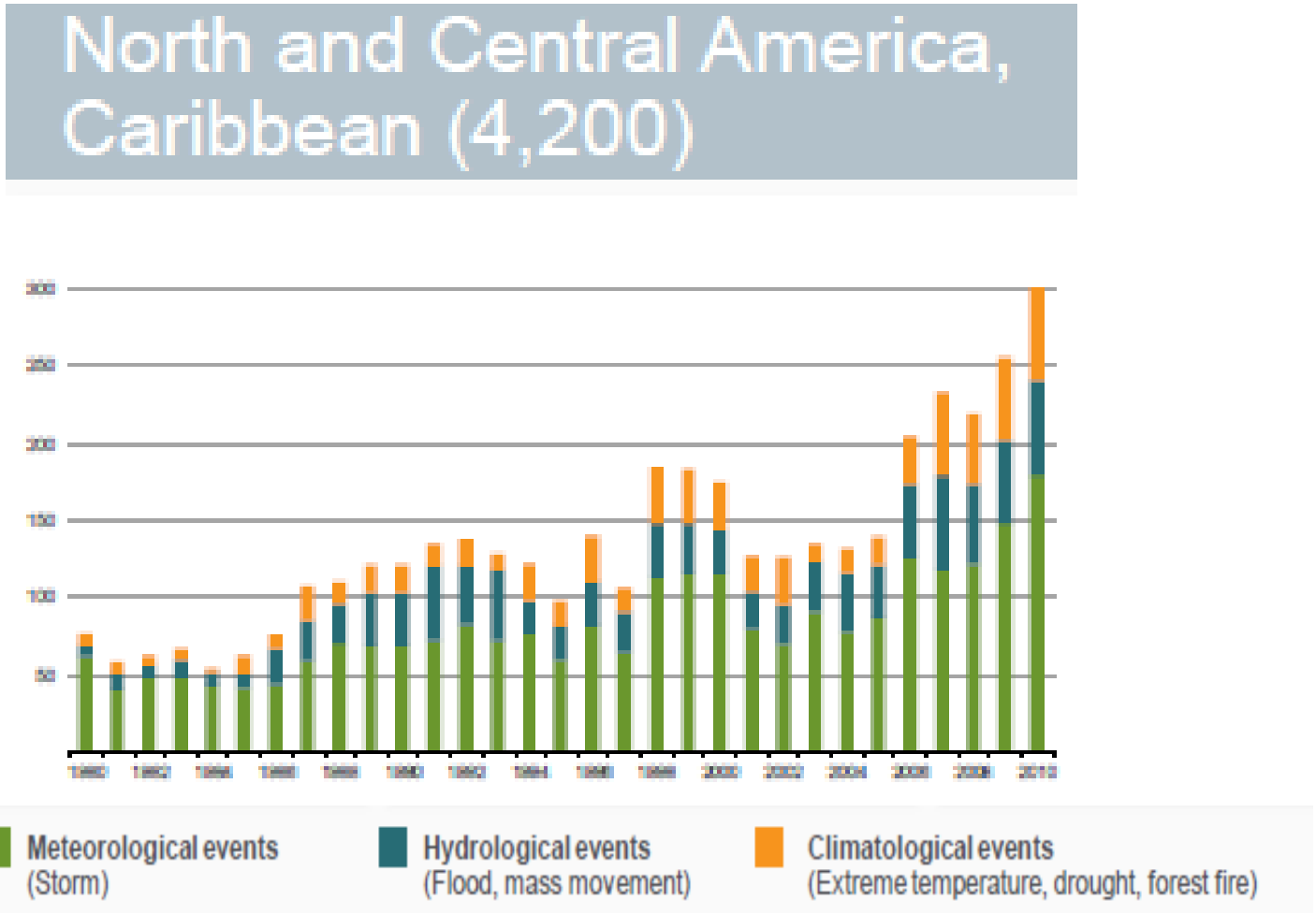
Lessons from the Environment



2011– Number of days with temperatures over 100.
Heat and drought depleted water resources and contributed to more than $10 billion in direct losses to agriculture. Severe water constraints strained the ability to meet electricity demands in Texas.

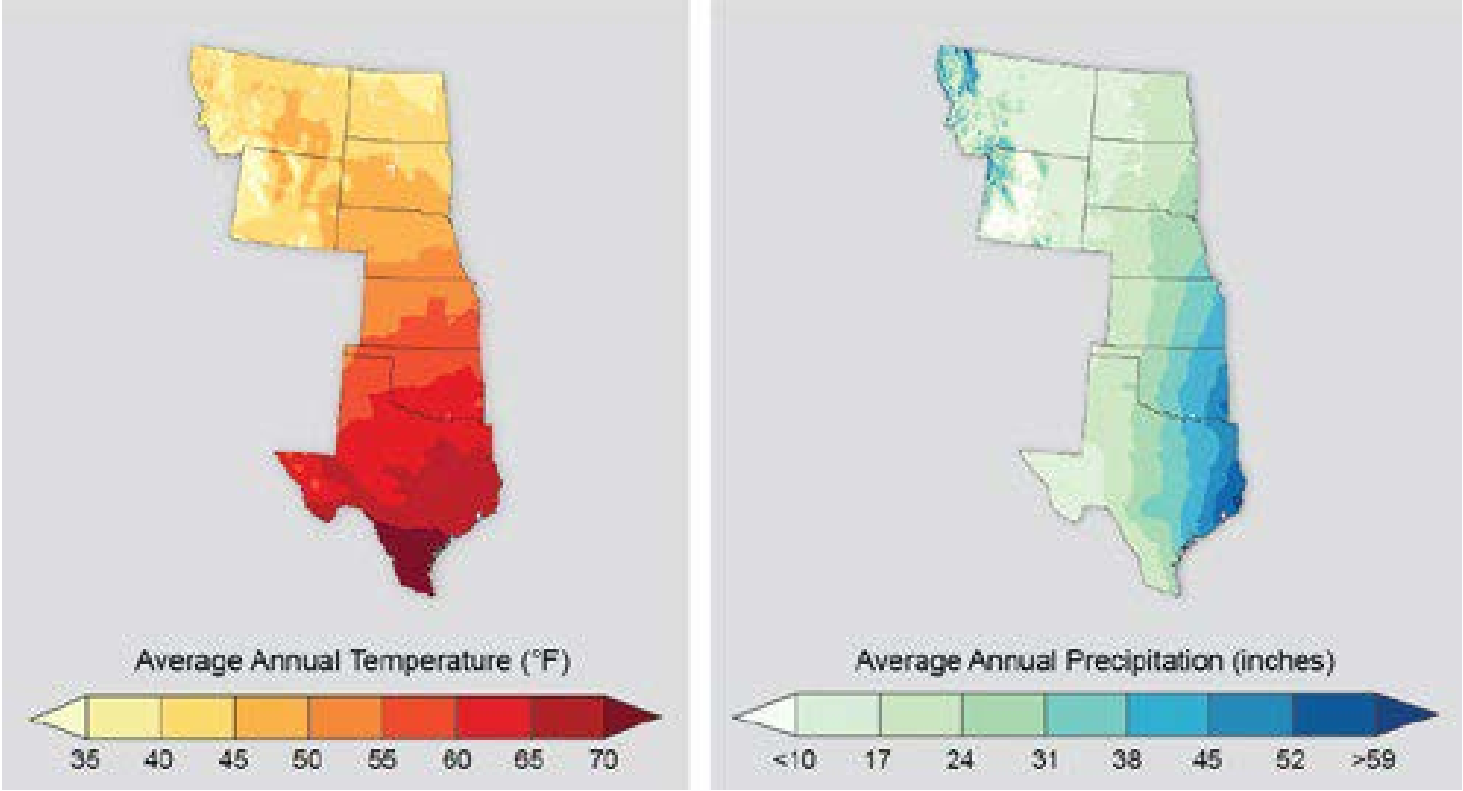
Third National Climate Assessment, May 2014
U.S. Global Change Research Program

Weather Catastrophes 1980–2010
Number of Weather Related Events



Munich RE, Geo Risks Research, March 2011

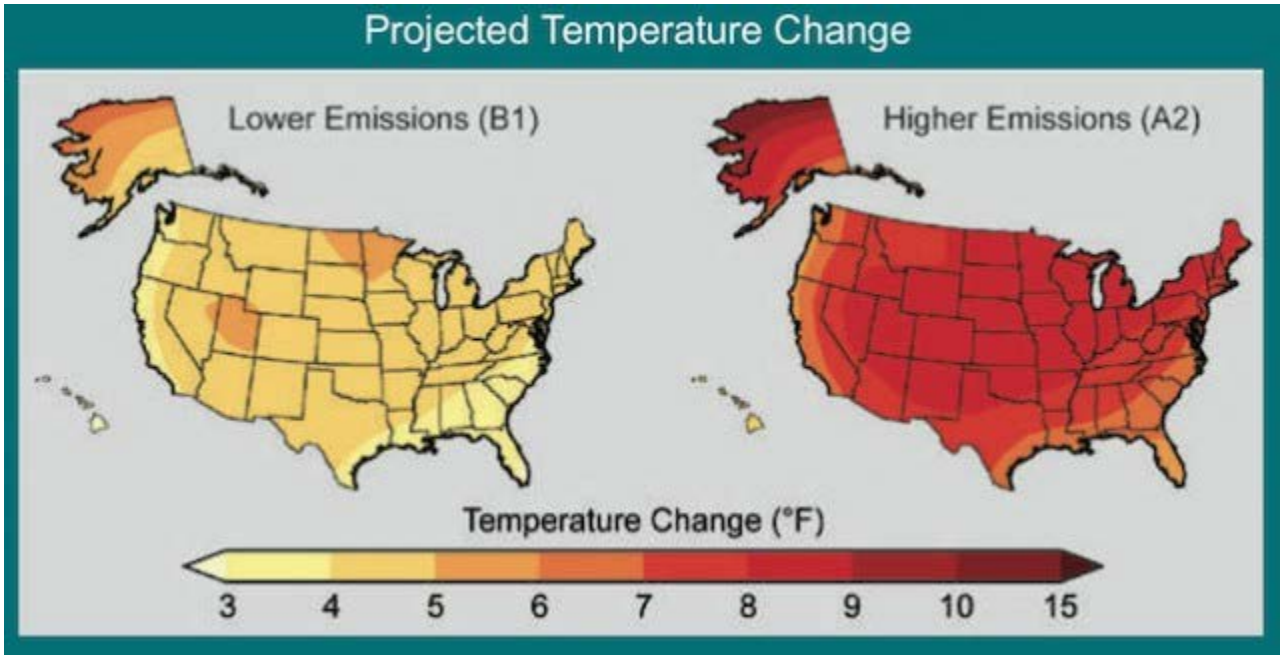
Great Plains: Home on the Range
Limit Methane Emissions to Preserve Climate?



Great Plains Temperature and Precipitation Distribution

Third National Climate Assessment, May 2014
U.S. Global Change Research Program

Our Urgent Climate Choices:
Action or Inaction on GHG emissions

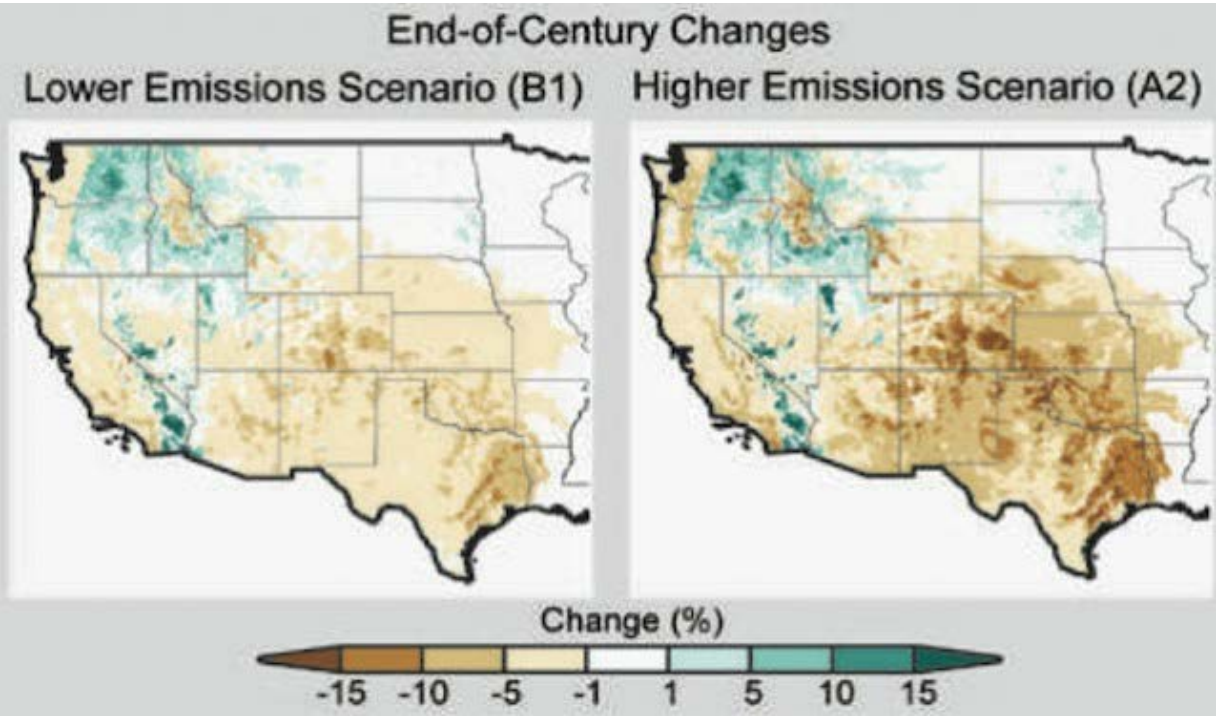


Projected average change in surface temperatures between years 2071-2100 compared to 1971-2000

Strong climate action OR continued inaction??

Third National Climate Assessment, May 2014
U.S. Global Change Research Program

Changes in Soil Moisture

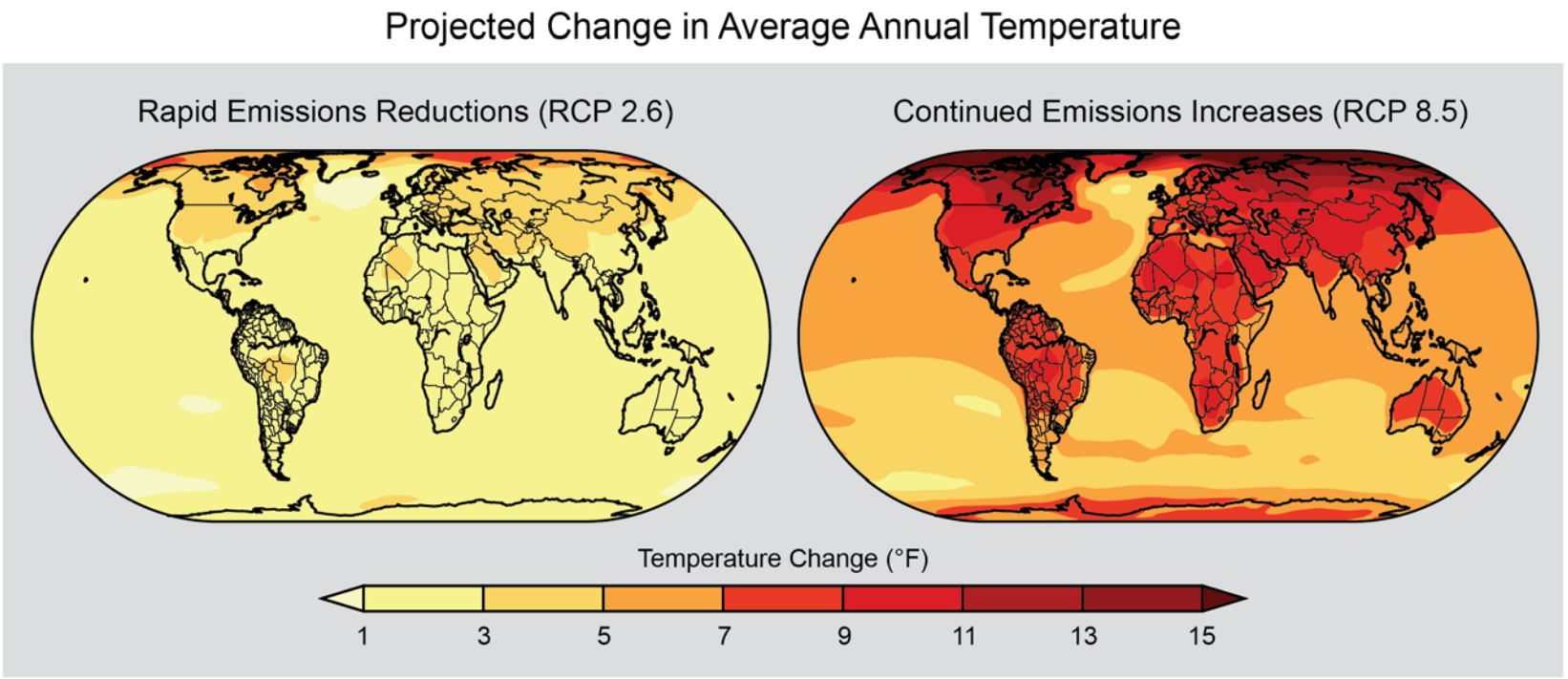


Projected average change in soil moisture between 2071-2100 compared to 1971-2000

Strong climate action OR continued inaction??

Third National Climate Assessment, May 2014
U.S. Global Change Research Program

Which world will we leave our children?



Changes in average annual temperature 2071-2099 (compared to 1970-1999). Compares a low emissions scenario assuming we make rapid reductions in concentrations of heat-trapping gases vs a scenario with continued increases in emissions. Figure source: NOAA NCDC/CICS-NC)

Third National Climate Assessment, May 2014
U.S. Global Change Research Program

AUSTIN'S CHOICE:

Wind/CAES/H2 VS Natural Gas

Competition for Future of Environment

Invest in smart, renewable energy to save the climate, agriculture, vital natural resources, money, and preserve our children's future!

VS

Pollute atmosphere with GHG, and burn up limited carbon-based resources for energy. Forget about our future!

Competition for Water

Use wastewater to create plentiful, clean, abundant H2 for transportation fuel

VS

Pollute local water and groundwater for hydraulic fracturing to release natural gas

AUSTIN'S CHOICE:

Risky investing in . . . . .

- Rising energy and fuel costs; carbon taxes
- Methane emissions; deteriorating climate
- Rising average temperatures; competition for water
- Droughts and reduced soil moisture
- Agricultural, social and economic challenges

or WindSoHy CAES/H2, the best choice for Austin's Energy Future