Themes

• Change of some kind is inevitable
  » through policy or the lack thereof

• When and what changes occur, and who experiences them, will depend on what we do and how nature responds.

• Hedge your bets.
Climate and Property: What are the linkages?

- **Impacts**: Projected climatic disruptions that affect property values
- **Adaptation**: Response of individuals, markets, and policy to climate disruptions
- **Mitigation**: Economic effects of policies to mitigate emissions
Climate Change Impacts

• Historical

• Projected
  » Emissions scenarios
  » Climate sensitivity

• Location, location, and location
What is the risk to global temps?

Thought experiment: $\Delta T$ to 2100, no policy

Source: MIT Joint Program on the Science and Policy of Global Change
http://globalchange.mit.edu/resources/gamble/no-policy_F.html
We buy a better wheel if we stabilize concentrations, e.g. at approx 550 ppmv.

Source: MIT Joint Program on the Science and Policy of Global Change
http://globalchange.mit.edu/resources/gamble/policy_F.html
National Impacts: United States

• *Global Climate Change Impacts in the United States*, US government, 2009

Source: GCCIUS
www.globalchange.gov
National

- Climate-related changes are already observed in the United States and its coastal waters.
  - Heavy downpours, rising temperature and sea level, rapidly retreating glaciers, thawing permafrost, lengthening growing seasons, lengthening ice-free seasons in the ocean and on lakes and rivers, earlier snowmelt, and alterations in river flows.
- These changes are projected to grow, especially in a “high emissions” scenario.

Source: GCCIUS
Why are changes bad?

• They’re not all bad.

• But:

• Our built environment fits the climate we’ve had.

• The rate of change may be rapid, making it hard for people and ecosystems to adapt.
Southwest Regional Predictions

- Increasingly scarce water supplies
- Increasing temperature, drought, wildfire, and invasive species
- Increased frequency and altered timing of flooding
- Decreased snow- and water-related tourism and recreation

Source: GCCIUS
Projected Temperature Increases in the Southwest

The average temperature in the Southwest has already increased roughly 1.5°F compared to a 1960-1979 baseline period. By the end of the century, average annual temperature is projected to rise approximately 4°F to 10°F above the historical baseline, averaged over the Southwest region. The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible.

Source: GCCIUS
Projected Precipitation in 2080-99 Relative to 1961-79

Lower Emissions Scenario\textsuperscript{91}

Higher Emissions Scenario\textsuperscript{91}

Percentage change in March-April-May precipitation for 2080-2099 compared to 1961-1979 for a lower emissions scenario\textsuperscript{91} (left) and a higher emissions scenario91 (right). Confidence in the projected changes is highest in the hatched areas.

Source: GCCIUS
Projected Change in Runoff 2041-2060 relative to 1901-1970

Runoff, which accumulates as streamflow, is the amount of precipitation that is not evaporated, stored as snow pack or soil moisture, or filtered down to groundwater. Projected changes in median runoff for 2041-2060, relative to a 1901-1970 baseline, are mapped by water-resource region. Colors indicate percentage changes in runoff. Hatched areas indicate greater confidence due to strong agreement among model projections. White areas indicate divergence among model projections. Results are based on emissions in between the lower and higher emissions scenarios.\(^{91}\)
Water stress could get worse anyway

• The population of the Mountain West (Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico) is projected to increase 65% from 2000 to 2030

• This would account for 1/3 of all projected U.S. population growth.

Source: GCCIUS
Adaptation in the US

- Over the long run, most cities will adapt.
- People will migrate from uneconomic or unsafe areas to areas more hospitable.
  - Mean temperature is a poor predictor of per capita income in the US.
- US is generally wealthy enough to adapt over many decades. Poorest in US and poor countries are most vulnerable.
- Extreme outcomes could overwhelm even US adaptation capacity.
- Haven’t considered ecosystems.
Mitigation: Cap-and-trade

- Set total allowable emissions in a given period
- Allocate allowances.
- Allow trading of allowances.
- Require covered entities to hold allowances
- Firms cover emissions with allowances unless abating is cheaper.
Waxman-Markey, HR 2454

• Passed House in June 2009
• Title 3 is Cap-and-trade
• 1418 pages
• 17 % reduction in US GHG emissions relative to 2005 by 2020
• 83% reduction by 2050
Energy Prices
H.R. 2454 Scenario Comparison (ADAGE)

- Gasoline and natural gas prices are inclusive of the allowance price (i.e. they represent the price faced by consumers, not the price received by producers which would be exclusive of the allowance price).
- The gasoline price is obtained by multiplying the petroleum price index in ADAGE by the 2010 price of gasoline from the AEO 2009 projection.
- The allocations to electric local distribution companies (LDC’s) prevent the household electricity price from increasing until the allocations phase out beginning in 2025.
Household Energy Expenditures

H.R. 2454 Scenario Comparison (ADAGE)

- In 2020, electricity prices are equal to reference levels in "scenario 8 – Updated H.R. 2454." In 2030 they increase by 21% over reference levels, and in 2050 the increase is 36%.
- Actual household energy expenditures increase by a lesser amount due to reduced demand for energy.
  - In 2020, the average household’s energy expenditures (excluding motor gasoline) falls by 5% in scenario 8 – updated H.R. 2454." In 2030, the increase is 6% over reference levels, and in 2050 the increase is 17%.
- In ADAGE, energy expenditures represent approximately 2% of total consumption in 2020, falling to 1% by 2050 in all scenarios.
- The energy expenditures presented here do not include any potential increase in capital or maintenance cost associated with more energy efficient technologies.
- While energy expenditures begin to rise by significant amounts in 2030 to 2050, these increases are largely offset by the per-capita rebate, protection for low-income households, and other ways of returning allowance value to households. (Slide 20 shows the net impact on households accounting for both increased costs and return of allowance value.)
Predicted Electricity Prices with H.R. 2454

(2007 cents per kilowatthour, all sectors average)

Reference
- Basic
- High Offsets
- High Cost
- No International
- No Int / Limited

Energy Information Administration, US Dept of Energy
Regional effects of cap-and-trade

• The economic effects of climate policy differ across the country due to different production and consumption patterns of energy and other goods and services.

• “Carbon footprint” is an imperfect predictor of which regions are hit relatively harder by policy.

• Regional disparities in effects of a carbon price aren’t huge.

• Total effects on households depend on details of implementation.
Southern and Midwestern Metro Areas Have Larger Average Transportation and Residential Footprints than Western and Northeastern Metro Areas

Regional effects of a hypothetical tax of $20.91 per ton of CO2 based on consumption patterns in 2006

Figure 2.
RFF’s Estimates of a Cap-and-Trade Program’s Average Costs per Household as a Share of Income, by Region

Conclusion

• Climate change could make existing problems worse.

• Energy bills are likely to go up, either because of climate policy (sooner) or because of a hotter climate (later) or both.

• Water likely to be a worsening source of conflict in the southwest.

• Energy and water efficiency could be a cost effective hedge against whatever changes emerge.