Current Climate Studies 8:

CLIMATE CHANGE IMPACTS: SCIENTIFIC ASSESSMENTS ACROSS SECTORS AND REGIONS

1. Print this file. Also answer the "Concept of the Week" questions in the *Weekly Climate News* File. (Check for additional *News* updates during the week.)

2. Complete the Investigation by responding to the *Chapter Progress Questions* (*Study Guide*) and the Investigations 8A and 8B from the *Climate Studies Investigations Manual*, and this *Current Climate Study*.

Notice: A course requirement is to prepare a *Plan of Action* for your climate science resource teacher activities following the course completion. If you have not already, click to download the guidelines for that Plan of Action. Consult your LIT leader or mentor if you have questions.

Introduction:

The USGCRP's National Climate Assessment (NCA) is described by its authors as an essential tool for linking science and decision making. It surveys and synthesizes science, within and between disciplines and across sectors and regions. It highlights key knowledge that can improve policy choices and identify significant gaps that can limit effective decision making. It also tracks progress by identifying changes in the condition of the Earth, changes in human response, and advances in science over time.

The Third NCA (NCA3) analyzes impacts on seven sectors – human health, water, energy, transportation, agriculture, forests, and ecosystems – and the interactions among sectors at the national level. It also assesses key impacts on U.S. regions.

To focus on NCA3 sector findings, access NCA3 *Highlights* by going to your bookmarked *Highlights* address, go to the course website and click on "National Climate Assessment Highlights", or go directly to the *Highlights* report at http://www.globalchange.gov/sites/globalchange/files/NCA3_Highlights_LowRes-small-FINAL_posting.pdf. Then, go to page 32. There, NCA3's *Finding 4: Widespread Impacts* is stated: "Impacts related to climate change are already evident in many sectors and are expected to become increasingly disruptive across the nation throughout this century and beyond."

1. The introductory paragraphs on page 32 point out that environmental, cultural, and socioeconomic systems are tightly coupled, so climate change impacts can be altered by cultural and socioeconomic decisions. An example given points out that in coastal areas rapid population growth and development tend to _____climate change related impacts.

[ ] reduce
[ ] amplify

2. Another example, on page 33, describes coral reef ecosystem collapse. Coral reefs are among the most spectacular ocean features and are highly productive habitats, second only to rain forests in biodiversity. They are habitat for about a quarter of all marine species. Coral reefs are threatened by _____.

   [ ] increased carbon dioxide
   [ ] rising ocean temperatures
   [ ] a variety of other factors caused by human activities
   [ ] all of these

3. NCA3 begins its sector analysis with its *Finding 5: Human Health*, on pages 34, which states: "Climate change threatens human health and well-being in many ways." Increasingly frequent key weather and climate drivers of health impacts include extreme heat, extreme precipitation, and rising sea levels. Of these, _____ events are the leading weather–related cause of death in the United States. Although such events are projected to increase in the future, many of the deaths they cause are preventable.

   [ ] extreme precipitation
   [ ] rising sea levels
   [ ] extreme heat

4. On page 37, NCA3 points out that policies and other strategies directed towards reduction of carbon pollution and the mitigation of climate change can often have independent influences on human health. Mentioned is a growing recognition that health "co-benefits" such as reducing air pollution and cardiovascular disease could be significant from _____ standpoint(s).

   [ ] a public health
   [ ] an economic
   [ ] both of these

On page 38, NCA3 presents its *Finding 6: Infrastructure*, which states, "Infrastructure is being damaged by sea level rise, heavy downpours, and extreme heat; damages are expected to increase with continued climate change."

5. Infrastructure refers to the fundamental facilities and systems serving a country, city, or area, such as transportation and communication systems, and power plants. As implied in the first paragraph of page 38, the threat of climate change impacts is heightened because most existing infrastructure was designed based on _____.

   [ ] historical conditions
   [ ] dynamic climate computer model output

6. The Key Messages concerning impacts of climate change due to extreme weather events and rising sea levels appear on page 39. Discussion of these key messages indicates that persons living in _____ environments are most vulnerable to disruptions in essential infrastructure services caused by these events. About 80% of the U.S. population lives in this most susceptible environment, resulting in climate change impacts on infrastructure to be most severe where most Americans reside.

   [ ] rural
   [ ] suburban
   [ ] urban

7. On page 40 are Key Messages specific to transportation infrastructure, along with background information. Transportation systems are somewhat unique in that they _____ climate change.

   [ ] are affected by
   [ ] contribute to
   [ ] are affected by and contribute to

8. According to the key messages all parts of the U.S. can expect increased vulnerability due to climate change. As an example, it is projected that 2,400 miles of major highways in the Gulf Coast region will experience flooding by a sea level rise of about 4 feet in the 21st century. In total, _____% of interstate highways in the Gulf Coast region are at elevations below 4 feet.

   [ ] 24
   [ ] 38
   [ ] 54
   [ ] 68

"Energy is at the heart of the global warming challenge."

The above statement is how the USGCRP succinctly stated the role of humanity's production and use of energy in climate change in its NCA2 published in 2009. Key Messages in NCA3 concerning Energy Supply and Use appear on page 41. Knowing information about energy sources and demand sectors, as well as their changes over time, is critical to understanding the impacts of climate change on assuring the U.S. energy system provides a secure supply of energy as well as the impact of energy consumption on forcing climate change. **Figure 1** is presented from the Energy Information Administration (EIA) of the U.S. Department of Energy [http://www.eia.gov/energyexplained/?page=us_energy_home] to describe the Sources and Demand Sectors of energy (in quadrillion Btu, 1 Btu = 1055 joules) consumed by the U.S. in 2015. The figure shows that the total primary energy consumption in the U.S. in 2015 was 97.7 quadrillion (10^{15}) Btu. [Notes: The Electric Power sector refers to generating plants whose primary business is to sell electricity to the public. It does not include industrial electric power plants. Also, sum of components in graph may not equal total due to independent rounding.]

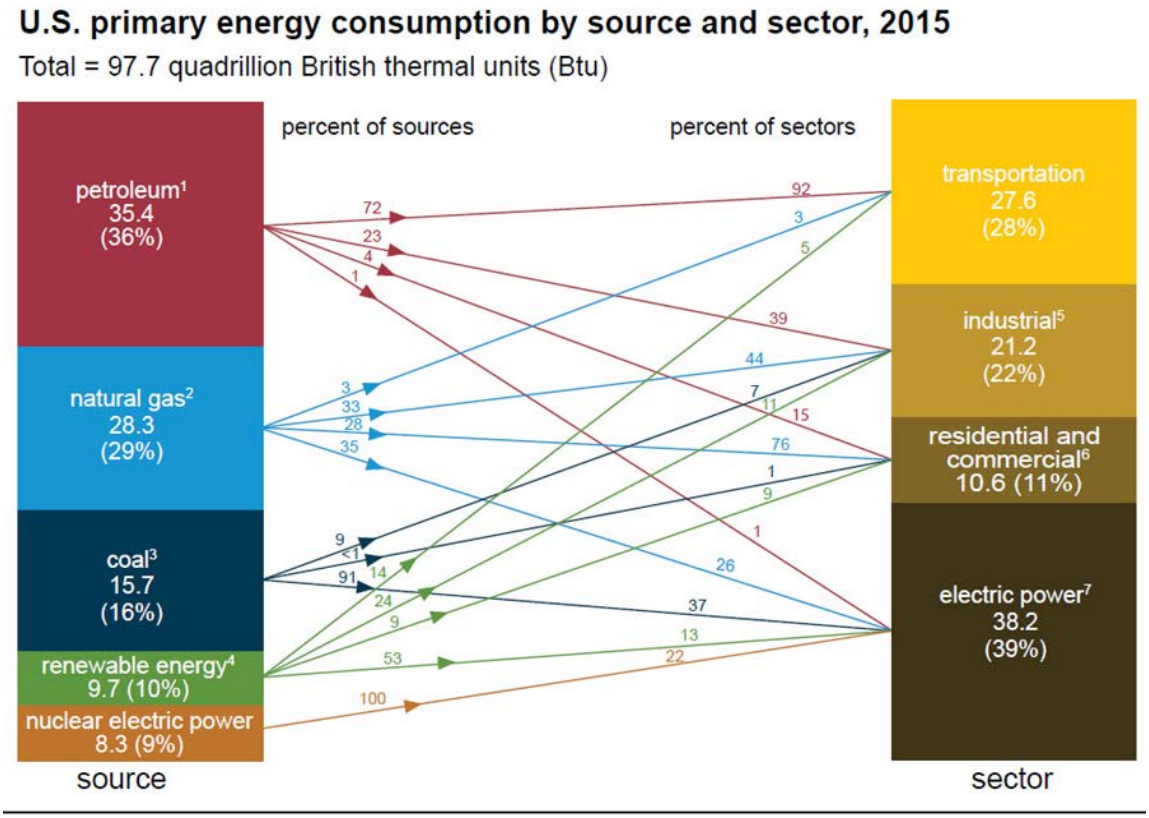

Figure 1. U.S. 2015 Primary Energy Consumption by Source and Sector in 10^{15} Btu and percentages. [EIA]

9. As seen along the lines connecting supply sources with demand sectors, Figure 1 breaks down the percentage of a supply source applied to a particular demand sector use (e.g., 72% of the petroleum used in 2015 was consumed in the transportation sector). Additionally, it reports what percentage of a demand sector was supplied by a particular source. For example, _____% of the energy used in transportation came from petroleum).

   [ ] 26.9
   [ ] 42
   [ ] 40
   [ ] 92

10. On the Source side of Figure 1, the value in parenthesis in each segment of the bar graph signifies the percentage of the nation's total energy consumed in 2015 provided by that energy source (e.g., petroleum provides 36% of the total). In 2015, fossil fuels (petroleum, natural gas, and coal) provided _____% of the total energy consumed in the U.S.

[ ] 19
[ ] 27
[ ] 52
[ ] 81

11. Electric power generation for public use consumed 39% of the total U.S. energy budget in 2015. Although greater use of electricity is often mentioned as a major component of a "clean energy" economy, _____% of the electrical power generated in 2015 actually came from burning fossil fuels.

    [ ] 19
    [ ] 27
    [ ] 64
    [ ] 92

12. The _____ sector is most dependent on a single energy source. The reason why this is so is a particular challenge when seeking energy source alternatives to reduce CO_2 emissions.

    [ ] transportation
    [ ] industrial
    [ ] residential & commercial
    [ ] electric power

On page 41 of NCA3, the Key Messages describe the ways in which changes in extreme weather, changes in water availability, sea level rises, etc., will cause energy disruptions impacting the economy and quality of life.

13. For example, the projected changes in U.S. summer and winter temperatures will increase electricity use and peak loads in _____ while decreasing electricity consumption in the opposite season, although the net electricity annual use is expected to increase.

    [ ] summer
    [ ] winter

Summary:

The United States faces significant climate change impacts related to its health and infrastructure. The coupling of environmental, cultural, and socioeconomic systems means that climate change impacts can be amplified or reduced by actions taken by humans.

It is clear that the use of energy is fundamental to climate change (and to mitigating global warming). Being a major country in terms of population and being the biggest per capita user (except for several small countries) and second only to China as the biggest national consumer in the world of energy from those sources that generate heat-trapping gas emissions, our energy policies have profound local, regional, national, and global

implications. Reducing emissions of heat-trapping greenhouse gases is an extremely urgent national and worldwide goal.

Instructions for Communications with Mentor:

Transmit this week's work to your LIT mentor by Monday, 31 October 2016, or as coordinated with your mentor. Include:

- **Chapter Progress Response Form** from the *Study Guide* or the *RealTime Climate Portal* course website.
- **Investigations Answer Form** for 8A and 8B from the *Study Guide* or *RealTime Climate Portal* website.
- **Current Climate Studies Answer Form** from *RealTime Climate Portal* website.