

**MAJOR TRENDS FACING  
NORTH CAROLINA  
IMPLICATIONS FOR OUR STATE  
AND  
THE UNIVERSITY OF NORTH  
CAROLINA**

University of North Carolina Tomorrow



**Energy and Environmental Challenges**

*Prepared For:*  
The University of North Carolina Tomorrow  
Commission

# **Energy and Environmental Challenges Confronting the University of North Carolina System**

A Brief Prepared for the UNC Tomorrow Commission  
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By  
Dennis Grady, PhD  
Professor of Political Science  
Director, Appalachian State University Energy Center  
Appalachian State University

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## **Introduction**

How we power our economy profoundly impacts the quality of our natural environment. Virtually every aspect of our economy is dependent upon energy for either fueling our transportation system or powering our homes, businesses and industries.

In 2004, North Carolinians spent \$23.2 billion on energy which equates to approximately 7% of the state's overall economic activity (GSP). Since North Carolina has no readily available fossil fuels, a little over \$16 billion of this was spent importing petroleum products (\$12.4 b), natural gas (\$2 b), and coal (\$1.6 b). This is \$16 billion leaving the state, not circulating within and, thereby, not multiplying within the state's economy. And, as Figure 1 in the Appendix indicates, the single largest contributor to North Carolina's anthropogenic (human generated) greenhouse gas emissions is the energy sector.

As illustrated, the electric power industry in North Carolina contributes approximately forty percent of the human generated carbon dioxide emitted into the atmosphere and this has remained fairly stable over the past decade. Transportation contributes a little over forty percent and this has grown slightly over time.

There is overwhelming scientific and world-wide political consensus that global climate change is a reality and that it is the direct result of energy choices and agricultural practices. According to the United Nation's Intergovernmental Panel on Climate Change (IPCC) 2007 report, "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level."

While the factors causing climate change are on a global scale, North Carolina is particularly vulnerable to its consequences. The same activities that contribute to increased carbon dioxide in the atmosphere also increase the emissions of air and water pollutants such as sulfur dioxide, nitrogen oxides, small particulate matter, lead, mercury, ozone, arsenic, carbon monoxide, and volatile organic compounds.

All of North Carolina's urban and suburban areas (30 counties) are out of compliance with national ozone standards which deters industries from locating and growing where we have the most developed infrastructure. Furthermore, given North Carolina's unique coastal geology, a one foot rise in sea level over the next seven decades (a conservative estimate) would move the shoreline between 2,000 to 10,000 feet inland causing a negative economic impact in the tens of billions of dollars not to mention the devastating impact on our state's culture, heritage and natural beauty.

While the interaction of energy choices, economic development, and environmental sustainability are intricately intertwined, one way to organize these complex interactions as they play out into the foreseeable future is to look at three large issue spheres:

- Preparing our economy for a carbon constrained future
- Insuring an adequate supply of safe drinking and fishing waters
- Balancing urban development pressures with land conservation.

This briefing paper will take each in turn and assess global, national and state trends in each sphere. It then turns to how these trends impact the role of the UNC system in the future.

## **Preparing Our Economy for a Carbon Constrained Future**

A report assembled in 2001 for the United Nations by over 1,360 scientific experts across the globe opened with this stark warning, **“Human activity is putting such a stain on the natural functions of Earth that the ability for the planet’s ecosystem to sustain future generations can no longer be taken for granted.”**

A more recent and widely discussed report developed for the British Government by economist Nicholas Stern in 2006 came to a similar conclusion but with more specific economic consequences should “business-as-usual” policies prevail across the globe. Again, the primary contributors to greenhouse gases are energy related as Figure 2 in the Appendix illustrates.

The message is clear. Reducing greenhouse gas emissions is a global economic imperative and to do so we must produce energy in a less carbon intensive manner.

The current global effort to reduce carbon emissions is the 1997 Kyoto Protocol (in which the US is not participating although 160 nations currently are) that requires nations to reduce their greenhouse gas emissions 5% below their 1990 output. This is to be achieved by a “cap and trade” system where carbon allocations are determined by country and credits are awarded for activities undertaken by carbon emitters that offset carbon use. While the jury remains out as to the eventual effectiveness of the Kyoto Protocol, it is certain that the world is moving to reduce carbon emissions. It further seems likely that a market-based approach like “cap and trade” will be the preferred route given the lack of an enforcement mechanism for a traditional “command and control” approach.

**While a “business-as-usual” future seems stark, there is little reason to assume that nations and states cannot change course. It would be irrational to do otherwise, the roadmap is not complicated, and North Carolina’s economy stands to gain from the transition.** Aggressively pursuing energy efficiency strategies, developing and deploying renewable energy systems, and altering agricultural practices (especially in developing nations) are the way forward. In fact, North Carolina has already started down this path through its legislatively empowered Climate Change Commission that will report out its findings in Fall 2007, the legislatively mandated North Carolina

Biofuels Strategic Roadmap that reported out in April 2007, DENR's Climate Action Plan Advisory Group that is working in tandem with the Climate Change Commission, the State Energy Plan that encourages investments in renewable energy and energy efficiency technologies and companies, and a likely Renewable Energy and Energy Efficiency Portfolio Standard (REPS) emerging from the 2007 legislative session, as well as other initiatives.

North Carolina is perfectly placed to reap the benefits of this state, national, and international transition. A report prepared for the Utilities Commission in winter 2007 found that a state 10% renewable energy and efficiency requirement for power producers would add between 1,500 to 2,700 additional jobs in the state with negligible impact on electricity rates. Another study found that a national REPS of 20% would result in an increase of 11,417 net new high tech jobs and \$2.5 billion in additional investments in the North Carolina economy. Currently over 100 North Carolina companies are engaged in manufacturing renewable energy products and equipment.

## **Water Quantity and Quality**

What goes into the air and onto the earth eventually winds up in the water through a process known as the hydrological cycle as depicted in Figure 3 in the Appendix.

Globally, the major environmental strain associated with water is the mismatch between population location and clean water availability among our least developed economies. As the developing nations become more populated and urbanized, water treatment (drinking and wastewater) systems are not keeping pace primarily for economic and political reasons. Additionally, according to a recent UN report, parts of Africa and Central Asia are experiencing rapid "desertification" (the conversion of crop land to desert) because of agricultural practices and temperature changes placing an estimated 50 million additional persons at risk over the next ten years.

According to the World Health Organization:

- Between 2002 and 2015, the world's population is expected to increase every year by 74.8 million people.
- In 2002, 1.1 billion people lacked access to improved water sources, which represented 17% of the global population.
- Of the 1.1 billion without improved water sources, nearly two thirds live in Asia.
- In sub-Saharan Africa, 42% of the population is still without improved water.
- In 2002, 2.6 billion people lacked access to improved sanitation, which represented 42% of the world's population.
- Over half of those without improved sanitation – nearly 1.5 billion people – live in China and India.
- Almost two billion people were affected by natural disasters in the last decade of the 20th century, 86% of them by floods and droughts.
- Flooding increases the ever-present health threat from contamination of drinking-water systems by inadequate sanitation, industrial waste and by refuse dumps.

- Droughts cause the most ill-health and death because they often trigger and exacerbate malnutrition and famine, and deny access to adequate water supplies.

Within the US, the 1972 Clean Water Act mandates that all publicly owned treatment works (16,024 systems) provide secondary sewage treatment and the 1974 Safe Drinking Water Act establishes national standards for over 100 drinking water contaminants in the approximately 54,000 community systems nationwide. Approximately 75% of the US population is served by public sewage systems with the remainder on septic systems. Ninety-three percent of drinking water systems serve populations under 10,000. EPA estimates that the nation will need to increase spending on clean water systems by \$388 billion by 2020 and an additional \$154 billion on drinking water systems over the same period to maintain these systems' integrity.

While North Carolina is blessed with abundant water quantity overall (on average 50 inches of rainfall a year), most of our future growth is expected to occur along the Piedmont Crescent where water is hardest to acquire due to hydrogeological conditions. Recent drought and water shortage situations in our urban areas are testament to this reality.

Figure 4 in the Appendix illustrates that almost half the state's population acquires its water from groundwater sources either through wells (34%) or public systems (17%) and this allocation has remained fairly stable over time.

According to the North Carolina Rural Center's *Water 2030* Report, the state's water quality is threatened from storm and agricultural runoff, inadequately treated municipal and industrial waste, and increasing urbanization gobbling up open space. Currently, the state has more than 700 river segments, totaling nearly 3,000 miles (9% of total), which are considered "impaired" by pollutants and unable to support designated uses. And according to the NC Division of Water Quality reports, 5% of the state's public water systems violated water quality standards in 2003.

Water demand is expected to grow 36% over the next decades from 1.6 million gallons per day in 2005 to 2.2 million gallons a day by 2030. Commercial and industrial demand accounts for 54% of this total. To insure a safe and clean water system for the state over this period, the Rural Center estimates we will need an additional \$7.7 billion for water system, \$7.5 billion for sewer system, and \$1.5 billion for stormwater system expansions and upgrades. Our economy cannot grow if we do not have the water resources to sustain growth.

## **Conserving Land while Growing**

The final policy sphere influencing global environmental sustainability is the preservation of open space and agricultural lands while accommodating an ever larger population. The loss of undeveloped land threatens the environment through the destruction of stream and forest ecosystems; degrades drinking water quality; degrades air quality; results in the loss of wildlife habitat; and diminishes recreational opportunities.

According to NASA satellite imaging, tropical deforestation is occurring worldwide at a rate that equals the land area of North Carolina each year. Figure 5 in the Appendix illustrates how the process occurs. This trend is problematic for several reasons:

- Deforestation increases the amount of carbon in the atmosphere by an annual rate of approximately 1.6 billion metric tons a year (compared to burning fossil fuels which releases about 6 billion metric tons each year).
- Deforestation increases global temperatures by reducing the moist, green canopy that allows large amounts of moisture to evaporate into the atmosphere creating the clouds and rain that produce the rain forests.
- Tropical rain forests provide environments for biodiversity to thrive. While the rate of extinction is not known precisely, NASA reports that up to 137 species disappear worldwide each year.

Desertification is also a global problem mentioned earlier related to land conservation and sustainability in arid and semi-arid regions of the world. It is due primarily to agricultural practices rather than rain shortages.

Fortunately, North Carolina is not immediately affected by either of these global tragedies, but that does not mean that we are immune to the environmental consequences of land conversion for development.

According to the non-profit Conservation Trust for North Carolina:

- In the past 20 years, North Carolina has lost 2.8 million acres of cropland and forest land to development. By 2022, it is projected that certain areas of the state will experience an additional 50% decrease in their forests and cropland. The regions surrounding Raleigh and Charlotte are projected to experience a 65% increase in developed land by 2022.
- Currently, the state is developing 277 acres of land a day, or over 100,000 acres per year - **the fifth fastest rate of land development of any state in the Nation.** This area is equivalent to the size of Winston-Salem and High Point combined.
- Together, agriculture and forestry are the state's number one industry, contributing \$68 billion annually to the economy. **North Carolina has the 7<sup>th</sup> largest agricultural economy in the nation.** It accounts for nearly one quarter of the state's income and employs 22% of the work force
- Less than 44 percent of the state's wetlands are currently working effectively. The main culprit is development, resulting in the loss of wetlands acreage and sedimentation.

- North Carolina is home to 43 endangered species, and hundreds more are classified as threatened, of special concern, or significantly rare. Fully 19% of all plant and animal species in North Carolina are threatened or endangered.
- Thousands of different types of plants and animals, including threatened and endangered species, depend on the state's natural areas. **North Carolina has over 4,100 species of native plants, making the state 4<sup>th</sup> in plant diversity in the U.S.**
- Currently, only 2.8 million acres (8.6%) of the state's total land area is permanently preserved.

## The UNC System and the Environment

Given these trends, what can and should the UNC System do? It would seem that its role falls into three general categories. First, adjust our own environmental footprint. Second, expand opportunities for teaching, research, and public service in sustainable development, environmental science and engineering, and environmental policy. Third, imbue environmental literacy throughout the System institutions' curricula.

Collectively, the 16 universities in the UNC System are, by far, the single biggest public energy and water user in the state of North Carolina. According to data supplied by the State Energy Office in the NC Department of Administration, the UNC System is responsible for 70% to 80% of state expenditures on energy as Figure 6 in the Appendix illustrates. In Fiscal Year 05-06, the System spent almost \$167 million on utilities of which \$156 million was for electricity.

The System is also the largest water user as Figure 7 in the Appendix illustrates. In FY 05-06 the System reported using 4.7 million gallons of water at a cost of \$10.7 million.

There are steps that the UNC institutions can and should take to reduce their environmental footprint, from small (putting light sensors in every classroom and laboratory) to large (requiring all new facilities to meet LEED - Leadership in Energy and Environmental Design certification) actions. Space does not allow a complete list of recommended actions (it's a long list), but leading by example should be a minimum expectation of each university, and accountability for reaching specific carbon targets should be a General Administration priority.

There is already a significant amount of environmental research, education and outreach occurring across the System. How much and how it relates to specific needs outlined above is an open question. For example, one System school (ASU) recently conducted a review of the research underway by faculty across its five colleges and found that over 60 faculty were engaged in environmental research, most of whom had no idea that others were also working in the environmental area. And this is just one campus.

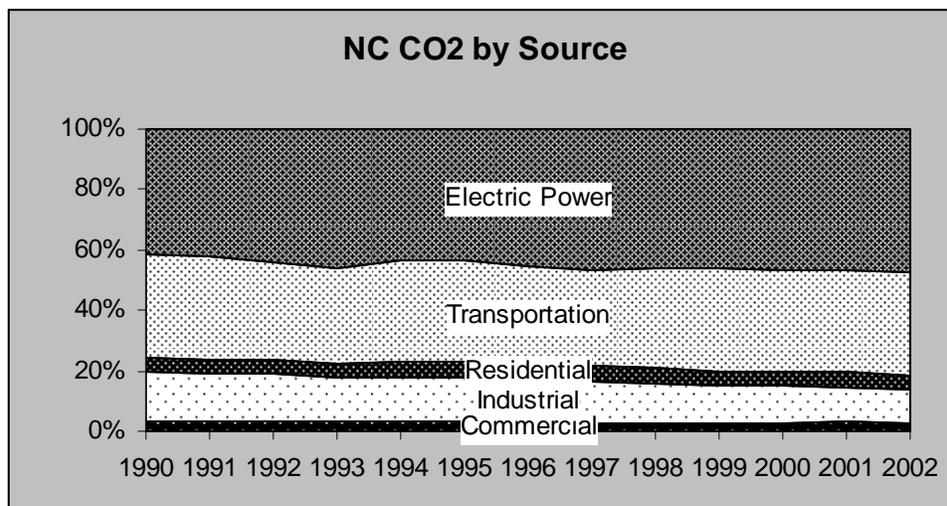
From an instructional perspective there should be mechanisms in place to allow students to pursue courses of study relying on the environmental science, engineering, and policy curricula of the entire UNC system. For example, NC A&T SU recently developed a PhD program in Energy and the Environment. It would be helpful to students in that program to be able to easily take courses in the ASU Appropriate Technology Graduate Program, UNC-CH's Environmental Sciences curriculum, NC State's Graduate Engineering Programs, and/or UNC Wilmington's Marine Sciences Programs.

Finally, just as we expect our graduates to be effective communicators and have advanced skills in their fields of study, we should also expect our graduates to have a basic sense of environmental literacy. Global changes begin at the individual level and the UNC System has an obligation to insure that each graduate has an appreciation of what s/he should do to make the globe sustainable for future generations. Environmental literacy should be a part of each institution's core curriculum.

Collectively, these actions could have a profound impact on the state, national and global environment.

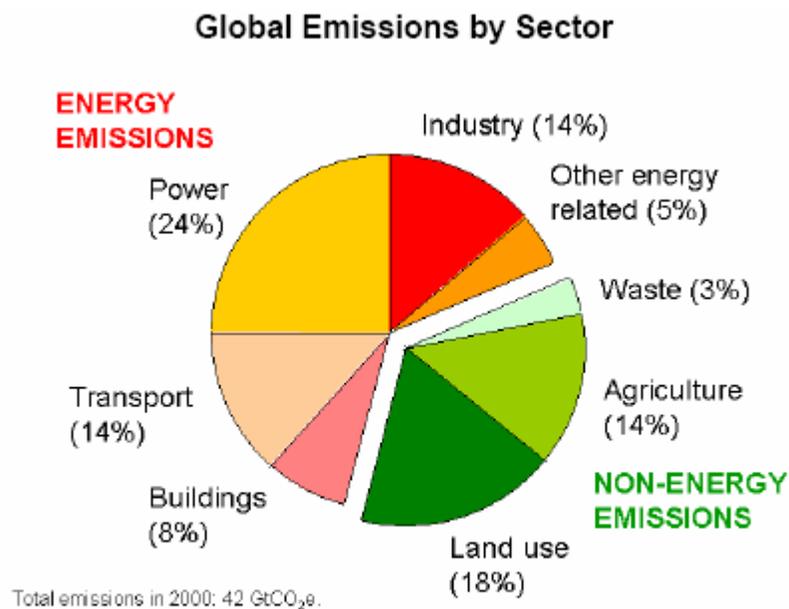
# Appendix

## FIGURE 1



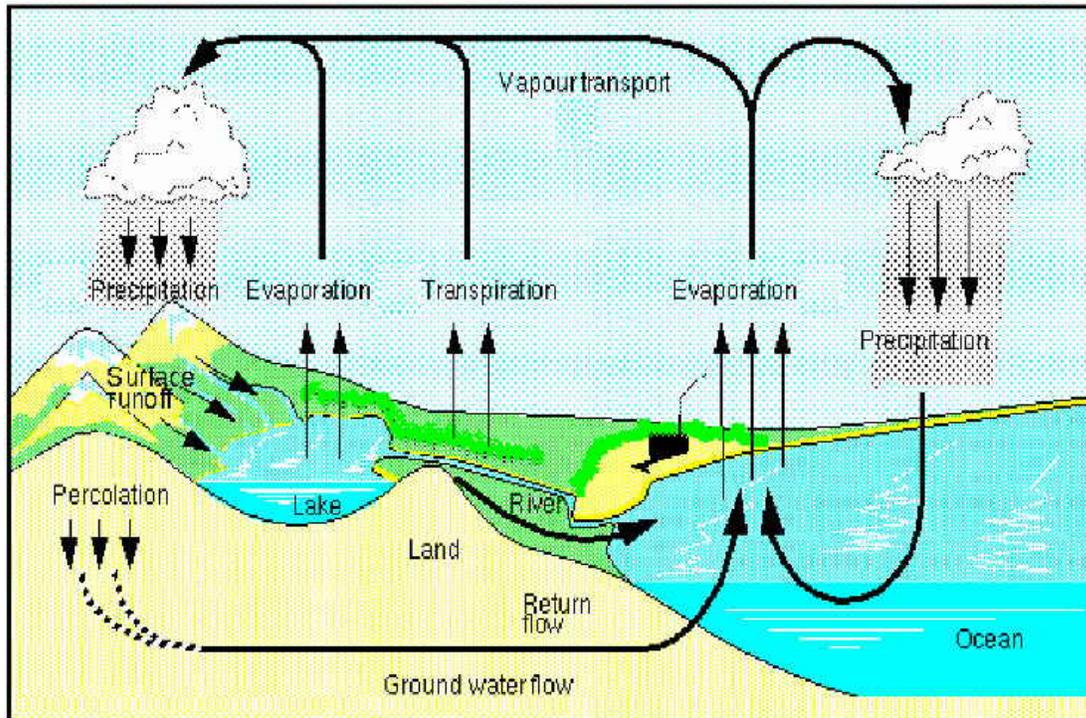
Source: EPA, [State CO2 Emissions from fossil fuel combustion, 1990-2002](#)

## FIGURE 2



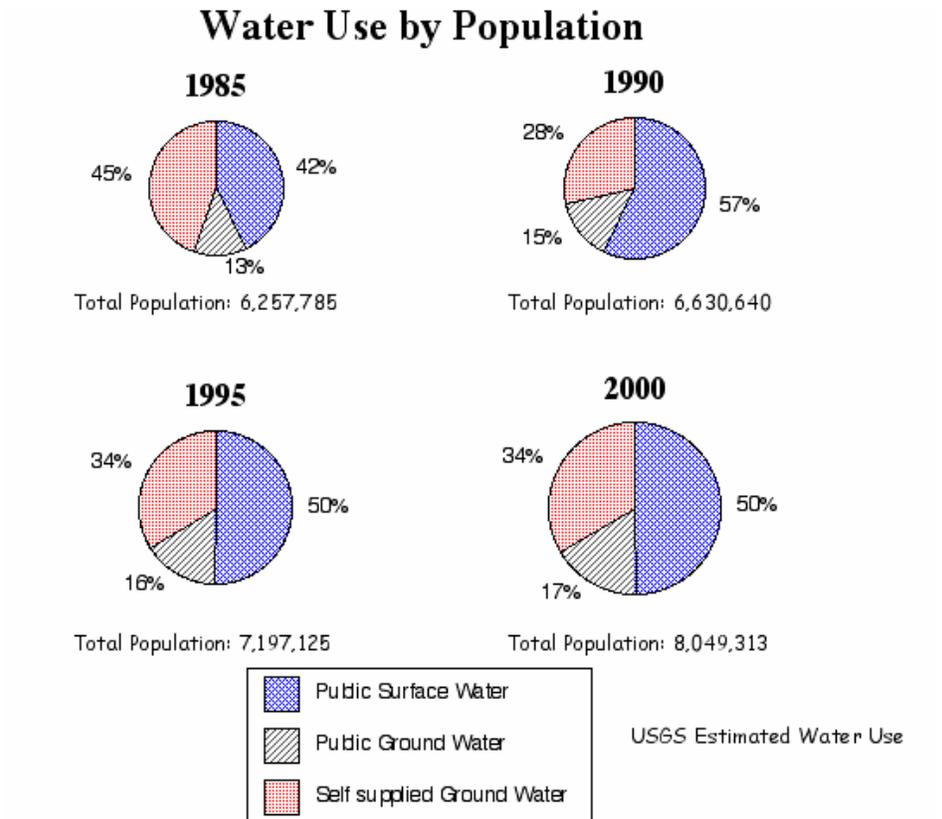
Source: Stern Review: The Economics of Climate Change. HMS Treasury, UK. 2007

**FIGURE 3**  
**THE HYDROLOGICAL CYCLE**



Source: [www.euwfd.com/html/hydrological\\_cycle.html](http://www.euwfd.com/html/hydrological_cycle.html)

**FIGURE 4  
NC WATER SOURCE OVER TIME**



Source: [NC Division of Water Resources](#),

## FIGURE 5

### Tropical Deforestation

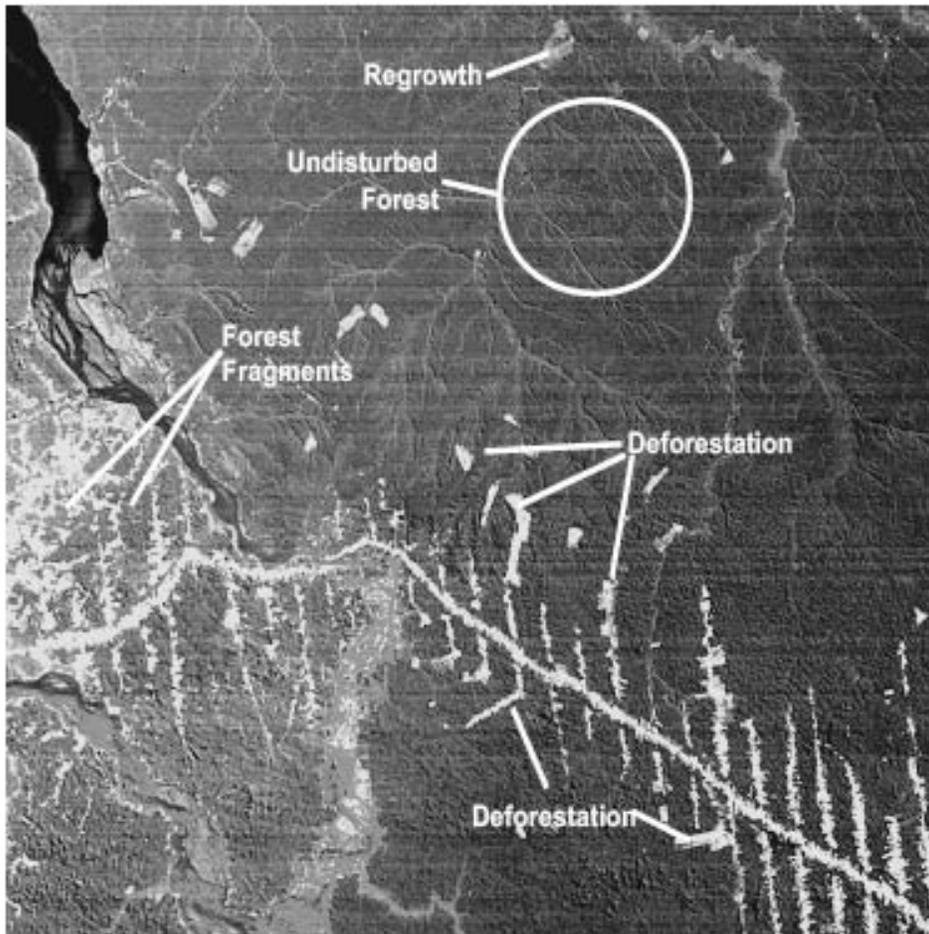
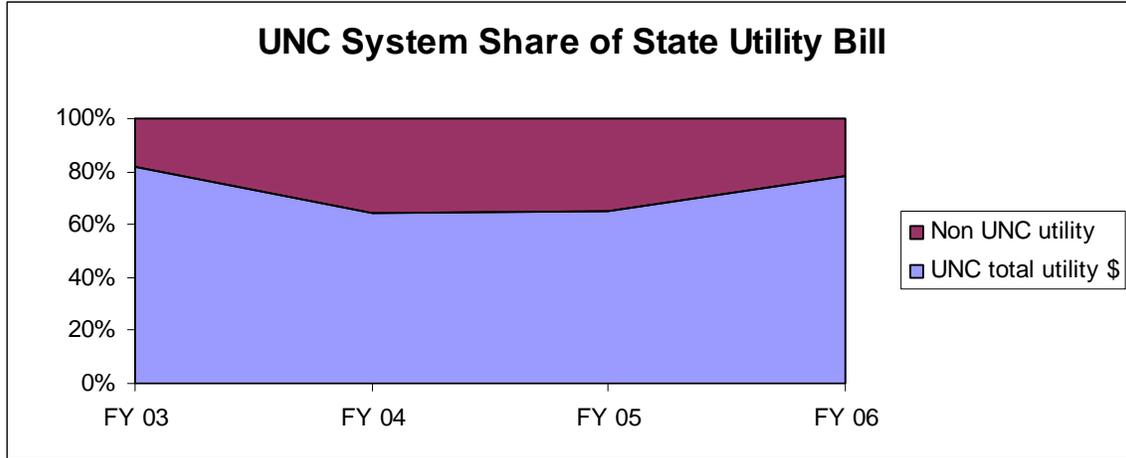


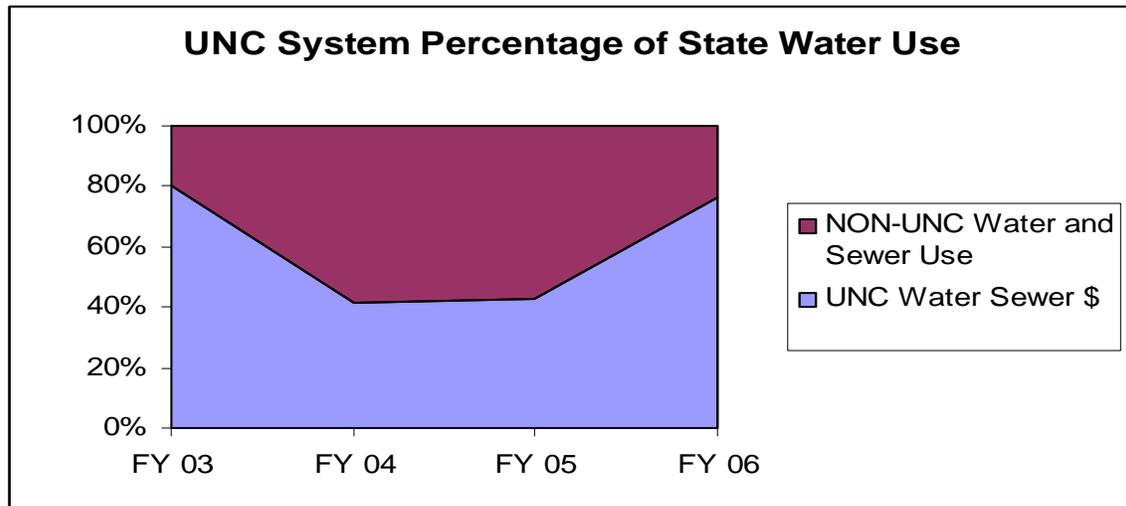
Figure 1. Satellite image of deforestation in the Amazon region, taken from the Brazilian state of Para on July 15, 1988. The dark areas are forest, the white is deforested areas, and the gray is re-growth. The pattern of deforestation spreading along roads is obvious in the lower half of the image. Scattered larger clearings can be seen near the center of the image.

**TABLE 6**



Source: State Energy Office, NC Department of Administration, Raleigh, NC.

**TABLE 7**



Source: State Energy Office, NC Department of Administration, Raleigh, NC.

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