AUSTIN ENERGY

THE CITY OF AUSTIN

ENERGY DEPLETION RISKS TASK FORCE REPORT

MAY 15, 2009

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EXECUTIVE SUMMARY

The decline of the world's current producing oil fields will offset new discoveries in the coming century, resulting in an overall net decline in available oil. Much of the current global economy is fueled by the availability of low-cost and high-energy density petroleum. Even a modest decline in supply could cause profound shifts in the social equity and economies in Austin and Central Texas.

The impact of energy depletion could be severe, moderate, or inconspicuous. In any case, a scenario involving disruption or depletion of energy supplies will probably cause some destabilizing effects. As with any economic crisis, those citizens, businesses and governments who foresee these destabilizing effects will benefit as they adapt more quickly than their competitors. Given sufficient leadership and cooperation, Austin may possess the technological and intellectual resources necessary to weather the economic uncertainties caused by energy supply disruption or depletion.

The following four basic sectors of life in Austin could be impacted by an energy supply disruption or depletion:

1. Transportation and Land Use
2. Food, Agriculture, and Water
3. Businesses, Economy, and Jobs
4. Low-Income Populations and Public Services

The Task Force identified several possible points of concern in each sector:

Transportation and Land Use

Existing mass transit in Austin lacks the capacity to serve additional new users. If the energy supply is disrupted or depleted, the following situations may occur.

- Single-occupancy automobile use may decline and citizens may seek more affordable transportation.
- Public schools may experience an increase in school bus ridership.
- Air travel may become unprofitable and unaffordable.
- Road and infrastructure maintenance may become prohibitively expensive.
- Fuel-intensive air and truck delivery may lose customers to rail and maritime freight shipping.

Food, Agriculture, and Water

At the present time, Austin maintains a low level of self suffiency in food supply to its citizens. While water resources may not be affected, a disruption or depletion in the energy supply could cause the following situations.

- Food could become much more expensive and food shortages could occur.
- Austin has a low level of food self sufficiency.
- The amount and variety of locally-produced food may increases slightly and the amount of food imported might decrease.
- Food retailing options may shift.
- Low-income households vulnerable to higher prices experience diet and nutrition deterioration.
- The kinds of foods produced and processed may change, introducing business pressures and opportunities for producers and processors.
- Diminishing tolerance for waste may bring changes in food packaging.
- The high cost and low supply of food may discourage use of petrochemicals in farming.
- Water resources might not be affected.

Business, Economy, and Jobs

While Austin's economy might be more resilient than other cities of its size, an energy disruption or depletion could still cause significant changes in the economic landscape.

- Rising prices could lead to inflation.
- Some businesses might experience significantly higher production and distribution costs, others may be impacted by change in demand for their products and services.
- Unemployment may increase.
- Strategically positioned companies may flourish with high oil and gas prices.

Low-Income Populations and Public Services

- Low-income populations will likely suffer first and hardest from energy shortages and resource depletion.
- Increasing costs and decreasing incomes may jeopardize public health, reduce health care coverage, and further stress the health care system.
- Demand for social services might increase, while ability to provide these services might declines.
- Electric utilities might not experience significant effects from an oil shortage, but could be greatly affected by a natural gas shortage.

Recommendations

The Task Force has formulated 10 recommendations. Some of the required actions are already under development, and some actions need City support.

1. Reduce total energy consumption by developing new programs and continuing existing programs to reduce total energy consumption.
    a. Austin Energy, Texas Gas Service, The Austin Water Utility, and numerous other service providers have effective programs in place to promote conservation. Support for these should continue.
    b. No public programs exist to encourage oil conservation. A program should be created.
        i. Capital Metro and the Capital Area Metropolitan Planning Organization may be well positioned to lead this effort.
        ii. The City may choose to pursue legislation to increase the gasoline tax.
2. Continue progress with fleet fuel efficiency and diversity.
3. Inform citizens about energy depletion and the potential effects on the City of Austin and the United States. Enlist the public, local media, and local schools to participate in energy-saving programs and coordinate efforts with existing programs, such as the Pecan Street Project and Austin Climate Protection Program.
4. Enlist the Office of Emergency Management to plan reductions in energy consumption and evaluate contingency plans for possible fuel supply disruptions or price spikes.
5. Promote infrastructure development to reduce energy consumption. Assign this project to Capital Metro or the Capital Area Metropolitan Planning Organization. Create new City programs that emphasize:
    a. Increasing rail mass transit, Metrorail, and transit-oriented development (TOD).
    b. Shifting trips from single-person cars to other modes of transport.
    c. Facilitating utilization of rail for both passenger and freight service to and from distant locations with Intermodal Transportation.
6. Encourage businesses to reduce energy consumption through telecommuting, staggered work hours, compressed work weeks, and corporate-organized ridesharing. A new program may need to be developed to coordinate with businesses, or this initiative could be handled by the Office of Emergency Management as part of Recommendation Four.
7. Review the components and identify gaps in the social safety net to protect vulnerable and marginalized populations. The Austin/Travis County Health Department could be enlisted to lead this effort, with the help of organizations such as Family Eldercare, Meals on Wheels, and Neighborhood Watch.

8. Prepare emergency contingency plans for sudden and severe fuel shortages. Enlist neighborhood-level organizations and the Office of Emergency Management to help ensure reliability of emergency plans.
9. Encourage local food production and processing, and actively protect local farmland to ensure food security. Enlist certain State agencies and other jurisdictions, as well as the Sustainable Communities Initiative and similar organizations, in this effort.
10. Use the nexus of energy and water to achieve synergistic gains. Invest in research and development.

The Task Force acknowledges the possibility for some positive outcomes of petroleum depletion, including reduced traffic congestion, improved air quality, increased walking and biking, decreased obesity and improved overall health of the community. Austin has already moved in the direction of preparing for fossil fuel shortages with the development of programs like Smart Growth, Austin Climate Protection Program, Energy Conservation Program, and Water Conservation program. This report recommends that Austin broaden these efforts to insure social and economic security. To mitigate the problems expected from resource depletion, dedicated leadership is required.

INTRODUCTION

America uses massive quantities of energy to advance its society and growing economy. Oil accounts for about 40 percent of all energy use in the U.S. and worldwide, and fuels virtually all U.S. transportation. Natural gas accounts for another 25 percent. Oil and natural gas combined account for nearly two-thirds of energy use.

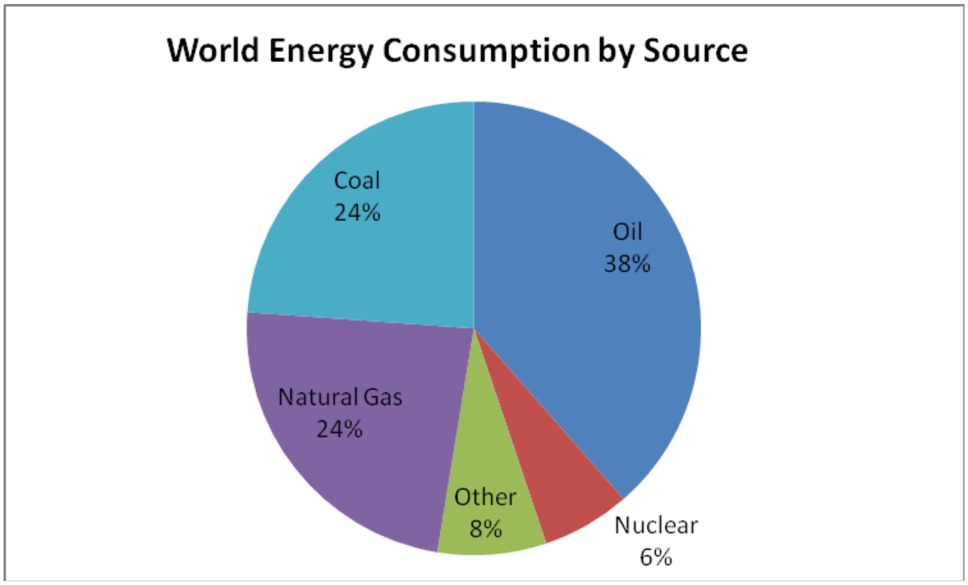

Figure 1: Eighty four percent of the global energy is derived from fossil fuels Source: The Energy Information Agency - www.eia.doe.gov/oiaf/ieo/pdf/ieoreftab_2.pdf

The world may soon approach maximum, or "peak," oil and gas production, after which production will decline, potentially causing increased price volatility and shortages. It is unlikely that alternate forms of energy will allow the world's population to maintain its current level of energy use in the future.

Adapting to the growing uncertainties of oil and gas supplies could profoundly affect society. Successful planning can mitigate the effects of peak oil, but requires a deep understanding of energy tradeoffs, ingenuity, capital investment, and common purpose. However, effective responses may take decades to implement (Hirsch Report).

A prudent first step is to anticipate consequences at the local level. In June 2007, the City of Austin established the Energy Depletion Risks Task Force to assess exposure to diminishing supplies of oil and natural gas and to recommend mitigation measures. The Task Force has found that energy depletion may curtail modes of travel, increase the cost of food and other goods, disrupt shipping and freight movement, and create local pockets of scarcity. Intervention may be necessary to ensure the survival of critical industries. In addition, energy depletion could cause potential economic disruptions affecting employment, home ownership, and social services. Government services could become increasingly expensive, necessitating difficult decisions on priorities for the citizens of Austin and Central Texas.

Situational Analysis

Fossil fuels have been the most prevalent form of energy used in the past century, and for want of viable and abundant alternatives, are projected to remain so for the foreseeable future. Oil is the most important source of primary energy today because of its unique physical characteristics and compatibility with a wide range of end uses. As shown in Figure 2, fossil fuel, including coal, is forecasted to continue accounting for over 85 percent of our primary energy fuel through 2030, with oil providing between 30 and 40 percent of the forecast demand.

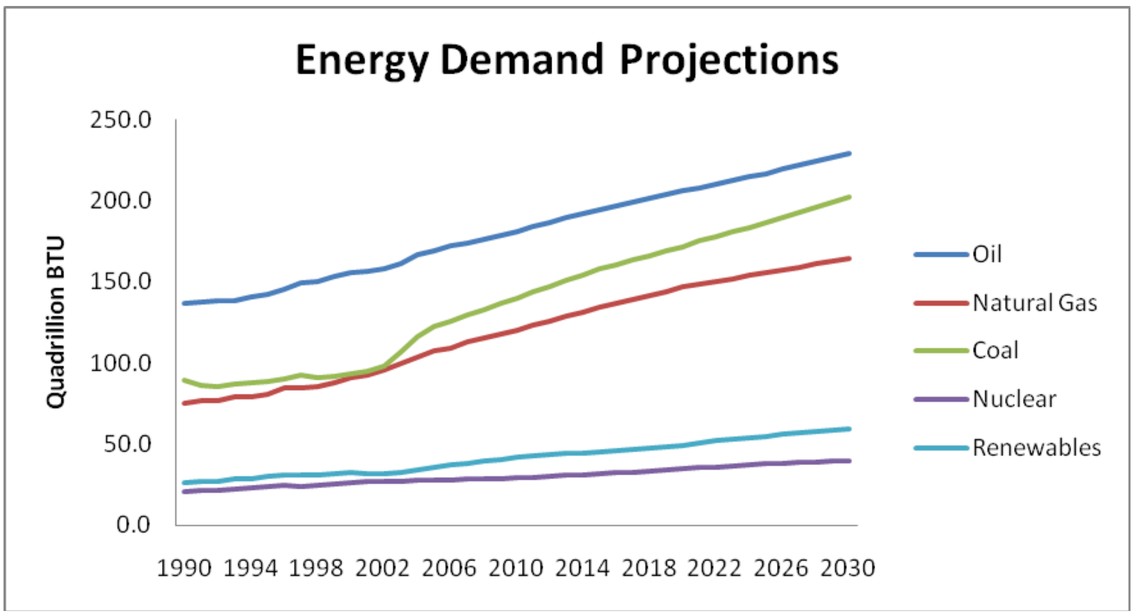

Figure 2: Fossil fuels are expected to provide the bulk of energy needs through 2030. Source: Energy Information Administration / International Energy Outlook 2008.

The forecast above, however, is based on the continuation of historic growth of supply and demand. There has been a mounting concern that the supply of oil will not keep pace with the demand, resulting in major shocks to the economies of industrialized nations depending on a steady supply of inexpensive oil to fuel economic growth[1].

In 1956, M. King Hubbert, geophysicist who worked at Shell Oil, conducted an analysis of oil depletion that stunned the oil industry by predicting the amount of oil produced in a field or region will resemble a “normal distribution” when plotted

[1] www.simmonsco-intl.com/files/IAEE%20Houston%20Chapter.pdf

against time. This analysis defines oil as a finite resource of which an ever increasing rate of consumption cannot be sustained and decreasing oil production is the inevitable outcome. It is also implied that at the peak of production, typically one half of the total resource has been consumed. For example, Figure 3 shows the amount of oil produced in the U.S. per decade since the first commercial production began.

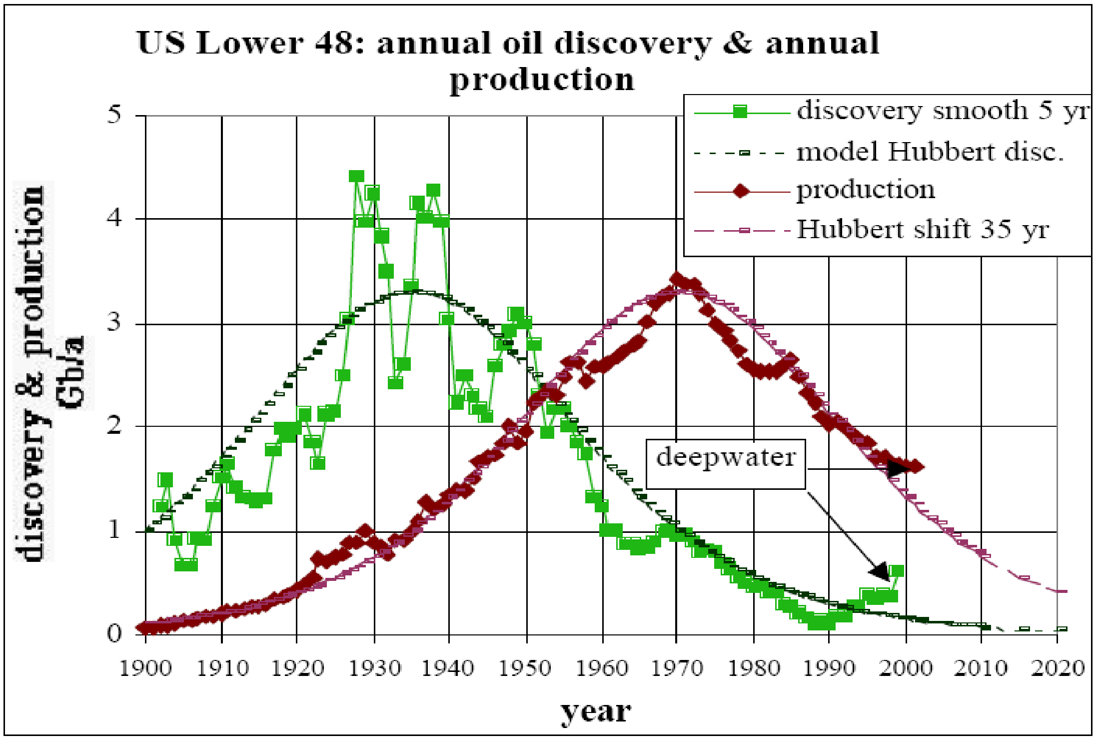

Figure 3: Annual unrestricted production history (in billion barrels per year, or Gb/a) of a large field of individual oil wells forms a "bell shaped" curve as seen in the data for U.S. crude oil production. The oil production curve fits well with Hubbert's model of oil discoveries, but with a delay of 35 years. (Source: Future of Oil Supplies. Jean Laherrere, May 2003)2

Hubbert argued peak production occurs at a predictable interval after the peak of discoveries. He accurately predicted the U.S. oil peak within two years of its actual occurrence. As shown in Figure 3, the amount of oil produced in the U.S. "peaked" in the early 1970's at around 10 million barrels per day and has been in decline ever since. Hubbert also predicted global oil production would peak in 1995, but because of the Arab oil embargo and worldwide recessions, the actual date would be after 2000. In a 1976 interview, Hubbert said the embargo could delay peak oil for 10 years.[3] The realization that one half of the U.S. oil supply has been consumed in less than 100 years, and the consumption of the remaining half could be well under way, is the driving force behind the current demands for energy security.

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[2] World Energy Outlook 2008, - "Current global trends in energy supply and consumption are patently unsustainable."
[3] M. King Hubbert. *The Hubbert Tribune.* <www.mkinghubbert.com/resources/video>

The world's production of oil is still meeting demand (the U.S. has been importing most of its oil for several decades to meet its demand), though with higher prices. Figure 4 shows the total oil produced worldwide annually for the past 25 years.

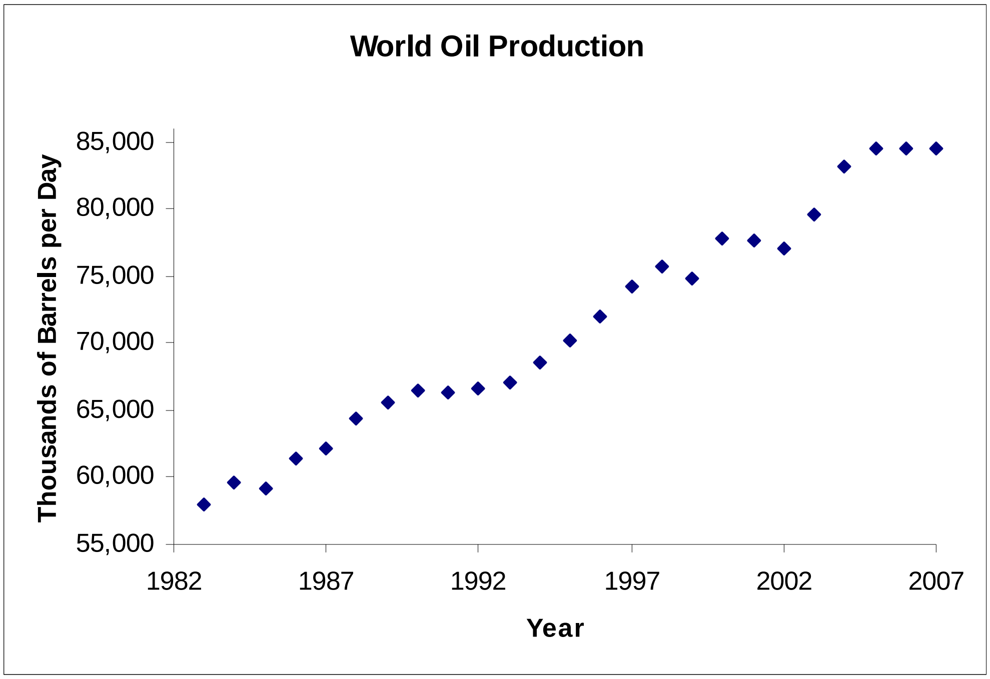

Figure 4: World oil production over the past 25 years shows steady growth, with short periods of no growth. Source: Energy Information Agency

Since the oil shocks of the 1970s and 1980s, annual consumption growth has slowed considerably, from the pre-1970s rate of almost eight percent annually to a more modest rate of approximately two percent per year. Figure 5 shows the production trend since 2004.

A closer look at the most recent two to three years indicates a "plateau" of production in spite of rapidly escalating prices[4]. Some experts have now asserted that the world's oil supply has peaked, and most agree that the peak is no more than 10 years away[i]. Figure 5 shows the 12-month moving averages for global oil production for the past several years, indicating a plateau has been reached. Whether this plateau is an anomaly or a sign of the onset of peak oil is not clear.

[4] Price Moderation in mid 2008 suggests that demand destruction has caused temporary price moderation as consumers have begun to conserve energy in response to high prices.

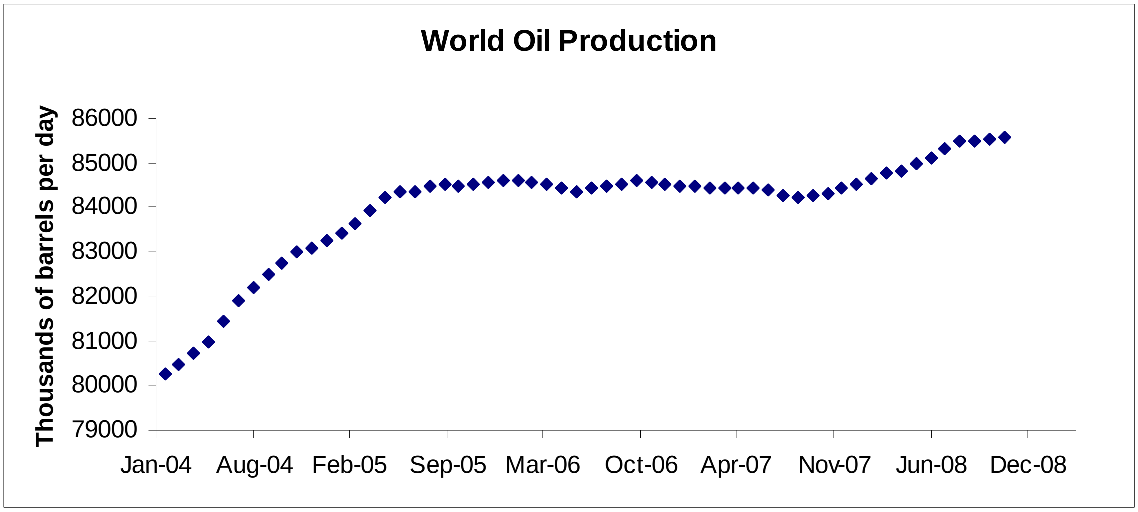

Figure 5: This chart shows a 12-month moving average of world oil production, with a plateau from mid-2005 to early 2008, after which production rises slightly. Source: Energy Information Agency

Consequences of a Peak in Production

Several scenarios come into play at the peak of oil production. First, more oil is produced at that moment than ever before, and there will never be a long-term increase in production after that point. However, experts disagree as to when and how fast production will decline, and this unknown variable is a critical inhibitor to effective mitigating action. U.S. production is already in decline as seen in Figure 3. However, expansion of existing production as well as new production worldwide has allowed for sustained supply levels up to this time.

A number of studies and assessments on resource depletion have been completed, many of which have a negative outlook about the downside risks. Other studies dispute whether peak production is imminent or serious. For the purpose of informing policymakers, this report focuses on potential problems that might result from a worldwide peak in oil or gas production. Of the many reports available, Robert Hirsch's report is one of the most highly cited and the main points of Hirsch's report are summarized below.

Conclusions from the Hirsch Report[5]

In 2005, the Department of Energy commissioned the Science Applications International Corporation to prepare a study examining the likelihood of the occurrence of peak oil, the necessary mitigating actions, and the likely impacts based on the timeliness of those actions. The following quotation is the opening paragraph of the executive summary of the report[6].

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[5] The following section is taken directly from the "Hirsch Report"

[6] Hirsch Report. www.netl.doe.gov/publications/others/pdf/Oil_Peaking_NETL.pdf

The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand sides, but to have substantial impact, they must be initiated more than a decade in advance of peaking[7]

Some conclusions of the Hirsch Report are:

World oil peaking is going to happen, and it will be abrupt and revolutionary.

- Oil peaking will adversely affect global economies, particularly those most dependent on oil.
- Oil peaking presents a unique challenge. The problem is liquid fuels, not solid fuels (with growth in demand mainly from the transportation sector).
- Mitigation efforts will require substantial time.
- Twenty years is required to transition without substantial impacts.
- A 10-year rush transition with moderate impacts is possible with extraordinary efforts from governments, industry, and consumers.
- Late initiation of mitigation may result in severe consequences.
- Both supply and demand will require attention.
- It is a matter of risk management (mitigating action must come before the peak).
- Government intervention will be required.
- Economic upheaval is not inevitable ("given enough lead-time, the problems can be solved with existing technologies").
- More information is needed to more precisely determine the peak time frame.

While the Task Force has not made a formal assessment of the analysis in Hirsch's report, the spirit of this study stems from his main conclusions.

[7] Robert Hirsch. *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*. Commissioned by the US Department of Energy. Prepared by the Science Applications International Corporation (SAIC), February, 2005. (www.netl.doe.gov/publications/others/pdf/Oil_Peaking_NETL.pdf)

TASK FORCE DOCTRINE

The research and discussion by the Task Force explores the potential for local hardships and economic recession, as well as the potential for worldwide recession should the supply of fuel cease to be cheap and abundant. While the solutions presented by the Task Force are designed to protect Austin from the difficulties caused by an era of oil and gas scarcity, the Task Force hopes these solutions will be considered by other American cities – in the same way that this Task Force learned from the work of the Portland Peak Oil Task Force. Readers of this report may notice parallels with the Austin Climate Protection Plan. However, differences exist, and this report strives to complement the earlier policies not replace them.

The primary goal of the recommendations is to reduce Austin's exposure to the impacts and vulnerabilities caused by fossil-resource depletion. Many recommendations are geared towards the anticipation of gradual and long-term price increases. Other recommendations are designed to reduce the impact from possible abrupt fuel shortages and economic disruptions and intended to help the City meet the vital needs of the community. In the broadest sense, the Task Force recommends reducing the consumption of oil and natural gas so that the economic and social effects of a supply shortage or dramatic price increase would be less pronounced. While the purpose of the Task Force is not to make peak oil predictions, the members do recognize the supply of a finite consumable resource, such as crude oil, is inherently limited, and preparations must be made for the sustainability of transportation, businesses, food, and society as a whole when energy supplies begin to decline. The Task Force acknowledges the likelihood of an energy paradigm shift and has constructed recommendations to help make this shift as smooth as possible from a local perspective.

The Task Force also emphasizes the need for immediate action. Waiting to take action with mitigating preparations will likely make the initiative more difficult and costly and decreases the readiness of the city. The Task Force has outlined several economic vulnerabilities, but would also like to acknowledge the potential for economic opportunities. If the city invests in viable alternative and renewable power sources, creates local expertise in conservation, and develops a strong local renewable energy industry, Austin could become a leader in the national and global energy markets in the face of oil and gas depletion. If Austin's renewable energy industry is well developed, other markets may turn to Austin for expertise, technology, and products essential to sustainable energy.

Principles for Decision Making

With the end of the cheap oil era approaching, the fundamental energy assumptions guiding actions, policies, and strategies with respect to fossil fuels must be re-examined. Since the beginning of the industrial era, fossil fuel consumption has inexorably grown. Until recently, the global industrial economy enjoyed a comfortable reserve margin for error with respect to natural resource supplies. Today's volatile energy prices reflect that the comfortable margin for error is shrinking. Going forward, new energy capacity must come from efficiency improvements rather than increased energy outlays. As Austin aims to reduce its resource consumption, basic strategies and principles guiding decision making should be reconsidered.

- **Do not consume energy faster than earth can produce it.** In making energy transactions, regions will need to consider return-on-energy-investment. Fossil fuel energy has enjoyed a very positive energy gain in the past, so much so that many of the non-fossil-fuel alternative energy sources are supported by hidden subsidies of fossil energy. Hidden subsidies and energy losses (energy sinks) will become more expensive and obvious as fossil fuel becomes less available. Energy sinks may include manufacturing of equipment and construction of infrastructure for biofuels, nuclear energy, solar PV energy, and wind energy. Analysis of return-on-energy-investment will help determine whether valuable stores of fossil energy are invested wisely.
- **Match technologies to the appropriate applications.** When developing new energy sources and technologies, the appropriate technology should be matched to the region and local resources and dispatched to where they are most effective. For example, solar power should not be developed in Seattle, when those same solar cells could be producing significantly more power in California. Technologies should also be matched to the appropriate load. For example, when heating water, solar water heaters may be more efficient than biomass-powered electricity.
- **Educate the public about energy economics.** Ensure the public is informed about peak oil and its effects on the geophysical, societal, and environmental costs. These costs are difficult to monetize, and commodity and consumer goods pricing will inevitably increase.
- **Preserve ecosystems to serve us without artificial interventions.** To be successful, a sustainable economy must maximize its use of natural energy from sun, wind, water movement, etc., while not destroying its enormous natural sources. The benefits of ecosystem services are often not realized until they are lost. For example, urban development may pave over areas that previously absorbed and purified waste waters naturally. As a consequence, expensive waste treatment becomes necessary to replace benefits of lost natural systems[8].
- **Consider future energy needs when planning today's energy budgets.** Substantial energy reserves will be needed for future stability against natural fluctuations, economic disruptions, natural disasters, and

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[8] Howard T. Odom. *Energy, Ecology and Economics*. Reprinted from the special energy edition of *Ambio* (No. 6, 1973) with the permission of the Royal Swedish Academy of Sciences in Stockholm, Sweden. Copyright 1973 by the Royal Swedish Academy of Sciences.

political or military threats. Rather than exhausting the remaining fossil fuels for a little more growth and tourism, these valuable resources should be considered a bridge to sustainable energy paths for future generations[9].

Leadership Concepts and Actions

The proposed recommendations are underscored by the need for strong and dedicated leadership. Without proper direction and support, problems and challenges that might arise with energy depletion may prove more difficult to deflect. To successfully mitigate the greatest risks, City and State leaders should:

- Facilitate a significant reduction in petroleum consumption.
- Design and develop an urban network that can function successfully in an oil depletion context, including increased walking, biking, and mass transit systems.
- Enlarge and empower conservation and efficiency programs.
- Encourage sustainable economic development that will flourish in a post-oil economy, including businesses providing energy solutions, employment, and economic sustainability and growth.
- Develop community-based, social-support systems that will mitigate or avert the impacts of high energy costs for the people of Austin, particularly for low-income households.
- Initiate emergency planning for sudden and dramatic price increases or supply disruptions.
- Establish Intermodal Transportation Transfer Centers (e.g.: long-distance trains to local trains, freight trains to local truck delivery, and train to air; not limited to containerized cargo).

Supply and Demand Scenarios

While the Task Force is not in the position to predict when worldwide oil production will peak or when oil and natural gas scarcity will become a worldwide issue, the group does believe the following scenarios portray possible timeframes and consequences due to high oil and gas prices and potentially volatile supplies. These scenarios are not projections, or facts, but rather possible outcomes and are not mutually exclusive; it is possible we will experience some interactive trends within each scenario.

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[9] ibid

Scenario I: Sustained price increase and diminishing supplies

While price increases are expected to have significant effects on transportation patterns and local and national economies, these effects may be gradual enough and take place over enough time so that aggressive, proactive planning can mitigate most problems associated with energy depletion. Technology and innovation within the oil and gas industry, along with high oil and gas prices, may spur further discoveries to avoid shortages in the short run. Nonetheless, the Task Force believes the Austin region should work towards a 25 percent reduction of oil use by 2020 for this scenario to apply.

Within this scenario, oil and gas prices will rise steadily with short periods of price volatility. Steadily increasing prices will send a clear market signal to induce changes in consumer behavior. These changes will likely focus first on elimination of waste (e.g. turning off lights more often, driving less, etc.), followed by investments in efficiency (e.g. by large industries installing new variable-drive motors, etc.). Reduced demand due to increased efficiency or alternative power sources could make prices artificially low for short periods of time. However, lower prices will only revitalize consumption, which would drive prices back up, causing a seesaw effect. Energy research and development is likely to increase with a diminishing supply of oil and natural gas, potentially causing economic turbulence in energy markets, as well as research and development programs worldwide.

Scenario II: Extreme supply volatility

For this scenario, sudden price spikes and supply shortages will cause sustained periods of hardship, requiring significant changes in lifestyle and social structure for many Americans. While the Task Force would like to discount this possibility, it is important to remember that about 90 percent of the world's oil and gas is controlled by governments and state-owned companies[10], meaning supply will be controlled by political constraints more than physical constraints. Should major oil exporting countries see a decline in production, they could reduce their exports before reducing their own domestic supply. Conversely, energy price spikes could induce recessionary demand destruction, which subsequently lowers oil prices, induces partial economic recovery, and creates a volitile economic cycle.

Scenario III: Social breakdown

In this scenario, significant, long-term supply shortages could cause social chaos. Such lack of resources yields competition for scarce goods, resulting in serious price escalation and disorder. Unemployment, crime, and hunger will become rampant. Governments might need to invest their resources in serving basic human needs. Such an event will necessitate the use of emergency plans

[10] Rahn, Richard W. "Socialist Oil Death Spiral." The Cato Institute. November 6, 2007. 6 Dec 2008 <www.cato.org/pub_display.php?pub_id=8778>

developed by various jurisdictions. Although a worst-case scenario, such events have historically occurred at a municipal level, for example Hurricane Katrina causing temporary energy supply cutoffs in New Orleans. If oil and gas production declines, the energy system will be strained and subject to more frequent, intense, and enduring supply disruptions caused by geopolitical events, natural disasters, war, terrorism, market failures, and accidents.

Impact on Transportation and Land Use

Single occupancy automobile use may decline and people may seek more affordable transportation.

With the price of crude oil and gasoline temporarily reaching record highs in 2008, the question rose: how much does gasoline have to cost before Americans change their driving habits? To some extent they already have. Many Americans have reduced their consumption temporarily, some permanently. One response to high fuel prices may be that people will do less driving. For example, instead of traveling long distances for summer vacations, people may seek vacation spots closer to home, or simply not travel for vacation. Americans drove almost four percent less on the Fourth of July and the days leading up to it in 2008 than they did the previous year, making it the 21st week in a row with gasoline consumption lower than the same week of 2007.[11]

Daily driving habits may change if prices stay high. In the short term, commuters may carpool more frequently and use public transportation. These trends could yield favorable results, such as reduced traffic congestion, reduced demand for parking, and reduced emissions. In addition, people would be more inclined to walk or ride a bicycle. Combined, these trends would harmonize with the goals of the Austin Climate Protection Plan, which seeks to reduce energy consumption and carbon emissions in Austin.

In the interim, a shift may occur in the size and type of vehicle driven to work. In households with more than one vehicle, the most fuel-efficient ones will be driven more often. The size and types of new vehicles purchased has already begun to shift. Small car and hybrid sales are doing well, while SUV and truck sales are down considerably from years past. In July 2008, Ford reported SUV sales were down 55 percent from July 2007. High gas prices for the foreseeable future may result in a higher percentage of small cars, motorcycles, and hybrid cars on the road. In the long term, there might be a greater desire for people to live close to their place of work.

Existing mass transit in Austin lacks capacity to absorb many new users.

Like many Sunbelt cities, Austin's development over the last few decades has been driven by the assumption that cheap oil will continue to make personal

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[11] Clifford Krauss. "Surprisingly, Oil Declines For 2nd Day". *New York Times*. <www.nytimes.com/2008/07/09/business/worldbusiness/09oil.html?scp=1&sq=Suprisingly,%20 Oil%20Declines%20for%202nd%20Day&st=cse>

automobiles the choice mode of transportation. Austinites depend heavily on their cars due to the city's dispersed population and underdeveloped public transportation system. Since 1994, the percentage of Central Texans driving their own car to work has gone from 84 percent to 90 percent, while the percentage taking the bus has dropped from eight percent to four percent.[12]These trends have created congestion in Austin, which results in wasted fuel and increased emissions of greenhouse gases and other pollutants.

The Capital Metropolitan Transportation Authority Board of Directors approved the "All Systems Go" long-range transit plan for the Central Texas service area in November of 2004.[13] The plan calls for commuter rail, regional intercity rail, bus rapid transit, streetcars, expanded express and local bus service, and circulators, such as the "Dillo". Based on a successful rail referendum in 2004, Capital Metro will begin passenger rail service from Leander to downtown Austin in mid 2009. This 32-mile rail line, known as Metrorail, is a significant step for the region, but the impact of a single rail line with limited initial service on the overall regional transportation system may be small. In addition, the capital and operating costs for the Metrorail line will, in the short term, consume a significant portion of funding available to Capital Metro. The challenge for the Central Texas region and Capital Metro is to rapidly expand both rail and bus service to accommodate future transit needs and foster higher density land use patterns that, in turn, support transit use.

Several major obstacles exist to a rapid expansion of rail and bus systems. First, the Central Texas region has not reached a consensus that a robust rail system is needed. Second, Texas State law requires Capital Metro to hold a referendum for any new or expanded rail systems only in odd-numbered years. Third, Capital Metro's ability to fund additional large-scale transit improvements is limited. If regional transit service is to expand on the scale required, a regional consensus will need to be forged and significant additional financial resources will be required.

Based on an increasing cost of fuel and limited funding, cutting routes is Capital Metro's current contingency plan to counter a substantial price increase in fuel. Unfortunately, such cuts might occur while fuel price increases motivate growth in ridership. Consequently, expanding routes might make more sense.

Public schools may see an increase in school bus ridership.

High fuel costs could result in increased school bus ridership, while funding for school bus routes will become more expensive. Already, Round Rock schools are cutting back routes, which force some middle and high school students to

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[12] "2006 Biennial Data Report". Central Texas Sustainability Indicators Project. < www.centex-indicators.org/annual_rept/ar2006.pdf>

[13] Ben Wear. *Austin-American Statesman*. "Capital Metro Rail team on board; agency OKs up to $8 million for consultants to help launch commuter train, buts projects"

walk as much as a half-mile to the nearest bus stop.[14] With parents driving their children to and from school every day becoming more costly, the bus may become a more appealing option. In the face of oil depletion, school districts may realize that expanding bus routes make more sense.

Road and infrastructure maintenance may become prohibitively expensive.

Since road maintenance is typically paid by fuel taxes, future revenue for highway development and maintenance is uncertain. About two-thirds of highway-user revenues are derived from fuel taxes, while the rest is generated by vehicle registration fees, operator license fees, toll fees, etc. Fuel taxes are collected on a volumetric basis, so a decline in motor fuel consumption, due to supply shortages, more fuel-efficient vehicles, or reduced demand, would significantly impact fuel tax revenue.[15] For every dollar Texans contribute to the Federal Highway Trust Fund, Texas receives 70 cents in federal highway program funds and eight cents in federal transit program funds. "Various studies predict that the Highway Trust Fund will run out of money in 2010".[16]

At the same time, construction costs continue to rise. Consequently, less money may be available for road work. Funding future projects may be more difficult. To address declining funds for highway development, Austin may see more toll roads and other road systems that "pay for themselves". Also, a substantial increase in partially or fully electric-powered cars may give way to an entirely new system for funding highway development. These vehicles will generate far fewer dollars per mile traveled, but will still cause wear and tear. Hybrid and other vehicles with improved fuel economy are gaining popularity and will weaken the revenue generation capability of the fuel tax without changes to make owners pay their full share of road use.

Fuel-intensive air and truck freight may lose customers to rail and maritime freight shipping.

Historically inexpensive fuel has allowed the development of a high-powered, high-speed shipping system, relying on long-distance hauling by trucks and airplanes. While fast, they are also the most fuel-intensive choices. Shipment by rail is approximately 10 times more efficient than shipment by truck and nearly 30 times more efficient than by plane in terms of BTU per short ton mile. Transport by cargo ship is about 50 percent more fuel intensive than shipment by train.[17]

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[14] Steve Albers. KVUE. <www.kvue.com/news/local/stories/081808kvuerrisdbuses-mm.eecc488.html>

[15] *The Fuel Tax and Alternatives for Transportation Funding*. National Research Council. Special Report 285. Pp. 25.

[16] Tonia M. Ramirez. "Uncertainty of Federal Financing". Texas Department of Transportation. < ftp://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/federal_financing.pdf>

[17] "Transportation Energy Data Book". U.S. Department of Energy –Energy Efficiency and Renewable Energy <cta.ornl.gov/data/tedb27/Edition27_Full_Doc.pdf>

The benefits of air freight are clear, it is significantly faster than truck, rail and boat, especially for intercontinental transportation. Shipping by boat takes days or weeks, while shipping by air takes only hours. However, the energy requirement for air freight is significantly higher than cargo ships by weight. If fuel prices increase, air freight may become prohibitively expensive in many cases. These costs may drive a broad shift from truck and air freight to rail and boat. Trucking, however, is unlikely to stop completely. A favorable scenario could consist of long distance hauling by trains and local distribution by trucks.

Impact on Food, Agriculture, and Water

Effects of energy depletion on American food will be negative, but will vary. Food could become much more expensive and food shortages could occur.

The American agricultural sector depends greatly on fossil fuels. In the last century, the technological development of agriculture has dramatically changed farming methods. As a consequence, food is abundant and inexpensive in the U.S. However, in the face of fossil fuel depletion, this situation could change.

Current food production and distribution in the United States requires 10 to 15 calories of fossil energy for every calorie of food produced,[18] partially because the average food item in the United States travels approximately 1,500 miles to its final destination.[19] Moreover, almost 40 percent of energy used in the food system goes towards the production of artificial fertilizers and pesticides,[20] which are typically synthesized from natural gas and petroleum.

High-volume use of oil-based pesticides and herbicides and natural gas-based fertilizers, coupled with diesel fuel to operate huge machines, enables one American farmer to feed 144 people. The table below shows a comparison between the commercial energy required for rice and maize production by modern methods in the United States and transitional and traditional (i.e. pre-industrial) methods used in the Philippines and in Mexico. A comparison shows that the modern methods give approximately five times greater production yields and are 30 to 80 times more energy-intensive than the traditional methods.[21]

[18] Joan Dye Gussow (1991) Chicken Little, Tomato Sauce & Agriculture: who will produce tomorrow's food? New York: The Bootstrap Press.
[19] John Hendrickson. "Energy Use in the U.S. Food System: a summary of existing research and analysis." Center for Integrated Agricultural Systems. UW-Madison. < www.cias.wisc.edu/wp-content/uploads/2008/07/energyuse.pdf>
[20] Fossil and Energy Use. <www.sustainabletable.org/issues/energy/>
[21] B A Stout. *Handbook of energy for world agriculture*, Elsevier Applied Science, London, 1990

	Rice production			**Maize production**	
	Modern (United States)	Transitional (Philippines)	Traditional (Philippines)	Modern (United States)	Traditional (Mexico)
Energy input (MJ/ha)	64,885	6,386	170	30,141	170
Productive yield (kg/ha)	5,800	2,700	1,250	5,100	950
Energy input yield (MJ/kg)	11.19	2.37	0.14	5.91	0.18

Table 1. Energy requirement comparison of farming methods: Traditional, transitional, and modern. Source: Environment and Natural Working Paper, Food and Agriculture Organization of the United Nations.

Due to the petroleum dependence of fertilizers, pesticides, agriculture equipment, and food transportation, a petroleum or natural gas supply constraint could have profound effects on agriculture. The American food supply network has developed in such a way that heavily populated areas and food producing areas are isolated from one another. Since industrial farming focuses on scale, increasing amounts of foods are produced in concentrated areas of the country. Some of this specialization is natural, due to soil and weather conditions, but crop specialization has become more extreme in the past few decades. Concentrated production requires long-haul transportation of food products across the country and the world. A price spike or shortage of transportation fuels could mean that food would be available near the farm, but may not reach consumers further away.

A long-term fuel supply shortage could severely hamper America's current food production and distribution networks. Due to the hydrocarbon-intensive nature of current farming practices, high fuel prices and potential supply shortages could cause farming to become increasingly expensive, making some farming costs prohibitive. The availability of biological controls and energy-efficient integrated pest management could mitigate the loss of petroleum-based chemicals, but it is not clear if these solutions are market ready.

While highly productive, today's energy-intensive agriculture is not sustainable in the long term. High prices for fossil fuels might result in re-localization of the food supply, where climate and adequate arable land make this possible. For areas where 100 percent of local food production is not possible, advanced planning is advised. Austin is one of those areas.

Austin has a low level of food self sufficiency.

Austin, like most cities in Texas, imports most of its food. A handful of local producers sell their wares in local farmers' markets and via community-supported agriculture, but Austin is not self sufficient and has a very limited ability to produce food. Thus, a fuel supply disruption could halt the supply of food to Austin.

Gardening in Central Texas is a challenge. The annual rainfall is adequate for some agricultural crops, but the amount of rainfall is minimal during the hot summer months. The extremely hot summers essentially divide the growing season into two short seasons, spring and fall, with many traditional vegetable crops unable to yield during summer months, when the temperatures are near 100 degrees Fahrenheit. There are a variety of soil types in the region, most of which require some level of amendment to grow crops. The presence of large trees is essential for mitigating the urban heat island effect and facilitating aquifer recharge. However, the arboreal canopy limits the type and amount of fruits and vegetables able to be grown.

If there are extreme shortages, people may focus on growing calorie crops, or crops with the most calories per cultivated area, and using all space available to grow food. Some public parks, school grounds, and vacant lots may be converted to community gardens, if the need becomes great enough. However, the current capacity for households to grow their own food is very limited. With a large percentage of the population living in apartments, condominiums, or small homes, very few households have yards or any type of space to host a significant food garden. Most people also lack the time and expertise to grow their own food.

Even if a household owns some arable land, a lack of knowledge and time probably represent the biggest obstacles to ordinary Austinites growing and preserving their own food crops. County agricultural extension agents might help to overcome the knowledge hurdle. Group living situations and community gardens could also assist in overcoming the time and labor hurdle.

The amount and variety of locally-produced food may increase slightly and the amount of food imported might decrease.

There are powerful economic and political forces supporting a global food network, such as the agricultural rules of the World Trade Organization (WTO)[22]. A study published in May 2008 by the Canadian investment bank, CIBC World Markets, calculates the recent surge in shipping costs is, on average, the equivalent of a nine percent tariff on trade including food. “The cost of moving goods, not the cost of tariffs, is the largest barrier to global trade today,” the report concluded, and as a result “has effectively offset all the trade liberalization efforts of the last three decades.”

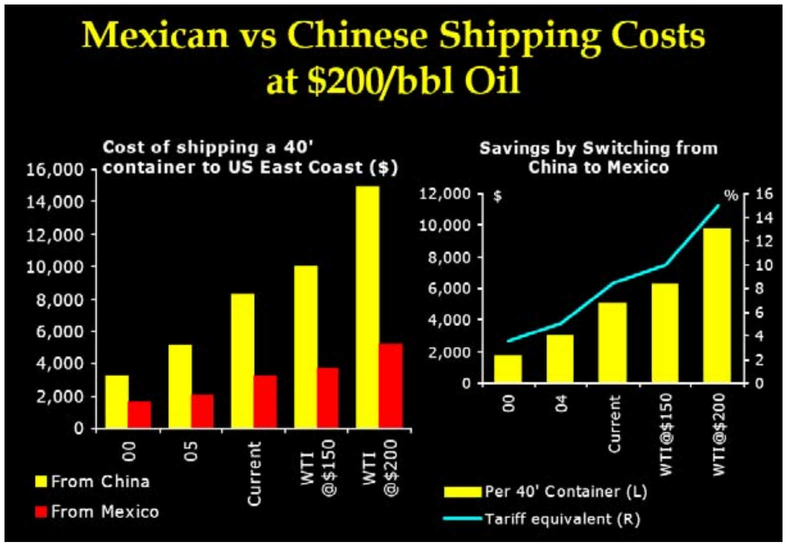

Figure 6: Source: The Age of Scarcity. Jeff Rubin. CIBC World Markets, Inc. July 2008.

For example, the cost of shipping a 40-foot container from Shanghai to the United States has risen from $3,000 early in the decade to $8,000 in 2008. Big container ships, the pack mules of the 21st-century economy, have shaved their top speed by nearly 20 percent to save on fuel costs, substantially slowing shipping times. [23] Rising transportation costs will have an impact on food, from bananas to salmon, and could eventually transform some items now found in the typical middle-class pantry into luxuries and further promote the local food movement developing in many American and European cities.

Localization of the food production chain means moving food producers and consumers closer together, but it also means relying on the local manufacture and regeneration of all of the elements of the production process - from seeds to tools and machinery.[24] However, localization does not mean an end to inter-

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22 World Trade Organization. <www.wto.org/english/docs_e/legal_e/ursum_e.htm>

23 Larry Rohter. *Shipping Costs Start to Crimp Globalization*. NY Times, August 3, 2008. < www.nytimes.com/2008/08/03/business/worldbusiness/03global.html?_r=1&scp=1&sq=Shipping%20Costs%20Start%20to%20Crimp%20Globalization&st=cse>

24 Richard Heinberg. *Threats of Peak Oil to the Global Food Supply*, FEASTA Conference, June 23 – 25, 2005, Dublin Ireland.

regional trade. The carrying capacity of a habitat is always limited by the scarcest resource. One way to increase carrying capacity is to trade surplus items from one habitat to another habitat in which that resource is scarce. However, the scope of this trade may be limited by time and distance.

Investments in greenhouses and irrigation systems can help overcome local limitations based on climate, but these “hard” investments require substantial financial resources for construction and maintenance. Locally-grown food is likely to cost more than the mass-produced crops grown with cheap energy over the past several decades, though there might be a local economic benefit from its production. Austin might need a major public education effort to build the horticultural skills necessary to grow a significantly larger quantity of food than is presently produced.

Food retailing options may shift.

Grocery stores offer a wide variety of foods that travel long distances to reach the store. Foods requiring long distance trucking and refrigeration or foods that are time-sensitive may become much more expensive. For these types of foods, consumers may shift toward local retailers such as farmers’ markets. However, certain temperate climate fruits requiring a lengthy winter chill to set fruiting buds (e.g.: most varieties of apples) cannot be grown locally. Foods produced locally will likely become more price competitive, if transportation costs rise. In addition, possible decreases in the use of preservatives would lower both the variety of foods available in grocery stores and the shelf life.

Texas has a wide range of climates. From the warm, wet and lush Gulf Coast to the Hill Country to the drier western part of the state, Texas can play host to a wide variety of foods. While some Texas regions receive adequate rainfall for farming, some do not. Arid regions using fossil water for irrigation will not provide a reliable source of food indefinitely.

Food production in Central Texas will require new strategies to cope with escalating oil prices. The distribution of food will undergo some dramatic shifts as well. The supply side of food production might become more diverse and entrepreneurial. These changes might also affect the business model of grocery stores. These stores will become smaller and more localized, reversing a decades-long trend towards larger, more centralized stores.

Low-income households are most vulnerable to higher prices and could see a decline in diet and nutrition.

Food and transportation account for a relatively high percentage of expenses for low-income families, some of which already rely on charitable assistance from food banks. As the economy struggles, more families might need assistance. Community gardening projects, with sufficient support, can help mitigate nutritional deficits for some low-income neighborhoods. These gardens are not likely to happen accidentally, nor is it likely that the market will flourish if left unaided.

For impoverished communities already grappling with chronic food insecurity, the impact of oil and gas scarcity may worsen the situation. Low-income families are the least equipped to manage the additional reduction of affordable and nutritious food, so they are likely to be hardest hit. Food pantries and relief organizations may prove inadequate to meet community needs in this situation.

The kinds of food produced and processed might shift, introducing business pressures and opportunities for food producers and processors.

If the price of oil and natural gas continues to rise, a reduction in energy-intensive food production may occur. For example, there may be a reduction in red meat production and consumption. Not only are cattle inefficient, consuming far more calories than they offer as food, but beef must be frozen in order to prevent spoilage, necessitating a relatively high price. Chicken and other livestock convert grain to meat more efficiently than beef, but still require refrigeration to prevent spoilage. Aqua culture (catfish farms, tilapia, etc.) produces protein very efficiently but requires sophisticated systems to maintain sanitary conditions and optimal growing conditions for the fish[25]. On the other hand, vegetables generally require significantly less energy input for the food energy they contain. Production of foods requiring significant refrigeration in order to maintain nutritional quality might become less prevalent in an energy scarcity scenario, while production of foods maintained at ambient temperatures might see increased demand. In an era of oil scarcity, agriculture may resemble the past more than the present. Local products may become available in raw or unprocessed form which, in some cases, can be healthier.

Diminishing tolerance for waste may bring changes in food packaging.

Americans waste an astounding amount of food — an estimated 27 percent of the food available for consumption, about 30 million tons per year. Furthermore, 66 percent of adult Americans are overweight[26]. Grocery stores commonly discard edible produce once it no longer looks aesthetically pleasing. Given these data, it is reasonable to assume that if the United States lost up to a third of its food-producing capacity, there might still be a sufficient food supply. While social responsibility has not driven substantial conservation, expensive food might curb waste. Furthermore, most current packaging is petroleum based, and is often designed for appearance rather than transportation and storage efficiency; for instance, a bag of chips is designed to be packed in a larger bag than necessary to take up more shelf space and capture consumer attention.

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[25] Lester Brown, Plan B <earth-policy.org/Books/PlanB_contents.htm>

[26] Around 0.48 megajoules (MJ) of energy is consumed to make one HDPE grocery store bag including the energy content of the bag (the embodied energy)

Plastic containers, shrink-wrap, and single-use food packaging tends to cost more than reusable packaging and requires petroleum and energy to manufacture. By comparison, the energy consumed by driving a car one kilometer is the equivalent of manufacturing 8.7 plastic bags.[27] Plastics, made from petroleum, are widely used throughout the food processing industry and their use could decline. Before plastic jugs and cardboard cartons were developed for retail distribution, milk arrived at homes in reusable glass bottles, a tradition that may return.

High cost and low supply may discourage use of petrochemicals in farming.

Oil and gas scarcity will yield a mixed blessing for agricultural pest control. Petrochemicals may become too expensive to use, causing a paradigm shift in pest control. Farmers will probably need to employ pest and disease control tactics mimicking those found in nature. Some natural pest control methods include polyculture farming, integrated pest management, and biological controls.

Water resources might not be affected.

Austin's water supply comes from local, natural sources and does not depend on oil. Thus, oil scarcity will not significantly affect Austin's water supply. The functions of the water supply requiring power are collection, distribution, and treatment, which are all fueled by electricity. Nationwide, water distribution and treatment only accounts for three to five percent of electricity use, but it does account for over half of the electricity consumed by city governments. On the other hand, power plants consume a significant amount of water for cooling. Power generation and oil and gas production combined account for 43 percent of industrial water use in Texas, though most of that water is not evaporated[28]. Therefore, should Austin's power needs continue to rise, so will demand for cooling water.

High energy prices will also have secondary effects on Austin's water. First, higher electricity prices will likely lead to more expensive water, but will probably not induce hardships or shortages, because prices are still likely to be relatively low. Second, maintaining water infrastructure is a relatively expensive task; the economic consequences of oil and gas scarcity may make it more difficult to invest in maintaining Austin's water infrastructure. Third, increased biofuel production could put pressure on water supplies, as grain biofuel production is more water intensive than conventional gasoline production.[29] Algae biofuels may require less water. Nonetheless, the City should continue all efforts to

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[27] Nolan-ITU Pty Ltd 2002, *Plastic Shopping Bags - Analysis of Levies and Environmental Impacts*, prepared for the Department of Environment and Heritage, Canberra

[28] HW Hoffman. *Energy and Water Relationships*. May 2006

[29] "Energy Demands on Water Resources". Sandia National Laboratories. <www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf>

reduce wasteful water consumption. In addition, localized water storage, using methods like rainwater capture systems, would also help to insulate Austin from possible water supply problems.

Impacts on Business, Economy, and Jobs

Recent history has shown that the condition of the U.S. economy is closely connected to the supply and price of oil and natural gas. Until a new infrastructure develops, high oil and gas prices and potential shortages might produce undesirable economic consequences.

Austin's economy might be more resilient than other cities of its size.

Austin's economy has some unique features that make it more resilient in an era of high energy prices, and some that make it more vulnerable. First, government represents a substantial portion of Austin's job market, comprising about a fifth of the total jobs in Austin. In addition, the University of Texas and Austin' school districts provide a significant number of local jobs. Together, education and health services combine to make up 10 percent of the jobs in Austin[30]. These sectors serve to partially insulate Austin's economy, because they are less likely to be significantly impacted by oil and gas scarcity. In addition, aside from distribution and shipping, Austin's largest companies do not require significant amounts of oil and gas to operate.

Many of Austin's largest companies are in the high-tech sector, which accounts for about 100,000 of Austin's jobs, or about 13 percent[31]. While these companies are not heavily dependent on oil and gas for operation, they may see a diminishing demand for their products as consumer purchasing power falls. The nationwide recession in the early 2000s proved how vulnerable the high-tech sector can be. On the other hand, the high-tech sector could play a significant role in energy efficiency and renewable energy technology.

Austin Energy, the City-owned utility, is considered a leader with respect to incentives for energy efficiency and conservation, green building, and renewable energy technology. This leadership, coupled with private companies in the renewable energy technology sector and research at the University of Texas, gives Austin the potential to become the center of a nationwide movement away from utilizing fossil fuels as the primary energy source. Consequently, oil and gas depletion could stimulate an economic boom for Austin.

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[30] Austin Chamber of Commerce: based on Texas Workforce Commission (www.tracer2.com) and U.S. Bureau of Labor Statistics

[31] Austin Chamber of Commerce Website: <www.austin-chamber.org/DoBusiness/TheAustinAdvantage/Semiconductor.html>

Rising prices could lead to inflation.

Transportation represents a large portion of many industries' and companies' operational costs. Thus, rising oil prices will likely produce higher prices for nearly all products. This trend will likely force consumers to devote more of their income to basic necessities, which would hurt businesses selling non-essential goods. Austin will be no different than any other city in the nation in this regard. A large increase in fuel prices could affect every aspect of the American market. Not only would fuel be more expensive, but food and all other energy-dependent products might become more expensive.

Some businesses might experience significantly higher production and distribution costs. Others may be impacted by change in demand for their products and services.

As previously mentioned, much of Austin's industry is not energy intensive and will not likely see dramatic changes in operating expenses in an era of oil and gas scarcity. One pertinent industry in Austin that is relatively energy intensive, however, is the semiconductor industry. It is not heavily dependent on oil, but does consume significant quantities of electricity and natural gas[32]. However, while energy costs may rise, the demand for semiconductor products could rise correspondingly, or be offset by the production of photovoltaic panels for "smart" systems that reduce energy consumption.

Unemployment may increase

If a large portion of household income is spent on food and fuel, less money may be available for other items, impacting business revenues. As a result, many businesses may need to make adjustments and change business models, which could lead to employee layoffs or business closures. However, a decrease in the use of fuel-intensive heavy machinery could create jobs previously eliminated by low oil prices (e.g. landscape maintenance).

Strategically positioned companies may flourish with high oil and gas prices.

Sustained increases in oil and natural gas prices will likely stimulate strong nationwide efforts to produce solutions to mitigate the impacts of oil and gas scarcity on a large scale. If businesses in Austin develop in a way that meets these new energy needs, they may become highly successful.

[32] Manufacturing Energy Consumption for All Purposes, 2002. Energy Information Administration.

Impact on Low-Income Populations and Public Services

Low-income populations are likely to be the first and hardest hit by resource depletion.

The increase in oil prices will have a larger impact on lower income households due to a lesser amount of discretionary income. Higher income individuals may be forced to give up some luxuries to pay the increasing energy costs, while lower income individuals will have to make sacrifice essential items, such as food or medicine.

Low-income populations will be the first to experience the negative consequences of higher oil prices in the form of higher transportation and food costs, as well as higher priced good and services. Low-income, marginalized populations are more likely to depend on public transportation. As fuel costs rise, public transportation fares are likely to increase as well. This population may have difficulty paying for transportation, resulting in job loss and further isolation from food, goods and services. In addition, the need for social services providing food and other goods will also increase. This population is probably the least knowledgeable about the effects of energy depletion and the least likely to be able to afford adaptive measures, like more fuel-efficient vehicles and energy-efficient home improvements.

Increasing costs and decreasing incomes may jeopardize public health, reduce health care coverage, and further stress the health care system.

Oil and gas scarcity could have several direct impacts on the medical and health care system. High oil prices could increase the cost of medical services, including the cost of transportation, medical facilities, pharmaceuticals, and medical equipment. Medical facilities already operating on tight margins may be forced to limit services. This trend could be exacerbated if demand for services grow and increasingly less of the population can pay for services rendered. As the cost of health care rises, businesses might be unable to provide coverage. If the uninsured and underinsured populations grow, medical treatment may be delayed, resulting in advanced illnesses that are more expensive and difficult to treat. As public health services decline due to budget challenges, the general public may be at an increased risk of epidemics due to lower-income populations unable to afford vaccinations for common preventable diseases.

Demand for social services might increase, while public ability to provide service might decrease.

A rise in oil prices could cause a decrease in food available to public service organizations, such as Meals on Wheels and soup kitchens, catering to low-income populations. In the face of higher energy and food prices, a higher number of people may seek aid from food banks. This shift would further strain the food bank supplies. For instance, The Capital Area Food Bank depends on trucks for receiving and distributing food donation, while many of the organization's employees live outside of Austin and commute to work. An increase in oil prices would greatly impact both of these areas of food bank operations.

A great number of social service organizations depend on private organizations and individuals to provide support. The number of persons, groups, and businesses able to provide charitable contributions and volunteer time may decline as higher fuel prices greatly impact their own budgets.

Electric utility impacts

Oil shortage

Austin Energy does not use oil as a primary fuel for electric generation; however, it does maintain some fuel oil reserves for emergency use in the event of natural gas supply disruptions. Also, Austin Energy relies on oil-based road fuels, such as diesel and gasoline, to operate its vehicle fleet, including repair trucks. Many Austin Energy employees rely on these fuels for personal transportation to and from work.

The primary impacts from an oil shortage would be:

- Inability or limited ability to resupply emergency fuel oil stocks, if consumed.
- Reduced ability to deliver field-based services, such as outage restoration, maintenance or new installations. This change could directly impact system reliability and overall service levels.
- Potential need to provide or arrange transportation for staff, particularly where system reliability or service may be affected.

Shortage of natural gas

Austin Energy relies heavily on natural gas as a fuel for electric generation, particularly during peak demand summer months. In 2007, natural gas supplied approximately 27 percent of the energy required to meet Austin's demand. Natural gas is a "peaking" fuel, meaning it is used when base load power sources, like coal and nuclear, cannot supply enough power to meet peak demand during hot summer days. ("Peaking" in this sense is different than the *peak* in *peak oil)*. Natural gas is utilized as a peaking fuel because it takes much less time to bring a natural gas plant online to full capacity (20 to 30 minutes) than base load fuel sources (2 to 3 hours). These peaking plants often only run for several hours at a time[33]. Consequently, natural gas use varies significantly

[33]Natural Gas Demand. <www.naturalgas.org/business/demand.asp#electricdemand>

throughout the year. During the peak of summer days, natural gas-based generation may supply up to 60 percent of the energy consumed.

A shortage of natural gas, particularly during the summer months, may require:

- Burning emergency fuel oil to the extent available. However, only two-thirds of Austin Energy's natural gas-powered generators have this capability, which may be inadequate to cover summer peaks.
- Purchase replacement power if available. Austin Energy is part of the Electric Reliability Council of Texas (ERCOT), the main grid for Texas and purchases power from the grid if it is less expensive than its own resources or if its resources are not available due to maintenance or unexpected outages. This option may not be available at an affordable price, since natural gas supplies approximately 65 percent of ERCOT's generating capability, and demand is likely to occur across the grid at the same time.
- Curtailment of energy consumption. A significant degree of voluntary and/or mandatory reductions in electricity consumption may be required to offset the heavy reliance on natural gas during summer peaks. Enforcing mandatory consumption limits by individual utility customers would be limited by the degree of deployment of smart meters that can report demand in real time and / or terminate service remotely. If voluntary or mandatory measures are insufficient, ERCOT would initiate rotating brown-outs to avoid a total system blackout.

Cooling Central Texas

For typical Central Texas residential electric customers, air conditioning can account for up to 36 percent of their annual energy consumption and as much as 60 percent of their consumption during summer months. During the peak hours of summer days the percentage is even higher. In the commercial sector, air conditioning also accounts for a large part of energy demand: nearly 20 percent annually, and as much as 37 percent in summer months.

Since air conditioning is such a large component of electric demand, it will continue to be the focus of energy efficiency and conservation efforts. Austin Energy offers rebate programs to promote the use of high-efficiency air conditioning units as well as proving free programmable thermostats which cycle participants' air conditioners for short periods during summer demand peaks.

Despite the success of these programs, peak power for air conditioning can be very expensive. If a major heat wave occurs and certain citizens cannot get satisfactory cooling, they might be at risk. During the 2003 heat wave in Europe, approximately 15,000 French people died, primarily because they did not have access to sufficient air conditioning.[34]

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[34] Earth Policy Institute. <www.earth-policy.org/Updates/Update29.htm>

Develop New and Continue Existing Programs to Reduce Total Energy Consumption.

Given that the U.S. consumes more energy than any other country in the world, we have the largest room for improvement so it is safe and reasonable to assume that a reduction in energy consumption is attainable. Energy consumption is generally separated into three categories: oil, natural gas and electricity.

Oil conservation programs are extremely underdeveloped.

If the United States increased its average fuel economy by just 25 percent, we would *still* have the worst average fuel economy in the world, but it would save as much gasoline as China consumes. A reduction in oil consumption is likely the easiest way to save the most energy; yet public conservation programs to conserve oil are almost non-existent and need to be established.

A partnership with the public could create new fuel sites to support emerging vehicle technology while encouraging consumers to purchase fuel-efficient transportation, and most importantly, to drive less. The cost of new vehicle technology is prohibitive to many, and programs and incentives need to be developed to encourage the public to purchase this vehicle technology.

One of the most effective ways to conserve oil is to increase the price of gasoline. The City of Austin may want to pursue legislation to increase the State fuel tax or to enact legislation allowing local governments to impose an increased gas tax. The incremental tax revenues could supplement alternative transportation incentives and rebates and help with the development of alternative technologies.

Capital Metro could be well positioned to lead the effort to reduce oil consumption, being the main proprietor of alternative transportation in Austin. Capital Metro is developing its own “All-Systems-Go” plan that includes light rail service. A light rail expansion can cause a measurable reduction in Austin’s oil consumption. The plan needs City support to expand. The Capital Area Metro Planning Organization may also be well positioned to contribute.

Programs are in place to conserve natural gas, but development must continue.

Residential natural gas consumption has decreased one percent per capita per year for the past 20 years. This reduction in consumption is due to improvements in new home construction, especially insulation, weatherization and more efficient appliances. The City of Austin should strive to continue these efficiency gains.

Texas Gas Service operates a conservation program for Austin customers, which provides incentives and rebates for customers to purchase efficient natural gas appliances and make energy-efficiency improvements. The City of Austin, which has regulatory authority over Texas Gas Service, should encourage them and Austin Energy to continue their success in providing meaningful incentives to customers who take steps to practice conservation.

While per capita consumption of natural gas had decreased in recent years, the total consumption of natural gas may increase in coming years as a result of the population growth and the expansion of natural gas power generation facilities. Therefore, significant reductions in total consumption in the next 10 to 20 years may not be feasible; rather, these conservation efforts might slow or stop the increased consumption.

Programs are in place to conserve electricity, but development must continue.

Austin Energy has been a sterling example of what electricity conservation can achieve. Austin Energy's conservation programs saved an estimated 600 MW of peak load in the last two decades, but there is room for more improvement. Austin Energy plans for a further 700 MW of future capacity to be met by 2020 through energy efficiency programs.

Austin Energy also plans to generate 30 percent of the city's power from renewable sources by 2020. These are very ambitious goals and city support is essential to acheive them.

Continue Progress with Fleet Fuel Efficiency and Diversity.

The City of Austin fleet is composed of approximately 5,000 units located in various departments around the city. Some of the departments include Police, Fire, Solid Waste, EMS, Austin Energy, Public Works, and Water Utility. City fleet consumes approximately 5 million gallons of fuel per year. About 51 percent of all City vehicles are capable of operating on alternative fuel or hybrid technology.

The City of Austin has enacted a plan to reduce its vehicle fleet fuel consumption. The current fleet plan prioritizes electric, alternative fuel and hybrid vehicles in lieu of traditionally fueled vehicles, especially for equipment such as forklifts, backhoes, and mowers that may be powered electrically or by natural gas. The plan involves reviewing the best available technology on the market, deciding when to replace vehicles and equipment, and the fleet's fuel infrastructure is continually transforming to include biodiesel, ethanol, compressed natural gas (CNG), and propane. Reducing fuel consumed in the City fleet will encompass a comprehensive utilization study designed to eliminate vehicles that are underutilized or not necessary to maintain City service levels. There will also be a focus on driver behavior and vehicle maintenance. The annual replacement rate is between 8 to 10 percent, and the City has already begun to phase out traditionally-powered vehicles. Changes in landscaping practices could reduce fuel consumption as well.

The City of Austin's solid waste collection fleet already consists of two CNG vehicles,and the purchase of five additional vehicles has been proposed. In addition to addressing fuel supply concerns, converting large diesel-powered trucks to CNG will reduce their emissions substantially.[35] Fleet Services is working with the Austin Climate Protection Program and other City departments to evaluate its current fueling infrastructure to provide support to an expanding service area. This plan will include looking at ways to work in partnership to provide access to bio fuels to the public.

Inform Citizens about Energy Depletion and the Potential Effects on the City of Austin and the United States.

By changing their behavior, Austinites can make a significant impact in reducing energy consumption. Small behavioral changes, without great sacrifice, can produce meaningful reductions in energy consumption.

With rising demand for oil and gas, and worldwide supplies tightening, current inexpensive fuel prices are not likely to persist. Realizing high fuel prices will likely become standard is important and will motivate consumers to change their behavior.

Public awareness about resource depletion can be raised using the media and public events in conjunction with existing information campaigns through Water Conservation, the Pecan Street Project and Austin Climate Protection Program. Working with local schools to encourage student interest in energy matters and conservation tactics may also be effective.

Individuals and families can reduce their personal oil consumption by doing the following things:

- Drive less. Combine trips, carpool and generally reevaluate when and where driving a personal vehicle is needed.
- Take the bus (or soon, the train), ride a bike or walk instead of driving.
- Car dealerships offer rebates to individuals trading in their vehicles for more efficient cars.
- In households with more than one vehicle, drive the more efficient vehicle whenever possible.
- The Texas Commission on Environmental Quality (TCEQ) offers a program providing up to $3,500 to those who qualify to replace a vehicle that is 10-years old or older or has failed an emissions test. Individuals can visit www.driveacleanmachine.org for more information.

Most consumer products are either made of petroleum or use petroleum to get to store shelves. Other ways to reduce per capita petroleum consumption are:

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[35] U.S. Department of Energy- Energy Efficiency and Renewable Energy. www.afdc.energy.gov/afdc/vehicles/natural_gas_emissions.html

- Buy in bulk whenever possible. Try not to buy individually packaged items.
- Don't waste food. Every calorie you eat takes about 10 to 15 hydrocarbon calories to get to your plate through farming, processing, and transportation. Buy what you need, eat what you buy.
- Try to reuse or fix old or broken items rather than buying new ones.
- Recycle
- Use reusable shopping bags whenever possible.

Enlist the Office of Emergency Management to Plan Reductions in Energy Consumption and Evaluate Contingency Plans for Possible Fuel Supply Disruptions or Price Spikes.

The Office of Emergency Management should develop a plan in coordination with government, community, and business leaders to make meaningful preparations for oil and gas shortages or sharp price increases.

The plan should encourage businesses to reconsider traditional practices emphasizing continual growth and expansion of energy consumption. Rather, encourage them to streamline their efforts, which could mean energy cost reductions. Preparations should also be made for functionality in an oil shortage scenario.

The City of Austin should set goals for energy reductions to serve as models for other businesses as well as the general public.

Promote Infrastructure Development that Reduces Energy Consumption.

Emphasize rail mass transit and transit-oriented development (TOD).

Encourage and support expansion of Austin's rail transportation capacity. Sustained high fuel costs will likely lead to a nationwide decrease in freight transport via truck and airplane and an increase in more fuel-efficient rail transport.

Austin can design and retrofit its infrastructure to promote energy-efficient transportation options and facilitate energy-efficient movement of freight and passengers. A new philosophy and a concerted effort to avoid new infrastructure investments that promotes high energy consumption or requires energy-intensive maintenance or operation will be needed. For example, building roads to suburbs encourages sprawl, locks in energy-intensive transportation, road maintenance, and extension of utilities. Alternatively, linking suburban developments with rail lines encourages compact development that will tend to cluster around train stations. TOD exemplifies a city-planning style that promotes, facilitates, and creates incentives for such lower energy-intensity alternative modes of transportation as walking, bicycling, and using public transit.

Austin must enlist participation from private sector organizations to participate in the public process to create solutions for Austin's growing traffic problems before they become mobility problems. A cooperative approach with these organizations will be necessary for success.

Shift trips from cars to other modes of transport.

The 2000 U.S. Census outlines the degree to which Austin's commuters depend on fossil fuels for daily transportation. Almost a decade ago, the Austin community of 359,804 employed civilians aged 16 or over utilized various transportation modes at the following rates:

Drove alone (car, truck, or van)……………….. 73.6%

Carpooled (car, truck, or van)…………………. 13.9%

Public transit……………………………………. 4.5%

Pedestrian…………………………………….. 2.5%

Other……………………………………………. 2.1%

Worked at home…………………..…………….. 3.4%

The City of Austin must emphasize a shift from single person vehicle travel to other modes by supporting mass transit and developing programs to increase biking and walking in Austin. Capital Metro and the Capital Area Metroplitan Planning Organization can be instrumental in the implementation of such programs.

Fuel prices alone can influence behavior. With the 2008 fuel price increase, the bus system experienced a 24 percent rise in express bus ridership in May and 56 percent in June. The fixed routes had a four percent increase in May and nine percent in June (Austin American Statesman, July 29, 2008).

These statistics demonstrate a willingness to use mass transit, especially related to direct travel to major areas of employment - the purpose of the express bus service. Numerous existing programs can provide starting points for reducing oil dependency.

The City of Austin and other major employers in Austin provide free bus passes to their employees, a practice that helps reduce oil dependency. The City's Air Quality Program also trains employees how to ride the bus. While this may be considered a basic activity, the program helps remove any reservations or confusion employees might have about riding public transportation and has been a very successful program. A similar training should be offered in all major employment areas.

The community as a whole has access to ride-share information through the website www.rivercityrideshare.com/en-US/. The website provides information on carpool/vanpool matches, biking and pedestrian information, and public transportation options which is ideal for employers to make available to their workforce.

Employers can take additional actions to encourage alternative transportation among their employers including not offering free parking for employees, providing incentives to employees not driving vehicles to work and providing showers for bicycling employees.

The Urban Heat Island Program has provided trees for shade over streets and sidewalks since 2002. Expanding this program and improving sidewalks, awnings, and street lamps makes walking in Austin more appealing and encourages employees to walk in pedestrian districts.

Additionally, the City of Austin is studying the connectivity of hike and bike trails, bike lanes, sidewalks of parks, schools, neighborhoods, shopping areas, and places of employment to create a master trail system. In some cases, private land owners can assist the City with this connectivity.

The City's Bicycle and Pedestrian Program staff developed a new bikeway plan, which includes a map featuring the major areas of employment (www.ci.austin.tx.us/bicycle/downloads/map_emp.pdf) The City installed over 1,500 bike racks and property owners in Austin may request free bike racks at their existing businesses.

Austin Energy provides incentives to encourage the purchase of all-electric motorcycles, bikes, scooters, and vehicles. Employers can assist with this alternative transportation by providing electric plugs in parking facilities where-electric vehicles can be recharged. The City of Austin hopes to shift much of its transportation use to an electric platform over the next 10 years partly as a way to reduce petroleum consumption. In anticipation of the coming changes, employers should prepare their parking facilities to support this next generation of vehicles.

Investments for improving roadways and public transportation systems can offer some fuel-saving potential. Traffic congestion wastes fuel in the transportation sector and, in Texas, costs drivers an average of $6.2 billion a year[36]. The Austin area has the worst congestion of any other midsize urban area in the nation[37]. While high gasoline prices may relieve congestion by rendering driving unaffordable to some Austinites, improvements like traffic light optimization and high occupancy vehicle (HOV) lanes can reduce both congestion and fuel consumption. Improving roads while neglecting rail, however, might actually increase driving and thus oil dependency.

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[36] TxDOT has a Plan. Strategic Plan for 2007-2011. ftp.dot.state.tx.us/pub/txdot-info/lao/strategic_plan2007.pdf

[37] *2006 Biennial Data Report*. Central Texas Sustainability Indicators Project. www.centex-indicators.org/annual_rept/ar2006.pdf

Create intermodal transportation hubs – Grand Central Terminal.

Intermodal transfer centers, including warehouse districts, rail yards, and major train stations allow the transportation system to achieve energy savings from long-distance train service while maintaining the convenience and necessity of local delivery services. Enhanced rail connections between Austin and ocean ports in Houston and Corpus Christi will improve the energy efficiency and expediency of passenger service, as well as freight shipping between Austin and overseas locations.

As fuel and transport costs increase, the pressure to economize will increase. When long-distance truck transport becomes prohibitively expensive, high-speed and expeditious train service will become more attractive and eventually necessary. When considering the importing of manufactured goods from overseas and food from Mexico, California, and other distant locations, trains will not reach every address or even every community. For that reason, people and freight will need to transfer from long-distance, high-capacity modes (mostly trains in Austin) to local low-capacity modes, such as delivery trucks for freight and electric light rail for passengers.

While Austin citizens will likely voice an opinion about the locations of rail yards, light industrial warehouse districts, and the "Grand Central Train Station," intermodal transfer hubs for people living and working in the middle of cities and urban villages. Intermodal transfer hubs for freight will most likely be located in districts designed for warehouses and light industrial activity.

Provide Incentives and Encouragement for Businesses to Reduce Energy Consumption Through Nontraditional Business Practices.

Telecommuting

Research conducted by Kate Lister and Tom Harnish shows 40 percent of Americans hold jobs that can be performed at home. Based on their synthesis of data from EPA, DOT and seven other recent sources, they found that "teleworking" can reduce greenhouse gases by up to 10 million metric tons of carbon dioxide a year and save as much as 625 million barrels of oil each year (approximately eight percent at 2008 consumption levels)[38].

In a high-tech community, such as Austin, many major employers provide laptops and remote access to files as incentives for telecommuting. A challenge to telecommuting is the community's expectation for a high level of service. This expectation requires employees to be at the work site, especially at governmental agencies in Austin. The new 311 service, which is a phone line

[38] Kate Lister and Tom Harnish. undress4success.com/tell-the-middle-east-to-pound-sand/

available to Austinites offers a variety of service and information upon request; this service can address the expectation from citizens[39].

Citizens should be encouraged to use on-line resources to make contact with governmental agencies. Additionally, the City and the school districts should provide computer connectivity in libraries, community centers, and schools.

Staggered work hours/compressed work week.

All businesses that require employees to travel to work may consider developing a planned compressed work week and flexible or staggered work hours. This planning could also serve as an emergency or business continuity plan. Many companies running multiple shifts throughout the day already employ compressed work weeks, as it allows them to have fewer employees working longer shifts. There are many options for employers that can be implemented based on their specific needs.

The fuel-saving potential of compressed work weeks is tremendous. According to Shiftwork Solutions LLC, the shift to a four-day, 10-hour per day work week has the potential to save 7.8 billion gallons of fuel a year (about 2.4 percent of U.S. consumption at 2008 levels)[40]. If compressed work weeks are simply not an option, companies can help reduce congestion, which will also reduces fuel consumption and emissions, by allowing their employees to work staggered hours within boundaries set by the company.

Corporate-organized ridesharing.

Austinites already have resources available to connect them with others to carpool. However, businesses are better positioned than other organizations to orchestrate successful carpool pairings. While many people may be hesitant to share a ride with strangers, they would likely feel comfortable riding to work with colleagues. While privacy must be a first priority, businesses have the necessary contact information and could easily pair employees.

Review the Components and Identify Gaps in the Social Safety Net to Protect Vulnerable and Marginalized Populations.

Increase affordable housing options near employment centers.

Food and transportation are the three largest expenses for most households. Under a scenario of sustained high-energy costs, low-income populations are especially vulnerable because affordable housing is often located in suburban or

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[39] Austin 3-1-1. <http://www.ci.austin.tx.us/311/index.cfm>

[40] Shiftwork Solutions LLC. <http://www.newsguide.us/search/?cx=partner-pub-1622057303050525%3Ahx1kto9dlfo&cof=FORID%3A11&ie=ISO-8859-1&q=Shiftwork+Solutions&sa=Search>

rural locations far from employment centers. These populations are highly dependent on cheap energy for their transportation needs.

Providing high-quality affordable housing near employment centers or in close proximity to transit centers with service to major employment centers has the potential to reduce transportation and housing costs, provide increased employment opportunities, and possibly improve public health through increased walking for low-income residents.

Develop public transit, health care, and public services to protect low-income populations.

The low-income population in Austin may be aided with public transit vouchers. Transit is more effective when it has higher ridership and providing this service to low-income citizens may help Capital Metro reach a critical mass of riders. Bus passes can be distributed through social service agencies.

Austin has a strong community clinic program, and it should continue to be supported. Social service agency funding should be reviewed yearly to ensure that the services fit the needs of the population.

Know your neighbors.

A “Know your neighbors” campaign can be created through the Community Action Network to increase awareness of the unmet needs. Combined with organizations such as Family Eldercare, Meals on Wheels, and Neighborhood Watch, the campaign can provide support and resources in the event of emergencies or resource reduction.

Prepare Emergency Contingency Plans for Sudden and Severe Shortages. Enlist Neighborhood-level Organizations and the Office of Emergency Management to Help Ensure Reliability of Emergency Plans.

- Develop an emergency energy protocol manual that clearly establishes interagency cooperation, lead agency responsibilities, and communications structure. (If a plan already exists, coordinate efforts with identified agencies to ensure current staff is aware of plans and are communicated with on a regular basis).
- Develop and/or update Citywide contingency planning and scenario-based table topics training exercises.
- Develop an early identification system in which energy-related agencies or analysts advise the City Manager of a potential significant energy shortage or emergency with advance notice. Early notification enhances the response capabilities of the City’s emergency planning and Emergency Operations Center.

- Develop and maintain a network of public and private sector contacts through the City's Office of Emergency Management.
- Develop cooperative contingency plans with the State of Texas Emergency Management Agency.
- Develop cooperative scenario-based training exercises with City and State agencies.
- Identify the prioritization of resources for energy restoration, allocation and supply based on the following objectives:
    - Preservation of life.
    - Maintaining security (City of Austin).
    - Maintaining public health and welfare.
    - Maintaining critical services and infrastructures.

Encourage Local Food Production and Processing and Actively Protect Local Farmland to Ensure Food Security.

Create a network to expand capacity for growing food locally.

Austin is working with local sustainable farming and gardening groups to develop urban food production strategies. As energy costs rise and more frequent crop-threatening weather events occur, localized food production becomes a very important function in preparedness. By bringing together the local players in sustainable agriculture, this synergy will strengthen the localized model and indirectly improve local energy security. This effort is in its beginning stages but the goal is to help catalyze three programs in particular:

Citizen Gardener offers assistance and education designed to encourage citizens to create food-producing gardens on their own property.

Community and Urban Gardening helps streamline the regulatory challenges many neighborhood and community groups encounter when establishing a shared garden. The group also integrates efforts in rain-water catchment and irrigation to further the positive impact of these gardens.

Urban Roots is a youth-development program sponsored by Youthlaunch that uses sustainable agriculture as means to build life skills and to nourish East Austin residents who currently have limited access to healthy foods. Young people will cultivate a local two to five acre diversified organic farm, selling a portion of their harvest in the Austin area and donating a portion to local hunger relief programs. Through this process young people can connect to the land and learn the benefits of growing, eating, selling, and donating organic food, as well as leadership and entrepreneurial skills and the importance of giving back to their community.

Build support networks to reinforce food security.

Austin cannot wait for State or Federal directives but instead must take the initiative to build supportive networks, ensuring food security through the protection of nearby farm land and increasing local capacity for horticultural and agricultural production. Austin should consider these tactics as part of an economic security strategy. Recent legislation might enable local jurisdictions to maintain agricultural production, if funding is granted. The 2005 Legislature passed SB1273, which created the Texas Farm and Ranch Lands Conservation Council and became ensconced in Texas Natural Resources Code, Title 8, Chapter 183, subchapter B, section 183.051 (to enable and facilitate the purchase and donation of agricultural conservation easements). Other resources exist at the American Farmland Trust and the U.S.D.A. Farm and Ranch Lands Protection Program for purchase of development rights.

Local efforts might include commercial-scale economic development projects (farms and food processors), as well as neighborhood and household-scale efforts. Commercial-scale projects might require a revolving loan program or a mechanism for the public sector to acquire equity interest in food-producing enterprises. Austin should also expand the capacity of local agricultural and horticultural extension agents to teach effective food-growing techniques to individuals and households.

Central Texans will be looking to supplement their diets from local resources. The flood control measures instituted with the Highland Lakes northwest of Austin creates potential for alternative forms of agriculture and transportation on the Colorado River. Lady Bird Johnson Lake in Austin offers an opportunity for aquaculture production that would provide protein and calories to supplement locally grown crops. Today, Texas catfish farmers are growing about 8900 lbs/acre/year (of catfish).[41]

Look to historical examples like "Victory Gardens."

During the Second World War, the U.S. government turned to its citizens and encouraged them to plant "Victory Gardens" to provide their own fruits and vegetables. Nearly 20 million Americans answered the call by planting gardens in backyards, empty lots, and even city rooftops. Neighbors pooled their resources, planted different kinds of foods, and formed cooperatives, all in the name of patriotism.[42] Austin should consider a similar approach.

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[41] Peter Woods. Status of Catfish Farming in Texas. Texas Cooperative Extension, Bay City, TX.[www.texasaquaculture.org/Presentations.html

[42] Claudia Reinhardt. *Victory Gardens*. The Ganzel Group www.livinghistoryfarm.org/farminginthe40s/crops_02.html

Diversify food transportation networks.

The residents of Austin cannot grow all of the food that they need, so Austin should work with all available interested parties to expand capacities for rail networks to transport food from distant growing regions in order to sustain Central Texans. Improvements in rail transportation between food growing regions and food consuming markets might help mitigate transportation fuel shortages.

Develop food distribution measures for low-income populations.

Localization of food production must still be able to provide adequate and nutritious food to low-income populations. In addition, local currencies like food stamps and the Women, Infants, and Children (WIC) voucher program are redeemable at the local farmers market but are currently not widely available. Such a system could be expanded to meet community needs.

Use the Nexus of Energy and Water to Achieve Synergistic Gains; Invest in Research and Development.

New technologies are developing that can help Austin produce its own transportation fuels and become more energy self sufficient. One such technology is electricity generation with aquatic biofuel production, requiring only sunlight, water, and carbon dioxide for growth. While the technology is still developing, the University of Texas is conducting significant research in converting algae to biomass. Power plants can inject the carbon dioxide they emit into algae ponds to grow algae and produce biofuels. Other such technologies include river hydro-electric, aquatic biofuels, engineered wetlands, and others. The City should invest in research and development to ensure the success of these technologies.

APPENDIX A: POTENTIAL POSITIVE EFFECTS OF ENERGY DEPLETION

While the U.S. is driven by fossil fuels and will likely face difficulties in an era of energy scarcity, there are also potential positive outcomes to note.

U.S. Food Consumption, Personal Health and Physical Fitness

Oil and natural gas were driving forces in the Green Revolution, which allowed farmers to produce more food, more efficiently at a lower price, generating a comfortable food supply for the United States. Concurrently, advances in automation have eliminated many jobs requiring intensive physical labor, which has lowered the average caloric intake necessary for Americans to remain healthy. These trends combined have produced two negative consequences. Americans, on average, have become progressively heavier over the last few decades and progressively more wasteful. The amount of calories available per day per capita for Americans is approximately 3,750, while average consumption is only 2,000.[43] Thus, nearly half of the food available in the United States is wasted.

Recent trends suggest that without government intervention or infrastructural changes, food prices tend to rise with rising fuel costs. Therefore, higher fuel costs will likely lead to further increases in food costs. These developments could potentially reverse trends of overeating and wasting of food.

Benefits of Declining Personal Automobile Use

Inexpensive and abundant oil has lead to the development of the automobile as the predominant form of transportation in Austin and many other Sunbelt cities. Consumers like having their own vehicle because it is convenient and makes them feel safe and independent. Thus, the "peak" of oil consumption will coincide with other peaks, such as traffic and emissions. If oil consumption peaks, traffic and vehicle emissions are likely to rise as well. Some areas that could see major improvement with strong leadership and action are:

> **Public Transportation-** Capital Metro provides bus routes and will soon offer a passenger train service However, Austin's current mass transit system would not be able to support a significant increase over current demand. Hopefully, an energy depletion scenario would encourage citizens to petition the City for improved public transportation and support the initial capital investments. A fully-occupied bus is six times more fuel efficient and a fully-occupied train 15 times more efficient than the average car in the U.S. [44]

[43] Energy at the Crossroads.Vaclav Smil. P356
[44] www.cas.usf.edu/philosophy/mass/Stephanie.html

Congestion- Likewise, bus, trains, and multi-passenger vehicles require less road space than single-passenger automobiles. Traffic congestion would improve with a decrease of single-occupancy vehicle driving.

Emissions- In addition to relieving congestion, increased public transportation use and reduced single-occupancy vehicle use could significantly reduce transit emissions and improve Austin's air quality.

Road Maintenance- While energy depletion will weaken gasoline tax revenues for road maintenance, fewer cars on the road will reduce wear and lengthen the time before roads require repair. Fewer personal automobiles will also limit the need to expand highway systems, which will save money and energy. Further, less road maintenance means avoided environmental degradation.

APPENDIX B: CASE STUDY OF AGRICULTURE IN PEAK OIL SITUATION

What is the range of Austin's self sufficiency in food? - Case studies in peak oil.[45]

In the late 1980's, with the demise of the Soviet Union's trading block, North Korea and Cuba both experienced a local version of peak oil. Within the span of two years, imports of oil to both countries fell by over 50 percent.

The drastically different outcomes of this experience are partly due to happenstance. The Cuban climate and arable land allow people to survive on food rations, whereas North Korea's harsh winters and difficult soil make sustainable food production more difficult; the more fundamental reason is policy. North Korea tried to carry on business as usual as long as possible, while Cuba implemented a proactive policy to move toward sustainable agriculture and self-sufficiency.

North Korea developed its agriculture on the Green Revolution model with its dependence on technology, imported machines, petroleum, chemical fertilizers, and pesticides. With the sudden collapse of the Soviet bloc in 1989, supplies of oil, farming equipment, fertilizers, and pesticides dropped significantly, which greatly contributed to the famine that followed.

The effect of the oil shock rippled through the automotive, building, and agricultural industries. The energy shortage also affected residential and commercial lighting, heating, and cooking. This, in turn, led to loss of productivity and reduced quality of life and adversely impacted public health. Total commercial energy consumption throughout society fell by 51 percent. Perhaps in no other sector was the crisis felt more acutely than in agriculture. The energy crisis quickly spawned a food crisis that proved fatal. Modern, industrialized agriculture collapsed without fossil fuel inputs. It is estimated that from one to three million people died as a result.

North Korea failed to change in response to the crisis. Commitment to the status quo precipitated the food shortages that continue to this day. Cuba faced similar problems. In some respects, the challenge was even larger in Cuba with the tightening of the U.S. embargo. Cuba lost 85 percent of its trade, and its fossil fuel-based agricultural inputs were reduced by more than 50 percent. Cuba responded with a national effort to restructure agriculture.

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[45] The following section is based on the following sources: Peak oil preview: North Korea & Cuba by Dale Jiajun Wen. Yes! Magazine online [www.yesmagazine.org/article.asp?ID=1462
and
The Agricultural Crises in North Korea and Cuba -- Part 1 by Dale Allen Pfeiffer, FTW Contributing Editor for Energy
www.fromthewilderness.com/free/ww3/111703_korea_cuba_1.html

The groundwork for change was laid before the 1990 crisis, primarily in response to the negative effects of intensive chemical use, as well as the 1970s energy crisis. In response, Cuban scientists began to develop bio-pesticides and bio-fertilizers to substitute for chemical inputs. They designed a two-phase program based on early experiments with biological agents. The first stage developed small-scale, localized production technologies; the second stage was aimed at developing semi-industrial and industrial technologies. This allowed Cuba to roll out substitutes for agricultural chemicals rapidly in the wake of the 1990 crisis.[46]

Cuban agriculture now consists of a diverse combination of organic farming, permaculture, urban gardens, animal power and biological fertilizing and pest control. In 2003, food production in Cuba was 90 percent of the pre-crisis levels.

How does Central Texas stack up?

Directly comparing the agricultural environment of any two disparate regions of the earth is difficult. Soils, climate, elevations, pests, and amount and timing of rainfall vary widely around the world. However, some vital statistics can be compared and some broad generalizations can be made. Cuba's average temperatures are less variable than those of Central Texas, and the rainfall is up to twice our annual average. These would seem to be distinct advantages to an organic type of agricultural production.

Austin Area Climate statistics are:

- Temperate, Humid Subtropical: Mild winters; hot summers
- Average: 69 degrees Fahrenheit
- Average Low: 58 degrees Fahrenheit
- Average High: 79 degrees Fahrenheit
- Average Annual Rainfall: 32.1"
- Average Days of Sunshine: 300 or so (includes partly cloudy)

[46] Dale Jiajun Wen. *Peak oil preview: North Korea & Cuba*. Yes! Magazine online www.yesmagazine.org/article.asp?ID=1462

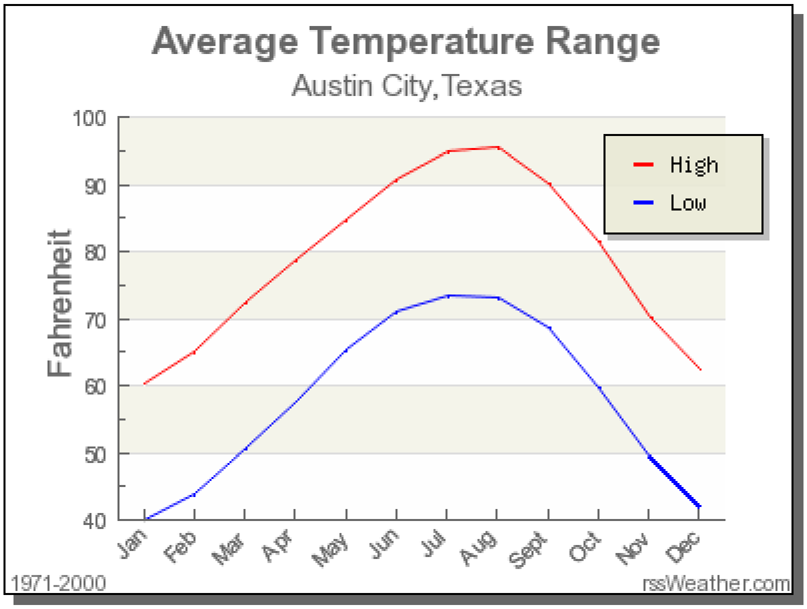

Figure 8: High and low temperatures in Austin, Texas. Source: rssweather.com (www.rssweather.com/climate/Texas/Austin%20City/)

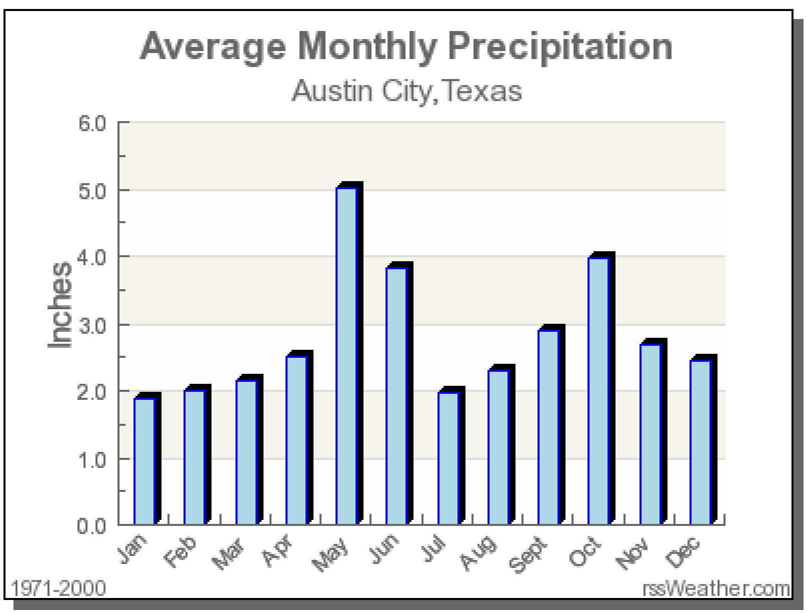

Figure 9: Average Monthly Precipitation in Austin, Texas. Source: rssweather.com (www.rssweather.com/climate/Texas/Austin%20City/)

Cuba Climate statistics

Except in the mountains, the climate of Cuba is semitropical or temperate. The average minimum temperature is 21°C (70° F), the average maximum 27°C (81° F). The mean temperature at Havana is about 25°C (77°F). The trade winds and sea breezes make coastal areas more habitable than temperature alone would indicate. Cuba has a rainy season from May to October. The mountain areas have an average precipitation of more than 180 cm (70 in); most of the lowland area has from 90 to 140 cm (35–55 in) annually; and the area around Guantánamo Bay has less than 65 cm (26 in). Droughts are common. Cuba's eastern coast is often hit by hurricanes from August to October, resulting in great economic loss.

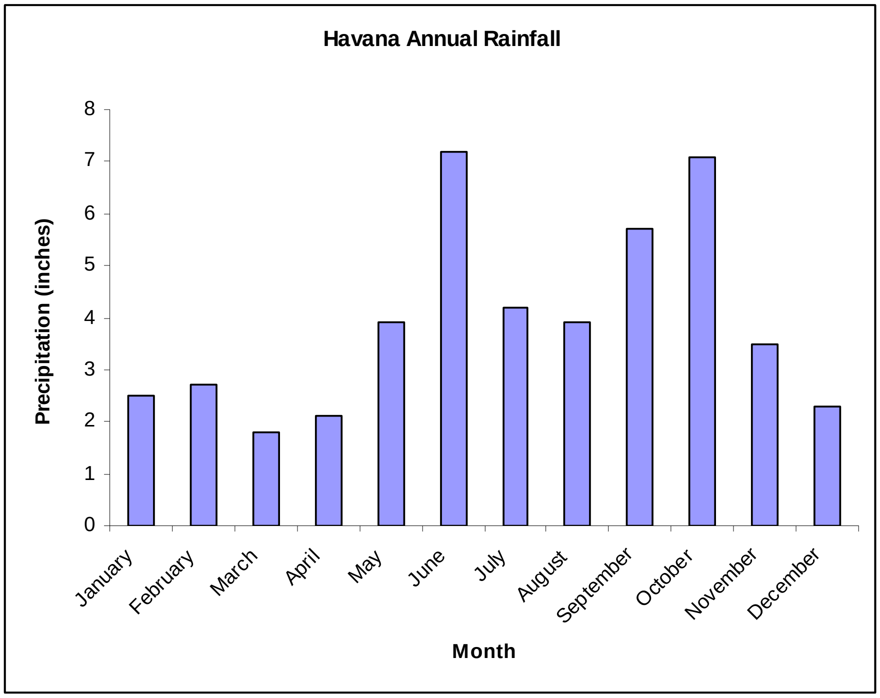

Figure 10: Annual Rainfall in Havana, Cuba Source data: The Weather Channel (www.weather.com/outlook/travel/businesstraveler/wxclimatology/monthly/graph/CUXX0003

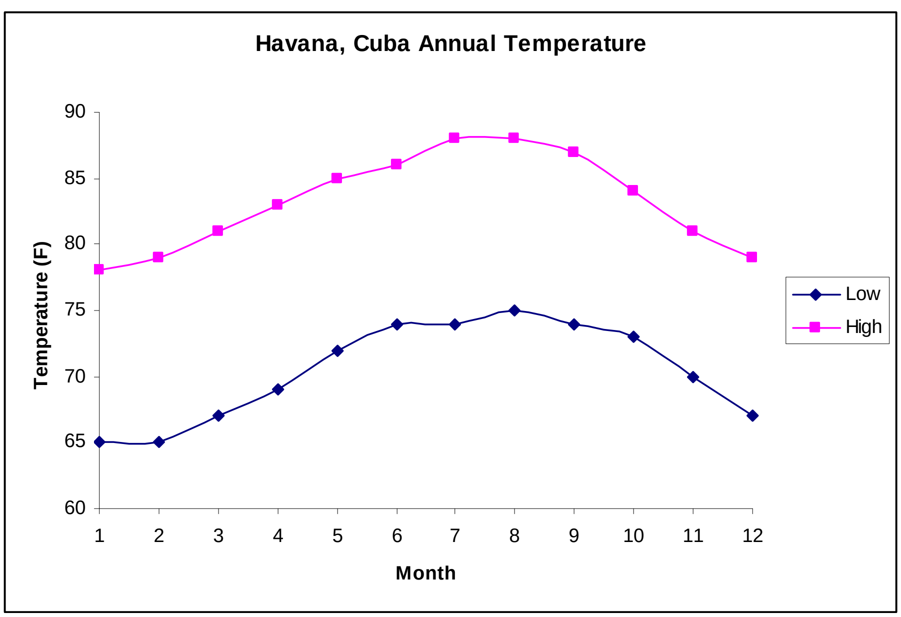

Figure 11: Temperatures in Havana, Cuba Source data: The Weather Channel (www.weather.com/outlook/travel/businesstraveler/wxclimatology/monthly/graph/CUXX0003)

As the above data illustrates, the Cuban climate, with ample rainfall and a more moderate temperature extremes than Austin, would seem at first glance to be more suitable to agriculture. A more problematic disparity in the two regions may be the amount of cropland/capita, which is about double in Cuba what it is in the central Texas area. Even adding in a “victory gardens” approach to local food production wouldn’t increase the amount of arable land in Austin to make much of a difference. The conclusion is that it will be very challenging to become an “island” unto ourselves – at the current population level. A study done by Crude Awakening Austin suggests a subsistence level diet for Austin residents would be extremely difficult to achieve, even with all the available open land in the city limits as well as Travis County converted to agriculture[47]. Developing new strategies for maximizing local food production and distribution, in addition to importing a good portion of our food supply on minimal oil requirements, will be needed.

	Cuba	**North Korea**	**Hays, Travis & Williamson Counties**
Population	11,382,820	23,113,019	1,285,395
Area (sq km)	110,860	120,540	7,269
Persons/sq km	103	192	177
Arable	30,630	27,000	1,890
Permanent cropland	7,250	2,000	145
Cropland/capita (acres)	0.82	0.31	0.39

[47] Nancy Denis. Travis County Agricultural Land.pdf. (http://groups.google.com/group/energy-depletion-risks-task-force/files?hl=en)

APPENDIX C

[i] The following are predictions of the timing of peak oil from various prognosticators.

Pickens, T. Boone (Oil & gas investor)..**2005**
Simmons, Matthew (Investment banker)..**May, 2005**
Deffeyes, K. (Retired Princeton professor & retired Shell geologist) ..... **December 2005**
Westervelt, E.T. et al.(US Army Corps of Engineers).. **At hand**
Bakhtiari, S. (Iranian National Oil Co. planner)...**Now**
Herrera, R. (Retired BP geologist)..**Close or past**
Groppe, H. (Oil / gas expert & businessman)... **Very soon**
Wrobel, S. (Investment fund manager) ....**By 2010**
Bentley, R. (University energy analyst)...**Around 2010**
Campbell, C. (Retired oil company geologist; Texaco & Amoco) **2010**
Skrebowski, C. (Editor of Petroleum Review)... **2010 +/a year**
Meling, L.M. (Statoil oil company geologist)........................... **A challenge around 2011**
Pang, X., et al. (China University of Petroleum)..**Around 2012**
Koppelaar, R.H.E.M. (Dutch oil analyst) ....**Around 2012**
Volvo Trucks.. **Within a decade**
de Margerie, C. (Oil company executive)... **Within a decade**
Al Husseini, S. (Retired Exec. VP of Saudi Aramco)...**2015**
Merrill Lynch (Brokerage / Financial) ....**Around 2015**
West, J.R., PFC Energy (Consultants) **2015-2020**
Maxwell, C.T., Weeden & Co. (Brokerage / Financial)............. **Around 2020 or earlier**
Wood Mackenzie (Energy consulting) .... **Tight balance by 2020**
Total (French oil company)..**Around 2020**
UBS (Brokerage / Financial) ....**Mid to late 2020s**
CERA (Energy consulting).. **Well after 2030**
CERA (Energy consulting)... **"Peak oil theory is garbage"**
ExxonMobil (Oil company).. **No sign of peaking**
Browne, J. (BP CEO).. **Impossible to predict**
OPEC .... **Deny peak oil theory**