OUT OF THE WILDERNESS

Strategies Austin Can Take for Clean Energy Without Federal Assistance

Scientists Alarmed at Number of Atlantic Hurricanes
Special to the New York Times
October 21, 2010

Experts at the National Oceanic & Atmospheric Administration are not just alarmed that Hurricane Eta is heading toward the Texas Gulf Coast at 150 mph. They are stunned that it is part of a season of records.

"As a scientist, I am fascinated that we have set so many records this year. As a human being, I am terrified," said John Cordoban, the Administration's chief forecaster. "History has shown nothing like this hurricane season.

Hurricane Eta is the 28th Atlantic disturbance in 2010. There have been so many tropical storms and hurricanes in the Atlantic basin that the official list of storm names for this season has been exhausted, and meteorologists have started to use the Greek alphabet to name new ones. This is also the fourth Category 5 hurricane in the basin in a single year, another record.

Powerlines – Electricity to the City
Stained-glass window above door of Dallas Power & Light Building
Photo by Dan Harrison

Ports along the Gulf Coast have sustained extensive damage this hurricane season. Some cities, including New Orleans, have not completely recovered from the 2005 hurricane season that included super-storm Hurricane Katrina. Oil and gas prices have been soaring as offshore wells have been knocked out of production.

"We began seeing this trend early in the new century," said Cordoban, "and it has now manifested itself as a hypertrend. More and more of my colleagues are convinced that global warming is the only way to explain this – the rising temperature of the sea."

Marshall Kappan, of the Global Climate Coalition, a recently reorganized group that has raised objections about the proof of global warming since 1989, disputed this. "The science on global warming's effects on storms is uncertain. Nature has a savage streak, and it runs in cycles. To blame this on fossil fuels is as scientific as balancing angels on the head of a pin."

BREAKING NEWS – ABC
Radical Islamists Assassinate Saudi Ruler
2:28 AM EST – February 11, 2011

King Abdul Al-Saud, the King of Saudi Arabia, has been killed in a bomb explosion along with about 400 others, including the member of the Royal Family most likely to succeed him in event of his death.

At 10:02 PM in Dharan, Saudi Arabia, a deadly suicide-bomb explosion of tremendous range and impact was detonated, killing 3 members of the Saudi Royal Family, including Nassar Mohammed Al-Saud, the defense minister, the man most likely to succeed King Abdul to the throne. In order to reach the King and his security force, the bomb range was set to harm people over 600 feet away from impact. A Saudi underground group linked to Al Qaeda, the Ikhwan, immediately claimed responsibility, though CIA terrorist experts are not yet commenting on the claim's reliability.

Upon news, the NYMEX oil futures market panicked wildly, rising $20 a barrel to $103.89 in a matter of an hour. The President has ordered the New York stock exchange to shut down to avoid a selling frenzy. Saudi Arabia currently provides the world with 13% of its oil, and the prospect of no leader in this absolute monarchy with no clear line of succession has Washington leaders confounded. The U.S. currently imports 65% of its oil, and soaring energy commodity prices can damage the U.S. economy….

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TRAVIS AUDUBON SOCIETY

Travis Audubon Society is a local non-profit organization that promotes the enjoyment and understanding of birds and wildlife in their natural habitats in Central Texas. The TAS volunteers are committed to the conservation of our natural resources.

We provide:

- **Field Trips**–free of charge and open to the public
- **Monthly Newsletter**
- **Monthly meetings with programs** on wildlife, conservation, and travel–free of charge and open to the public
- **Two wildlife sanctuaries**–680 acres in northwest Travis County for nesting Golden-cheeked Warblers and a 10-acre preserve, both managed by our Sanctuary Committee
- **Conservation and education**–through our Conservation, Education, and Bird Records committees
- **Online Information**–a 24-hour information system at our Web site (www.travisaudubon.org) about TAS events and birds sighted in our area
- **Christmas bird count**–open to the public

For more information, see our listing under Environmental Groups.
For a sample newsletter, call John Kelly at 331-8693.

Ft. Worth Residents Warned Not to Return
Officials Say Danger Not Past
Austin American Statesman
July 13, 2015

Over two weeks after one of the nuclear reactors at Comanche Peak power station ruptured due to a partial meltdown, health authorities are still not allowing residents in Ft. Worth and many surrounding communities south and west of it to go back to their homes.

"We simply have not done tests to determine the radius of harm and the effect of wind plumes (that spread radiation)," said Victor Ricks, health physicist with the U.S. Environmental Protection Agency. "I know people want to get on with their lives. But it is going to take us about 4 to 8 more weeks to run the tests necessary to ensure safety."

Ricks said that an area of about 15 miles surrounding the plant will be indefinitely closed to human occupation. "Some of this is contaminated beyond human repair, and it will be several generations before nuclear isotopes decay to safe levels. We also have established a safety buffer….

……Many evacuees displaced in cities in and around the southwest are not dealing with displacement well. (See "Evacuees Distraught," p. 12). There is political pressure from both the evacuees and the cities hosting them to resolve a return date for areas not directly affected by the radiation. But Ricks said "You can't legislate physics. We want to take every precaution that the wind has not contaminated any part of the Metroplex."

…..In a development related to the accident, 72 Westinghouse nuclear reactors around the country have been ordered to reduce their output to 70% of rated power pending safety review. This is causing mayhem in electric utilities in several regions of the U.S. heavily dependent on them. "This has crippled our ability to meet summer peak demand," said Gina Housen, spokesperson for the Edison Electric Institute. She predicted brownouts in several major cities during some portion of the summer as well as massive rate hikes to buy spot power "if we can even get it."

ON OUR OWN

Our country's energy policy has been a profound failure. The oil industry has the lowest tax rate of any major industry, actually 1/3 of the nominal corporate tax. Yet lawmakers beholden to it continue to increase these benefits. The auto industry and Auto Worker's union continue to lobby against increased fuel efficiency standards while American soldiers die for oil. The U.S. Congress and federal agencies are proposing laws to weaken states' rights to prevent dangerous energy projects proposed within their borders. Clean energy is acknowledged, but as a sideline. Most of the money, attention, and effort in the new national energy bill went to conventional energy sources.

While the situation is not absolute, most people in the federal government and major energy companies in charge

John Dolley

of energy policy do not care about solving the long-term environmental, consumer, and social problems inherent in the dangerous and failed energy policies of this country.

So I structured this last article to answer the question "What can a community do to solve their energy problems despite the federal government's lack of interest?"

This is not meant to set a course of rugged individualism. The world's environmental problems are so complex and formidable that we will need lots of help and allies. Nor is it meant to completely isolate Austinites from the federal government or major energy companies. If 5% of their policies and projects coincide with our own, so much the better.

But this article is meant as a direction for local leadership and community self-reliance. We are in denial if we continue to pretend that the federal government has a realistic energy plan to drill its way out of the crises.

Ten ideas for broad and sweeping local action are discussed here. Most of them carry financial costs, and political risks as well. Most will force one or more powerful constituencies to confront their own role in our future. All will require hard work. None are assured of success. But to do nothing in the face of impending crises is irresponsible.

Of course, these ideas also carry benefits. In addition to a cleaner environment, these policies will stabilize energy costs and the economy that is dependent on them. They create a new kind of national security, which wins resource wars by preventing them. And they will create thousands of jobs from the manufacture or installation of clean energy strategies and technologies.

As I watch the horrible effects U.S. energy policy continues to have on the world, it is hard to be optimistic. But it is not human to live without hope. And there really are solutions – if we want them.

Paul Robbins, 2/1/2006

1. Hold On To the Wind
Accelerating Renewable Energy Development

Courtesy Cielo Wind Power

The City of Austin has set a goal of incorporating renewable energy into its electric system, asserting that by the year 2020, 20% of the City's municipal utility, Austin Energy, will run on these sources. But progress is incremental, crawling at a growth rate of about 1% of total use per year. Since 2000, the City has achieved 6% of its use from renewables. Even sustaining this 1% might be difficult given current strategies. All renewable purchasing is voluntary. And if renewable energy is erratic and not made predictable through some types of storage, a utility can only integrate a low percentage of wind power into its overall supply.

Given the near crises in environmental damage, price escalations, and national security created by reliance on conventional energy, we need to increase our renewable use exponentially. At this time, the most technically-developed and cost-effective technology is the state's wind power. It will have to serve as a bridge until other production sources are developed. We need to propel a change in strategy that surpasses the cautious moves Austin has made up to now.

The price of wind power has come down 80% in the last 25 years, and its cost is much less than natural gas fuel for generating electricity. About 1/3 of the cost is currently subsidized by federal tax credits. But conventional fuels are also subsidized, and have hidden costs such as increased illnesses and deaths from environmental side effects. Moreover, wind power has every likelihood of becoming more competitive as economies of scale lower prices.

The state of Texas has enough potential wind power to supply 4 times its current electricity consumption. Texas has the second-highest wind potential of any state, only edged out by North Dakota, with 2% more.**(1)** Both Texas and North Dakota conservatively each have enough potential windpower to beat Saudi Arabia's current oil imports to the United States. Put another way, there is at least twice as much equivalent annual energy in Texas wind as in its current oil production.

If the City of Austin is to achieve, let alone exceed, its 20% renewable energy goal, it will need to take bold action to acquire more wind power. Other technologies may hold promise in the near-term, but nothing prevents Austin from reaching its goal with wind power alone. There are 5 strategies Austin needs to implement.

A. Own the Wind – Despite our region's foresight in finding renewable energy for its electric system, it has not had the farsightedness to keep it. Currently Austin provides about 6% of its electricity with renewables, almost all of it wind power under contract with private wind power developers.**(2)** But Austin does not own the machinery, the land it is on, or the contractual rights to lease the land. In fact, these wind power contracts are for limited time periods of 10-12 years, at which time the agreements will need to be renegotiated, which could mean higher prices or even loss of supply.

The first thing Austin needs to do to secure an ample supply of wind energy is to own it. Austin needs to guarantee a stable wind power supply for its future by owning the machinery, getting an option to buy the windmills when lease arrangements expire, or at least owning the lease rights.

B. Sell the Wind – Austin Energy has, by measured accounts, the most successful renewable energy marketing program in the country, directly selling more electricity from its GreenChoice program than any other individual utility with similar programs. GreenChoice allows customers to pay for a 100% renewable energy supply in the fuel charge portion of their bill. The charge is often slightly higher in the beginning, but the program allows customers to lock in the rate for 10 years. So if fuel goes higher, the renewable energy rate can actually be lower than conventional power. To date, about 6% of Austin Energy's electricity is supplied by GreenChoice sold to 3% of its customers.

GreenChoice has succeeded for 3 reasons: 1) part of Austin's customer base cares about environmental issues; 2) good marketing of the program; 3) the 10-year rate lock, which encourages commercial customers to price hedge conventional electricity costs with renewables.

But there are nagging questions about the program's long-term success.

- If fuel goes down again, will people and businesses continue to participate at the same level?

- Is 6% enough to deal with urgent environmental and fuel supply problems?

- How much more "goodwill" can a voluntary program sustain if it is to grow beyond its current market share?

• Should a pollution control program be voluntary? You would not expect an *optional* air-pollution control device on a new car.

• Utility customers do not voluntarily pay for other kinds of power plants (coal, nuclear).

• Is Austin really the renewable energy leader? While Austin is THE leader in direct renewable energy marketing, it is not the leading utility in percentage of renewable power on its system.

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In other utilities, the renewable energy cost is spread over the entire customer base. If Austin is ever to reach it goals of 20% renewable energy supplied to its customers by 2020, it will need to start charging *all* its customers for some amount of renewable energy in the fuel mix. Had Austin Energy the foresight to buy enough wind power when costs were low to supply 20% of its energy, it would have saved about $17 million in 2006.**(3)**

The popular 100% renewable GreenChoice option is an important anchor for renewable energy support. But it is time for the rest of the customers to start participating at a lesser but substantial level. Environmental problems as well as long-term fuel cost and supply problems need to be addressed. Price hedging strategies should apply across the whole utility, not just the clever few.

C. Bank the Wind – Wind power is currently economical in Texas, but primarily as a fuel saver. Its erratic nature does not allow it to displace electric power generators because wind energy cannot be "dispatched" when it is needed. This is a particular problem in Texas because the windiest areas are in West Texas where almost all of the current capacity is built. The wind is greater in the spring than the summer season when it is most needed, and greater in the night than the day. Both these factors work against wind power reliably displacing summer peak-day demand. At some point, this technically limits the total percentage of wind power that can be used.

Courtesy Alabama Electric Coop

Compressed Air Energy Storage/natural gas power plant in McIntosh Alabama

It seems paradoxical to try to capture the wind, but it is technically and economically possible. Compressed Air Energy Storage (CAES) uses a simple concept. An air compressor is located next to a geologic formation like a salt dome, an aquifer, or abandoned mine or oil well. Electricity from wind power, cheap night-time, off-peak generation, or another desired source is used to drive compressed air into the formation at 100 times normal pressure. When this power is needed later, the compressed air is heated (the standard fuel being natural gas), and run through a turbine to create electricity.

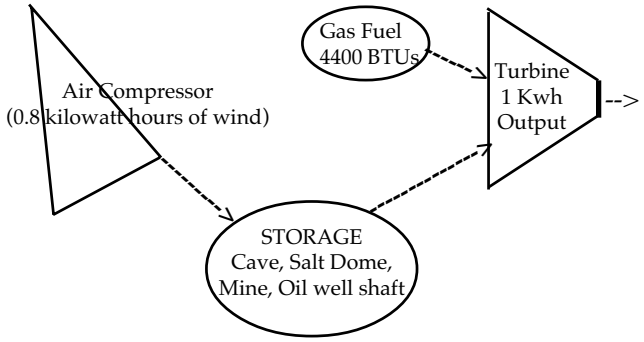
Currently, there is a CAES plant in Alabama storing off-peak power for peak use, and another planned in Iowa that will use a combination of wind and off-peak coal to store compressed air in an aquifer. There is also a proposal in Ohio using off-peak power to store compressed air in an old mine cavern. All the equipment is off the shelf, and it is commonly used in oil drilling. And storing gas is common in the natural gas industry. In 2000, about 15% of all gas was stored in geologic formations for peak winter use.

A CAES/Wind plant is not cheap. The capital cost for a 270 MW unit is as high as $200 million.**(4)** But any new power source will be expensive. Cost wise, a CAES/Wind plant can compete with new "baseload" gas power plants (low-cost plants that operate every day possible) when fuel costs are above $3.75 per million BTUs. (It was $10.66 in October of 2005.**(5)**) And it runs circles around the cost of intermediate and peak power plants that operate less frequently. It is not even that much more expensive than a new coal plant.

Hold On To The Wind
Compressed Energy Storage (1)

Wind power is not a consistent power source, reducing its value to utilities. The most economical energy storage to date is Compressed Air Energy Storage (CAES).

An air compressor is located next to a geologic formation like a salt dome, or an old mine or oil well. Electricity from wind power, cheap night time, off-peak generation, or another desired source is used to drive compressed air into the formation. When this power is needed later, the compressed air is heated (the standard fuel being natural gas), and run through a turbine to create electricity. Cost wise, it can compete with new "baseload" power plants.



Wind power can also be used to make hydrogen for the heating fuel from electrolysis. It will increase the cost, but not outrageously.

The costs here assume natural gas fuel at $3.75/million BTUs. Two hydrogen costs are calculated, one assuming equipment prices with mass production (which has not occurred yet), and the second using the current, higher cost of hand-built equipment.

WHOLESALE POWER COSTS PER KILOWATT HOUR(6)

Compressed Energy Storage System/Wind – 4.7-5.7¢
New Baseload Coal Generator – 4.6¢
New Baseload Coal with Carbon Tax – 5.7¢
(at New Zealand's rate of $13 per ton)
New Baseload Combined Cycle Gas Generator – 6.9¢
New Intermediate/Peak Load Gas Turbine – 10.6¢
CAES/Wind with Hydrogen – 6.5-7.5¢
(Mass-Production of Electrolyzer)
South Texas Nuclear Project – 7.1¢
CAES/Wind with Hydrogen Fuel – 7.7-8.9¢
(Handmade Electrolyzer)

Austin Energy will need to replace 357 MW of power from the Holly Street generators that will be retired in 2007, plus add a baseload plant for expected load growth. The CAES/Wind strategy could provide this electricity.

Of course a CAES/Wind plant is a hybrid that still relies on (about 6-8%) fossil fuel. But it is technically feasible to use wind to create hydrogen from water through electrolysis for use as the heating booster.

The "hydrogen economy" has always been the Holy Grail of environmental technology. While the fuel is virtually pollution free, and able to power existing combustion engines with incredible maintenance savings (no carbon buildup), the energy cost of electrolytic conversion is large and not considered cost-effective.

But what if hydrogen were produced by low-cost wind and used in a CAES/Wind system? The *Environmental Directory's* analysis showed that this combination could produce power for a cost of only 12% more than the new efficient gas plant previously referenced with current hydrogen technology. (If electrolyzers were mass-produced at 30% of current cost of individually built, hand-made units, the cost would be less than a new natural gas plant.) But there would be no global warming or air pollutants, no reliance on imported fuels, and the supply would last as long as there was water. And at the lower cost, it would still be less than Austin's infamous white elephant, the South Texas Nuclear Project.

The costs below assume natural gas fuel at $7/million BTUs and wind energy at 3-4¢/kwh. Two hydrogen costs are calculated, one assuming equipment prices with mass production (which has not yet occurred), and the second using the current, higher cost of hand-built equipment.

D. Corner the Market – *There is no technical reason that Austin Energy could not get 80% of its power from wind generation within a decade if it had the will.* The only conventional electricity that would be needed would be peak demand and backup power. But Austin will have to come to grips with two major obstacles: its current investments in power plants and the temptation to buy cheap power on the spot market.

Austin's coal plant is almost paid for, and the cost to operate it will be lower than a new power plant of any kind. Austin's most expensive plant, the South Texas Nuclear Project, still carries a large debt. Austin's utility will be motivated to run the plant as often as possible in an effort to extract value from it. And the utility will often cut off its

Photo by Mark Kapner

own power plants when neighboring utilities offer short-term discounts.

The trouble with looking at the bottom line is that it often takes you to the bottom. The values of energy independence and environment are corrupted in search of short-term bargains.

2. National R&D Consortium for Clean Energy The Backroad to Utopia

On August 22, 2005, an Austin press conference was convened in City Hall Chambers. Only about 100 people spoke or attended, and it was little noticed outside of *River City*. Many of the attendees did not even realize its full implications. But its significance was international and historic: Austin's City government would pool its buying power with that of large Austin businesses and local consumers to create a market for an innovation that would revolutionize the auto industry, the Plug-in Hybrid Electric Vehicle that gets 125 miles to the gallon. And Austin would then collaborate with 49 of the largest cities in the country to create an even larger market, one that major auto manufacturers might actually respect and supply.

Heretofore, the model of industrial consumerism has too often been creating demand for conspicuous consumption through advertising. Occasionally, the market is modified by regulations governing safety or environment. Sometimes manufacturing policies are influenced by boycotts and renegade stockholders.

On various occasions, consumers have even been known to do the best thing for the environment for less than altruistic reasons, such as buying energy-efficient appliances because they save money. The market is sometimes tweaked by tax deductions and rebates from governments and utilities to influence purchasing decisions for policy goals. *But rarely have consumers spoken en masse to a large and powerful industry demanding a product that does not yet exist.*

Electric vehicles are nothing new.**(7)** They were originally invented in 1842, followed by the lead acid storage battery in 1859, which gave them better range. In 1897, the first commercial fleet of electric vehicles was established in New York City for taxicabs. The first commercially built electric car was sold in 1902; it had a range of 18 miles and a top speed of 14 mph.

While it enjoyed commercial success into the 1920s, several factors eventually combined to make them obsolete. Gasoline cars had greater range, which made more of a difference as longer roads were built to accommodate the increase in motor vehicles. Gasoline became cheap and plentiful. Electric starters were invented that took the place of inconvenient (and sometime dangerous) hand cranks. And most importantly, gasoline-powered cars became less expensive with mass production while electric cars stayed high in cost. By the mid-30s, electric vehicles were practically extinct.

After the energy price rises that began in the 1970s, several companies began retrofitting new car bodies with electric motors. Since electric car motors can last much longer than their gasoline counterparts, many of these cars are still around today. In the 1990s, the state of California required major automobile manufacturers to make limited quantities of electric vehicles as part of an effort to reduce the state's infamous air pollution problems.

Collectively, about 5,000 of these vehicles were made and leased to customers. The cars had good range (65-110 miles), good pickup, and could achieve speeds of 65–80 mph. They were quiet, energy-efficient compared to gasoline powered vehicles, had a smooth ride, and had greatly reduced air emissions compared to internal combustion engines.

But the major auto companies stopped making them because California backed off of its requirements. The companies claimed there was little market because of high first costs. Jack Doyle, author of *Taken for a Ride*, a history of how major auto companies have defied pollution regulations, believes that the cost of electric vehicles was kept artificially high because of the vested interest auto companies had in maintaining the status quo.**(8)**

Interestingly, a recent campaign was launched by the lessors of these vehicles to demand that the auto companies sell them to their lessors instead of demolish them at the end of the lease term. Ford and Toyota capitulated to this pressure. GM eventually scrapped its electric cars, but only after ardent protesters of their policy were arrested.

Today, few electric cars are made. They are mostly glorified golf carts. Only 3 companies in North America are currently making electric vehicles that can run at over 30 mph, and they are relatively expensive.

But hybrid cars appear to be the backdoor to a new wave of electric vehicles. Hybrid vehicles contain both electric and gasoline motors. While they use the electric drivetrain for primary motion, an internal combustion engine adds power when needed for rapid acceleration, long trips, etc. The brakes actually salvage energy typically wasted in conventional vehicles and feed it back to the battery. And the cars do not idle when stopped. These features combine to save energy in the majority of hybrid models sold.

It is not a great leap of imagination to wonder if hybrids can run without any internal combustion backup. In fact, the Toyota Prius does this. The Prius models sold in Japan and Europe have an override button allowing cars to run in quiet, battery-only "stealth" mode for a limited distance. This button is disabled on American-sold models. But some clever engineers have figured out how to hack the circuitry. It was not a great extra leap of imagination to want to add more batteries for greater distance. Several scientific labs and private companies have accomplished this.

The Plug-in Hybrid Electric Vehicle has enough lithium batteries to travel about 20 miles on electricity in back. More storage would extend the range to 60 miles.

Courtesy Carlos Cordova, Austin Energy

The result is the Plug-In Hybrid Electric Vehicle (PHEV), a.k.a. the Gas Optional Hybrid (GO-Hybrid). The electric-only distance is limited by the amount of storage, but electric ranges of 20-60 miles are expected if commercialized. Considering the average American vehicle travels less than 30 miles a day, it might be realistically possible to make routine trips by a nightly battery recharge at home, and only use gasoline for long-distance trips. Hence PHEVs can theoretical get 125 miles (or more) to a gallon.

Of course, electricity uses energy too. But electric vehicles are inherently more efficient: they use only about half of the primary energy used in petroleum driven vehicles. And pollution is less, since one central power plant can better control emissions than several million separate autos.

In an apples-to-apples *energy* comparison, a 125 mpg PHEV Prius traveling 50% of the time on batteries alone would generally be the energy *equivalent* of a between 49-99 miles per gallon car when corrected for total energy use. The high figure assumes the use of renewable energy for the electric contribution, which avoids fossil fuel power plant conversion losses.

In *dollar* terms, an electric car in Austin would use about 75¢ to drive as far as a gasoline vehicle per gallon of gas. Air pollutants and greenhouse gases would be greatly reduced, and the electric portion could run on renewable energy. These vehicles also have important implications for national security, in that locally generated electricity will eventually take the place of foreign oil.

Currently, the only PHEVs that exist are prototypes by labs or small companies, and a few pilot vans sold by Daimler-Chrysler. (The City of Austin has one of these on order.) But Austin's vision is to create a viable market so that these vehicles can be mass produced.

To do this, the City's municipal utility will budget $1 million for rebates for the first Austin purchasers of these vehicles. It will purchase them for the City vehicle fleet, and will encourage other government and business fleets to purchase them as well. To enlist business participation, it has asked the Greater Austin Chamber of Commerce to be a partner in the effort. A petition drive obtained signatures of consumers who will consider buying these vehicles when they purchase a new car.

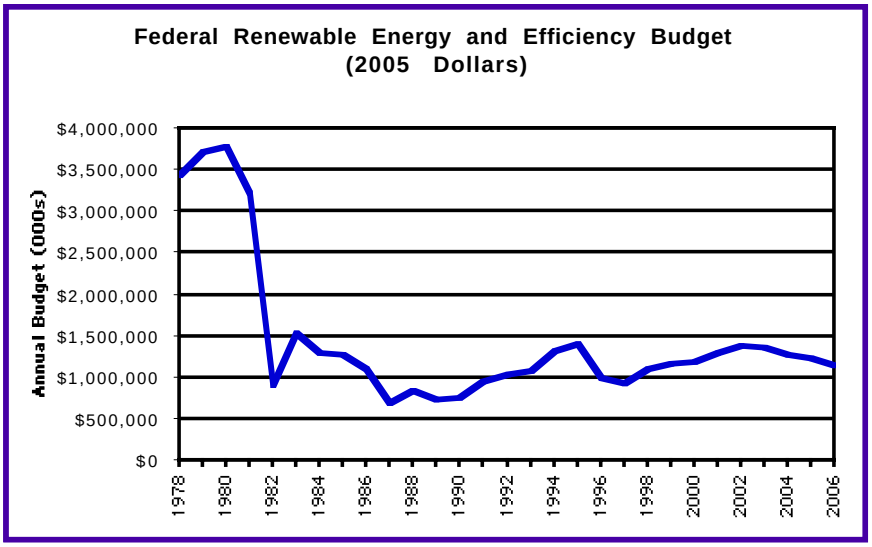
The campaign has been presented to the U.S. Conference of Mayors Energy Committee, with the intent of starting similar campaigns in 49 other U.S. cities. With dozens of utilities committing to rebates, tens of thousands of orders for the new vehicles, and hundreds of thousands (or millions) of pledges from consumers, the program hopes to jump start the mass production of PHEVs by major auto manufacturers.

To be sure, this program faces obstacles – perhaps formidable ones. Some of the commitments for vehicle orders or rebate money may be cancelled. And the auto companies, most skilled at avoiding regulations, may resist as a group, just as they did when they successfully defeated the electric car in the 1990s.

But there are several current circumstances that might also portend success. First, hybrid cars are a growing market trend, so auto companies already have expertise and a vested interest in building them. As Toyota has proven, it only takes one maverick to create a new market. Fuel costs are currently soaring, and are now a top consideration in the purchase of new vehicles. And there appears to be uneasy acknowledgement that U.S. national security interests are threatened by continued vulnerability of foreign fuel imports.

It will probably take several years for this campaign to reach its goal. But there are 2 important things of note: 1) this "shot heard round the world" started with a single city government; and 2) the same type of collaboration can be used to commercialize a dozen (or a hundred) other technologies related to renewable energy, energy efficiency, and environmental protection.

A Grand Scheme



In 1977, when Jimmy Carter was President, energy alternatives were a priority and Research & Development were heavily funded. Real dollar spending for conservation and renewable R&D energy expenditures fell by 78% between the last year of the Carter Administration and the last year under Ronald Reagan (2005 dollars).**(9)** Even in 2006, with the Afghan War and the confrontation with Iraq shrouded in oil politics, these renewable energy and conservation expenditures are still 70% below Carter-era levels.

Dependence on one major sponsor (or "angel" in business parlance) for alternative energy development can lead to another round of vulnerability similar to the federal cutbacks in the U.S. in 1980. It *should* be the national government's responsibility to develop clean energy as part of its obligation to protect the environment, the economy, and national security. Other governments such as Japan and Germany pursue renewable energy development aggressively.

But unlike celestial angels, government policy is not immortal, or always inspired by divine motives. The federal government of the United States has largely left its population to the mercy of the "free" market. The recently signed energy bill is a prime example of shortsighted policy that heavily subsidizes conventional and dangerous energy sources while underfunding clean energy.

If the federal government will not do its job to protect its citizens from environmental dangers, potential shortages, price increases, and the stark national security implications of conventional energy sources, it is up to those institutions that care to compensate for this incompetence.

A collection of states, counties, cities, utilities, foundations, and other institutions needs to be established to pool R&D money and buying power to establish new clean energy technologies. If one of these members left the consortium for financial or political reasons, it would still be protected by the membership of several (or many) other members.

There have been precedents for this.

• Appliance "Contests" – In 1993, the "Golden Carrot" program (as in 'carrots and sticks') enlisted a group of utilities from around the U.S. that would develop and promote the country's most energy-efficient residential refrigerator.**(10)** The utilities pledged $30 million in rebates to the refrigerator manufacturer that won a contest to develop and produce a model that met advanced efficiency standards. The winning manufacturer, Whirlpool, had a guaranteed market that allowed it to recoup its development costs and profit from the new product.

• California – Since 1996, the California Energy Commission has administered an R&D effort called PIER (Public Interest Energy Research). This program spent $62.5 million in 2003 to develop products and technologies that contribute to the efficiency and environmental performance of California utilities.**(11)** PIER is funded with a surcharge on utility sales, and technologies it develops include efficient appliances such as air conditioners and water heaters, lighting, environmental combustion technologies for power plants and boilers, renewable energy, energy storage, and water conservation technologies. A separate funding source administered by PIER funds geothermal research.**(12)**

Many of PIER's projects eventually find their way into the marketplace. In most cases, PIER receives a royalty from these sales.

One of PIER's new programs is similar to the refrigerator contest: the development of an efficient residential gas tank water heater. Unlike the refrigerator contest (discussed above) that chose just one winner, any company that develops a certain standard will be allowed to receive rebates for its product.

• Connecticut –The Connecticut Clean Energy Fund (CCEF) is a clever program devised when the state deregulated its electric utilities. Since 2000, the state has used a surcharge on electric utilities to install clean energy technologies or as venture capital equity invested in clean energy firms that will potentially create employment by development or manufacture of these technologies. In 2003, the Fund spent $15 million on projects including fuel cells, wind power, biomass gasification, and photovoltaics.**(13)** The program has committed $75 million to date in various projects.**(14)**

The investment funds and demonstration projects have helped enable Connecticut to become a center for fuel cell education and businesses. About 1/3 of all the manufacturing employment in this fledgling industry in the U.S. and Canada is located in the state.**(15)**

• New York – The New York State Energy Research and Development Authority (NYSERDA), chartered in 1975, has a long history of R&D related to energy efficiency and renewable energy in buildings, utilities, industry, and transportation. Between 1998 and 2005, its annual R &D budget averaged $26 million (nominal dollars), and its projects included demonstration projects for renewable energy and cogeneration, as well as product development.(16) Additionally, about $6 million a year was spent on R&D for fuel-efficient passenger vehicles and railroad equipment.(17) One of NYSERDA's research projects, electric –powered mail delivery vehicles, lead to the commercial purchase of 550 vehicles by the Postal Service.(18)

• Texas – Despite its reputation as an environmental backwater, even the Lone Star State has an environmental R&D effort. Given the State's huge air pollution problems in East Texas, particularly Houston, its government set up the Texas Emissions Research Consortium. It is funded with revenues from surcharges on the sales of new personal vehicles and heavy diesel equipment; vehicle registration and inspection surcharges; and diesel-fuel taxes.(19) The Consortium spent about $12 million in both 2004 and 2005 to develop new pollution reduction technologies including advanced engines, engine retrofit devices, and fuel additives or mixtures.(20)

Austin itself should start an R&D effort, capitalizing on the initiative with its hybrid electric car project. The organization could be housed in the electric utility, or spun off as a non-profit. As the organization gained members, most of the administrative expenses would no longer be borne by the City. Alternatively, Austin may wish to join ongoing efforts that have been established elsewhere, such as PIER, or the Western Governors Association's efforts to fund mass production of Concentrating Solar Power (see below). The organization should initially focus on 3 to 5 up-and-coming technologies for its first several years to prove its effectiveness.

Predicting the Future

The idea of a member-based R&D group can be unwieldy. It is a different concept than many of the targeted institutions are used to. Some may have a hard time justifying such an effort to their constituents. Putting R&D money into solar arrays in the desert may not seem to be a particularly good use of money for people in the Northeastern U.S. Investing money in wave power may mean little to taxpayers in the Heartland. And pilot plant locations may provoke member rivalries between those who want the status and economic development such installations may bring.

The hardest part will be teaching members to be patient; almost all commercializing technologies have bugs that cannot be predicted in advance. Keeping all members happy may become the proverbial "wheelbarrow full of frogs."

But to do nothing is to wait for the inevitable: more oil wars, energy shortages, and environmental damage. At some point, responsibility falls to those willing to take it.

There is also a case to be made for competitiveness of today's electric power industry, which has a poor record of investing in new technology. A study by the National Academy of Science in 1999 showed that the industry invested about 1/2 of 1% of its net sales in R&D, compared with the computer industry at 10% and the telecommunications industry at 12%.(21)

A few possible technologies that are candidates for commercialization are below. These are by no means the only ones to be considered. *These technologies can be fostered by laboratory and field research, commitments for direct purchase of equipment, commitments of indirect purchase in the form of power sales from merchant plants, or a combination of these strategies.*

Solar Powered Generators – Relatively few people realize just how advanced the technology for direct electrical generation from solar heat is. Concentrating Solar Power (CSP) employs sophisticated mirrors to focus direct sunlight, creating heat to boil a working fluid for turbine-power generation. Some configurations have separate mirrors focusing on a single point, while others use parabolic troughs to focus sunlight on a heat pipe running a few feet above them at the focal point.

Nine CSP plants totaling 354 MW have been operating in the Mojave Desert almost 2 decades.(22) The largest of these plants is 80 MW in size. Built between 1985-1989, they have an impressive record: maintenance costs have come down while generation output has increased. These plants generate about 90% of their power from solar energy while employing natural gas as backup. As such, they operate at over 100% of their designed capacity, and their output coincides with the utility's peak demand.(23) The last plant that was built was the least expensive due to a learning curve. It produces power at 13¢/kwh, roughly 150% of the cost of a new natural gas plant. But this was without mass production.(24)

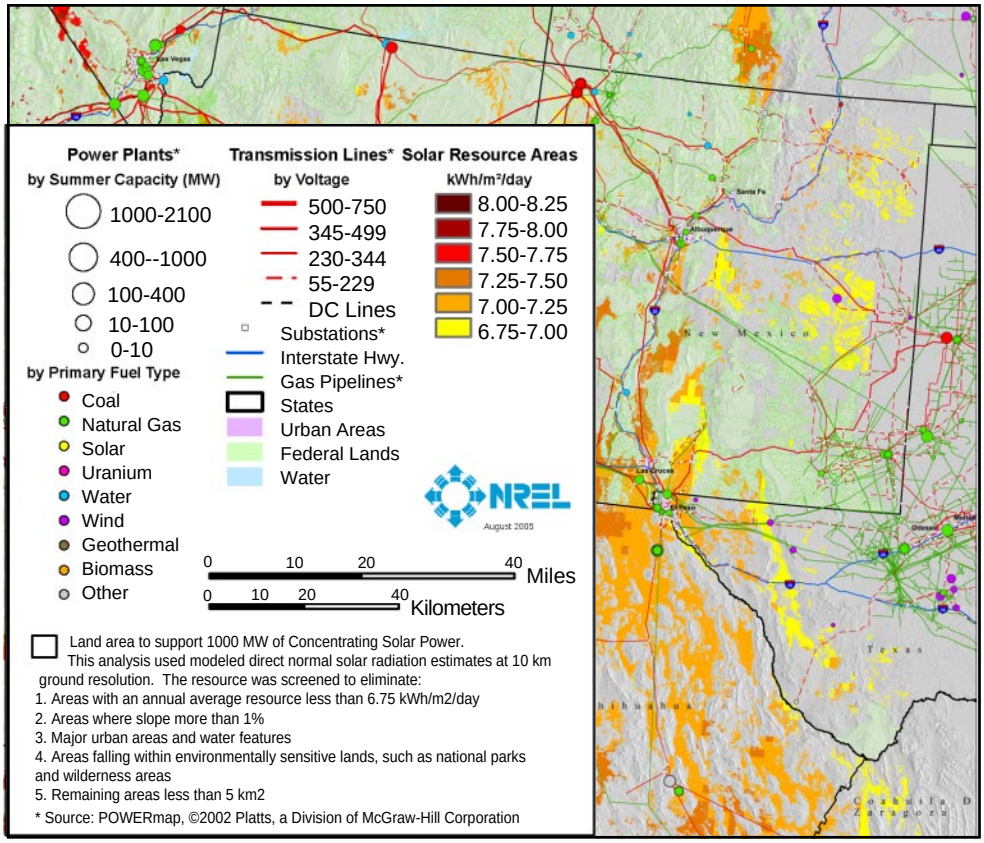
To operate economically, CSP needs large amounts of direct sunlight typical of the climate in the Western desert areas of the U.S. This includes large parts of California, Nevada, New Mexico, Arizona, and sizeable areas of Colorado and (West) Texas.(25) In round numbers, it takes 5 acres of land per Megawatt of electricity. In the Southwestern United States, there are 54,000 square miles of suitable area, enough area with intense direct sun and low slope to provide almost 4 times the country's total electric use.(26) (Theoretically this is enough to provide electricity to the entire world at its current use. (27)) In West Texas, there are 1,200 square miles of potential site area, enough suitable land to provide 79% of the state's electricity.(28)

To reach economies of scale to lower the cost of CSP to that of a gas or coal plant, a sustained orderly development program needs to be created that can guarantee minimum orders that will allow the industry to gear up to economies

of scale. This level of commitment has been predicted to be a cumulative total of 4,000 MW.**(29)** At current estimates, this is about $7-10 billion, a lot of money to an individual, but a trifle when spread over the electric ratepayers of 6 states over a 10-year period.**(30)** In fact, the Western Governors Association is spearheading such an effort, though details are not worked out at this time.

Another CSP technology has "dish" clusters of mirrors focused on individual generators. Sterling Energy Systems of Arizona has signed a contract with Southern California Edison to purchase as much as 850 MW of power over the next 20 years.**(31)** Each modular unit has its own 25 KW sterling engine generator with hydrogen as the working fluid in a closed loop system instead of steam. At this time there are no back-up or storage scenarios, though in California, solar peak output is generally similar to utility peak demand. Installation of the first 1 MW (40 units) is scheduled for 2006, followed by an 18-month shake-out period. Following this, installations will proceed at full pace. San Diego Gas & Electric has also signed a similar contract with the Arizona company for as much as 900 MW.

Geothermal Energy – There are about 600,000 active and abandoned oil and gas wells in Texas.**(32)** Many of them are deep enough that the water in them is 100˚ C or hotter. This low heat can be extracted with Organic Rankine Cycle (ORC) turbines. These are similar in concept to steam turbines, except that they use pressurized hydrocarbons instead of steam to turn the turbine, and that these hydrocarbons are continually recycled in a closed loop system, the same way an air conditioner reuses refrigerant.



Optimal areas for Concentrating Solar Power in Texas

National Renewable Energy Laboratory

Concentrating Solar Power trough

Until recently, ORCs have required large volumes of heat to be cost effective. But new equipment is now available to economically extract heat in smaller volumes.**(33)** This, combined with the rising cost of energy, has created interest in extracting heat from hot brine water co-produced with oil (commonly called "produced water") to create electricity. Since the largest cost, well drilling, is already accomplished, the major costs will be the generation equipment, minor maintenance, and the transmission lines. In abandoned wells, there will be costs associated with pumping hot water to the surface. But in existing wells, this is already part of the oil extraction process.

Since the equipment is developed, the major challenge with employing this technique is technology transfer from the geothermal power industry to the oil industry. A major incentive to do this would be guaranteed market. Austin could devise a set amount of geothermal generation to purchase in its mix to reach its renewable energy goals. And it could concurrently "package" its quota with other utilities to create a larger market and the economies of scale that come with it. While this geothermal harvesting technique cannot be done everywhere, it can be used throughout much of the Gulf Coast, the Rocky Mountains, Michigan, and Pennsylvania.**(34)**

Research money may also be necessary to refine the harvesting techniques and develop resource estimates of the amount of energy available.

Wind Power–Despite wind power's advanced state of development compared to other renewable energy technologies, it would be a mistake to say the technology cannot improve. There are uncommercialized inventions that can make it more common and cost-effective.

"Architectural wind" turbines atop aquarium building

A "downwind" system mounts the blades in back of the turbine instead of in front, allowing the blades to flex with the wind. The reduced stress lessens the needs for rigid materials, which reduces costs. Wind Turbine Company in Bellevue, WA, has been researching this technology with financial assistance from the California PIER program and the U.S. Dept. of Energy.

A recent contender for improving wind power was announced in late 2005 by Terra Moya Aqua, a Wyoming-based R&D firm with a vertical access wind turbine. The blades are capable of harvesting energy at high speeds where conventional wind turbines shut down to prevent damage from centrifugal force. This higher output allows the turbine to run more cost-effectively.

A California firm, AeroVironment, has developed the concept of "architectural wind." Looking like sophisticated box fans, these miniature (4 feet X 4 feet X 1.5 feet deep) wind generators are fixed on the top of roofs to add building character and onsite generation to flat-roofed buildings. Each module provides about 400 watts of power, and harvests the wind as it blows upward from building walls. A similar concept by Mag-wind in Richmond Hill, Ontario, uses a vertical-axis wind turbine mounted on a roof. Resembling a large attic ventilator, it uses the roof surface to increase the amount of wind reaching the turbine. These machines will be beta-tested in several locations, including Austin.

Another technology of importance is wind-powered flywheels for energy storage. Flywheels use spinning wheels "charged" with electricity to store energy, then drawing on this stored energy during times of electric demand. They are useful in producing a constant output wind turbine by supplementing fluctuating generators in real time. Beacon Energy of Wilmington, MA, is one of the leaders in energy storage flywheel. It is currently selling prototype units for $1,000/stored kwh.

Liquid Biofuels – The cutting edge technology in renewable liquid fuels is cellulosic alcohol. It employs enzymes to convert cellulose into sugar that can be easily converted to alcohol instead of the expensive, energy-intensive process used with conventional production. As opposed to grain alcohol that only ferments the seeds, cellulosic alcohol can use the entire plant, as well as waste wood, paper mill waste, and many types of municipal solid waste. At least 3 companies in North America are building pilot production facilities for this fuel.**(35)**

Two coal-to-oil facilities in the U.S. are currently using guaranteed purchases by governments as a way to ensure profitable operation and financing. Price hedging and economic development are the justification. The same could be done for renewable fuels. Local government agencies in the Austin area use about 3.2 million gallons of gasoline per year.**(36)**

Gaseous Biofuels – Pyrolysis, heating carbon-based fuel without oxygen to produce combustible gas, was first used commercially in the U.S. in the early 19th century to create "city gas" from coal for use in lighting and heating. The process was used extensively during W.W.II to create gas from wood. But synthetic gas all but vanished in the face of cheap natural gas.

Modern commercial pyrolysis equipment exists to turn wood or plastic into synthetic gas, which is currently used to create heat and, occasionally, steam turbines that produce electricity. But syngas use in modern efficient combustion turbines is hampered by tar residue in the gas that

Wood gasification manufactured by Chiptec used to power a cogeneration system. This particular unit employs a steam turbine rather than a combustion turbine, so wood tar does not damage equipment.

ruins the equipment. Several gasification companies claim to have solved the problem, but their inventions are either prototypes or in early commercial production.

In order to commercialize this equipment, money will be needed for research and purchase of the first units, and minimum amounts of purchase may need to be guaranteed for lower equipment costs. One way the latter might be ensured is with guaranteed utility purchases of green power produced exclusively from biomass gasification.

Energy-Efficiency – There are numerous emerging technologies that could be assisted to commercialization through R&D. There are so many, in fact, that a new consortium trying to gain credibility might have to focus on only a few to start with. A couple examples where advances are promising are street lighting and air conditioning that drives summer peak load in the southern U.S.

Electronic ballasts have the potential to save 15% on street lighting in the near future, and might attract interest from many local governments who pay considerable amounts to provide this service.**(37)**

Several novel types of Heating, Ventilation, and Air Conditioning systems are emerging that can reduce the strain on utilities trying to reduce peak demand. Among them are forgiving (some would say "idiot proof") ducts and air conditioners that better tolerate mistakes made by unconscientious installers. Plastic and metal "snap together" ducts are being piloted that reduce most of the leakage in these systems.**(38)** "Robust air conditioners" that can adapt their energy use to compensate for duct leakage, low refrigerant charges, and other common installation problems hold promise in many new apartments and tract homes where quality is often overlooked.**(39)**

3. Maximum Efficiency Factor 10

Efficient use of energy is generally cheaper than any new power source, including renewable energy. In 1994, an international group of environmentalists formed the Factor 10 Club, which advocated that industrialized nations of the world increase the efficiency of their natural resource use (energy, water, materials) by a factor of 10 to compensate for environmental damage, increasing global population, and industrialization in the developing world. The group theorized Factor 10 would have to take place over the course of 30-50 years.

This goal almost seems an unattainable virtue today. Some of the technologies are either not manufactured or even invented yet. Others are relatively expensive compared to conventional prices that do not factor in hidden costs such as environmental damage and national security. And while some methods of efficiency can be incorporated into new buildings and vehicles with relative ease, incorporating them into the existing fleet is difficult and costly. Retrofitting an existing home for passive design is usually an expensive remodeling project. Converting an existing gasoline-powered automobile to hybrid power is a labor-intensive hobby.

Factor 10 seems unimaginable. And it is hard to actually define. Do we use the current fleet of buildings and vehicles as the baseline, or the most recent code and standard requirements? Should Factor 10 include renewable energy, or just be based on efficiency gains? Should it include lifestyle choices that do not contribute to actual mechanical efficiency (e.g. bicycling instead of driving, washing dishes by hand instead of with a machine?) If population continues to increase dramatically, will even Factor 10 be enough?

And most fundamentally, how much is it worth to you? Should the budgeted cost be based on the cost of resources today, or in the future when they are scarcer and the environment even more polluted than it is now?

An Efficiency Plan for Austin

In the Austin region, the electric utility has goal of displacing 15% of its power with energy-efficiency by 2020. But it has no plan on how to achieve this. Austin's gas utility has no plan *or* goal.

Neither does the Capital Area Metropolitan Planning Organization, which sets direction of transportation infrastructure. It has no long-term efficiency goal, only minimal funding goals to encourage alternative bicycles, buses, and pedestrians. Capital Metro, the regional mass transit system, does have a plan to increase ridership. But even this increase is only expected to sustain the same tiny market share *percentage* for transit that exists today.

The City of Austin, to its credit, has established Transit Oriented Development Zones that cluster mixed-use development near future rail transit lines to save travel distance and energy. But none of these developments have yet to even break ground, and they are planned for future, not current, populations.

While uncharted, there are some basic things that Austin can do to begin its ascent to the Factor 10 goal.

A. The Inventory – You can't improve if you don't know where you started from, and Austin has little knowledge of the efficiency of its buildings and vehicles. We need a baseline inventory of our current level of efficiency. In the utility industry, this is called a "saturation survey," and it has been many years since one was conducted for Austin's electric utility. One possible and relatively inexpensive way to do this for buildings is by employing real estate inspectors already in buildings at the time of sale. Analysis of vehicle registrations in the region will give a good estimate of auto efficiencies.

B. The Definition – Once we have a baseline, we need

rules for what Factor 10 really means. My own preference, at least in the immediate future, would be to achieve the 10-fold efficiency improvement with renewables as well as conservation. Another interim suggestion is to include lifestyle changes enhanced by technology, such as substituting light rail for cars.

C. Strategies – The path to greater efficiencies will be different for each energy end use, employing existing technologies and products as well as ones that have not been invented or commercialized yet.

Every major end use (e.g., residential water heating, commercial water heating, residential air conditioning) needs to be scrutinized for state of development, commercialization, and cost-effectiveness. And it should be matched with the baseline inventory: Factor 10 in a retrofitted building will have different economics than in a new structure.

While current energy prices should be one consideration, future energy prices and their externalities (environment, national security, etc.) should also be taken into account. For instance, some oil from Saudi Arabia costs only $2/barrel to produce, while the world price in November of 2005 was over $50/barrel. But if this oil cannot be obtained because of political reasons, the low costs do not matter, and a realistic cost expectation must replace it.

The Factor 10 plan would use several strategies to encourage efficient technologies and measures, and these would be used in conjunction with each other to achieve the overall goals

• Research & Development: The need for regional involvement in Research & Development of clean energy technology was extensively discussed earlier. If the effort succeeds and establishes success with near-term technologies, more long-range R&D might take place. Such high-risk R&D includes the use of microchips for air conditioning and refrigeration, promising great efficiency as vapor compression technology is replaced. This research would blend well with Austin's electronics industry.

• The Buyer's Club: There are many technologies that do not need extensive Research & Development expenditures. They are already commercial, but do not have a large market share because they are on the margin of cost-effectiveness, or have a higher first cost that dissuades most consumers.

A good example of this is geothermal heat pumps. Unlike typical heat pumps which transfer heat or cold from between the inside of a building and the outdoors, these devices transfer heat or cold between the inside of a building and the ground via plastic pipe. Since the earth's average temperature below ground is relatively constant (55-70˚ F in Central Texas), the heat pump is not vulnerable to the losses of efficiency from wide temperature extremes (which can range from 10 to 110˚ F in Austin's climate). They can last twice as long as air-source equipment because of this.

The devices can provide comfort conditioning, hot water, and even refrigeration in commercial applications, and are incredibly efficient compared to most conventional equipment. Geothermal heat pumps also do not raise utility peak demand in the winter the way standard heat pumps do, since they do not need resistance heating back-up.

While there are almost half a million geothermal heat pumps employed in the U.S., they are less than 1% of the total market, in large part due to their first-cost premium. One Austin contractor estimated this to be $6,000-$7,000 over the cost of a conventional unit for a typical single family home.**(40)** This premium can be lowered or partially mitigated with direct utility involvement.

If geothermal units were installed *en masse*, throughout a new subdivision, apartment complex, or strip center, the premium would fall because the cost of the drilling for the heat loop would fall with economies of scale. And the increased cost of the loop could be financed by a utility, which in turn bills the customer on a monthly basis, the same way it bills for other services such as electricity and water.

This would buffer the imposing first cost of the installations. And the utility would receive a profit, as well as reduced peak demand and fuel costs for its investment. In larger commercial installations, this profit might be enhanced by selling waste heat to neighboring businesses that need it instead of transferring the heat into the ground.

Another technology that is in production but lacks market traction is the hot-water heat pump. Similar in concept to air-source Heating, Ventilation and Air Conditioning (HVAC) units, this equipment pulls heat out of the air and transfers it to a water heater. It saves most of the energy consumed by a typical electric (strip) water heater. But the first cost is still too high for most consumers. In this case, an equipment-leasing program coupled with a volume purchase in mass conversion settings such as apartments and strip centers would create economies of scale. Concurrent leasing programs by other utilities could magnify the economies of scale much more than a program in just one region.

• Mandates: Some of these technologies can be required through building codes and mandatory retrofits, which are discussed in Parts 4 and 6 of this section. A minimum goal would be a doubling of HVAC efficiency compared to the current building code.

• Incentives – The "Max Rebate": The City of Austin has used efficiency rebates as a tool since 1982 to achieve a positive long-term trend. But the programs have often allowed customers to pick and choose. And since some measures are more cost effective than others, customers

often choose incremental gains over maximum efficiency. This disadvantage is also passed on to newer technologies that are not as cost effective because they have not been in production as long.

One way to market Factor 10 is to give bonuses or *Max Rebates* to customers that choose entire retrofit packages or newer, more expensive equipment. *Max Rebate Assessments* should also be given in certain situations to acquaint building owners and operators with the program and potential savings.

• Demonstration Projects: Documented case studies of buildings that have achieved large reductions in total energy use (Factor 3 and above) should be conducted as a way to market the feasibility of this approach to customers. An ideal location would be the main University of Texas student thoroughfare on Guadalupe, between Martin Luther King and 35th Street (discussed below).

What Factor 10 Looks Like

It is extremely difficult to show how Factor 10 might be accomplished in the real world. Austin has no baseline. Many of the technologies are not invented or marketed yet. Others still have high first costs that discourage widespread use. There will inevitably be resistance to some of the mandatory codes proposed here. And it is human nature to cheat and install only inexpensive, "cream-skimming" measures rather than a comprehensive, more expensive strategy.

But then it is also human nature to try to excel. It is certainly human nature to ensure one's own survival, which clean energy technologies do. So below is a "first draft" of a few examples of what a Factor 10 policy might look like. This will have to be adjusted *many* times during its evolution.

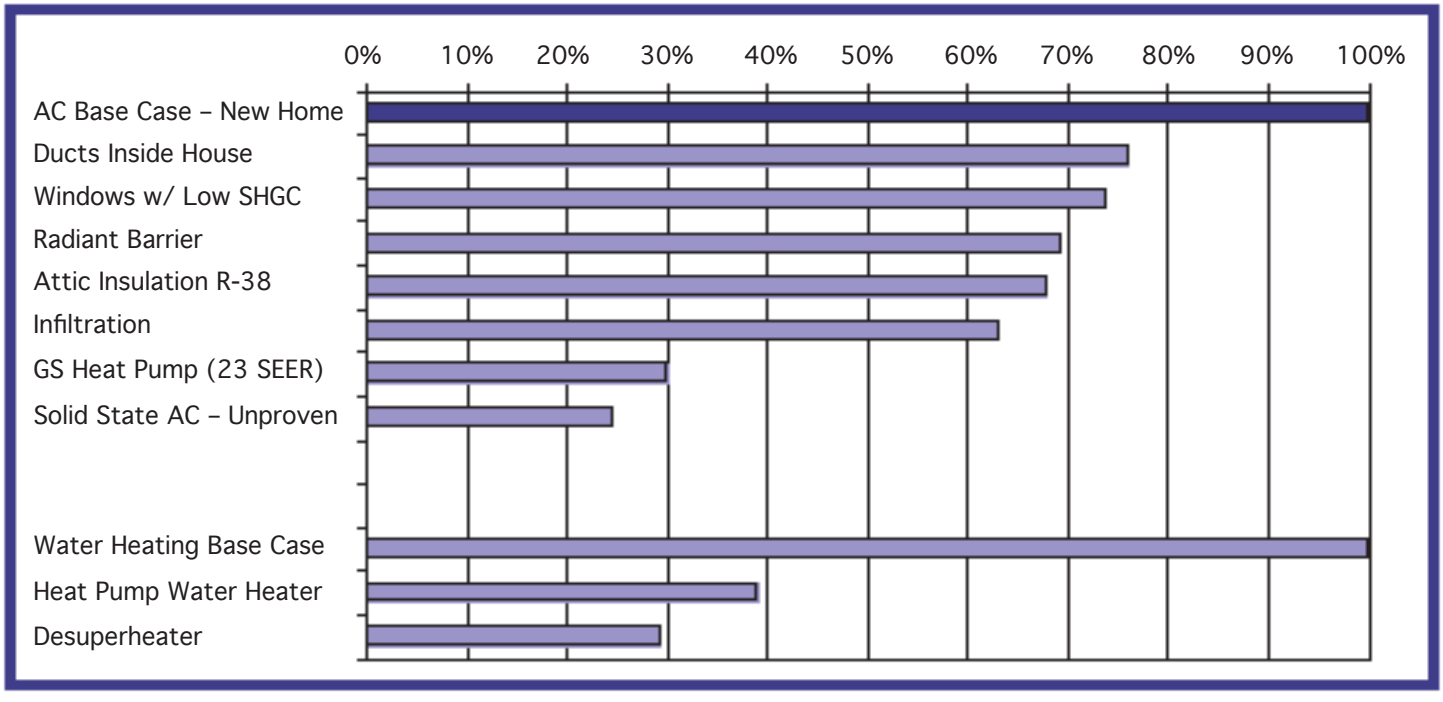
The chart below exhibits one way to achieve maximum savings in a new home for cooling, heating, and water heating.(41) It employs building shell modifications and a geothermal system for space cooling and heating, and a heat pump water heater to replace a air source heat pump and all electric water heater. It also assumes that a heat recovery water heater (desuperheater) is added.

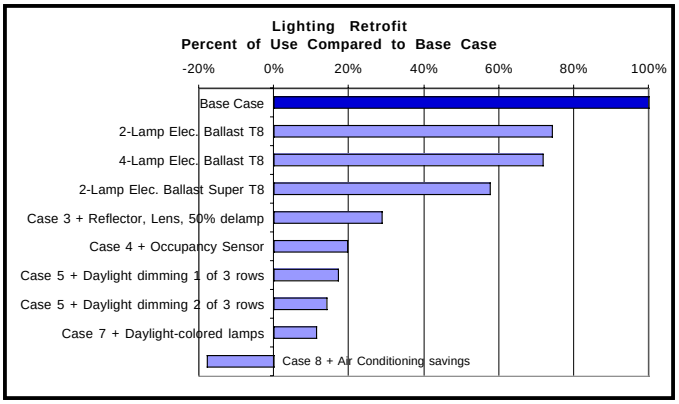
The savings cost comes out to 10.6¢ per kwh for cooling and heating and 10.1¢ per kwh for water heating. This is high compared to the cost of a new coal plant (4.6¢/kwh), but it does not factor in environmental costs. It is breakeven compared to the current cost of a new natural gas plant. It is below the cost of *retail* power (which has transmission costs, administration, and utility profit added in). Admittedly, the geothermal heat pump costs depend on a number of uncommon assumptions such as mass installations, economies of scale, ground loop costs split with the heat pump water heater, and a doubled life for equipment compared to conventional HVAC.

HVAC is now at Factor 3 (1/3 of energy code requirements). If this were compared to an existing 1960s house, it would be Factor 7 reduction (1/7 of older home use). Water heating is almost Factor 4.

City programs that could encourage these savings include building code amendments, testing of air infiltration with blower-door tests as *part* of building inspection, and rebates.

Even more could be saved with experimental technologies such as solid state AC. One prediction is that this technology will lower energy use almost 20%, raising HVAC to a Factor 4 (1/4 of energy code requirements), or Factor 9 compared to an existing home. This would require investment in long-term research.





In the second example, a commercial building with an old T12 fluorescent lamp system with "energy-efficient" 34-watt lamps is compared to retrofits with various new systems.**(42)** The best case includes Super T8 lamps with electronic ballasts, specular reflectors and high-efficiency lenses, photosensor dimmers that reduce lamp output when sunlight is available from windows, and lamps that resemble daylight that allow people to see with 20-30% less lumens. Even using more efficient T-8 lamps as the standard will allow a Factor 8 reduction. Combined with air conditioning savings (one unit of air conditioning saved for every 3 units of heat-producing lamp energy saved), there is a net energy *gain*.

Such minor miracles currently do not extend to commercial HVAC, where maximum savings are typically more like 20-40%. Still, a combination of measures could double efficiency in new commercial buildings, with renewable energy providing the balance.

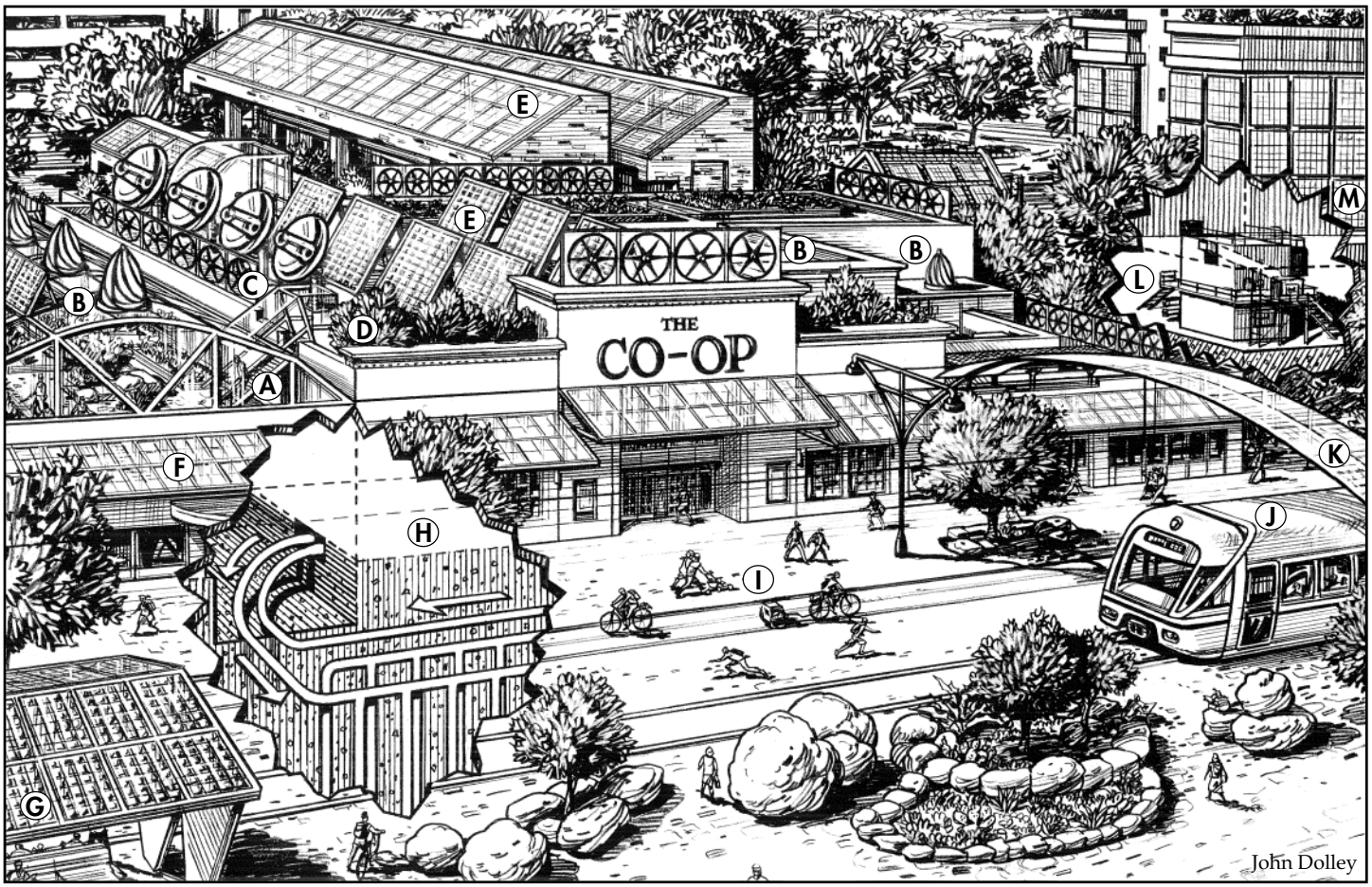
The University of Solar at Austin
Austin' s Hidden Energy Source

Ye Shall Know the Truth, and the Truth Shall Make You Free

—Legend above entrance to Tower at the University of Texas.

What could harness the enthusiasm and idealism of the University of Texas student population and serve as a positive example of renewable energy, energy conservation, and energy independence? Let's ask them to redesign and retrofit Guadalupe street, the main thoroughfare near the institution, for zero-energy use. In a University best known for its college of petroleum engineering, all the buildings on "the Drag" would be retrofitted with onsite renewable energy and efficient equipment.

Photovoltaic panels would be on many roofs and walls, and they would also serve as awnings. Prototypes of "architectural wind" units would be spinning on roofs in plain sight. Meters would be placed on these installations



The University of Texas Factor 10 energy demonstration project: A) Rooftop greenhouse; B) Architectural wind turbines; C) Solar heliostat light guides; D) "Green roof" garden; E) Rooftop solar cells; F) Solar cell awnings; G) Solar cell transit shelter; H) Geothermal Heat Pump; I) Bike paths; J) Electric rail car; K) Solar cell streetlamp arches; L) Wood gasification-powered cogeneration system; M) Electrochromic windows

as part of the demonstration to show pedestrians how much energy is being produced.

The most efficient lighting and appliances would be installed. Cutting edge technologies, such as "light guides" that use plastic tubes to convey natural light to the inside of a building, light emitting diodes, and the most efficient fluorescent lamp fixtures would replace conventional equipment. It might even be possible (space-allowing) in one or two locations to install cogeneration equipment with biomass gasifiers to run it.

The street would be mitigated for the heat island effect: more trees, white roofs, light-colored parking lots, and concrete streets.

The project could use a variety of funding sources: the municipal utility, the University, the federal Dept. of Energy, and foundations, in addition to money from the building owners. Ultimately, it may involve several million dollars in collective funding over several years. Electric streetcars may also be part of this project, or complement it. Funding for this will probably come from a variety of sources, such as the City, Capital Metro, the University, and private developers.

Student projects would be involved in the initial planning, feasibility calculations, monitoring of results, and publicity for various phases of the project. Facets of the plan could be the subject of various theses and would embellish early professional resumes.

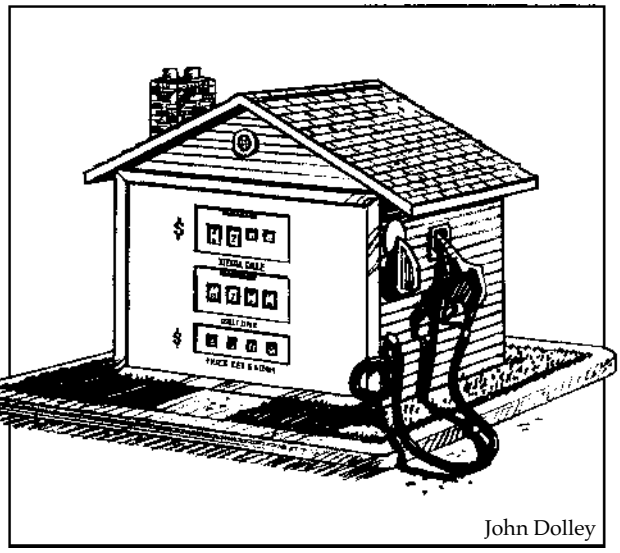
Most importantly it would be something students could take back and take forward. Students visiting home in other parts of Texas would report on what they saw or worked on while living in Austin. And it would be a formative experience for a generation of students to inspire their future careers.

The "zero-energy campus" idea might also be duplicated in other universities like A & M. Perhaps generations of rivalry can inspire more energy than a bonfire.

4. More Effective Building and Appliance Codes The Least You Can Do

Since the mid-1980s, Austin has become a boom town. About 40% of residences in Travis County have been built between 1985-2005.**(43)** It is much less expensive and easier to construct a building to be energy efficient from the start than to retrofit it after completion. It is certainly less expensive than building a new power plant.

One can cogently argue that a City that cannot increase its energy supply sustainably should not be growing at all. But it is foolish to grow without ensuring that every cost-effective energy measure is employed before increasing dependence on conventional energy supplies. Austin has lost considerable opportunity to build efficient structures



John Dolley

over the last 20 years. There are several viable strategies for using mandates to boost efficiency.

1. Enforcement of the Current Code: The City of Austin has a good energy building code whose complete enforcement is suspect. Even before a new code is promulgated, the City can reap great saving by properly inspecting new buildings by the *current* code.

The first thing that needs to be done is to inspect the Building Inspection Department. An outside observer needs to inspect a random sample of energy code inspections to audit how well they are really carried out.

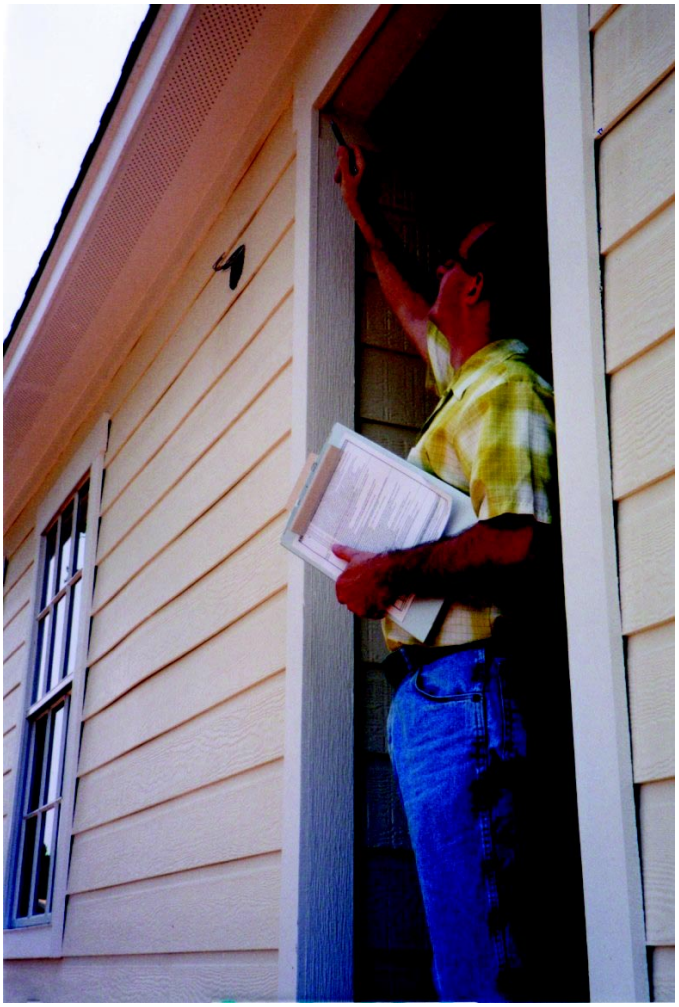
Oversized air conditioners and duct leakage are the 2 most important measures that can be taken to save energy in a new home. Building code requirements that address them are largely ignored. HVAC units are typically oversized, which causes them to cycle more and dehumidify less. Unsealed ducts commonly leak 20-25% of conditioned air into the attic.

The current building code requires a "Manual J" calculation be done to properly size air conditioners. But the calculations are seldom made, and there is no staff person to review the few calculations that are done for accuracy.

The current building code requires ducts to be sealed to prevent leaks, but inspection is visual. There is no mechanical ("Energy Star" duct blaster) test to assure if ducts are sealed to maximum efficiency. Literal horror stories of energy waste have come from technicians retrofitting ducts in poorly built apartment buildings that are only partially connected to the air handling system.

Random Energy Star tests of ducts, air conditioning systems, and air infiltration should become an ongoing requirement.

2. New Code Changes: Code changes can save even more energy or reduce peak demand.



• Mandating hardwire fluorescent lighting in kitchens, bathrooms, and outdoors;

• Mandating radiant barriers or roofs with a high Solar Reflective Index to deflect summer heat off roofs and attics;

• Moving air conditioning evaporator coils out of hot attics and into indoor closets;

• Moving air conditioner compressors off rooftops of condos and apartments;

• Reinforcing fiberglass-batt horizontal insulation in fireplaces and kneewalls with air barriers;

• Installing air ducts inside the conditioned space of a building so you are not reheating or recooling the conditioned air in an attic;

• Requiring onsite renewable energy or thermal energy storage for buildings with a conventional energy load over a certain size;

• Planting shade trees around the building.

Aspen in particular has a creative attachment to its code called the Renewable Energy Mitigation Program. Owners of new homes that exceed their energy code requirements for uses such as outdoor driveway and pool heating must either be fueled by onsite renewable energy or pay into a mitigation fund that is used to fund renewable energy and conservation programs throughout the area.**(44)**

Another strategy is to trade off appliance efficiencies with structural code items. Local and state governments are preempted from mandating efficiencies for home appliances such as air conditioners by a national code. But a City can unofficially raise efficiencies by offering a trade against an existing code item. For instance, the City might require ducts to be placed inside a building, but waive the requirement if the builder installs a higher efficiency HVAC unit.

The State of Florida, considered a leader of code-based energy efficiency in southern climes, has a trade-off system similar to this. Rather than on a prescriptive code, compliance is based on a rating points system that encompasses the overall cooling, heating, and water heating efficiencies based on the efficiency of the thermal envelope and equipment efficiencies. Certification is verified with private-sector professional inspectors.

3. Green Building Code: Still another direction for increasing efficiency of energy as well as water and building materials is to mandate a certain level rating in Austin's Green Building Program. This rating is achieved by scoring points from a large menu of options promoting energy efficiency, renewable energy, recycled or organic building materials, indoor air quality, water efficiency, and recycling.

Some localities with green building programs are starting to employ this option. They include: Frisco, TX; Cotati, Novato, Pleasanton, Santa Monica, and Sebastopol, CA; and Boulder and Aspen, Colorado.**(45)**

Mandating a Green Building "Three-Star" standard in the Austin Building Code will add no more than $1,200 onto the cost of an average home.**(46)** Short of city-wide mandates, the City could start requiring Three-Star levels for its "Smart Housing" developments, which eliminate developer fees for affordable housing in return for compliance with various standards.

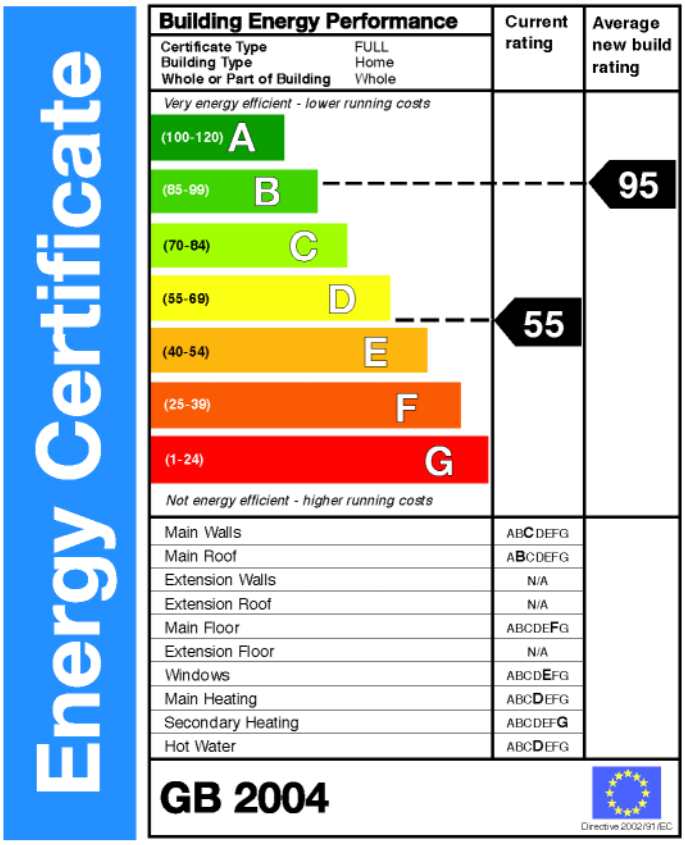
There will no doubt be critics of these proposals, including builders who oppose more regulations, and some affordable housing advocates who believe that such codes will raise the cost of an affordable dwelling. But these costs are generally minimal, and usually pay for themselves with lower utility bills and lower building maintenance. (And who can put a cost on better health?) This problem can also be approached the way Pleasanton, CA has, mandating green building for large houses (over 2,000 square feet), which will usually spare entry level home buyers.**(47)**

4. Regional Appliance Standards: Another strategy Austin can employ on its own to mandate efficiency in buildings is to mandate basic levels of efficiency in energy-using equipment. While a national appliance code preempts cities and states from enacting their own requirements on many home appliances such as air conditioners and refrigerators, there are many kinds of equipment that are totally unregulated by it.

A study done by the American Council for an Energy Efficient Economy identified 15 kinds of equipment that would produce major savings and are ripe for local regulation.**(48)** These could collectively save about 2% of national electricity once they reach market saturation.**(49)** Three of these, residential furnace fans, metal halide lamp fixtures, and liquid-immersed distribution transformers, represent 72% of this savings.**(50)**

This would require local enforcement of store outlets that will be resented by some retailers, and some retailers on the borders of Austin will be exempt if the same standard is not applied in neighboring jurisdictions. It would be a better regulatory situation if this regulation were implemented statewide. But the urgency of the energy situation dictates that Austin cannot wait for or count on this to happen.

5. Energy Labeling on All Buildings: Perhaps the most significant step in energy codes in the world is the Energy Performance Certification program (EPC) being implemented in the European Union.**(51)** In order to comply with the Kyoto treaty to reduce Greenhouse gas emissions, the EU will undertake a mandatory building performance standard and rating program. Similar to the way appliances and cars are currently rated in the U.S. for energy consumption, most new and existing buildings will be rated for their energy performance. The program will begin rating buildings in 3 EU countries in 2006. Each country in the EU will have autonomy over administering the mandate.



European Energy Performance Certification rating label

EPC requires the following:

1) For new buildings, a certain level of performance must be achieved. The certification becomes part of the legal document in a sales transaction. Technical and economic feasibility of renewable energy, district heating and cooling, and heat pumps must be assessed.

Existing buildings over 1,000 square meters in size must be retrofitted with energy upgrades to the point they are functionally and economically feasible.

2) Existing buildings must have EPC when they are sold or rented. Certain structures that are historic or religious in nature are exempted. Though owner-occupied buildings are not required to meet a defined standard, cost-effective retrofit recommendations must accompany the rating. Rental buildings must be rated no less than once every 10 years.

3) Public buildings larger than 1,000 square meters such as hotels, shopping centers, and government offices must be rated and have this rating prominently displayed.

4) Heating systems above a certain size must be inspected every 2-4 years, with cost-effective recommendations given on ways to improve the efficiency of equipment 15 years and older. Cooling systems above a certain size must also be inspected, though the inspection schedule is not defined.

EPC is the most widely applied program of its kind in the world. EPC requires the employ of qualified contractors to carry out the inspection, which will slightly raise the cost of a building sale or lease. But it has the potential to save many times its cost in energy reductions.

5. Expand the Green Building Program Falling Off the Leading Edge

The City of Austin piloted the first Green Building Program in the country in 1992. While many utility programs of that era rated homes for energy use, Austin took the lead in adding ratings for water use, indoor air quality, organic and recycled building materials, and construction waste recycling. Due to Austin's long-term efforts, its program is renowned throughout the world.

Compared to most other places in the U.S. that don't even have such a program, Austin is well off. But due to lack of staff and budget, the Green Building Program fails to affect the majority of new buildings in Austin. And it completely fails to reach buildings in the greater Austin region. While many Program supporters believe its highest virtue is voluntary participation, a voluntary program will only go so far without enough adequately paid staff and sufficient educational resources.

The Green Building Program rates about 25% of the

Portland's Green Investment Fund has encouraged innovation. A grocery store uses natural lighting to enhance its produce area.

A commerical building employs a green roof for insulation and flood prevention.

An office building uses natural lighting to save energy while boosting employee morale.

homes built in the Austin Energy service area, and a small percentage of commercial buildings.**(52)** And it totally misses buildings served by utilities surrounding it, most notably Pedernales Electric Coop and TXU. The program plainly lacks buy-in from its neighbors to hire additional staff to reach these new areas.

TXU has an energy efficiency rating program (Energy Star) for residential buildings only, not apartments or commercial buildings. Unlike Green Building standards, the TXU program has only a minimum level of compliance, and completely ignores other environmental areas such as water efficiency, green materials, and recycling. Pedernales Electric Coop has no building rating program at all. If these utilities joined the Austin effort by committing funding and support, a regional presence for the Green Building Program would be established.

Austin has also fallen away from the leading edge regarding green building educational strategies. Other communities have developed projects and ideas that Austin should emulate.

• In Portland, the City government and regional utilities have created the "Green Investment Fund," which awards $500,000 per year to innovative residential and commercial building projects exhibiting leading edge technologies and building practices.**(53)** These buildings incorporate novel energy devices, rainwater harvesting methods, green roofs, and storm water management systems.

• In the Denver Metro area and Colorado Springs, the regional green building program spends about $200,000 in TV advertising each spring, while Austin's program has no TV budget.**(54)**

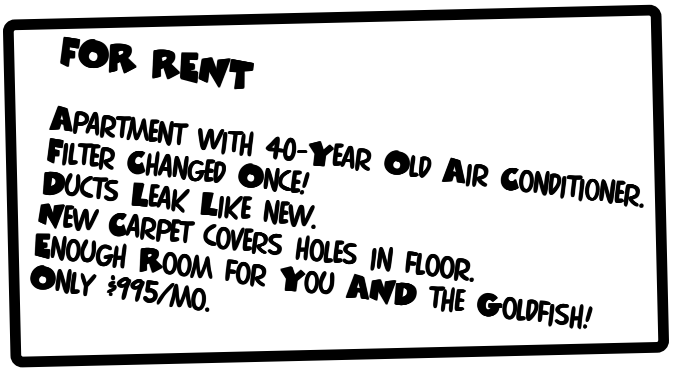
• In Boston, the region's green building program, The Green Roundtable, is remodeling the floor of an existing building to be a green building resource center. **(55)** The "Nexus" will house program offices, a reading and building materials library, exhibit spaces for green products and services, and rooms to host events and conferences. The remodeling cost of approximately $700,000 will be defrayed through several sources, including grants, donated materials and professional services, leased exhibit spaces and meeting rooms, and the organization's revenues from green design services.

If Austin established such a center, a good location would be the City building permits office. Since many builders or subcontractors already frequent this office and sometimes wait in line for permits, an onsite exhibit and resource center would make for an interesting diversion.

The Austin Green Building Program is currently paid to consult with other cities and organizations to advise them on ways to set up programs in their locale. Yet it does not have the funding or authority to have a stronger effect in its own home. The City government claims to be proud of these environmental efforts and the worldwide acknowledgement that has been received from this program. But this pride has not resulted in the political will to have a greater impact.

A voluntary program can be geared to reach a much greater percentage of the general public, but only if the public knows where to find it.

6. Mandatory Retrofits of Rental Buildings
The Downside of the Free Market



The invisible hand that rules the market fails to solve many problems. A good (bad) example of this is energy use in rental units. The majority (55%) of residential units in Austin, as well as a large percentage of commercial

buildings, are rented. As energy prices gyrate to even higher and more unstable levels, residents in rental dwellings and tenants in leased commercial buildings will suffer the most.

Tenants are at a disadvantage for at least 4 reasons. 1) Owners of homes and businesses that own their buildings are usually more economically able to make energy efficiency improvements. 2) Since most conservation improvements are not portable (insulation, central air conditioning, etc.), renters have a disincentive to spend money, since the retrofits will be installed in a building they do not own. 3) Landlords do not have a direct incentive to upgrade a building that they do not pay utilities for. 4) Rental buildings such as apartments are often intentionally built cheaply (and poorly), and for that reason energy bills are generally higher than they should be.

One way to address these disparities is to mandate retrofits for the rental sector. Three California cities still have energy and water conservation retrofit requirements in place from the era of high power costs in the early 1980s. San Francisco, Berkeley, and Davis mandate that homes and apartments are brought up to a certain code when buildings change owners.**(56)** The Bay Area cities of Oakland, Emeryville, and Pleasanton are strongly considering such laws.**(57)**

The City of Los Angeles currently mandates low-flush toilets be installed at the time of sale; the neighboring city of Santa Monica also requires this, and may consider energy mandates in the near future.**(58)**

Berkeley has perhaps the only point of sale requirement for commercial buildings in the U.S., requiring over 30 different tune-up or retrofit items. While most are relatively low cost, certain of the requirements have a higher costs and benefits. These include change-out of inefficient lighting systems and duct sealing.**(59)** At one time, San Francisco also had a point of sale ordinance for commercial buildings, but it was abandoned because it was not written or enforced well. However, a more effective commercial ordinance is being proposed.**(60)**

These ordinances have spending caps that prevent large increases in the cost of buildings. San Francisco has a $1,300 maximum; Berkeley's cap on residences is $750 per $100,000 in cost. The measures generally upgrade the building envelope or water heating system, and include ceiling and wall insulation, duct sealing, water heater blankets, and low-flow showerheads and toilets.

The State of Wisconsin also has a retrofit ordinance exclusively for rental units in both single family and multifamily buildings.**(61)** The law has been on the books since 1985 and requires building shell modifications such as ceiling insulation, caulking, weatherstripping, and storm windows and doors. Currently, about 6,000 buildings (with varying numbers of units) are certified as complying per year.

The whole of the European Union has launched a mandatory rating program for all rental buildings, both residential and commercial.**(62)** Christened "Energy Performance Certification," it is similar to energy-efficiency labels for cars and appliances. All rental dwellings will carry a rating label that must be shown to prospective tenants. Commercial buildings above 1,000 square meters must be retrofitted for cost-effective measures. And the universal nature of the labels will harness market forces to upgrade smaller, low-rated buildings that do not have mandatory conservation standards. The program is set to begin in 3 countries in 2006.

Apartments will be required to be rated every 10 years unless remodeling or energy upgrades are done. If a building serves large numbers of people (such as a shopping center), the rating certificate must be publicly displayed.

While one can make an argument that building owners have an incentive to save energy and that government should leave such decisions to the market, tenants are often (literally) left in the cold. To the City of Austin's credit, it has one of the best programs in the country to provide rebates and technical assistance for upgrades of multifamily buildings. Since 1989, the program has granted rebates for air conditioners and weatherization to about 20% of eligible units in Austin.**(63)**

The City program has also sealed about 8% of all ducts in Austin apartments. But well over 100,000 units are still unaffected by this long-term effort.**(64)**

The rate of apartment retrofits, while low, is far better than that of single-family and duplex rental units. About 30% of all the single-family homes as well as most duplex units in Travis County are rented. And almost none of these participate in the retrofit programs and rebates provided by the utility. This totals another estimated 74,000 units in need of conservation upgrades.**(65)**

Commercial buildings are in a similar situation. Unless the building is owner-occupied, or in a situation where the owner or management company pay the bills, hapless tenants are exposed to this market failure. By one estimate, 85-90% of the energy conservation retrofits that take place through Austin's commercial programs is going to owner-occupied commercial buildings.**(66)**

While concurrent rebate and technical assistance programs will eliminate some of the problems with mandatory retrofits, mandates will inevitably be opposed by a significant number of landlords. A few enlightened rental property owners see competitive advantages of conservation retrofits, as satisfied tenants renew their leases or are better able to stay in business with lower energy bills. But to most, mandatory conservation measures are an additional cost in money and time.

Even if such mandates were to be enacted, they would

mean little without enforcement and technical assistance. Some owners/managers who were unmotivated prior to enforcement could install mandatory measures incorrectly, eliminating some or all of their presumed benefits.

But the majority of residential units and many commercial buildings in Austin are rented. And most simply will not become energy efficient unless it is mandated by law. If Austin really wants to solve this problem, we need to confront the fact that the current remedies are not working well, or in some cases, at all.

In the case of rental building retrofits, the invisible hand of the market place has vanished.

7. Streetcars
National Security on Main Street

What would happen if imported oil was cut off and there wasn't even enough fuel for Austinites to drive their cars to necessary places such as food stores, employment, and schools? Fuel, when one could buy it, would be exorbitantly high, magnifying inflation through the economy. Austin is not a planned city, and urban sprawl makes it difficult and sometimes dangerous for drivers who want to become pedestrians or bicycle riders. Electric cars are currently not manufactured by any of the major carmakers, and alternative fuels such as biodiesel make up only a tiny percentage of the market.

Pressure would build on the government to provide an alternative relatively quickly. What would Austin do?

One solution might be modern electric streetcars. These could be built relatively quickly on Austin's most heavily traveled routes, providing both short and mid-range travel plans.

There are many advantages to this strategy.

• The streetcars provide a lifeline in national security situations where fuel becomes scarce.

• The infrastructure is relatively quick to build if using existing street lanes, causing a minimum of disruption to existing traffic and businesses. The track can often be laid at a rate of a block a week. And streetcars can run in mixed traffic.

• While not cheap, they are a bargain compared to widened streets, carrying many times the number of passengers a car lane can during rush-hour traffic. Streetcars (called "trams") can also run in express mode. They make relatively few stops, assisted with streetlight prioritization to greatly shorten commuting time.

• They are cleaner than conventional vehicles, contributing no direct pollution within a city and less pollution

overall since central electric plants emit less pollution per unit of energy than cars. The streetcars might even run on renewable energy, emitting no air pollutants or greenhouse gases. Calgary (Alberta), for example, powers its light rail system from windmills at the base of the Rocky Mountains.

• Depending on the situation, streetcars can reduce the amount of time commuting – sometimes markedly.

• They can be a magnet for compact city growth, preventing or at least mitigating the urban sprawl pattern that Austin has become so accustomed to.

• Establishing a network of streetcars would be an incremental way to eventually establish a light rail system in Austin, which would run even faster and more efficiently. Rather than spending huge amounts of money at one time, track suitable for both streetcars and light rail could be laid in the most heavily traveled areas of Austin. Then as ridership builds to high levels, the cars and signalization can be changed to light rail.

There is no ideal answer in an emergency. If ten other cities had the same idea to deal with a fuel crisis, factory backorders would delay vehicle delivery. But given all the benefits a streetcar system can bring to Austin, why wait for an emergency to build it?

The established routes would not serve everyone, especially people in low-density suburbs not within easy walking or cycling distance of the lines. But it would be a lifeline for a sizeable number of people. And a streetcar system would begin building the infrastructure for the most historically proven form of modern alternative transportation.

The Greenest City in the Country?

"Most cities spend their transportation money moving people from one place to another. In Portland, we spend some of our transportation money allowing people to stay in one place."

—Charles Hales, Former City Councilmember in Portland

Austin's reputation as a center of environmental consciousness is somewhat overblown. Our region has certainly conducted several longstanding efforts to save resources and guarantee open space. Some of these programs have won national awards. But in alternative transportation, Austin is not even on the map.

Of the 58 cities with populations over 600,000 evaluated in the Federal Highway Administration's annual *Highway Statistics* report in 2004, Austin ranks 17th highest in the number of Vehicle Miles Traveled (VMT) per person.(67) This shows how Austin has continued to employ urban sprawl as its preferred method of land use and growth, and the region's general disdain for mass transit. This custom has earned Austin the dubious honor of being ***NUMBER ONE*** in mid-sized cities in the U.S. for time delays in commuting.(68)

When Austin had a chance to begin to rectify the problem in 2000 with the election to fund a light rail system, the election narrowly failed. While Austin has no fixed rail system for intra-city travel, dozens of other U.S. cities in do.

To see a different picture, one should compare Austin to Portland and its urban growth patterns and mass transit system.

Of the 58 cities in the U.S. that were above 600,000 in population in 2004, Portland was the 13th highest in population per square mile. Austin ranked 56th.(69) Portland has the 8th lowest rate of VMT per capita of the 59 most populated metropolitan areas in the U.S.(70) People in Portland travel about 24% less vehicle miles than in Austin.(71)

Portland's density was accomplished intentionally over a period of several decades with land use policies that discouraged urban sprawl and encouraged density. These goals were assisted by the state government, which allows cities land use controls over development that most other states do not. And these goals were also aided by an aggressive transit system that made traveling affordable and convenient. TriMet, the transit agency that serves the greater Portland area, has light rail and numerous connector routes served by conventional buses.

Some 25% of all the travel to work trips in Portland comes from alternative forms of transportation (transit, walking, bicycles) or are saved by the worker using a home office, versus less than 12% in Austin.(72) And there are several other American cities that exceed them by a large degree. In most Western European countries, moreover, 50% of all trips are made without personal vehicles.(73)

ALTERNATIVE TRANSPORTATION FROM HOME TO WORK

Rank	City	Percent
1	New York	69.5%
2	Washington, DC	52.8%
3	San Francisco	49.0%
4	Boston	46.1%
5	Philadelphia	37.9%
6	Chicago	36.6%
7	Baltimore	36.6%
8	Pittsburgh	34.7%
9	Seattle	30.3%
10	Minneapolis	26.7%
11	Portland	25.4%
30	Austin	11.7%

Things were going in the opposite direction in years past. Between 1980 and 1993, VMT in Portland nearly doubled. But it has remained relatively stable since then, largely as a result of compact city planning aided by alternative transit.(74)

The process of planning and building this system began almost a quarter-century ago in 1982 when TriMet started planning its first electric light rail system from the airport to downtown. Completed in 1986, this was 15 miles. Today it is 44 miles, all of it added since 1998.(75) About 26% of downtown commuters in certain sections of the city use this system.(76) The City has also embarked on aggressive bicycle infrastructure program that has installed 259 miles of bike lanes, trails, and paths in the area as of 2006.(77)

In 2001, the City of Portland, independently from Trimet, expanded the region's alternative transportation system further. It introduced a downtown streetcar circulator

Transportation Mode Split in Europe and North America

Country	Bicycle	Walking	Transit	Total
Netherlands	30%	18%	5%	53%
Denmark	20%	21%	14%	55%
West Germany	12%	22%	16%	50%
Switzerland	10%	29%	20%	59%
Sweden	10%	39%	11%	60%
Austria	9%	31%	13%	53%
East Germany	8%	29%	14%	51%
England & Wales	7%	12%	14%	33%
France	5%	30%	12%	47%
Italy	5%	28%	16%	49%
Canada	1%	10%	14%	25%
U.S.A.	1%	9%	3%	13%

ROUTE CHARACTERISTCS PER MILE (78)

	Cost (Million $)	People at Peak Hour
New Road Lane*	$1-3 million / lane	660
Streetcar Lane	$1-15 million	4,000 (5 minute intervals)
Light Rail Lane	$9-36 million	7,500 (3 minute intervals)

* Construction only, no ROW

system. Today there are 6 miles of streetcar tracks in the area, and the system is adding more.

Part of the attractiveness of mass transit in Portland is that much of it is electric. Unlike internal combustion engines, it rides much smoother, and is quieter to both the passenger and neighbors. Electric engines can accelerate and decelerate more quickly, adding to maneuverability.

Cyclists can enter light rail cars easily, not with the typical delay that takes place when their bicycles are mounted on racks on the front of a motorized bus. Low-floor rail cars allow the cycles to wheel right on as the floor is level with the boarding station. The same is true for wheelchairs. There are storage racks in the cars, though many cyclists simply hold onto them in their seats if the car is not too crowded.

Another advantage of streetcars and light rail is their permanency. Passengers and developers along the route feel secure that the routes will not change, unlike motorized buses that can quickly be changed to remove advantages mass transit affords. This security often influences people's choices of major decisions such as how to commute, whether to own a car, and even where they live. To an even greater degree it influences where major urban developments are located.

In terms of moving people, rail and streetcars are also cheaper than building new roads and freeways. Just 80 cars going 35 mph take up an entire acre of land. So consider how much a city takes up during rush hour. Street railways greatly magnify the number of people that a traffic lane can move at peak travel times, making rail less costly than new road infrastructure.

Note that in the chart above, 1 rail lane can take the place of 6 highway lanes. While streetcars carry about as many people per million dollars of infrastructure, there is almost no practical price or way to get 6 additional lanes in any major Austin roadway.

And in rush hours, even in mixed traffic, street railways almost always make trips faster than autos. Any mass transit can override normal traffic signals to get prioritization for its routes. Streetcars and light rail, if the track is off the street (railroad line, tunnels, separate grades above the road) can go even faster because they are not competing with car traffic in any way. Light rail can go up to 65 mph; streetcar trams as fast as 40 mph. In a populated area at rush hour, this uninterrupted speed is rarely matched by auto traffic.

Streetcars systems are also relatively quick to build. Portland's track was built in 3-block segments that took about 3 weeks to finish, or about 1 week per block. The street was never closed to traffic at any time, so inconvenience to merchants and traffic was greatly reduced.

Reinventing a City

Simply put, if you can shop and work close to where you live, you don't need a car to commute. Portland streetcars encourage growth and redevelopment by making it easy to live in the downtown area. The transportation is prompt, comfortable, relatively non-polluting, and routed in such a way as to encourage people to abandon their cars to live in the area. Since the tracks are built to run in mixed traffic, the streetcars have a maximum speed of only 30 mph for safety reasons.

Between 2001-2006 when the streetcars were in operation, about 4.6 million square feet of development and redevelopment worth about $2.3 billion (nominal dollars) has occurred in the service area.**(79)** This includes 7,300 residential units. It is a very successful example of "transit oriented development" (TOD) that has only recently been espoused as a goal for Austin.

Portland's light rail lines have had the same densifying affect on the region, except on a vastly larger scale. Major employers, apartment complexes, and commercial buildings often locate near light rail terminals. Since 1978, about $3.8 billion in development has taken place along the "MAX" light rail lines, most of it since 1998.**(80)**

In Austin, critics and proponents of TOD ironically agree on what the results of this kind of development are: increased property values that encourage density and make it less affordable for people with modest incomes to own low-rise structures. With Austin being the highest price home market in Texas, many Austinites still believe that TOD is a siren's song for Austin as it was.

TOD opponents plainly think this urban form will make it more difficult for people with lower incomes to economically survive. While this can happen with transit lines, it can also happen (and is happening in Austin) without them. TOD advocates believe that more densely populated areas will adapt to affordability through apartments and condominiums.

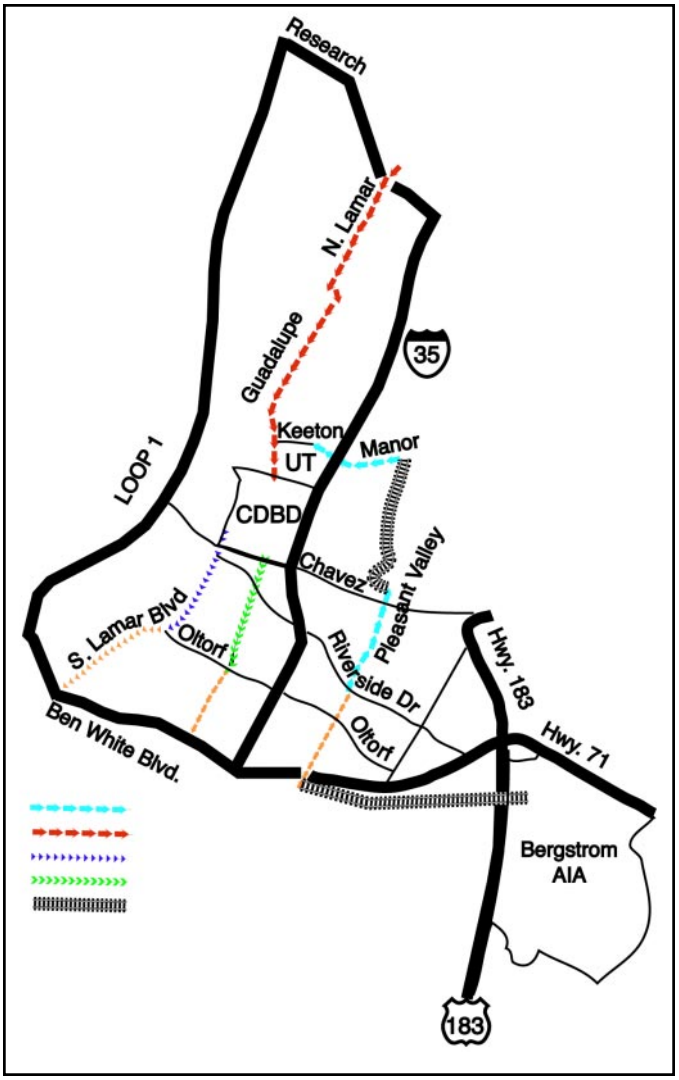
Personally, I wish Austin were the smaller town it used to be when I moved here in the early 1970s. One can also argue that Austin has not yet "learned" how to be a denser city. For instance, the City does not adequately enforce its noise ordinances, which discourage people from wanting more TOD development. But the train has left the station. Gentrification will happen with or without a good mass transit system. If Austin does not employ more mass transit and better land use models, it can look forward to continued traffic jams without alternatives, long commuter times, air pollution problems, fuel price increases,

and continued dependence on foreign oil.

The Foundation

Light rail technically can be run on foundation slabs only 18 inches deep, which eliminates the need for moving expensive infrastructure such as water mains that are built under roads. Streetcars and trams can run on the exact same line with siding track that keeps streetcars off the track while express trams pass them. *Running streetcars on this track until there is enough demand to justify heavier and more expensive light rail equipment/infrastructure is an incremental, fiscally cautious way to introduce rail to Austin.*

There is serious discussion of placing streetcars in the downtown/University of Texas area in the next year. While this is a great start, it might be too cautious considering current traffic congestion and imminent national security environmental, consumer problems related to energy use. It is the *Directory's* proposal to build several lines simultaneously around Austin that can later be expanded in length and passenger capacity. This will serve 2 purposes in addition to solving the problems mentioned above.



It will allow all sections of the city a chance to experience rail, so that there will not be a subcultural divide between downtown/UT and other parts of the city. And as these segments become more numerous, they can eventually be connected to each other as part of a larger rail network.

To be responsive to both traffic demand and numbers of people that can economically justify a rail route, the *Directory* makes the following route suggestions.

1. Riverside Drive to UT/Downtown east of IH-35 – This is one of the most heavily trafficked transit corridors per mile in Austin because of students traveling between the University of Texas and Apartment City. Six separate (diesel-powered) shuttle bus routes follow the same path from the campus to E. Riverside Dr. and then turn into separate clusters of apartment complexes. In 2005, there were already 12.777 trips per day.**(81)** By 2030, 21,180 trips are predicted.**(82)** This would increase considerably via rail, as riders tend to prefer rail to bus routes.

This proposal would avoid the congestion of both downtown and the freeway. Instead, riders would be carried short distances from their complex via jitneys or feeder buses to central points near Riverside Drive. The route would go east to Pleasant Valley, use existing rail right of way from 5th Street to Martin Luther King Blvd. where the City of Austin is already planning a transit oriented development complex. (This complex may eventually contain up to 2,200 residential units as well as commercial buildings.)**(83)**

The route would then travel west to UT. Interconnections with downtown transit could also occur on the route, probably at the proposed circulator route at 26th Street going both east to the Mueller Airport redevelopment and west to connect with the proposed UT/downtown ("Longhorn Loop") streetcar.

This spur could eventually be expanded farther south down Pleasant Valley Road to Oltorf to accommodate the considerable number of apartment residents in the area. It could then be extended south and then east along the rail right of way parallel to Burleson Road to access Austin Bergstrom International Airport.

While the use of Capital Metro owned rail right of way would save money, a rail bridge across Longhorn Dam on Pleasant Valley Road would be probably be needed.

2. Downtown/UT to Intramural Fields and north to N. Lamar Transfer Center (Park & Ride) facility at 8000 N. Lamar – This is the most heavily trafficked transit area in the City measured by number of riders. It includes the UT Intramural Field route from campus to 48th Street and Guadalupe, and riders on Capital Metro's most heavily traveled #1 Lamar line. There are an estimated 13,226 riders today, and this will increase to about 19,480 by 2030.**(84)**

The proposal would have it travel from along the same UT shuttle route to 48th Street, veer slightly west to Lamar, and then north to the North Austin Transfer Center at Lamar and Hwy. 183.

Eventually the rail lines could be extended north and south on Lamar, the most heavily trafficked (non-highway) road in Austin.

3. South Austin Main Arterials – Downtown to Oltorf via S. Congress and Downtown to Oltorf via S. Lamar – While these roads are very highly traveled by cars, they are very poorly traveled by bus riders. This largely has to do with low density, which will change as the City grows.

The City of Austin is in the process of planning for 6 Transit Oriented Developments that make use of rail and mixed use development in the Austin area. These include both undeveloped land and redevelopment of existing sites. None of these are in South Austin.

It would make sense to build pilot routes from downtown to Oltorf to encourage development along the corridors and provide for downtown commuting to existing South Austin neighborhoods. Lines could be extended as these routes gain respectable ridership. South Congress has about 23-33,000 auto trips per day and 2,371 bus-rider trips a day along the road segment being discussed; S. Lamar has about 42-48,000 auto trips per day and 1,676 bus-rider trips per day along this route.**(85)**

The cost of these lines would collectively run about $340 million. This money could come from a variety of sources. A large percentage would probably have to come from municipal or Capital Metro bonds. But cost sharing could come from businesses served on the lines (a kind of tax increment finance district), parking taxes, the University of Texas (for routes to campus), and Austin Energy, who could fund the electric infrastructure and recoup the costs through monthly sales to the rail system.

The cost of these systems is not cheap, though it would be gradual, and does compete well with new roads. Please note when evaluating these costs that:

1) the cost to condemn land for right of way to get more lanes for cars is both politically and economically expensive, and car lanes have only 9-17% the capacity of rail;

2) the value of the last 2 bond elections for road improvements in Austin has been about $150 million each;**(86)**

3) the heavily protested toll road system in Central Texas will cost $3.6 billion, or about $9 million per lane mile;**(87)**

4) the Austin light rail proposal that narrowly failed in the 2000 referendum cost $919 million.**(88)**

COSTS FOR PROPOSED ROUTES (89)

Riverside Dr./UT – 5.3 route miles (double track) – 1 major bridge, 49% on railroad right of way with one track already built – $92 million.

Downtown/UT to North Austin Transfer Station – 4.4 route miles (double track) – $132 million.

Ceasar Chavez/Oltorf on S. Congress – 2.1 route miles (double track) – $66 million.

Ceasar Chavez/Oltorf on S. Lamar – 1.6 route miles (double track) – $48 million.

Not a Panacea

For all the good things one can say about rail, it cannot be a complete solution, or even the main one, for most American cities. Rail will often have to traverse land that is already developed. Shoehorning a line into an existing neighborhood can be expensive if the taking of new right of way is required, though the same can be said for new roads.

Geology can also be problematic. In most cases, rail cannot generally be located on slopes above 9%. An extreme example took place in Portland. To deal with slopes and existing neighborhoods, a 3-mile light rail tunnel 21 feet wide was drilled 260 feet below ground at a huge expense.**(90)** This project created the deepest rail terminal in North America.

Another consideration is that there are many low-density suburban neighborhoods where rail is simply not suitable. It is possible feeder buses can bring these residents to rail lines. But even if motor fuel reaches unprecedented prices, it is not likely most of these neighborhoods will densify quickly.

Rail is, however, a good tool for diversifying fuel sources and mitigating traffic congestion in the right locations.

Rail also not the best way to respond to an *acute* emergency. Streetcar and rail equipment is made in small increments by a relatively small number of factories. In an emergency, many other cities would have the same idea to build or increase rail use, exacerbating backlog in demand. If the U.S. undertook massive redeployment of auto factories, as happened at the beginning of W.W.II, there would be a way to get the necessary rail equipment in a timely manner. But given the shortsightedness of the federal government's energy policy thus far, such expectations are fantasy.

As in so many other circumstances, the best way to deal with an emergency is not to have one. Austin cannot wait on the federal government to muster political will it does not possess. Austin should start its rail projects on its own.

8. Heat Island Mitigation
Cooling the Asphalt Jungle

Cities are typically 2-9˚ F hotter than the rural land that surrounds them due to the retention of the sun's heat in streets and buildings. With much of the original landscape removed, there are also fewer opportunities for relief from shade by trees and shrubs. This widely recognized phenomenon is called the "heat island effect."

Heat Islands not only make cities uncomfortable. They cause other environmental problems. Hot urban areas drive the need for air conditioners and the energy to run them. This not only causes increased costs, but the additional ambient heat contributes to ozone formation on hot summer days. This creates additional pollution beyond that emitted by power plants running the air conditioners.

The heat island effect can be controlled by a region-wide effort to plant trees on a massive scale, and modifying the surfaces of building roofs and streets with light-colored surfaces to reflect sunlight. As an example, a study was done to determine what would happen if the City of Los Angeles planted 10 million trees (over 5% of the city's land area) and changed some of its roofs to a brighter color.**(91)** The results were large and multifaceted:

- a 5˚ F drop in peak temperature;
- an 18% drop in air conditioning costs, resulting in $100 million in *direct* savings in buildings in shady areas with reflective roofs;
- a 1˚ drop in overall temperature, with an *indirect* savings in air conditioning costs of $70 million, including buildings not directly benefiting from reflective roofs and shade trees;
- a 12% drop in smog due to the decreased ambient heat that "cooks" ozone, translating into a $360 million drop in health related costs.

Courtesy of Houston Advanced Research Center

Thermal photography of heat retention in urban landscape. Yellow represents a commercial rooftop. Red represents parking and lower density development.

Closer to home, the Environmental Protection Agency has analyzed Houston and found that temperatures on roofs and roads can be 149˚ F, compared to 77˚ F in cooler areas of the city.**(92)** This results in an average air temperature rise of 3˚ F and a peak rise of 6˚ F throughout the region.

In Austin, each degree Fahrenheit of peak temperature drop would save 20 MW of gas-fired electric generation at a capital cost of $11 million as well as $4 million annually in fuel.**(93)**

In almost all mainland U.S. climates, savings in energy used for cooling outweighs winter heating losses.

In Travis County, it has been calculated that there are about 1,100 square feet of roof for every person, and about 33 square miles of roofs in developed areas.**(94)** There is also an estimated 2,000 square feet of hardscape (parking lots, driveways, and sidewalks) per person, with almost 60 square miles of impervious cover in developed areas.**(95)** Nationally, the area covered in roads and parking lots is the size of the state of Indiana.**(96)**

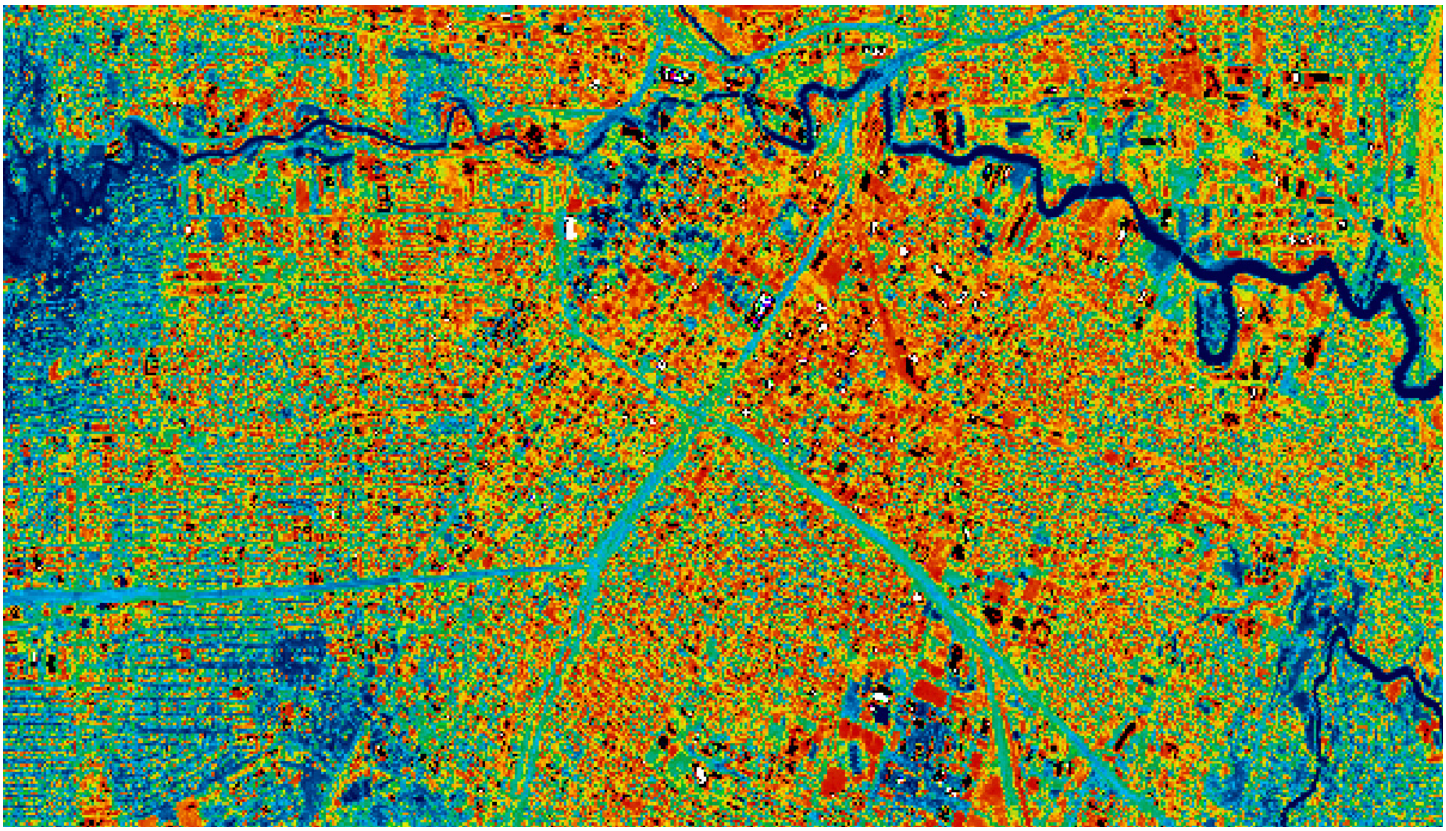
During the boom years between 1985-1997, about 2 square miles a year of forest land was lost in Travis County.**(97)** In addition, approximately 1 total square mile a year of grassland and agricultural land was lost to sprawl during the same period. There are no reliable estimates of tree loss within urban areas, but it is believed to be substantial. With rampant population growth and construction, the trend has undoubtedly continued, and there is no substantive effort to replace the shade surrounding or inside the city.

A few places in the country are beginning to take action to mitigate heat islands.

ROOFS –Approximately 2/3 of commercial roofs are flat or low-sloped, which are typically replaced within a 10-year period. Cost-effective technology allows almost all roof material to be replaced with surfaces that have high reflectance and emittance, saving energy both directly in buildings in which the roof is installed, and by lowering the ambient temperatures throughout the region.

- In California, the new "Title 24" commercial building code requires all low-sloped roofs to have a certain reflectance and emittance. The requirement was found cost-effective in all the state's climate zones, as the additional cost for heat-rejecting materials is either low or non-existent.**(98)** Annual incremental electric peak demand savings for new and existing buildings was estimated at 36 MW, with $107 million in annual energy savings and equipment costs.**(99)** These savings would increase by this amount every year until all old buildings were reroofed.

- The State of Georgia has adopted a "White Roof Amendment" mandating all buildings (new and replacement) either have roofs with a minimum reflectivity and emittance factor of 0.75, or a certain level of insulation.**(100)**



Courtesy of Houston Advanced Research Center

Thermal flyover map of Houston illustrating the Heat Island Effect.
Yellow and red generally denote heat retaining roofs and streets, while green and blue represent landscape and water.

• The City of Chicago has also implemented a minimum reflectance requirement for low-sloped roofs.

TREES – The number of new trees that need to be added in large urban areas to reduce ambient heat is immense. In addition to trees lost from disease and old age, development additions of buildings, driveways, and parking lots decimate canopy cover. The urban forest in most growing cities simply cannot keep up with these factors.

Funding necessary for such a vast urban reforesting effort will be substantial. There are some precedents in other regions that hint at what Austin needs to do.

• In Houston, the regional branch of the Texas Dept. of Transportation has received $23 million to plant trees and landscape near roadways as part of the 2005 federal highway bill.**(101)** And CenterPoint Energy has launched a utility rebate program to encourage air conditioning savings.

• The Sacramento Municipal Utility District paid for the planting of 21,000 trees in 2004. The budget (currently about $1.5 million) is cost-justified through utility energy savings.**(102)** Since its program began in 1990, the utility has planted 360,000 trees.**(103)**

• The City of Los Angeles requires trees in its building code: one tree for every 25 feet of wall exposure.**(104)** The City-owned utility, the Los Angeles Water & Power Dept., also has ambitious plans for restoring tree cover. It will fund as many as 100,000 free trees a year. But due to lack of advertising funds, the program's popularity has peaked at 15,000 per year.**(105)** Progress may be reinvigorated, as the newly elected Mayor has expressed a desire to plant 1 million trees.

• Too often, dying trees are not replaced in commercial parking lots, even though they were required at the time of development. The City of Sacramento, CA, recently hired an inspector to ensure that the landscape ordinance requiring canopy cover is enforced throughout the life of a development.**(106)**

HARDSCAPE - There are several strategies to build reflective hardscape to mitigate its heat retention. Most of them carry a first-cost premium over typical "black-top" asphalt. But they also have long-term benefits.

Many (though not all) public works professionals believe that using concrete instead of asphalt is usually less expensive on a life-cycle basis, since asphalt needs significantly more maintenance and repair. Concrete often (though not always) carries a premium.

Pervious pavement, both concrete and asphalt, is also available, allowing rain to seep through hardscape. The water underneath, as well as the voids in the material, keep the pavement cooler. But this also carries an extra price.

Lightening the color of asphalt can also be obtained for a premium. One technique literally adds light-colored paint to the material. Another uses a clear pine resin in place of petroleum as a binder.

There are other benefits to these alternatives beyond heat island mitigation. Lighter surfaces mean more reflectance at night, lowering energy costs for street lighting. The material itself also lasts longer because it is not as vulnerable to damaging heat and wide temperature swings that cause brittleness. And reflective pavement helps reduce smog in two ways. It reduces the heat island effect that contributes to ozone creation, and it lowers heat in parking lots, which mitigates fuel evaporation (a source of air pollution) from parked cars.

Many professionals believe concrete streets are not closed as often for maintenance, avoiding time-consuming traffic jams and slow-downs. Some studies assert that concrete uses less energy in materials manufacture and installation compared to asphalt, and uses less overall aggregate and base material because it is stronger. Several studies assert it is more fuel efficient for large trucks and buses to travel on, since concrete provides more traction than asphalt. This added traction also makes it safer to drive on in wet weather.

Unlike light-colored roofs and trees, there is sometimes a substantial first cost for concrete that deters its widespread use. But this is not universal.

- The City of Ft. Worth grants a cost preference of 5-10% for concrete in bids for Capital Improvement street reconstruction.**(107)** The increased cost is covered in yearly budgets, but maintenance budgets will go down due to a higher quality pavement. Since 1986, most streets in new developments have been built with concrete, as well as new arterial and industrial roads.**(108)**
- Numerous other cities in Northeast Texas have a preference for concrete, including Addison, Garland, Grand Prairie, Irving, McKinney, North Richland Falls, Plano, Richardson, and Wichita Falls.**(109)** Reasons for this include aesthetics, lower maintenance, and durability in clay soils.
- The City of Houston has a preference for concrete in new and rebuilt residential streets due to its longevity and aesthetics.**(110)** All its major thoroughfares are concrete, though maintenance is often done with asphalt overlays.

Off the Island

In 2001, the Austin City Council sought to implement a comprehensive policy to increase tree planting, tree preservation, and increase the reflectiveness of Austin's roofs and streets. But in the 4 years since the policy was enacted, little has been accomplished.

The number of trees planted by various City of Austin programs each year (6,000) is the same as it was prior to devising the policy. (The municipal utility's electric department actually trims the equivalent of 12,400 trees each year just to protect its power lines.)**(111)** Tree planting in parks has been cut back due to budget constraints. Pitch black roofs are installed routinely, while two entire states have changed their building and roofing codes to prohibit this.

Photo by Mark Wieland

Tree planting money set aside for new roadways has not been increased. City departments have often fought *against* road right-of-way trees, each claiming their department's infrastructure (powerlines, water mains, sidewalks, etc.) are more important. Since the City does not even budget the money to adequately maintain its asphalt roads, it has little funding to invest in upgrading to concrete.

Meanwhile, Houston, reviled by many Austin environmentalists for its many pollution problems, has a more comprehensive approach to heat island mitigation. The federal government has conducted 2 thermal photograph flyovers of the region to detect "hot spots" for quick remediation. Its Congressional delegation has secured funding for tree planting near federal highways, and its state elected officials have made it easier to obtain electric utility financing for tree planting programs.

If Austin is ever to cool its asphalt jungle, it needs to muster the political will and money to do it.

A. At least 2 full-time employees need to be hired to coordinate a comprehensive program, complete with tree planting, roofing codes, and light-colored pavements.

B. Part of their task will be to prepare baseline data such as thermal photography flyovers and tree surveys, and to publicly disseminate the information.

C. The region needs to fund massive remediation of tree cover with funds from local and federal road projects and local electric and watershed utilities. The $4 million of yearly fuel savings in electric generation that Austin's utility could save by lowering the City's temperature 1 degree F would fund the planting of about 100,000 trees annually.**(112)**

D. Demonstration projects need to be conducted at shopping centers and neighborhoods where roofs and pavement are lightened and more trees are planted. In Philadelphia, a "cool block" contest was held, where the winning residential blocks took heat island measures that reduced the temperature 1° F lower than nearby neighborhoods.**(113)**

E. The region should levy a tree remediation fund on developers of virgin land that would fund urban reforestation.

F. Lifecycle costing comparing concrete and asphalt for street and parking lot materials should be mandatory for all new developments and pavement rebuilds in the region, and in areas with high amounts of impervious cover such as the Central Business District and the University of Texas. This analysis should include not only installation and repair, but also energy savings in driving and security lighting, ozone pollution reduction, safety, waste disposal, and time saved for motorists due to reduced road maintenance.

Eventually, parking lots will need to have reflective pavement mandated by code.

Experiments with alternative paving materials such as "asphalt" using tree-resin binder and porous paving need to be started to assess their longevity and cost.

9. Municipalize the Gas Company An Accountable Utility

While Austin's electric utility is municipally owned, the main gas utility that serves Austin is not. Texas Gas Service (TGS), formerly Southern Union Gas, serves 177,000 residential and 17,000 commercial customers in the Austin area, and provides the Austin area with roughly 16% of its primary energy needs for buildings and facilities. TGS has been lacking in environmental and consumer protection efforts. It is time to consider what can be done to correct the company's failings. And one of the options is to buy it.

There are over 950 publicly owned gas utilities in the U.S., serving some 4.8 million customers, about 8% of total gas hook-ups.**(114)** The 10 largest systems include the areas of Philadelphia, PA; San Antonio, TX; Memphis, TN; Indianapolis, IN; Omaha, NE, Colorado Springs, CO; Long Beach, CA; Richmond, VA; Springfield, IL; and Knoxville, TN. (Number 11 is Corpus Christi, TX.)

Some arguments for purchase of TGS are consumer related as opposed to environmental. In recent history, the company has had relatively high fuel costs. Its gas costs were 9% higher than what Austin's municipal utility paid according to a 28-month analysis from November of 2003 to February of 2006.**(115)** And it had the 7th highest fuel costs of the top 25 gas utilities in Texas in 2004.**(116)** Combined fuel purchases of the electric and gas utilities would probably reduce costs. Other functions, such as combined billing and customer service, might also lower bills.

TGS has also shorted the City on its yearly franchise fee payments. It is typical for City governments to charge private utilities a franchise fee for use of their streets and public easements. These fees typically go to fund city government. But as in the mid-1980s, around the time the current franchise agreement was signed, large industrial and building purchasers began buying their gas on the open market, only paying TGS for transport costs. Since the gas was not technically sold by TGS, large customers that formerly paid a franchise fee on fuel no longer do. The bottom line is the poorest residential customers in Austin pay a 5% franchise fee while wealthy corporations pay less than half of one percent for this fee. And the City lost about $22 million in General Fund revenue (2005 dollars) between 1996-2005 because of this loophole.**(117)**

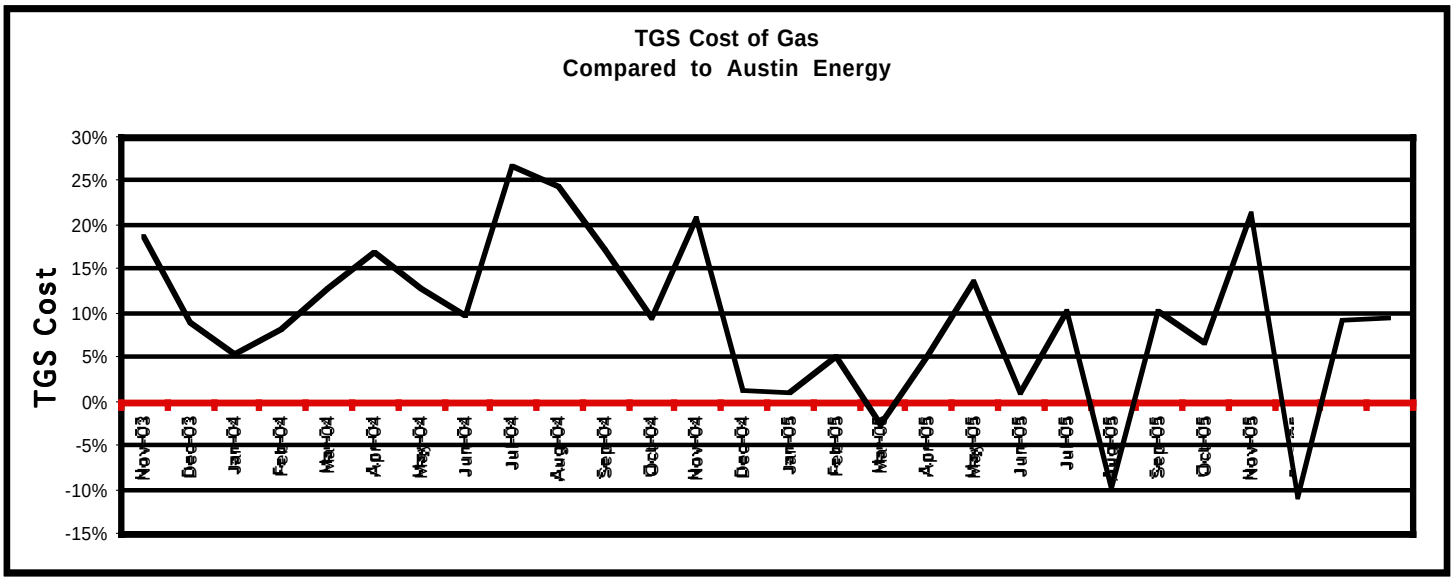
Another consumer-related reason to consider purchase is to gain a source of revenue for the City government. Currently 16% of Austin's General Fund expenditures are supplied by the City's electric utility, and another 4% from the City's water utility.

One estimate of the net profit from TGS in Austin is about $7.2 million.**(118)** In the City of Long Beach, a public gas system with a similar number of customers transferred $12 million to its General Fund in 2004.**(119)** Colorado Springs collects no return on investment, but transferred $22 million for payments en lieu of taxes in 2003.**(120)** Omaha also acts as a non-profit, providing lower cost service en lieu of a profit.**(121)** But it transfers 2% of gas and water sales revenue as payment en lieu of taxes to itself and other cities in the service area, about $4.3 million in 2004. Though there has been no official estimate of what it would cost for the City to purchase TGS, the last official estimate of the Austin company's assets (1993) valued its worth at $72 million.**(122)**

There are environmental reasons to consider purchase as well. Due to public pressure in the mid-1980s, TGS has one of the only gas utility conservation programs in this part of the country. While laudable, the amount spent and the savings are relatively low. This is in part due to the fact that large customers are not charged for energy conservation services. While the lackluster performance could be changed through regulation and franchise revisions, it can also be accomplished by municipal ownership by a city that has a long commitment to such efforts.

Natural gas can also be used to displace electric demand through fuel switching. In many energy uses, such as water heating, direct use of natural gas has superior efficiency to electric appliances. While this strategy has been encouraged in other regions, fuel switching has not been pursued in any way in Austin because of the competing interests of the two utilities. Municipalization can change the situation.

Still another environmental reason for purchase is to "green" the gas utility. While Austin Energy currently provides about 6% of its power through renewable energy, there is no green power product for gas utilities locally or nationally. Probably the most likely source of this would be from biomass gasification to create syngas for onsite cogeneration at large facilities. Utilities would change their business structure from providing centralized power dispatched over power lines and gas mains to a distributed generation system. The profit would come from engineer-



ing, financing, and operating these onsite plants. While TGS is technically capable of adapting this model, it has all but ignored the possibilities. Meanwhile, Austin Energy has moved aggressively on several cogeneration and central chilling projects.

Another possibility, though more expensive, would be to convert the same syngas from a biomass reactor into methane and transport it through gas mains. And while again, the City, as regulator, could require experiments with this technology on the part of TGS, the gas company has not exhibited any initiative to date.

Publicly owned utilities are not a magic bullet to a perfect organization. But they do offer more democratic accountability, and often provide lower cost and environmentally preferable services.

10. 100% Green Energy for Local Governments Renewable Energy Stabilizing Taxes

The City of Austin has the most effective voluntary renewable energy marketing program in the country. Many programs around the country allow consumers to purchase renewable energy at a higher cost. The collective volume of these subscriptions is used to purchase renewable energy from wind power, biomass, solar cells, and small hydroelectric generators on a larger scale. These voluntary purchases thus provide a percentage of renewable energy to the overall electric system without impacting non-subscribing customers.

Austin began its GreenChoice Program in 2000. It charges a different, usually slightly higher price for renewable power than normal utility costs. But the rate is locked in at the time of purchase for 10 years, so if conventional fuel continues its upward spiral, GreenChoice can actually be a money saver. With the recent fuel price escalations that occurred in 2006, *all* GreenChoice customers are now paying less than the normal price of electricity.

A guaranteed cost is one reason the program has gained at least 65 large commercial customers, who buy part or all of their power at the GreenChoice price as a method of price hedging. Currently there are about 610 total commercial and 10,150 residential GreenChoice subscribers. In 2006, the City of Austin will sell 650 million kilowatt hours of green power to subscribers, amounting to 6% of its total power sales.**(123)**

But up until 2004, the City refused to buy its own product. And this despite the fact that the City of Austin is one of the largest purchasers of electricity in the region. (The City is also one of the largest employers in the region.) In 2004, the City bought 3% of total power sales.**(124)** The majority was used for the City's water/wastewater utility, but streetlights, City buildings, and the airport also consume large amounts of electricity.

In 2004, there were only 5 buildings (including the new City Hall) that were on the GreenChoice rate, representing only 2% of the City's total electric use. In 2006, the addition of more buildings will make up 18% of the City's total power consumption.**(125)** So when natural gas caused electric bills to go up in 2006, the City actually lost about $2.4 million compared to what it would have spent if all its power had been purchased from 2003 ("Batch 2") GreenChoice rate.**(126)**

If the City is serious about its commitment, it should lead by example. Since the City is in the process of buying more renewable energy, it is not yet known what the new cost for GreenChoice is. But if it were even 1¢ more per kwh, it would amount to an increase of about $2.7 million a year to have all its electricity from GreenChoice, compared to an overall City budget of $2.2 billion.**(127)**

Most of the increase for green power will be in Enterprise Funds of the water and electric utilities and the airport, which can absorb the costs through trivial rate increases instead of taxes. For instance, 100% GreenChoice use in the water utility (at a 1¢ per kwh premium) would increase its rates by about 6/10ths of 1%.**(128)** Benefits of

AUSTIN-AREA GOVERNMENT ENERGY USE			
Agency	Conventional	GreenChoice	Diesel
	Electricity (kwh)	Electricity (kwh)	Gallons
Austin ISD	108,860,945	48,827,000	719,141
Del Valle ISD	15,616,186	0	166,443
Travis County	28,969,404	0	241,296
Round Rock ISD	0	16,266,124	600,000
Leander ISD	3,099,007	0	222,497
Manor ISD	1,417,634	0	91,895
Lake Travis ISD	8,838,905	0	73,428
Pflugerville ISD	13,865,458	0	214,571
Eanes ISD	16,017,198	0	69,469
City of Austin	268,250,193	59,200,000	2,001,433
Capital Metro	6,595,518	732,835	3,592,105
TOTAL	471,530,448	125,025,959	7,992,278

price hedging and a cleaner environment would also occur.

If Capital Metro, the government of Travis County and 8 surrounding school districts are added to the effort, total green power in Austin will increase 73% and supply 10% of the utility's total power mix.**(129)**

There are multiple examples of large government purchases of green power.**(130)** They include:

- the City of Portland, OR, 100%;
- the City of Santa Monica, CA, 100%;
- Dyess Air Force Base, TX, and Fairchild Air Force Base, WA, close to 100%;
- the U.S. Environmental Protection Agency, 87%;
- the City of Aspen, CO, 75% by 2010;
- the State of Maine, 40% (with goal of 50%);
- the State of Connecticut, 50% by 2020.

Some cities, such as San Francisco and San Diego, are constructing large renewable energy installations on municipally owned buildings or land for their own use.**(131)**

Another type of green energy that local governments in Central Texas should consider purchasing is biodiesel, vegetable oil or animal fat that has been chemically altered to run diesel engines. The original diesel engine, invented in 1893, was in fact designed to run on peanut oil. Most vegetable oils (including canola, soy, peanut, cottonseed), as well as waste cooking oil from restaurants that has been purified, can be used as feedstock. And biodiesel performance is generally on par with conventional fuels.

The same local governments mentioned above for the GreenChoice program also use about 8 million gallons of diesel fuel a year.**(132)** The cost is currently about $2 a gallon and climbing. The breakeven cost of biodiesel is somewhere between $1.70-$2.30 per gallon. At some point, oil costs will go down from their historic highs, but they will probably bounce back up again. Biodiesel will ensure that diesel costs have a predictable ceiling.

An economic feasibility study for a biodiesel manufacturing plant owned by these local governments should be undertaken. Again, the motivation is partially based on price hedging. While biodiesel can be widely purchased from private companies, ownership of the factory can protect these governments from price spikes caused by the commodity market for auto fuels. As the process of manufacturing cellulosic alcohol becomes more developed, it could also be produced with this co-op model.

If Austin still aspires to be the "Clean Energy Capital of the World," it is time to take action on a relatively easy and inexpensive decision. The trophy, as well as environmental benefits and possible savings for taxpayers, are long past claiming.

The Clean Energy Capital of the World
The City That Said "I Can"
New York Times– Feature
Sunday, April 19, 2026

…Twenty years ago, when energy prices started their drastic increases, the nation was unprepared. The City of Austin, prodded by environmental activists, embarked on an unconventional plan to become as independent as possible from OPEC, major energy companies, and polluting fossil fuels.

Its municipal utility delayed the building of new conventional power plants and began purchasing renewable energy in an aggressive way. The utility invested in the research and development of alternative energy and energy efficient technologies. The City mandated maximum efficiency in its building code. It also mandated its existing stock of rental units be weatherized, to the alarm and outrage of hundreds of property owners.

It built the first government-owned biofuels coop, which eventually manufactured both biodiesel and alcohol for vehicle fleets of local governments with locally-grown crops.

In a bold move that was seen by many citizens as loony at the time, the region began building streetcars rails down major thoroughfares. But they quickly became popular as gas costs skyrocketed. Some of these lines were converted to light rail.

Today, it's a different town. Some politicians boast it is the "Clean Energy Capital of the World." About 15% of passenger miles in Austin come from mass transit, and 5% from bicycles. Liquid fuel cars save 60% of the petroleum energy used per vehicle compared to 20 years ago. While some of this is due to federal fuel efficiency standards, Austin set the lead in piloting these standards with its programs to institutionalized Plug-In

Hybrid Electric Vehicles and its research programs into new engines.

Almost 50% of its electricity energy comes from renewable sources. Most of this is wind, though about 20% of its renewable energy comes from other sources, ironically including geothermal electric power from Texas oil and gas wells. Per capita use of energy overall is reduced by 20% compared to other Texas cities because of its efficiency efforts.

And the City has a core of several thousand jobs related in some way to these technologies…

FOOTNOTES

1 American Wind Energy Association, *Wind Energy: An Untapped Resource,* Wind Energy Fact Sheet, Washington, DC (based on 1991 analysis).

2 Phone interview with Carol Harwell, Product Development Coordinator with Austin Energy, on March 1, 2006 and e-mail correspondence with Kathy Foster, Accounting Manager with Austin Energy, on April 11, 2006.

3 Fiscal year 05 sales of 10,903,639,167 kwh X difference between GreenChoice rate and normal rate X 20%.

4 LCG Consulting, *Compressed Air Energy Storage (CAES) Feasibility and Risk Assessment*, Los Altos, CA (Austin Energy: Austin, TX, September 7, 2004), p. 6.

5 "Form 423," Federal Energy Regulatory Commission, Washington, D.C., October 2005. Online at www.ferc.gov/docs-filing/eforms/form-423/data.asp

6 Capital costs for gas plants; and variable and fixed O&M costs for all plants from Ridge Energy Storage & Grid Services, *The Economic Impact of CAES on Wind in TX, OK, and NM* (Austin, TX: Texas State Energy Conservation Office, June 27, 2005), p. 85.
Capital costs for CAES plant from Footnote 4.
Capital cost for coal plant from San Antonio plant estimate of $1,333 per KW.
Coal plant fuel costs from Ridge; natural gas estimated at $7/MMBtus.
Hydrogen Storage numbers include storage rates from 2 dockets of companies in recent rate cases for underground gas storage before the Texas Railroad Commission: Centana (#9243) and Oneok Texas Gas Storage LP (#9250). These average 34¢ per million BTUs.
Costs and characteristics of electrolyzers from Paul Scott, Director of Projects, Stuart Energy Systems, in telephone interviews on January 17, January 28, and May 3, 2002 regarding hydrogen electrolysis.

Coal Plant Assumptions:
Fixed Charges: 0.12
Combined Cycle Cost/KW: $1,333
BTU/Kwh: 10,500
Efficiency: 33%
Capacity: 70%
Fuel Assumptions
Natural Gas: $1.20/MMBTUs

Combined Cycle Gas Assumptions:
Fixed Charges: 0.12
Combined Cycle Cost/KW: $563
BTU/Kwh: 7,500
Efficiency: 46%
Capacity: 65%
Fuel Assumptions
Natural Gas: $7/MMBTUs

Peaking Turbine Assumptions
Fixed Charges: 0.12
Peaking Turbine Cost: $430
BTU/Kwh: 10,500
Efficiency: 33%
Capacity: 25%
Fuel Assumptions
Natural Gas: $7/MMBTUs

Compressed Air Storage/Natural Gas
Fixed Charges: 0.12
% of Wind Direct to Grid: 80%
% of Wind Kwh used per CAS Kwh: 80%
CAS Cost/KW: $746
Capacity: 20%
Fuel Assumptions
Wind: $0.03-0.04
Natural Gas: $7/MMBTUs

CAES/Hydrogen Assumptions
Fixed Charges: 0.12
% of Wind Direct to Grid: 80%
% of Wind Kwh used per CAS Kwh: 80%
Cost/KW: $746
Fuel Assumptions
Wind: $0.03-$0.04
Based on $300/KW with mass production up to $1,000 for handmade units. Units would run at 70% efficiency and 30% capacity.
Hydrogen Storage/MMBTUs: $0.34/MMBTUs
Total/MMBTUs: $14.86–$31.16 for stored hydrogen

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	Base Case	New Case	Geothermal Case
Square Feet	2000	2000	2000
Window S.F.	330	330	330
Wall Insulation	0	0	0
Ceiling Insulation	11	30	30
Air Change Per Hour	0.5	0.35	0.35
Duct Leakage	20%	10%	10%
Duct Insulation	3	6	6
Window SHGC	1	0.4	0.4
Window U-Value	1.17	1.17	1.17
Gas Heating Efficiency	0.66 AFUE	0.8 AFUE	NA
Heat Pump Efficiency	5 HSPF	8.5 HSPF	5 COP
Cooling Efficiency	13	15.5	23
Radiant Barrier	No	No	No
Summer Temp Setpoint	75/78 10PM-6AM	Same	Same
Winter Temp Setpoint	70	70	70

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