Florida Dependence on Petroleum

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Petroleum is Florida's number one energy source and demand is growing. Transportation and power generation are the two areas where petroleum use must be reduced in order to reduce dependence on oil. The following is a synopsis of petroleum supply and demand in Florida, followed by a best-case scenario for reducing use of petroleum. The data come from the US Department of Energy/Energy Information Administration, the US Environmental Protection Agency, and a variety of sources in peer-reviewed and gray literature.

Petroleum supply

Florida has no oil refineries and relies entirely on petroleum products delivered by pipeline, tanker, and barge to marine terminals near the state's major coastal cities. With 0.3% of US known reserves, Florida produces only 0.1% of US oil from 57 wells, and ranks third among states in terms of total energy of all forms imported from beyond its borders (87 percent of total energy used). Once petroleum is refined and reaches Florida, it is fungible with respect to source of origin. The non-domestic supply of US petroleum is shown in Figure 1 below. As a rule of thumb, roughly 60 percent of US oil is non-domestic in origin. The US gets 57 percent of non-domestic oil from five countries: Canada, Mexico, Nigeria, Saudi Arabia, and Venezuela. The US domestic production in 2000 was 9.3 million barrels a day and it imported 10.4 million barrels a day. Current consumption is over 20 million barrels a day. US production is projected to steadily decline over the next decade. US proven reserves amount to 11 years at current rates of consumption.

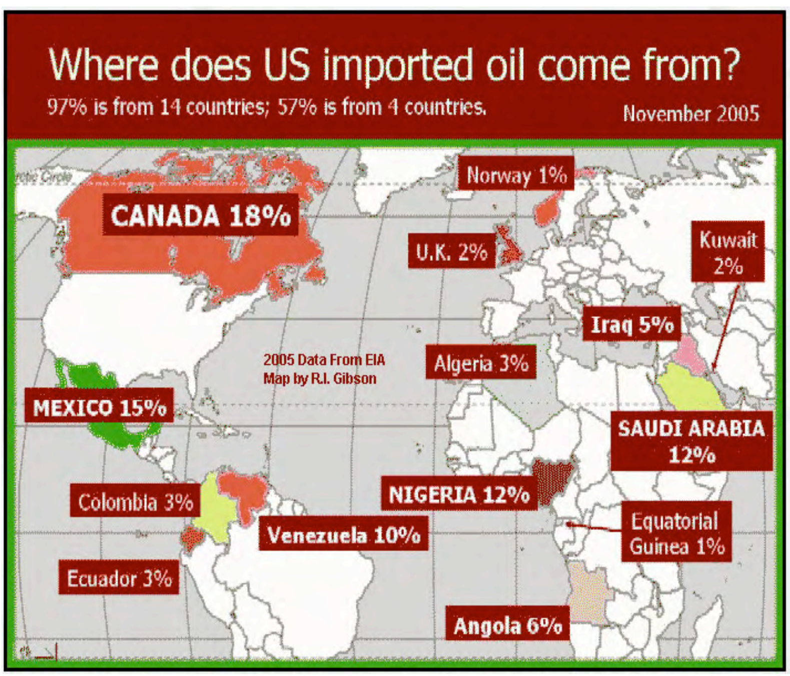

Figure 1. Imported oil sources for the US.

Figure 2 below shows that global oil use is highly interdependent, with most developed nations dependent on non-domestic sources. All major oil fields in the US are in various degrees of declining production, and Figure 3 shows that most large non-US fields are in decline. Refining capacity in the US is operating at near its maximum capacity.

Region	Total Use	Local Production	Imports	Exports	Net Exports / (Imports)
	---------- Thousands Barrels Daily (2005) ----------				
USA	20,655	6,830	13,526	1,129	-12,396
Europe	14,716	5,894	13,261	2,149	-11,112
Japan	5,360		5,225		-5,225
Greater China	8,157	3,267	4,890		-4,896
Other Asia	10,440	4,375	9,032	2,967	-6,065
FSU	5,634	11,685	1,025	7,076	6,051
Canada	2,241	3,047	1,395	2,201	806
Mexico	1,978	3,759	284	2,065	1,781
Central & South America	4,776	6,964	1,340	3,528	2,188
Middle East	5,739	25,119	441	19,821	19,386
Africa	2,763	9,835	356	7,428	7,072
Total	82,459	80,775	50,775	48,364	-2,410

SIMMONS and COMPANY INTERNATIONAL

Figure 2. Interdependence of global oil use (FSU = Former Soviet Union). Source Simmons & Company International.

Key Oil Exporter	Major Supply Sources	Status
Middle East	- Ghawar (Saudi Arabia)	In decline
	- Burgan (Kuwait)	In decline
	- Iran's six giant fields	In decline
	- Iraq's 2 super giant fields	In decline
	- Syria, Yemen, Oman	In decline
FSU	- Most giant oilfields	In steep decline
Canada	- Conventional oil	In decline
Central & S. America	- Venezuela, Argentina, Colombia	In decline
Mexico	- Cantarell (60%) of oil	In steep decline
Africa	- Onshore oil in most countries	In decline

Figure 3. Major non-domestic oil fields in decline (FSU = Former Soviet Union). Source Simmons & Company International.

US speculated reserves are usually assumed to be four times proven reserves, but these include mainly offshore and very deep deposits. Oil recovery rate from these speculated reserves is unknown and dependent on infrastructure that has yet to be built, while current infrastructure is aging and often in disrepair. The consensus among experts (e.g., Simmons and Company, and many others) is that extracting oil from speculated reserves will be very expensive. Our best information suggests that, regardless of source, petroleum production will peak and will not be a cost effective source of energy sometime within the next 25 years (i.e., "peak oil"). Extraction of remaining known reserves will be increasingly expensive. From these data it is arguable that petroleum, regardless of source of origin, must be phased out as a source of energy. The remainder of this report is focused on demands for petroleum and how to reduce dependence of petroleum use for power generation and transportation.

Florida petroleum use

The US demand for petroleum is expected to grow by at least 37 percent by 2030. Based on recent trends in population growth and vehicle miles traveled, it is reasonable to assume that Florida's demand will grow faster than the US rate if unchecked. Due in part to the tourist industry, Florida's demand for petroleum-based transportation fuels (i.e., motor gasoline and jet fuel) is among the highest in the United States. The traffic at the international airports in Miami and Orlando is among the heaviest in the country.

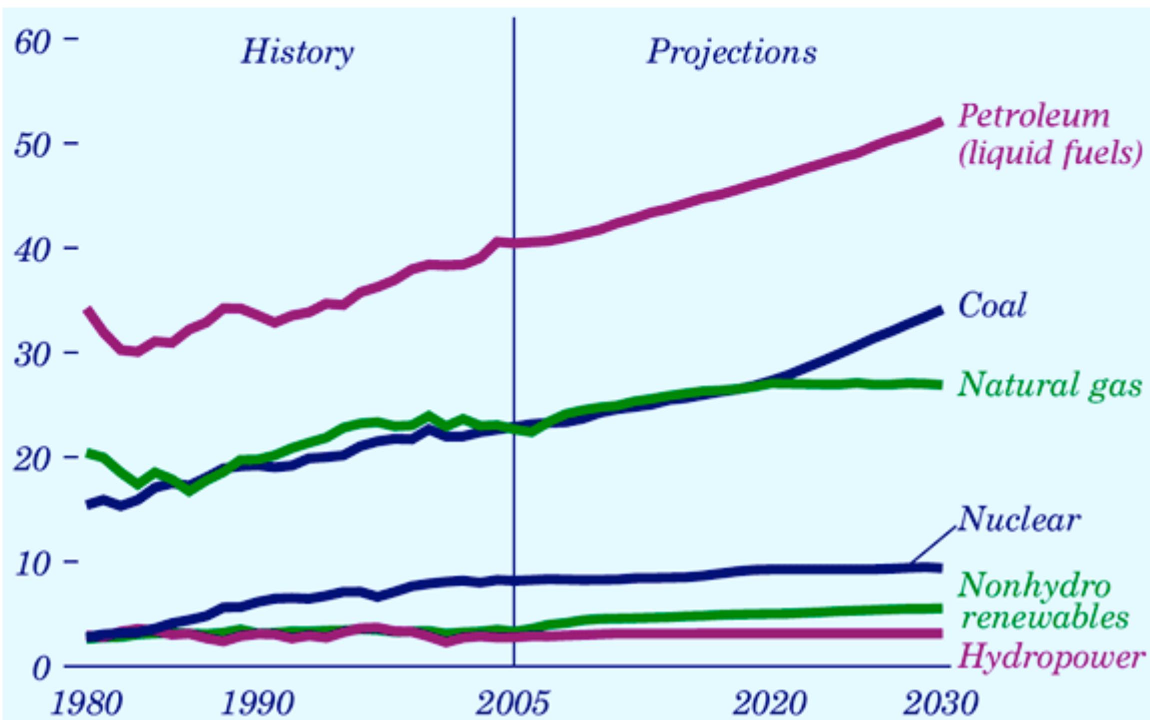

Figure 4. US energy use in quadrillion Btu through 2030. ([*http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2007).pdf*](http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2007).pdf))

Florida uses about 5 percent of US consumption, or approximately 382 million barrels of oil per year (CY 2004), and petroleum is the largest single source of energy used by Floridians (Figure 5). Floridians consume about 21 barrels of oil per person per year (based on estimated population in 2004), and transportation is the largest sector for overall energy use (36 percent, Figure 6). Though Florida petroleum reserves are about 0.3 percent of US reserves, Florida ranks third among states in petroleum use (Figure 7), and about 73 percent of Florida petroleum consumption is for transportation (Figure 8). Florida production of electrical power from oil fluctuates between 12 and 17 percent (Figure 9). It is clear from these data that transportation and power production are the two sectors where Florida must focus its efforts if it wishes to reduce its dependence on petroleum.

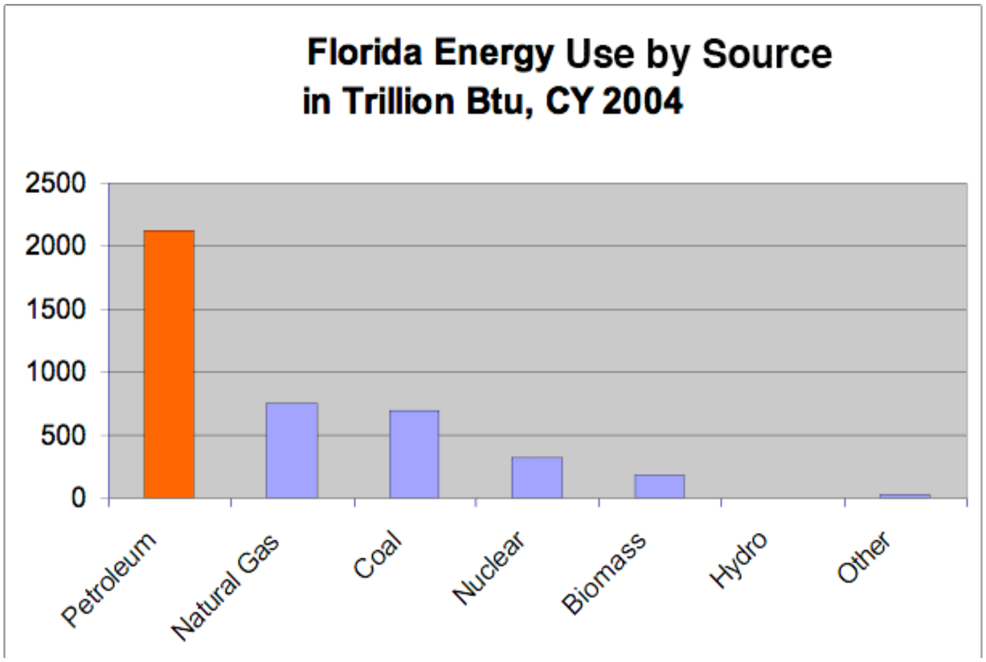

Figure 5. Florida energy use by source.

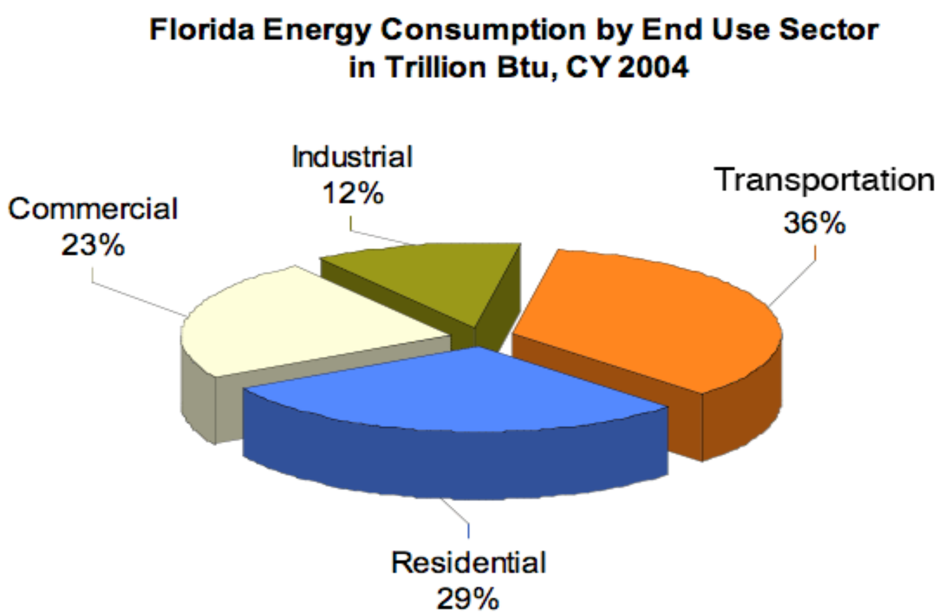

Figure 6. Florida energy consumption by end use sector.

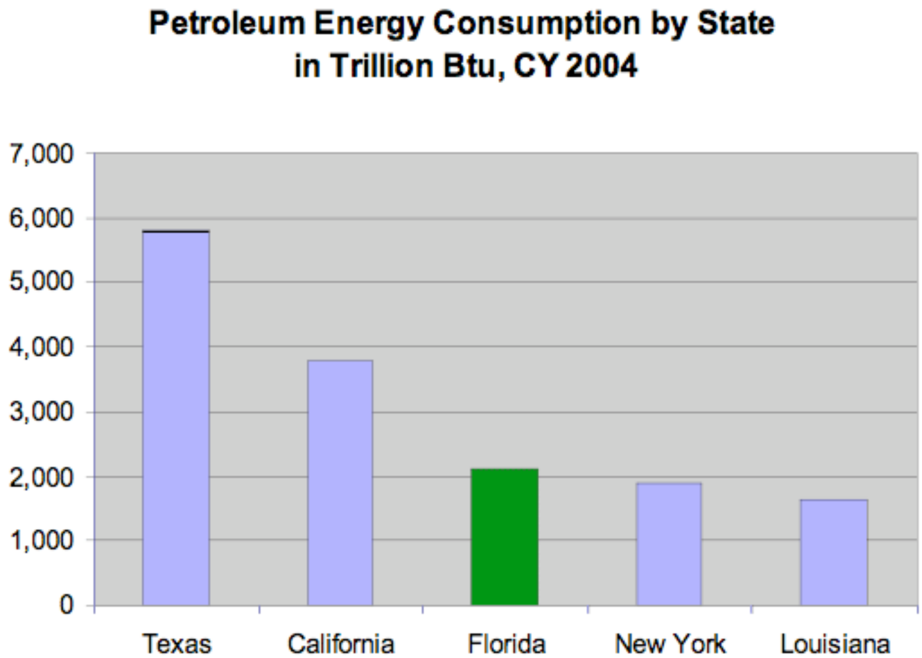

Figure 7. Florida petroleum energy consumption relative to other major oil consuming states.

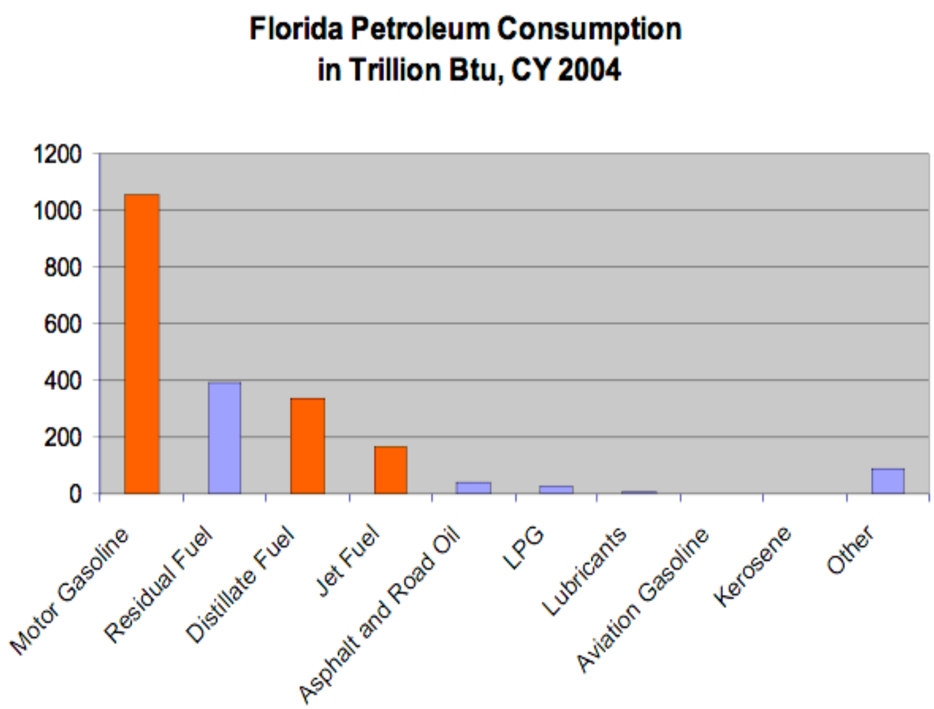

Figure 8. Florida petroleum consumption by use. *Source for Figures 5-7: (http://www.eia.doe.gov/emeu/states/sep_sum/plain_html/sum_btu_1.html)*

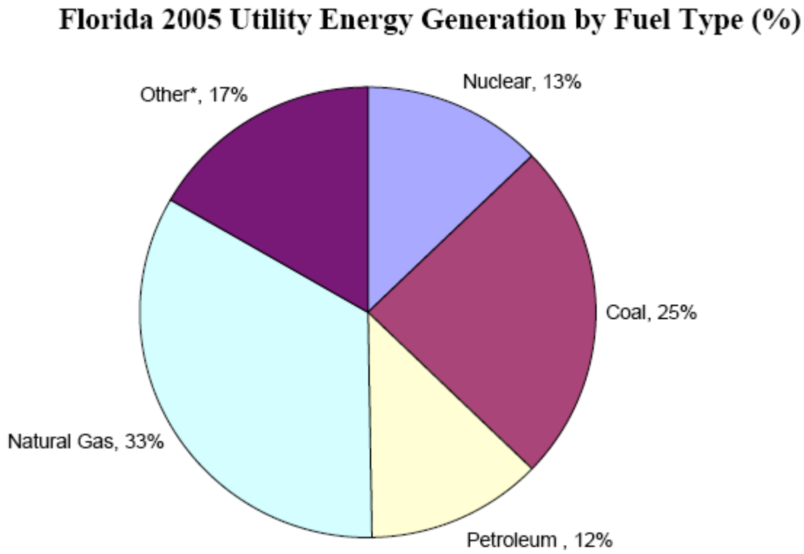

Figure 9. Florida utility energy generation by fuel type (ACEEE 2007). Note that DOE/EIA figures show 16.8% power generation by petroleum in Florida.

Because all refined petroleum is from out of state, all revenues except taxes leave Florida for economic activity associated with petroleum. Assuming a market value of $60 per barrel, the current financial activity associated with Florida transportation petroleum excluding jet fuel is $14.8 billion per year. Of this, $1.79 billion represents state tax and remains as part of state revenues (Figure 10). The difference represents the potential total cost to Florida (without considering local taxes and fees), and can be thought of as a benchmark for assessing what could be spent annually to reduce consumption or develop new technologies.

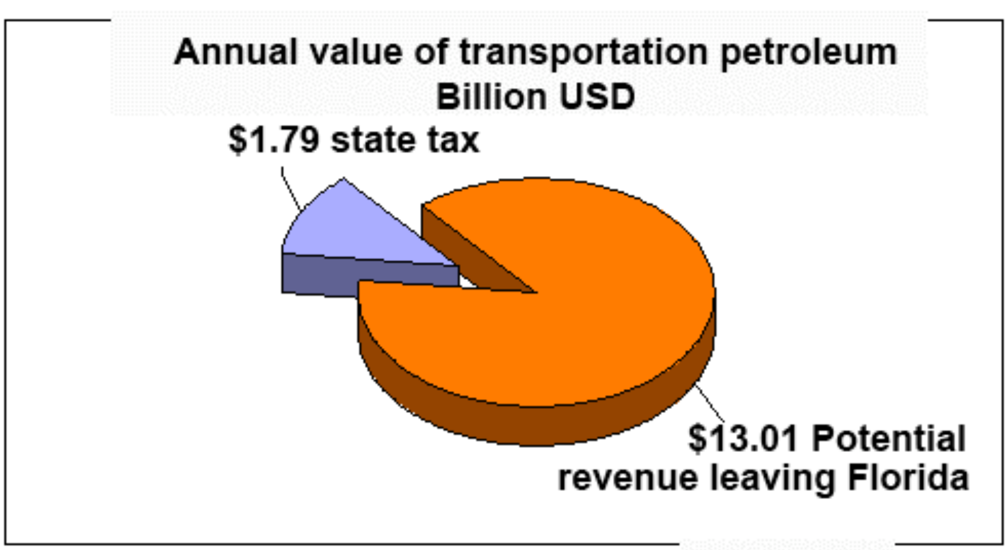

Figure 10. Annual economic activity associated with transportation petroleum exclusive of jet fuel.

Options for reducing petroleum use in Florida

The numbers above show that Florida has enormous dependence on petroleum and the implications are sobering. Significantly reducing Florida's dependence on oil by 2030 would require decisive and immediate action in order to begin moving the economy in the desired direction with the least disruption. This would affect every area of the Florida economy and require significant long-term financial commitments, supported by robust federal, state, and local policy mechanisms. Gaining consensus for what amounts to an expensive (e.g., $60 million for a new ethanol plant), multi-decadal Marshall-type plan is key to insuring the likelihood of success. It is unlikely that Florida can develop policies without coordination with overarching federal incentives and mandates.

[Note: Only existing or soon to be available technologies are considered in the options below. In the calculations below, it is assumed that 1barrel of petroleum equals 42 gallons of motor fuel. All calculations designated as barrels are corrected for equivalence.]

1. Eliminate petroleum as a source of energy for electrical power

At lease twelve percent of Florida power generation is derived from petroleum, but without data from the utility sector, we are unable to estimate the amount of oil that is used for this purpose. The best options for eliminating this use of oil include a portfolio of reducing demand for electricity, power generation from renewables, and improving efficiency of power production. Elliot et al. (2007) outline these options in a report for the American Council for an Energy Efficient Economy (ACEEE) available at http://www.aceee.org/. Below is Table ES-1 (Table 1) from the report showing the recommended policies. Power generation from petroleum could be the top priority for these policies, but they apply equally well across all sources of energy for power generation. Using these tools, it should be possible to eliminate the use of petroleum for power production by reducing power consumption by more than the percentage currently generated from oil. Sources of renewable energy for power generation have been reviewed in two recent reports by S. Mulkey to the Century Commission (2006, 2007).

Annual Savings in 2013 and 2023

		2013		2023	
	Energy Efficiency (EE) Policies	Electricity Savings (million kWh)	Demand Savings (MW)	Electricity Savings (million kWh)	Demand Savings (MW)
1	Utility savings target	7,183	1,375	30,962	5,828
2	More stringent building codes	1,760	336	12,286	2,302
3	Public buildings program	1,536	293	4,608	847
4	Improved CHP policies	1,097	172	3,291	517
5	Short-term public ed. & rate incentives	4,582	873	3,549	653
6	Appliance & equipment standards	776	233	3,680	990
7	Advanced buildings program	458	336	7,503	2,302
8	Industrial competitiveness initiative	232	44	676	124
9	Expanded RD&D efforts	23	6	2,800	756
	Subtotal	*17,647*	*3,668*	*69,354*	*14,319*
	Renewable Energy (RE) Policies				
10	Onsite renewables policy package	2,542	486	20,183	3,775
11	Renewable portfolio standard	4,090	779	12,976	2,386
	Subtotal	*6,631*	*1,265*	*33,159*	*6,161*
	Total	**24,278**	**4,933**	**102,513**	**20,480**

Table 1. ACEEE recommended policies for meeting projected power demand in 2013 and 2023.

2. Ethanol production

Ethanol is the most common biofuel in the US for use in transportation, where it is usually blended with gasoline at rates of 10-85 percent. Although several plants are in development, there is presently no ethanol produced for fuel in Florida. In 2006, only 12 filling stations sold ethanol or other alternative fuels, and in 2003 the state had somewhat more than 17,000 alternative fueled vehicles in use (operating on mostly compressed natural gas or liquefied petroleum gas). Most US ethanol is produced from corn, which is a minor crop in Florida. In theory, sugar cane holds the greatest promise in Florida for ethanol production directly from fermentation of carbohydrates. Florida has extensive sugar cane, sorghum, and citrus by-products that could be diverted to this process, but current market values and subsidies make development of these resources unlikely. Assuming conversion of all Florida sugarcane, corn, sweet sorghum, and citrus molasses to ethanol, Florida could produce about 298.4 million gallons (7.1 million barrel) per year (A. Hodges, University of Florida).

Sustainable ethanol production will utilize cellulosic materials such as wood and various woody waste products. USDOE/NREL and various universities have conducted research on the technology for cellulosic ethanol production for 20 years, but significant technical obstacles remain. Although raw materials for production are abundant, because of technical issues it is unclear when cellulosic ethanol may be available in large quantities. In the most favorable scenario, cellulosic ethanol production in the US could reach 10 billion gallons by 2030, but baseline projections are considerably lower (DOE; A. Hodges, University of Florida). Estimates of potential cellulosic ethanol production in Florida range widely, with one estimate as high 8 billion gallons per year (L. Ingram, University of Florida). This apparently assumes large-scale conversion of arable land to energy crops such as short rotation trees, grasses, and canes, and highly efficient use of residues from agriculture, forestry, and municipal green waste.

Until the technical limitations on cellulosic ethanol are overcome, speculation on production is specious. Moreover, given that markets will be a major driver for resources devoted to production, it is difficult to realistically identify the resource base in Florida. Nevertheless, one estimate of cellulosic ethanol production in Florida could be derived from the sources of biomass shown in Table 2 (http://trees.ifas.ufl.edu/Energy%20Options.PDF). This is perhaps appropriate for use as an upper estimate because it is derived from the primary productivity of existing acreage and uses. Using these data, Florida could produce about 38 million barrel annually of ethanol from all sources (carbohydrate and cellulosic), assuming optimistically that all cellulosic biomass in Table 2 could be converted to ethanol. It should be noted that much of this biomass has competing uses in existing markets. Additionally, some of this biomass could also be used as feedstock for the generation of electricity.

Table 2: Potential available land, and biomass production[1] by land use types

Land use types	Area (1000 ha)	Potential biomass production (1000 Mg/year)
Crop & pasture	877	5,021
Pine forest	522	2,931
Hardwood plantations	462	2,796
Mixed hardwoods, dead	278	1,628
Oak, exotic forest	195	1,024
Reclaimed land	29	167
Industrial, other	94	NA
All Types	2,457	13,567

Source: Soil Conservation Service (1993), State Soil Geographic Data Base (Statsgo), Data Users Guide, SCS Misc. Pub. 1492.
[1] Estimates of biomass productivity were based on soil types.

3. Existing technologies for improving efficiency of automobiles

In a report dated October 2005, the US EPA reviewed new powertrain technologies for improving fuel economy of automobiles. The key results for gasoline vehicles, advanced diesel vehicles, gasoline/battery hybrids, and diesel/battery hybrids are shown in Table 3 (http://www.epa.gov/otaq/technology/420s05013.pdf). These data suggest that new gasoline power technologies can improve in performance at a bit more than half the rate at which consumption is projected to increase (assume 37 percent by 2030). Only diesel hybrids roughly match the rate of increase of petroleum use. The technology assessment report above emphasizes "These results should not be taken to imply that these technologies will necessarily move into the mainstream market in the near future. Decisions by manufacturers to invest in, and consumers to buy, new technologies involve many factors well beyond the scope of this paper." This means that technically these improvements are possible, but non-technical factors ultimately control their rollout.

Gasoline vehicles		Fuel Economy Improvement (%)	CO2 Reduction (%)	Vehicle Price Increase* ($)	Consumer Payback (years)	Lifetime Savings ($)
Large SUV	NAS	42%	30%	$1,467	1.8	$4,386
	NESCCAF	31%	24%	$1,619	2.5	$3,288
Midsize Car	NAS	20%	17%	$712	3.8	$897
	NESCCAF	41%	29%	$1,318	3.9	$1,552

Advanced Diesel vehicles		Fuel Economy Improvement (%)	CO2 Reduction Vehicle (%)	CO2 Reduction Lifecycle[1] (%)	Vehicle Price Increase*	Consumer Payback (years)	Lifetime Savings ($)
Large SUV	FEV/EPA	41%	18%	21%	$1,760	2.1	$4,284
	ORNL	33%	14%	16%	$2,560	4.1	$2,597
Midsize Car	FEV/EPA	40%	18%	21%	$1,252	3.8	$1,563
	ORNL	33%	14%	16%	$1,810	7.7	$634

Gasoline/Battery Hybrid vehicles		Fuel Economy Improvement (%)	CO2 Reduction (%)	Vehicle Price Increase* ($)	Consumer Payback (years)	Lifetime Savings ($)
Large SUV	EPRI	52%	34%	$4,464	5.0	$3,179
	ORNL	35%	26%	$3,039	4.1	$2,882
Midsize Car	EPRI	45%	31%	$2,500	7.4	$934
	ORNL	40%	29%	$2,683	9.5	$509

Diesel/Battery Hybrid vehicles		Fuel Economy Improvement (%)	CO2 Reduction Vehicle (%)	CO2 Reduction Lifecycle (%)	Vehicle Price Increase* ($)	Consumer Payback (years)	Lifetime Savings ($)
Large SUV	EPA-derived	72%	33%	35%	$5,912	5.8	$3,321
Midsize Car	EPA-derived	71%	33%	35%	$4,123	11.4	$344

Table 3. Efficiency gains in automobiles from existing technology. Specific technologies are described in the report.

4. Soon to be available electric cars

Electric cars capable of going 40 miles between charges will soon be available in the US market, possibly as early as 2010. In terms of carbon emissions, such cars would produce up to 40 percent less greenhouse gas than gasoline mainly because the mix of fuels available for electric power generation includes nuclear and renewables. Because most automobile travel consists of short drives, electric cars could be a major offset of petroleum use, while offering a modest improvement in overall greenhouse emissions.

5. Reducing the use of automobiles

Perhaps the best and most challenging offset for transportation petroleum is to get people out of their cars and into public transportation or onto their bicycles or on foot. The state would need to make major investment in the design and construction of public transportation (including buses and trains) that is useful to the majority of commuters. It is arguable that the biggest impediment to this is the design of our communities, which consists of residential zones separated from commercial and industrial zones. Mixed-use zoning could permit multimodal transportation, including bicycles, and shorter distances between residence and workplace. The current infrastructure of most metropolitan areas is not amenable to such changes without major redevelopment and infill. Discussion of better community design is covered in more detail in the document "Towards a Sustainable Florida" prepared for the Century Commission (S. Mulkey, ed. 2006).

Summary best-case transportation scenario for 2030 using new powertrain technologies and ethanol

For the purpose of this analysis, let's assume performance of gasoline vehicles doubles in 1/4 of the vehicle fleet, and that diesel hybrids increase performance by 70% and constitute 3/4 of the vehicle fleet in 2030. In 2030, petroleum use is projected to be 525 million barrel annually, with about 339 million barrels used in transportation exclusive of jet fuel (about 65 percent of total). The new technologies described above would reduce consumption by 91 million barrel annually by 2030. Given that Florida could produce around 38 million barrel annually as ethanol, in the best-case scenario this leaves of gap of 210 million barrel for transportation that will need to be covered by some other means (Figures 11, 12).

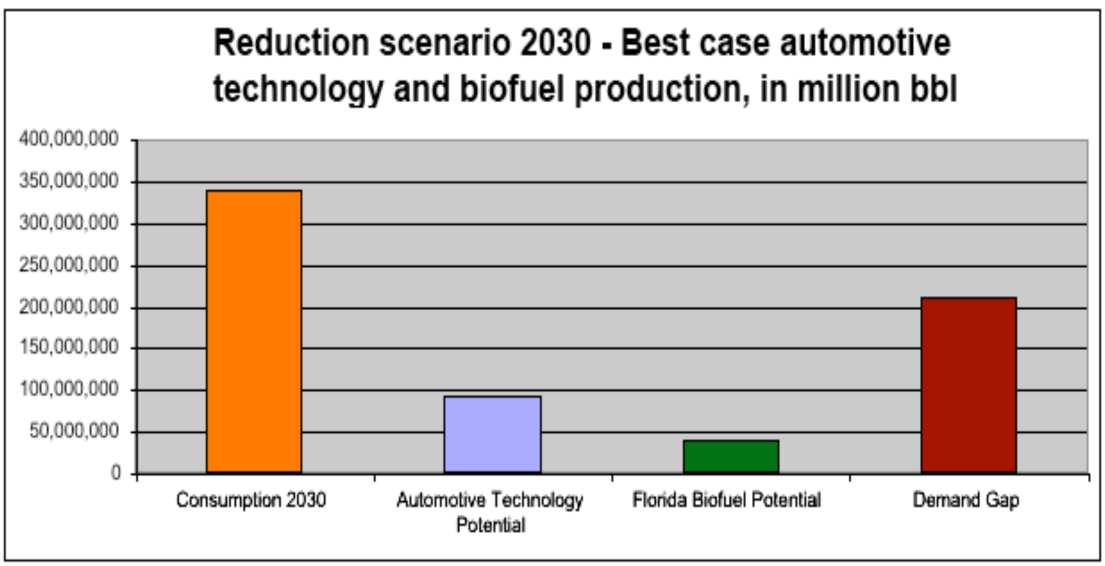

Figure 11. Best-case scenario for reduction of transportation petroleum in Florida by 2030 in million barrels of oil.

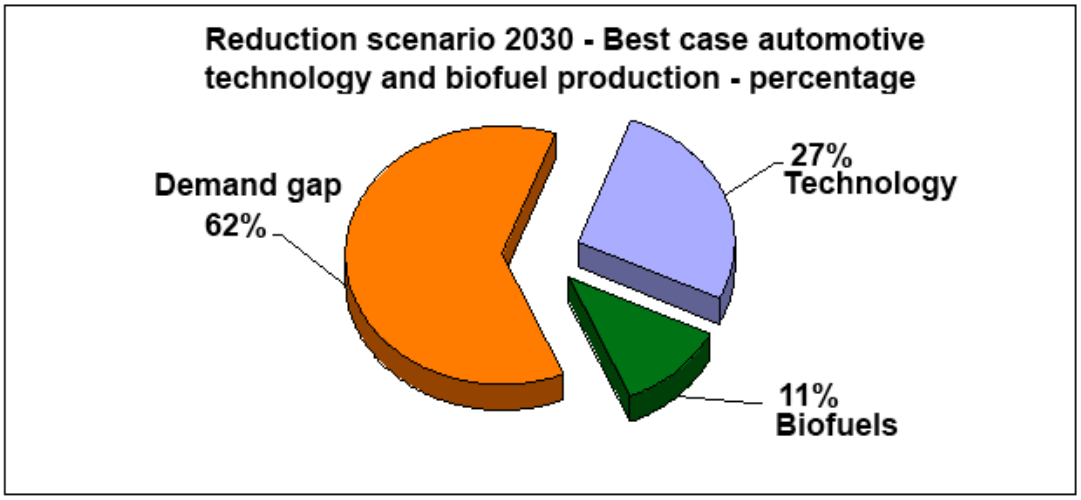

Figure 12. Best-case scenario for reduction of transportation petroleum in Florida by 2030 in percentage of use.

Bottom line assessment

This analysis indicates that under optimistic projections for transportation we cannot come close to meeting current or projected increases in demand with existing technologies and strategies. It is possible that extensive conversion of Florida lands to short rotation energy crops for production of cellulosic ethanol could increase the role of biofuels, but such land use change would result in significant negative environmental consequences and disrupt existing markets. Note also that this report does not include production of biodiesel, which is currently produced in very small quantities in Florida. Assuming that we desire to maintain present lifestyles and transportation intensity, it is appropriate to devote major resources to research and development of alternative fuels and new transportation technologies. Additionally, we should also rapidly begin to implement mechanisms to reduce demand for traditional transportation fuels and reduce use of the automobile. Development of biodiesel, electric cars and alternative or public transportation could cover part of this gap.

Authors

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