The Real Corn-Ethanol Transportation System

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Table 1: True cost of corn ethanol to taxpayers

Line	Fact	Value	Units
1	2005 EtOH production capacity[a]	4486	10^6 gallons denatured/year
2	"Small producers"[b] EtOH capacity	2597	10^6 gallons denatured/year
3	Mean ethanol tax credit[c] for "small producers"	0.0579	$/gallon denatured
4	VEETC tax credit[d]	0.5100	$/gallon denatured
5	Mean total ethanol tax credits	0.5679	$/gallon denatured
6	Cumulative corn subsidies[e] in US from 1995 to 2004	41.90	$ Billion
7	Cumulative corn produced[f] in US from 1995 to 2004	95.31	Billion Bushels
8	Average[g] corn subsidies from 1995 to 2004	0.4396	$/bushel
9	Mean rack price[h] of EtOH (04/14/06)	2.51	$/gallon denatured
10	Mean EtOH yield[i] from 2000 to 2004	2.48	gallons EtOH/bushel
11	Mean subsidy[j] of EtOH from corn subsidies	0.1774	$/gallon EtOH
12	Mean tax bias[k] against ethanol	-0.1347	$/gallon EtOH denatured
13	Total mean subsidy[l] of EtOH	0.6106	$/gallon EtOH denatured
14	Mean cost[m] of EtOH to taxpayer	3.12	$/gallon EtOH denatured
15	**Energy-equivalent[n] cost of EtOH to taxpayer**	**4.74**	**$/GGE**

[a] http://www.ethanolrfa.org/industry/locations/, updated 04/12/06
[b] As in *a*. A small-producers credit of $0.10/gallon for producers of up to 60 million gallons EtOH per year (up from 30 million gallons with the new Energy Bill)
[c] Line $2/1 \times 10$
[d] The Federal Volumetric Ethanol Excise Tax Credit, http://www.irs.gov/irb/2005-02_IRB/ar14.html
[e] http://www.ewg.org/farm/region.php?fips=00000, accessed 4/14/06
[f] http://www.ers.usda.gov/Briefing/Corn/, accessed 04/14/06
[g] Line 6/7
[h] http://www.axxispetro.com/ace.shtml, accessed 04/14/06. The mean rack price in the largest ethanol producing states in the Midwest. The rack price of ethanol delivered to both coasts will be at least $0.15 higher because of transportation costs
[i] The mean of (Industry-reported yields - Brazilian imports), multiplied by 0.95 to remove gasoline denaturant
[j] Line 8/10
[k] Ethanol has less energy per unit volume than gasoline, but taxes collected on both are equal. Federal excise tax on gasoline is 18.4 cents, and mean state excise tax is 21 cents (DOE EIA). The energy-equivalent tax bias against ethanol is $39.4 \times (1 - 0.95 \times 0.64 - 0.05)$. One could argue that ethanol subsidies counteract this bias
[l] Lines $5 + 11 + 12$
[m] Lines $9 + 13$
[n] Direct cost, excluding state tax credits and environment subsidies. Line $13/(0.95 \times 0.64 + 0.05)$. GGE = Gallon Gasoline Equivalent

Suppose that one accepted the unrealistically high ethanol yield[1] used by the USDA and their nonphysical coproduct energy credits[2], and one claimed that the net energy ratio of corn ethanol production were as high as 1.34. Consistently with this claim, for each 1 unit of input fossil energy, one would get 1.34 units of output fossil energy as ethanol, or for 3 units of input energy, one would get 4 units of output energy. This means that one has to use the amount of fossil energy equivalent to 3 gallons of ethanol to produce one extra gallon of automotive fuel ethanol. Therefore, it would take the energy in $4/(0.95 \times 0.64 + 0.05) = 6.1$ gallons of denatured ethanol to eliminate 1 gallon of gasoline. The current cost of these 6.1 gallons EtOH is $6.1 \times \$3.12 = \$18.97$, but one would save one gallon of premium high-octane gasoline retailing at \$3.09 as of 04/14/06. So the net cost of displacing one gallon of premium gasoline with corn ethanol would be $\$18.97 - \$3.09 = \$15.88$ as of 04/14/06.

In 2005, the U.S. burned ∼140 billion gallons of gasoline. If one wanted to run a "sustainable" corn-ethanol transportation system[3], one would have to produce $6.1 \times 140 = 854$ billion gallons of denatured ethanol, with 5% gasoline by volume, or 811 billion gallons of pure ethanol. The unrealistically[4] low cost of producing this ethanol would be \$13.6 trillions, more than the 2005 U.S. GDP of \$12.4 trillions.

At 2.48 gallons EtOH/bushel, one would have to produce 327 billion bushels of corn per year (34 times the mean annual U.S. corn production over the last decade) to replace gasoline currently used in the U.S. Let's suppose that this corn were produced every year at the all-time record yield of 180 bushels/acre in Iowa[5]. One would have to grow corn on 1.8 billion acres, year-after-year, for decades. There are about 400 million acres of arable land now in cultivation in the U.S. Therefore, one would have to use the land area equal to 4.5 times the current arable land area just to satisfy the automotive gasoline use in the U.S. There would never be enough water and soil, and other environmental services to support such a mad dream.

Alternatively, one may claim that the U.S. car drivers receive a subsidy of \$13.6 trillion - \$0.43 trillion for premium gasoline = \$13.2 trillion per year from ancient solar energy and the world. This amount of wealth would disappear *every year*, once the latter subsidy stops. Since the continuous disappearance of wealth at this rate is impossible, the U.S. economy will have to shrink dramatically and reconnect with its natural resource foundation.

I have not discussed here the 45 billion gallons per year of diesel fuel and 25 billion gallons per year of jet fuel used in the U.S.

[1] This yield counts 5% of gasoline denaturant, fusel alcohol, and Brazilian imports of ethanol as parts of the true yield of ethanol produced in the U.S.

[2] To separate starch from the remainder of corn kernels (coproducts), one does not have to spend the enormous amount of fossil energy necessary to distil ethanol beer.

[3] A system in which corn ethanol would serve as the main fossil energy source to drive corn agriculture and ethanol refineries. Physics makes such a system clearly unfeasible.

[4] One would have to spend additional \$ trillions to expand industrial farming (35-fold if all corn went to ethanol) and ethanol refining (200-fold), and protect the entire national water and food supplies, public health, and the environment. Water shortage and pollution, and soil destruction would become extreme across the U.S.

[5] Such consistently high yields are absolutely impossible if one cultivated only corn on all arable land, including marginal fields, and expanding agriculture to non-agricultural land. Also the hybrid seed production would take an enormous additional area and fossil energy.